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Statement of Basis Approval of No Further Action Volume 26 of 30 January 2000, Solid Waste Management Unit 65E, Operable Unit 1333, Round 11

Sandia National Laboratories/NM

Sandia National Laboratories

Statement of Basis
Approval of No Further Action
Volume 26 of 30

January 2000

Solid Waste Management Unit 65E
Operable Unit 1333
Round 11

(RCRA Permit No. NM5890110518)

NFA Originally Submitted September 15, 1998 (Chapter 5)
RSI Originally Submitted September 1999

Environmental Restoration Project

United States Department of Energy
Albuquerque Operations Office

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5.0 SOLID WASTE MANAGEMENT UNIT 65E, FAR FIELD DISPERSION AREA, LURANCE CANYON EXPLOSIVE TEST SITE

5.1 Summary

Sandia National Laboratories/New Mexico (SNL/NM) is proposing a risk-based no further action (NFA) decision for Solid Waste Management Unit (SWMU) 65E, Far-Field Dispersion Area, Operable Unit (OU) 1333. SWMU 65E is the farthest extent (far field) of the fragmentation area associated with open-detonation tests at the Lurance Canyon Explosives Test Site (LCETS). Review and analysis of all relevant data for SWMU 65E indicate that concentrations of constituents of concern (COC) at this site are less than applicable risk assessment action levels. Thus, SWMU 65E is proposed for an NFA decision based upon confirmatory sampling data demonstrating that COCs that may have been released from the SWMU into the environment pose an acceptable level of risk under current and projected future land use, as set forth by Criterion 5, which states, "The SWMU/AOC [area of concern] has been characterized or remediated in accordance with current applicable state or federal regulations, and the available data indicate that contaminants pose an acceptable level of risk under current and projected future land use" (NMED March 1998).

5.2 Description and Operational History

Section 5.2 describes SWMU 65E and discusses its operational history.

5.2.1 Site Description

SWMU 65E is a subunit of SWMU 65, identified as the LCETS on the Resource Conservation and Recovery Act (RCRA) Hazardous and Solid Waste Amendments (HSWA) permit. The site is located on U.S. Air Force (USAF) land withdrawn from Bureau of Land Management (BLM) and permitted to the U.S. Department of Energy (DOE) (SNL/NM July 1994a). This site is situated on the canyon floor alluvium in the upper reaches of the Lurance Canyon drainage. The Lurance Canyon drainage is surrounded by moderately steep sloping canyon walls, and the immediate topographic relief around the site is over 500 feet (Figure 5.2.1-1). A 25- to 50-ft-wide road is cut on the hillsides as a firebreak and encircles the site (Figure 5.2.1-2). The canyon floor at the site is isolated by the canyon walls except for the western drainage into the Arroyo del Coyote. Coyote Springs Road follows this drainage and is the main access into the Lurance Canyon (Figure 5.2.1-1).

Due to the complex testing history of the site, the LCETS was subdivided into five subunits as proposed in the "RCRA Facility Investigation [RFI] Work Plan for the OU 1333, Canyons Test Area" (SNL/NM September 1995). Based upon the location of detonations and the types of tests conducted at SWMU 65, the site has been divided into five subunits: SWMU 65A, Small Debris Mound; SWMU 65B, Primary Detonation Area; SWMU 65C, Secondary Detonation Area; SWMU 65D, Near-Field Dispersion Area; and SWMU 65E, Far-Field Dispersion Area. Figure 5.2.1-2 shows all of these inactive subunits. The SWMU 65 subunits are each being addressed in separate NFA proposals. Future submittals will address SWMUs 65A, 65B, 65C, and 65D.

445000 450000 455000 460000 465000

1465000 1460000

Madera Canyon

Arroyo del Coyote

Coyote Springs Rd

Lurance Canyon

Sol se Mete Canyon

TSA-1

CYN-MW1D
CYN-MW2S

65D 12A 94A
12B
94F
94E
94G
65E
94C
65C
13
65D 65A
65B
94B
94D

Site 12A
Piezometer Location
Burn Site Well
Burn Site Spring

6800 7000 7200 7400 6600 6400 6200 6000 7600

Legend

- Kirtland Air Force Base Boundary
- Surface-Water Features
- 200 Foot Contour Interval
- SWMU 65E
- Other SWMU Sites
- Well
- Piezometer Location
- Road

0 2400 4800
Scale in Feet

0 580 1160
Scale in Meters

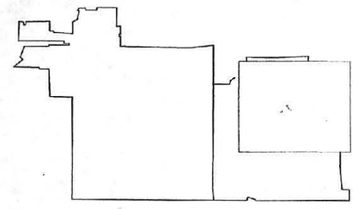

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Figure 5.2.1-1
Location of SWMU 65E
Far Field Dispersion Area
within Operable Unit 1333

Transverse Mercator Projection, New Mexico State Plane Coordinate System, Central Zone, 1927 North American Horizontal Datum, 1929 North American Vertical Datum

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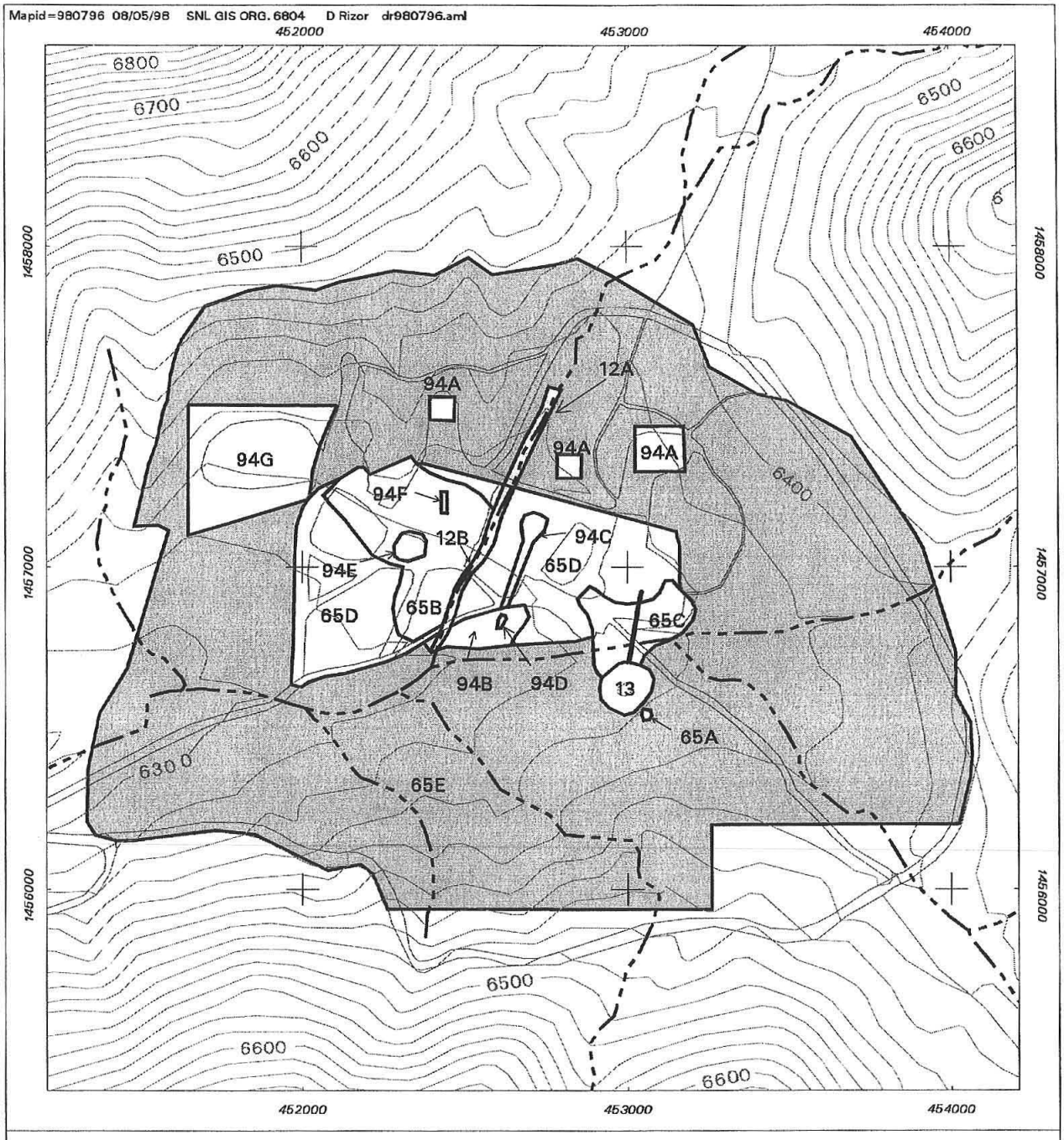

Legend

- Road
- 20 Foot Contour
- Surface Drainage
- SWMU 65E
- Other SWMUs

Figure 5.2.1-2
Site Map of
SWMU 65E

0 250 500
Scale in Feet

0 60 120
Scale in Meters

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SWMU 65 is presently an inactive site. It was used from the late-1960s to the early 1990s for general explosives tests. Its location is coincident with SWMU 94, Lurance Canyon Burn Site (LCBS), which is used for testing fire survivability of transportation equipment, storage equipment, simulated weapons, and satellite components. SWMU 94 activities began in the mid-1970s and continue to the present.

SWMU 65E lies on approximately 77 acres of land at a mean elevation of 6,365 feet above sea level (SNL/NM April 1995). The site represents the farthest extent (far-field) of the fragmentation area associated with the open-detonation tests at LCETS. The fragmentation area boundary was confirmed by the surface gamma radiation survey performed by RUST Geotech Inc. in December 1994 (RUST Geotech Inc. December 1994) and in subsequent surveys performed in 1996 (SNL/NM September 1997a). No documented tests were conducted at SWMU 65E, but the area is considered a dispersion area for general explosives testing activities in ER Sites 65B and 65C. The Lurance Canyon arroyo, which flows through the boundaries of SWMU 65E, may have received materials from surface runoff and air dispersion.

Historical published information regarding the hydrogeology of Lurance Canyon has been summarized in the "RFI Work Plan for the OU 1333, Canyons Test Area" (SNL/NM September 1995). Since that time, additional bedrock wells and alluvial piezometers have been installed in the Lurance Canyon and data collected from the new bedrock wells have supported the hydrologic model of semiconfined to confined groundwater conditions at a depth of approximately 222 feet below ground surface (bgs) beneath the Lurance Canyon SWMUs. The data collected from the alluvial piezometers support the absence of alluvial groundwater. Hydrologic data have been collected from the Burn Site Well, CYN-MW1D, 12AUP01 (piezometer), and CYN-MW2S (piezometer). The remainder of this section summarizes the hydrologic conditions at each monitoring well location.

The Burn Site well was drilled in February 1986 to a total depth of 350 feet bgs and is shown on Figure 5.2.1-1. A total of 74 feet of clay, silt, and shale units were encountered overlying the bedrock identified as metamorphic shists and fractured granite. Water-bearing bedrock was encountered at a depth of 222 to 350 feet bgs (New Mexico State Engineers Office Well Record RG-44986). Following well completion, the water level rose to 68 feet bgs.

A shallow underflow piezometer was installed in November 1996 in SWMU 12A located within the SWMU 65E boundary (Figure 5.2.1-1). The NFA proposal for SWMU 12A has been submitted to the New Mexico Environment Department (NMED) for an NFA decision (SNL/NM May 1997). The piezometer was installed in conformance with an understanding between SNL/NM and the NMED Oversight Bureau (OB) (Dawson August 1996). The subsurface geology at the site is comprised of approximately 55 feet of alluvial sand, silt, and gravel overlying metamorphic phyllite to schist bedrock. The piezometer was completed to a depth of approximately 58 feet bgs and was identified as 12AUP01. Moist soil was encountered in the first 5 feet of alluvium. The remaining 53 feet to bedrock were dry. No groundwater was encountered during drilling. The piezometer was instrumented in February 1997 and has been collecting data since that time. In addition, manual checks have been conducted for the presence of water as a verification procedure. No water has been recorded in the piezometer subsequent to its installation.

The Burn Site Spring (Figure 5.2.1-1) is an ephemeral spring or, more accurately, a seep located approximately 1,200 feet northeast of SWMU 65E. The seep discharges small quantities of water from fractures and/or bedding plane permeability within the carbonate rocks

(Goodrich [Unk.] 1993). The source of the water is hypothesized to be from the seasonal recharge of fractures from the surrounding mountain terrain.

A groundwater monitoring well nest was installed in November and December 1997 approximately 3,000 feet west (downgradient) of the LCETS (Figure 5.2.1-1). The groundwater wells were installed in conformance with an understanding between SNL/NM and the NMED (SNL/NM July 1997, SNL/NM September 1997b). This well nest is comprised of a shallow underflow piezometer (CYN-MW2S) and a deep groundwater well (CYN-MW1D). The subsurface geology at the nest location is characterized by approximately 25 feet of alluvial sand, silt, and gravel, unconformably overlying the Manzanita Gneiss. The Manzanita Gneiss is fractured. No water was encountered during drilling in the alluvium, and CYN-M2S has had no recorded measurements of water since its installation. Groundwater was first encountered in CYN-MWD at a depth of 372 feet bgs, and the static level rose to 320 feet bgs. This indicates semiconfined to confined groundwater conditions similar to those encountered in the Burn Site well (Figure 5.2.1-1).

In summary, the groundwater beneath the LCETS occurs at depths of at least 222 feet bgs under semiconfined to confined conditions in fractured metamorphic rock. There has been no record to date of shallow groundwater occurring in the alluvium overlying the bedrock.

For a detailed discussion regarding the local setting at SWMU 65E, refer to the RFI work plan for OU 1333 (SNL/NM September 1995).

5.2.2 Operational History

Historical aerial photographs indicate that construction of the LCETS had begun by October 1967; by 1971 the test site was in full operation, and several structures were visible (SNL/NM August 1994). To protect the surrounding area from accidental fires caused by detonation of explosives or burn testing, a fire break road was constructed around the site between 1967 and mid-1971 (SNL/NM August 1994).

Interviews with past SNL/NM personnel have been used to reconstruct historical operations at SWMU 65. SWMU 65 was established between 1967 (Larsen and Palmieri August 1994a) and 1969 (Palmieri December 1994b) as an explosives test area designed with a 10,000-foot dispersion radius to provide an adequate buffer for open detonations of up to 10,000 pounds of high explosives (HE) (Gaither et al. May 1993, Author [unk] Date [unk]a, Larsen and Palmieri August 1994a, Larsen and Palmieri August 1994b). The majority of the open-detonation explosives tests were conducted between 1967 and 1975 (Table 5.2.2-1). All open-detonation explosives tests were concluded by the early 1980s (Larsen and Palmieri August 1994b). The frequency of testing at SWMU 65 between 1968 and 1980 has been estimated at 20 tests per year (Gaither et al. May 1993, Author [unk] Date [unk]a). Based upon information provided in the interviews, open-detonation explosives tests were conducted within the primary (SWMU 65B) and secondary (SWMU 65C) detonation areas (refer to Figure 5.2.1-2).

In addition to open-detonation explosives tests, fuel-fire burn tests of test units containing explosives were conducted at SWMU 65 from 1969 to 1979 in excavated pits (Littrell February 1969, Jercinovic et al. November 1994) (Table 5.2.2-1). Portable pans and engineered burn

Table 5.2.2-1
Summary of Tests Conducted at SWMU 65, Lurance Canyon Explosive Test Site

Test Category	Test Type	Test Date	Number of Recorded Tests	Test Materials	Test Location	Reference
General Explosives Tests	Open-Detonation Tests	1967 to 1980	260 (20 per year)	Weapons containing HE and DU	Primary and secondary detonation area	65-3 65-10 65-54 65-59
	Ammonium Nitrate/Fuel Rod Shipping Container Test	Between 1967 and 1975	1	Shipping containers for spent fuel rods, ammonium nitrate	Near the LOBP in secondary detonation area	65-3 65-37 65-54
	Penetration Tests	Between 1980 and 1985	Unknown	B-61 warhead containing HE and DU	East of camera bunker, west of arroyo in primary detonation area	65-3 65-54 65-63
	Propagation Test	Between 1965 and 1979	1	Weapons containing HE	Approximately 1,100 ft SE of Bunker 9830 near SWMU 13	65-61 65-67
Burn Pit Tests (Fuel Fire)	Cloudmaker Tests	January 1969	3	JP-4 fuel, PVC, TNT, ammonium nitrate, aluminum powder, steel cylinder	Approximately 1,000 ft SE of Bunker 9830 in secondary detonation area	65-32
	Other Ammonium Nitrate Tests	January 1969	2	JP-4 fuel, ammonium nitrate, steel cylinder	SE of Bunker 9830 in secondary detonation area	65-37
	Liquid Fuel Fire and Solid Rocket Propellant Burn Tests on Pioneer Capsules	September 1970	7	JP-4 fuel, TP-H-3062 rocket propellant, Pioneer capsules	SE of Bunker 9830 in secondary detonation area	65-38 65-39
	Plutonium Shipping Container Tests	May to June 1972	5	JP-4 fuel, PVC, polyethylene bottles, Dy-Kem steel-blue layout dye, Celotex insulation, steel containers	Lined fire pit facility in secondary detonation area	65-41
	TC-708 Emergency Denial Device Test	February 1973	1	Diesel fuel, PVC, chromel/alumel thermocouples	Approximately 1,000 ft SE of Bunker 9830 in secondary detonation area	65-40

Refer to footnotes at end of table.

Table 5.2.2-1 (Concluded)
Summary of Tests Conducted at SWMU 65, Lurance Canyon Explosive Test Site

Test Category	Test Type	Test Date	Number of Recorded Tests	Test Materials	Test Location	Reference
Miscellaneous Burn Tests (nonpetroleum-fuel-fire)	Wood Crib Fire Tests	September 1988 to September 1989	17	Wood, HE, detonators	Graded area south of SWISH Unit in primary detonation area	65-48 65-73
	Liquid Oxygen Torch Tests	January 1984 to April 1985	19	Propane, oxygen as liquid and gas, aluminum powder, nitrogen gas, graphite, steel rods	Graded area within 30 ft of camera bunker in primary detonation area	65-48 65-73
	Rocket Propellant Tests	January 1984 to August 1993	10	Rocket propellant, empty weapon casings, aluminum	4 locations in primary detonation area and Bomb Burner and CON-CON trenches (Figure 5-3)	65-48 65-72 65-73
Cone Tests	Overburden Penetration Tests	March 1982 to May 1984	22	C-4 HE, sodium-24 isotope ($t_{1/2}$ = 15 hr), uranium dioxide powder, sand, aqueous foam	CON-CON Unit	65-48 65-49
TABS Tests	Torch Burn Tests on Weapons	February 1975 to February 1977	12	PBX 9404 HE, DU, beryllium, aluminum	Location A was 45 ft SE of camera bunker in primary detonation area and in Bomb Burner trench	65-50 65-56 65-57
Slow-Heat tests	Detonation of HE with Heat Tape	February 1982 to August 1986	16	PBX 9501, PBX 9404, PBX 9407, HMX, TATB HE; lead tape; chromel/alumel thermocouples; steel test vessel; plywood and vermiculite packaging	Graded area between camera bunker and CON-CON Unit (Figure 5-3)	65-29 65-30 65-31 65-48

65-3 = Gaither et al. May 1993.
65-10 = Author [Unk] Date [Unk]b.
65-29 = Luna October 1985.
65-30 = Luna June 1983.
65-31 = Moore and Luna February 1982.
65-32 = Littrel February 1969.
65-37 = Karas June 1993.
65-38 = Foy April 1971.
65-39 = Clark December 1970.
65-40 = Walkington April 1973.
65-41 = Stravasnik September 1972.
65-48 = SNL/NM August 1986.
65-49 = Church March 1982.
65-50 = Kurowski January 1979.
65-54 = Larsen E. and Palmieri D. August 1994b.
65-56 = Jercinovic et al. November 1994.
65-57 = Larsen August 1994.
65-59 = Larsen and Palmieri August 1994a.
65-61 = Palmieri November 1994a.
65-63 = Palmieri December 1994b.
65-67 = Palmieri December 1994a.
65-72 = Palmieri December 1994d.
65-73 = Hickox and Abitz December 1994.
C-4 = Composition-4.
CON-CON = Conical Containment.
DU = Depleted uranium.
HE = High explosive(s).
HMX = Cyclotetramethylene tetranitramine.
LOBP = Large Open Burn Pool.
PBX = Plastic-bonded high explosive.
PVC = Polyvinyl chloride.
SNL/NM = Sandia National Laboratories/New Mexico.
SWISH = Small Wind-Shielded.
$t_{1/2}$ = Half life.
TABS = Torch Activated Burn System.
TATB = Triaminotrinitrobenzene.
TNT = Trinitrotoluene.

structures completely replaced burn pit tests by 1979 (Jercinovic et al. November 1994). From the mid-1970s, a variety of nonpetroleum-fuel-fire burn tests were conducted. These tests included slow-heat detonations (1983 to 1986) (Luna June 1983, Luna October 1985, Moore and Luna February 1982), Torch-Activated Burn System tests (1975 to 1977) (Kurowski January 1979, Jercinovic et al. November 1994, Larsen August 1994), rocket propellant burn tests (1984 to 1993) (Palmieri December 1994d, Hickox and Abitz December 1994), liquid oxygen torch tests (1984 to 1985) (Hickox and Abitz December 1994), and wood crib fire tests (1988 to 1989) (Hickox and Abitz December 1994). Small explosives tests were also conducted in the former Conical Containment (CON-CON) Unit in 1982 (SNL/NM August 1986, Church March 1982). Table 5.2.2-2 correlates the SWMU 65 subunits with the explosives/burn testing programs. Annex 5-A contains a summary of all explosives testing at SWMU 65 and shows the locations of these tests.

5.3 Land Use

Section 5.3 discusses the current and future proposed land use for SWMU 65E.

5.3.1 Current

SWMU 65E is located within the boundaries of KAFB (Figure 5.3.1-1) within the active industrial LCBS (SWMU 94).

5.3.2 Future/Proposed

The projected land use for SWMU 65E is recreational (DOE et al. October 1995).

5.4 Investigatory Activities

SWMU 65E has been investigated in a series of three investigations. Section 5.4 describes these activities.

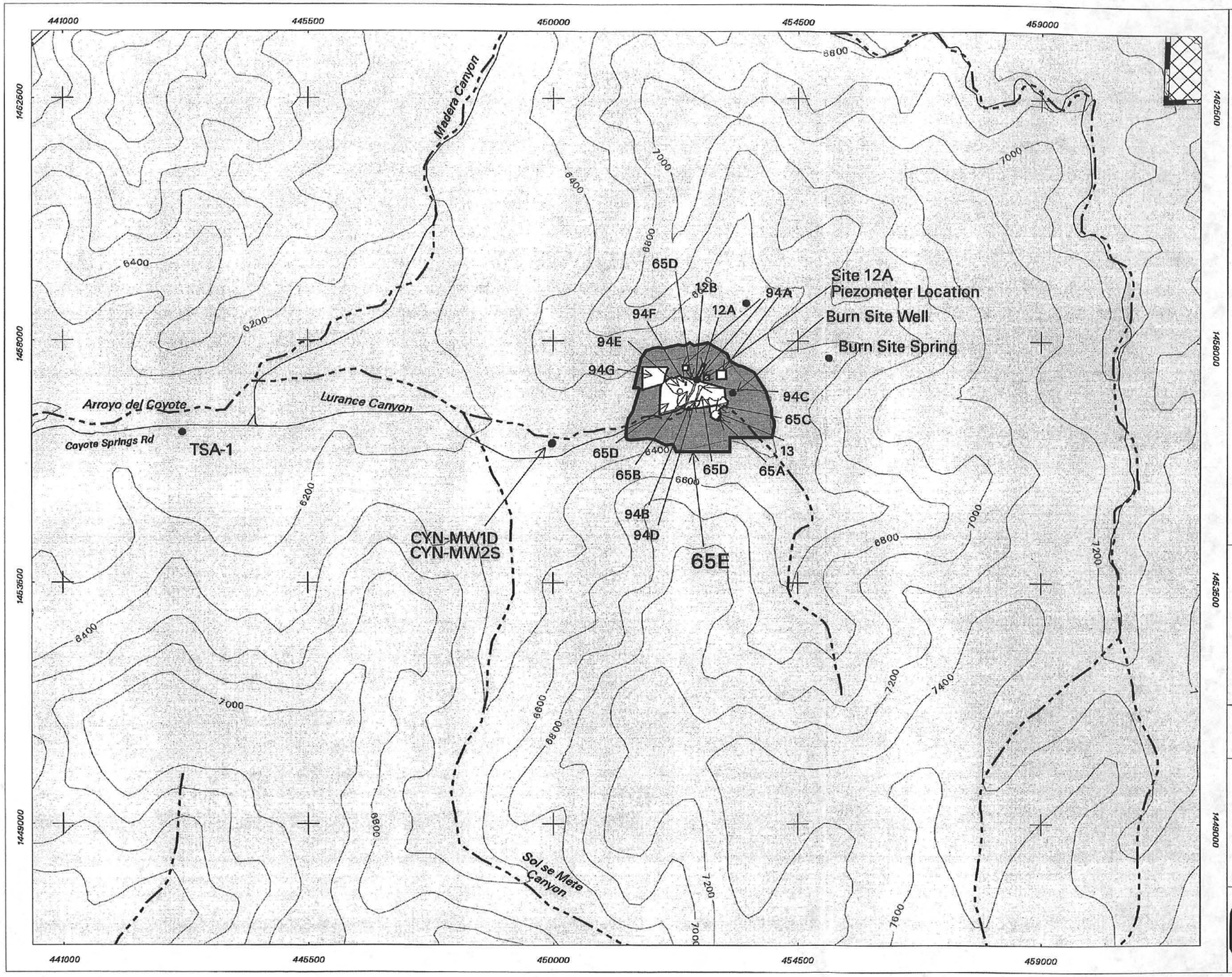
5.4.1 Summary

SWMU 65E was initially investigated under the DOE Comprehensive Environmental Assessment and Response Program (CEARP) in the mid-1980s (Investigation #1) in conformance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). In 1993, preliminary investigations began that included background information reviews, interviewing, field surveys, and scoping sampling (Investigation #2). From 1995 through 1998, a radiological voluntary corrective measure (VCM) and confirmatory soil sampling were conducted (Investigation #3).

Table 5.2.2-2
Correlation Chart of SWMU 65 Subunits with Explosive/Burn Testing Programs

Subunit Number/Name	Testing Programs	Test Nature of Operational Release	Rationale for Characterization
SWMU 65A Small Debris Mound (soil-covered concrete bunker)	Propagation Test (unconfirmed)	Open Detonations	Potential release of HE and metals.
SWMU 65B Primary Detonation Area	General Explosives Tests Open-Detonation Tests Penetration Tests	Open Detonations	Potential release of HE, metals, and DU.
	Miscellaneous Burn Tests Wood Crib Fire Tests Liquid Oxygen Torch Tests Rocket Propellant Tests	Open Burning/ Open Detonations	Potential release of HE from Wood Crib Fire Tests only.
	Slow-Heat Tests	Open Detonations	Potential release of HE.
	TABS Test Location A	Open Burning	Potential release of metals and DU.
SWMU 65C Secondary Detonation Area	General Explosives Tests Ammonium Nitrate/Fuel Rod Shipping Container Test	Open Detonation/No Release	None. No ammonium nitrate residue. Shipping container did not rupture.
	Burn Pit Tests Cloudmaker Tests Other Ammonium Nitrate Tests Liquid Fuel Fire and Solid Rocket Propellant Tests on Pioneer Capsules Plutonium Shipping Container Tests TC-708 Emergency Denial Device Tests	Open Burning/Open Detonations	Potential release of JP-4, diesel fuels, and metals.
SWMU 65D Near-Field Dispersion Area	Miscellaneous Burn Tests Wood Crib Fire Tests Liquid Oxygen Torch Tests Rocket Propellant Tests	Open Burning/Open Detonations	Potential release of HE from Wood Crib Fire Tests only.
	Cone Tests	Detonations/No Release	None. Detonation was contained by CON-CON facility.
	Slow-Heat Tests	Open Detonations	Potential release of HE.
	Dispersion Area for General Explosives Tests	Open Detonations	Potential release of HE, metals, and DU.
SWMU 65E Far-Field Dispersion Area	Dispersion Area for General Explosives Tests	Open Detonations	Potential release of HE, metals, and DU.

CON-CON = Conical Containment.
DU = Depleted uranium.
HE = High explosive.
SWMU = Solid waste management unit.
TABS = Torch-activated burn system.



Legend

- Kirtland Air Force Base Boundary
- Surface-Water Features
- 200 Foot Contour Interval
- SWMU 65E
- OU 1333 SWMU Sites
- Well
- Piezometer Location
- Recreational Land Use
- Industrial Land Use

0 2000 4000
Scale in Feet

0 480 960
Scale in Meters

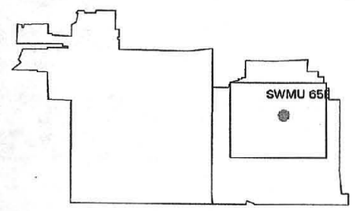


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Figure 5.3.1-1
SWMU 65E, OU1333 SWMU Sites and Associated Land Uses within KAFB Boundary & Vicinity

Transverse Mercator Projection, New Mexico State Plane Coordinate System, Central Zone, 1927 North American Horizontal Datum, 1929 North American Vertical Datum

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Unclassified		SNL GIS ORG. 6804
D Rizor	dr980973.aml	08/31/98

5.4.2 Investigation #1—Comprehensive Environmental Assessment and Response Program

5.4.2.1 Nonsampling Data Collection

SWMU 65 was identified as the LCETS during investigations conducted under the CEARP (DOE September 1987). The CEARP Phase I report documented that both free air and cased explosive charges were detonated at the site, scattering lead and depleted uranium (DU) (DOE September 1987).

5.4.2.2 Sampling Data Collection

No sampling activities were conducted at SWMU 65E as part of the CEARP.

5.4.2.3 Data Gaps

A lack of information prevented calculating of Hazard Ranking System and Modified Hazard Ranking System migration mode scores. SWMU 65 was not investigated as part of the RCRA Facility Assessment (EPA April 1987).

5.4.2.4 Results and Conclusions

The CERCLA finding under the CEARP was uncertain for Federal Facility Site Discovery and Identification Findings, preliminary assessment, and preliminary site inspection.

5.4.3 Investigation #2—SNL/ER Preliminary Investigations

5.4.3.1 Nonsampling Data Collection

This section describes the nonsampling data collected at SWMU 65E.

5.4.3.1.1 Background Review

A background review was conducted to collect available and relevant information regarding SWMU 65E. Background information sources included interviews with SNL/NM staff and contractors familiar with the site's operational history and existing historical site records and reports. The study was documented completely and has provided traceable references that sustain the integrity of the NFA proposal. Table 5.4.3-1 lists the information sources that were used to assist in evaluating SWMU 65E.

Table 5.4.3-1
Summary of Background Information Review for SWMU 65E

Information Source	Reference
Technical test reports and project log books	Littrel February 1969 Clark December 1970 Foy April 1971 Stravasnik September 1972 Walkington April 1973 Kurowski January 1979 Church March 1982 Moore and Luna February 1982 Luna June 1983 SNL/NM August 1986
Engineering drawings	Hazard Zones of Explosive Detonation Sites, Drawing Number 82272, August 1962 High Explosive Testing Area Used by Sandia Corporation, Drawing Number 88494, August 1966
Site inspections (field notes, aerial photograph review, site photographs, radiological, UXO/HE, biological, and cultural resource surveys)	Gaither [Date unk] Luna October 1985 Havlena August 1991 Gaither October 1992 Oldewage May 1993 Karas June 1993 Oldewage December 1993a Oldewage December 1993b Oldewage February 1994 SNL/NM August 1994 Young September 1994 Freshour March 1998 Freshour May 1998
Employee interviews, 19 interviews with 17 facility personnel (current and retired)	Martz September 1985 Martz November 1985 Gaither et al. May 1993 Young et al. February 1994 Brouillard June 1994 Larsen August 1994 Larsen and Palmieri August 1994a Larsen and Palmieri August 1994b Larsen and Palmieri August 1994c Larsen and Palmieri October 1994 Palmieri and Larsen October 1994 Jercinovic et al. November 1994 Palmieri November 1994a Palmieri November 1994b Hickox and Abitz December 1994 Palmieri December 1994a Palmieri December 1994b Palmieri December 1994c Palmieri December 1994e

5.4.3.1.2 UXO/HE Survey

In October 1993, KAFB Explosive Ordnance Disposal personnel conducted a visual survey for the presence of unexploded ordnance (UXO)/HE on the ground surface at SWMU 65. The survey identified one trip flare as live ordnance and one slap flare and one rifle-propelled illuminator round as ordnance debris. In addition, the survey report documented that metal fragments were found in the hills surrounding these sites (Young September 1994).

5.4.3.1.3 Radiological Survey(s)

SWMU 65 is classified as a radioactive material management area (RMMA) (SNL/NM November 1994). On April 30 and May 4, 1993, SNL/NM Radiation Protection Office (RPO) personnel conducted surveys of several sections of road in the Coyote Canyon area. The survey consisted of driving on the roads and performing periodic contamination surveys of the vehicle and taking samples of air from behind the vehicle as it was moving. No contamination was detected on the vehicle using direct scan swipe, nor was airborne radioactivity detected in the dust kicked up by the vehicle (Oldewage May 1993).

During November and December 1993 and January 1994, RUST Geotech Inc. conducted a Phase I surface gamma radiation survey of SWMU 65 in conjunction with SWMUs 12, 13, and 94. All anomalies found during the survey were identified as either point or area sources. Any anomalies occurring within the active, graded portion (SWMU 65D) of the LCBS were identified with a "94E" designation. However, all anomalies are associated with the LCETS open burning/detonation activities and were designated for a VCM (see Section 5.4.4.2.1). At the time of initial radiological surveys, the SWMU 65 subunits had not been defined.

A gamma scan survey was performed at 6-foot centers (100-percent coverage) over the surface of the graded portion of the site (SWMU 65D); the remainder of the survey area (SWMU 65E) was surveyed at 10-foot centers (70-percent coverage). Sixty-seven point sources and thirteen area sources of gamma activity 30 percent or greater than the natural background were identified during this survey (SNL/NM September 1997a). The majority of anomalies located in SWMU 65E were point sources (Figure 5.4.3-1) consisting of thin, black DU fragments that ranged in size from approximately 3/4 by 2 inches to a single fragment 6 by 3 inches. The fragments were found throughout the site, but primarily in the hill slopes comprising SWMU 65E. Where fragments were not visible, the response of the radiological survey instruments suggested that the anomalous soil point sources in SWMU 65D were the result of buried DU fragments. These soil area sources were located exclusively in SWMU 65D. The potentially buried DU fragments and soil area sources were further investigated and removed during the subsequent VCM in March 1995 and May, June, and October 1996 (Section 5.4.4.2.1).

In December 1993 (Oldewage December 1993a, Oldewage December 1993b) and January 1994 (Oldewage February 1994), the SNL/NM RPO personnel conducted follow-up surveys of the anomalies found by RUST Geotech Inc. The surveys consisted of direct beta/gamma contamination measurements with a Geiger-Müller pancake probe (Oldewage December 1993a, Oldewage February 1994). Many of the anomalies were discovered to have significant radioactivity. However, none of the swipe surveys indicated removable radioactivity above the limits of the Radcon Manual, Table 2-2 (1,000 disintegrations per minute [dpm] per 100 square centimeters [/cm^2] alpha, and 1,000 dpm/100 cm^2 beta/gamma) (Oldewage December 1993b, Oldewage February 1994). No anomalies had dose rates above the limit for posting a radiation

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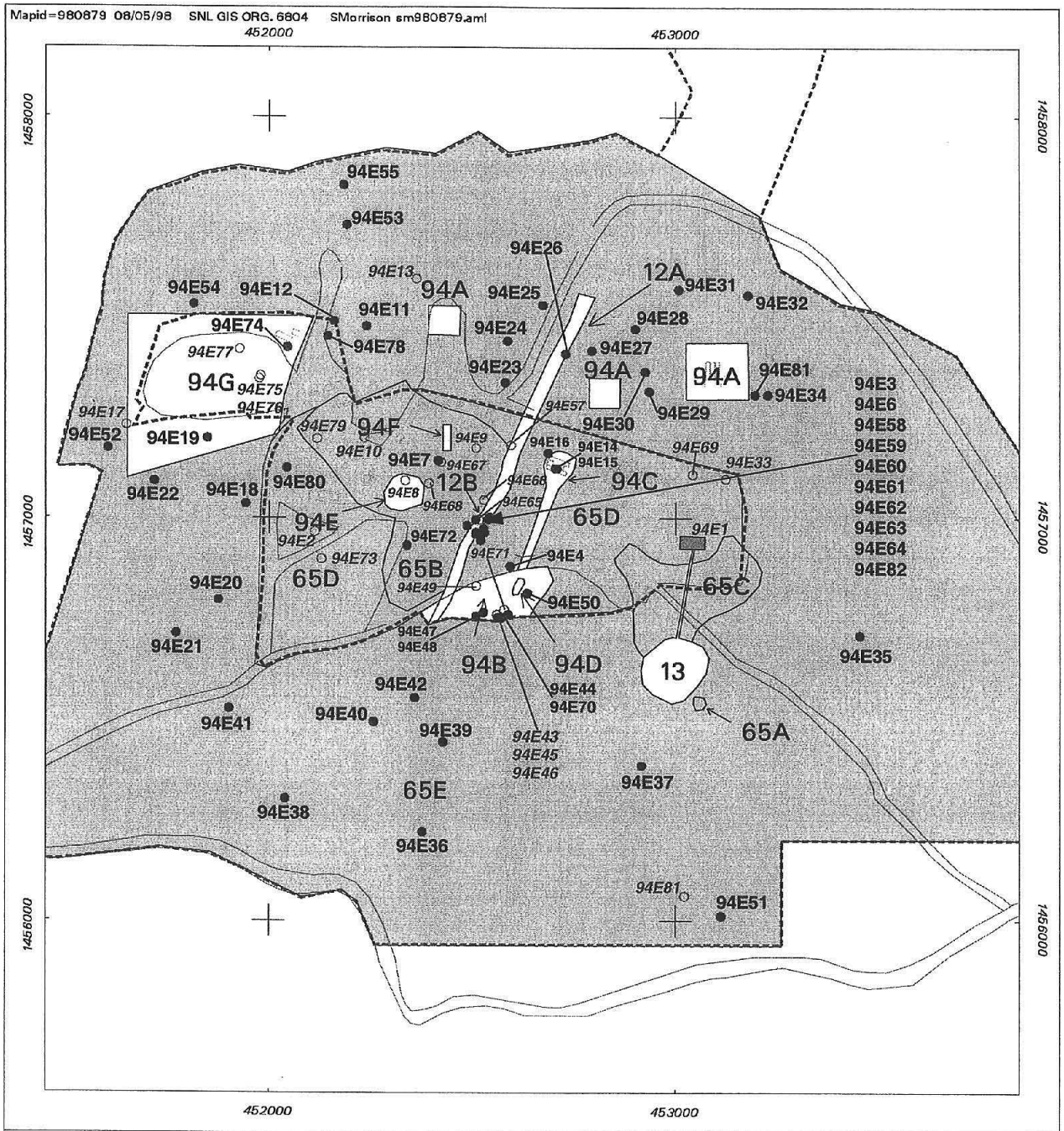

Legend

94E21 — Point Source Gamma Radiation Anomaly (Elevated relative to site specific background)

Road

Building/Structure

Rad Survey Boundary (100% Coverage)

Rad Survey Boundary (70% Coverage)

SWMU 65

94E81 — Area Source Gamma Radiation Anomaly (Elevated relative to site specific background) (○ = Area Source < 400 sq. ft.)

Other SWMUs

0 200 400
Scale in Feet

0 48 96
Scale in Meters

Figure 5.4.3-1
Phase 1
Survey Radiation Anomalies at SWMU 65

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area (5 millirems [mrem] per hour [/hr] at 1 foot) (Oldewage December 1993b, Oldewage February 1994). Therefore, immediate radiological anomaly removal was unnecessary to protect the site workers. All radiological anomalies were scheduled for removal during the subsequent VCM in March 1995 (Section 5.4.4.2.1).

5.4.3.1.4 Cultural-Resources Survey

A cultural-resources survey of SWMU 65 was conducted as part of the assessment of the Burn Site. Seven cultural resources sites were identified within the boundary of SWMU 65E (Hoagland and Dello-Russo February 1995). As a mitigation measure, all VCM and sampling activities were conducted at least 100 feet away from all cultural-resources boundaries. A U.S. Forest Service Archaeologist approved all VCM and sampling locations prior to activity initiation. All radiological anomalies were removed from SWMU 65E without impacting cultural resources.

5.4.3.1.5 Sensitive-Species Survey

A sensitive-species survey was conducted as part of a biological assessment of the LCBS (Biggs May 1991). No sensitive species were found. The site is disturbed, but is surrounded by undisturbed riparian woodland and piñon-juniper woodland vegetation. Although searches for small cacti (grama grass cacti and Wright's pincushion cacti) were not conducted during this survey, the elevation of the site and the potential for cold air drainage in this upper reach of the Lurance Canyon make the presence of these species unlikely (IT February 1995).

5.4.3.1.6 Geophysical Survey(s)

In 1994, surface and borehole geophysical investigations were conducted at two locations in the OU 1333 area to determine the depth to bedrock. Test Location 1 was on the eastern edge of SWMU 65E. Test Location 2 was farther downgradient in the Lurance Canyon near the Sol se Mete Canyon. The seismic results from Test Location 1 suggested that alluvial thickness was between 60 and 80 feet (Bay Geophysical Associates, Inc. October 1994). The thickness of the alluvium in this area is known to range from between 58 feet in the boring for 12AUP01 and 74 feet at the Burn Site Well location.

5.4.3.2 Sampling Data Collection

In July 1995, SWMU 65E was investigated as part of a sitewide scoping sampling program. The purpose of this effort was to obtain preliminary analytical data to support the ER Project site ranking and prioritization. Samples were collected from the western, southern, and eastern portions of the SWMU and identified as CY65E-GR-001, CY65E-GR-002, and CY65E-GR-003, respectively (Figure 5.4.3-2). Both surface soil samples (SS) (at 0 to 6 inches) and near-SSs (at 6 to 12 inches) were collected. Duplicate SSs were collected from CY65E-GR-001 and CY65E-GR-002. The Environmental Restoration Chemistry Laboratory (ERCL) analyzed the six environmental samples and two sample duplicates for RCRA metals (plus beryllium) using modified U.S. Environmental Protection Agency (EPA) Method 6010 (EPA November 1986) and for HE using EPA Method 8330. In addition, the Radiation Protection Sample Diagnostics (RPSD) Laboratory analyzed the samples for gamma-emitting radionuclides using gamma spectroscopy.

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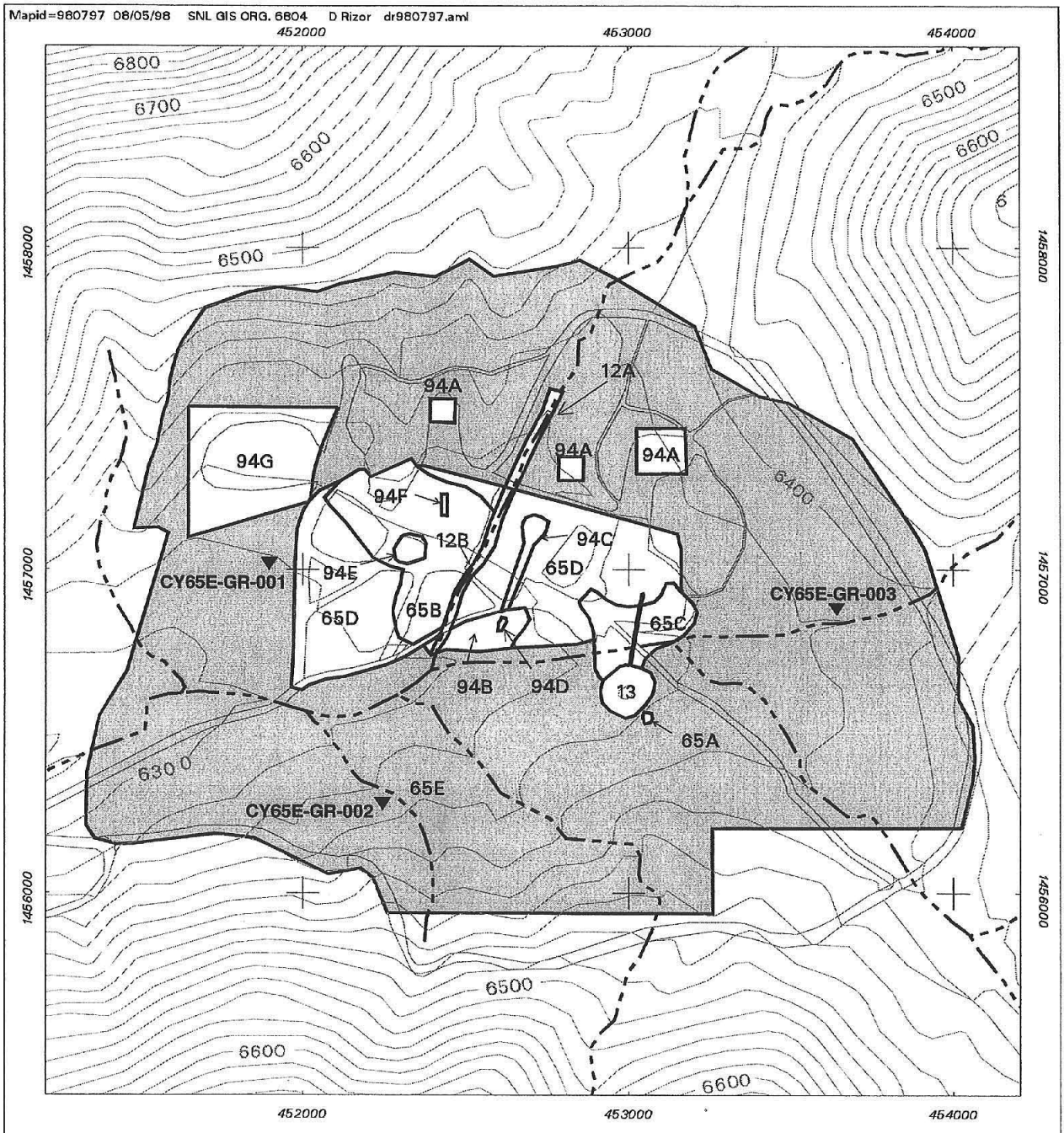

Legend

- Scoping Sample Location
- Road
- 20 Foot Contour
- Surface Drainage
- SWMU 65E
- Other SWMUs

Figure 5.4.3-2
Scoping Sample Locations at SWMU 65E

0 250 500
Scale in Feet

0 60 120
Scale in Meters

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5.4.3.3 Data Gaps

Information gathered from process knowledge, from reviewing historical site files, and from personal interviews aided in identifying the most likely COCs at SWMU 65E and in selecting the types of analyses to be performed on soil samples. However, the preliminary scoping sampling data are not adequate to support a risk screening assessment.

5.4.3.4 Results and Conclusions

Only barium and lead were detected in the soil samples. Barium concentrations were below the background limit of 246 milligrams (mg) per kilogram (/kg). Lead concentrations were all estimated and ranged between 14 J and 31 J mg/kg, with seven of the eight exceeding the background limit of 18.9 mg/kg. Arsenic, cadmium, chromium, mercury, selenium, and silver were not detected; however, the method detection limits (MDL) ranged from 0.2 (mercury) to 50 mg/kg (arsenic and selenium). Duplicate metals analytical results were comparable. No HE compounds were detected in any of the soil samples or sample duplicates at MDLs ranging from 150 to 750 micrograms (µg)/kg.

Uranium-235 and uranium-238 were not detected in any samples above the minimum detectable activity (MDA). However, the MDA for all uranium-235 analyses exceeded the background activity limit of 0.16 picocuries (pCi) per gram (/g). In five of the samples, the uranium-238 MDA exceeded the background activity limit of 2.31 pCi/g. Thorium-232 was detected in all samples at levels below the background activity limit of 1.03 pCi/g. Cesium-137 was detected above the background activity limit (0.515) in only one sample (CY65E-GR-003-0.5-S) at an activity of 1.65 pCi/g.

5.4.4 Investigation #3—SNL/NM ER Project Voluntary Corrective Measure and Confirmatory Sampling

5.4.4.1 Nonsampling Data Collection

No nonsampling data collection activities were associated with Investigation #3 of SWMU 65E.

5.4.4.2 Sampling Data Collection

This section discusses the radiological VCM, site-specific background sampling activities, and confirmatory sampling activities at SWMU 65E.

5.4.4.2.1 Voluntary Corrective Measure

VCM activities were conducted during March 1995 and May, June, and October 1996. Resurveying (scanning) was not performed at these sites. Point sources and small area sources were removed in March 1995. Larger area sources were remediated in May, June, and October 1996.

Cleanup activities included radiation scanning to verify anomaly location, removing fragment and/or soil until readings were less than 1.3 times site-specific background levels, and postcleanup (verification) soil sampling for gamma spectroscopy analysis.

During the initial cleanup, 52 point sources and 4 small area sources were removed. Excavation of two closely spaced sources (94E14 and 94E15) showed them to be linked to one large area source. This area source and nine other large area sources were removed during subsequent cleanup activities. Cleanup was initiated on one area source (94E63) but was stopped because the lateral and vertical extent of elevated radiation exceeded the capabilities of manual cleanup procedures. Remediation on this area source was completed in October 1996 using a backhoe. Figure 5.4.4-1 shows VCM verification sampling locations (postcleanup).

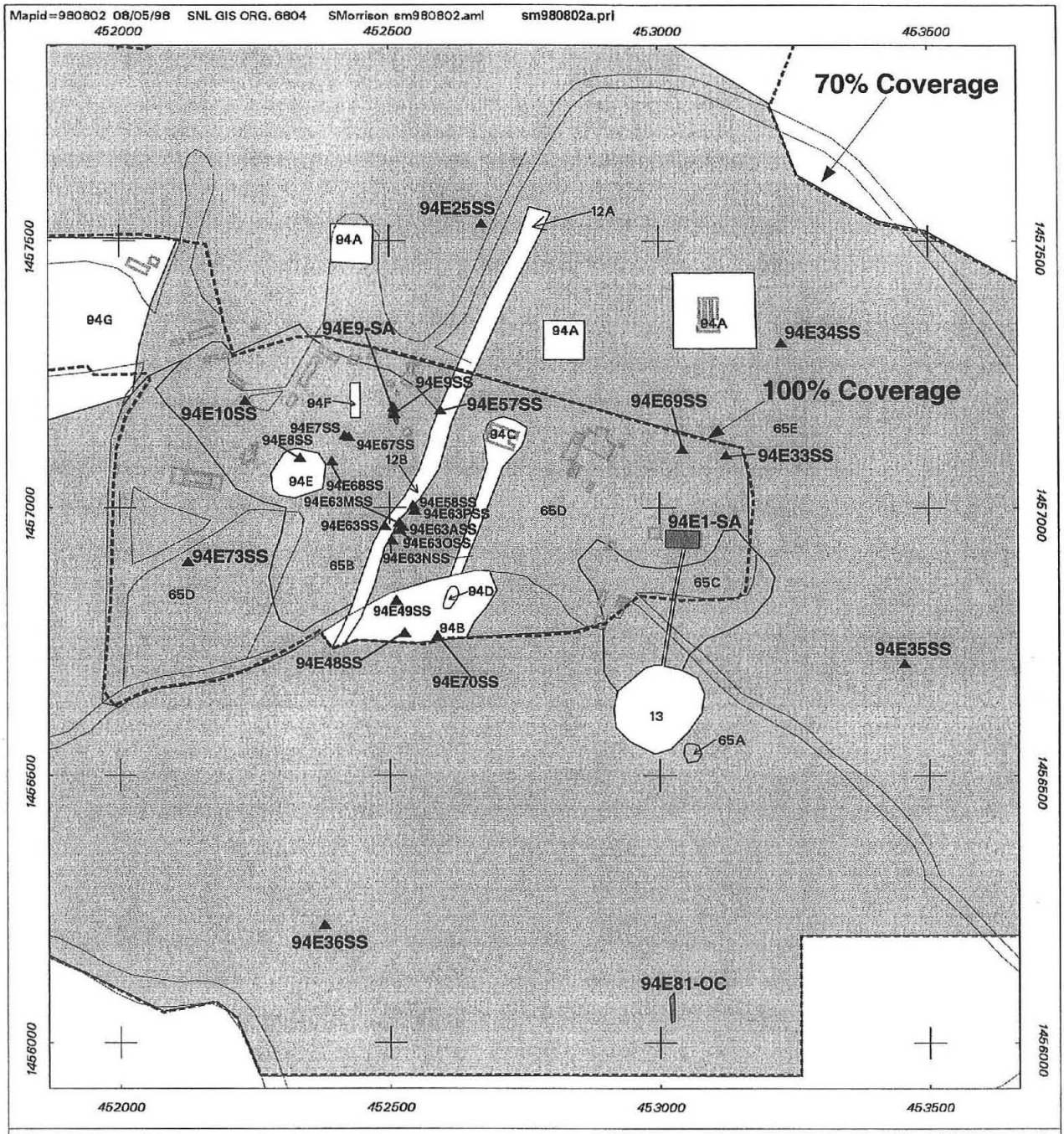
Two new sources were detected in the graded portion of the site (SWMU 65D) during the initial cleanup and were removed at that time. These gamma anomalies were at a depth beyond the detection capabilities of the gamma scintillometers during the initial survey and had become exposed over time by weathering events. Cleanup was completed on all sources and no additional point or area sources were identified during this VCM. However, the majority of SWMU 65E was surveyed at only 70-percent coverage, and additional anomalies may remain. Radiological sources are not regulated under the RCRA HSWA permit.

After radiologically contaminated soils were removed, 21 postcleanup (verification) samples were collected from areas that had exhibited the highest residual gamma radiation readings detected during the Phase I radiological survey. Gamma spectroscopy analysis was performed on these samples to characterize the residual radioactivity remaining in the soil. The radiological COC was DU (uranium-238, uranium-235, and uranium-234). The postcleanup (verification) samples collected at the site are summarized as follows:

Point Source Sample Number			Area Source Sample Number		
94E25SS	94E33SS	94E34SS	94E7SS	94E8SS	94E9SS
94E35SS	94E36SS	94E48SS	94E10SS	94E49SS	94E57SS
94E58SS	94E63SS[a]	94E63SS[a]	94E67SS	94E68SS	94E69SS
94E63ASS	94E63MSS	94E63NSS			
94E63OSS	94E63PSS	94E63PSD[b]			
94E70SS	94E73SS				

[a]Anomaly location sampled on two separate dates.
[b]Sample duplicate.

All point and area sources of gamma activity that were 30 percent or greater than the natural background were removed from the site with the exception of one area source associated with the large open burn pool (Figure 5.4.4-2), a test structure associated with SWMU 94 LCBS. This source was not removed because it is contained within the entire concrete structure and will be addressed during decontamination and decommissioning activities. Further radiological characterization is planned for the graded portion (SWMU 65D) at the LCETS. The "Final Report, Survey and Removal of Radioactive Source Contamination at Environmental Restoration Sites, Sandia National Laboratories/New Mexico" summarizes the gamma spectroscopy sample verification data (SNL/NM September 1997a).



Legend

- Post-cleanup (Verification) Soil Sample Location (SS = Soil Sample)
- Road
- Building/Structure
- Rad Survey Boundary (100% Coverage)
- Rad Survey Boundary (70% Coverage)
- SWMU 65
- Area Source Gamma Radiation Anomaly (Elevated relative to site specific background)
- Other SWMUs

0 150 300
Scale in Feet

0 36 72
Scale in Meters

Figure 5.4.4-1
VCM Surface Soil Sampling Locations at SWMU 65

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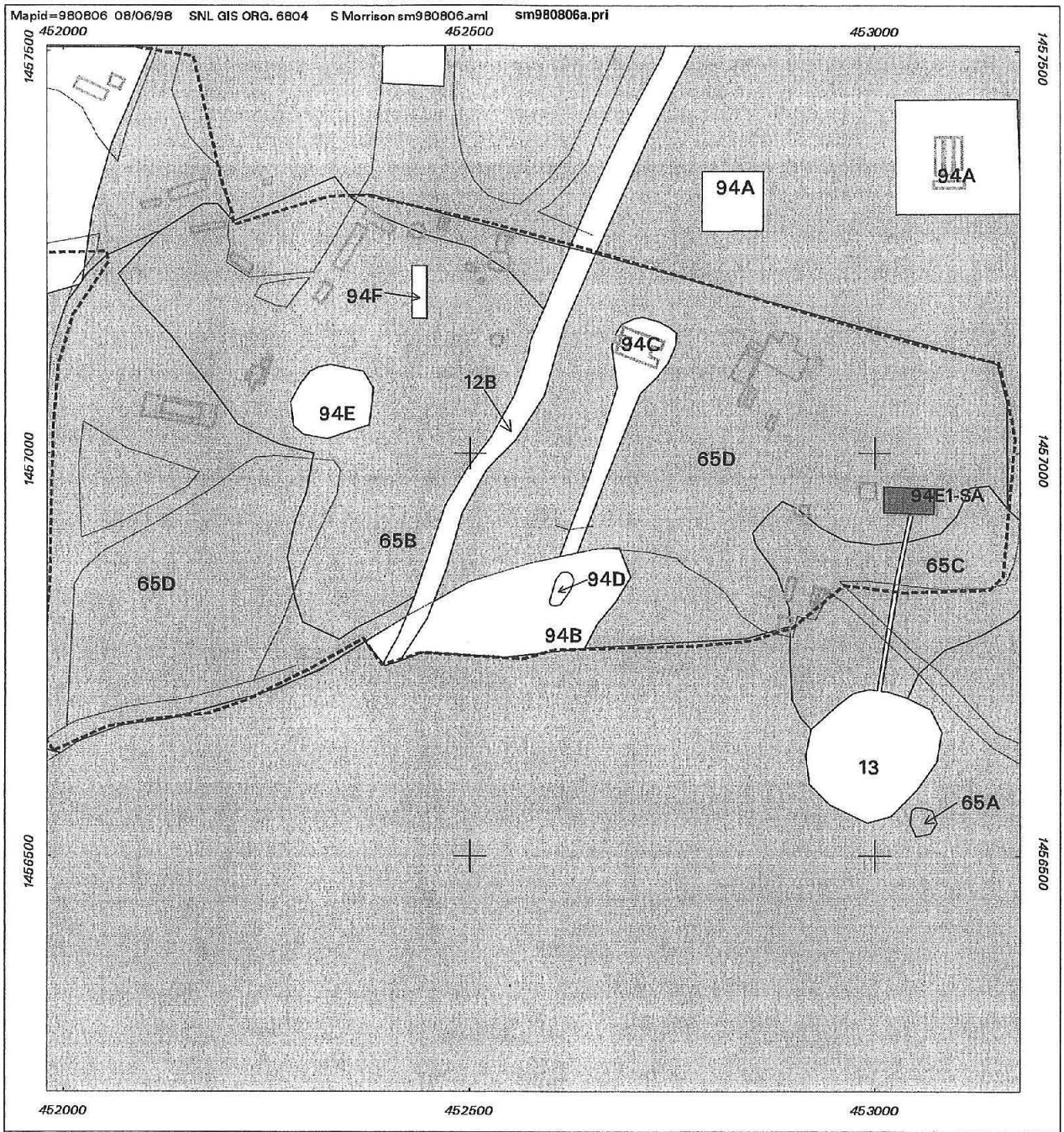

Legend

- Road
- Building/Structure
- Rad Survey Boundary
- SWMU 65
- Area Source Gamma Radiation Anomaly, No Cleanup Attempted (SA = Soil Area)
- Other SWMUs

Figure 5.4.4-2
Radiation Anomaly Remaining After Completion of the VCM at SWMU 65E

0 100 200
Scale in Feet

0 24 48
Scale in Meters

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The cleanup activities produced soil, metal fragment, and personal protective equipment (PPE) wastes. All waste was containerized in either 30- or 55-gallon drums. A total of 202 waste drums were generated during cleanup activities: 198 soil drums, 1 metal fragment drum, and 3 PPE drums. Waste consolidation was performed to minimize the number of drums produced for each waste stream. SNL/NM Department 7577 (Waste Operations), which packaged and secured waste drums for transfer to Envirocare of Utah, handled the disposal of regulated VCM waste. Nonregulated waste was disposed of using standard SNL/NM-approved waste disposal methods.

5.4.4.2.2 Site-Specific Background Sampling

SNL/NM conducted background soil and arroyo sediment sampling at the LCETS in June 1996 to establish site-specific background concentrations and activities for metals and radionuclides, respectively. The background sampling activities were performed in accordance with the rationale and procedures described in the OU 1333 RFI work plan (SNL/NM September 1995), as reviewed by the NMED. In addition to the analyses specified in the OU 1333 RFI work plan, SNL/NM also analyzed the samples for isotopic thorium, uranium, and strontium, and gross alpha and gross beta activity. The purpose of the additional analyses was to assess the viability of using gross alpha and gross beta analyses as a low-cost screening tool for future environmental assessment activities by comparing results to more accurate isotopic analysis results. Based upon the request for supplemental information (RSI) (Dinwiddie August 1997 and SNL/NM December 1997), additional background soil samples were collected in June 1998 and analyzed for gross alpha and gross beta. SNL/NM chain-of-custody and sample documentation procedures were followed for all samples collected. Figure 5.4.4-3 shows the background soil and arroyo sediment sample locations associated with SWMU 65E.

In June 1996, surface (at 0 to 0.5 foot bgs) and near-surface (at 0.5 to 1.0 foot bgs) background soil and arroyo sediment samples were collected outside the boundary of SWMU 65E. Five background soil sample locations and six background arroyo sediment sample locations were specified in the OU 1333 work plan. In June 1998, additional soil samples (from 0 to 0.5 foot bgs) were collected at 15 locations outside the boundary of SWMU 65E for gross alpha/beta analyses. These 15 background soil sample locations were approved by the NMED. Quality assurance (QA)/quality control (QC) samples that were collected include one duplicate soil sample and one duplicate arroyo sediment sample.

The background soil and arroyo sediment samples collected in June 1996 were analyzed off site for RCRA metals plus beryllium, isotopic thorium, uranium, and strontium, and gross alpha and gross beta. The samples collected in June 1996 were also analyzed on site for radionuclides using gamma spectroscopy. Lockheed Analytical Services of Las Vegas, Nevada, analyzed the samples for RCRA metals plus beryllium using EPA Method 6010/7000 (EPA November 1986); for isotopic thorium, uranium, and strontium using alpha spectroscopy and proportional gas counter; and for gross alpha and gross beta using EPA Method 900.0 (EPA November 1986). SNL/NM Department 7713, RPSD Laboratory, analyzed the samples on site for radionuclides using gamma spectroscopy. The background soil samples collected in June 1998 were analyzed off site for gross alpha and gross beta. Core Laboratories, Inc., of Casper Wyoming, analyzed these samples for gross alpha and gross beta using EPA Method 900.0 (EPA November 1986).

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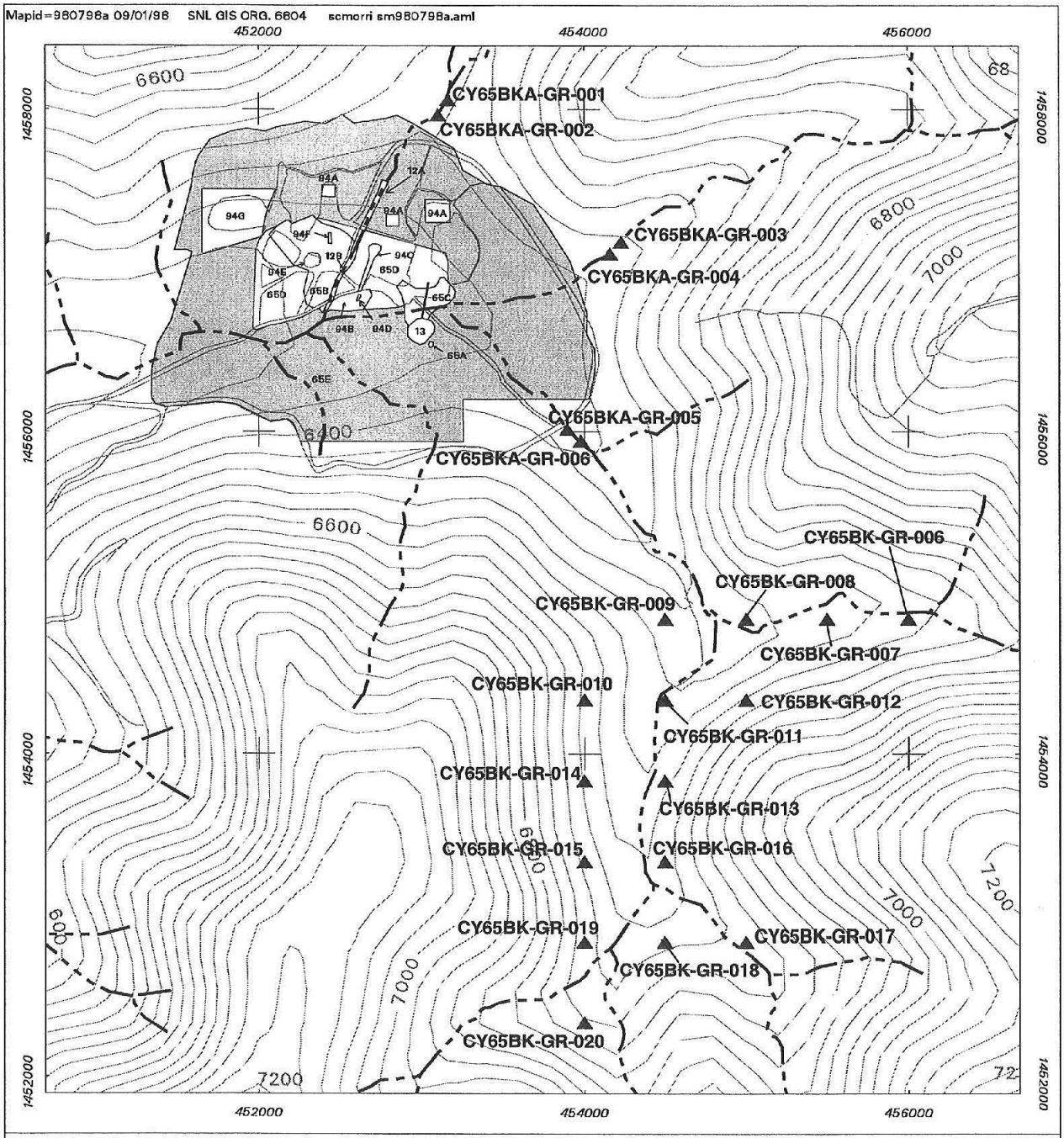

Legend

- Background Sample Location
- Road
- 40 Foot Contour
- Surface Drainage
- SWMU 65E
- Other SWMUs

Figure 5.4.4-3
Background Sample Locations at SWMU 65E

0 500 1000
Scale in Feet

0 120 240
Scale in Meters

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Analytical results for the metal analyses performed on the background soil and arroyo sediment samples that were collected in June 1996 were included in the formulation of Canyons Area background metal concentrations developed in response to the NMED "Request for Supplemental Information (RSI) for Background Concentrations of Constituents of Concern to the Sandia National Laboratories/New Mexico Environmental Restoration Project and the Kirtland Air Force Base Installation Restoration Program Report" (Zamorski December 1997). Analytical results for the gross alpha and gross beta analyses performed on the background soil samples that were collected in June 1998 were included in formulating preliminary Canyons Area background gross alpha and gross beta activities developed by the SNL/NM Environmental Restoration Program (Tharp July 1998). Annex 5-B and Annex 5-C respectively present a summary of the metal, radionuclide, isotopic thorium, uranium, and strontium, and gross alpha and gross beta results for the site-specific background soil and arroyo sediment samples collected near SWMU 65E.

5.4.4.2.3 Confirmatory Sampling

SNL/NM conducted confirmatory soil and arroyo sediment sampling at SWMU 65E in June 1996 and March 1998 to determine whether potential COCs were present at levels exceeding background limits at the site and/or sufficient to pose a risk to human health or the environment. All sampling activities were performed in accordance with the rationale and procedures described in the OU 1333 RFI work plan (SNL/NM September 1995), as reviewed by the NMED. SNL/NM chain-of-custody and sample documentation procedures were followed for all samples collected. Figure 5.4.4-4 shows the confirmatory sample locations associated with SWMU 65E.

Soil Sampling

In June 1996, surface (0 to 0.5 foot bgs) and near-surface (0.5 to 1.0 foot bgs) soil samples were collected at SWMU 65E from ten randomly selected locations within a grid pattern and from six judgmental locations selected from the former six highest gamma activity radiological point or area source anomalies for remediation confirmation. These six judgmental sample locations were identified as radiological anomalies 94E19, 94E20, 94E24, 94E53, 94E75, and 94E76 (see Section 5.4.3.1, Section 5.4.4.2.1, and Figure 5.4.4-1). Five sediment samples were collected from the Lurance Canyon arroyo. In addition, soil samples were collected from two locations within the debris mound at SWMU 65E (Mound 1) and from two locations underlying the mound. The ten random sample locations were selected from a grid pattern comprised of 100 185- by 185-foot cells that encompass all of SWMU 65E. The six judgmental sample locations were based upon the locations of the six highest radiological source area anomalies that were remediated during the radiological VCM conducted at the Burn Site (see Section 5.4.4.2.1). The debris mound was trenched in four locations in order to investigate its contents and the contents of the underlying soils. QA/QC samples collected included three duplicate samples, three split samples for off-site verification, and three equipment blanks.

The soil samples collected in June 1996 were analyzed on site for RCRA metals plus beryllium, and for gamma-emitting radionuclides. These soil samples were also to have been analyzed on site for HE compounds. However, the on-site HE analyses were never performed, and in March 1998 SWMU 65E was resampled to enable such analyses to be performed. SNL/NM Department 6684, ERCL, analyzed the samples for RCRA metals plus beryllium using

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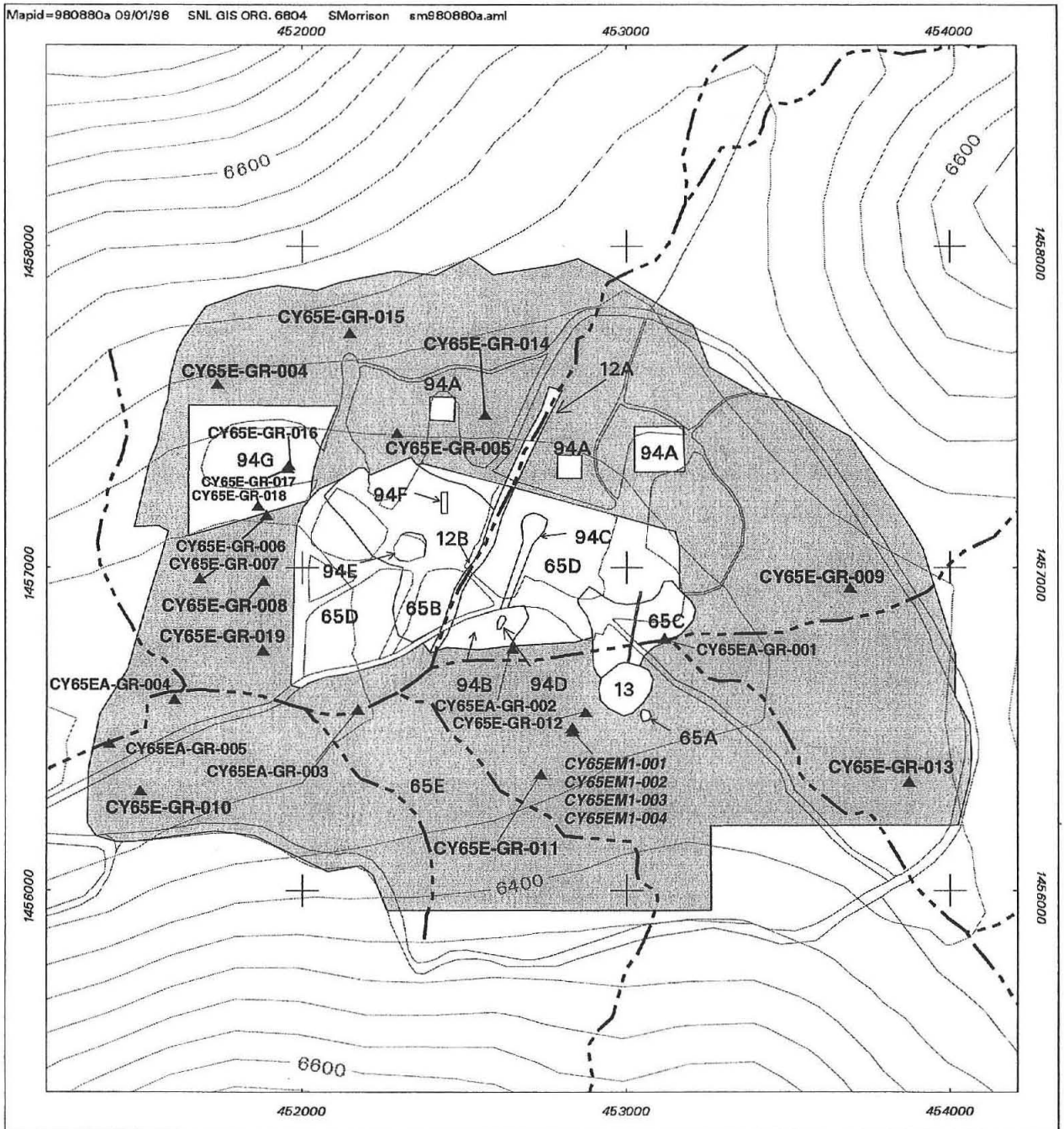

Legend

- Soil Sample Location
- Road
- 40 Foot Contour
- Surface Drainage
- SWMU 65E
- Other SWMUs

Figure 5.4.4-4
Confirmatory Sample Locations at SWMU 65E

0 250 500
Scale in Feet

0 60 120
Scale in Meters

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EPA Method 6010/7000 (EPA November 1986) and for HE using a micellar electrokinetic chromatograph (MEKC). SNL/NM Department 7713, RPSD Laboratory, analyzed the samples on site for radionuclides using gamma spectroscopy. In addition, the three duplicate samples that had been collected in June 1996 were split for analysis at an off-site laboratory, including the three QA/QC equipment rinsate samples. Lockheed Analytical Services of Las Vegas, Nevada, analyzed the samples for RCRA metals plus beryllium using EPA Method 6010/7000 (EPA November 1986) and for HE using EPA Method 8330 (EPA November 1986).

Arroyo Sediment Sampling

In June 1996, surface (0 to 0.5 foot bgs) and near-surface (0.5 to 1.0 foot bgs) arroyo sediment samples were collected from five judgmental locations at SWMU 65E within the Lurance Canyon main arroyo channel and associated tributaries. The sample locations were spaced approximately 500 feet apart in the active arroyo channel beginning at the confluence of the southern tributary and ending just downstream from the SWMU 65E boundary (see Figure 5.4.4-4). QA/QC samples collected included one duplicate sample and one equipment blank.

The arroyo sediment samples collected in June 1996 were analyzed on site for RCRA metals plus beryllium, for gamma-emitting radionuclides, and for gross alpha and gross beta activity. They were also to have been analyzed on site for HE compounds, but these analyses were never performed, and in March 1998 the arroyo was resampled to enable on-site analysis for HE compounds. SNL/NM Department 6684, ERCL, analyzed the samples on site for RCRA metals plus beryllium using EPA Method 6010/7000 (EPA November 1986) and for HE using MEKC. SNL/NM Department 7713, RPSD Laboratory, analyzed the samples on site for radionuclides using gamma spectroscopy, and for gross alpha and gross beta using EPA Method 900.0 (EPA November 1986). In addition, the single duplicate sample that was collected in June 1996 was analyzed at an off-site laboratory, including the QA/QC equipment rinsate sample. Lockheed Analytical Services of Las Vegas, Nevada, analyzed the samples for RCRA metals plus beryllium using EPA Method 6010/7000 (EPA November 1986) and for HE using EPA Method 8330 (EPA November 1986).

5.4.4.3 Data Gaps

Analytical data from confirmatory sampling are sufficient to characterize the nature and extent of releases of COCs at the site. There are no further data gaps regarding characterization of SWMU 65E.

5.4.4.4 Results and Conclusions

5.4.4.4.1 Soil Sampling

In June 1996 and March 1998 representative surface and near-surface soil samples were collected from 16 locations in SWMU 65E. During the June 1996 sampling activities, soil samples were also collected from four locations associated with Mound 1. Tables 5.4.4-1, 5.4.4-2, 5.4.4-3, 5.4.4-4, and 5.4.4-5 summarize the metals, HE, and radionuclide analytical

Table 5.4.4-1
Summary of SWMU 65E Random Grid and Judgmental Soil Sampling Metals Analytical Results, May–June 1996

Sample Attributes			Metals (EPA 6010/7000)[a] (mg/kg)[b]								
Record Number[c]	ER Sample ID (Figure 5.4.4-4)	Sample Depth (ft)	Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
Random Grid Samples											
05238	CY65E-GR-004-0-SS	0–0.5	ND (26)	110	ND (0.11)	ND (2.1)	8.4 J (19)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
05238	CY65E-GR-004-0.5-S	0.5–1.0	ND (26)	140	ND (0.11)	ND (2.1)	9.8 J (19)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
05238	CY65E-GR-005-0-SS	0–0.5	ND (26)	87	ND (0.11)	ND (2.1)	ND (5)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
05238	CY65E-GR-005-0.5-S	0.5–1.0	ND (26)	100	ND (0.11)	ND (2.1)	9.3 J (19)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
05238	CY65E-GR-006-0-SS	0–0.5	ND (26)	71	ND (0.11)	ND (2.1)	8.4 J (19)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
05238	CY65E-GR-006-0-SD	0–0.5	ND (26)	67	ND (0.11)	ND (2.1)	17 J (19)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
05237	CY65E-GR-006-0-SD (off-site laboratory)	0–0.5	7.4	120	**0.82 J (0.98)**[c]	ND (0.59)	**21**	**20 B**	ND (0.095)	ND (0.79)	ND (0.20)
05238	CY65E-GR-006-0.5-S	0.5–1.0	ND (26)	78	ND (0.11)	ND (2.1)	8.8 J (19)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
05238	CY65E-GR-007-0-SS	0–0.5	ND (26)	130	ND (0.11)	ND (2.1)	12 J (19)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
05238	CY65E-GR-007-0.5-S	0.5–1.0	ND (26)	89	ND (0.11)	ND (2.1)	5.9 J (19)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
05238	CY65E-GR-008-0-SS	0–0.5	ND (26)	73	ND (0.11)	ND (2.1)	7.9 J (19)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
05238	CY65E-GR-008-0.5-S	0.5–1.0	ND (26)	77	ND (0.11)	ND (2.1)	9.1 J (19)	ND (3.4)	ND (0.06)	**80 J (191)**	ND (1.7)
05238	CY65E-GR-009-0-SS	0–0.5	ND (26)	73	ND (0.11)	ND (2.1)	9.4 J (19)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
05238	CY65E-GR-009-0.5-S	0.5–1.0	ND (26)	82	ND (0.11)	ND (2.1)	5 J (19)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
05238	CY65E-GR-010-0-SS	0–0.5	ND (26)	81	ND (0.11)	ND (2.1)	7.8 J (19)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
05238	CY65E-GR-010–0.5-S	0.5–1.0	ND (26)	86	ND (0.11)	ND (2.1)	5.5 J (19)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
05238	CY65E-GR-011-0-SS	0–0.5	ND (26)	90	ND (0.11)	ND (2.1)	8.8 J (19)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
05238	CY65E-GR-011-0.5-S	0.5–1.0	ND (26)	78	ND (0.11)	ND (2.1)	5.7 J (19)	ND (3.4)	ND (0.06)	**63 J (191)**	ND (1.7)
05238	CY65E-GR-012-0-SS	0–0.5	ND (26)	80	ND (0.11)	ND (2.1)	5.2 J (19)	ND (3.4)	ND (0.06)	**55 J (191)**	ND (1.7)
05238	CY65E-GR-012-0-SD	0–0.5	ND (26)	80	ND (0.11)	ND (2.1)	ND (5)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
05237	CY65E-GR-012-0-SD (off-site laboratory)	0–0.5	5.2	150	0.69 J (0.98)	ND (0.59)	17	11 B	ND (0.10)	ND (0.79)	ND (0.20)
05238	CY65E-GR-012-0.5-S	0.5–1.0	ND (26)	87	ND (0.11)	ND (2.1)	6.3 J (19)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
05238	CY65E-GR-013-0-SS	0–0.5	ND (26)	110	ND (0.11)	ND (2.1)	ND (5)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
05238	CY65E-GR-013-0.5-S	0.5–1.0	ND (26)	120	ND (0.11)	ND (2.1)	8.5 J (19)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
Judgmental Samples											
05356	CY65E-GR-014-0-SS	0–0.5	ND (26)	52	ND (0.11)	ND (2.1)	ND (5)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
05356	CY65E-GR-015-0-SS	0–0.5	ND (26)	84	ND (0.11)	ND (2.1)	9.4 J (19)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
05356	CY65E-GR-015-0.5-S	0.5–1.0	ND (26)	95	ND (0.11)	ND (2.1)	9.3 J (19)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
05356	CY65E-GR-016-0-SS	0–0.5	ND (26)	80	ND (0.11)	ND (2.1)	**19**	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
05356	CY65E-GR-016-0-SD	0–0.5	ND (26)	89	ND (0.11)	ND (2.1)	18 J (19)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
05358	CY65E-GR-016-0-SD (off-site laboratory)	0–0.5	7.9	150	**1.1**	0.45 J (0.97)	**25**	15	ND (0.10)	ND (0.58)	ND (0.19)

Refer to footnotes at end of table.

Table 5.4.4-1 (Concluded)
Summary of SWMU 65E Random Grid Judgmental Soil Sampling Metals Analytical Results, May–June 1996

Sample Attributes			Metals (EPA 6010/7000)[a] (mg/kg)[b]								
Record Number[c]	ER Sample ID (Figure 5.4.4-4)	Sample Depth (ft)	Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
05356	CY65E-GR-016-0.5-S	0.5–1.0	ND (26)	85	ND (0.11)	ND (2.1)	10 J (19)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
05356	CY65E-GR-017-0-SS	0–0.5	ND (26)	64	ND (0.11)	ND (2.1)	10 J (19)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
05356	CY65E-GR-017-0.5-S	0.5–1.0	ND (26)	74	ND (0.11)	ND (2.1)	8.6 J (19)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
05356	CY65E-GR-018-0-SS	0–0.5	ND (26)	81	ND (0.11)	ND (2.1)	11 J (19)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
05356	CY65E-GR-018-0.5-S	0.5–1.0	ND (26)	81	ND (0.11)	ND (2.1)	13 J (19)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
05356	CY65E-GR-019-0-SS	0–0.5	ND (26)	93	ND (0.11)	ND (2.1)	7.8 J (19)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
05356	CY65E-GR-019-0.5-S	0.5–1.0	ND (26)	93	ND (0.11)	ND (2.1)	5.2 J (19)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
Background Soil Concentrations—Canyon Area[d]			9.8	246	0.75	0.64	18.8	18.9	0.055	3.0	<0.5
Quality Assurance/Quality Control Samples (all in mg/L)											
05358	CY65E-GR-001-EB (off-site laboratory)	NA	ND (0.0030)	ND (0.0050)	ND (0.0010)	ND (0.0010)	ND (0.0020)	ND (0.0020)	ND (0.00020)	ND (0.0030)	0.0011 J (0.010)
05237	CY65E-GR-002-EB (off-site laboratory)	NA	0.0034 J (0.010)	ND (0.0010)	ND (0.0010)	ND (0.0030)	ND (0.0040)	ND (0.0020)	ND (0.00020)	ND (0.0040)	0.0020 J (0.010)
05237	CY65E-GR-003-EB (off-site laboratory)	NA	ND (0.0030)	ND (0.0010)	ND (0.0010)	ND (0.0030)	ND (0.0040)	ND (0.0020)	ND (0.00020)	ND (0.0040)	ND (0.0010)

[a]EPA November 1986.
[b]Analysis request/chain-of-custody record.
[c]Values in bold exceed background soil concentrations.
[d]From Zamorski December 1997.

B = Analyte detected in associated blank.
CY = Canyon.
EB = Equipment blank.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab sample.
ID = Identification.
J ( ) = The reported value is greater than or equal to the method detection limit (MDL) but is less than the practical quantitation limit for on-site laboratory analyses or the contract required detection limit for off-site laboratory analyses, shown in parenthesis.
mg/kg = Milligrams per kilogram.
mg/L = Milligrams per liter.
NA = Not applicable.
ND = Not detected above the MDL, shown in parenthesis.
S = Subsurface soil sample.
SD = Surface soil sample duplicate.
SS = Surface soil sample.
SWMU = Solid waste management unit.

Table 5.4.4-2
Summary of SWMU 65E Debris Mound Soil Sampling Metals Analytical Results, May–June 1996
(On-Site Laboratory)

Sample Attributes			Metals (EPA 6010/7000)[a] (mg/kg)								
Record Number[b]	ER Sample ID (Figure 5.4.4-4)	Sample Depth (ft)	Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
05246	CY65EM1-001-0-SS	0–0.5	ND (26)	130	ND (0.11)	ND (2.1)	ND (5)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
05246	CY65EM1-002-0-SS	0–0.5	ND (26)	150	ND (0.11)	ND (2.1)	5.5 J (19)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
05246	CY65EM1-003-1.5-S	1.5–2.0	ND (26)	110	ND (0.11)	ND (2.1)	8.4 J (19)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
05246	CY65EM1-004-1.5-S	1.5–2.0	ND (26)	84	ND (0.11)	ND (2.1)	ND (5)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
Background Soil Concentrations—Canyon Area[c]			9.8	246	0.75	0.64	18.8	18.9	0.055	3.0	<0.5

[a] EPA November 1986.
[b] Analysis request/chain-of-custody record.
[c] From Zamorski December 1997.

CY = Canyon.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
ID = Identification.
J ( ) = The reported value is greater than or equal to the method detection limit (MDL) but is less than the practical quantitation limit, shown in parenthesis.
M1 = Mound 1.
mg/kg = Milligrams per kilogram.
ND = Not detected above the MDL, shown in parenthesis.
S = Subsurface soil sample.
SS = Surface soil sample.
SWMU = Solid waste management unit.

Table 5.4.4-3
Summary of HE Analysis Detection Limits
Used for SWMU 65E Confirmatory Soil Sampling, June 1996 and March 1998

Compounds	HE Detection Limits	
	On-Site Analyses by MEKC (mg/kg)	Off-Site Analyses by EPA Method 8330[a] (µg/g)
1,3,5-trinitrobenzene	0.1–0.13	0.070
1,3-dinitrobenzene	0.071–0.09	0.10
2,4,6-trinitrotoluene	0.27–0.35	0.11
2,4-dinitrotoluene	0.23–0.3	0.16
2,6-dinitrotoluene	0.27–0.35	0.19
2-amino-4,6-dinitrotoluene	0.12–0.15	0.13
2-nitrotoluene	0.14–0.18	0.070
3-nitrotoluene	0.14–0.18	0.16
4-amino-2,6-dinitrotoluene	0.1–0.13	0.055
4-nitrotoluene	0.12–0.15	0.17
HMX	0.12–0.15	0.42
Nitrobenzene	0.16–0.21	0.15
Pentaerythritol tetranitrate	0.32–0.41	NA
RDX	0.17–0.22	0.19
Tetryl	NA	0.34

[a]EPA November 1986.

EPA = U.S. Environmental Protection Agency.
HE = High explosives.
HMX = 1,3,5,7-tetranitro-1,3,5,7-tetrazacyclooctance.
MEKC = Micellar electrokinetic chromatography.
mg/kg = Milligrams per kilogram.
NA = Not applicable.
RDX = 1,3,5-trinitro-1,3,5-triazacyclohexane.
Tetryl = 2,4,6-trinitrophenylmethylnitramine.
µg/g = Micrograms per gram.

Table 5.4.4-4
Summary of SWMU 65E Random Grid and Judgmental Soil Sampling Gamma Spectroscopy Analytical Results, May–June 1996 (On-Site Laboratory)

Sample Attributes			Gamma Spectroscopy Activity (pCi/g)[a]							
			Uranium-238		Thorium-232		Uranium-235		Cesium-137	
Record Number[a]	ER Sample ID (Figure 5.4.4-4)	Sample Depth (ft)	Result	Error[c]	Result	Error[c]	Result	Error[c]	Result	Error[c]
Random Grid Samples										
05240	CY65E-GR-005-0-SS	0-0.5	ND (1.22E+00)	--	7.90E-01	1.29E+00	ND (1.71E-01)	--	6.88E-02	2.68E-02
05236	CY65E-GR-006-0-SS	0-0.5	ND (1.00E+00)	--	8.68E-01	4.82E-01	ND (1.23E-01)	--	4.33E-01	7.38E-02
05240	CY65E-GR-009-0-SS	0-0.5	1.02E+00	1.33E+00	9.93E-01	4.73E-01	ND (2.13E-01)	--	**7.13E-01**[c]	1.22E-01
05240	CY65E-GR-010-0-SS	0-0.5	1.43E+00	1.08E+00	7.28E-01	3.62E-01	ND (1.94E-01)	--	4.55E-01	8.03E-02
05240	CY65E-GR-012-0-SS	0-0.5	5.88E-01	7.22E-01	8.63E-01	4.18E-01	ND (1.96E-01)	--	6.23E-02	3.22E-02
05236	CY65E-GR-012-0-SD	0-0.5	ND (9.63E-01)	--	8.45E-01	4.20E-01	ND (1.23E-01)	--	3.60E-02	2.10E-02
05240	CY65E-GR-013-0-SS	0-0.5	ND (1.62E+00)	--	8.98E-01	8.18E-01	ND (2.15E-01)	--	4.18E-01	2.60E-01
Judgmental Samples										
05354	CY65E-GR-014-0-SS	0-0.5	ND (2.78E+00)	--	5.15E-01	2.40E-01	ND (1.95E-01)	--	1.65E-01	3.57E-02
05355	CY65E-GR-015-0-SS	0-0.5	ND (3.61E+00)	--	6.46E-01	6.75E-01	ND (2.56E-01)	--	**8.59E-01**	4.48E-01
05355	CY65E-GR-016-0-SS	0-0.5	ND (3.44E+00)	--	8.87E-01	4.32E-01	ND (2.36E-01)	--	1.05E-01	2.95E-02
05355	CY65E-GR-016-0-SD	0-0.5	ND (1.99E+00)	--	9.25E-01	4.37E-01	ND (2.45E-01)	--	3.98E-01	1.22E-01
05355	CY65E-GR-017-0-SS	0-0.5	**2.08E+01**	6.02E+00	8.06E-01	3.88E-01	**2.60E-01**	1.80E-01	5.06E-01	2.11E-01
05355	CY65E-GR-018-0-SS	0-0.5	ND (3.72E+00)	--	9.15E-01	4.41E-01	ND (2.59E-01)	--	3.28E-01	5.78E-02
05354	CY65E-GR-019-0-SS	0-0.5	ND (3.38E+00)	--	8.87E-01	6.57E-01	ND (2.36E-01)	--	1.00E-01	3.99E-02
Background Soil Concentrations—Upper Canyons[c]			2.31	NA	1.03	NA	0.16	NA	0.515	NA

[a]Values in bold exceed background soil concentrations.
[b]Analysis request/chain-of-custody record.
[c]Two standard deviations above the mean detected activity.
[d]From Dinwiddie September 1997.

CY = Canyon.
ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab sample.
ID = Identification.
NA = Not applicable.
ND = Radionuclide not detected above the minimum detectable activity, shown in parenthesis.
pCi/g = Picocuries per gram.
SD = Surface soil sample duplicate.
SS = Surface soil sample.
SWMU = Solid waste management unit.
-- = Error not calculated for nondetectable results.

Table 5.4.4-5
Summary of SWMU 65E Mound Soil Sampling
Gamma Spectroscopy Analytical Results, May–June 1996
(On-Site Laboratory)

Sample Attributes			Gamma Spectroscopy Activity (pCi/g)[a]							
Record Number[b]	ER Sample ID (Figure 5.4.4-4)	Sample Depth (ft)	Uranium-238		Thorium-232		Uranium-235		Cesium-137	
			Result	Error[c]	Result	Error[c]	Result	Error[c]	Result	Error[c]
05242	CY65EM1-001-0-SS	0-0.5	ND (1.47E+00)	--	7.74E-01	3.85E-01	ND (2.09E-01)	--	**1.03E+00**[c]	1.67E-01
05245	CY65EM1-002-0-SS	0-0.5	ND (1.29E+00)	--	8.87E-01	4.68E-01	ND (9.92E-02)	--	3.71E-02	1.48E-02
05242	CY65EM1-003-1.5-S	1.5-2.0	ND (1.55E+00)	--	7.80E-01	3.93E-01	ND (2.08E-01)	--	2.93E-01	1.74E-01
05242	CY65EM1-004-1.5-S	1.5-2.0	ND (1.45E+00)	--	9.20E-01	4.45E-01	ND (2.01E-01)	--	5.83E-02	2.56E-02
Background Soil Concentrations—Upper Canyons[d]			2.31	NA	1.03	NA	0.16	NA	0.515	NA

[a]Values in bold exceed background soil concentrations.
[b]Analysis request/chain-of-custody record.
[c]Two standard deviations above the mean detected activity.
[d]From Dinwiddie September 1997.

CY = Canyon.
ER = Environmental Restoration.
ft = Foot (feet).
ID = Identification.
M = Mound.
NA = Not applicable.
ND = Radionuclide not detected above the minimum detectable activity, shown in parenthesis.
pCi/g = Picocuries per gram.
S = Subsurface soil sample.
SS = Surface soil sample.
SWMU = Solid waste management unit.
-- = Error not calculated for nondetectable results.

results for all of the confirmatory soil samples collected at SWMU 65E. Annex 5-D contains complete results for the gamma spectroscopy analyses.

An example identification (ID) in the ER Sample ID column of the data summary tables is CY65E-GR-004-0-SS (see Table 5.4.4-1). This ID refers to a sample collected from SWMU 65E within the Canyons Test Area of SNL/NM (CY65E). The grab sample (GR) was number 004 collected at a beginning depth of 0 foot and thereby designated SS. This section briefly describes the results of confirmatory sampling at SWMU 65E.

As indicated in Table 5.4.4-1, MDLs for all on-site analyses of metals exceeded the background concentration limits for arsenic, cadmium, mercury, selenium, and silver. However, the MDL for on-site analysis of mercury is very close to the background concentration limit. The on-site analysis MDL for mercury is 0.06 mg/kg as compared to the background concentration limit of 0.055 mg/kg. The off-site laboratories provided a lower MDL for metals analyses, with only a single exception. The MDL that Lockheed Analytical Services used to analyze for mercury ranged from 0.095 to 0.10 mg/kg.

Metals

Table 5.4.4-1 summarizes the metals analysis results for soil samples collected from the ten random grid and six judgmental locations at SWMU 65E. The random grid and judgmental samples consist of 31 surface and near-SSs, three duplicate samples, and three split samples. Table 5.4.4-2 summarizes the metals analysis for the four soil samples collected from Mound 1 within SWMU 65E.

Arsenic, cadmium, mercury, and silver were not detected in any of the random grid, judgmental, and debris mound soil samples analyzed by the on-site laboratory. However, as noted above, the MDLs used for those analyses exceeded the corresponding background concentration limits. Results for the three split samples analyzed by the off-site laboratory indicate that arsenic, cadmium, mercury, and silver were either not detected above the background concentration limits or not detected at or above the MDLs.

Although the 50-mg/kg MDL used for the on-site analysis of selenium was significantly higher than the 3.0-mg/kg background concentration limit, selenium was detected in estimated concentrations ranging from 55 J to 80 J mg/kg in three random grid samples (CY65E-GR-008-0.5-S, CY65E-GR-011-0.5-S, and CY65E-GR-012-0-SS) that were analyzed by the on-site laboratory. However, the practical quantitation limit (PQL) for all three results was 191 mg/kg. Selenium was not detected in any of the judgmental and debris mound samples analyzed on site. In addition, selenium was not detected in the three split samples analyzed off site, which used an MDL ranging from 0.58 to 0.79 mg/kg.

Barium was not detected above the background concentration limit in any of the random grid, judgmental, or debris mound soil samples that were collected at SWMU 65E. Beryllium, chromium, and lead were detected slightly above the background concentration limits in one or more of the random grid and judgmental samples. Beryllium slightly exceeded the background limit of 0.75 mg/kg in the split samples CY65E-GR-006-0-SD and CY65E-GR-016-0-SD that were analyzed off site, but not the corresponding sample duplicate pairs that were analyzed on site. Chromium slightly exceeded the background limit of 18.8 mg/kg in the split sample CY65E-GR-006-0-SD, but not the corresponding sample duplicate pair that was analyzed on site. Chromium slightly exceeded the background limit in sample CY65E-GR-016-0-SS and the

split sample CY65E-GR-016-0-SD, but not the duplicate sample CY65E-GR-016-SD. Lead slightly exceeded the background limit of 18.9 mg/kg in the split sample CY65E-GR-006-0-SD that was analyzed off site, but not the corresponding sample duplicate pair that was analyzed on site.

High Explosives

Because there are no applicable background concentrations for HE compounds in soil, any detectable HE compounds in the samples collected at SWMU 65E can be considered an indication of contamination. However, no HE compounds were detected in any of the random grid, judgmental, or debris mound soil samples collected at SWMU 65E. Table 5.4.4-3 summarizes the detection limits used for analyzing HE compounds by the on-site and off-site laboratories.

Radionuclides

Tables 5.4.4-4 and 5.4.4-5 summarize the on-site gamma spectroscopy analysis results for the random grid, judgmental, and debris mound samples collected at SWMU 65E. The gamma spectroscopy results indicate that uranium-238 and uranium-235 activities exceeded background in only one sample, CY65E-GR-017-0-SS; this corresponds to the gamma radiation anomaly 94E76. In all other samples the gamma spectroscopy results show uranium-238 or uranium-235 was either not detected above the minimum detectable activity (MDA) or not detected above background. However, the MDA associated with nondetectable results for uranium-238 and uranium-235 exceeded background in several instances. Although this situation inhibits any comparison to background, uranium-238 and uranium-235 results can be compared because both coexist in DU. As a result, any elevated uranium-238 activity would be accompanied by a corresponding elevation in uranium-235 activity. Using this comparison, the nondetectable results obtained for uranium-235 that have MDAs above background in the random grid and debris mound samples do not show corresponding elevated activities in the results for uranium-238. No comparison is possible for the nondetectable results obtained for the judgmental samples because the MDAs are above background for both uranium-238 and uranium-235.

The gamma activity from thorium-232 did not exceed background in any of the samples collected from SWMU 65E. However, the gamma activity from cesium-137 slightly exceeded background in one sample collected from each of the random grid, judgmental, and debris mound locations (CY65E-GR-009-0-SS, CY65E-GR-015-0-SS, and CY65EM1-GR-001-0-SS).

Quality Assurance/Quality Control Results

This section briefly describes the data quality assessment results for the soil sample results.

Table 5.4.4-1 presents results of the analysis for metals QA/QC samples collected during the confirmatory sampling program at SWMU 65E. The QA/QC samples collected consist of three equipment blanks. All three QA/QC samples were analyzed off site for metals. Detectable concentrations of both arsenic and silver were reported for the equipment blank sample CY65E-GR-002-EB. Detectable concentrations of silver were also reported in the equipment blank

sample CY65E-GR-001-EB. However, because both arsenic and silver were detected above the MDLs but below the PQLs, the reported values are estimations.

To assess the precision of soil sampling procedures, three soil samples were collected and analyzed in replicate on site. Relative percent differences (RPD) were calculated from the data and are presented in Table 5.4.4-6. Because the majority of results for the sample pairs are nondetect, RPDs could only be calculated for barium. The corresponding RPDs for barium ranged from 0 to 10.7 percent in the three sample duplicate pairs. In general, the results obtained for the three sample duplicate pairs are in agreement.

Each of the three duplicate samples collected was also split and analyzed for metals off site. Because of the disparity in MDLs associated with the on-site and off-site analyses, comparisons between the duplicate and split duplicate sample results are limited. Barium, beryllium, and lead concentrations were notably higher in the off-site analysis of each split duplicate.

As discussed previously, no HE compounds were detected in any of the soil samples collected at SWMU 65E. As a result, only the MDLs associated with the laboratory analyses performed are presented (see Table 5.4.4-3). Three equipment blank QA/QC samples were collected and analyzed off site for HE compounds. Detectable concentrations of 1,3-dinitrobenzene were reported in sample CY65E-GR-001-EB. In addition, five of the samples collected were analyzed in replicate. Identical results were obtained for each of the five sample duplicate pairs collected at SWMU 65E.

No QA/QC samples were collected for radionuclide analysis. However, two samples were collected and analyzed in replicate on site (Table 5.4.4-4). The results obtained for the sample duplicate pairs are consistent.

5.4.4.4.2 Arroyo Sediment Sampling

In June 1996 and March 1998, representative surface and near-surface arroyo sediment samples were collected from five locations within the main channel of the Lurance Canyon arroyo at SWMU 65E. Tables 5.4.4-7, 5.4.4-8, and 5.4.4-9 summarize the metals, radionuclide, and gross alpha and gross beta analytical results, respectively, for the confirmatory arroyo sediment samples collected at SWMU 65E. Annex 5-D contains complete results for the gamma spectroscopy analyses.

As discussed in Section 5.4.4.4.1 and indicated in Table 5.4.4-7, the MDLs for all on-site analyses of metals exceeded the background concentration limits for arsenic, cadmium, mercury, selenium, and silver. However, the MDL for on-site analysis of mercury is very close to the background concentration limit. The on-site analysis MDL for mercury is 0.06 milligrams mg/kg as compared to the background concentration limit of 0.055 mg/kg. The off-site laboratories provided a lower MDL for metals analyses, with only a single exception. The MDL used by Lockheed Analytical Services for the analysis of mercury ranged from 0.095 and 0.10 mg/kg.

Metals

Table 5.4.4-7 summarizes the metals analysis results for arroyo sediment samples collected from the five judgmental locations within the Lurance Canyon main channel arroyo at

Table 5.4.4-6
Summary of SWMU 65E Field Duplicate Relative Percent Differences

Sample Attributes			Relative Percent Difference (RPD)								
Record Number[a]	ER Sample ID (Figure 5.4.4-4)	Sample Depth (ft)	Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
Random Grid Samples											
05238	CY65E-GR-006-0-SS CY65E-GR-006-0-SD	0–0.5	NC	5.8	NC	NC	NC	NC	NC	NC	NC
05238	CY65E-GR-012-0-SS CY65E-GR-012-0-SD	0–0.5	NC	0.0	NC	NC	NC	NC	NC	NC	NC
05356	CY65E-GR-016-0-SS CY65E-GR-016-0-SD	0–0.5	NC	10.7	NC	NC	NC	NC	NC	NC	NC

[a]Analysis request/chain-of-custody record.

CY = Canyon.
ER = Environmental Restoration.
Ft = Foot (feet).
GR = Grab sample.
ID = Identification.
NC = Not calculated for estimated values or nondetected results.
SD = Sample duplicate.
SS = Surface soil sample.
SWMU = Solid waste management unit.

Table 5.4.4-7
Summary of SWMU 65E Arroyo Sediment Sampling Metals Analytical Results, May–June 1996

Sample Attributes			Metals (EPA 6010/7000)[a] (mg/kg)[b]								
Record Number[c]	ER Sample ID (Figure 5.4.4-4)	Sample Depth (ft)	Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
05356	CY65EA-GR-001-0-SS	0–0.5	ND (26)	63	ND (0.11)	ND (2.1)	ND (5)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
05356	CY65EA-GR-001-0.5-S	0.5–1.0	ND (26)	93	ND (0.11)	ND (2.1)	7.6 J (19)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
05356	CY65EA-GR-002-0-SS	0–0.5	ND (26)	67	ND (0.11)	ND (2.1)	5.7 J (19)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
05356	CY65EA-GR-002-0.5-S	0.5–1.0	ND (26)	120	ND (0.11)	ND (2.1)	9.5 J (19)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
05356	CY65EA-GR-003-0-SS	0–0.5	ND (26)	42	ND (0.11)	ND (2.1)	ND (5)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
05358	CY65EA-GR-003-0-SD (off-site laboratory)	0–0.5	2.3	75	0.34 J (0.96)	0.26 J (0.96)	6.6	5.3	ND (0.095)	1.1	ND (0.19)
05356	CY65EA-GR-003-0.5-S	0.5–1.0	ND (26)	70	ND (0.11)	ND (2.1)	ND (5)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
05356	CY65EA-GR-004-0-SS	0–0.5	ND (26)	66	ND (0.11)	ND (2.1)	ND (5)	ND (3.4)	ND (0.06)	ND (50)	**1.9 J (6.4)**
05356	CY65EA-GR-004-0.5-S	0.5–1.0	ND (26)	54	ND (0.11)	ND (2.1)	5.8 J (19)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
05356	CY65EA-GR-005-0-SS	0–0.5	ND (26)	43	ND (0.11)	ND (2.1)	ND (5)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
05356	CY65EA-GR-005-0.5-S	0.5–1.0	ND (26)	49	ND (0.11)	ND (2.1)	ND (5)	ND (3.4)	ND (0.06)	ND (50)	ND (1.7)
Background Soil Concentrations—Canyons Area[d]			9.8	246	0.75	0.64	18.8	18.9	0.055	3.0	<0.5
Quality Assurance/Quality Control Sample (in mg/L)											
05358	CY65EA-GR-006-EB (off-site laboratory)	NA	ND (0.0030)	ND (0.0050)	ND (0.0010)	ND (0.0010)	ND (0.0020)	ND (0.0020)	ND (0.00020)	ND (0.0030)	ND (0.0010)

[a] EPA November 1986.
[b] Values in bold exceed background soil concentrations.
[c] Analysis request/chain-of-custody record.
[d] From Zamorski December 1997.

A = Arroyo.
CY = Canyon.
EB = Equipment blank.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab sample.
ID = Identification.
J ( ) = The reported value is greater than or equal to the method detection limit (MDL) but is less than the practical quantitation limit for on-site laboratory analyses or the contract required detection limit for off-site laboratory analyses, shown in parenthesis.
mg/kg = Milligrams per kilogram.
mg/L = Milligrams per liter.
NA = Not applicable.
ND = Not detected above the MDL, shown in parenthesis.
S = Subsurface sediment sample.
SD = Surface sediment sample duplicate.
SS = Surface sediment sample.
SWMU = Solid waste management unit.

Table 5.4.4-8
Summary of SWMU 65E Arroyo Sediment Sampling
Gamma Spectroscopy Analytical Results, May–June 1996
(On-Site Laboratory)

Sample Attributes			Gamma Spectroscopy Activity (pCi/g)							
			Uranium-238		Thorium-232		Uranium-235		Cesium-137	
Record Number[a]	ER Sample ID (Figure 5.4.4-4)	Sample Depth (ft)	Result	Error[b]	Result	Error[b]	Result	Error[b]	Result	Error[b]
05355	CY65EA-GR-001-0.5-S	0.5-1.0	ND (2.86E+00)	--	4.00E-01	2.10E-01	ND (2.07E-01)	--	2.29E-01	4.39E-02
05355	CY65EA-GR-002-0.5-S	0.5-1.0	ND (2.70E+00)	--	5.15E-01	2.55E-01	ND (1.92E-01)	--	3.55E-02	3.23E-02
05355	CY65EA-GR-003-0-SS	0-0.5	ND (2.61E+00)	--	5.57E-01	2.67E-01	ND (1.85E-01)	--	1.62E-02	1.12E-02
05354	CY65EA-GR-003-0-SD	0-0.5	ND (2.79E+00)	--	4.91E-01	2.30E-01	6.65E-02	1.44E-02	4.91E-03	8.81E-03
05355	CY65EA-GR-004-0-SS	0-0.5	ND (2.87E+00)	--	6.21E-01	2.96E-01	ND (2.05E-01)	--	5.02E-02	2.69E-02
05355	CY65EA-GR-005-0-SS	0-0.5	ND (2.50E+00)	--	5.27E-01	2.58E-01	ND (1.77E-01)	--	2.01E-02	1.23E-02
Background Soil Concentrations—Upper Canyons[c]			2.31	NA	1.03	NA	0.16	NA	0.515	NA

[a]Analysis request/chain-of-custody record.
[b]Two standard deviations above the mean detected activity.
[c]From Dinwiddie September 1997.

A = Arroyo.
CY = Canyon.
ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab sample.
ID = Identification.
NA = Not applicable.
ND = Radionuclide not detected above the minimum detectable activity, shown in parenthesis.
pCi/g = Picocuries per gram.
S = Subsurface sediment sample.
SD = Surface sediment sediment sample duplicate.
SS = Surface sediment sample.
SWMU = Solid waste management unit.
-- = Error not calculated for nondetectable results.

Table 5.4.4-9
Summary of SWMU 65E Arroyo Sediment Sampling
Gross Alpha and Gross Beta Analytical Results, May–June 1996
(On-Site Laboratory)

Sample Attributes			Gamma Spectroscopy Activity (pCi/g)			
Record Number[a]	ER Sample ID (Figure 5.4.4-4)	Sample Depth (ft)	Gross Alpha	Error[b]	Gross Beta	Error[b]
05355	CY65EA-GR-001-0.5-S	0.5-1.0	ND (4.75E+00)	--	ND (1.91E+01)	--
05355	CY65EA-GR-002-0.5-S	0.5-1.0	ND (4.75E+00)[c]	--	ND (1.91E+01)	--
05355	CY65EA-GR-003-0-SS	0-0.5	ND (4.75E+00)	--	ND (1.91E+01)	--
05354	CY65EA-GR-003-0-SD	0-0.5	ND (4.84E+00)	--	ND (1.88E+01)	--
05355	CY65EA-GR-004-0-SS	0-0.5	ND (4.75E+00)	--	ND (1.91E+01)	--
05355	CY65EA-GR-005-0-SS	0-0.5	ND (4.75E+00)[c]	--	ND (1.91E+01)[c]	--
Background Soil Concentrations—Canyons Area[d]			18.3	NA	52.7	NA

[a]Analysis request/chain-of-custody record.
[b]Two standard deviations above the mean detected activity.
[c]Result exceeds 2-sigma error.
[d]From Tharp July 1998.

CY = Canyon.
ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab sample.
ID = Identification.
NA = Not applicable.
ND = Radionuclide not detected above the minimum detectable activity, shown in parenthesis.
pCi/g = Picocuries per gram.
S = Subsurface sediment sample.
SD = Surface sediment sample duplicate.
SS = Surface sediment sample.
SWMU = Solid waste management unit.
-- = Error not calculated for nondetectable results.

SWMU 65E. The judgmental samples consist of 10 surface and near-surface arroyo sediment samples and one duplicate sample.

Arsenic, beryllium, cadmium, lead, mercury, and selenium were not detected in any of the judgmental arroyo sediment samples analyzed by the on-site laboratory. As noted above, the MDLs used for the on-site analysis of arsenic, cadmium, and mercury exceeded the corresponding background concentration limits. However, results for the duplicate sample analyzed by the off-site laboratory indicate that arsenic, cadmium, and mercury were either not detected above the background concentration limits or not detected at or above the MDLs. Beryllium, lead, and selenium results for the duplicate sample analyzed by the off-site laboratory are below the background concentration limits.

Barium was not detected above the background concentration limit in any of the arroyo sediment samples collected at SWMU 65E. In addition, chromium was either not detected above the background concentration limit or not detected at or above the MDL of 5 mg/kg.

Although the 1.7 mg/kg MDL used for the on-site analysis of silver is higher than the nonquantified <0.5 mg/kg background value, silver was detected in one sample (CY65EA-GR-004-0-SS) that was analyzed by the on-site laboratory. Silver was not detected in any other arroyo sediment samples, including the duplicate sample that was analyzed by the off-site laboratory. The MDL used for the analysis of silver in the duplicate sample was 0.19 mg/kg.

High Explosives

Similar to the discussion presented in Section 5.4.4.4.1 for SWMU 65E soil sample results, no HE compounds were detected in any of the judgmental arroyo sediment samples collected at SWMU 65E in March 1998. Table 5.4.4-3 summarizes the detection limits used by the on- and off-site laboratories for analyzing HE compounds.

Radionuclides

Table 5.4.4-8 summarizes the on-site gamma spectroscopy analysis results for the arroyo sediment samples collected at SWMU 65E. The gamma spectroscopy results indicate that uranium-238 or uranium-235 was either not detected above the MDAs or not detected above background. However, the MDA associated with nondetectable results for both uranium-238 and uranium-235 exceeded background in most instances. As a result, no comparison to background and no comparison between uranium-238 and uranium-235 results is applicable. The gamma activity from thorium-232 and cesium-137 did not exceed background in any of the samples collected from SWMU 65E.

Gross Alpha and Gross Beta

Table 5.4.4-9 presents a summary of the on-site gross alpha and gross beta analysis results for the arroyo sediment samples collected at SWMU 65E. Gross alpha and gross beta activity was not detected in any arroyo samples. The MDAs used in the analyses ranged from 4.75 to 4.84 pCi/g for gross alpha and 18.8 to 19.1 pCi/g for gross beta. The MDAs were well below the preliminary background activities for gross alpha and gross beta (18.3 and 52.7 pCi/g), respectively.

5.4.4.4.3 Data Validation

SNL/NM Department 7713 (RPSD Laboratory) reviewed all gamma spectroscopy results according to "Laboratory Data Review Guidelines", Procedure No. RPSD-02-11, Issue No. 2 (SNL/NM July 1996). In addition, all off-site laboratory results were reviewed and verified/validated according to "Data Verification/Validation Level 2-DV-2" in Attachment B or "Data Verification/Validation Level 3–DV3" in Attachment C of the Technical Operating Procedure 94-03, Rev. 0 (SNL/NM July 1994b). Annex 5-E contains off-site data validation reports. The verification/validation process confirmed that the data are acceptable for use in this NFA proposal for SWMU 65E.

5.5 Site Conceptual Model

The site conceptual model for SWMU 65E is based upon the residual COCs identified in the soil samples collected from the surface and near-surface of the Far-Field Dispersion Area of the LCETS following a radiological VCM. Although an investigation of the Lurance Canyon main arroyo channel located within the LCETS was conducted simultaneously with the investigation of SWMU 65E, the arroyo sediment assessment results are not included in the site conceptual model developed for SWMU 65E. The Lurance Canyon arroyo sediment is currently under investigation as part of an SNL/NM sitewide surface-water monitoring program (NMED May 1997 and NMED DOE OB February 1998).

5.5.1 Nature and Extent of Contamination

The COCs at SWMU 65E are metals and radionuclides associated with the dispersion of test material shrapnel from explosives and burn tests conducted at SWMU 65B and SWMU 65C (Annex 5-A). Metal and radionuclide COCs were determined by comparing sample results to background concentrations and activities established for the Canyons Area (Dinwiddie September 1997 and Zamorski December 1997). Any metal or radionuclide found to exceed background in any sample is considered a potential COC for the site. Because the MDLs for all on-site analyses of several metals exceeded background concentration limits and the MDAs for certain uranium-235 and uranium-238 analyses exceed background activity limits (see Section 5.4.4.3), nondetect sample results are also considered in identifying potential COCs. In the case of metals, the MDL for nondetect results is used for comparison to background. In the case of radionuclides, the MDA is used for comparison to background. As a result, metal COCs include arsenic, beryllium, cadmium, chromium, lead, mercury, selenium, and silver. Radionuclide COCs include cesium-137, uranium-235, and uranium-238. Table 5.5.1-1 summarizes the COCs and the sample locations where metals and radionuclides exceed background. The table does not include the Lurance Canyon arroyo sediment because the drainage is now separately under investigation (NMED May 1997 NMED DOE OB February 1998).

Nineteen surface and near-surface environmental samples were collected from ten random grid locations across the approximate 77-acre site. In addition, 12 surface and near-surface environmental samples were collected from six locations where the highest radiological source anomalies had been removed during VCM activities conducted at the site (see Section 5.4.4.2.1). Four environmental samples were also collected from the single debris mound located in SWMU 65E. In almost all cases (the exception being selenium), the COCs are only slightly elevated above the maximum background concentration or activity limits

Table 5.5.1-1
Summary of COCs for SWMU 65E

COC Type	Number of Samples	COCs Greater Than Background	Maximum Background Limit/Canyons Area[a] (mg/kg except where noted)	Maximum Concentration (mg/kg except where noted)	Average Concentration[b] (mg/kg except where noted)	Sampling Locations Where Background Concentration Exceeded[c]
Metals	35 environmental; 3 duplicates; 3 off-site split duplicates	As	9.8	ND (26)	24.6	All samples analyzed on-site (all nondetect)
		Be	0.75	1.1	0.17	CY65E-GR-006-0-SD (split duplicate) CY65E-GR-016-0-SD (split duplicate)
		Cd	0.64	ND (2.1)	2.0	All samples analyzed on-site (all nondetect)
		Cr	18.8	25	9.4	CY65E-GR-006-0-SD (split duplicate) CY65E-GR-016-0-SS CY65E-GR-016-0-SD (split duplicate)
		Pb	18.9	20 B	4.27	CY65E-GR-006-0-SD (split duplicate)
		Hg	0.055	ND (0.10)	0.06	All samples (all nondetect)
		Se	3.0	80 J	47.6	CY65E-GR-008-0.5-S CY65E-GR-011-0.5-S CY65E-GR-012-0-SS All nondetect samples analyzed on-site
		Ag	<0.5	ND (1.7)	1.59	All samples analyzed on-site (all nondetect)

Refer to footnotes at end of table.

Table 5.5.1-1 (Concluded)
Summary of COCs for SWMU 65E

COC Type	Number of Samples	COCs Greater Than Background	Maximum Background Limit/Canyons Area[a] (mg/kg except where noted)	Maximum Concentration (mg/kg except where noted)	Average Concentration[b] (mg/kg except where noted)	Sampling Locations Where Background Concentration Exceeded[c]
Radionuclides	16 environmental; 2 duplicates	U-238	2.31 pCi/g	20.8 pCi/g	Not Calculated[d]	CY65E-GR-014-0-SS CY65E-GR-015-0-SS CY65E-GR-016-0-SS CY65E-GR-017-0-SS CY65E-GR-018-0-SS CY65E-GR-019-0-SS
		U-235	0.16 pCi/g	0.260 pCi/g	Not Calculated[d]	CY65E-GR-005-0-SS CY65E-GR-009-0-SS CY65E-GR-010-0-SS CY65E-GR-012-0-SS CY65E-GR-013-0-SS CY65E-GR-014-0-SS CY65E-GR-015-0-SS CY65E-GR-016-0-SS CY65E-GR-016-0-SD CY65E-GR-017-0-SS CY65E-GR-018-0-SS CY65E-GR-019-0-SS CY65EM1-001-0-SS CY65EM1-003-1.5-S CY65EM1-004-1.5-S
		Cs-137	0.515 pCi/g	1.03 pCi/g	Not Calculated[d]	CY65E-GR-009-0-SS CY65E-GR-015-0-SS CY65EM1-001-0-SS

[a]From Zamorski December 1997 (for metals); from Dinwiddie September 1997 (for radionuclides).
[b]Average concentration includes all samples. For nondetectable results, the detection limit is used to calculate the average. Does not include arroyo sediment samples.
[c]Includes samples with nondetect results where the MDL or MDA exceeds the approved background limit.
[d]An average minimum detectable activity is not calculated because of the variability in instrument counting error and the number of reported nondetectable activities.

B = Analyte detected in associated blank.
COC = Constituent of concern.
J = Estimated value detected at a level less than the practical quantitation limit and greater than or equal to the method detection limit.
MDA = Minimum detectable activities.
MDL = Minimum detection limit.
mg/kg = Milligram(s) per gram.
ND ( ) = Not detected at or above the method detection limit, shown in parenthesis.
pCi/g = Picocurie(s) per gram.
SWMU = Solid waste management unit.

specified for the Canyons Area (Dinwiddie September 1997 and Zamorski December 1997). The COCs that exceed background limits typically occur as isolated "hot spots" with no particular COC associations or correlation to particular locations or areas that could be delineated as contaminated. No COCs are anticipated below a depth of 1 foot from the ground surface. This conceptual model is supported by the results of the Phase I radiological survey which revealed only surface DU fragments associated with SWMU 65E. All area sources and buried DU fragments are associated with SWMU 65D (Section 5.4.4.2.1) because the release mechanism was essentially atmospheric fallout resulting in surficial deposition of test material shrapnel.

The results for all on-site analyses of arsenic, cadmium, mercury, and silver are nondetect; however, the MDLs for all on-site analyses of these metals exceeded the background concentration limits. All results for the off-site analyses of arsenic, cadmium, mercury, and silver are either nondetect or not detected above background. Beryllium, chromium, and lead are only slightly elevated above the maximum background concentration at only one or two sample locations. Although the 50 mg/kg MDL for all on-site analyses of selenium exceeded the 3.0 mg/kg background concentration limit, selenium was detected at three random grid sample locations. Two of these sample locations where selenium was detected are south of the Lurance Canyon main arroyo. However, selenium was not detected at two other random sample locations that are south of the arroyo. Selenium was not detected in any of the judgmental or debris mound samples collected.

Uranium-238 and uranium-235 was detected above the maximum background activity at only one judgmental sample location. This corresponds to the former point source anomaly 94E76 (Section 5.4.4.2.1). No other sample locations were found to exceed background for uranium-238 and uranium-235, although the MDAs associated with several uranium-238 and uranium-235 analyses were above background. Cesium-137 was detected above the maximum background activity in one sample from the random grid, judgmental, and debris mound locations.

5.5.2 Environmental Fate

The primary source of COCs for SWMU 65E was general explosives tests and burn tests conducted on weapons and other devices containing HE at SWMU 65B and 65C (Figure 5.5.2-1). The primary release mechanism of COCs was the detonation and subsequent fallout of test material shrapnel from the explosives and burn test activities. Although HE was involved with the tests conducted at the SWMU 65B and 65C, these contaminants are not present at SWMU 65E. Results of the confirmatory sampling indicate that no HE compounds were detected in the surface and near-surface soils collected from the random grid, judgmental, or debris mound sample locations (see Section 5.4.4.3).

Table 5.5.1-1 summarizes potential COCs for SWMU 65E. Based upon the nature and extent of contamination at the site (Section 5.5.1), metal and radionuclide COCs occur sporadically in the surface and near-surface soils. Arsenic, cadmium, mercury, and silver are considered potential COCs solely because the analytical detection limits exceed the maximum background concentration limits. Beryllium, chromium, and lead occur slightly above background at only one or two sample locations. Selenium concentrations exceed background significantly at two sample locations south of the Lurance Canyon main arroyo and at one location in the western portion of SWMU 65E. Uranium-238 and uranium-235 exceed background only at the location of a former point source anomaly remediated during the radiological VCM conducted at the

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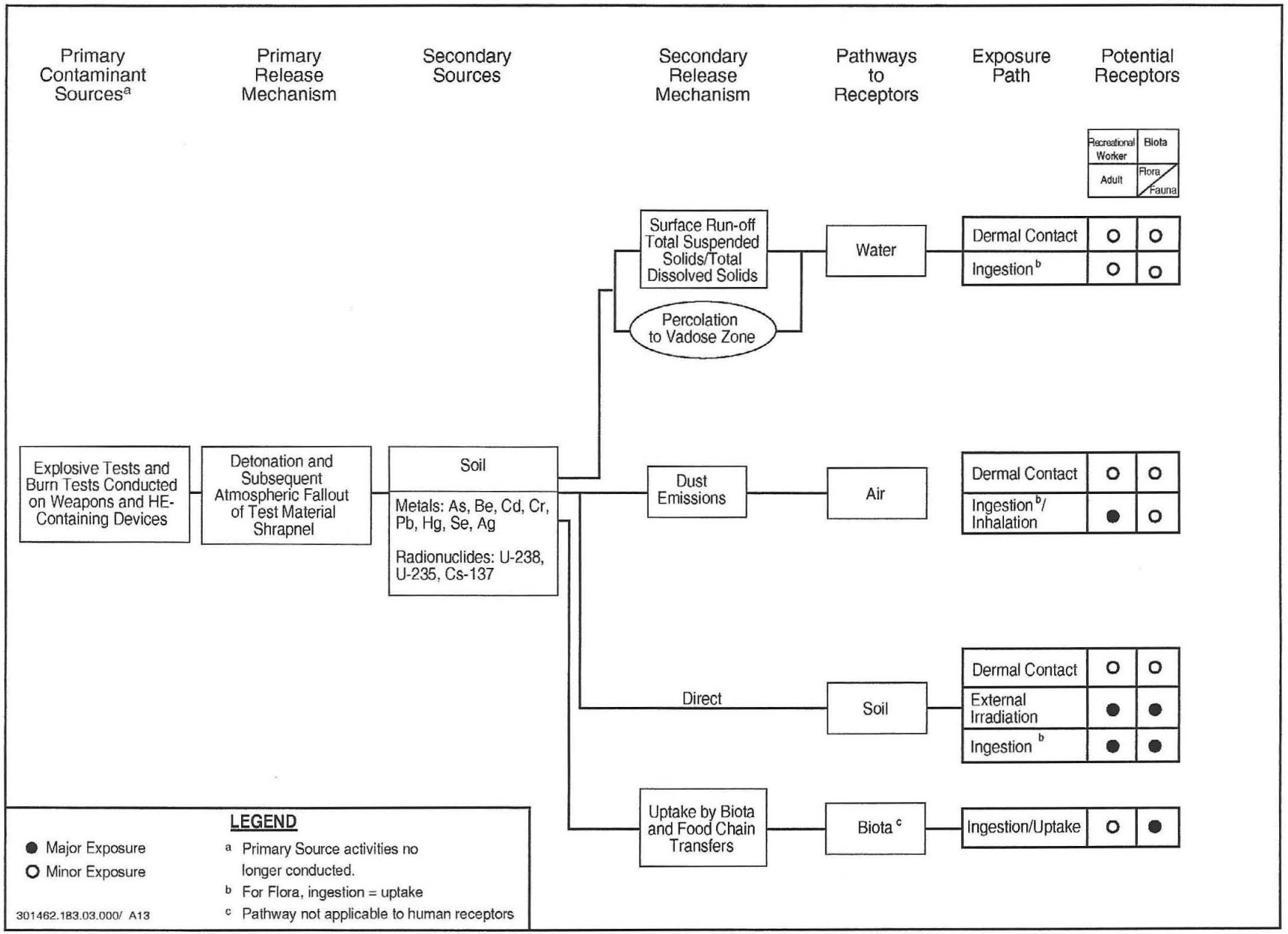

Figure 5.5.2-1

Conceptual Model Flow Diagram for SWMU 65E, Far Field Dispersion Area

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LCETS. Cesium-137 exceeds background at one random grid sample location, one judgmental sample location, and one debris mound sample location. In general, no distinct horizontal distribution of contamination is present. In addition, no COCs are anticipated bgs because the release mechanism was essentially fallout resulting in the surficial deposition of test material shrapnel. All potential COCs were retained in the conceptual model and evaluated in the human health and ecological risk assessments.

Since the LCETS is no longer active, only secondary sources of COCs remain at the site in the form of residual metals and radionuclides in the surface and near-surface soils. The secondary release mechanisms at SWMU 65E are the suspension and/or dissolution of COCs in surface-water runoff and percolation to the vadose zone, direct contact with soil (radionuclides only), dust emissions, and uptake of COCs in the soil by biota (Figure 5.5.2-1). However, the depth to groundwater at the site is approximately 222 feet bgs under semiconfined to confined conditions, which precludes the migration of COCs to the aquifer. In addition, high partitioning coefficients and low mobility in the transporting medium would enhance dilution of the already low COC concentrations. The pathways to receptors are surface water, soil water, air, and soil. Biota are also a pathway through food chain transfers. Annex 5-F, Section V provides additional discussion of the fate and transport of COCs at SWMU 65E.

The current land use for SWMU 65E is industrial. However, because the future land use for SWMU 65E is recreational (DOE et al. October 1995), the potential human receptor is considered a recreational user of the site. For all applicable pathways, the exposure route for the recreational user is dermal contact and ingestion/inhalation. Only soil ingestion is considered a major exposure route for the recreational user. Potential biota receptors include flora and fauna at the site. Similar to the recreational user, direct soil ingestion is considered the major exposure route for biota, in addition to ingesting COCs through food chain transfers or the direct uptake of COCs. Annex 5-F, Section V provides additional discussion of the exposure routes and receptors at SWMU 65E.

5.6 Site Assessments

The site assessment process for SWMU 65E includes risk screening assessments, followed by risk baseline assessments (as required) for both human health and ecological risk. The following sections provide a brief summary of the site assessment results. Annex 5-F provides details of the assessment.

5.6.1 Summary

The site assessment concludes that SWMU 65E does not have potential to affect human health under a recreational land-use scenario. After considering the uncertainties associated with the available data and modeling assumptions, ecological risks associated with SWMU 65E were found to be very low. Section 5.6.2 briefly describes and Annex 5-F provides details of the site assessments.

5.6.2 Screening Assessments

Risk screening assessments were performed for both human health risk and ecological risk for SWMU 65E. The following discusses the results.

5.6.2.1 *Human Health*

SWMU 65E has been recommended for recreational land-use (DOE et al. October 1995). Annex 5-F provides a complete discussion of the risk assessment process, results, and uncertainties. Because of the presence of COCs in concentrations or activities greater than background levels, it was necessary to perform a health risk assessment analysis for the site. Besides COC metals, this assessment included any volatile or semivolatile organic compounds detected above their reporting limits and any radionuclide compounds detected either above background levels and/or MDAs. The risk assessment process provides a quantitative evaluation of the potential adverse human health effects caused by constituents in the site's soil. The Risk Screening Assessment Report calculated the hazard index (HI) and excess cancer risk for a recreational land-use setting. The excess cancer risk from nonradiological COCs and the radiological COCs is not additive (EPA 1989).

In summary, the HI calculated for SWMU 65E nonradiological COCs is 0.00 for a recreational land-use setting, which is less than the numerical standard of 1.0 suggested by risk assessment guidance (EPA 1989). Incremental risk is determined by subtracting risk associated with background from potential nonradiological COC risk. There is no incremental HI. The total excess cancer risk for SWMU 65E nonradiological COCs is 8E-7 for a recreational land-use setting, which is also below the acceptable risk value provided by the NMED (NMED March 1998). Guidance from the NMED indicates that excess lifetime risk of developing cancer by an individual must be less than 1E-6 for Class A and B carcinogens and less than 1E-5 for Class C carcinogens (NMED March 1998). The incremental cancer risk for SWMU 65E is 2E-7.

The incremental total effective dose equivalent for radionuclides for a recreational land-use setting for SWMU 65E is 0.10 mrem/year (yr), which is well below the recommended dose limit of 15 mrem/yr found in EPA's OSWER Directive No. 9200.4-18 and reflected in a document entitled "Sandia National Laboratories/New Mexico Environmental Restoration Project—RESRAD Input Parameter Assumptions and Justification" (February 1998). The incremental excess cancer risk for radionuclides is 1.4E-6 for a recreational land-use scenario, which is much less than risk values calculated from naturally occurring radiation and from intakes considered background concentration values.

The residential land-use scenarios for this site are provided only for comparison in the Risk Screening Assessment Report (Annex 5-F). The report concludes that SWMU 65E does not have potential to affect human health under a recreational land-use scenario.

5.6.2.2 *Ecological*

An ecological screening assessment that corresponds with the screening procedures (NMED March 1998) in the EPA's Ecological Risk Assessment Guidance for Superfund (EPA 1997) was performed as set forth by the NMED Risk-Based Decision Tree. An early step in the evaluation is comparing COC concentrations and identifying potentially bioaccumulative constituents. Annex 5-F, Sections III and VI and Sections VII.2 and VII.3 discuss this. This methodology also requires that a site conceptual model and a food web model be developed and that ecological receptors be selected. Each of these items is presented in the "Predictive Ecological Risk Assessment Methodology for SNL/NM ER Program, Sandia National Laboratories/New Mexico" (IT July 1998) and will not be duplicated here. The screen also includes estimation of exposure and ecological risk.

Tables 14, 15, 16, and 17 of Annex 5-F present the results of the ecological risk assessment screen. Site-specific information was incorporated into the screening assessment when such data were available. Hazard quotients greater than unity were originally predicted; however, closer examination of the exposure assumptions revealed an overestimation of risk primarily attributable to exposure concentration (maximum COC concentration was used in the estimation of risk), exposure setting (area use factors of one were assumed), background risk, and the use of detection limits as exposure concentrations. Based upon an evaluation of these uncertainties, ecological risks associated with this site are expected to be very low.

5.6.3 Baseline Risk Assessments

This section discusses the baseline risk assessments for human health and ecological risk.

5.6.3.1 Human Health

Based upon the fact that human health results of the screening assessment summarized in Section 5.6.2.1 indicate that SWMU 65E does not have potential to affect human health under a recreational land-use setting, a baseline human health risk assessment is not required for SWMU 65E.

5.6.3.2 Ecological

Based upon the fact that ecological results of the screening assessment summarized in Section 5.6.2.2 indicate that SWMU 65E has very low ecological risk, a baseline ecological risk assessment is not required for SWMU 65E.

5.6.4 Other Applicable Assessments

5.6.4.1 SNL/NM Surface Water Monitoring Program

As specified in the OU 1333 Work Plan (SNL/NM September 1995), background arroyo sediment samples were collected from the section of the Lurance Canyon arroyo (and tributaries) immediately upstream from SWMU 65E. The samples were analyzed for metals and radionuclides. Based upon the RSI (Dinwiddie August 1997), the analyses specified for background arroyo sediment samples were expanded to include gross alpha and gross beta. Because investigation of the Lurance Canyon arroyo has been included in the SNL/NM Surface-Water Monitoring Program (SNL/NM in progress), an assessment of the results obtained for the background arroyo sediment sampling activities is not included in the SWMU 65E NFA. However, Annex 5-C presents a summary of the Lurance Canyon arroyo background sample results (NMED May 1997 and NMED DOE OB February 1998).

5.6.4.2 Groundwater

Based upon NMED concerns regarding nitrate concentrations detected in groundwater samples collected from the Burn Site production well (SNL/NM July 1997, SNL/NM September 1997b) and contaminant concentrations in wastewater stored in aboveground tanks at the Burn Site (Dinwiddie August 1997), investigation of groundwater in the Canyons Area was initiated. Pursuant to the RSI (Dinwiddie August 1997), the 12A piezometer and the Narrows Well were installed. Since the installation of the 12A piezometer in November 1996, no groundwater has been detected. Pursuant to a notice of deficiency (Garcia March 1998), groundwater samples have been collected at the Narrows Well once every three months. Two sampling events have already been completed at the Narrows Well, and when the third sampling event is completed (scheduled for late September 1998), results of the monitoring activities will be summarized in the SNL/NM Groundwater Protection Program Annual Groundwater Monitoring Report.

5.7 No Further Action Proposal

5.7.1 Rationale

Based upon field investigation data and the human health risk assessment analysis, an NFA is being recommended for SWMU 65E for the following reason: no COCs (metals and radionuclides) were present in concentrations considered hazardous to human health for a recreational land-use scenario.

5.7.2 Criterion

Based upon the evidence provided above, SWMU 65E is proposed for an NFA decision in conformance with Criterion 5 (NMED March 1998), which states that "The SWMU/AOC has been characterized or remediated in accordance with current applicable state or federal regulations and that available data indicate that contaminants pose an acceptable level of risk under current and projected future land use."

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ANNEX 5-A
Summary of Testing Activities at SWMU 65, Lurance Canyon Explosive Test Site

The Lurance Canyon Explosive Test Site (LCETS) was used for explosive testing from the late-1960s to the early 1990s. Testing programs at the LCETS can be grouped into the following six categories:

- General explosive tests
- Burn pit tests (fuel fire)
- Miscellaneous burn tests (nonfuel fire)
- Cone tests
- Torch-activated burn system (TABS)
- Slow-heat tests

The following sections describe the six types of explosive/burn testing associated with SWMU 65 subunits. Figures 5A-1 and 5A-2 show the locations of each of these tests.

A.1 GENERAL EXPLOSIVES TESTS

SWMU 65 was designed with a 10,000-foot dispersion radius to provide an adequate buffer for detonating up to 10,000 lb of high explosive (HE) (Gaither et al. May 1993a, Author [unk] Date [unk]a, Larsen and Palmieri August 1994a, Larsen and Palmieri August 1994b). When construction of the SWMU 94 burn structures began in 1977, the explosives testing limit was reduced to 1,000 lb (Martz September 1985). Most of the explosives tests were conducted in the disturbed areas designated SWMU 65B (Larsen and Palmieri August 1994a, Larsen and Palmieri August 1994b), and SWMU 65C (Littrel February 1969, Karas June 1993, Foy April 1971, Clark December 1970, Walkington April 1973, Stravasnik September 1972). Explosives tests were conducted at grade or at 2 to 3 feet above grade (Gaither et al. May 1993b). Fragments may have been widely scattered over the site (Gaither Date [unk.], Gaither October 1992, Mortz November 1985, DOE September 1987), and material may also have been driven into the ground at the detonation location (Gaither et al. May 1993a). Metal shrapnel has been found and observed in an area defined by a circular perimeter with an approximate radius of 1,000 feet centered on the primary detonation area (Hickox November 1994). Past test locations are not currently visible because of ongoing grading and construction activities associated with SWMU 94.

Materials that may have been involved in general explosives tests include HE, DU, lead, aluminum powder, fuel-rod shipping containers, steel slurry vessels, and live and mock weapons (Gaither et al. May 1993a, Gaither Date [unk.], Gaither October 1992, Karas June 1993, Mortz November 1985, Larsen and Palmieri August 1994a, Larsen and Palmieri August 1994b, Palmieri November 1994a, Palmieri December 1994a, Palmieri December 1994b, DOE September 1987). Details on some of the tests are given below.

A.1.1 Open-Detonation Tests

It is expected that other HE tests were conducted at SWMU 65 for which no specific information is available in the current archive records. Archive records state that 15 to 20 HE tests per year were conducted at SWMU 65 between 1968 and 1980 (Gaither et al. May 1993a, Author [unk] Date [unk]a). However, it was not possible to obtain information or specific records on all of these tests.

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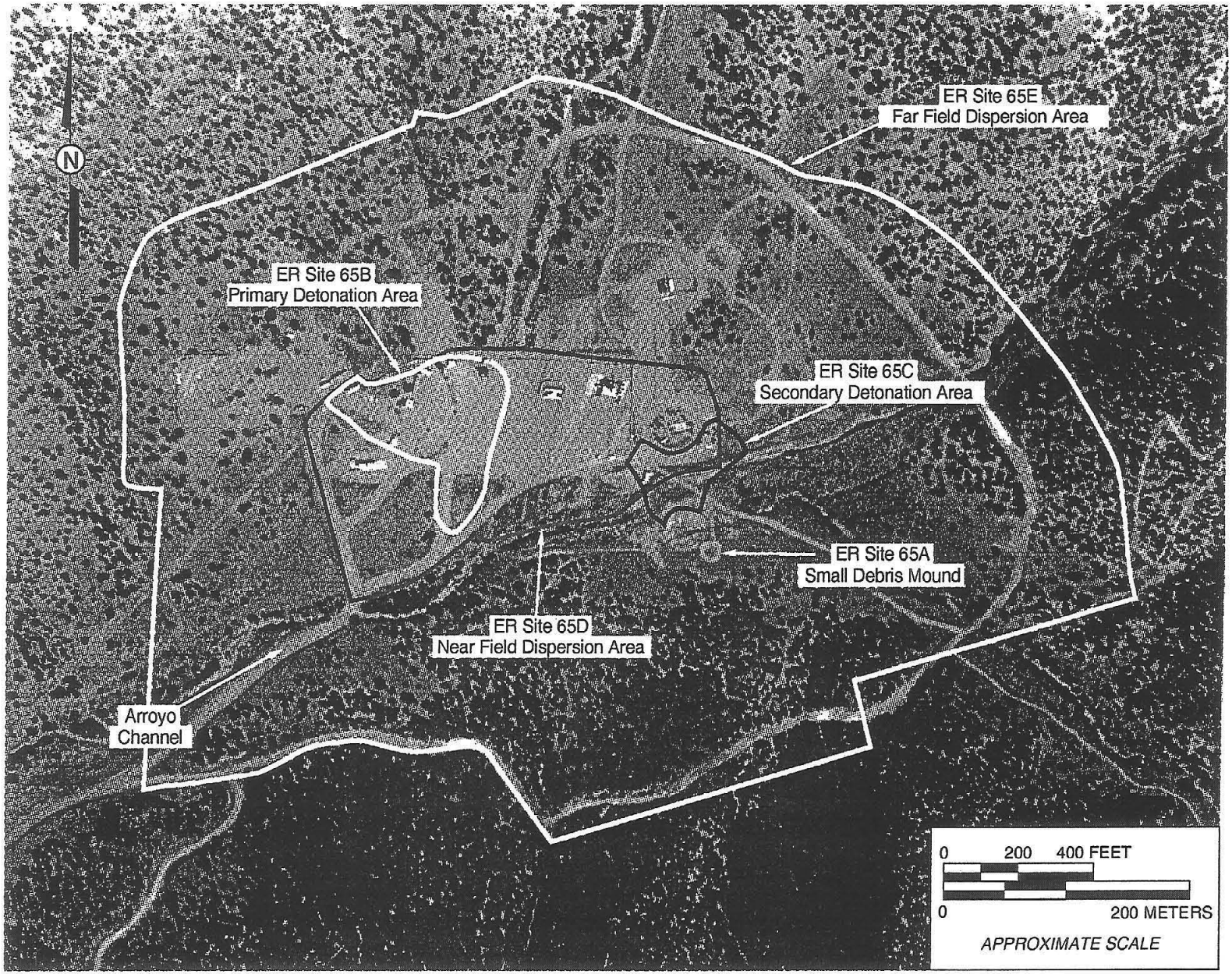
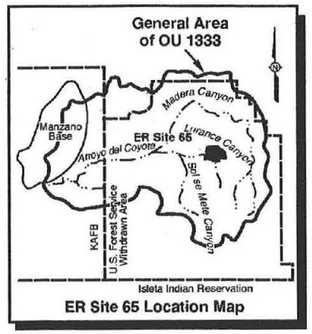


Low-altitude photograph of Lurance Canyon in 1992. ER Site 65 subunits are identified.

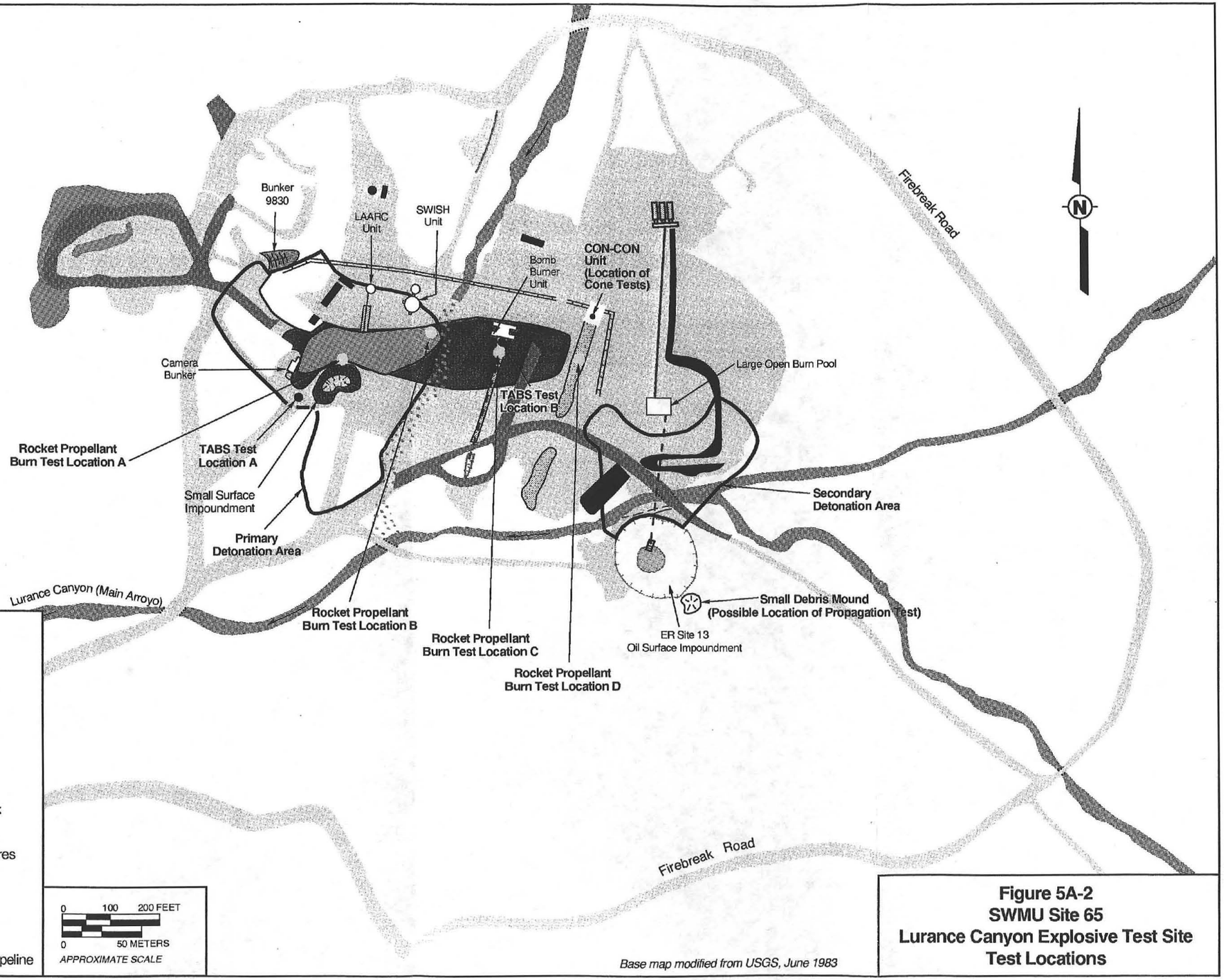
Figure 5A-1

SWMU 65, Lurance Canyon Explosive Test Site, Designated Subunits

301462.183.03.000/zc B4



ER Site 65 Location Map



LEGEND

- Active Road
- Inactive Road
- Arroyo Channel (Flow Direction)
- Slope Direction on Berm/Mound
- Scrap Yard
- Location of Slow Heat Tests
- Rocket Propellant Burn Test Location
- TABS Test Location
- Surface Depression
- Trailer/Building
- Buried Portion of Arroyo
- Trench
- Above Ground Fuel Tank
- Above Ground Water Tank
- Location of Liquid Oxygen Torch Tests, Wood Crib Fires and Penetration Tests
- Engineered Soil Berm
- Above-Ground Pipeline
- Underground Discharge Pipeline

0 100 200 FEET
0 50 METERS
APPROXIMATE SCALE

Base map modified from USGS, June 1983

Figure 5A-2
SWMU Site 65
Lurance Canyon Explosive Test Site
Test Locations

A.1.2 Ammonium Nitrate/Fuel Rod Shipping Container Test

An explosives test was performed at SWMU 65 with fuel-rod shipping containers and an ammonium nitrate slurry bomb (Gaither et al. May 1993a, Larsen and Palmieri August 1994b, DOE September 1987). The test was conducted with 4,000 lb of ammonium nitrate slurry to evaluate the impact of the detonation on the integrity of two containers. The containers were reportedly dented but not fragmented from the detonation (Gaither et al. May 1993a, Karas June 1993, Larsen and Palmieri August 1994b). A specific location for the test was not given, but large detonations were reported to have taken place in the secondary detonation area (SWMU 65C) near the area now occupied by the Large Open Burn Pool (LOBP) (Palmieri December 1994b).

A.1.3 Penetration Tests

Bullet penetration tests on B-61 warheads containing DU surrounded by HE (Larsen and Palmieri August 1994b) were conducted at SWMU 65B between 1980 and 1985 (Gaither et al. May 1993a, Palmieri December 1994b). These tests consisted of firing a high-velocity projectile into the B-61 warhead to detonate the HE and fragment the weapon (Larsen and Palmieri August 1994b). The tests were conducted in the region between the camera bunker and the northeast-southwest-trending arroyo channel located on the east side of the primary detonation area (Larsen and Palmieri August 1994b).

A.1.4 Propagation Test

One interview record noted that two live weapons were used in a propagation test conducted in a concrete bunker (SWMU 65A) in the area adjacent to SWMU 13, Oil Surface Impoundment. The test may have taken place sometime between 1965 and 1979 (Palmieri December 1994a). One weapon was placed inside the bunker and one was placed outside the bunker (Palmieri November 1994a). The test was designed to determine whether the shock wave created by the detonation of the weapon outside of the bunker could detonate the weapon on the inside. The weapon inside the bunker did not detonate (Palmieri November 1994a). The small debris mound possibly associated with this test is designated SWMU 65A.

A.2 BURN PIT TESTS (FUEL FIRE)

Burn tests were conducted on weapons components, reentry vehicles, ammonium nitrate bombs, and nuclear materials containers at SWMU 65C. Burn tests at SWMU 65 began in approximately 1969 (Littrel February 1969, Karas June 1993) and were initially carried out in excavated pits. The burn pits were replaced by portable pans before 1979 (Jercinovic et al. November 1994). Burn tests in portable pans will be discussed in SWMU 94 NFA proposals.

Burn pits were excavated and lined with black polyethylene or polyvinyl chloride (PVC) film, water was placed in the pit, and a layer of JP-4 fuel was placed on the water (Littrel February 1969, Foy April 1971, Stravasnik September 1972, Larsen and Palmieri August 1994b, Jercinovic et al. November 1994, Palmieri November 1994a). Stands or frames that held the test devices were constructed of steel, and sometimes platinum strips were used to separate the test device from the steel frame (in order to avoid reaction between the test device and the

frame) or to suspend the device above the pool (Young et al. February 1994, Littrel February 1969, Foy April 1971, Clark December 1970, Walkington April 1973). When thermocouples and other electronic wiring were used to monitor the burn tests, the control wiring was insulated with ceramic and placed on a ceramic-insulated steel frame (Author [unk] June 1993). In some tests, a metal *chimney* was placed over the pool prior to igniting the fuel to eliminate wind effects and control the fire (Jercinovic et al. November 1994).

To control the burn time, the thickness of the JP-4 fuel layer was accurately measured before the test was conducted (Foy April 1971, Walkington April 1973, Stravasnik September 1972). The test pits may have leaked water and fuel through holes in the plastic (Larsen and Palmieri August 1994b) because flames melted exposed parts of the black plastic liner. The pits were left uncovered upon completion of these burn tests (Author [unk] June 1993), and in general, cleanup was not performed (Young et al. February 1994). At the conclusion of the test, the remaining water and fuel were left to evaporate or infiltrate (Larsen E. and Palmieri D. August 1994b, Jercinovic et al. November 1994, Palmieri November 1994a).

The exact locations of the burn pits used during testing cannot be determined, because grading and construction activities related to SWMU 94 erased all evidence of the depressions or features associated with the test locations. However, Based upon technical reports (Littrel February 1969, Walkington April 1973, Stravasnik September 1972) and interpretation of historical aerial photographs (SNL/NM August 1994), burn pits were excavated in the area designated SWMU 65C.

Materials that may have been used in the burn pit tests include JP-4 fuel, diesel fuel, rocket propellant, ammonium nitrate slurry, TNT, chromel/alumel thermocouples, steel shipping containers, Celotex™ insulation, polyethylene containers, PVC, Dy-Kem steel-blue layout dye, argon, and ceramic insulation (Young et al. February 1994, Moore and Luna February 1982, Littrel February 1969, Foy April 1971, Clark December 1970, Walkington April 1973, Stravasnik September 1972). Details on these testing events are given below.

A.2.1 Cloudmaker Tests and Other Ammonium Nitrate Tests

In January 1969, three burn tests were conducted in pits at SWMU 65C to determine the effect of a fuel fire on an ammonium nitrate slurry bomb, referred to as the Cloudmaker (Young et al. February 1994, Littrel February 1969). The slurry mixture contained 50 percent ammonium nitrate, 35 percent aluminum powder, 14 percent water, and 1 percent gums and stabilizers (Littrel February 1969). The first two tests were conducted on the TNT booster charge that was used to detonate the ammonium nitrate slurry; the third test involved detonating the ammonium nitrate. The Cloudmaker burn test used 8,100 lb of slurry (equivalent to 10,500 lb of TNT) that consisted of 50 percent ammonium nitrate (Littrel February 1969) and was detonated 1,000 feet southeast of Bunker 9830. When actual detonation occurred in the third Cloudmaker test, the explosion scattered dust and shrapnel as far as 800 feet in all directions (Littrel February 1969).

One interview record states that additional ammonium nitrate tests were conducted using 15,000-lb ammonium nitrate slurry bombs that were intended to be representative of a portion of a 35,000-lb bomb (Karas June 1993). The purpose of these tests was to determine whether a Composition-4 (C-4) charge would successfully detonate ammonium nitrate. Detonations were successful in tests that were completed in 1969 and 1970 (Karas June 1993). An additional 15,000-lb ammonium nitrate slurry bomb was unexpectedly detonated during a burn test when

steam pressure from the slurry built up, popped the relief valve, and detonated the ammonium nitrate (Karas June 1993, Larsen and Palmieri August 1994b). Although a specific location for the tests was not given, it is reported that large HE tests were conducted at SWMU 65C near the area now occupied by the LOBP (Palmieri December 1994b). This is in the same general vicinity as the 1969 Cloudmaker test.

A.2.2 Liquid Fuel Fire and Solid Rocket Propellant Burn Tests on Pioneer Capsules

Burn tests in excavated pits were conducted on Pioneer capsules in 1970 to determine whether the capsule could survive a launch abort (Foy April 1971). The test sequence, carried out at SWMU 65C, consisted of two liquid-fuel-fire tests and three solid rocket propellant tests (two direct-fire tests and one proximity test) and ended with two liquid-fuel-fire tests (Foy April 1971). Rocket propellant tests designated as direct fire involved thermocouples that were directly attached to the propellant block, whereas the proximity test had the thermocouple positioned between two propellant blocks. Approximately 1,400 gallons (gal) of JP-4 fuel was used in each liquid fuel test, and one to two 12- by 12- by 18-in. block(s) of TP-H-3062 rocket propellant was used in each solid propellant fire test (Foy April 1971). In the liquid-fuel-fire tests, Pioneer capsules P-12 and P-19 were preheated to 1,800°F, and P-9 and P-15 were preheated to 1,300°F in an argon atmosphere oven prior to being placed in the fuel fire (Foy April 1971, Clark December 1970). The test reports do not describe the materials used in the construction of the Pioneer capsules.

A.2.3 Plutonium Shipping Container Tests

Several JP-4 fuel fire tests of shipping containers designed to carry plutonium were conducted in excavated pits in 1972. Department of Transportation (DOT) Class II plutonium containers (DOT-6M, DOT-SP5795, and L-10) were tested in a 1,800°F fire for one hour (Stravasnik September 1972). To assess the integrity of the containers, polyethylene bottles were filled with a Dy-Kem steel-blue layout dye and alcohol solution, were wrapped in Celotex™ insulation, and were placed inside each container (Stravasnik September 1972). The DOT-6M container failed to retain the solution, but all of the others did retain the solution (Stravasnik September 1972). A photo included within a test report (Stravasnik September 1972) shows that the location of the test is in the historic arroyo channel located at SWMU 65C. This location conforms to all other known burn pit test locations that were conducted for the Cloudmaker and TC-708 Emergency Denial Device (see below).

A.2.4 TC-708 Emergency Denial Device Tests

In February 1973 a diesel-fuel fire test on a TC-708 Emergency Denial Device was conducted at SWMU 65C in an excavated pit located approximately 1,000 feet southeast of Bunker 9830 (Walkington April 1973). The test report gave no specific information on the test materials or on the use or purpose of the device, but it noted that six chromel/alumel thermocouples (Type K) were attached to the unit and that the unit melted after approximately 4 minutes (min) into the test (Walkington April 1973). No specific information is provided regarding the composition of the chromel/alumel thermocouples.

A.3 MISCELLANEOUS BURN TESTS (NONPETROLEUM-FUEL-FIRE)

Miscellaneous burn tests conducted at SWMU 65 include wood crib tests, liquid oxygen torch tests, and rocket propellant tests (Palmieri December 1994d, Hickox and Abitz December 1994). The tests, which began in 1984 and ended in 1993, occurred at SWMU 65B and SWMU 65D. Materials that may have been used in the miscellaneous burn tests include rocket propellant, HE detonators, propane, empty weapon casings, liquid oxygen, aluminum powder, nitrogen gas, graphite, and steel rods (Hickox and Abitz December 1994). The following paragraphs provide additional details on these tests.

A.3.1 Wood Crib Fire Tests

Seventeen wood crib tests were conducted at SWMU 65B from September 1988 to September 1989. These tests consisted of cross stacking 1- by 4-in. by 6-foot-long planks to a height of about 8 feet to make a 6- by 6- by 8-foot stack or crib (Hickox and Abitz December 1994). A suitcase containing detonators and HE components was placed in the crib and the wood was ignited. The wood fire induced an explosion of the detonators when the HE critical temperature was reached. The purpose of the test was to evaluate the performance of the suitcase by recording the distance that the ejected components traveled. All components had to stay within a specified radius for the suitcase to pass the test. The composition of the components is unknown, but all component parts are believed to have been collected (Hickox and Abitz December 1994).

A.3.2 Liquid Oxygen Torch Tests

Nineteen liquid oxygen torch tests were conducted at SWMU 65B in 1984 and 1985 to determine whether a torch could simulate a controlled rocket propellant fire (Hickox and Abitz December 1994). The liquid oxygen torch consisted of a nozzle welded to a steel frame. Liquid oxygen and aluminum powder were fed to the nozzle via gas lines and valves with a high-pressure nitrogen gas reservoir. Propane and gaseous oxygen were used as the pilot light system with some testing of the torch involving graphite or steel rods. The only burn product associated with operating the torch was aluminum oxide. Design and proofing tests were conducted in SWMU 65B. The nose cones of reentry vehicles were eventually tested with the torch at Thunder Range (Hickox and Abitz December 1994).

A.3.3 Rocket Propellant Tests

Ten fire tests with rocket propellant and simulated weapons were conducted in 1983 and 1984 at several locations within SWMU 65B and SWMU 65D (Palmieri December 1994d, 65-76). A PII propellant burn rate test was conducted at Location A (Figure 5A-2) on January 12, 1984. This test measured the uninhibited burn rate of the propellant at 6 in. per minute, and the inhibited burn rate was measured at 3 in. per minute. Propellant used for the inhibited burn rate test contained axle grease to reduce the burn rate of the propellant. Three burn tests with the W-85 weapon casing (no HE present) were conducted in February and March 1984 at Location B (Figure 5A-2). These tests were conducted to investigate the burn time required to rupture the aluminum weapon casing. Three propellant burn tests were conducted at Location C (Figure 5A-2) with the W-88 weapon casing in May and July of 1987. Specific notes

on test results are absent from the test log. One rocket propellant test involving 375 lb of rocket propellant used in the SRAM II missile was conducted at Location C (Figure 5A-2) in August 1993. The test log notes that industrial hygiene personnel were present to monitor for hydrochloric acid. In August and September 1986, two propellant burn tests were conducted at Location D (Figure 5A-2) using the W-31/Y1-3 and W-87/LTU-7 weapon/propellant systems. The test log for the W-31/Y1-3 burn test noted that one propellant cylinder detonated 2 min into the test. A comprehensive list of materials used in these tests was not provided in the test log.

A.4 CONE TESTS

The CON-CON Unit was constructed between late 1981 and early 1982 (SNL/NM August 1994) for tests that investigated the penetration of a radioactive tracer (i.e., sodium-24 and uranium dioxide) into unconsolidated overburden. A series of 22 tests were conducted between March 1982 and March 1984 (SNL/NM August 1986, Church March 1982, Palmieri November 1994a). The CON-CON Unit was part of SNL/NM's Nuclear Emergency Search Team project, which studied mitigation techniques for reducing the consequences of an accidental detonation of a nuclear materials explosives dispersal device (Church March 1982).

In constructing the CON-CON Unit, a trench and depression were excavated to a depth of approximately 10 feet, a width of 14.5 feet, and a length of 40 feet (Church March 1982, Jercinovic et al. November 1994). A corrugated culvert was laid down in the excavation (Jercinovic et al. November 1994), and a 17-foot-high steel cone with a base diameter of 6 feet was placed apex down into a port in the center of the culvert (Church March 1982). An 11-foot-long vertical steel cylindrical diagnostic containment section with a diameter of 6 feet was mounted on top of the cone, and the excavation was backfilled to the top of the cone. The southern part of the culvert was left open to allow access for placing the test units at the apex of the cone (Church March 1982, Jercinovic et al. November 1994). A shallow, open trench (30 by 350 feet) extended southward from the culvert opening (SNL/NM August 1994).

The apex of the cone was the location for the C-4 explosives and sodium-24 tracer. The sand or foam overburden material being tested for penetrability was placed over the sodium-24 tracer (Church March 1982, Jercinovic et al. November 1994). The diagnostic containment section was placed above the cone and was equipped with valves to pull air samples, high efficiency particulate air (HEPA) filters, and camera parts (Palmieri November 1994c). The diagnostic containment section contained and measured aerosol and particle dispersion via the activity of the sodium-24 isotope (Palmieri November 1994a).

A total of 22 tests were conducted: one with uranium dioxide powder, seven with sodium-24 tracer (with a half-life of 15 hours (hr) [GE 1989]), two misfires, and twelve involving instrument calibration, facility seal integrity, and firing system effectiveness. In the tracer tests, a 50- to 150-gram (g) HE charge of C-4 was placed in the cone apex with the sodium-24 tracer (no more than 10 microcuries [mCi]) positioned directly above the HE (SNL/NM August 1986, Church March 1982, Jercinovic et al. November 1994). Aerosol generated from the C-4 detonation was monitored for radioactivity in the diagnostic containment section (Palmieri November 1994a, Palmieri November 1994b, Palmieri November 1994c).

The CON-CON Unit was dismantled in 1988 (Palmieri and Larsen October 1994) and the SMERF was built in the same location (Jercinovic et al. November 1994). The trench that

remained from the CON-CON Unit dismantling was widened to accommodate the SMERF (SNL/NM August 1994, Jercinovic et al. November 1994).

A.5 TORCH-ACTIVATED BURN SYSTEM (TABS) TESTS

The TABS test program was conducted from February 1975 to February 1979 to investigate the deflagration-to-detonation transition of HE in weapons, weapon pit damage, dispersal of toxic pit materials, and thermal modeling (Kurowski January 1979). This program consisted of 12 tests with 14 test units that used six different weapon types (B-54, B-57, B-53, B-61, W-44, and W-48) (Kurowski January 1979). Torches were mounted to the weapons test unit and ignited to determine whether the torch could successfully burn through the weapons casing and ignite and burn the enclosed HE without detonating the weapons. Successful burning was accomplished in all weapons types except one, where three of the five test units detonated (Kurowski January 1979). The unsuccessfully tested weapon was not identified. Materials that were involved in the TABS tests include HE, DU, beryllium, aluminum, and torches (Kurowski January 1979, Larsen August 1994).

The TABS test report (Kurowski January 1979) does not identify the location of the individual TABS tests, with the exception of noting that Test V was conducted at the Coyote Test Field on July 28, 1978. Based upon information obtained from ER interview records (Jercinovic et al. November 1994, Larsen August 1994, Palmieri December 1994e), it is known that four of the fourteen tests were conducted at SWMU 60, Bunker Site, and two tests were conducted at SWMU 65. At SWMU 65, one test (Test VI) detonated in the trench of the Bomb Burner Unit (TABS test Location B; Figure 5A-2), and one test took place near the camera bunker (TABS test Location A, SWMU 65B; Figure 5A-2). The TABS test Location B is included with SWMU 94C. The remaining eight tests took place at three locations in Technical Area 2 (Palmieri December 1994e). All of the tests were recorded by movie and still cameras (Kurowski January 1979).

In the TABS tests, a torch was mounted on the weapons component and ignited with a hot-wire device. Torch burn time varied from 10 to 27 seconds (sec) to allow the torch to cut through the weapons casing and ignite the HE (Kurowski January 1979). HE burn time varied from 4 to 7.8 min in the successful burn tests and varied from 11 to 47 sec in the two tests that detonated (Kurowski January 1979). Residue in the weapons and the weapons components continued to burn for approximately 3 to 80 min after the HE was consumed (Kurowski January 1979). For the successful burn test at SWMU 65B, postburn examination of the weapons indicated that the HE was completely consumed (Kurowski January 1979). The weapons in Test VI (TABS Test Location B, Bomb Burner trench, SWMU 94C) detonated 47 sec into the test, dispersing DU fragments that ignited a few small fires northeast of the detonation area (Jercinovic et al. November 1994, Larsen August 1994, Larsen and Palmieri August 1994c). There is no discussion on the dispersal of pit material in the test report (Kurowski January 1979), and test personnel could not discuss the information because of its classified nature (Palmieri December 1994e).

After a TABS test was performed, SNL/NM health physics personnel conducted radiation surveys of the site (Larsen August 1994). All uncontaminated (i.e., nonradioactive) debris was taken to the scrap yard located in the northwestern corner of the site, and debris contaminated with radioactivity was transported to the Mixed Waste Landfill in Technical Area 3 (Larsen August 1994).

A.6 SLOW-HEAT TESTS

Slow-heat tests were conducted between 1982 and 1986 in the general area between the camera bunker and the CON-CON Unit in the primary detonation area and near-field dispersion area (SWMU 65B and SWMU 65D) (Jercinovic et al. November 1994, Palmieri November 1994a). The 11 recorded tests investigated the quantity of HE consumed by detonations induced by slowly heating the test unit with electrical current passed through heat tape (Luna October 1985, Luna June 1983, Moore and Luna February 1982, SNL/NM August 1986). Materials that were involved in the slow-heat tests include HE, steel test vessels, chromel/alumel thermocouples, lead tape, plywood boxes, and vermiculite packaging (Luna October 1985, Luna June 1983, Moore and Luna February 1982).

A three-sided concrete block bunker was constructed for the slow-heat tests, and a plywood box was placed in the center (Jercinovic et al. November 1994). The test unit consisted of an 8- or 10-in. steel containment vessel rated at 2,000 to 40,000 lb per square inch (psi) that held 6 to 6.5 lb of HE (Luna October 1985, Luna June 1983, Moore and Luna February 1982). Heat tape was wrapped around the containment vessel, and chromel/alumel thermocouples (Type K) were secured to the test vessel with lead (Luna October 1985) or aluminum (Luna June 1983) tape. The test vessel was then sealed in the plywood shipping container and surrounded with vermiculite (Luna October 1985, Luna June 1983, Moore and Luna February 1982). Current was passed through the heat tape to produce a nominal heating rate of 50 degrees Celsius (°C) per hr, and the test unit was heated for 4 to 5 hr until the HE detonated (Luna October 1985, Luna June 1983, Moore and Luna February 1982). Vessel fragments and unexpended HE were picked up after completion of the tests (Luna October 1985, Luna June 1983), and undetonated explosives may have been turned over to KAFB EOD (Martz September 1985). Because the purpose of the tests was to see how much HE was expended during a slow-heat detonation, unexpended HE was recovered for mass balance calculations (Jercinovic et al. November 1994).

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ANNEX 5-B
SWMU 65E Lurance Canyon Explosive Test Site
Site-Specific Background
Soil Sample Results
May–June 1996
June 1998

Table 5B-1
Summary of SWMU 65E Background Soil Sampling Metals Analytical Results, May–June 1996
(Off-Site Laboratory)

Sample Attributes			Metals (EPA 6010/7000)[a] (mg/kg)								
Record Number[b]	ER Sample ID (Figure 5.4.4-3)	Sample Depth (ft)	Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
05191	CY65BK-GR-001-0-SS	0–0.5	6.0	180	0.62 J (1.0)	ND (0.60)	16	14	ND (0.10)	2.4	ND (0.20)
05191	CY65BK-GR-001-0.5-S	0.5–1.0	5.6	170	0.65 J (0.98)	ND (0.59)	16	9.0	ND (0.091)	1.6	ND (0.20)
05191	CY65BK-GR-002-0-SS	0–0.5	4.8	150	0.64 J (0.99)	0.99 J (0.99)	18	16	ND (0.10)	1.9	0.26 J (2.0)
05191	CY65BK-GR-002-0.5-S	0.5–1.0	4.9	150	0.59 J (1.0)	0.61 J (1.0)	16	8.5	ND (0.10)	2.6	ND (0.20)
05191	CY65BK-GR-003-0-SS	0–0.5	3.9	170	0.56 J (0.98)	ND (0.59)	15	12	ND (0.10)	2.5	ND (0.20)
05191	CY65BK-GR-003-0-SD	0–0.5	4.2	170	0.58 J (1.0)	0.64 J (1.0)	14	12	ND (0.10)	2.2	ND (0.20)
05191	CY65BK-GR-003-0.5-S	0.5–1.0	4.0	160	0.62 J (0.98)	ND (0.59)	15	11	ND (0.10)	1.8	ND (0.20)
05191	CY65BK-GR-004-0-SS	0–0.5	6.1	220	0.68 J (0.97)	0.63 J (0.97)	20	14	ND (0.087)	2.0	ND (0.19)
05191	CY65BK-GR-004-0.5-S	0.5–1.0	5.6	210	0.61 J (1.0)	ND (0.60)	17	8.1	ND (0.10)	2.3	ND (0.20)
05191	CY65BK-GR-005-0-SS	0–0.5	6.0	180	0.63 J (0.99)	ND (0.60)	18	10	ND (0.10)	1.8	ND (0.20)
05191	CY65BK-GR-005-0.5-S	0.5–1.0	4.3	230	0.72 J (0.99)	ND (0.60)	20	10	ND (0.095)	1.4	ND (0.20)
Background Soil Concentrations—Canyons Area[c]			9.8	246	0.75	0.64	18.8	18.9	0.055	3.0	<0.5
Quality Assurance/Quality Control Sample (in mg/L)											
05191	CY65BK-GR-006-EB	NA	ND (0.0030)	0.0018 J (0.20)	ND (0.0010)	ND (0.0030)	ND (0.0040)	ND (0.0020)	ND (0.00020)	ND (0.0040)	0.0026 J (0.010)

[a] EPA November 1986.
[b] Analysis request/chain of custody record.
[c] Zamorski December 1997; contains data set listed above.

BK = Background.
CY = Canyon.
EB = Equipment blank.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab sample.
ID = Identification.
J ( ) = The reported value is greater than or equal to the method detection limit (MDL) but is less than the contract required detection limit, shown in parenthesis.
mg/kg = Milligrams per kilogram.
mg/L = Milligrams per liter.
NA = Not applicable.
ND = Not detected above the MDL, shown in parenthesis.
S = Subsurface soil sample.
SD = Surface soil sample duplicate.
SS = Surface soil sample.
SWMU = Solid waste management unit.

Table 5B-2
Summary of SWMU 65E Background Soil Sampling
Gamma Spectroscopy Analytical Results, May–June 1996
(On-Site Laboratory)

Sample Attributes			Gamma Spectroscopy Activity (pCi/g)							
			Uranium-238		Thorium-232		Uranium-235		Cesium-137	
Record Number[a]	ER Sample ID (Figure 5.4.4-3)	Sample Depth (ft)	Result	Error[b]	Result	Error[b]	Result	Error[b]	Result	Error[b]
05192	CY65BK-GR-001-0-SS	0-0.5	ND (2.88E+00)	--	6.26E-01	3.12E-01	ND (2.03E-01)	--	7.09E-01	1.00E-01
05192	CY65BK-GR-001-0.5-S	0.5-1.0	ND (3.34E+00)	--	7.21E-01	9.93E-01	ND (1.42E-01)	--	3.88E-02	2.52E-02
05192	CY65BK-GR-002-0-SS	0-0.5	ND (2.95E+00)	--	5.72E-01	2.92E-01	ND (2.09E-01)	--	5.52E-01	7.81E-02
05192	CY65BK-GR-002-0.5-S	0.5-1.0	ND (3.34E+00)	--	6.88E-01	3.66E-01	ND (2.25E-01)	--	ND (3.59E-02)	--
05192	CY65BK-GR-003-0-SS	0-0.5	ND (3.60E+00)	--	5.43E-01	2.74E-01	ND (2.37E-01)	--	6.67E-01	1.05E-01
05192	CY65BK-GR-003-0-SD	0-0.5	ND (2.02E+00)	--	5.515E-01	2.80E-01	ND (2.28E-01)	--	7.38E-01	1.14E-01
05192	CY65BK-GR-003-0.5-S	0.5-1.0	ND (3.14E+00)	--	5.59E-01	2.79E-01	ND (2.18E-01)	--	ND (1.96E-02)	--
05192	CY65BK-GR-004-0-SS	0-0.5	1.01E+00	1.20E+00	6.17E-01	3.07E-01	ND (2.25E-01)	--	4.80E-01	7.76E-02
05192	CY65BK-GR-004-0.5-S	0.5-1.0	ND (3.23E+00)	--	6.21	3.08E-01	ND (2.29E-01)	--	1.40E-02	1.54E-02
05192	CY65BK-GR-005-0-SS	0-0.5	ND (3.49E+00)	--	8.22E-01	3.78E-01	ND (2.44E-01)	--	2.15E-01	3.86E-01
05192	CY65BK-GR-005-0.5-S	0.5-1.0	ND (3.45E+00)	--	ND (1.33E-01)	--	ND (2.35E-01)	--	2.00E-02	1.48E-02
Background Soil Concentrations—Upper Canyons[c]			2.31	NA	1.03	NA	0.16	NA	0.515	NA
Quality Assurance/Quality Control Sample (in pCi/L)										
05191	CY65BK-GR-006-EB (off-site laboratory)	NA	0.128 B	0.065	ND (0.039)	--	0.041	0.042	NT	NA

[a] Analysis request/chain of custody record.
[b] Two standard deviations above the mean detected activity.
[c] Dinwiddie September 1997, does not contain data set listed above.

B = Radionuclide detected in associated blank.
BK = Background.
CY = Canyon.
EB = Equipment blank.
ER = Environmental Restoration.
GR = Grab sample.
ft = Foot (feet).
ID = Identification.
NA = Not applicable.
ND = Radionuclide not detected above the minimum detectable activity, shown in parenthesis.
NT = Not tested.
pCi/g = Picocuries per gram.
pCi/L = Picocuries per liter.
S = Subsurface soil sample.
SD = Surface soil sample duplicate.
SS = Surface soil sample.
SWMU = Solid waste management unit.
-- = Error not calculated for nondetectable results.

Table 5B-3
Summary of SWMU 65E Background Soil Sampling
Isotopic Thorium, Uranium, and Strontium Analytical Results, May 1996
(Off-Site Laboratory)

Sample Attributes			Activity (pCi/g)													
Record Number[a]	ER Sample ID (Figure 5.4.4-3)	Sample Depth (ft)	Thorium-228		Thorium-230		Thorium-232		Uranium-233/234		Uranium-235		Uranium-238		Strontium-89/90	
			Result	Error[b]	Result	Error[b]	Result	Error[b]	Result	Error[b]	Result	Error[b]	Result	Error[b]	Result	Error[b]
05191	CY65BK-GR-001-0-SS	0-0.5	0.91	0.11	0.96	0.11	0.864	0.10	0.715B	0.076	0.053B	0.019	0.764	0.079	ND (0.39)B	--
05191	CY65BK-GR-001-0.5-S	0.5-1.0	0.970	0.10	0.912	0.095	1.029	0.10	0.637B	0.072	0.046	0.018	0.731	0.078	ND (0.16)B	--
05191	CY65BK-GR-002-0-SS	0-0.5	0.979	0.10	0.879	0.095	0.881	0.095	0.650B	0.076	0.035B	0.016	0.752	0.083	ND (0.43)B	--
05191	CY65BK-GR-002-0.5-S	0.5-1.0	0.923	0.10	0.896	0.097	0.922	0.099	0.608B	0.075	0.037B	0.017	0.684	0.080	ND (0.41)B	--
05191	CY65BK-GR-003-0-SS	0-0.5	0.824	0.10	0.816	0.097	0.804	0.096	0.612B	0.077	0.0120 B	0.010	0.664	0.081	0.33 B	0.26
05191	CY65BK-GR-003-0-SD	0-0.5	0.832	0.095	0.877	0.094	0.881	0.094	0.680B	0.085	0.028B	0.017	0.667	0.084	0.35 B	0.25
05191	CY65BK-GR-003-0.5-S	0.5-1.0	0.93	0.11	0.907	0.10	0.98	0.11	0.546B	0.071	0.041B	0.018	0.595	0.074	ND (0.44)B	--
05191	CY65BK-GR-004-0-SS	0-0.5	0.861	0.096	1.024	0.10	0.968	0.099	0.709B	0.088	0.075B	0.026	0.864	0.099	ND (0.41)B	--
05191	CY65BK-GR-004-0.5-S	0.5-1.0	0.90	0.11	0.95	0.11	0.826	0.10	0.733B	0.089	0.046B	0.021	0.747	0.090	ND (0.40)B	--
05191	CY65BK-GR-005-0-SS	0-0.5	0.99	0.12	1.05	0.12	0.97	0.12	0.779B	0.10	0.069B	0.030	0.762	0.10	ND (0.52)B	--
05191	CY65BK-GR-005-0.5-S	0.5-1.0	0.98	0.12	1.00	0.12	1.11	0.13	0.763B	0.087	0.047B	0.021	0.742	0.085	ND (0.40)B	--
Background Soil Concentrations—Upper Canyons[c]			NE	--	NE	--	1.03	--	2.31	--	0.16	--	2.31	--	1.08	--
Quality Assurance/Quality Control Sample (in pCi/L)																
05191	CY65BK-GR-006-EB	NA	ND (0.15)	--	ND (0.055)	--	ND (0.039)	--	0.103	0.067	0.041	0.042	0.128	0.065	0.31	0.27

[a]Analysis request/chain of custody record.
[b]Two standard deviations about the mean detected activity.
[c]Dinwiddie September 1997, does not contain data set listed above.

B = Radionuclide detected in associated blank.
BK = Background.
CY = Canyon.
EB = Equipment blank.
ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab sample.
ID = Identification.
NA = Not applicable.
NE = Not established.
ND ( ) = Not detected at or above the minimum detectable activity, shown in parenthesis.
pCi/g = Picocurie(s) per gram.
pCi/L = Picocurie(s) per liter.
S = Subsurface soil sample.
SD = Surface soil sample duplicate.
SS = Surface soil sample.
SWMU = Solid waste management unit.
-- = Error not calculated for nondetectable results.

Table 5B-4
Summary of SWMU 65E Background Soil Sampling
Gross Alpha and Gross Beta Analytical Results, June 1998

Sample Attributes			Gamma Spectroscopy Activity (pCi/g)			
			Gross Alpha		Gross Beta	
Record Number[a]	ER Sample ID (Figure 5.4.4-3)	Sample Depth (ft)	Result	Error[b]	Result	Error[b]
05192	CY65BK-GR-001-0-SS (on-site laboratory)	0–0.5	ND (4.39E+00)	--	ND (1.95E+01)	--
05192	CY65BK-GR-001-0.5-S (on-site laboratory)	0.5-1.0	ND (4.39E+00)	--	ND (1.95E+01)	--
05192	CY65BK-GR-002-0-SS (on-site laboratory)	0–0.5	ND (4.39E+00)	--	ND (1.95E+01)	--
05192	CY65BK-GR-002-0.5-S (on-site laboratory)	0.5-1.0	ND (4.39E+00)	--	ND (1.95E+01)	--
05192	CY65BK-GR-003-0-SS (on-site laboratory)	0–0.5	ND (4.39E+00)	--	ND (1.95E+01)	--
05192	CY65BK-GR-003-0-SD (on-site laboratory)	0–0.5	ND (4.39E+00)	--	ND (1.95E+01)	--
05192	CY65BK-GR-003-0.5-S (on-site laboratory)	0.5-1.0	ND (4.39E+00)	--	ND (1.95E+01)	--
05192	CY65BK-GR-004-0-SS (on-site laboratory)	0–0.5	ND (4.39E+00)	--	ND (1.95E+01)	--
05192	CY65BK-GR-004-0.5-S (on-site laboratory)	0.5-1.0	ND (4.39E+00)	--	ND (1.95E+01)	--
05192	CY65BK-GR-005-0-SS (on-site laboratory)	0–0.5	ND (4.39E+00)	--	ND (1.95E+01)	--
05192	CY65BK-GR-005-0.5-S (on-site laboratory)	0.5-1.0	ND (4.39E+00)	--	ND (1.95E+01)	--
600318	CY65BK-GR-006-SS	0	3.95	4.29	13.3	3.28
600318	CY65BK-GR-007-SS	0	14.2	5.02	30.4	3.74
600318	CY65BK-GR-008-SS	0	11.1	4.81	19.8	3.46
600318	CY65BK-GR-009-SS	0	9.67	4.71	25.6	3.62
600318	CY65BK-GR-010-SS	0	13.0	4.94	17.8	3.41
600318	CY65BK-GR-011-SS	0	11.1	4.81	18.3	3.42
600318	CY65BK-GR-012-SS	0	13.2	4.95	29.0	3.70
600318	CY65BK-GR-013-SS	0	14.4	5.03	17.1	3.39
600318	CY65BK-GR-014-SS	0	11.8	4.86	28.1	3.68
600318	CY65BK-GR-015-SS	0	15.9	5.13	45.1	4.09
600318	CY65BK-GR-016-SS	0	17.7	5.24	29.1	3.71
600318	CY65BK-GR-017-SS	0	16.8	5.19	42.0	4.02
600318	CY65BK-GR-018-SS	0	5.51	4.40	22.1	3.52
600318	CY65BK-GR-019-SS	0	13.2	4.95	24.4	3.59
600318	CY65BK-GR-020-SS	0	10.9	4.80	17.8	3.41
Background Soil Activity—Canyons Area[c]			18.3	NA	52.7	NA

[a]Analysis request/chain of custody record.
[b]Two standard deviations above the mean detected activity.
[c]Tharp July 1998, contained data from samples CY65BK-GR-006-SS through CY65BK-GR-020-SS.

BK = Background.
CY = Canyon.
ER = Environmental Restoration.
GR = Grab sample.
ft = Foot (feet).
ID = Identification.
NA = Not applicable.
ND = Radionuclide not detected above the minimum detectable activity, shown in parenthesis.
pCi/g = Picocuries per gram.
S = Subsurface soil sample.
SD = Surface soil sample duplicate.
SS = Surface soil sample.
SWMU = Solid waste management unit.
-- = Error not calculated for nondetectable results.

ANNEX 5-C
SWMU 65E Lurance Canyon Explosive Test Site
Site-Specific Background
Arroyo Sediment Sample Results
May–June 1996

Table 5C-1
Summary of SWMU 65E Background Arroyo Sediment Sampling Metals Analytical Results, May–June 1996 (Off-Site Laboratory)

Sample Attributes			Metals (EPA 6010/7000)[a] (mg/kg)								
Record Number[b]	ER Sample ID (Figure 5.4.4-3)	Sample Depth (ft)	Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
05227	CY65BKA-GR-001-0-SS	0–0.5	3.8	130	0.42 J (0.98)	ND (0.59)	14	8.7	ND (0.095)	2.5	ND (0.20)
05227	CY65BKA-GR-001-0.5-S	0.5–1.0	3.5	110	0.33 J (0.98)	0.74 J (0.98)	13	6.6	ND (0.10)	2.2	0.20 J (2.0)
05227	CY65BKA-GR-002-0-SS	0–0.5	3.6	110	0.31 J (0.99)	ND (0.60)	11	7.3	ND (0.095)	2.4	ND (0.20)
05227	CY65BKA-GR-002-0-SD	0–0.5	2.3	73	0.20 J (0.98)	ND (0.59)	9.0	4.3	ND (0.10)	2.3	ND (0.20)
05227	CY65BKA-GR-002-0.5-S	0.5–1.0	3.7	130	0.31 J (0.96)	ND (0.58)	11	8.0	ND (0.10)	2.3	ND (0.19)
05227	CY65BKA-GR-003-0-SS	0–0.5	9.6	77	0.27 J (0.98)	ND (0.59)	10	8.0	ND (0.095)	3.0	ND (0.20)
05227	CY65BKA-GR-003-0.5-S	0.5–1.0	3.3	73	0.26 J (1.0)	ND (0.60)	9.4	6.1	ND (0.091)	3.0	0.30 J (2.0)
05227	CY65BKA-GR-004-0-SS	0.5–1.0	3.9	130	0.39 J (0.99)	ND (0.60)	12	9.1	ND (0.095)	2.4	ND (0.20)
05227	CY65BKA-GR-004-0.5-S	0.5–1.0	2.9	400	0.27 J (0.97)	ND (0.58)	9.9	5.8	ND (0.10)	2.6	ND (0.19)
05227	CY65BKA-GR-005-0-SS	0–0.5	4.3	210	0.73 J (0.96)	ND (0.58)	17	18	ND (0.10)	1.9	ND (0.19)
05227	CY65BKA-GR-005-0.5-S	0.5–1.0	3.2	110	0.36 J (0.99)	ND (0.60)	11	8.1	ND (0.10)	2.6	ND (0.20)
05227	CY65BKA-GR-006-0-SS	0–0.5	3.9	150	0.46 J (1.0)	ND (0.60)	12	12	ND (0.10)	2.4	ND (0.20)
05227	CY65BKA-GR-006-0.5-S	0.5–1.0	2.9	73	0.26 J (0.98)	0.64 J (0.98)	10	6.1	ND (0.10)	3.1	ND (0.20)
Background Soil Concentrations— Canyons Area[c]			9.8	246	0.75	0.64	18.8	18.9	0.055	3.0	<0.5
Quality Assurance/Quality Control Sample (in mg/L)											
05227	CY65BKA-GR-007-EB	NA	ND (0.0030)	0.0012 J (0.20)	ND (0.0010)	ND (0.0030)	ND (0.0040)	ND (0.0020)	ND (0.00020)	ND (0.0040)	0.0023 J (0.010)

[a]EPA November 1986.
[b]Analysis request/chain of custody record.
[c]Zamorski December 1997, contains data set listed above.

BKA = Background arroyo.
CY = Canyon.
EB = Equipment blank.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab sample.
ID = Identification.
J ( ) = The reported value is greater than or equal to the method detection limit (MDL) but is less than the contract required detection limit, shown in parenthesis.
mg/kg = Milligrams per kilogram.
mg/L = Milligrams per liter.
NA = Not applicable.
ND = Not detected above the MDL, shown in parenthesis.
S = Subsurface sediment sample.
SD = Surface sediment sample duplicate.
SS = Surface sediment sample.
SWMU = Solid waste management unit.

Table 5C-2
Summary of SWMU 65E Background Arroyo Sediment Sampling
Gamma Spectroscopy Analytical Results, May–June 1996
(On-Site Laboratory)

Sample Attributes			Gamma Spectroscopy Activity (pCi/g)							
			Uranium-238		Thorium-232		Uranium-235		Cesium-137	
Record Number[a]	ER Sample ID (Figure 5.4.4-3)	Sample Depth (ft)	Result	Error[b]	Result	Error[b]	Result	Error[b]	Result	Error[b]
05228	CY65BKA-GR-001-0-SS	0-0.5	ND (1.18E+00)	--	4.65E-01	2.18E-01	ND (1.61E-01)	--	1.23E-01	1.76E-01
05228	CY65BKA-GR-001-0.5-S	0.5-1.0	ND (1.02E+00)	--	2.58E-01	3.93E-01	ND (1.40E-01)	--	ND (1.84E-02)	--
05228	CY65BKA-GR-002-0-SS	0-0.5	4.34E-01	7.41E-01	2.47E-01	1.81E-01	ND (1.36E-01)	--	5.38E-02	3.05E-02
05228	CY65BKA-GR-002-0.5-S	0.5-1.0	ND (9.36E-01)	--	2.70E-01	1.99E-01	ND (1.37E-01)	--	ND (1.89E-02)	--
05228	CY65BKA-GR-003-0-SS	0-0.5	8.04E-01	8.42E-01	2.33E-01	1.93E-01	ND (1.43E-01)	--	6.50E-02	2.38E-02
05228	CY65BKA-GR-003-0.5-S	0.5-1.0	ND (1.01E+00)	--	2.73E-01	1.81E-01	ND (1.45E-01)	--	6.95E-02	2.45E-02
05228	CY65BKA-GR-004-0-SS	0-0.5	ND (1.03E+00)	--	2.80E-01	4.11E-01	ND (1.46E-01)	--	1.49E-01	5.76E-02
05228	CY65BKA-GR-004-0.5-S	0.5-1.0	4.79E-01	7.29E-01	2.59E-01	2.88E-01	ND (1.35E-01)	--	4.44E-02	2.74E-02
05228	CY65BKA-GR-005-0-SS	0-0.5	ND (1.66E+00)	--	8.38E-01	4.43E-01	ND (2.29E-01)	--	8.79E-01	1.59E-01
05228	CY65BKA-GR-005-0.5-S	0.5-1.0	ND (9.33E-01)	--	3.11E-01	2.11E-01	ND (1.31E-01)	--	2.39E-01	7.34E-02
05228	CY65BKA-GR-006-0-SS	0-0.5	ND (1.38E+00)	--	3.98E-01	2.50E-01	ND (1.83E-01)	--	6.25E-01	1.06E-01
05228	CY65BKA-GR-006-0.5-S	0.5-1.0	ND (1.21E+00)	--	3.37E-01	2.33E-01	ND (1.65E-01)	--	2.97E-01	6.92E-02
Background Soil Concentrations—Upper Canyons[c]			2.31	NA	1.03	NA	0.16	NA	0.515	NA
Quality Assurance/Quality Control Sample (in pCi/L)										
05227	CY65BKA-GR-007-EB (off-site laboratory)	NA	0.080 B	0.049	ND(0.070)	--	0.036	0.032	NT	NA

[a] Analysis request/chain of custody record.
[b] Two standard deviations above the mean detected activity.
[c] Dinwiddie September 1997, does not contain data set listed above.

BKA = Background arroyo.
CY = Canyon.
EB = Equipment blank.
ER = Environmental Restoration.
ft = Feet.
GR = Grab sample.
ID = Identification.
NA = Not applicable.
ND = Radionuclide not detected above the minimum detectable activity, shown in parenthesis.
NT = Not tested.
pCi/g = Picocuries per gram.
S = Subsurface sediment sample.
SS = Surface sediment sample.
SWMU = Solid waste management unit.
-- = Error not calculated for nondetectable results.

Table 5C-3
Summary of SWMU 65E Background Arroyo Sediment Sampling
Isotopic Thorium, Uranium, and Strontium Analytical Results, May–June 1996
(Off-Site Laboratory)

Sample Attributes			Activity (pCi/g)													
Record Number[a]	ER Sample ID (Figure 5.4.4-3)	Sample Depth (ft)	Thorium-228		Thorium-230		Thorium-232		Uranium-233/234		Uranium-235		Uranium-238		Strontium-89/90	
			Result	Error[b]	Result	Error[b]	Result	Error[b]	Result	Error[b]	Result	Error[b]	Result	Error[b]	Result	Error[b]
05227	CY65BKA-GR-001-0-SS	0-0.5	0.927 B	0.096	0.975	0.095	0.880	0.089	0.599	0.099	0.033	0.024	0.81	0.12	ND (1.4)	--
05227	CY65BKA-GR-001-0.5-S	0.5-1.0	0.889 B	0.086	0.934	0.085	0.699	0.071	0.82	0.13	0.110	0.045	0.81	0.13	ND (0.46) B	--
05227	CY65BKA-GR-002-0-SS	0-0.5	0.821 B	0.083	0.878	0.083	0.715	0.073	0.76	0.11	0.057	0.028	0.73	0.11	ND (1.1)	--
05227	CY65BKA-GR-002-0-SD	0-0.5	0.693 B	0.083	0.887	0.093	0.773	0.086	0.74	0.12	0.050	0.030	0.575	0.10	ND (1.0)	--
05227	CY65BKA-GR-002-0.5-S	0.5-1.0	9.30 B	0.52	1.031	0.091	0.739	0.073	0.93	0.13	0.123	0.045	0.79	0.12	ND (1.0)	--
05227	CY65BKA-GR-003-0-SS	0-0.5	0.606B	0.068	0.785	0.075	0.553	0.061	0.81	0.12	0.038	0.025	0.81	0.12	ND (1.2)	--
05227	CY65BKA-GR-003-0.5-S	0.5-1.0	0.494 B	0.059	0.805	0.075	0.494	0.055	0.83	0.12	0.060	0.031	0.89	0.12	ND (1.3)	--
05227	CY65BKA-GR-004-0-SS	0-0.5	1.271 B	0.10	0.873	0.080	0.703	0.069	1.17	0.15	0.139	0.049	0.91	0.13	ND (1.1)	--
05227	CY65BKA-GR-004-0.5-S	0.5-1.0	0.728 B	0.076	0.835	0.080	0.679	0.070	0.75	0.12	0.127	0.046	0.75	0.12	ND (1.2)	--
05227	CY65BKA-GR-005-0-SS	0-0.5	0.976 B	0.091	1.042	0.092	0.949	0.086	0.76	0.11	0.054	0.028	0.74	0.11	ND (0.70)	--
05227	CY65BKA-GR-005-0.5-S	0.5-1.0	0.788 B	0.084	0.904	0.088	0.883	0.087	0.534	0.091	0.034	0.024	0.634	0.099	ND (0.54)	--
05227	CY65BKA-GR-006-0-SS	0-0.5	0.906 B	0.089	0.984	0.091	0.850	0.083	0.614	0.10	0.068	0.036	0.76	0.12	ND (1.2)	--
05227	CY65BKA-GR-006-0.5-S	0.5-1.0	0.802 B	0.089	0.809	0.086	0.707	0.079	0.605	0.10	0.052	0.031	0.63	0.11	ND (1.2)	--
Background Soil Concentrations—Upper Canyons[c]			NE	--	NE	--	1.03	--	2.31	--	0.16	--	2.31	--	1.08	--
Quality Assurance/Quality Control Sample (in pCi/L)																
05227	CY65BKA-GR-007-EB	NA	ND (0.18)	--	ND (0.094)	--	ND (0.070)	--	0.080 B	0.055	0.036	0.032	0.080 B	0.049	ND (0.62)	--

[a]Analysis request/chain of custody record.
[b]Two standard deviations about the mean detected activity.
[c]Dinwiddie September 1997, does not contain data set listed above.

B = Radionuclide detected in associated blank.
BKA = Background arroyo.
CY = Canyon.
EB = Equipment blank.
ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab sample.
ID = Identification.
NA = Not applicable.
NE = Not established.
ND ( ) = Not detected at or above the minimum detectable activity, shown in parenthesis.
pCi/g = Picocurie(s) per gram.
pCi/L = Picocurie(s) per liter.
S = Subsurface sediment sample.
SD = Surface sediment sample duplicate.
SNL/NM = Sandia National Laboratories, New Mexico.
SS = Surface sediment sample.
SWMU = Solid waste management unit.
-- = Error not calculated for nondetectable results.

Table 5C-4
Summary of SWMU 65E Background Arroyo Sediment Sampling
Gross Alpha and Gross Beta Analytical Results, May–June 1996
(On-Site Laboratory)

Sample Attributes			Gamma Spectroscopy Activity (pCi/g)			
Record Number[a]	ER Sample ID (Figure 5.4.4-3)	Sample Depth (ft)	Gross Alpha	Error[b]	Gross Beta	Error[b]
05228	CY65BKA-GR-001-0-SS	0-0.5	ND (4.40E+00)	--	ND (1.92E+01)	--
05228	CY65BKA-GR-001-0.5-S	0.5-1.0	ND (4.40E+00)	--	ND (1.92E+01)	--
05228	CY65BKA-GR-002-0-SS	0-0.5	ND (4.40E+00)	--	ND (1.92E+01)	--
05228	CY65BKA-GR-002-0.5-S	0.5-1.0	ND (4.40E+00)	--	ND (1.92E+01)	--
05228	CY65BKA-GR-003-0-SS	0-0.5	ND (4.40E+00)	--	ND (1.92E+01)	--
05228	CY65BKA-GR-003-0.5-S	0.5-1.0	ND (4.40E+00)	--	ND (1.92E+01)	--
05228	CY65BKA-GR-004-0-SS	0-0.5	ND (4.40E+00)	--	ND (1.92E+01)	--
05228	CY65BKA-GR-004-0.5-S	0.5-1.0	ND (4.40E+00)	--	ND (1.92E+01)[c]	--
05228	CY65BKA-GR-005-0-SS	0-0.5	ND (4.40E+00)	--	ND (1.92E+01)	--
05228	CY65BKA-GR-005-0.5-S	0.5-1.0	ND (4.40E+00)	--	ND (1.92E+01)	--
05228	CY65BKA-GR-006-0-SS	0-0.5	ND (4.40E+00)	--	ND (1.92E+01)	--
05228	CY65BKA-GR-006-0.5-S	0.5-1.0	ND (4.40+00)	--	ND (1.92E+01)	--
Background Soil Concentrations—Canyons Area[d]			18.3	NA	52.7	NA

[a]Analysis request/chain of custody record.
[b]Two standard deviations above the mean detected activity.
[c]Result exceeds 2-sigma error.
[d]Tharp July 1998, does not contain data set listed above.
BKA = Background arroyo.
CY = Canyon.
ER = Environmental Restoration.
ft = Feet.
GR = Grab sample.
ID = Identification.
NA = Not applicable.
ND = Radionuclide not detected above the minimum detectable activity, shown in parenthesis.
pCi/g = Picocuries per gram.
S = Subsurface sediment sample.
SS = Surface sediment sample.
SWMU = Solid waste management unit.
-- = Error not calculated for nondetectable results.

ANNEX 5-D
Gamma Spectroscopy Results
June 1996 through June 1998

ER/1333/65E/04

65E= GRID & SPEC

COC# 05236

RUSH

SMO ANALYTICAL DATA ROUTING FORM

Project Name: CANYONS TESTAREA Case Number: 3621.400

SNL Task Leader: LOJEK Org/Mail Stop: 7585/1148

SMO Project Coordinator: LYON Sample Ship Date: 6/13/96

ARCOC	Lab	Lab ID
05236	7713	600909

Date Results Received:

Preliminary: _____ Final: 6/14/96

Corrections Requested From Laboratory: _____ Requestor: _____

Date Corrections Received: _____

Date Assigned to SMO Reviewer: _____ Reviewer: _____

Date Review Complete: _____ Signature: _____

Date of Preliminary Notification: _____ Person Notified: _____

Date of Final Transmittal: 6/25/96 Transmitted To: LOJEK

Transmitted By: _____ Filed In Record Center: _____

Comments: _____

SF 2001-COC (8-96)

nal Lab batch No. 600909

ANALYSIS REQUEST A[illegible] CHAIN OF CUSTODY

PAGE [illegible]

AR/COC- 05236

Dept. No./Mail Stop: 7585 MS 1148
Project/Task Manager: Carole Lojek
Project Name: Canyons Test Area
Record Center Code: ER/1333/65E/DAT
Logbook Ref No: 0057
Service Order No.: CF0181

Date Samples Shipped: 6-13-96
Carrier/Waybill No.: HC
Lab Contact: Fernando Dominguez
Lab Destination: RPSD Bldg 889
SMO Contact/Phone: Mark Lyon 262-8920
Send Report to SMO Kathy Becker

Contract No.: N/A
Case No.: 3621.400
SMO Authorization: [illegible]
Bill to: Sandia National Laboratories
Supplier Services Department
P.O. Box 5800 MS 0154
Albuquerque, NM 87185-0154

Parameter & Method Requested: Gamma Spec

Location: Tech Area N/A
Building N/A Room N/A

Reference LOV (available at SMO)

Sample No. - Fraction	ER Sample ID or Sample Location Detail	Beginning Depth in Ft.	ER Site No.	Date/Time Collected	Sample Matrix	Container Type	Container Volume	Preservative	Sample Collection Method	Sample Type	Gamma Spec	Lab Sample ID
029908-03	CY65E-GR-006-0-SS	0	65E	6/11/96 1045	S	P	500ml	none	G	SA	X	
029923-03	CY65E-GR-012-0-SD	0	65E	6/11/96 0930	S	P	500ml	none	G	DU	X	
-												
-												
-												
-												
-												
-												
-												
-												

RMMA ☒ Yes ☐ No Ref. No.
Sample Disposal ☒ Return to Client ☐ Disposal by lab
Turnaround Time ☐ Normal ☒ Rush Required Report Date

Sample Tracking
Date Entered (mm/dd/yy) 6/21/96
Entered by: [illegible]
QC Inits.

Special Instructions/QC Requirements
Fax copy to C. Brown 284-2614 to release to RPSD Lab
C.O.C #05236 release
C.O.C #05237 to Lockheed
C.O.C #05238 to Killmanstetter
C.O.C #05239 to Rodacy

Abnormal Conditions on Receipt

Sample Team Members	Name	Signature	Init	Company/Organization/Phone
	Rod Angel	[signature]	RA	IT/7584
	[illegible]	[signature]		IT/7584

	Org.	Date	Time
1. Relinquished by [signature]	IT/7584	6/13/96	1025
1. Received by [signature]	SNL/7513	6/13/96	1025
2. Relinquished by [signature]	7513	6/13/96	1107
2. Received by [signature]	SNL/7713	6/13/96	1107
3. Relinquished by [signature]	SNL/7713	6/14/96	0950
3. Received by [signature]	7713	6/14/96	0950
4. Relinquished by			
4. Received by			
5. Relinquished by			
5. Received by			
6. Relinquished by			
6. Received by			

WHITE - To Accompany Samples, Laboratory Copy BLUE - To Accompany Samples, Return to SMO YELLOW - SMO Suspense Copy PINK - Field Copy

Sandia National Laboratories
Radiation Protection Sample Diagnostics Program [881 Laboratory]
6-13-96 5:31:02 PM

Analyzed by: 6/14/96 Reviewed by: 6/14/96

Customer : C.LOJEK/E.RANKIN (7585/SMO)
Customer Sample ID : 029908-03
Lab Sample ID : 60090901

CY65E-gR-006-0-S

Sample Description : MARINELLI SOLID SAMPLE
Sample Quantity : 791.000 gram
Sample Date/Time : 6-11-96 10:45:00 AM
Acquire Start Date/Time : 6-13-96 3:41:58 PM
Detector Name : LAB04
Elapsed Live/Real Time : 6000 / 6004 seconds

Comments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	Not Detected	---	1.00E+00
TH-234	Not Detected	---	3.57E-01
RA-226	1.83E+00	4.86E-01	4.49E-01
PB-214	9.11E-01	1.45E-01	3.60E-02
BI-214	8.94E-01	1.76E-01	3.71E-02
TH-232	8.68E-01	4.82E-01	1.12E-01
RA-228	8.59E-01	2.23E-01	1.24E-01
[illegible]-228	8.19E-01	1.96E-01	6.62E-02
[illegible]-228	2.15E-01	2.09E-01	3.79E-01
RA-224	8.36E-01	2.79E-01	6.29E-02
PB-212	6.92E-01	1.18E-01	3.95E-02
BI-212	Not Detected	---	3.97E-01
TL-208	7.69E-01	1.39E-01	5.38E-02
~~U-235~~	~~6.30E-02~~	~~7.50E-02~~	1.23E-01 not detected 6/14/96
TH-231	Not Detected	---	1.11E+00
PA-231	Not Detected	---	8.67E-01
TH-227	Not Detected	---	1.18E-01
RA-223	Not Detected	---	8.90E-02
RN-219	Not Detected	---	2.50E-01
PB-211	Not Detected	---	5.76E-01
TL-207	Not Detected	---	9.05E+00
AM-241	Not Detected	---	1.07E-01
PU-239	Not Detected	---	2.35E+02
NP-237	Not Detected	---	1.66E-01
PA-233	Not Detected	---	3.56E-02
TH-229	Not Detected	---	1.22E-01

[Summary Report] - Sample ID: : 60090901

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
AG-110m	Not Detected	---	2.78E-02
BA-133	Not Detected	---	2.18E-02
BE-7	Not Detected	---	1.62E-01
CD-109	Not Detected	---	5.77E-01
CD-115	Not Detected	---	8.41E-02
CE-139	Not Detected	---	1.54E-02
CE-141	Not Detected	---	2.89E-02
CE-144	Not Detected	---	1.19E-01
CO-56	Not Detected	---	2.09E-02
CO-57	Not Detected	---	1.56E-02
CO-58	Not Detected	---	1.91E-02
CO-60	Not Detected	---	2.25E-02
CR-51	Not Detected	---	1.41E-01
CS-134	Not Detected	---	1.82E-02
CS-137	4.33E-01	7.38E-02	2.26E-02
EU-152	Not Detected	---	1.43E-01
EU-154	Not Detected	---	9.78E-02
EU-155	Not Detected	---	6.34E-02
FE-59	Not Detected	---	4.53E-02
GD-153	Not Detected	---	4.52E-02
HG-203	Not Detected	---	1.86E-02
I-131	Not Detected	---	2.08E-02
IR-192	Not Detected	---	1.65E-02
K-40	1.23E+01	1.87E+00	2.10E-01
MN-54	Not Detected	---	2.21E-02
MO-99	Not Detected	---	2.63E-01
NA-22	Not Detected	---	2.56E-02
NA-24	Not Detected	---	2.45E-01
NB-95	Not Detected	---	8.23E-02
ND-147	Not Detected	---	1.41E-01
NI-57	~~1.39E-01~~	~~6.51E-02~~	6.08E-02 not detected 6/14/96
RU-103	Not Detected	---	1.80E-02
RU-106	Not Detected	---	1.88E-01
SB-122	Not Detected	---	4.35E-02
SB-124	Not Detected	---	1.88E-02
SB-125	Not Detected	---	5.49E-02
SR-85	Not Detected	---	2.28E-02
TA-182	Not Detected	---	1.25E-01
TA-183	Not Detected	---	1.23E-01
TC-99m	Not Detected	---	6.70E+00
TL-201	Not Detected	---	8.86E-02
XE-133	Not Detected	---	1.01E-01
Y-88	Not Detected	---	1.91E-02
ZN-65	Not Detected	---	5.58E-02
ZR-95	Not Detected	---	3.73E-02

Sandia National Laboratories
Radiation Protection Sample Diagnostics Program [881 Laboratory]
6-13-96 7:07:21 PM

Analyzed by: 6/14/96 Reviewed by: 6/14/96

ustomer : C.LOJEK/E.RANKIN (7585/SMO)
ustomer Sample ID : 029923-03
ab Sample ID : 60090902

CY65E-9R-012-0-

ample Description : MARINELLI SOLID SAMPLE
ample Quantity : 747.000 gram
ample Date/Time : 6-12-96 9:30:00 AM
cquire Start Date/Time : 6-13-96 5:23:19 PM
etector Name : LAB04
lapsed Live/Real Time : 6000 / 6004 seconds

omments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	Not Detected	---	9.63E-01
TH-234	Not Detected	---	3.60E-01
RA-226	1.89E+00	5.00E-01	4.76E-01
PB-214	7.84E-01	1.31E-01	3.64E-02
BI-214	7.86E-01	1.46E-01	3.57E-02
TH-232	8.45E-01	4.20E-01	1.14E-01
-228	9.65E-01	2.35E-01	1.12E-01
-228	8.84E-01	1.99E-01	6.68E-02
TH-228	2.05E-01	1.61E-01	3.68E-01
RA-224	8.44E-01	2.74E-01	5.54E-02
PB-212	7.36E-01	1.37E-01	4.17E-02
BI-212	9.26E-01	1.40E+00	2.32E-01
TL-208	7.20E-01	2.23E-01	5.15E-02
U-235	~~9.00E-02~~	~~7.60E-02~~	1.23E-01
TH-231	Not Detected	---	1.03E+00
PA-231	Not Detected	---	8.17E-01
TH-227	Not Detected	---	1.17E-01
RA-223	Not Detected	---	8.34E-02
RN-219	Not Detected	---	2.39E-01
PB-211	Not Detected	---	5.42E-01
TL-207	Not Detected	---	9.44E+00
AM-241	Not Detected	---	1.10E-01
PU-239	Not Detected	---	2.44E+02
NP-237	Not Detected	---	1.72E-01
PA-233	Not Detected	---	3.39E-02
TH-229	Not Detected	---	1.23E-01

Not detected 6/14/96

[Summary Report] - Sample ID: : 60090902

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
AG-110m	Not Detected	---------	2.12E-02
BA-133	Not Detected	---------	2.19E-02
BE-7	Not Detected	---------	1.59E-01
CD-109	Not Detected	---------	5.92E-01
CD-115	Not Detected	---------	6.07E-02
CE-139	Not Detected	---------	1.53E-02
CE-141	Not Detected	---------	2.81E-02
CE-144	Not Detected	---------	1.21E-01
CO-56	Not Detected	---------	1.97E-02
CO-57	Not Detected	---------	1.55E-02
CO-58	Not Detected	---------	1.93E-02
CO-60	Not Detected	---------	2.49E-02
CR-51	Not Detected	---------	1.38E-01
CS-134	Not Detected	---------	1.91E-02
CS-137	3.60E-02	2.10E-02	1.84E-02
EU-152	Not Detected	---------	1.44E-01
EU-154	Not Detected	---------	1.04E-01
EU-155	Not Detected	---------	6.38E-02
FE-59	Not Detected	---------	4.74E-02
GD-153	Not Detected	---------	4.59E-02
HG-203	Not Detected	---------	1.89E-02
I-131	Not Detected	---------	1.88E-02
IR-192	Not Detected	---------	1.70E-02
K-40	1.55E+01	2.29E+00	2.12E-01
MN-54	Not Detected	---------	2.27E-02
MO-99	Not Detected	---------	2.36E-01
NA-22	Not Detected	---------	2.90E-02
NA-24	Not Detected	---------	9.45E-02
NB-95	Not Detected	---------	6.92E-02
ND-147	Not Detected	---------	1.31E-01
NI-57	Not Detected	---------	3.96E-02
RU-103	Not Detected	---------	1.75E-02
RU-106	Not Detected	---------	1.99E-01
SB-122	Not Detected	---------	3.79E-02
SB-124	Not Detected	---------	1.92E-02
SB-125	Not Detected	---------	5.29E-02
SR-85	Not Detected	---------	2.28E-02
TA-182	Not Detected	---------	1.25E-01
TA-183	Not Detected	---------	1.12E-01
TC-99m	Not Detected	---------	5.79E-01
TL-201	Not Detected	---------	7.04E-02
XE-133	Not Detected	---------	7.26E-02
Y-88	Not Detected	---------	1.95E-02
ZN-65	Not Detected	---------	5.71E-02
ZR-95	Not Detected	---------	3.75E-02

ANALYSIS REQUEST AND CHAIN OF CUSTODY

Internal Lab Batch No. 6J0911

AR/COC- 05240

Dept. No./Mail Stop: 7585 MS 1145
Project/Task Manager: Carole Lojek
Project Name: Canyons Test Area
Record Center Code: ER/1333/65E/DAT
Logbook Ref No: 0057
Service Order No.: CF0191

Date Samples Shipped: 6/13/96
Carrier/Waybill No.: HC
Lab Contact: Fernando Dominguez
Lab Destination: RFSD Bldg 651
SMO Contact/Phone: Mark Lyon 262-8720
Send Report to SMO Kathy Bocker

Contract No.: NA
Case No.: 3621.401.01
SMO Authorization: [signature]
Bill to: Sandia National Laboratories
Supplier Services Department
P.O. Box 5800 MS 0154
Albuquerque, NM 87185-0154

Location
Tech Area NA
Building NA Room NA

Sample No. - Fraction	ER Sample ID or Sample Location Detail	Beginning Depth in Ft.	ER Site No.	Date/Time Collected	Reference LOV (available at SMO): Sample Matrix	Container: Type	Container: Volume	Preservative	Sample Collection Method	Sample Type	Parameter & Method Requested: Gamma Spec	Lab Sample ID
279061-03	CY65E-GR-005-0-SS	0	65E	6/11/96 1020	S	P	500 ml	none	G	SA	X	
279115-03	CY65E-GR-007-0-SS	0		6/12/96 1290						SA	X	
279117-03	CY65E-GR-010-0-SS	0		6/12/96 0700						SA	X	
279121-03	CY65E-GR-012-0-SS	0		6/12/96 0730						SA	X	
279124-03	CY65E-GR-013-0-SS	0		6/11/96 1220						SA	X	

RMMA ☒ Yes ☐ No Ref. No. —

Sample Disposal ☐ Return to Client ☐ Disposal by lab

Turnaround Time ☒ Normal ☐ Rush Required Report Date —

Sample Tracking
Date Entered (mm/dd/yy) 6/13/96
Entered by: [illegible]
QC Info.

Special Instructions/QC Requirements
For rpt to C. Brown
25A-2617 to release
to TERRA LAB

Abnormal Conditions on Receipt

Sample Team Members	Name	Signature	Init	Company/Organization/Phone
	Kel Nagel	[signature]	KN	IT/7584
	[illegible]	[signature]	[illegible]	IT/7585

1. Relinquished by	[signature]	Org. IT/7584	Date 6/13/96	Time 1025	4. Relinquished by		Org.		Date		Time
1. Received by	[signature]	Org. SNL 7513	Date 6/13/96	Time 1025	4. Received by		Org.		Date		Time
2. Relinquished by	[signature]	Org. 7513	Date 6/13/96	Time 1115	5. Relinquished by		Org.		Date		Time
2. Received by	[signature]	Org. SNL 7513	Date 6/13/96	Time 1115	5. Received by		Org.		Date		Time
3. Relinquished by	[signature]	Org. SNL 7513	Date 6/13/96	Time 1415	6. Relinquished by		Org.		Date		Time
3. Received by	[signature]	Org. SNL 7513	Date 6/13/96	Time 1415	6. Received by		Org.		Date		Time

WHITE - To Accompany Samples, Laboratory Copy BLUE- To Accompany Samples, Return to SMO YELLOW- SMO Suspense Copy PINK- Field Copy

CR/1333/65E/DAT

SMO ANALYTICAL DATA ROUTING FORM

Project Name: CHLYDNS TEST AREA Case Number: 3621.400

SNL Task Leader: C. LOJEK Org/Mail Stop: 7585/1148

SMO Project Coordinator: LYDIA Sample Ship Date: 6/13/96

ARCOC	Lab	Lab ID
0524D	M713	600911

Date Results Received:

Preliminary: _____ Final: 6/18/96

Corrections Requested From Laboratory: _____ Requestor: _____

Date Corrections Received: _____

Date Assigned to SMO Reviewer: _____ Reviewer: _____

Date Review Complete: _____ Signature: _____

Date of Preliminary Notification: _____ Person Notified: _____

Date of Final Transmittal: 6/24/96 Transmitted To: LOJEK

Transmitted By: Cfj Filed In Record Center: Cfj

Comments: _____

COC 05240

Sandia National Laboratories
Radiation Protection Sample Diagnostics Program [881 Laboratory]
6-14-96 3:53:06 AM

Analyzed by: 6/14/96 Reviewed by: S.B. Ebara 6/17/96

Customer : C.LOJEK/E.RANKIN (7585/SMO)
Customer Sample ID : 029906-03
Lab Sample ID : 60091101

CY65E-9R-005-05

Sample Description : MARINELLI SOLID SAMPLE
Sample Quantity : 932.000 gram
Sample Date/Time : 6-11-96 10:20:00 AM
Acquire Start Date/Time : 6-14-96 2:10:20 AM
Detector Name : LAB01
Elapsed Live/Real Time : 6000 / 6003 seconds

Comments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	Not Detected	---	1.22E+00
TH-234	1.13E+00	3.66E-01	4.19E-01
RA-226	1.49E+00	5.78E-01	4.40E-01
PB-214	6.17E-01	1.29E-01	4.24E-02
BI-214	Not Detected	---	4.94E-02
TH-232	7.90E-01	1.29E+00	1.39E-01
)-228	7.68E-01	2.17E-01	1.50E-01
AC-228	8.42E-01	2.47E-01	9.57E-02
TH-228	8.23E-01	9.60E-01	4.48E-01
RA-224	8.20E-01	3.17E-01	5.11E-02
PB-212	7.87E-01	1.45E-01	3.54E-02
BI-212	6.83E-01	2.69E-01	2.62E-01
TL-208	7.43E-01	2.61E-01	6.73E-02
U-235	Not Detected	---	1.71E-01
TH-231	Not Detected	---	1.72E+00
PA-231	Not Detected	---	1.24E+00
TH-227	Not Detected	---	2.98E-01
RA-223	Not Detected	---	1.38E-01
RN-219	Not Detected	---	3.41E-01
PB-211	Not Detected	---	7.60E-01
TL-207	Not Detected	---	1.29E+01
AM-241	Not Detected	---	1.61E-01
PU-239	Not Detected	---	3.14E+02
NP-237	Not Detected	---	2.46E-01
PA-233	Not Detected	---	5.11E-02
TH-229	Not Detected	---	1.91E-01

[Summary Report] - Sample ID: : 60091101

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
AG-110m	Not Detected	---------	3.51E-02
BA-133	Not Detected	---------	3.76E-02
BE-7	Not Detected	---------	2.29E-01
CD-109	Not Detected	---------	5.82E-01
CD-115	Not Detected	---------	1.38E-01
CE-139	Not Detected	---------	2.41E-02
CE-141	Not Detected	---------	4.05E-02
CE-144	Not Detected	---------	1.71E-01
CO-56	Not Detected	---------	3.52E-02
CO-57	Not Detected	---------	2.19E-02
CO-58	Not Detected	---------	3.12E-02
CO-60	Not Detected	---------	3.53E-02
CR-51	Not Detected	---------	2.05E-01
CS-134	Not Detected	---------	4.04E-02
CS-137	6.88E-02	2.68E-02	2.45E-02
EU-152	Not Detected	---------	2.37E-01
EU-154	Not Detected	---------	1.77E-01
EU-155	Not Detected	---------	9.45E-02
FE-59	Not Detected	---------	7.42E-02
GD-153	Not Detected	---------	7.41E-02
HG-203	Not Detected	---------	2.73E-02
I-131	Not Detected	---------	3.17E-02
IR-192	Not Detected	---------	2.46E-02
K-40	1.84E+01	2.75E+00	2.92E-01
MN-54	Not Detected	---------	3.39E-02
MO-99	Not Detected	---------	4.75E-01
NA-22	Not Detected	---------	4.22E-02
NA-24	Not Detected	---------	6.31E-01
NB-95	Not Detected	---------	1.88E-01
ND-147	Not Detected	---------	2.13E-01
NI-57	Not Detected	---------	1.59E-01
RU-103	Not Detected	---------	2.68E-02
RU-106	Not Detected	---------	2.73E-01
SB-122	Not Detected	---------	7.34E-02
SB-124	Not Detected	---------	2.90E-02
SB-125	Not Detected	---------	7.44E-02
SR-85	Not Detected	---------	3.53E-02
TA-182	Not Detected	---------	1.54E-01
TA-183	Not Detected	---------	1.97E-01
TC-99m	Not Detected	---------	3.30E+01
TL-201	Not Detected	---------	1.31E-01
XE-133	Not Detected	---------	1.75E-01
Y-88	Not Detected	---------	2.61E-02
ZN-65	Not Detected	---------	1.03E-01
ZR-95	Not Detected	---------	5.84E-02

Sandia National Laboratories
Radiation Protection Sample Diagnostics Program [881 Laboratory]
6-14-96 5:38:14 AM

Analyzed by: 6/14/96 Reviewed by: S.B. Ebara 6/17/96

Customer : C.LOJEK/E.RANKIN (7585/SMO)
Customer Sample ID : 029915-03
Lab Sample ID : 60091102 LY65E-9R-009-0-SS

Sample Description : MARINELLI SOLID SAMPLE
Sample Quantity : 704.000 gram
Sample Date/Time : 6-12-96 12:40:00 PM
Acquire Start Date/Time : 6-14-96 3:55:28 AM
Detector Name : LAB01
Elapsed Live/Real Time : 6000 / 6003 seconds

Comments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	1.02E+00	1.33E+00	1.16E+00
TH-234	1.42E+00	4.72E-01	5.23E-01
RA-226	1.95E+00	1.01E+00	7.20E-01
PB-214	9.76E-01	1.81E-01	5.64E-02
BI-214	8.73E-01	1.88E-01	5.80E-02
TH-232	9.93E-01	4.73E-01	1.43E-01
)-228	1.05E+00	4.97E-01	1.94E-01
-228	9.27E-01	2.45E-01	9.82E-02
TH-228	7.07E-01	3.95E-01	5.03E-01
RA-224	9.31E-01	3.21E-01	9.46E-02
PB-212	9.95E-01	1.77E-01	4.38E-02
BI-212	1.29E+00	4.42E-01	3.40E-01
TL-208	9.17E-01	2.57E-01	8.50E-02
U-235	Not Detected	---	2.13E-01
TH-231	Not Detected	---	2.17E+00
PA-231	Not Detected	---	1.57E+00
TH-227	Not Detected	---	3.83E-01
RA-223	Not Detected	---	1.61E-01
RN-219	Not Detected	---	4.67E-01
PB-211	Not Detected	---	1.07E+00
TL-207	Not Detected	---	1.68E+01
AM-241	Not Detected	---	2.07E-01
PU-239	Not Detected	---	3.91E+02
NP-237	Not Detected	---	3.10E-01
PA-233	Not Detected	---	6.39E-02
TH-229	Not Detected	---	2.43E-01

[Summary Report] - Sample ID: : 60091102

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
AG-110m	Not Detected	---------	8.27E-02
BA-133	Not Detected	---------	5.05E-02
BE-7	Not Detected	---------	3.22E-01
CD-109	Not Detected	---------	7.94E-01
CD-115	Not Detected	---------	1.29E-01
CE-139	Not Detected	---------	3.01E-02
CE-141	Not Detected	---------	5.09E-02
CE-144	Not Detected	---------	2.04E-01
CO-56	Not Detected	---------	2.66E-02
CO-57	Not Detected	---------	2.69E-02
CO-58	Not Detected	---------	3.73E-02
CO-60	Not Detected	---------	4.26E-02
CR-51	Not Detected	---------	2.67E-01
CS-134	Not Detected	---------	5.09E-02
CS-137	7.13E-01	1.22E-01	3.17E-02
EU-152	Not Detected	---------	2.97E-01
EU-154	Not Detected	---------	2.16E-01
EU-155	Not Detected	---------	1.18E-01
FE-59	Not Detected	---------	8.57E-02
GD-153	Not Detected	---------	9.01E-02
HG-203	Not Detected	---------	3.44E-02
I-131	Not Detected	---------	3.70E-02
IR-192	Not Detected	---------	3.09E-02
K-40	1.61E+01	2.49E+00	3.83E-01
MN-54	Not Detected	---------	4.39E-02
MO-99	Not Detected	---------	4.65E-01
NA-22	Not Detected	---------	4.75E-02
NA-24	Not Detected	---------	2.52E-01
NB-95	Not Detected	---------	2.00E-01
ND-147	Not Detected	---------	2.55E-01
NI-57	Not Detected	---------	1.22E-01
RU-103	Not Detected	---------	3.40E-02
RU-106	Not Detected	---------	3.38E-01
SB-122	Not Detected	---------	7.28E-02
SB-124	Not Detected	---------	3.44E-02
SB-125	Not Detected	---------	1.01E-01
SR-85	Not Detected	---------	4.47E-02
TA-182	Not Detected	---------	1.95E-01
TA-183	Not Detected	---------	2.21E-01
TC-99m	Not Detected	---------	2.42E+00
TL-201	Not Detected	---------	1.30E-01
XE-133	Not Detected	---------	1.62E-01
Y-88	Not Detected	---------	3.61E-02
ZN-65	Not Detected	---------	1.30E-01
ZR-95	Not Detected	---------	7.03E-02

Sandia National Laboratories
Radiation Protection Sample Diagnostics Program [881 Laboratory]
6-14-96 7:23:23 AM

Analyzed by: 6/14/96 Reviewed by: S.B. Ebata 6/17/96

Customer : C.LOJEK/E.RANKIN (7585/SMO)
Customer Sample ID : 029917-03
Lab Sample ID : 60091103

6765E-9R-010-055

Sample Description : MARINELLI SOLID SAMPLE
Sample Quantity : 716.000 gram
Sample Date/Time : 6-12-96 9:00:00 AM
Acquire Start Date/Time : 6-14-96 5:40:40 AM
Detector Name : LAB01
Elapsed Live/Real Time : 6000 / 6002 seconds

Comments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	1.43E+00	1.08E+00	1.31E+00
TH-234	1.10E+00	3.61E-01	4.78E-01
RA-226	1.86E+00	8.73E-01	6.14E-01
PB-214	8.12E-01	1.56E-01	4.97E-02
BI-214	7.15E-01	1.36E-01	4.86E-02
TH-232	7.28E-01	3.62E-01	1.58E-01
PB-228	6.02E-01	2.09E-01	1.53E-01
AC-228	6.78E-01	2.22E-01	1.00E-01
TH-228	7.39E-01	4.19E-01	5.03E-01
RA-224	7.63E-01	3.07E-01	7.82E-02
PB-212	7.40E-01	1.41E-01	4.06E-02
BI-212	8.20E-01	3.59E-01	3.36E-01
TL-208	7.15E-01	4.30E-01	7.49E-02
U-235	Not Detected	---	1.94E-01
TH-231	Not Detected	---	1.91E+00
PA-231	Not Detected	---	1.41E+00
TH-227	Not Detected	---	3.34E-01
RA-223	Not Detected	---	1.41E-01
RN-219	Not Detected	---	3.84E-01
PB-211	Not Detected	---	8.83E-01
TL-207	Not Detected	---	1.50E+01
AM-241	Not Detected	---	1.83E-01
PU-239	Not Detected	---	3.57E+02
NP-237	Not Detected	---	2.68E-01
PA-233	Not Detected	---	6.12E-02
TH-229	Not Detected	---	2.10E-01

[Summary Report] - Sample ID: : 60091103

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
AG-110m	Not Detected	---	6.71E-02
BA-133	Not Detected	---	4.39E-02
BE-7	Not Detected	---	2.96E-01
CD-109	Not Detected	---	6.33E-01
CD-115	Not Detected	---	1.22E-01
CE-139	Not Detected	---	2.67E-02
CE-141	Not Detected	---	4.52E-02
CE-144	Not Detected	---	1.88E-01
CO-56	Not Detected	---	2.81E-02
CO-57	Not Detected	---	2.42E-02
CO-58	Not Detected	---	3.36E-02
CO-60	Not Detected	---	3.55E-02
CR-51	Not Detected	---	2.25E-01
CS-134	Not Detected	---	4.38E-02
CS-137	4.55E-01	8.03E-02	2.57E-02
EU-152	Not Detected	---	2.63E-01
EU-154	Not Detected	---	1.85E-01
EU-155	Not Detected	---	1.08E-01
FE-59	Not Detected	---	7.41E-02
GD-153	Not Detected	---	8.09E-02
HG-203	Not Detected	---	3.08E-02
I-131	Not Detected	---	3.35E-02
IR-192	Not Detected	---	2.75E-02
K-40	1.12E+01	1.79E+00	3.52E-01
MN-54	Not Detected	---	3.78E-02
[illegible]O-99	Not Detected	---	4.04E-01
[illegible]-22	Not Detected	---	4.18E-02
NA-24	Not Detected	---	2.90E-01
NB-95	Not Detected	---	1.84E-01
ND-147	Not Detected	---	2.19E-01
NI-57	Not Detected	---	1.24E-01
RU-103	Not Detected	---	3.02E-02
RU-106	Not Detected	---	2.88E-01
SB-122	Not Detected	---	6.80E-02
SB-124	Not Detected	---	2.97E-02
SB-125	Not Detected	---	9.05E-02
SR-85	Not Detected	---	3.72E-02
TA-182	Not Detected	---	1.79E-01
TA-183	Not Detected	---	2.01E-01
TC-99m	Not Detected	---	4.16E+00
TL-201	Not Detected	---	1.23E-01
XE-133	Not Detected	---	1.54E-01
Y-88	Not Detected	---	2.78E-02
ZN-65	~~7.72E-03~~	~~7.54E-03~~	4.81E-02 Not detected 6/14/96
ZR-95	Not Detected	---	6.17E-02

Sandia National Laboratories
Radiation Protection Sample Diagnostics Program [881 Laboratory]
6-14-96 11:39:16 AM

Analyzed by: 6/14/96 Reviewed by: S.B. Ebara 6/17/96

Customer : C.LOJEK/E.RANKIN (7585/SMO)
Customer Sample ID : 029921-03
Lab Sample ID : 60091104 CY65E-9R-012-0-SS

Sample Description : MARINELLI SOLID SAMPLE
Sample Quantity : 743.000 gram
Sample Date/Time : 6-12-96 9:30:00 AM
Acquire Start Date/Time : 6-14-96 9:56:29 AM
Detector Name : LAB01
Elapsed Live/Real Time : 6000 / 6002 seconds

Comments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	5.88E-01	7.22E-01	1.10E+00
TH-234	1.05E+00	3.45E-01	4.85E-01
RA-226	Not Detected	---	5.64E-01
PB-214	8.77E-01	1.67E-01	4.77E-02
BI-214	8.34E-01	1.72E-01	5.01E-02
TH-232	8.63E-01	4.18E-01	1.59E-01
RA-228	9.30E-01	3.43E-01	1.69E-01
AC-228	9.34E-01	2.44E-01	9.73E-02
TH-228	8.06E-01	4.22E-01	5.26E-01
RA-224	9.21E-01	3.28E-01	7.39E-02
PB-212	8.98E-01	1.73E-01	4.05E-02
BI-212	9.83E-01	4.90E-01	3.66E-01
TL-208	8.24E-01	1.83E-01	7.43E-02
U-235	Not Detected	---	1.96E-01
TH-231	Not Detected	---	1.96E+00
PA-231	Not Detected	---	1.40E+00
TH-227	Not Detected	---	3.58E-01
RA-223	Not Detected	---	1.51E-01
RN-219	Not Detected	---	4.04E-01
PB-211	Not Detected	---	8.84E-01
TL-207	Not Detected	---	1.48E+01
AM-241	Not Detected	---	1.85E-01
PU-239	Not Detected	---	3.61E+02
NP-237	Not Detected	---	2.80E-01
PA-233	Not Detected	---	5.92E-02
TH-229	Not Detected	---	2.14E-01

[Summary Report] - Sample ID: : 60091104

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
AG-110m	Not Detected	---------	3.79E-02
BA-133	Not Detected	---------	4.50E-02
BE-7	Not Detected	---------	2.66E-01
CD-109	Not Detected	---------	6.22E-01
CD-115	Not Detected	---------	1.33E-01
CE-139	Not Detected	---------	2.77E-02
CE-141	Not Detected	---------	4.57E-02
CE-144	Not Detected	---------	1.95E-01
CO-56	Not Detected	---------	2.85E-02
CO-57	Not Detected	---------	2.51E-02
CO-58	Not Detected	---------	3.55E-02
CO-60	Not Detected	---------	3.89E-02
CR-51	Not Detected	---------	2.37E-01
CS-134	Not Detected	---------	4.85E-02
CS-137	6.23E-02	3.22E-02	2.48E-02
EU-152	Not Detected	---------	2.63E-01
EU-154	Not Detected	---------	1.93E-01
EU-155	Not Detected	---------	1.08E-01
FE-59	Not Detected	---------	8.17E-02
GD-153	Not Detected	---------	8.40E-02
HG-203	Not Detected	---------	3.07E-02
I-131	Not Detected	---------	3.33E-02
IR-192	Not Detected	---------	2.79E-02
K-40	1.45E+01	2.28E+00	3.83E-01
MN-54	Not Detected	---------	3.84E-02
MO-99	Not Detected	---------	4.57E-01
[illegible]-22	Not Detected	---------	4.74E-02
[illegible]A-24	Not Detected	---------	3.24E-01
NB-95	Not Detected	---------	2.02E-01
ND-147	Not Detected	---------	2.22E-01
NI-57	Not Detected	---------	1.43E-01
RU-103	Not Detected	---------	2.99E-02
RU-106	Not Detected	---------	2.99E-01
SB-122	Not Detected	---------	7.37E-02
SB-124	Not Detected	---------	3.28E-02
SB-125	Not Detected	---------	8.72E-02
SR-85	Not Detected	---------	4.09E-02
TA-182	Not Detected	---------	1.84E-01
TA-183	Not Detected	---------	2.08E-01
TC-99m	Not Detected	---------	6.20E+00
TL-201	Not Detected	---------	1.29E-01
XE-133	Not Detected	---------	1.64E-01
Y-88	Not Detected	---------	2.97E-02
ZN-65	Not Detected	---------	1.23E-01
ZR-95	Not Detected	---------	6.83E-02

Sandia National Laboratories
Radiation Protection Sample Diagnostics Program [881 Laboratory]
6-14-96 1:24:31 PM

Analyzed by: 6/14/96 Reviewed by: S.B. Ebara 6/17/96

Customer : C.LOJEK/E.RANKIN (7585/SMO)
Customer Sample ID : 029924-03
Lab Sample ID : 60091105 CY05E-QR-013-0-55

Sample Description : MARINELLI SOLID SAMPLE
Sample Quantity : 654.000 gram
Sample Date/Time : 6-12-96 12:20:00 PM
Acquire Start Date/Time : 6-14-96 11:41:42 AM
Detector Name : LAB01
Elapsed Live/Real Time : 6000 / 6002 seconds

Comments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	Not Detected	---	1.62E+00
TH-234	1.10E+00	3.68E-01	5.15E-01
RA-226	2.05E+00	8.40E-01	6.48E-01
PB-214	8.63E-01	1.99E-01	5.30E-02
BI-214	8.14E-01	6.64E-01	5.68E-02
TH-232	8.98E-01	8.18E-01	1.61E-01
PB-228	9.42E-01	2.63E-01	1.84E-01
AC-228	8.38E-01	7.26E-01	1.17E-01
TH-228	7.51E-01	3.86E-01	5.25E-01
RA-224	8.41E-01	3.25E-01	8.27E-02
PB-212	9.29E-01	1.65E-01	4.42E-02
BI-212	1.09E+00	4.85E-01	3.70E-01
TL-208	8.89E-01	3.81E-01	8.29E-02
U-235	~~1.45E-01~~	~~1.47E-01~~	2.15E-01 not detected 6/14/96
TH-231	Not Detected	---	2.14E+00
PA-231	Not Detected	---	1.58E+00
TH-227	Not Detected	---	3.91E-01
RA-223	Not Detected	---	1.64E-01
RN-219	Not Detected	---	4.49E-01
PB-211	Not Detected	---	1.04E+00
TL-207	Not Detected	---	1.61E+01
AM-241	Not Detected	---	1.99E-01
PU-239	Not Detected	---	3.95E+02
NP-237	Not Detected	---	3.11E-01
PA-233	Not Detected	---	6.59E-02
TH-229	Not Detected	---	2.35E-01

[Summary Report] - Sample ID: : 60091105

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
AG-110m	Not Detected	---------	6.99E-02
BA-133	Not Detected	---------	4.76E-02
BE-7	Not Detected	---------	3.09E-01
CD-109	Not Detected	---------	8.17E-01
CD-115	Not Detected	---------	1.39E-01
CE-139	Not Detected	---------	2.93E-02
CE-141	Not Detected	---------	5.06E-02
CE-144	Not Detected	---------	2.10E-01
CO-56	Not Detected	---------	2.97E-02
CO-57	Not Detected	---------	2.66E-02
CO-58	Not Detected	---------	3.88E-02
CO-60	Not Detected	---------	4.68E-02
CR-51	Not Detected	---------	2.70E-01
CS-134	Not Detected	---------	5.09E-02
CS-137	4.18E-01	2.60E-01	3.32E-02
EU-152	Not Detected	---------	3.02E-01
EU-154	Not Detected	---------	2.07E-01
EU-155	Not Detected	---------	1.18E-01
FE-59	Not Detected	---------	8.51E-02
GD-153	Not Detected	---------	8.98E-02
HG-203	Not Detected	---------	3.40E-02
I-131	Not Detected	---------	3.58E-02
IR-192	Not Detected	---------	3.13E-02
K-40	1.41E+01	2.23E+00	4.45E-01
MN-54	Not Detected	---------	4.32E-02
MO-99	Not Detected	---------	5.19E-01
[illegible]-22	Not Detected	---------	4.84E-02
NA-24	Not Detected	---------	3.52E-01
NB-95	Not Detected	---------	2.16E-01
ND-147	Not Detected	---------	2.59E-01
NI-57	Not Detected	---------	1.43E-01
RU-103	Not Detected	---------	3.52E-02
RU-106	Not Detected	---------	3.51E-01
SB-122	Not Detected	---------	7.82E-02
SB-124	Not Detected	---------	3.57E-02
SB-125	Not Detected	---------	1.00E-01
SR-85	Not Detected	---------	4.52E-02
TA-182	Not Detected	---------	2.01E-01
TA-183	Not Detected	---------	2.22E-01
TC-99m	Not Detected	---------	6.04E+00
TL-201	Not Detected	---------	1.35E-01
XE-133	Not Detected	---------	1.75E-01
Y-88	Not Detected	---------	3.89E-02
ZN-65	Not Detected	---------	1.32E-01
ZR-95	Not Detected	---------	7.01E-02

ER/1333/65E/DAT

SMO ANALYTICAL DATA ROUTING FORM

Project Name: GNYDAS TEST AREA Case Number: 3621.400

SNL Task Leader: LOJEK Org/Mail Stop: MS85/1142

SMO Project Coordinator: LYDN Sample Ship Date: 6/13/96

ARCOC	Lab	Lab ID
05242	7713	600910

Date Results Received:

Preliminary: _____ Final: 6/18/96

Corrections Requested From Laboratory: _____ Requestor: _____

Date Corrections Received: _____

Date Assigned to SMO Reviewer: _____ Reviewer: _____

Date Review Complete: _____ Signature: _____

Date of Preliminary Notification: _____ Person Notified: _____

Date of Final Transmittal: 6/27/96 Transmitted To: LOJEK

Transmitted By: glj Filed In Record Center: glj

Comments: _____

ANALYSIS REQUEST AND CHAIN OF CUSTODY

SF 2001-COC (6-95)

Batch No. 610910

AR/COC- 05242

Dept. No./Mail Stop:
Project/Task Manager:
Project Name:
Record Center Code:
Logbook Ref No:
Service Order No.:

Date Samples Shipped: 6-13-96
Carrier/Waybill No.: HC
Lab Contact:
Lab Destination:
SMO Contact/Phone: Alan Ly
Send Report to SMO Cathy Bo

Contract No.: NA
Case No.:
SMO Authorization:
Bill to: Sandia National Laboratories
Supplier Services Department
P.O. Box 5800 MS 0154
Albuquerque, NM 87185-0154

Parameter & Method Requested

Gamma (GEA)

Location

Tech Area
Building
Room 114

Sample No. - Fraction	ER Sample ID or Sample Location Detail	Beginning Depth in Ft.	ER Site No.	Date/Time Collected	Reference LOV (available at SMO) Sample Matrix	Container Type	Container Volume	Preservative	Sample Collection Method	Sample Type	Gamma (GEA)	Lab Sample ID
0 2 9 7 3 1 - 0 1	SYASEA01-001-0-SS	0	SSE	6/6 1015	S	J	500 ml	none	G	SA	X	
0 2 9 7 3 1 - 0 2	SYASEA01-003-1.5-S	1.5	SSE	6/6 1125	S	J	500 ml	none	G	SA	X	
0 2 9 7 3 1 - 0 3	SYASEA01-004-1.5	1.5	SSE	6/6 1130	S	J	500 ml	none	G	SA	X	

RMMA ☒ Yes ☐ No Ref. No.

Sample Disposal ☐ Return to Client ☒ Disposal by lab

Turnaround Time ☒ Normal ☐ Rush Required Report Date

Sample Tracking
Date Entered (mm/dd/yy) 6/26/96
Entered by:
QC Initial

Special Instructions/QC Requirements

Abnormal Conditions on Receipt

Sample Team Members	Name	Signature	Init	Company/Organization/Phone

1. Relinquished by		Org.		Date	6/13/96	Time	1025	4. Relinquished by	Org.	Date	Time
1. Received by		Org.		Date	6/13/96	Time	1025	4. Received by	Org.	Date	Time
2. Relinquished by		Org.		Date	6/13/96	Time	1111	5. Relinquished by	Org.	Date	Time
2. Received by		Org.		Date	6/13/96	Time	1111	5. Received by	Org.	Date	Time
3. Relinquished by		Org.		Date	6/18/96	Time	1415	6. Relinquished by	Org.	Date	Time
3. Received by		Org.		Date	6/18/96	Time	1415	6. Received by	Org.	Date	Time

WHITE - To Accompany Samples, Laboratory Copy BLUE- To Accompany Samples, Return to SMO YELLOW- SMO Suspense Copy PINK- Field Copy

Sar. . National Laboratories
Radiation Protection Sample Diagnostics

Sample Analysis Requ. Form
Page 1 of 1

To be completed by Customer

Shaded areas are for RPSD use only

Customer: Carole Cajek
Organization: 7585 MS 1148
Project Location: Canyons Test Area
Phone: 50867
Date Results Needed: 6-20-96
Suspect Isotopes: none
Other Information: C.O.C # 05242

Hazards/Special Instructions:
RMMA - non rush

Batch Log Number: 600910
Logged By: JM

Analysis Type:
- ☒ Gamma Spec
- ☐ H-3
- ☐ Alpha/Beta
- ☐ Alpha Spec
- ☐ Total U
- ☐ Other

LIMS Login
Results Faxed
Sample Disposal

Customer Sample ID	Sample Type	Date/Time Collected	Sample Volume	Requested Analysis	RPSD Sample ID	Rad Scan CPM	Sample Weight	Remarks AP Coc	Remarks Sample No.
029928-03	Soil	6-12-96 1015	500ml	Gamma Spec	01	<300	668g	05242	CY65EM1-001-0.5S
029930-03	Soil	6-12-96 1125	500ml	Gamma Spec	02	<300	617g	"	CY65EM1-003-1.5-S
029931-03	"	" 1130	"	"	03	<300	662g	"	CY65EM1-004-1.5-S
LCS	—	1NOV96	—	γ Spec	04	NA	NA		

Relinquished by: [signature] Date 6/13/96 Time 11:11 Received by: [signature] Date 6/13/96 Time 11:11
Relinquished by: [signature] Date 6/18/96 Time 1415 Received by: [signature] Date 6/18/96 Time 1415
Relinquished by: _____ Date _____ Time _____ Received by: _____ Date _____ Time _____
Relinquished by: _____ Date _____ Time _____ Received by: _____ Date _____ Time _____

Sandia National Laboratories
Radiation Protection Sample Diagnostics Program [881 Laboratory]
6-13-96 10:26:23 PM

Analyzed by: [signature] 6/14/96 Reviewed by: S.B. Ebara 6/17/96

Customer : C.LOJEK/E.RANKIN (7585/SMO)
Customer Sample ID : 029928-03
Lab Sample ID : 60091001 C165EM1-001-0-SS

Sample Description : MARINELLI SOLID SAMPLE
Sample Quantity : 668.000 gram
Sample Date/Time : 6-12-96 10:15:00 AM
Acquire Start Date/Time : 6-13-96 8:37:46 PM
Detector Name : LAB01
Elapsed Live/Real Time : 6000 / 6002 seconds

Comments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	Not Detected	---	1.47E+00
TH-234	9.60E-01	3.47E-01	4.72E-01
RA-226	1.60E+00	6.17E-01	6.35E-01
PB-214	7.35E-01	1.56E-01	5.32E-02
BI-214	7.87E-01	1.53E-01	5.43E-02
TH-232	7.74E-01	3.85E-01	1.77E-01
-228	8.30E-01	2.63E-01	1.53E-01
-228	6.95E-01	2.13E-01	1.09E-01
TH-228	7.02E-01	5.52E-01	5.25E-01
RA-224	7.27E-01	2.92E-01	7.13E-02
PB-212	7.94E-01	1.43E-01	4.08E-02
BI-212	9.77E-01	3.77E-01	3.46E-01
TL-208	7.38E-01	1.69E-01	8.32E-02
U-235	~~1.54E-01~~	~~1.43E-01~~	2.09E-01 Not detected 6/14/96
TH-231	Not Detected	---	2.03E+00
PA-231	Not Detected	---	1.55E+00
TH-227	Not Detected	---	3.63E-01
RA-223	Not Detected	---	1.50E-01
RN-219	Not Detected	---	4.58E-01
PB-211	Not Detected	---	1.02E+00
TL-207	Not Detected	---	1.49E+01
AM-241	Not Detected	---	1.94E-01
PU-239	Not Detected	---	3.81E+02
NP-237	Not Detected	---	2.86E-01
PA-233	Not Detected	---	6.36E-02
TH-229	Not Detected	---	2.25E-01

[Summary Report] - Sample ID: : 60091001

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
AG-110m	Not Detected	---------	9.78E-02
BA-133	Not Detected	---------	4.72E-02
BE-7	Not Detected	---------	3.02E-01
CD-109	Not Detected	---------	7.75E-01
CD-115	Not Detected	---------	1.16E-01
CE-139	Not Detected	---------	2.87E-02
CE-141	Not Detected	---------	4.69E-02
CE-144	Not Detected	---------	2.00E-01
CO-56	Not Detected	---------	2.83E-02
CO-57	Not Detected	---------	2.51E-02
CO-58	Not Detected	---------	3.62E-02
CO-60	Not Detected	---------	4.38E-02
CR-51	Not Detected	---------	2.65E-01
CS-134	Not Detected	---------	5.07E-02
CS-137	1.03E+00	1.67E-01	3.05E-02
EU-152	Not Detected	---------	2.83E-01
EU-154	Not Detected	---------	2.10E-01
EU-155	Not Detected	---------	1.12E-01
FE-59	Not Detected	---------	8.37E-02
GD-153	Not Detected	---------	8.57E-02
HG-203	Not Detected	---------	3.36E-02
I-131	Not Detected	---------	3.51E-02
IR-192	Not Detected	---------	3.16E-02
K-40	1.22E+01	2.09E+00	3.93E-01
MN-54	Not Detected	---------	3.97E-02
MO-99	Not Detected	---------	4.37E-01
-22	Not Detected	---------	4.48E-02
-24	Not Detected	---------	1.73E-01
NB-95	Not Detected	---------	1.85E-01
ND-147	Not Detected	---------	2.49E-01
NI-57	Not Detected	---------	1.08E-01
RU-103	Not Detected	---------	3.47E-02
RU-106	Not Detected	---------	3.25E-01
SB-122	Not Detected	---------	6.73E-02
SB-124	Not Detected	---------	3.33E-02
SB-125	Not Detected	---------	1.01E-01
SR-85	Not Detected	---------	4.23E-02
TA-182	Not Detected	---------	1.74E-01
TA-183	Not Detected	---------	2.01E-01
TC-99m	Not Detected	---------	1.29E+00
TL-201	Not Detected	---------	1.14E-01
XE-133	Not Detected	---------	1.40E-01
Y-88	Not Detected	---------	2.87E-02
ZN-65	Not Detected	---------	1.14E-01
ZR-95	Not Detected	---------	6.72E-02

Sandia National Laboratories
Radiation Protection Sample Diagnostics Program [881 Laboratory]
6-14-96 12:17:51 AM

Analyzed by: 6/14/96 Reviewed by: S.B. Ebara 6/17/96

Customer : C.LOJEK/E.RANKIN (7585/SMO)
Customer Sample ID : 029930-03
Lab Sample ID : 60091002 CY65EM1-003-1.5-S

Sample Description : MARINELLI SOLID SAMPLE
Sample Quantity : 617.000 gram
Sample Date/Time : 6-12-96 11:25:00 AM
Acquire Start Date/Time : 6-13-96 10:29:14 PM
Detector Name : LAB01
Elapsed Live/Real Time : 6000 / 6002 seconds

Comments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	Not Detected	---------	1.55E+00
TH-234	1.09E+00	3.69E-01	5.32E-01
RA-226	2.19E+00	9.79E-01	6.22E-01
PB-214	8.25E-01	1.94E-01	5.36E-02
BI-214	7.42E-01	1.58E-01	6.01E-02
TH-232	7.80E-01	3.93E-01	1.88E-01
\-228	7.70E-01	2.31E-01	1.87E-01
-228	8.17E-01	1.97E-01	1.00E-01
TH-228	4.44E-01	2.88E-01	5.16E-01
RA-224	7.87E-01	3.67E-01	8.84E-02
PB-212	8.03E-01	1.44E-01	4.47E-02
BI-212	1.24E+00	6.82E-01	3.63E-01
TL-208	8.02E-01	2.24E-01	8.67E-02
U-235	Not Detected	---------	2.08E-01
TH-231	Not Detected	---------	2.14E+00
PA-231	Not Detected	---------	1.50E+00
TH-227	Not Detected	---------	3.72E-01
RA-223	Not Detected	---------	1.57E-01
RN-219	Not Detected	---------	4.60E-01
PB-211	Not Detected	---------	1.02E+00
TL-207	Not Detected	---------	1.64E+01
AM-241	Not Detected	---------	2.03E-01
PU-239	Not Detected	---------	3.83E+02
NP-237	Not Detected	---------	3.03E-01
PA-233	Not Detected	---------	6.42E-02
TH-229	Not Detected	---------	2.33E-01

[Summary Report] - Sample ID: : 60091002

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
AG-110m	Not Detected	---	6.37E-02
BA-133	Not Detected	---	4.98E-02
BE-7	Not Detected	---	3.10E-01
CD-109	Not Detected	---	8.91E-01
CD-115	Not Detected	---	1.18E-01
CE-139	Not Detected	---	2.97E-02
CE-141	Not Detected	---	4.88E-02
CE-144	Not Detected	---	2.05E-01
CO-56	Not Detected	---	4.46E-02
CO-57	Not Detected	---	2.57E-02
CO-58	Not Detected	---	3.54E-02
CO-60	Not Detected	---	4.31E-02
CR-51	Not Detected	---	2.51E-01
CS-134	Not Detected	---	5.28E-02
CS-137	2.93E-01	1.74E-01	3.15E-02
EU-152	Not Detected	---	2.89E-01
EU-154	Not Detected	---	2.24E-01
EU-155	Not Detected	---	1.14E-01
FE-59	Not Detected	---	8.66E-02
GD-153	Not Detected	---	8.98E-02
HG-203	Not Detected	---	3.28E-02
I-131	Not Detected	---	3.47E-02
IR-192	Not Detected	---	3.13E-02
K-40	1.37E+01	2.30E+00	4.22E-01
MN-54	Not Detected	---	4.36E-02
MO-99	Not Detected	---	4.34E-01
-22	Not Detected	---	5.05E-02
-24	Not Detected	---	2.05E-01
NB-95	Not Detected	---	1.88E-01
ND-147	Not Detected	---	2.42E-01
NI-57	Not Detected	---	1.18E-01
RU-103	Not Detected	---	3.60E-02
RU-106	Not Detected	---	3.18E-01
SB-122	Not Detected	---	6.91E-02
SB-124	Not Detected	---	3.67E-02
SB-125	Not Detected	---	9.74E-02
SR-85	Not Detected	---	4.45E-02
TA-182	Not Detected	---	1.92E-01
TA-183	Not Detected	---	2.12E-01
TC-99m	Not Detected	---	1.46E+00
TL-201	Not Detected	---	1.20E-01
XE-133	Not Detected	---	1.48E-01
Y-88	Not Detected	---	3.27E-02
ZN-65	Not Detected	---	1.27E-01
ZR-95	Not Detected	---	6.94E-02

Sandia National Laboratories
Radiation Protection Sample Diagnostics Program [881 Laboratory]
6-14-96 2:07:51 AM

Analyzed by: 6/14/96 Reviewed by: S.B. Ebara 6/17/96

Customer : C.LOJEK/E.RANKIN (7585/SMO)
Customer Sample ID : 029931-03
Lab Sample ID : 60091003 CY65EM1-004-1.5-S

Sample Description : MARINELLI SOLID SAMPLE
Sample Quantity : 662.000 gram
Sample Date/Time : 6-12-96 11:30:00 AM
Acquire Start Date/Time : 6-14-96 12:20:44 AM
Detector Name : LAB01
Elapsed Live/Real Time : 6000 / 6002 seconds

Comments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	Not Detected	---	1.45E+00
TH-234	7.90E-01	3.93E-01	5.35E-01
RA-226	1.76E+00	8.32E-01	5.34E-01
PB-214	7.71E-01	1.22E-01	4.82E-02
BI-214	7.08E-01	1.20E-01	5.28E-02
TH-232	9.20E-01	4.45E-01	1.51E-01
-228	7.12E-01	2.29E-01	1.70E-01
-228	7.35E-01	1.86E-01	1.02E-01
TH-228	1.08E+00	1.29E+00	4.83E-01
RA-224	7.74E-01	3.27E-01	8.29E-02
PB-212	7.95E-01	1.41E-01	4.03E-02
BI-212	8.77E-01	1.58E+00	3.89E-01
TL-208	7.26E-01	1.56E-01	7.64E-02
U-235	Not Detected	---	2.01E-01
TH-231	Not Detected	---	1.97E+00
PA-231	Not Detected	---	1.43E+00
TH-227	Not Detected	---	3.51E-01
RA-223	Not Detected	---	1.49E-01
RN-219	Not Detected	---	3.77E-01
PB-211	Not Detected	---	8.81E-01
TL-207	Not Detected	---	1.44E+01
AM-241	Not Detected	---	1.82E-01
PU-239	Not Detected	---	3.66E+02
NP-237	Not Detected	---	2.89E-01
PA-233	Not Detected	---	5.62E-02
TH-229	Not Detected	---	2.17E-01

[Summary Report] - Sample ID: : 60091003

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
AG-110m	Not Detected	---------	4.10E-02
BA-133	Not Detected	---------	4.57E-02
BE-7	Not Detected	---------	2.64E-01
CD-109	Not Detected	---------	6.54E-01
CD-115	Not Detected	---------	1.18E-01
CE-139	Not Detected	---------	2.77E-02
CE-141	Not Detected	---------	4.64E-02
CE-144	Not Detected	---------	1.96E-01
CO-56	Not Detected	---------	3.99E-02
CO-57	Not Detected	---------	2.46E-02
CO-58	Not Detected	---------	3.60E-02
CO-60	Not Detected	---------	4.10E-02
CR-51	Not Detected	---------	2.46E-01
CS-134	Not Detected	---------	4.90E-02
CS-137	5.83E-02	2.56E-02	2.60E-02
EU-152	Not Detected	---------	2.83E-01
EU-154	Not Detected	---------	2.07E-01
EU-155	Not Detected	---------	1.08E-01
FE-59	Not Detected	---------	7.80E-02
GD-153	Not Detected	---------	8.25E-02
HG-203	Not Detected	---------	3.12E-02
I-131	Not Detected	---------	3.25E-02
IR-192	Not Detected	---------	2.73E-02
K-40	1.26E+01	2.10E+00	3.94E-01
MN-54	Not Detected	---------	3.96E-02
[illegible]-99	Not Detected	---------	4.48E-01
[illegible]-22	Not Detected	---------	4.75E-02
NA-24	Not Detected	---------	1.96E-01
NB-95	~~4.16E-02~~	~~3.33E-02~~	9.25E-02
ND-147	Not Detected	---------	2.38E-01
NI-57	Not Detected	---------	1.05E-01
RU-103	Not Detected	---------	3.16E-02
RU-106	Not Detected	---------	3.16E-01
SB-122	Not Detected	---------	6.61E-02
SB-124	Not Detected	---------	3.30E-02
SB-125	Not Detected	---------	8.78E-02
SR-85	Not Detected	---------	4.23E-02
TA-182	Not Detected	---------	1.78E-01
TA-183	Not Detected	---------	1.92E-01
TC-99m	Not Detected	---------	1.72E+00
TL-201	Not Detected	---------	1.15E-01
XE-133	Not Detected	---------	1.44E-01
Y-88	Not Detected	---------	3.23E-02
ZN-65	Not Detected	---------	1.18E-01
ZR-95	Not Detected	---------	7.30E-02

Not detected 6/14/96

ER/1333 65E/ ~~DAT~~

SMO ANALYTICAL DATA ROUTING FORM

Project Name: ~~CANYONS TEST AREA~~ Case Number: 3621.400

SNL Task Leader: C. LOJEK Org/Mail Stop: 7585/1148

SMO Project Coordinator: LYON Sample Ship Date: 6/13/96

ARCOC	Lab	Lab ID
D5245	7713	600908

Date Results Received:

Preliminary: _____ Final: 6/14/96

Corrections Requested From Laboratory: _____ Requestor: _____

Date Corrections Received: _____

Date Assigned to SMO Reviewer: _____ Reviewer: _____

Date Review Complete: _____ Signature: _____

Date of Preliminary Notification: _____ Person Notified: _____

Date of Final Transmittal: 6/20/96 Transmitted To: C. LOJEK

Transmitted By: _____ Filed In Record Center: _____

Comments: _____

ANALYSIS REQUEST AN CHAIN OF CUSTODY

Ir. al Lab Batch No. 6W108

AR/COC- 05245

SF-2001-COC (6-95)

Dept. No./Mail Stop: [illegible]
Project/Task Manager: [illegible]
Project Name: [illegible]
Record Center Code: [illegible]
Logbook Ref No: [illegible]
Service Order No.: [illegible]

Date Samples Shipped: 6-13-96
Carrier/Waybill No.: Hc
Lab Contact: [illegible]
Lab Destination: [illegible]
SMO Contact/Phone: [illegible]
Send Report to SMO [illegible]

Contract No.: N/A
Case No.: 3621.xxx
SMO Authorization: [illegible]
Bill to: Sandia National Laboratories
Supplier Services Department
P.O. Box 5800 MS 0154
Albuquerque, NM 87185-0154

Parameter & Method Requested

Location: Tech Area	Building	Room	Sample No. - Fraction	ER Sample ID or Sample Location Detail	Beginning Depth in Ft.	ER Site No.	Date/Time Collected	Reference LOV (available at SMO): Sample Matrix	Container: Type	Container: Volume	Preservative	Sample Collection Method	Sample Type	Lab Sample ID
N/A	N/A	N/A	0297-1-03	CWLSEM1-002-0-SS	0	65F	6-12-96 1030	S	P	500ml	none	G	SA	X
			-											
			-											
			-											
			-											
			-											
			-											
			-											
			-											
			-											

RMMA ☒ Yes ☐ No Ref. No. _____

Sample Disposal ☒ Return to Client ☐ Disposal by lab

Turnaround Time ☐ Normal ☒ Rush Required Report Date _____

Sample Tracking
Date Entered (mm/dd/yy): 6/19/96
Entered by: [illegible]
QC Initials: [illegible]

Special Instructions/QC Requirements
- C.O.C 05244 to Calvary
- C.O.C # 05246 to [illegible]
- Fax Copy to C. Brown [illegible] for release to FREDLABS

Abnormal Conditions on Receipt

Sample Team Members	Name	Signature	Init	Company/Organization/Phone
	Rod Nagel	[signature]	RN	S.T. 17554
	[illegible]	[signature]	[illegible]	ST 17554

1. Relinquished by	[signature]	Org. S.T. 17554	Date 6/13/96	Time 1025	4. Relinquished by	Org.	Date	Time
1. Received by	[signature]	Org. SNL 7513	Date 6/13/96	Time 1025	4. Received by	Org.	Date	Time
2. Relinquished by	[signature]	Org. SNL 7513	Date 6/13/96	Time 1105	5. Relinquished by	Org.	Date	Time
2. Received by	[signature]	Org. SNL 7513	Date 6/13/96	Time 1101	5. Received by	Org.	Date	Time
3. Relinquished by	[signature]	Org. SNL 7713	Date 6/14/96	Time 0950	6. Relinquished by	Org.	Date	Time
3. Received by	[signature]	Org. SNL 7517	Date 6/14/96	Time 0950	6. Received by	Org.	Date	Time

WHITE - To Accompany Samples, Laboratory Copy BLUE- To Accompany Samples, Return to SMO YELLOW- SMO Suspense Copy PINK- Field Copy

Sandia National Laboratories
Radiation Protection Sample Diagnostics

RUSH

Sample Analysis Request Form
Page 1 of 1

To be completed by Customer

Shaded areas are for RPSD use only

Customer: Carole Lojek
Organization: 7595 MS1148
Project Location: Canyons Test Area
Phone: 50867
Date Results Needed: 6-14-96
Suspect Isotopes: none
Other Information: C.O.C # 05245

Hazards/Special Instructions: RMMA Rush

Batch Log Number: 600908
Logged By: JM

Analysis Type:
- [x] Gamma Spec
- [ ] H-3
- [ ] Alpha/Beta
- [ ] Alpha Spec
- [ ] Total U
- [ ] Other

LIMS Login
Results Faxed
Sample Disposal

Customer Sample ID	Sample Type	Date/Time Collected	Sample Volume	Requested Analysis	RPSD Sample ID	Rad Scan CPM	Sample Weight	Remarks
029929-03	Soil	6-12 96 1020	500ml	Gamma Spec	01	<300	649 g	
LCS	—	INTERN	—	"	02	NA	NA	

Relinquished by _____ Date 6/13/96 Time 1105 Received by _____ Date 6/13/96 Time 1105
Relinquished by _____ Date 6/14/96 Time 0950 Received by _____ Date 6/14/96 Time 0950
Relinquished by _____ Date _____ Time _____ Received by _____ Date _____ Time _____
Relinquished by _____ Date _____ Time _____ Received by _____ Date _____ Time _____

PARTIAL COPY
65EM1

Sandia National Laboratories

Operated for the U.S. Department of Energy by
Sandia Corporation

Albuquerque, New Mexico 87185-1132

date: June 14, 1996

RUSH ONLY

to: Warren Strong, MS-1132 (7584)

from: Craig D. Brown (Environmental Dimensions Inc.), MS-1132 (7714)

subject: Review of Radiological Data for ER Site 65E

The sample numbers provided below may be processed as radiologically non-contaminated in the ER Chemistry Lab (including explosives analysis). A copy of the original data is attached.

Sample Number	
029929-03	CY65EM1-002-SS
029908-03	CY65E-GR-006-0-SS
029923-03	CY65E-GR-012-0-SD

Based on site history and information provided by the Assistant Task Leader (Devon Jercinovic), the radiological contaminant of concern for Site 65E is depleted uranium (DU) and samples may be considered surface samples. The activities used as background were taken from the document, "Background Concentrations of Constituents of Concern to the Sandia National Laboratories/New Mexico Environmental Restoration Project and the Kirtland Air Force Base Installation Restoration Program." Values for the Canyons Area Background Group best represent Site 65E background and were as follows:

Cs-137: 1.063 pCi/gram
Ra-226: 2.6 pCi/gram
Ra-228: 1.08 pCi/gram
Th-232: 1.03 pCi/gram
Th-234: 2.31 pCi/gram
U-234: 2.31 pCi/gram
U-235: Consistent with U-238 concentration
U-238: 2.31 pCi/gram

Copy to:
MS1148 Devon Jercinovic (7585)
MS1307 Art Lynch (7577)
Correspondence File: winword\correspondence\chem\96007.doc

Sandia National Laboratories
Radiation Protection Sample Diagnostics Program [881 Laboratory]
6-13-96 1:53:22 PM

Analyzed by: 6/13/96 Reviewed by: S.B. Ebata 6/13/96

Customer : C.LOJEK/E.RANKIN (7585/SMO)
Customer Sample ID : 029929-03
Lab Sample ID : 60090801 CY65E M1-002-C-SS

Sample Description : MARINELLI SOLID SAMPLE
Sample Quantity : 649.000 gram
Sample Date/Time : 6-12-96 10:20:00 AM
Acquire Start Date/Time : 6-13-96 12:05:06 PM
Detector Name : LAB03
Elapsed Live/Real Time : 6000 / 6003 seconds

Comments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	Not Detected	---	1.29E+00
TH-234	1.06E+00	3.34E-01	3.92E-01
RA-226	2.31E+00	7.67E-01	5.95E-01
PB-214	8.39E-01	1.85E-01	4.92E-02
BI-214	7.22E-01	2.32E-01	5.19E-02
TH-232	8.87E-01	4.68E-01	1.67E-01
RA-228	9.92E-01	3.76E-01	1.90E-01
AC-228	8.89E-01	3.85E-01	1.02E-01
TH-228	3.97E-01	2.59E-01	5.06E-01
RA-224	9.63E-01	3.45E-01	1.19E-01
PB-212	9.68E-01	2.12E-01	4.06E-02
BI-212	1.05E+00	4.69E-01	3.74E-01
TL-208	8.42E-01	3.96E-01	8.21E-02
U-235	Not Detected	---	9.92E-02
TH-231	Not Detected	---	1.66E+00
PA-231	Not Detected	---	1.34E+00
TH-227	Not Detected	---	4.01E-01
RA-223	Not Detected	---	1.22E-01
RN-219	Not Detected	---	4.12E-01
PB-211	Not Detected	---	9.07E-01
TL-207	Not Detected	---	1.50E+01
AM-241	Not Detected	---	1.57E-01
PU-239	Not Detected	---	3.52E+02
NP-237	Not Detected	---	2.57E-01
PA-233	Not Detected	---	6.22E-02
TH-229	Not Detected	---	1.85E-01

[Summary Report] - Sample ID: : 60090801

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
AG-110m	Not Detected	---------	4.00E-02
BA-133	Not Detected	---------	6.87E-02
BE-7	Not Detected	---------	2.76E-01
CD-109	Not Detected	---------	6.58E-01
CD-115	Not Detected	---------	1.04E-01
CE-139	Not Detected	---------	2.70E-02
CE-141	Not Detected	---------	4.31E-02
CE-144	Not Detected	---------	1.78E-01
CO-56	Not Detected	---------	3.59E-02
CO-57	Not Detected	---------	2.40E-02
CO-58	Not Detected	---------	3.60E-02
CO-60	Not Detected	---------	4.23E-02
CR-51	Not Detected	---------	2.45E-01
CS-134	Not Detected	---------	5.83E-02
CS-137	3.71E-02	1.48E-02	2.80E-02
EU-152	Not Detected	---------	2.73E-01
EU-154	Not Detected	---------	2.03E-01
EU-155	Not Detected	---------	9.51E-02
FE-59	Not Detected	---------	7.77E-02
GD-153	Not Detected	---------	7.07E-02
HG-203	Not Detected	---------	2.99E-02
I-131	Not Detected	---------	3.42E-02
IR-192	Not Detected	---------	2.91E-02
K-40	1.26E+01	2.01E+00	3.44E-01
MN-52	Not Detected	---------	4.07E-02
N-54	Not Detected	---------	3.99E-02
O-99	Not Detected	---------	3.77E-01
NA-22	Not Detected	---------	4.83E-02
NA-24	Not Detected	---------	1.24E-01
~~NB-95~~	~~3.36E-02~~	~~3.17E-02~~	7.74E-02 not detected 6/13/96
ND-147	Not Detected	---------	2.22E-01
NI-57	Not Detected	---------	9.16E-02
RU-103	Not Detected	---------	3.19E-02
RU-106	Not Detected	---------	3.38E-01
SB-122	Not Detected	---------	6.08E-02
SB-124	Not Detected	---------	3.54E-02
SB-125	Not Detected	---------	9.50E-02
SR-85	Not Detected	---------	4.30E-02
TA-182	Not Detected	---------	1.73E-01
TA-183	Not Detected	---------	1.53E-01
TC-99m	Not Detected	---------	4.53E-01
TL-201	Not Detected	---------	1.02E-01
XE-133	Not Detected	---------	1.04E-01
Y-88	Not Detected	---------	3.03E-02
ZN-65	Not Detected	---------	1.19E-01
ZR-95	Not Detected	---------	6.80E-02

ER/1333/65E/RAT

SMO ANALYTICAL DATA ROUTING FORM

Project Name: CANYONS TEST AREA Case Number: 3621.400

SNL Task Leader: LOJEK Org/Mail Stop: 7585/1148

SMO Project Coordinator: LYON Sample Ship Date: 6/6/96

ARCOC	Lab	Lab ID
05354	7713	600846

Date Results Received:

Preliminary: _____ Final: 6/7/96

Corrections Requested From Laboratory: _____ Requestor: _____

Date Corrections Received: _____

Date Assigned to SMO Reviewer: _____ Reviewer: _____

Date Review Complete: _____ Signature: _____

Date of Preliminary Notification: _____ Person Notified: _____

Date of Final Transmittal: 7/17/96 Transmitted To: LOJEK

Transmitted By: _____ Filed In Record Center: _____

Comments: _____

ER/1333/65E/RAT

SMO ANALYTICAL DATA ROUTING FORM

Project Name: CANYONS TEST AREA Case Number: 3621.400

SNL Task Leader: LOSEK Org/Mail Stop: 7585/1148

SMO Project Coordinator: LYON Sample Ship Date: 6/6/96

ARCOC	Lab	Lab ID
05354	7713	600846

Date Results Received:

Preliminary: _____ Final: 6/7/96

Corrections Requested From Laboratory: _____ Requestor: _____

Date Corrections Received: _____

Date Assigned to SMO Reviewer: _____ Reviewer: _____

Date Review Complete: _____ Signature: _____

Date of Preliminary Notification: _____ Person Notified: _____

Date of Final Transmittal: 7/17/96 Transmitted To: LOSEK

Transmitted By: _____ Filed In Record Center: _____

Comments: _____

ANALYSIS REQUEST AND CHAIN OF CUSTODY

SF 2001-COC (6-95)

ıal Lab
ı No. 6108416

AR/COC- 00354

Dept. No./Mail Stop: 7585 MS 0154
Project/Task Manager: Carol Lajoie
Project Name: Coyote Test Area
Record Center Code: ER/1333/65E/047
Logbook Ref No:
Service Order No.: CF0181

Date Samples Shipped: 6-6-96
Carrier/Waybill No.: DC
Lab Contact: Fernando Dominguez
Lab Destination: RFSD Bldg 881
SMO Contact/Phone: Mark Lyon 262-8721
Send Report to SMO Kathy Becker

Contract No.: NA
Case No.: 31.21.400
SMO Authorization:
Bill to: Sandia National Laboratories
Supplier Services Department
P.O. Box 5800 MS 0154
Albuquerque, NM 87185-0154

Location Tech Area NA
Building NA Room NA

Sample No. - Fraction	ER Sample ID or Sample Location Detail	Beginning Depth in Ft.	ER Site No.	Date/Time Collected	Reference LOV (available at SMO): Sample Matrix	Container: Type	Container: Volume	Preservative	Sample Collection Method	Sample Type	Parameter & Method Requested: Gamma Spec	Gross Alpha/Beta	Lab Sample ID
023191-03	CY65E-GR-014-0-5 (0-35 cm)	0	65E	6/5/96 0845	S	J	500ml	none	G	SA	X		
027881-03	CY65EA-GR-003-0-SD	0	65 EA	6/5/96 1020	↓	↓	↓	↓	↓	DU	X	X	
027701-03	CY65EA-GR-019-0-SS	0	65E	6/5/96 1050	↓	↓	↓	↓	↓	SA	X	X	

RMMA ☒ Yes ☐ No Ref. No. ____

Sample Disposal ☐ Return to Client ☒ Disposal by lab

Turnaround Time ☐ Normal ☒ Rush Required Report Date ____

Sample Tracking
Date Entered (mm/dd/yy) 6/6/96
Entered by:
QC Inits.

Special Instructions/QC Requirements
C.O.C # 05354 releases
C.O.C.'s # 05358 to Lockheed
C.O.C. # 05357 to Rodney
C.O.C. # 05356 to Nathan Hall
Fax results to Craig Brown

Abnormal Conditions on Receipt

Sample Team Members	Name	Signature	Init	Company/Organization/Phone
	Red Angel	Red Angel	RA	IT/7534

1. Relinquished by	Red Angel	Org.	IT/7534	Date 6/6/96	Time 0945	4. Relinquished by	Org.	Date	Time
1. Received by	DM Nelson	Org.	SMO 7513	Date 6/6/96	Time 0945	4. Received by	Org.	Date	Time
2. Relinquished by	[illegible]	Org.	SMO 7513	Date 6/6/96	Time 1106	5. Relinquished by	Org.	Date	Time
2. Received by	[illegible]	Org.	SNL 7713	Date 6/6/96	Time 1106	5. Received by	Org.	Date	Time
3. Relinquished by	[illegible]	Org.	SNL 7713	Date 6/7/96	Time 1005	6. Relinquished by	Org.	Date	Time
3. Received by	[illegible]	Org.	7513	Date 6/7/96	Time 1005	6. Received by	Org.	Date	Time

WHITE - To Accompany Samples, Laboratory Copy BLUE- To Accompany Samples, Return to SMO YELLOW- SMO Suspense Copy PINK- Field Copy

San. . National Laboratories
Radiation Protection Sample Diagnostics

Rad Gamma

Sample Analysis Requ Form
Page 1 of 1

To be completed by Customer

Shaded areas are for RPSD use only

Customer : Carole Lojek
Organization: 7585 MS1148
Project Location: Canyons Test Area
Phone: Debby Jercinovic 284-2529
Date Results Needed: 6/7/96
Suspect Isotopes: none
Other Information: COC 05354

Hazards/Special Instructions:
• RMMA Rush
• Please Fax results to Craig Brown

RUSH

Batch Log Number: 60846
Logged By: JDS
LIMS Login
Results Faxed
Sample Disposal

Analysis Type:
☒ Gamma Spec
☐ H-3
☒ Alpha/Beta
☐ Alpha Spec
☐ Total U
☐ Other

Customer Sample ID	Sample Type	Date/Time Collected	Sample Volume	Requested Analysis	RPSD Sample ID	Rad Scan CPM	Sample Weight	Remarks
029891-03	Soil	6/5/96 & DIG OPAS	500 ml	Gamma Spec	01	<300	843 g	
029884-03	↓	6/4/96 1020	↓	↓ Gross Alpha Gross Beta	02	<300	909 g	
029901-03	↓	6/5/96 1090	↓	↓	03	<300	723 g	
LCS	—	INDUED	—	γ Spec	04	NA	NA	

Relinquished by [signature] Date 6/6/96 Time 1106 Received by [signature] Date 6/6/96 Time 1106
Relinquished by [signature] Date 6/7/96 Time 1005 Received by [signature] Date 6/7/96 Time 1005.
Relinquished by _____ Date _____ Time _____ Received by _____ Date _____ Time _____
Relinquished by _____ Date _____ Time _____ Received by _____ Date _____ Time _____

Sandia National Laboratories
Radiation Protection Sample Diagnostics Program [881 Laboratory]
6-06-96 11:54:07 AM

Analyzed by: 2/7/96 Reviewed by: S.B. Stark 6/7/96

CY65E-gR-014-0-S

Customer : C.LOJEK/E.RANKIN (7585/SMO)
Customer Sample ID : 029891-03
Lab Sample ID : 60084601

Sample Description : MARINELLI SOLID SAMPLE
Sample Quantity : 843.000 gram
Sample Date/Time : 6-05-96 9:45:00 AM
Acquire Start Date/Time : 6-06-96 10:11:28 AM
Detector Name : LAB02
Elapsed Live/Real Time : 6000 / 6003 seconds

Comments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	Not Detected	---	2.78E+00
TH-234	8.08E-01	3.13E-01	4.39E-01
RA-226	1.46E+00	6.12E-01	4.49E-01
PB-214	5.09E-01	1.03E-01	3.68E-02
BI-214	4.64E-01	8.87E-02	3.44E-02
TH-232	5.15E-01	2.40E-01	1.11E-01
228	4.93E-01	1.78E-01	1.24E-01
228	5.52E-01	1.77E-01	6.64E-02
TH-228	6.28E-01	2.12E-01	4.05E-01
RA-224	5.14E-01	1.86E-01	6.90E-02
PB-212	5.02E-01	1.34E-01	3.31E-02
BI-212	5.96E-01	2.65E-01	2.39E-01
TL-208	4.49E-01	9.69E-02	4.97E-02
U-235	Not Detected	---	1.95E-01
TH-231	Not Detected	---	2.23E+00
PA-231	Not Detected	---	1.19E+00
TH-227	Not Detected	---	2.79E-01
RA-223	Not Detected	---	1.56E-01
RN-219	Not Detected	---	3.20E-01
PB-211	Not Detected	---	7.34E-01
TL-207	Not Detected	---	1.12E+01
AM-241	Not Detected	---	4.56E-01
PU-239	Not Detected	---	3.62E+02
NP-237	Not Detected	---	2.25E-01
PA-233	Not Detected	---	4.92E-02
TH-229	Not Detected	---	2.32E-01

[Summary Report] - Sample ID: : 60084601

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
AG-110m	Not Detected	---------	3.81E-02
BA-133	Not Detected	---------	4.90E-02
BE-7	Not Detected	---------	2.09E-01
CD-109	Not Detected	---------	7.74E-01
CD-115	Not Detected	---------	6.92E-02
CE-139	Not Detected	---------	2.42E-02
CE-141	Not Detected	---------	4.48E-02
CE-144	Not Detected	---------	1.96E-01
CO-56	Not Detected	---------	2.98E-02
CO-57	Not Detected	---------	2.58E-02
CO-58	Not Detected	---------	2.51E-02
CO-60	Not Detected	---------	3.01E-02
CR-51	Not Detected	---------	1.92E-01
CS-134	Not Detected	---------	3.95E-02
CS-137	1.65E-01	3.57E-02	1.95E-02
EU-152	Not Detected	---------	2.02E-01
EU-154	Not Detected	---------	1.37E-01
EU-155	Not Detected	---------	1.14E-01
FE-59	Not Detected	---------	6.07E-02
GD-153	Not Detected	---------	9.07E-02
HG-203	Not Detected	---------	2.35E-02
I-131	Not Detected	---------	2.45E-02
IR-192	Not Detected	---------	2.31E-02
K-40	1.68E+01	2.37E+00	1.79E-01
MN-52	Not Detected	---------	2.93E-02
MN-54	Not Detected	---------	2.71E-02
-99	Not Detected	---------	2.61E-01
-22	Not Detected	---------	3.45E-02
NA-24	Not Detected	---------	8.95E-02
NB-95	Not Detected	---------	1.57E-01
ND-147	Not Detected	---------	1.68E-01
NI-57	Not Detected	---------	6.41E-02
RU-103	Not Detected	---------	2.24E-02
RU-106	Not Detected	---------	2.22E-01
SB-122	Not Detected	---------	4.15E-02
SB-124	Not Detected	---------	2.59E-02
SB-125	Not Detected	---------	6.81E-02
SR-85	Not Detected	---------	2.92E-02
TA-182	Not Detected	---------	1.29E-01
TA-183	Not Detected	---------	4.51E-01
TC-99m	Not Detected	---------	4.02E-01
TL-201	Not Detected	---------	1.61E-01
XE-133	Not Detected	---------	1.40E-01
Y-88	Not Detected	---------	2.20E-02
ZN-65	Not Detected	---------	8.63E-02
ZR-95	Not Detected	---------	4.69E-02

Sandia National Laboratories
Radiation Protection Sample Diagnostics Program [881 Laboratory]
6-06-96 1:38:53 PM

Analyzed by: 6/7/96 Reviewed by: S.B. Ebata 6/7/96

Customer : C.LOJEK/E.RANKIN (7585/SMO)
Customer Sample ID : 029884-03
Lab Sample ID : 60084602

C465EA-QR-003-0-SD

Sample Description : MARINELLI SOLID SAMPLE
Sample Quantity : 909.000 gram
Sample Date/Time : 6-04-96 10:20:00 AM
Acquire Start Date/Time : 6-06-96 11:56:05 AM
Detector Name : LAB02
Elapsed Live/Real Time : 6000 / 6003 seconds

Comments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	Not Detected	---	2.79E+00
TH-234	1.61E+00	8.33E-01	4.93E-01
RA-226	1.46E+00	4.93E-01	3.89E-01
PB-214	6.84E-01	1.76E-01	3.28E-02
BI-214	6.20E-01	1.07E-01	3.33E-02
TH-232	4.91E-01	2.30E-01	1.18E-01
-228	5.25E-01	1.43E-01	1.15E-01
228	5.06E-01	1.31E-01	6.27E-02
TH-228	3.59E-01	1.57E-01	3.67E-01
RA-224	5.61E-01	1.97E-01	6.02E-02
PB-212	5.36E-01	1.37E-01	3.10E-02
BI-212	6.93E-01	3.20E-01	2.51E-01
TL-208	4.47E-01	9.55E-02	5.23E-02
U-235	6.65E-02	1.44E-02	7.85E-02
TH-231	Not Detected	---	2.25E+00
PA-231	Not Detected	---	1.15E+00
TH-227	Not Detected	---	2.76E-01
RA-223	Not Detected	---	1.66E-01
RN-219	~~3.05E-01~~	~~2.76E-01~~	3.14E-01 Not detected
PB-211	Not Detected	---	7.16E-01
TL-207	Not Detected	---	1.06E+01
AM-241	Not Detected	---	4.41E-01
PU-239	Not Detected	---	3.70E+02
NP-237	Not Detected	---	2.04E-01
PA-233	Not Detected	---	4.64E-02
TH-229	Not Detected	---	2.37E-01

6/7/96

[Summary Report] - Sample ID: : 60084602

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
AG-110m	Not Detected	---------	2.52E-02
BA-133	Not Detected	---------	5.26E-02
BE-7	Not Detected	---------	1.89E-01
CD-109	Not Detected	---------	7.04E-01
CD-115	Not Detected	---------	9.18E-02
CE-139	Not Detected	---------	2.48E-02
CE-141	Not Detected	---------	4.50E-02
CE-144	Not Detected	---------	1.97E-01
CO-56	Not Detected	---------	1.83E-02
CO-57	Not Detected	---------	2.58E-02
CO-58	Not Detected	---------	2.52E-02
CO-60	Not Detected	---------	2.83E-02
CR-51	Not Detected	---------	1.92E-01
CS-134	Not Detected	---------	4.17E-02
CS-137	4.91E-03	8.81E-03	1.48E-02
EU-152	Not Detected	---------	1.87E-01
EU-154	Not Detected	---------	1.41E-01
EU-155	Not Detected	---------	1.14E-01
FE-59	Not Detected	---------	5.78E-02
GD-153	Not Detected	---------	9.43E-02
HG-203	Not Detected	---------	2.40E-02
I-131	Not Detected	---------	2.67E-02
IR-192	Not Detected	---------	2.22E-02
K-40	1.40E+01	2.05E+00	1.80E-01
MN-52	Not Detected	---------	2.82E-02
MN-54	~~8.93E-03~~	~~9.58E-03~~	1.42E-02 not detected 1/7/96
[illegible]-99	Not Detected	---------	3.26E-01
[illegible]A-22	Not Detected	---------	3.17E-02
NA-24	Not Detected	---------	2.60E-01
NB-95	Not Detected	---------	1.90E-01
ND-147	Not Detected	---------	1.72E-01
NI-57	Not Detected	---------	4.35E-02
RU-103	Not Detected	---------	2.17E-02
RU-106	Not Detected	---------	2.27E-01
SB-122	Not Detected	---------	5.29E-02
SB-124	Not Detected	---------	2.51E-02
SB-125	Not Detected	---------	6.60E-02
SR-85	Not Detected	---------	2.80E-02
TA-182	Not Detected	---------	1.24E-01
TA-183	Not Detected	---------	5.00E-01
TC-99m	Not Detected	---------	7.26E+00
TL-201	Not Detected	---------	2.05E-01
XE-133	Not Detected	---------	1.98E-01
Y-88	Not Detected	---------	1.92E-02
ZN-65	Not Detected	---------	8.31E-02
ZR-95	Not Detected	---------	4.50E-02

Sandia National Laboratories
Radiation Protection Sample Diagnostics Program [881 Laboratory]
6-06-96 3:23:21 PM

Analyzed by: 6/7/96 Reviewed by: S.B. Ebadian 6/7/96

Customer : C.LOJEK/E.RANKIN (7585/SMO)
Customer Sample ID : 029901-03
Lab Sample ID : 60084603

019
CY65E-9R-044-0-SS

Sample Description : MARINELLI SOLID SAMPLE
Sample Quantity : 723.000 gram
Sample Date/Time : 6-05-96 10:50:00 AM
Acquire Start Date/Time : 6-06-96 1:40:36 PM
Detector Name : LAB02
Elapsed Live/Real Time : 6000 / 6003 seconds

Comments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	Not Detected	---	3.38E+00
TH-234	1.25E+00	4.26E-01	5.55E-01
RA-226	1.89E+00	8.45E-01	5.29E-01
PB-214	7.79E-01	1.32E-01	4.32E-02
BI-214	7.11E-01	8.74E-01	4.28E-02
TH-232	8.87E-01	6.57E-01	1.36E-01
228	8.89E-01	3.97E-01	1.42E-01
228	8.32E-01	4.40E-01	8.21E-02
TH-228	6.49E-01	2.22E-01	4.60E-01
RA-224	8.47E-01	3.86E-01	8.52E-02
PB-212	8.21E-01	2.59E-01	4.06E-02
BI-212	1.07E+00	6.05E-01	3.20E-01
TL-208	7.30E-01	2.92E-01	6.40E-02
U-235	Not Detected	---	2.36E-01
TH-231	Not Detected	---	2.76E+00
PA-231	Not Detected	---	1.48E+00
TH-227	Not Detected	---	3.67E-01
RA-223	Not Detected	---	1.90E-01
RN-219	~~2.23E-01~~	~~3.47E-01~~	3.91E-01 Not detected 6/7/96
PB-211	Not Detected	---	9.15E-01
TL-207	Not Detected	---	1.33E+01
AM-241	Not Detected	---	5.51E-01
PU-239	Not Detected	---	4.50E+02
NP-237	Not Detected	---	2.72E-01
PA-233	Not Detected	---	5.88E-02
TH-229	Not Detected	---	2.89E-01

[Summary Report] - Sample ID: : 60084603

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
AG-110m	Not Detected	---------	4.00E-02
BA-133	Not Detected	---------	6.35E-02
BE-7	Not Detected	---------	2.46E-01
CD-109	Not Detected	---------	9.35E-01
CD-115	Not Detected	---------	9.36E-02
CE-139	Not Detected	---------	3.01E-02
CE-141	Not Detected	---------	5.43E-02
CE-144	Not Detected	---------	2.39E-01
CO-56	Not Detected	---------	3.39E-02
CO-57	Not Detected	---------	3.17E-02
CO-58	Not Detected	---------	3.16E-02
CO-60	Not Detected	---------	3.59E-02
CR-51	Not Detected	---------	2.28E-01
CS-134	Not Detected	---------	5.17E-02
CS-137	1.00E-01	3.99E-02	2.40E-02
EU-152	Not Detected	---------	2.48E-01
EU-154	Not Detected	---------	1.83E-01
EU-155	Not Detected	---------	1.42E-01
FE-59	Not Detected	---------	6.95E-02
GD-153	Not Detected	---------	1.15E-01
HG-203	Not Detected	---------	2.99E-02
I-131	Not Detected	---------	3.00E-02
IR-192	Not Detected	---------	2.79E-02
K-40	1.77E+01	2.57E+00	2.21E-01
MN-52	Not Detected	---------	3.61E-02
MN-54	Not Detected	---------	3.44E-02
)-99	Not Detected	---------	3.25E-01
A-22	Not Detected	---------	4.04E-02
NA-24	Not Detected	---------	1.15E-01
NB-95	Not Detected	---------	2.11E-01
ND-147	Not Detected	---------	2.03E-01
NI-57	~~6.72E-02~~	~~5.00E-02~~	4.30E-02 Not detected 7 1/4/96
RU-103	Not Detected	---------	2.74E-02
RU-106	Not Detected	---------	2.70E-01
SB-122	Not Detected	---------	5.27E-02
SB-124	Not Detected	---------	3.20E-02
SB-125	Not Detected	---------	8.52E-02
SR-85	Not Detected	---------	3.73E-02
TA-182	Not Detected	---------	1.50E-01
TA-183	Not Detected	---------	5.51E-01
TC-99m	Not Detected	---------	6.37E-01
TL-201	Not Detected	---------	2.07E-01
XE-133	Not Detected	---------	1.78E-01
Y-88	Not Detected	---------	2.76E-02
ZN-65	Not Detected	---------	9.97E-02
ZR-95	Not Detected	---------	5.72E-02

```
**********************************************************************
* Sandia Radioactive Sample Diagnostics Program              6-7-1996 *
**********************************************************************
 SC Analysis Program - version 5.1

Batch Number        : 60084602
Count Protocol      : 3
Client              : CANYON TEST AREA SOIL  (C.LOJEK 7585)     60084602
Laboratory ID       : 881-2
Count Date          : 06-Jun-96
Protocol Name       : H3AB -- SWIPE/SOIL
Region of Interest  : 20-600
Count Time          : 60.0 minutes
Background cpm      : 2.85 +- 0.44
Background tSIE     : 226.8
Background Eff      : 0.986
Systematic Error    :  8.90%
Sample Aliquot      : 0.100 g

Alpha MDA =  4.84E+00 pCi/g
Alpha CL  =  2.32E+00 pCi/g

Alpha Efficiency = 0.9937 - exp(-0.06849*tSIE^0.7874)

Flag Description:

>CL : Result > 2-sigma Error  and  Result > Critical Level.
<CL : Result < 2-sigma Error  and  Result < Critical Level.
 ?L : Result < 2-sigma Error  and  Result > Critical Level.
 !L : Result > 2-sigma Error  and  Result < Critical Level.
```

S#	RPSD ID	Client ID	cpm	Error	tSIE	Eff	Alpha Activity pCi/g	Error	Flag
2	002	29884-3	3.20E+00	4.62E-01	332	0.992	1.59E+00	4.22E+00	<CL
3	003	29901-3	2.32E+00	3.93E-01	292	0.991	-2.42E+00	3.98E+00	<CL

```
**************************************************************************
* Sandia Radioactive Sample Diagnostics Program              6-7-1996 *
**************************************************************************
.SC Analysis Program - version 5.1

Batch Number        : 60084602
Count Protocol      : 3
Client              : CANYON TEST AREA SOIL  (C.LOJEK 7585)     60084602
Laboratory ID       : 881-2
Count Date          : 06-Jun-96
Protocol Name       : H3AB -- SWIPE/SOIL
Region of Interest  : 12-2000
Count Time          : 60.0 minutes
Background cpm      : 37.00 +- 1.57
Background tSIE     : 226.8
Background Eff      : 0.888
Systematic Error    :  6.30%
Sample Aliquot      : 0.100 g

Beta MDA =  1.88E+01 pCi/g
Beta CL  =  9.28E+00 pCi/g

Beta Efficiency = 0.8970 - exp(-0.03002*tSIE^0.9335)

Flag Description:

>CL : Result > 2-sigma Error  and  Result > Critical Level.
<CL : Result < 2-sigma Error  and  Result < Critical Level.
 CL : Result < 2-sigma Error  and  Result > Critical Level.
@CL : Result > 2-sigma Error  and  Result < Critical Level.
```

S#	RPSD ID	Client ID	cpm	Error	tSIE	Eff	Beta Activity pCi/g	Error	Flag
2	002	29884-3	3.76E+01	1.58E+00	332	0.896	3.02E+00	1.60E+01	<CL
3	003	29901-3	3.87E+01	1.61E+00	292	0.895	8.46E+00	1.65E+01	<CL

Copy

6SE
Subcontract/arroyo
& SPEC

ER/1333/6SE/DAT

SMO ANALYTICAL DATA ROUTING FORM

Project Name: Canyons Test ~~Area~~ Case Number: 3621.401

SNL Task Leader: C. LOJEK Org/Mail Stop: 7585/1148

SMO Project Coordinator: K LYON Sample Ship Date: 6/6/96

ARCOC	Lab	Lab ID
03355	7713	600847

Date Results Received:

Preliminary: _____ Final: 6/12/96

Corrections Requested From Laboratory: _____ Requestor: _____

Date Corrections Received: _____

Date Assigned to SMO Reviewer: _____ Reviewer: _____

Date Review Complete: _____ Signature: _____

Date of Preliminary Notification: _____ Person Notified: _____

Date of Final Transmittal: 6/19/96 Transmitted To: LOJEK

Transmitted By: glj Filed In Record Center: glj

Comments: _____

Internal Lab Batch No. 600847

ANALYSIS REQUEST AND CHAIN OF CUSTODY

AR/COC- 05355

Dept. No./Mail Stop: 7585 / MS 1145
Project/Task Manager:
Project Name:
Record Center Code: ER/1333/65E/DAT
Logbook Ref No:
Service Order No.: CF-L 151

Date Samples Shipped: 6-6-96
Carrier/Waybill No.: NC
Lab Contact:
Lab Destination: RPSD Bldg 551
SMO Contact/Phone:
Send Report to SMO:

Contract No.: NA
Case No.: 7221.400
SMO Authorization:
Bill to: Sandia National Laboratories
Supplier Services Department
P.O. Box 5800 MS 0154
Albuquerque, NM 87185-0154

Location: Tech Area 1 A; Building 1 1; Room N/A

Reference LOV (available at SMO)

Parameter & Method Requested: Gamma Spec; Gross Alpha, Beta

Sample No. - Fraction	ER Sample ID or Sample Location Detail	Beginning Depth in Ft.	ER Site No.	Date/Time Collected	Sample Matrix	Container Type	Container Volume	Preservative	Sample Collection Method	Sample Type	Gamma Spec	Gross Alpha, Beta	Lab Sample ID
021892-03	CY65E-GR-015-0-SS	0	65E	6/5/96 0910	S	P	500ml	none	G	SA	X		
021 [illegible]-03	CY65E-GR-016-0-SS	0		6/5/96 0935						SA	X		
021896-03	CY65E-GR-016-0-SD	0		6/5/96 0935						DU	X		
021897-03	CY65E-GR-017-0-SS	0		6/5/96 1020						SA	X		
021899-03	CY65E-GR-018-0-SS	0		6/5/96 1105						SA	X		
~~0[illegible]-03~~	~~CY65EA-GR-001-0.5-S~~												
021[illegible]-03	CY65EA-GR-001-0.5-S	.5	65 EA	6/9/96 0725	S	P	500ml	none	G	SA	X	X	
021890-03	CY65EA-GR-002-0-SS	0		6/9/96 0950						SA	X	X	
021893-03	CY65EA-GR-003-0-SS	0		6/9/96 1020						SA	X	X	
021885-03	CY65EA-GR-004-0-SS	0		6/9/96 1100						SA	X	X	

RMMA ☒ Yes ☐ No Ref. No.

Sample Disposal ☐ Return to Client ☒ Disposal by lab

Turnaround Time ☒ Normal ☐ Rush Required Report Date

Sample Tracking
Date Entered (mm/dd/yy) 6/10/96
Entered by:
QC Inits.

Special Instructions/QC Requirements

Abnormal Conditions on Receipt

Sample Team Members	Name	Signature	Init	Company/Organization/Phone
	Rod Nagel	Rod Nagel		IT/7584

		Org.	Date	Time
1. Relinquished by	Rod Nagel	IT/7584	6/6/96	0955
1. Received by		7513	6/6/96	0955
2. Relinquished by		7513	6/6/96	1108
2. Received by		SNL 7713	6/6/96	1108
3. Relinquished by		SNL 7713	6/12/96	0955
3. Received by		7513	6/12/96	0955
4. Relinquished by				
4. Received by				
5. Relinquished by				
5. Received by				
6. Relinquished by				
6. Received by				

WHITE - To Accompany Samples, Laboratory Copy BLUE- To Accompany Samples, Return to SMO YELLOW- SMO Suspense Copy PINK- Field Copy

SF 2001-COD (9-94)

AR/COC- 05

BATCH #600847

Project Name: Canyons Test Area Project/Task Manager: Carole Lejeal Case No.: 3621.400

Location Tech Area NA

Building NA Room NA

Sample No. - Fraction	ER Sample ID or Sample Location Detail	Beginning Depth in Ft.	ER Site No.	Date/Time Collected	Reference LOV (available at SMO)						Parameter & Method Requested										Lab Sample ID
					Sample Matrix	Container Type	Container Volume	Preservative	Sample Collection Method	Sample Type	Gamma Spec	Gross Alpha, Beta									
027847-07-003	CY65EA-CR-05-0-SS	0	65 EA	6/9/96 1120	S	P	500ml	4°C	G	SA	X	X									
				6/10/96																	

Abnormal Conditions on Receipt

Recipient Initials _____

WHITE - To Accompany Samples, Laboratory Copy BLUE- To Accompany Samples, Return to SMO YELLOW- SMO Suspense Copy PINK- Field Copy

Sandia National Laboratories
Radiation Protection Sample Diagnostics

Sample Analysis Request Form
Page 1 of 1

To be completed by Customer

Shaded areas are for RPSD use only

Customer: Carole Lojek
Organization: 7585 MS 1148
Project Location: Canyons Test Area
Phone: Okvon Jarcmovic 284-2529
Date Results Needed: 6-14-96
Suspect Isotopes: none UNK
Other Information: C.o.c 05355

Hazards/Special Instructions:
RMMA
non-rush

Batch Log Number: 600947
Logged By: JM
LIMS Login
Results Faxed
Sample Disposal

Analysis Type:
- [x] Gamma Spec
- [ ] H-3
- [x] Alpha/Beta
- [ ] Alpha Spec
- [ ] Total U
- [ ] Other

Customer Sample ID	Sample Type	Date/Time Collected	Sample Volume	Requested Analysis	RPSD Sample ID	Rad Scan CPM	Sample Weight	Remarks
029892-03	Soil	6/5/96 0910	500 ml	Gamma Spec	01	< 300	591 g	
029894-03	↓	6/5/96 0955	↓	↓	02	< 300	754 g	
029896-03		6/5/96 0935			03	< 300	733 g	
029897-03		6/5/96 1020			04	< 300	771 g	
029899-03	↓	6/5/96 1105	↓	↓	05	< 300	674 g	
029879-03		6/4/96 0925		Gamma Spec / Gross Alpha Gross Beta	06	< 300	715 g	1
029880-03		6/4/96 0950			07	< 300	858 g	2
029882-03		6/4/96 1020			08	< 300	993 g	3 LSC
029885-03		6/4/96 1100			09	< 300	871 g	4
029887-03	↓	6/4/96 1120	↓	↓	10	< 300	1046 g	5
LCS	—	1100/50	—	γ spec ASG	11	NA	NA	
					12			

Relinquished by _____ Date 6/6/96 Time 1108 Received by _____ Date 6/6/96 Time 1108
Relinquished by _____ Date 6/12/96 Time 0955 Received by _____ Date 6/12/96 Time 0955
Relinquished by _____ Date _____ Time _____ Received by _____ Date _____ Time _____
Relinquished by _____ Date _____ Time _____ Received by _____ Date _____ Time _____

Sandia National Laboratories
Radiation Protection Sample Diagnostics Program [881 Laboratory]
6-06-96 5:36:54 PM

Analyzed by: 6/7/96 Reviewed by: S.B. Ebara 6/7/96

Customer : C.LOJEK/E.RANKIN (7585/SMO)
Customer Sample ID : 029892-03
Lab Sample ID : 60084701

C465E-gp-015-0-S

Sample Description : MARINELLI SOLID SAMPLE
Sample Quantity : 591.000 gram
Sample Date/Time : 6-05-96 9:10:00 AM
Acquire Start Date/Time : 6-06-96 3:54:11 PM
Detector Name : LAB02
Elapsed Live/Real Time : 6000 / 6003 seconds

Comments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	Not Detected	---	3.61E+00
TH-234	Not Detected	---	8.48E-01
RA-226	1.92E+00	6.22E-01	5.71E-01
PB-214	8.73E-01	1.72E-01	5.12E-02
BI-214	7.67E-01	3.14E-01	4.64E-02
TH-232	6.46E-01	6.75E-01	1.46E-01
[illegible]28	7.18E-01	2.80E-01	1.29E-01
A[illegible]28	7.57E-01	1.99E-01	7.55E-02
TH-228	8.70E-01	3.07E-01	5.03E-01
RA-224	5.91E-01	2.55E-01	9.63E-02
PB-212	7.18E-01	1.31E-01	4.57E-02
BI-212	7.59E-01	4.90E-01	3.06E-01
TL-208	6.09E-01	1.43E-01	6.87E-02
U-235	Not Detected	---	2.56E-01
TH-231	Not Detected	---	2.98E+00
PA-231	Not Detected	---	1.65E+00
TH-227	Not Detected	---	3.88E-01
RA-223	Not Detected	---	2.15E-01
RN-219	Not Detected	---	4.37E-01
PB-211	Not Detected	---	1.04E+00
TL-207	Not Detected	---	1.36E+01
AM-241	Not Detected	---	5.90E-01
PU-239	Not Detected	---	4.92E+02
NP-237	Not Detected	---	4.23E-01
PA-233	Not Detected	---	6.49E-02
TH-229	Not Detected	---	3.14E-01

Sandia National Laboratories
Radiation Protection Sample Diagnostics Program [881 Laboratory]
6-06-96 7:21:30 PM

Analyzed by: 6/7/96 Reviewed by: S.B. Ebata 6/7/96

CY65E-QR-016-0

ustomer : C.LOJEK/E.RANKIN (7585/SMO)
ustomer Sample ID : 029894-03
ab Sample ID : 60084702

ample Description : MARINELLI SOLID SAMPLE
ample Quantity : 754.000 gram
ample Date/Time : 6-05-96 9:35:00 AM
cquire Start Date/Time : 6-06-96 5:38:37 PM
etector Name : LAB02
lapsed Live/Real Time : 6000 / 6003 seconds

omments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	Not Detected	---------	3.44E+00
TH-234	1.84E+00	6.87E-01	6.21E-01
RA-226	2.05E+00	8.44E-01	5.15E-01
PB-214	9.24E-01	1.53E-01	4.49E-02
BI-214	9.11E-01	1.66E-01	4.15E-02
TH-232	8.87E-01	4.32E-01	1.46E-01
[illegible]28	8.70E-01	2.13E-01	1.32E-01
AC-228	9.85E-01	1.93E-01	8.18E-02
TH-228	9.55E-01	2.64E-01	4.75E-01
RA-224	9.17E-01	3.10E-01	5.80E-02
PB-212	8.83E-01	1.83E-01	4.08E-02
BI-212	9.05E-01	3.95E-01	2.72E-01
TL-208	8.79E-01	1.68E-01	6.27E-02
U-235	Not Detected	---------	2.36E-01
TH-231	Not Detected	---------	2.75E+00
PA-231	Not Detected	---------	1.40E+00
TH-227	Not Detected	---------	3.71E-01
RA-223	Not Detected	---------	1.95E-01
RN-219	Not Detected	---------	3.85E-01
PB-211	Not Detected	---------	9.01E-01
TL-207	Not Detected	---------	1.33E+01
AM-241	Not Detected	---------	5.52E-01
PU-239	Not Detected	---------	4.55E+02
NP-237	Not Detected	---------	2.99E-01
PA-233	Not Detected	---------	5.75E-02
TH-229	Not Detected	---------	2.85E-01

Sandia National Laboratories
Radiation Protection Sample Diagnostics Program [881 Laboratory]
6-06-96 9:06:16 PM

Analyzed by: 6/7/96 Reviewed by: S.B. Ebota 6/7/96

ustomer : C.LOJEK/E.RANKIN (7585/SMO)
ustomer Sample ID : 029896-03
ab Sample ID : 60084703

ample Description : MARINELLI SOLID SAMPLE
ample Quantity : 733.000 gram
ample Date/Time : 6-05-96 9:35:00 AM
cquire Start Date/Time : 6-06-96 7:23:13 PM
etector Name : LAB02
lapsed Live/Real Time : 6000 / 6003 seconds

CY65E-GR-016-0-SD

omments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	Not Detected	---	1.99E+00
TH-234	1.96E+00	5.41E-01	6.07E-01
RA-226	2.39E+00	8.51E-01	6.04E-01
PB-214	9.33E-01	1.59E-01	4.61E-02
BI-214	8.62E-01	1.48E-01	4.52E-02
TH-232	9.25E-01	4.37E-01	1.44E-01
P 28	7.85E-01	2.04E-01	1.29E-01
AC 228	8.89E-01	3.32E-01	7.31E-02
TH-228	8.07E-01	9.68E-01	4.57E-01
RA-224	9.07E-01	2.87E-01	6.41E-02
PB-212	8.59E-01	1.44E-01	4.01E-02
BI-212	9.39E-01	3.47E-01	2.73E-01
TL-208	7.09E-01	1.33E-01	5.95E-02
U-235	Not Detected	---	2.45E-01
TH-231	Not Detected	---	2.79E+00
PA-231	Not Detected	---	1.46E+00
TH-227	Not Detected	---	3.71E-01
RA-223	Not Detected	---	1.97E-01
RN-219	Not Detected	---	4.01E-01
PB-211	Not Detected	---	9.28E-01
TL-207	Not Detected	---	1.31E+01
AM-241	Not Detected	---	5.68E-01
PU-239	Not Detected	---	4.64E+02
NP-237	Not Detected	---	3.03E-01
PA-233	Not Detected	---	5.86E-02
TH-229	Not Detected	---	2.80E-01

Sandia National Laboratories
Radiation Protection Sample Diagnostics Program [881 Laboratory]
6-06-96 10:51:14 PM

Analyzed by: 6/7/96 Reviewed by: S.B. Ebora 6/7/96

CY65 E -JP-017-0-SS

Customer : C.LOJEK/E.RANKIN (7585/SMO)
Customer Sample ID : 029897-03
Lab Sample ID : 60084704

Sample Description : MARINELLI SOLID SAMPLE
Sample Quantity : 771.000 gram
Sample Date/Time : 6-05-96 10:20:00 AM
Acquire Start Date/Time : 6-06-96 9:08:14 PM
Detector Name : LAB02
Elapsed Live/Real Time : 6000 / 6004 seconds

Comments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	2.08E+01	6.02E+00	3.49E+00
TH-234	1.95E+01	3.83E+00	6.89E-01
RA-226	6.11E+00	1.09E+00	5.92E-01
PB-214	9.12E-01	1.71E-01	4.68E-02
BI-214	8.09E-01	7.18E-01	4.58E-02
TH-232	8.06E-01	3.88E-01	1.45E-01
P[illegible]28	8.38E-01	2.12E-01	1.28E-01
AC-228	8.11E-01	7.59E-01	7.82E-02
TH-228	9.59E-01	6.21E-01	4.93E-01
RA-224	7.68E-01	2.27E-01	7.31E-02
PB-212	8.46E-01	1.42E-01	4.28E-02
BI-212	9.18E-01	3.03E-01	2.69E-01
TL-208	7.83E-01	1.53E-01	6.23E-02
U-235	2.60E-01	1.80E-01	1.85E-01
TH-231	Not Detected	---	3.77E+00
PA-231	Not Detected	---	1.53E+00
TH-227	Not Detected	---	3.70E-01
RA-223	Not Detected	---	2.72E-01
RN-219	Not Detected	---	4.25E-01
PB-211	Not Detected	---	9.80E-01
TL-207	Not Detected	---	1.27E+01
AM-241	Not Detected	---	6.96E-01
PU-239	Not Detected	---	5.02E+02
NP-237	Not Detected	---	3.50E-01
PA-233	Not Detected	---	6.07E-02
TH-229	Not Detected	---	3.65E-01

Sandia National Laboratories
Radiation Protection Sample Diagnostics Program [881 Laboratory]
6-07-96 12:35:47 AM

Analyzed by: 6/7/96 Reviewed by: S.B. Ebara 6/7/96

ustomer : C.LOJEK/E.RANKIN (7585/SMO)
ustcmer Sample ID : 029899-03
ab Sample ID : 60084705

C965E-9R-018-0-

ample Description : MARINELLI SOLID SAMPLE
ample Quantity : 674.000 gram
ample Date/Time : 6-05-96 11:05:00 AM
cquire Start Date/Time : 6-06-96 10:52:57 PM
etector Name : LAB02
lapsed Live/Real Time : 6000 / 6003 seconds

omments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	Not Detected	---------	3.72E+00
TH-234	1.44E+00	4.93E-01	5.99E-01
RA-226	2.67E+00	8.95E-01	6.02E-01
PB-214	1.04E+00	1.78E-01	4.96E-02
BI-214	9.24E-01	3.01E-01	4.98E-02
TH 232	9.15E-01	4.41E-01	1.58E-01
:28	1.06E+00	3.92E-01	1.55E-01
AC-228	1.05E+00	2.27E-01	8.38E-02
TH-228	1.11E+00	2.98E-01	4.92E-01
RA-224	9.16E-01	3.01E-01	7.74E-02
PB-212	9.55E-01	1.67E-01	4.25E-02
BI-212	1.21E+00	3.49E-01	2.70E-01
TL-208	8.83E-01	1.87E-01	6.67E-02
U-235	Not Detected	---------	2.59E-01
TH-231	Not Detected	---------	3.00E+00
PA-231	Not Detected	---------	1.58E+00
TH-227	Not Detected	---------	4.04E-01
RA-223	Not Detected	---------	2.12E-01
RN-219	Not Detected	---------	4.29E-01
PB-211	Not Detected	---------	9.99E-01
TL-207	Not Detected	---------	1.40E+01
AM-241	Not Detected	---------	6.03E-01
PU-239	Not Detected	---------	4.89E+02
NP-237	Not Detected	---------	2.81E-01
PA-233	Not Detected	---------	6.53E-02
TH-229	Not Detected	---------	3.13E-01

Sandia National Laboratories
Radiation Protection Sample Diagnostics Program [881 Laboratory]
6-07-96 2:20:17 AM

Analyzed by: [signature] 6/7/96 Reviewed by: S.B. Ebata 6/7/96

Customer : C.LOJEK/E.RANKIN (7585/SMO)
Customer Sample ID : 029879-03
Lab Sample ID : 60084706

C465 EA-SR-001-0.5

Sample Description : MARINELLI SOLID SAMPLE
Sample Quantity : 715.000 gram
Sample Date/Time : 6-04-96 9:25:00 AM
Acquire Start Date/Time : 6-07-96 12:37:30 AM
Detector Name : LAB02
Elapsed Live/Real Time : 6000 / 6002 seconds

Comments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)	
U-238	Not Detected	---	2.86E+00	
TH-234	6.36E-01	3.60E-01	4.46E-01	
RA-226	1.76E+00	7.25E-01	5.19E-01	
PB-214	7.44E-01	1.33E-01	3.68E-02	
BI-214	6.22E-01	2.96E-01	3.67E-02	
TH-232	4.00E-01	2.10E-01	1.08E-01	
PB-228	4.31E-01	1.75E-01	1.29E-01	
AC-228	4.33E-01	1.10E-01	6.27E-02	
TH-228	2.53E-01	1.51E-01	4.17E-01	
RA-224	4.65E-01	1.88E-01	7.19E-02	
PB-212	3.98E-01	9.66E-02	3.65E-02	
BI-212	4.48E-01	2.33E-01	2.35E-01	
TL-208	3.65E-01	8.61E-02	5.21E-02	
~~U-235~~	~~8.65E-02~~	~~1.60E-01~~	2.07E-01	not detected [signature] 6/7/96
TH-231	Not Detected	---	2.32E+00	
PA-231	Not Detected	---	1.24E+00	
TH-227	Not Detected	---	2.84E-01	
RA-223	Not Detected	---	1.77E-01	
~~RN-219~~	~~2.52E-01~~	~~3.01E-01~~	3.45E-01	not detected [signature] 6/7/96
PB-211	Not Detected	---	8.02E-01	
TL-207	Not Detected	---	1.12E+01	
AM-241	Not Detected	---	4.59E-01	
PU-239	Not Detected	---	3.74E+02	
NP-237	Not Detected	---	2.14E-01	
PA-233	Not Detected	---	4.97E-02	
TH-229	Not Detected	---	2.40E-01	

Sandia National Laboratories
Radiation Protection Sample Diagnostics Program [881 Laboratory]
6-07-96 4:04:54 AM

Analyzed by: 6/7/96 Reviewed by: S.B. Ebata 6/7/96

C465EA-9P-002-0.5

.stomer : C.LOJEK/E.RANKIN (7585/SMO)
.stomer Sample ID : 029880-03
b Sample ID : 60084707

mple Description : MARINELLI SOLID SAMPLE
mple Quantity : 858.000 gram
mple Date/Time : 6-04-96 9:50:00 AM
quire Start Date/Time : 6-07-96 2:22:00 AM
tector Name : LAB02
apsed Live/Real Time : 6000 / 6003 seconds

mments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
-238	Not Detected	---	2.70E+00
H-234	7.98E-01	3.41E-01	4.24E-01
A-226	1.40E+00	2.38E+00	4.65E-01
B-214	6.52E-01	1.20E-01	3.26E-02
I-214	5.69E-01	4.52E-01	3.34E-02
F 232	5.15E-01	2.55E-01	1.15E-01
28	6.80E-01	2.55E-01	1.11E-01
C-228	6.41E-01	1.39E-01	6.28E-02
H-228	6.39E-01	1.99E-01	3.61E-01
A-224	6.19E-01	2.27E-01	6.12E-02
B-212	5.85E-01	5.95E-01	3.24E-02
I-212	7.80E-01	2.91E-01	2.17E-01
L-208	5.42E-01	1.03E-01	4.50E-02
-235	Not Detected	---	1.92E-01
H-231	Not Detected	---	2.23E+00
A-231	Not Detected	---	1.16E+00
H-227	Not Detected	---	2.88E-01
A-223	Not Detected	---	1.71E-01
N-219	Not Detected	---	3.06E-01
B-211	Not Detected	---	7.24E-01
L-207	Not Detected	---	1.12E+01
M-241	Not Detected	---	4.38E-01
U-239	Not Detected	---	3.58E+02
P-237	Not Detected	---	1.91E-01
A-233	Not Detected	---	4.63E-02
H-229	Not Detected	---	2.35E-01

****

Sandia National Laboratories

Radiation Protection Sample Diagnostics Program [881 Laboratory]

6-07-96 5:49:23 AM

****

A. lyzed by: 6/7/96 Reviewed by: S.B. Thur 6/7/96

****

stomer : C.LOJEK/E.RANKIN (7585/SMO)
stomer Sample ID : 029882-03
b Sample ID : 60084708

CY65EA-9P-003-0-

mple Description : MARINELLI SOLID SAMPLE
mple Quantity : 993.000 gram
mple Date/Time : 6-04-96 10:20:00 AM
quire Start Date/Time : 6-07-96 4:06:36 AM
tector Name : LAB02
apsed Live/Real Time : 6000 / 6003 seconds

mments:

****

uclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
-238	Not Detected	---------	2.61E+00
H-234	1.13E+00	3.75E-01	4.82E-01
A-226	1.29E+00	4.79E-01	4.41E-01
B-214	6.58E-01	1.14E-01	3.44E-02
I-214	5.98E-01	1.07E-01	3.17E-02
H-232	5.57E-01	2.67E-01	9.93E-02
28	6.47E-01	5.65E-01	1.06E-01
28	5.63E-01	1.92E-01	5.55E-02
H-228	5.21E-01	2.21E-01	3.49E-01
A-224	5.40E-01	1.67E-01	4.74E-02
B-212	5.63E-01	1.59E-01	3.09E-02
I-212	6.10E-01	2.55E-01	1.97E-01
L-208	4.84E-01	9.66E-02	4.22E-02
-235	Not Detected	---------	1.85E-01
H-231	Not Detected	---------	2.20E+00
A-231	Not Detected	---------	1.08E+00
H-227	Not Detected	---------	2.67E-01
A-223	Not Detected	---------	1.67E-01
N-219	~~2.13E-01~~	~~2.56E-01~~	2.89E-01 not detected 6/7/96
B-211	Not Detected	---------	6.61E-01
L-207	Not Detected	---------	1.01E+01
M-241	Not Detected	---------	4.22E-01
U-239	Not Detected	---------	3.44E+02
P-237	Not Detected	---------	2.36E-01
A-233	Not Detected	---------	4.38E-02
H-229	Not Detected	---------	2.22E-01

Sandia National Laboratories
Radiation Protection Sample Diagnostics Program [881 Laboratory]
6-07-96 7:33:57 AM

Analyzed by: 6/7/96 Reviewed by: S.B. Ebar 6/7/96

C465EA-gp-004-0

ustomer : C.LOJEK/E.RANKIN (7585/SMO)
ustomer Sample ID : 029885-03
ab Sample ID : 60084709

ample Description : MARINELLI SOLID SAMPLE
ample Quantity : 871.000 gram
ample Date/Time : 6-04-96 11:00:00 AM
cquire Start Date/Time : 6-07-96 5:51:06 AM
etector Name : LAB02
lapsed Live/Real Time : 6000 / 6003 seconds

omments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	Not Detected	---	2.87E+00
TH-234	1.12E+00	3.59E-01	4.74E-01
RA-226	1.98E+00	1.06E+00	5.60E-01
PB-214	7.49E-01	1.24E-01	3.45E-02
BI-214	6.77E-01	1.45E-01	3.33E-02
TH-232	6.21E-01	2.96E-01	1.13E-01
228	6.29E-01	1.77E-01	1.11E-01
AC-228	6.38E-01	1.59E-01	6.71E-02
TH-228	6.82E-01	4.06E-01	3.94E-01
RA-224	7.14E-01	2.42E-01	5.39E-02
PB-212	6.47E-01	1.18E-01	3.31E-02
BI-212	6.29E-01	2.12E-01	2.37E-01
TL-208	5.91E-01	3.91E-01	4.75E-02
U-235	Not Detected	---	2.05E-01
TH-231	Not Detected	---	2.34E+00
PA-231	Not Detected	---	1.23E+00
TH-227	Not Detected	---	2.99E-01
RA-223	Not Detected	---	1.81E-01
RN-219	Not Detected	---	3.26E-01
PB-211	Not Detected	---	7.61E-01
TL-207	Not Detected	---	1.09E+01
AM-241	Not Detected	---	4.58E-01
PU-239	Not Detected	---	3.81E+02
NP-237	Not Detected	---	2.34E-01
PA-233	Not Detected	---	4.79E-02
TH-229	Not Detected	---	2.43E-01

Sandia National Laboratories
Radiation Protection Sample Diagnostics Program [881 Laboratory]
6-07-96 9:18:41 AM

Analyzed by: 6/7/96 Reviewed by: S.B. Ebuta 6/7/96

CY65EA-gR-005-0-S

Customer : C.LOJEK/E.RANKIN (7585/SMO)
Customer Sample ID : 029887-03
Lab Sample ID : 60084710

Sample Description : MARINELLI SOLID SAMPLE
Sample Quantity : 1046.000 gram
Sample Date/Time : 6-04-96 11:20:00 AM
Acquire Start Date/Time : 6-07-96 7:35:55 AM
Detector Name : LAB02
Elapsed Live/Real Time : 6000 / 6003 seconds

Comments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	Not Detected	---------	2.50E+00
TH-234	6.84E-01	2.77E-01	4.11E-01
RA-226	1.55E+00	4.56E-01	4.42E-01
PB-214	6.87E-01	1.82E-01	3.13E-02
BI-214	6.30E-01	1.17E-01	3.16E-02
TH-232	5.27E-01	2.58E-01	1.04E-01
P 228	5.30E-01	1.50E-01	1.05E-01
A 228	5.98E-01	1.51E-01	5.93E-02
TH-228	5.72E-01	4.29E-01	3.49E-01
RA-224	4.89E-01	1.66E-01	5.39E-02
PB-212	5.47E-01	9.58E-02	3.07E-02
BI-212	6.29E-01	2.73E-01	2.26E-01
TL-208	4.59E-01	8.97E-02	4.56E-02
U-235	Not Detected	---------	1.77E-01
TH-231	Not Detected	---------	2.07E+00
PA-231	Not Detected	---------	1.06E+00
TH-227	Not Detected	---------	2.55E-01
RA-223	Not Detected	---------	1.61E-01
RN-219	~~1.68E-01~~	~~2.49E-01~~	2.80E-01 Not Detected 6/7/96
PB-211	Not Detected	---------	6.42E-01
TL-207	Not Detected	---------	1.02E+01
AM-241	Not Detected	---------	3.98E-01
PU-239	Not Detected	---------	3.38E+02
NP-237	Not Detected	---------	1.98E-01
PA-233	Not Detected	---------	4.25E-02
TH-229	Not Detected	---------	2.14E-01

```
**********************************************************************
* Sandia Radioactive Sample Diagnostics Program              6-11-1996 *
**********************************************************************
  ? Analysis Program - version 5.1

Batch Number        : 60084706
Count Protocol      : 1
Client              : CANYONS TEST AREA SOIL  (C.LOJEK 7585)    60084706
Laboratory ID       : 881-2
Count Date          : 10-Jun-96
Protocol Name       : H3AB -- SWIPE/SOIL
Region of Interest  : 20-600
Count Time          : 60.0 minutes
Background cpm      : 2.75 +- 0.43
Background tSIE     : 241.8
Background Eff      : 0.988
Systematic Error    :  8.90%
Sample Aliquot      : 0.100 g

Alpha MDA =  4.75E+00 pCi/g
Alpha CL  =  2.27E+00 pCi/g

Alpha Efficiency = 0.9937 - exp(-0.06849*tSIE^0.7874)

Flag Description:

>CL : Result > 2-sigma Error  and  Result > Critical Level.
<CL : Result < 2-sigma Error  and  Result < Critical Level.
  ? : Result < 2-sigma Error  and  Result > Critical Level.
  L : Result > 2-sigma Error  and  Result < Critical Level.
```

S#	RPSD ID	Client ID	cpm	Error	tSIE	Eff	Alpha Activity pCi/g	Error	Flag
2	006	29879-3	2.87E+00	4.37E-01	300	0.991	5.32E-01	3.98E+00	<CL
3	007	29880-3	3.37E+00	4.74E-01	322	0.992	2.80E+00	4.34E+00	@CL
4	008	29882-3	2.85E+00	4.36E-01	309	0.992	4.54E-01	3.96E+00	<CL
5	009	29885-3	3.12E+00	4.56E-01	296	0.991	1.67E+00	4.17E+00	<CL
6	010	29887-3	3.30E+00	4.69E-01	317	0.992	2.50E+00	4.30E+00	@CL

ANNEX 5-E
Data Validation Results

Regional Office

INTERNATIONAL TECHNOLOGY CORPORATION

5301 Central Avenue, N.E.—Suite 700
Albuquerque, New Mexico 87108-1513
505-262-8800
Fax: 505-262-8855

September 23, 1996

Project No. 301455.324.01.000

Sandia National Laboratories
Att.: Mr. Lon Dawson
Department 7582
P.O. Box 5800, M/S 1147
Albuquerque, NM 87185-1147

Data Validation for Operable Unit 1333,
Environmental Restoration Site 65 BK Analysis Reports

Dear Mr. Dawson:

Data validation levels 1 and 2 (DV1 and DV2) were performed on one laboratory analytical data package containing sample analysis results, summary quality control data, and raw laboratory data for soil and water samples collected at Environmental Restoration (ER) Site 65 BK. Data validation was performed in accordance with the SNL/NM Sample Management Office procedure, "Verification and Validation of Chemical and Radiochemical Data, TOP 94-03." These samples were collected at ER Site 65 BK and recorded on ARCOC 05191. The analyses were performed at Lockheed Analytical Services laboratory and released in report numbered L7206. Any typographical or transcription errors that were identified were either hand corrected, initialed and dated, or corrected analytical reports were requested and obtained from the laboratory. Data validation findings are discussed below.

Lockheed Analytical Report L7206 (ARCOC 05191)

Soil and aqueous equipment blank samples were analyzed for Resource Conservation and Recovery Act (RCRA) regulated metals plus beryllium and radionuclide isotopes of thorium, uranium, and strontium. None of the samples recorded on the ARCOC were designated for a matrix spike and matrix spike duplicate. Sample 029858 was designated as a duplicate sample and appears to be the field duplicate of sample 029856.

RCRA Metals plus Beryllium

Resource Conservation and Recovery Act (RCRA) toxic characteristic metals list, plus beryllium, were analyzed and reported on a total metal, as received (wet weight) basis. Silver concentrations were qualified with "U" for undetected in the equipment rinsate blank sample (029863) and soil sample 029854 because of silver contamination in the laboratory method blank. Cadmium reported in soil

samples 029854, 029855, 029858, and 029859 were also qualified with "U" for undetected again because of laboratory method blank contamination with cadmium.

Except as noted above, inductively-coupled plasma emission spectroscopy (ICP and Trace-ICP) and atomic absorption cold-vapor analyses met quality control limits for accuracy, precision, and blank contamination evidenced by results reported for laboratory control sample, laboratory control sample duplicate, and the laboratory method blank. The matrix spike and matrix spike duplicate analyses reported by the laboratory in report L7206 for batch quality control showed acceptable results but was not from ARCOC 05191.

Radiochemistry

Analytical results for isotopic thorium, uranium, and strontium appear consistent with previous reported data from the site. Laboratory control sample and control sample duplicate results were acceptable. There was low-level method blank contamination with isotopes of uranium and strontium in method blanks applicable to the aqueous and soil samples. The laboratory appropriately flagged sample results with "B" indicating associated blank contamination. During review, several of the blank-contamination-flagged analysis results were further qualified with "U" for undetected when the sample analysis value was less than 5-times the activity found in the method blank.

Reviewer comments and assigned qualifiers (if any) relevant to specific samples are found on the data validation forms. Unless noted otherwise, all analysis results are acceptable as reported. Please review the validation documentation and contact either myself or Pam Puissant, Dept. 7513, with any questions. Review comments have been provided to the SMO for inclusion and filing with the laboratory report original

If you have any questions or require additional information please contact me at 262-8920.

Respectfully submitted,

IT CORPORATION

Mark Lyon

Mark Lyon
Project Chemist

ML:dlr
Enclosures

Rvwd 11-9-95

DOCUMENTATION COMPLETENESS CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 1 - DV1)

Project Leader Carole Lojek / Devon Jevtovic / Lon Dawson Project Name OU 1333, ER Site 65 BK Canyon Test Areas Case No. 3621.400

AR/COC No. 05191 Analytical Lab Lockheed Analytical Svs. SDG No. L72066

In the tables below, mark any information that is missing or incorrect and give an explanation.

1.0 Analysis Request and Chain of Custody Record

Line No.	Item	Complete? Yes	Complete? No	If no, explain	Resolved? Yes	Resolved? No
1.1	All items on COC complete - data entry clerk initialed and dated	✓				
1.2	Container type(s) correct for analyses requested	✓				
1.3	Sample volume adequate for # and types of analyses requested	✓				
1.4	Preservative correct for analyses requested	✓				
1.5	Custody records continuous and complete	✓				
1.6	Lab sample number(s) provided	✓		OU Lab log-in documentation		
1.7	Condition upon receipt information provided	✓		Two samples for RAD had top off/broken - added to associated samples		
1.8	Tritium Screen data provided (Rad labs)			NOT APPLICABLE		

2.0 Analytical Laboratory Report

Line No.	Item	Complete? Yes	Complete? No	If no, explain	Resolved? Yes	Resolved? No
2.1	Data reviewed, signature	✓				
2.2	Date samples received	✓				
2.3	Method reference number(s) complete and correct	✓				
2.4	Quality control data provided (MB, LCS, LCD, Detection Limit)	✓				
2.5	Matrix spike/matrix spike duplicate data provided(if requested)	✓		Not requested - metals run batch MS/MSD		
2.6	Narrative provided	✓				
2.7	TAT met		✓	Original report 2 wks late - metals re-report 4 wks late		
2.8	Hold times met	✓				
2.9	All requested result data provided	✓				

Based on the review, this data package is complete ☑ Yes ☐ No

If no, provide : correction request tracking # _____ and date correction request was submitted: _____

Reviewed by: Mark Tyson Date: 9-19-96 Closed by: _____ Date: _____

DATA QUALITY INDICATOR CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 2—DV2)

Project Name OU 1333, ER Site 65 BK, Canyons Test Areas

Case Number 3621.400

Sample Numbers 029863-1-3, 029852-1-3, 029853-1-3, 029854-1,-3, 029855-1,-3
029856-1,-3, 029857-1,-3, 029859-1,-3, 029860-1,-3, 029861-01-03, 029862-01,-03
029858-01,-3

AR/COC No. 05191 Analytical laboratory Lockheed AS SDG No. L7206

AR/COC No. _____ Analytical laboratory _____ SDG No. _____

AR/COC No. _____ Analytical laboratory _____ SDG No. _____

AR/COC No. _____ Analytical laboratory _____ SDG No. _____

1.0 EVALUATION

Item	Yes	No	If no, Sample ID No./Fraction(s) and Analysis
1) Sample volume, container, and preservation correct?	✓		
2) Holding times met for all samples?	✓		
3) Reporting units appropriate for the matrix and meet project-specific requirements?	✓		
4) Quantitation limit met for all samples?	✓		
5) Accuracy a) Laboratory control sample accuracy reported and met for all samples?	✓		
b) Surrogate data reported and met for all organic samples analyzed by a gas chromatography technique?	/		Not Applicable

Reviewed by: Mark Lyon

Date: 9-20-96

DATA QUALITY INDICATOR CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 2—DV2)

Item	Yes	No	If no, Sample ID No./Fraction(s) and Analysis
c) Matrix spike recovery data reported and met for all samples for which it was requested?	✓		NOT Requested - batch MS/MSD reported for metals was from other SNL/NM ARCOCs
6) Precision a) Laboratory control sample precision reported and met for all samples?	✓		
b) Matrix spike duplicate RPD data reported and met for all samples for which it was requested?	✓		See (5c) above
7) Blank data a) Method or reagent blank data reported and met for all samples?		✓	Estimated "J" values in metals method blank for soils & water; Positive values above MDA in Radiochem method blank - see comment
b) Sampling blank (e.g., field, trip, and equipment) data reported and met?	✓	*	Estimated "J" values for barium & silver in equip blank - Possible low Rad values in Equip blank see comments.
8) Narrative included, correct, and complete?	✓		

2.0 COMMENTS: All items marked "No" above must be explained in this section. For each item, give SNL/NM ID No. and the analysis, if appropriate, of all samples affected by the finding.

7(a) Aqueous method blank contained 0.0012 mg/L cadmium and 0.0020 mg/L silver. Both estimated "J" values less than reporting limit but will qualify associated concentrations in equipment blank sample 029863. Estimated "J" values for cadmium (0.43), chromium (0.66), and silver (0.51) all mg/kg in metals method blank. May

Reviewed by: Mark Lyon

Date: 9-20-96

DATA QUALITY INDICATOR CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 2—DV2)

2.0 COMMENTS CONTINUATION SHEET

quality associated soil sample results. In Radiochem method blanks: Water: Sr-90 (0.365), U-233/4 (0.149), U-238 (0.051) pci/L activities, all were below the laboratory acceptance limit and all affected sample results are qualified w/ "B" flag in report. Soils Sr-90 (0.321), U-233/4 (0.0561), and U-235 (0.0102) in method blank all were less than laboratory's acceptance limit and all associated sample results are qualified with "B" flags in the report.

7(b). In equipment blank sample 029863 estimated silver value of 0.0026 mg/L is qualified as non-detect because it is less than 5X the method blank silver value of 0.0020 mg/L. Lab contamination is suspected.

The following samples are qualified as nondetect in soil samples because of method blank samples contamination - 029854-01 (Cd, Ag), 029855 (Cd), 029858 (Cd), 029859 (Cd), Several radiochem results are qualified as undetected because of lab method blank contamination: 029863-03 U-233/4 (0.103), U-238 (0.128) pci/L, Sr-90 (0.31); ~~029852 - U-233/4 (0.745)~~ mcc 029852, U-235 (0.053), 029853 U-235 (0.046), 029854, U-235 (0.035), 029855, U-235 (0.037), 029856, Sr-90 (0.33) U-235 (0.0120), 029857, U-235 (0.041), 029858, Sr-90 (0.35) 029858 U-235 (0.028), 029860 U-235 (0.046), 029862, U-235 (0.047)

Reviewed by: Mark Lyon

Date: 9-20-96

DATA QUALITY INDICATOR CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 2—DV2)

3.0 SUMMARY: Summarize the findings in the table below. List only samples/fractions for which deficiencies have been noted. Use the qualifiers given at the end of the table if possible. Explain any other qualifiers in the comments column.

Sample/ Fraction No.	Analysis	Qualifiers	Comments
029863-01	Silver-Ag	U	value less than 5 times value in lab method blank, lab contamination suspected
029854-01	cadmium-Cd	U	
029854-01	silver-Ag	U	
029855-01	cadmium-Cd	U	
029858-01	cadmium-Cd	U	
029859-01	cadmium-Cd	U	
029863-03	U-233/4	U	
029863-03	U-238	U	
029863-03	Sr-90	U	

Attach continuation sheet for additional samples

QUALIFIERS:

J = Estimated quantity (provide reason)
B = Contamination in blank (indicate which blank)
P = Laboratory precision does not meet criteria
R = Reporting units inappropriate
N = There is presumptive evidence of the presence of the material
UJ = The material was analyzed for but was not detected. The associated value is an estimate and may be inaccurate or imprecise.
Q = Quantitation limit does not meet criteria
A = Laboratory accuracy does not meet criteria
U = Analyte is undetected (indicate which analyte and reason for qualification)
NJ = There is presumptive evidence of the presence of the material at an estimated quantity.

Reviewed by: Mark Jaramillo

Date: 4-20-94

DATA QUALITY INDICATOR CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 2—DV2)

SAMPLE FINDINGS SUMMARY CONTINUATION SHEET

Sample/ Fraction No.	Analysis	Qualifiers	Comments
~~029852-03~~	~~U-233/4~~	~~U~~	
029852-03	U-235	U	Value less than 5 times value in the lab method blank, lab contamination possible
029853-03	U-235	U	
029854-03	U-235	U	
029855-03	U-235	U	
029856-03	Sr-90	U	
029856-03	U-235	U	
029857-03	U-235	U	
029858-02	Sr-90	U	
029858-03	U-235	U	
029860-03	U-235	U	
029862-03	U-235	U	
029863-03	U-235	J	Estimated value is less than 2-sigma error, MDA, but greater than critical level

Reviewed by: Mark Lyon Approved by:* _____

Date: 9-20-96 Date: _____

*Task/Project Leader must approve data package.

TOP 9[illegible] ...
Rev. 1
Attachment A
November 1995

Dmd 11-9-95

DOCUMENTATION COMPLETENESS CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 1 - DV1)

Project Leader Carole Lojek / Devon Jerkovic Project Name OU 1333, ER Site 65 BKA Case No. 3621.400

AR/COC No. 05227 Analytical Lab Lockheed Analytical Svs. SDG No. L7178

In the tables below, mark any information that is missing or incorrect and give an explanation.

1.0 Analysis Request and Chain of Custody Record

Line No.	Item	Complete? Yes	Complete? No	If no, explain	Resolved? Yes	Resolved? No
1.1	All items on COC complete - data entry clerk initialed and dated	✓				
1.2	Container type(s) correct for analyses requested	✓				
1.3	Sample volume adequate for # and types of analyses requested	✓				
1.4	Preservative correct for analyses requested	✓				
1.5	Custody records continuous and complete	✓				
1.6	Lab sample number(s) provided	✓		with lab acknowledgement document		
1.7	Condition upon receipt information provided	✓		" " "		
1.8	Tritium Screen data provided (Rad labs)	—	—	Not Applicable		

2.0 Analytical Laboratory Report

Line No.	Item	Complete? Yes	Complete? No	If no, explain	Resolved? Yes	Resolved? No
2.1	Data reviewed, signature	✓				
2.2	Date samples received	✓				
2.3	Method reference number(s) complete and correct	✓				
2.4	Quality control data provided (MB, LCS, LCD, Detection Limit)	✓				
2.5	Matrix spike/matrix spike duplicate data provided(if requested)	✓		Not requested on ARCOC, Lab batch MS/MSD reported		
2.6	Narrative provided	✓				
2.7	TAT met		✓	Report received late, but less than 10 days over		
2.8	Hold times met	✓				
2.9	All requested result data provided	✓		Metals data re-formatted & reported 7/29/96		

Based on the review, this data package is complete ☑ Yes ☐ No

If no, provide : correction request tracking # _____ and date correction request was submitted: _____

Reviewed by: M. Lyon Date: 9-9-96 Closed by: _____ Date: _____

DATA QUALITY INDICATOR CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 2—DV2)

Project Name OU 1333 ER Site 65 BKA

Case Number 3621.402

Sample Numbers 029864 — 029877 inclusive

AR/COC No. 05227 Analytical laboratory Lockheed AS SDG No. L7178

AR/COC No. _____ Analytical laboratory _____ SDG No. _____

AR/COC No. _____ Analytical laboratory _____ SDG No. _____

AR/COC No. _____ Analytical laboratory _____ SDG No. _____

1.0 EVALUATION

Item	Yes	No	If no, Sample ID No./Fraction(s) and Analysis
1) Sample volume, container, and preservation correct?	✓		
2) Holding times met for all samples?	✓		
3) Reporting units appropriate for the matrix and meet project-specific requirements?	✓		
4) Quantitation limit met for all samples?	✓		
5) Accuracy a) Laboratory control sample accuracy reported and met for all samples?	✓		
b) Surrogate data reported and met for all organic samples analyzed by a gas chromatography technique?	/		NOT Applicable

Reviewed by: M. Lyon

Date: 9-9-96

DATA QUALITY INDICATOR CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 2—DV2)

2.0 COMMENTS CONTINUATION SHEET

(7a) Soil radiochem blanks for Th-228 and Sr 89/90 show activity greater than sample specific MDA. Associated sample analyses are flagged w/ qualifiers. Aqueous blank showed positive results above MDA for U-233/4 and U-238. The only affected sample is the Equipment Blank 029876-02, -03 which is flagged appropriately.

(7b) Equipment blank had positive values above MDA for U-233/4, U-235, and U-238. U-233/4 and U-238 are qualified non-detect because of lab method blank contamination. All values are low and near the MDA

Metals method blank showed no values above reporting limits Estimated "J" values > IDL < RL for cadmium 0.0012 mg/L silver 0.0020 mg/L, silver 0.42 ~~mg~~/kg

Metals Equipment blank shows estimated "J" values for barium 0.0012 mg/L and silver 0.0023 mg/L

Reviewed by: Mark Ya

Date: 9-10-96

DATA QUALITY INDICATOR CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 2—DV2)

SAMPLE FINDINGS SUMMARY CONTINUATION SHEET

Sample/ Fraction No.	Analysis	Qualifiers	Comments

Reviewed by: Mark Lyon

Date: 9-10-96

Approved by:* _____

Date: _____

*Task/Project Leader must approve data package.

INORGANIC DATA ASSESSMENT SUMMARY FORM
(Data Verification/Validation Level 3—DV3)

SITE OR PROJECT OU1333, ER Site 65 BKA — CASE NO. 3621.400

ANALYTICAL LABORATORY LAS L7178 — SAMPLE IDS 029864 — 029875, 029877

LABORATORY REPORT # L7178 — Soils; 029876 - water

TASK LEADER Carole Lojek / Dewan Jercinovic

NO. OF SAMPLES

DATA ASSESSMENT SUMMARY

		ICP	AA	MERCURY	CYANIDE
1.	HOLDING TIMES	✓		✓	
2.	CALIBRATIONS	✓		✓	
3.	BLANKS	U		✓	
4.	ICS	✓			
5.	LCS	✓			
6.	DUPLICATE ANALYSIS	✓		✓	
7.	MATRIX SPIKE	✓		✓	
8.	MSA				
9.	SERIAL DILUTION	✓			
10.	SAMPLE VERIFICATION	✓		✓	
11.	OTHER QC	✓		✓	
12.	OVERALL ASSESSMENT	✓		✓	

✓ (check mark) — Acceptable
Other — Qualified:
J - Estimate
UJ - Undetected, estimated
R - Unusable (analyte may or may not be present)

ACTION ITEMS: Qualify as "U" cadmium result in EB 029876-01 - due to method blank contamination. Other Kilauea results qualified in DV-2

AREAS OF CONCERN:

REVIEWED BY: M. Ryan

DATE REVIEWED: 9-12-96

INORGANIC DATA ASSESSMENT SUMMARY FORM
(Data Verification/Validation Level 3—DV3)

1.0 HOLDING TIMES

List holding time criteria used to evaluate samples, indicating which samples exceed the holding time. Holding time begins with validated time of sample collection.

Parameter	Holding Time Criteria	Sample ID	Days Holding Time was Exceeded	Action
RCRA metals + Be	6 mos			
Hg	28 day			
				All met holding times

Were the correct preservatives used? Yes ☑ No ☐

List below samples that were incorrectly preserved.

Sample No.	Type of Samples	Deficiency	Action

Reviewed By: Mark Lyon Date: 9-10-96

INORGANIC DATA ASSESSMENT SUMMARY FORM
(Data Verification/Validation Level 3—DV3)

Were the correlation coefficients for the calibration curves for AA, Hg, CN, and other spectrophotometric methods ≥0.995? (Check calculations performed for calibration curves.) Yes ☑ No ☐

If no, list: _____

Date	Analyte	Coefficient	Action	Samples Affected
6/25/96	Hg	r= 0.998952	none	

Check for transcription and calculation errors involving calibration summary forms and raw data. Briefly summarize errors and associated actions when data quality might have been affected.

3.0 BLANK ANALYSIS

3.1 Initial and Continuing Calibration Blanks

Have Initial and Continuing Calibration Blanks (ICB/CCB) been analyzed at the frequency required in the EPA method? Yes ☑ No ☐

If no, summarize problems and resolutions in the narrative report.

List analytes detected in ICB and CCBs below:

NOTE: For soil samples, convert blank values to mg/kg using digestion weights and volumes.

Analysis Date	ICB/CCB No.	Analyte	Conc.	Required Detection Limits	Action Level	Samples Affected
6/30/96	#3 7:33	Cadmium	0.26 mg/kg	0.98	1.3 mg/kg	029865-01 Cd, Ag
		Silver	0.34 mg/kg	2.0	1.7	
	#4 9:08	Cadmium	0.44 mg/kg	0.98	2.2	
		Silver	0.6 mg/kg	2.0	3.0	
		Chromium	0.66 mg/kg	12.0 ↓	3.3 ↓	
		Selenium	0.16 mg/kg	0.98 ↓	0.8	

Reviewed By: Mark Lyon Date: 9-10-96

INORGANIC DATA ASSESSMENT SUMMARY FORM
(Data Verification/Validation Level 3—DV3)

3.3 Field/Rinse/Equipment Blanks

Was a field/equipment blank analyzed as required by the EPA method or QAPjP? Yes ☑ No ☐

List below analytes detected in the field blanks. NOTE: For soil samples, calculate blank values using digestion weights and volumes.

Ag (silver) 0.0023 mg/L sample 029876-01
Cd (cadmium) 0.0012 mg/L ↓ ↓

Equip Blank samples will not qualify any soil samples

Collection Date	Blank ID	Analyte	Conc.	Required Detection Limits	Action Level	Samples Affected

4.0 ICP INTERFERENCE CHECK SAMPLE ANALYSIS

Was an ICP interference check sample (ICS) analyzed at the beginning and end of a run or at least twice every 8 hours? (Not required for Ca, Mg, K, and Na) Yes ☑ No ☐

Samples affected: not required in method 6010

Are the values of the ICS for solution AB within 80-120%R? Yes ☑ No ☐

If no, is the concentration of Al, Ca, Fe, or Mg lower than in ICS? Yes ☐ No ☐

Reviewed By: Mark Yan Date: 9-12-96

INORGANIC DATA ASSESSMENT SUMMARY FORM
(Data Verification/Validation Level 3—DV3)

List below any LCS recoveries not within limits.

Preparation Date	Analyte	%R	Action	Samples Affected

6.0 LABORATORY DUPLICATE ANALYSIS

Were laboratory duplicates analyzed at required frequency? Yes ☑ No ☐

Samples affected: LCS/LCD and MSD run in this batch
no straight duplicate was run nor required

Was laboratory duplicate analysis performed on field or equipment blanks? Yes ☐ No ☑

Samples affected: _____

Is any value for sample duplicate pair <PQL and the other value >10xPQL? Yes ☐ No ☑

Samples affected: _____

Reviewed By: Mark Lyon Date: 9-12-96

INORGANIC DATA ASSESSMENT SUMMARY FORM
(Data Verification/Validation Level 3—DV3)

Samples affected: Dup pair from field 029866-01 and 029877-01 both w/ descriptor GR-002-0-S As, Ba, Be, Pb all exceed 40 RPD - possibl. sample heterogeneity or else poor analytical precision - no qualifiers assigned

List below the analytes that do not meet RPD or PQL criteria. Use the same criteria as those used for laboratory duplicate analysis or criteria specified in EPA method or sampling plan.

Sample ID	Matrix	Collection Date	RPD	Control Limit	Action	Samples Affected

Check for transcription/calculation errors. Briefly summarize errors and associated actions when data quality might have been affects.

8.0 MATRIX SPIKE ANALYSIS

NOTE: *This matrix spike is a predigestion/predistallation spike.*

Was a matrix spike prepared and analyzed at the required frequency? Yes ☑ No ☐

Reviewed By: Mark Lyon Date: 9-12-96

INORGANIC DATA ASSESSMENT SUMMARY FORM
(Data Verification/Validation Level 3—DV3)

NOTE: If preparation blank spikes are analyzed, evaluate recoveries. These recoveries can indicate whether excursions in matrix spike recovery are caused by sample matrix effects or poor digestion efficiencies and/or problems with matrix spike solution. For example, if matrix spike recovery for selenium is 0% and preparation blank spike recovery for selenium is 92%, this may indicate sample matrix effects.

9.0 FURNACE ATOMIC ABSORPTION ANALYSIS

Were duplicate injections present for each sample, including required QC analyses (not required if MSA is done)? Yes ☐ No ☐

Samples affected: _____

_____

_____

Were postdigestion spikes analyzed for samples, including QC samples? Yes ☐ No ☐

Were postdigestion spikes analyzed at the required concentration? Yes ☐ No ☐

Samples affected: _____

_____

_____

Was a dilution analyzed for samples with postdigestion spike recovery <40%? Yes ☐ No ☐

Samples affected: _____

_____

_____

MSA Analysis (Method of Standard Additions)—MSA is required when serial dilutions are not with ± 10%. Was MSA required for any sample but not performed? Yes ☐ No ☐

Are MSA calculations outside the linear range of the calibration curve? Yes ☐ No ☐

Reviewed By: M. Lyon Date: 9-12-96

INORGANIC DATA ASSESSMENT SUMMARY FORM
(Data Verification/Validation Level 3—DV3)

11.0 SAMPLE RESULT VERIFICATION

11.1 Verification of Instrumental Parameters

Are instrument detection limits present and verified on a quarterly basis? Yes ☑ No ☐

Are IDLs present for each analyte and each instrument used? Yes ☑ No ☐

Is the IDL greater than the required detection limits for any analyte? Yes ☐ No ☑
(If IDL > required detection limits, flag values less than 5xIDL.)

Samples affected: _____

_____

_____

Are ICP Interelement Correction Factors established and verified annually? Yes ☑ No ☐

Are ICP Linear Ranges established and verified quarterly? Yes ☑ No ☐

If no for any of the above, review problems and resolutions in narrative report. _____

_____

_____

11.2 Reporting Requirements

Were sample results reported down to the PQL? Yes ☑ No ☐

If no, indicate necessary corrections. _____

_____

Were sample results that were analyzed by ICP for Se, Tl, As, or Pb at least 5xIDL? Yes ☐ No ☑
-Trace ICP used for all elements

Were sample weights, volumes, and dilutions taken into account when reporting sample results and detection limits? Yes ☑ No ☐ Results reported as-received, wet weight

Reviewed By: Mon Date: 9-12-96

ANALYTICAL RADIOCHEMISTRY DATA VALIDATION CHECKLIST

Project Name ER OU 1333				Site Name '65 BKA	
Laboratory Name/Job No./Batch No. Lockheed AS, 47178				Chain of Custody No. 05227	
Analysis Method Iso-Th, Iso-U, Sr-90				Parameter List: —	
REVIEW ITEM	YES	NO	NA	COMMENTS	
A. HOLDING TIMES					
1. Preparation and analysis holding times met?	✓				
2. Short-half life parameters analyzed for and checked?			✓		
B. CALIBRATION VERIFICATION					
1. Detectors numbered and documented?	✓				
2. Frequency: Daily ✓, weekly ____, or monthly ____?				Calibration for alpha spec and strontium w/newly prepared sources is approx. quarterly Cal. check daily.	
3. Acceptance criteria: Met?	✓				
C. LABORATORY CONTROL SAMPLES					
1. Standard: Independent, certified reference material?	✓				
2. Frequency: Each batch?	✓				
3. % Recovery 80-120% or ____?	✓			75-125% R for Sr-90	
D. METHOD BLANK					
1. Frequency: Each batch?	✓				
2. Matrix: Matrix specific?	✓				
3. Preparation: Entire procedure?	✓				
4. Blanks show contamination?	✓			See note	
E. MATRIX SPIKE					
1. Frequency: Each batch?		✓		MS/MSD not performed on Radiochem analyses	
2. Matrix: Matrix specific?		✓			
3. Preparation: Entire procedure?		✓			
4. % Recovery: 75-125% or ____?		✓			
F. ANALYTICAL YIELDS/OTHER					
1. Tracer: Correct type, recovery met?	✓				
2. Ingrowth and/or decay: Correct factors applied?	✓				
3. Solids density: Planchette loading <5 mg/cm²?	✓			for SR-90	
G. DUPLICATE					
1. Type: Lab or field?	✓			Lab Control Duplicate, Field Duplicate	
Frequency: Each batch?	✓			↓ ↓ ↓ ↓	
3. Matrix: Matrix specific?	✓				
4. Preparation: Entire procedure?	✓				

METALS ANALYSIS DATA VALIDATION CHECKLIST (CONTINUED)

Project Name	ER DU 1333			Site Name	65 BKA
Laboratory Name/Job No./Batch No.	Lockheed AS L7178			Chain of Custody No.	05227
Analysis Method	I-50-Th, I-50-U, S-90			Parameter List:	—
REVIEW ITEM	YES	NO	NA	COMMENTS	
H. ANALYTE DETECTION					
1. Detection limit sample/batch specific?	✓			Sample specific MDA & LC	
2. Errors evaluated?	✓				
3. False positives/negatives suspected?		✓		See note	

Reviewed by: Mark Ryan, ITC 9/16/96

ANALYTICAL RADIOCHEMISTRY DATA VALIDATION
CONTINUING COMMENT SHEET

Project Name	ER OU 1333	Site Name	65 BKA
Laboratory Name/Job No.	Lockheed AS, L7178	Chain of Custody	05227

REVIEW ITEM REFERENCE	COMMENT
B-1	Detector #8 is not functional on cal. check 6/13/96 w/ notation that it will be replaced (this is for alpha-spec). Have not found re-cal data for new detector. This will impact analysis for Iso-Th and Iso-U for 029868-03. Data appear consistent
D-4	Soil method blank above the MDA for Th-228 and Sr-90. Aqueous method blank above MDA for U-233/4 and U-238. Laboratory flagged the blank and samples accordingly.
H-3	Th-228 result is approx 10 X greater than other soil samples on 029867-03. Raw data does not indicate any discrepancies - the counts are there as is a higher than normal background correction. Recommend the lab re-check this results.

Reviewed by: _____

Regional Office

INTERNATIONAL TECHNOLOGY CORPORATION

5301 Central Avenue. N.E.—Suite 700
Albuquerque. New Mexico 87108-1513
505-262-8800
Fax: 505-262-8855

September 18, 1996

Project No. 301455.324.01.000

Sandia National Laboratories
Attn: Mr. Lon Dawson
Department 7582
P.O. Box 5800, M/S 1147
Albuquerque, New Mexico 87185-1147

Data Validation for Operable Unit 1333,
Environmental Restoration Site 65 E Analysis Reports

Dear Mr. Dawson:

Data validation levels 1 and 2 (DV1 and DV2) were performed on one laboratory analytical data package containing sample analysis results, summary quality control data, and raw laboratory data for soil and water samples collected at Environmental Restoration (ER) Site 65 E. Data validation was performed in accordance with the Sandia National Laboratories/New Mexico Sample Management Office procedure, "Verification and Validation of Chemical and Radiochemical Data, TOP 94-03." These samples were collected at ER Site 65 E and recorded on analysis request and chain of custody (ARCOC) 05237. The analyses were performed at Lockheed Analytical Services laboratory and released in report numbered L7242. Any typographical or transcription errors that were identified were either hand corrected, initialed and dated, or corrected analytical reports were requested and obtained from the laboratory. Data validation findings are discussed below.

Lockheed Analytical Report L7242 (ARCOC 05237)

Soil and aqueous equipment blank samples were analyzed for Resource Conservation and Recovery Act (RCRA) regulated metals plus beryllium and explosives residues by Method 8330. Soil samples were designated as field duplicate samples on the ARCOC. Parent samples of the soil duplicate samples are not indicated on the ARCOC.

RCRA Metals plus Beryllium

RCRA toxic characteristic metals list plus beryllium were analyzed and reported on a total metal, as-received (wet weight) basis. Mercury was not detected in the soil samples, however the qualifiers "UJ" indicating an estimated reporting limit are assigned because of low bias reported for mercury in the laboratory control sample and laboratory-batch matrix spike and poor precision in the laboratory-batch matrix spike duplicate.

An estimated value for silver in the equipment rinsate blank sample was qualified with "U" for undetected because of contamination in the laboratory-batch method blank. Low-level contamination in the

laboratory method blanks for other metals did not qualify positive results in the associated soil or equipment blank samples.

Except as noted above, inductively coupled plasma emission spectroscopy (ICP and Trace-ICP) and atomic absorption cold-vapor analyses met quality control limits for accuracy, precision, and blank contamination evidenced by results reported for laboratory control sample, laboratory control sample duplicate, matrix spike, matrix spike duplicate, and laboratory method blank.

Explosives by Method 8330

Results for explosives residue analyses in soil and water are acceptable. All quality control measures met acceptance criteria or had no effect on the resulting data.

Reviewer comments and assigned qualifiers (if any) relevant to specific samples are found on the data validation forms. Unless noted otherwise, all analysis results are acceptable as reported. Please review the validation documentation and contact either myself or Pam Puissant, Dept. 7513, with any questions. Review comments have been provided to the SMO for inclusion and filing with the laboratory report original.

If you have any questions or require additional information please contact me at 262-8920.

Respectfully submitted,

IT CORPORATION

Mark Lyon

Mark Lyon
Project Chemist

ML:ca
Enclosures

SMO ANALYTICAL DATA ROUTING FORM

Project Name: CAUPONS TEST AREA Case Number: 3621.400

SNL Task Leader: C. J. LOJEK Org/Mail Stop: 7585/1148

SMO Project Coordinator: LYON Sample Ship Date: 6/14/96

ARCOC	Lab	Lab ID
0537	LAS	L7242

Date Results Received:

Preliminary: _____ Final: 7/29/96

Corrections Requested From Laboratory: _____ Requestor: _____

Date Corrections Received: _____

Date Assigned to SMO Reviewer: 7/29/96 Reviewer: LYON

Date Review Complete: 9-16-9-17-96 MLL Signature: Mark Lyon

Date of Preliminary Notification: _____ Person Notified: _____

Date of Final Transmittal: 9-17-96 Transmitted To: Lon Dawson

Transmitted By: Mark Lyon Filed In Record Center: _____

Comments: DV1 and DV2 completed 9/17/96

TOP 94-03
Rev. 1
Attachment A
November 1995

Dmd 11-9-95

DOCUMENTATION COMPLETENESS CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 1 - DV1)

Project Leader Carole Lojek / Devon Jerricovic / Lon Dawson Project Name Canyons Test Areas ERSite 65E Case No. 3621.400

AR/COC No. 05237 Analytical Lab Lockheed Analytical Svs. SDG No. L7242

In the tables below, mark any information that is missing or incorrect and give an explanation.

1.0 Analysis Request and Chain of Custody Record

Line No.	Item	Complete? Yes	Complete? No	If no, explain	Resolved? Yes	Resolved? No
1.1	All items on COC complete - data entry clerk initialed and dated	✓				
1.2	Container type(s) correct for analyses requested	✓				
1.3	Sample volume adequate for # and types of analyses requested	✓				
1.4	Preservative correct for analyses requested	✓				
1.5	Custody records continuous and complete	✓				
1.6	Lab sample number(s) provided	✓		ON Lab log in pages provided		
1.7	Condition upon receipt information provided	✓		In laboratory narrative		
1.8	Tritium Screen data provided (Rad labs)			NOT APPLICABLE		

2.0 Analytical Laboratory Report

Line No.	Item	Complete? Yes	Complete? No	If no, explain	Resolved? Yes	Resolved? No
2.1	Data reviewed, signature	✓				
2.2	Date samples received	✓				
2.3	Method reference number(s) complete and correct	✓				
2.4	Quality control data provided (MB, LCS, LCD, Detection Limit)	✓				
2.5	Matrix spike/matrix spike duplicate data provided(if requested)	✓		Not requested but reported for some batch QC		
2.6	Narrative provided	✓				
2.7	TAT met		✓	Report approx. 2 wks late past 30 days		
2.8	Hold times met	✓				
2.9	All requested result data provided	✓				

Based on the review, this data package is complete ☑ Yes ☐ No

If no, provide : correction request tracking # _____ and date correction request was submitted: _____

Reviewed by: Mark Lyon Date: 9-17-96 Closed by: _____ Date: _____

DATA QUALITY INDICATOR CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 2—DV2)

Project Name Canyons Test Areas KR Site 65E

Case Number 3621.400

Sample Numbers 029926-04,05, 029727-04,05, 029910-04,05, 029923-04,05

AR/COC No. 25237 Analytical laboratory Lockheed AS SDG No. L7242

AR/COC No. _____ Analytical laboratory _____ SDG No. _____

AR/COC No. _____ Analytical laboratory _____ SDG No. _____

AR/COC No. _____ Analytical laboratory _____ SDG No. _____

1.0 EVALUATION

Item	Yes	No	If no, Sample ID No./Fraction(s) and Analysis
1) Sample volume, container, and preservation correct?	✓		
2) Holding times met for all samples?	✓		
3) Reporting units appropriate for the matrix and meet project-specific requirements?	✓		
4) Quantitation limit met for all samples?	✓		
5) Accuracy a) Laboratory control sample accuracy reported and met for all samples?		✓	Mercury in soil LCS recovery for batch 38347 low biased
b) Surrogate data reported and met for all organic samples analyzed ~~by a gas chromatography technique~~?	✓		For HPLC Exp. by 8330 all good

Reviewed by: Mark Yow

Date: 9-17-96

DATA QUALITY INDICATOR CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 2—DV2)

Item	Yes	No	If no, Sample ID No./Fraction(s) and Analysis
c) Matrix spike recovery data reported and met for all samples for which it was requested?	✓		NOT REQUESTED - but batch QC showed low bias MS/MSD for mercury in D29910-04 soils
6) Precision a) Laboratory control sample precision reported and met for all samples?	✓		
b) Matrix spike duplicate RPD data reported and met for all samples for which it was requested?	✓	1	Precision for batch QC mercury at 21% MSD in soils exceeds precision limits
7) Blank data a) Method or reagent blank data reported and met for all samples?		✓	Soils - "J" value est. conc. of cadmium & silver in water, in soil "J" value barium and positive value lead
b) Sampling blank (e.g., field, trip, and equipment) data reported and met?	✓		"J" value est. concentrations of arsenic & silver, in equip blank D29926-004 below reporting limit
8) Narrative included, correct, and complete?	✓		

2.0 COMMENTS: All items marked "No" above must be explained in this section. For each item, give SNL/NM ID No. and the analysis, if appropriate, of all samples affected by the finding.

(5a)(5c)(6b) mercury in soils will be qualified by low LCS, MS, recoveries, and poor MSD precision

(7a) Silver in aqueous method blank will qualify silver in equip. blank D29926-04

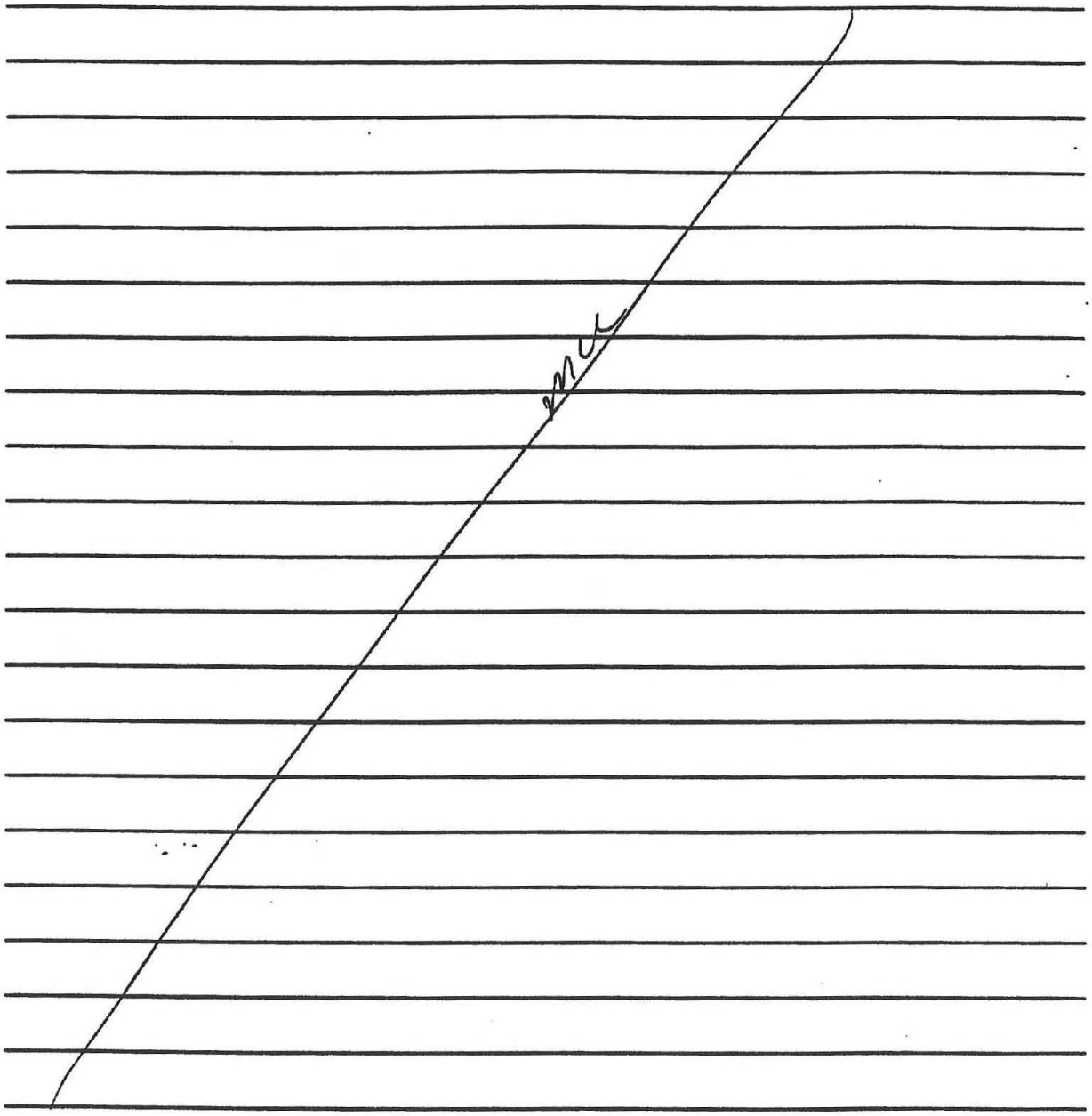
(7b) Arsenic in equip blank is too low to qualify soil sample values.

Reviewed by: Mark Ryan

Date: 9-17-94

DATA QUALITY INDICATOR CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 2—DV2)

2.0 COMMENTS CONTINUATION SHEET



Reviewed by: Mark Upson

Date: 9-17-96

DATA QUALITY INDICATOR CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 2—DV2)

3.0 SUMMARY: Summarize the findings in the table below. List only samples/fractions for which deficiencies have been noted. Use the qualifiers given at the end of the table if possible. Explain any other qualifiers in the comments column.

Sample/ Fraction No.	Analysis	Qualifiers	Comments
029910-04	Hg-mercury	UJ/AP	LCS, LCD, MSD low bias accuracy, poor precision -
029923-04	Hg-mercury	UJ/AP	actual reporting limit should be higher
029926-04	Ag-silver	U	Sample value is less than 5 times method blank value

Attach continuation sheet for additional samples

QUALIFIERS:

- J = Estimated quantity (provide reason)
- B = Contamination in blank (indicate which blank)
- P = Laboratory precision does not meet criteria
- R = Reporting units inappropriate
- N = There is presumptive evidence of the presence of the material
- UJ = The material was analyzed for but was not detected. The associated value is an estimate and may be inaccurate or imprecise.
- Q = Quantitation limit does not meet criteria
- A = Laboratory accuracy does not meet criteria
- U = Analyte is undetected (indicate which analyte and reason for qualification)
- NJ = There is presumptive evidence of the presence of the material at an estimated quantity.

Reviewed by: Mark Lya

Date: 9-17-96

DATA QUALITY INDICATOR CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 2—DV2)

SAMPLE FINDINGS SUMMARY CONTINUATION SHEET

Sample/ Fraction No.	Analysis	Qualifiers	Comments

Reviewed by: Mark Logan

Date: 9-17-96

Approved by:* _____

Date: _____

*Task/Project Leader must approve data package.

Regional Office

INTERNATIONAL TECHNOLOGY CORPORATION

5301 Central Avenue, N.E.—Suite 700
Albuquerque, New Mexico 87108-1513
505-262-8800
Fax: 505-262-8855

September 18, 1996

Project No. 301455.324.01.000

Sandia National Laboratories
Attn: Mr. Lon Dawson
Department 7582
P.O. Box 5800, M/S 1147
Albuquerque, New Mexico 87185-1147

Data Validation for Operable Unit 1333,
Environmental Restoration Site 65 E Analysis Reports

Dear Mr. Dawson:

Data validation levels 1 and 2 (DV1 and DV2) were performed on one laboratory analytical data package containing sample analysis results and summary quality control data for soil and water samples collected at Environmental Restoration (ER) Site 65 E. Data validation was performed in accordance with the Sandia National Laboratories/New Mexico Sample Management Office procedure, "Verification and Validation of Chemical and Radiochemical Data, TOP 94-03." These samples were collected at ER Site 65 E and recorded on analysis request and chain of custody (ARCOC) 05358. The analyses were performed at Lockheed Analytical Services laboratory and released in report numbered L7186. Any typographical or transcription errors that were identified were either hand corrected, initialed and dated, or corrected analytical reports were requested and obtained from the laboratory. Data validation findings are discussed below.

Lockheed Analytical Report L7186 (ARCOC 05358)

Soil and aqueous equipment blank samples were analyzed for Resource Conservation and Recovery Act (RCRA) regulated metals plus beryllium and explosives residues by Method 8330. Soil samples were designated as field duplicate samples on the ARCOC. Parent samples of the soil duplicate samples are not indicated on the ARCOC.

RCRA Metals plus Beryllium

RCRA toxic characteristic metals list plus beryllium were analyzed and reported on a total metal as-received (wet weight) basis. Estimated laboratory "J" flagged values for cadmium in two soil samples were qualified during the review as "U" or undetected because of laboratory method blank contamination. Similarly, an estimated value for silver in one of the equipment blank samples was qualified in the review as "U" for undetected.

nductively coupled plasma emission spectroscopy (ICP and Trace-ICP) and atomic absorption cold-vapor analyses generally met quality control limits for accuracy, precision, and blank contamination as

evidenced by results reported for laboratory control sample, laboratory control sample duplicate, matrix spike, matrix spike duplicate, and laboratory method blank.

Explosives by Method 8330

Analysis of the aqueous equipment blank samples for explosives residues was rejected as unusable during the data review. Initial extraction and analysis of the samples was reported by the laboratory to be contaminated with nontarget compounds that interfered with quantitation, surrogate recoveries, and quality control. Reextraction and analysis of the aqueous samples was performed outside of the extraction holding time and showed unacceptable control sample recoveries and precision. Matrix spike and matrix spike duplicate were not performed in the aqueous matrix because of limited sample volume.

Soil sample results for explosives residues are acceptable. All quality control measures met acceptance criteria or had no effect on the resulting data.

Reviewer comments and assigned qualifiers (if any) relevant to specific samples are found on the data validation forms. Unless noted otherwise all analysis results are acceptable as reported. Please review the validation documentation and contact either myself or Pam Puissant, Dept. 7513, with any questions. Review comments have been provided to the SMO for inclusion and filing with the laboratory report original.

If you have any questions or require additional information please contact me at 262-8920.

Respectfully submitted,

IT CORPORATION

Mark Lyon

Mark Lyon
Project Chemist

ML:ca
Enclosures

AL/9-96/WP/SNL:L-Dawson

SMO ANALYTICAL DATA ROUTING FORM

Project Name: CANYON STEST AREA Case Number: 3621.400

SNL Task Leader: C. & COTEK Org/Mail Stop: 7585 / 1148

SMO Project Coordinator: LYON Sample Ship Date: 6/7/96

ARCOC	Lab	Lab ID
05358	CAS	L7186

Date Results Received:

Preliminary: _____ Final: 7/29/96

Corrections Requested From Laboratory: _____ Requestor: _____

Date Corrections Received: _____

Date Assigned to SMO Reviewer: 7/29/96 Reviewer: LYON

Date Review Complete: 9-16-96 Signature: M. Lyon

Date of Preliminary Notification: _____ Person Notified: _____

Date of Final Transmittal: 9-17-96 Transmitted To: Lon Dawson

Transmitted By: M. Lyon Filed In Record Center: _____

Comments: _____

DV2 completed 9-17-96

TOP 94-03
Rev. 1
Attachment A
November 1995

Dmd 11-9-95

DOCUMENTATION COMPLETENESS CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 1 - DV1)

Project Leader Carole Lyrk / Donna Jerrenaire Low Dawson Project Name DU 1333 Canyons Test Area Site 65E Case No. 0362 1.400

AR/COC No. 05358 Analytical Lab Lockheed Analytical Svs. SDG No. L 7186

In the tables below, mark any information that is missing or incorrect and give an explanation.

1.0 Analysis Request and Chain of Custody Record

Line No.	Item	Complete? Yes	Complete? No	If no, explain	Resolved? Yes	Resolved? No
1.1	All items on COC complete - data entry clerk initialed and dated		✓	No logbook or collection log reference		✓
1.2	Container type(s) correct for analyses requested	✓				
1.3	Sample volume adequate for # and types of analyses requested	✓				
1.4	Preservative correct for analyses requested	✓				
1.5	Custody records continuous and complete	✓				
1.6	Lab sample number(s) provided	✓		DU Lab log in sheets included		
1.7	Condition upon receipt information provided	✓				
1.8	Tritium Screen data provided (Rad labs)			NOT REQUIRED		

2.0 Analytical Laboratory Report

Line No.	Item	Complete? Yes	Complete? No	If no, explain	Resolved? Yes	Resolved? No
2.1	Data reviewed, signature	✓				
2.2	Date samples received	✓				
2.3	Method reference number(s) complete and correct	✓				
2.4	Quality control data provided (MB, LCS, LCD, Detection Limit)	✓				
2.5	Matrix spike/matrix spike duplicate data provided(if requested)	✓		Not requested but batch MS/MSD provided		
2.6	Narrative provided	✓				
2.7	TAT met		✓	Report recd late by approx 3wks	✓	
2.8	Hold times met		✓	Some re-extractions, re-analyses outside HT	✓	
2.9	All requested result data provided	✓				

Based on the review, this data package is complete ☐ Yes ☑ No

If no, provide : correction request tracking # _____ and date correction request was submitted: _____

Reviewed by: Mark Lyer Date: 9-16-96 Closed by: _____ Date: _____

DATA QUALITY INDICATOR CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 2—DV2)

Project Name 8U 1333 Canyons Test Area

Case Number 3621.400

Sample Numbers 029903-04,05; 029896-04,05; 029889-04,05; 029884-04,-05

AR/COC No. 05358 Analytical laboratory Lockheed A S SDG No. L7186

AR/COC No. _____ Analytical laboratory _____ SDG No. _____

AR/COC No. _____ Analytical laboratory _____ SDG No. _____

AR/COC No. _____ Analytical laboratory _____ SDG No. _____

1.0 EVALUATION

Item	Yes	No	If no, Sample ID No./Fraction(s) and Analysis
1) Sample volume, container, and preservation correct?	✓		
2) Holding times met for all samples?		✓	Re-extraction for re-analysis of 029903-05 and 029889-05 outside hold time
3) Reporting units appropriate for the matrix and meet project-specific requirements?	✓		
4) Quantitation limit met for all samples?	✓		
5) Accuracy a) Laboratory control sample accuracy reported and met for all samples?		✓	Batch 37905 LCS/LCD - Aqueous Exp Analysis for 029903-05 and 029889-05; and Batch B38230 for re-analysis of above
b) Surrogate data reported and met for all organic samples analyzed ~~by a gas chromatography technique~~? MLL		✓	029903-05 for explosives Analysis

Reviewed by: MLyon

Date: 9-17-96

DATA QUALITY INDICATOR CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 2—DV2)

Item	Yes	No	If no, Sample ID No./Fraction(s) and Analysis
c) Matrix spike recovery data reported and met for all samples for which it was requested?		✓	MS for Explosives in soil on 029896-05 was high bias for 3-Nitrotoluene
6) Precision a) Laboratory control sample precision reported and met for all samples?		✓	37905 Batch LCD for Explosives in Aqueous Poor RPD for 1,3-Dinitrotoluene, nitrobenzene 38230 Batch LCD review of 37905 nitro benzene and nitrotoluene poor
b) Matrix spike duplicate RPD data reported and met for all samples for which it was requested?		✓	MSD for explosives in soil was high bias for 3-nitrotoluene
7) Blank data a) Method or reagent blank data reported and met for all samples?		✓	estimated "J" value less than reporting limit cadmium and silver in metals method blanks for both aqueous and soil, also chromium in Soil MB
b) Sampling blank (e.g., field, trip, and equipment) data reported and met?	✓		"J" estimated value for silver in equipment blank 029903-004
8) Narrative included, correct, and complete?	✓		

2.0 COMMENTS: All items marked "No" above must be explained in this section. For each item, give SNL/NM ID No. and the analysis, if appropriate, of all samples affected by the finding.

See next page

Reviewed by: Mark Lyon

Date: 4-17-96

DATA QUALITY INDICATOR CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 2—DV2)

2.0 COMMENTS CONTINUATION SHEET

(2)(5a)(5b)(6a) Analysis for explosives in aqueous matrix, samples 029903-05 and 029889-05 originally extracted within holding time and analyzed in batch (QC) 37905 is rejected as unusable. Lab reported the entire batch contaminated w/ non-target compounds interfering with quantitation. Poor, low, surrogate recovery in 029903-005. Zero recovery in LCS for 4 compounds. Same 4 compounds outside control in LCD. 2 compounds out for RPD in LCD. Re-extraction ~~and re-analysis~~ was outside holding time, and re-analysis showed poor recovery and precision in LCD for 4 more compounds. See re-extraction analysis batch 36230. Re-analysis also rejected as unusable.

(5c)(6b) MS/MSD batch run explosives in soils on 029896-05 showed 3-Nitrotoluene % recovery with high bias above control limits Because soil samples are non-detect for 3-Nitrotoluene and MS/MSD bias is high this will not qualify explosives soil data

(7a)(7b) low level cadmium and silver in aqueous batch method blank, will qualify as non-detect to low level action in equipment blank 029903-004. Cadmium is qualified in soil samples.

Reviewed by: Mark Yow

Date: 9-17-96

DATA QUALITY INDICATOR CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 2—DV2)

3.0 SUMMARY: Summarize the findings in the table below. List only samples/fractions for which deficiencies have been noted. Use the qualifiers given at the end of the table if possible. Explain any other qualifiers in the comments column.

Sample/ Fraction No.	Analysis	Qualifiers	Comments
029903-05	Explosives 8330	A, P	Data unusable from original analysis
029889-05	↓ ↓	↓	and reanalysis. Poor accuracy, surrogate,
029896-04	Cd	U	precision, and/or hold time violated.
029884-04	↓	↓	Est. value is equivalent to conc. found in method blank
029903-04	Ag	↓	method blank conc. exceeds sample conc.

Attach continuation sheet for additional samples

QUALIFIERS:

- J = Estimated quantity (provide reason)
- B = Contamination in blank (indicate which blank)
- P = Laboratory precision does not meet criteria
- R = Reporting units inappropriate
- N = There is presumptive evidence of the presence of the material
- UJ = The material was analyzed for but was not detected. The associated value is an estimate and may be inaccurate or imprecise.
- Q = Quantitation limit does not meet criteria
- A = Laboratory accuracy does not meet criteria
- U = Analyte is undetected (indicate which analyte and reason for qualification)
- NJ = There is presumptive evidence of the presence of the material at an estimated quantity.

Reviewed by: M. Lyon

Date: 9-17-96

DATA QUALITY INDICATOR CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 2—DV2)

SAMPLE FINDINGS SUMMARY CONTINUATION SHEET

Sample/ Fraction No.	Analysis	Qualifiers	Comments

Reviewed by: Mark Yan

Date: 9-17-96

Approved by:* _____

Date: _____

*Task/Project Leader must approve data package.

TOP
Rev.
Attachment A
November 1995

DOCUMENTATION COMPLETENESS CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 1 - DV1)

Project Leader: Sharissa | Project Name: 65E HE Sampling | Case No: 7214.282

AR/COC No.: 510602 | Analytical Lab: ERCL | SDG No.: NA

In the tables below, mark any information that is missing or incorrect and give an explanation.

1.0 Analysis Request and Chain of Custody Record

Line No.	Item	Complete? Yes	Complete? No	If no, explain	Resolved? Yes	Resolved? No
1.1	All items on COC complete - data entry clerk initialed and dated	NA		Not applicable		
1.2	Container type(s) correct for analyses requested	✓				
1.3	Sample volume adequate for # and types of analyses requested	✓				
1.4	Preservative correct for analyses requested	✓				
1.5	Custody records continuous and complete	✓				
1.6	Lab sample number(s) provided	✓				
1.7	Condition upon receipt information provided	✓				
1.8	Tritium Screen data provided (Rad labs)	✓				

2.0 Analytical Laboratory Report

Line No.	Item	Complete? Yes	Complete? No	If no, explain	Resolved? Yes	Resolved? No
2.1	Data reviewed, signature	✓				
2.2	Date samples received	✓				
2.3	Method reference number(s) complete and correct	✓				
2.4	Quality control data provided (MB, LCS, LCD, Detection Limit)		✓	LCD not analyzed with submitted samples		
2.5	Matrix spike/matrix spike duplicate data provided(if requested)	✓		Note: not requested		
2.6	Narrative provided	✓				
2.7	TAT met	NA		Not applicable		
2.8	Hold times met	✓				
2.9	All requested result data provided	✓				

Based on the review, this data package is complete ☒ Yes ☐ No

If no, provide : correction request tracking # _____ and date correction request was submitted: _____

Reviewed by: Jeffrey A. Rabe Date: 6/10/98 Closed by: _____ Date: _____

DATA QUALITY INDICATOR CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 2—DV2)

Project Name 65E HE Sampling

Case Number 7214.282

Sample Numbers CY65E-GR-014-0-55 through CY65E-GR-013-0.5-5 (53 samples)

AR/COC No. 510602 Analytical laboratory ERCL SDG No. NA

AR/COC No. _____ Analytical laboratory _____ SDG No. _____

AR/COC No. _____ Analytical laboratory _____ SDG No. _____

AR/COC No. _____ Analytical laboratory _____ SDG No. _____

1.0 EVALUATION

Item	Yes	No	If no, Sample ID No./Fraction(s) and Analysis
1) Sample volume, container, and preservation correct?	✓		
2) Holding times met for all samples?	✓		
3) Reporting units appropriate for the matrix and meet project-specific requirements?	✓		
4) Quantitation limit met for all samples?	✓		
5) Accuracy a) Laboratory control sample accuracy reported and met for all samples?		NA	LCS not analyzed with submitted samples ①
b) Surrogate data reported and met for all organic samples analyzed by a gas chromatography technique?	✓		

Reviewed by: [signature]

Date: 6/10/98

DATA QUALITY INDICATOR CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 2—DV2)

Item	Yes	No	If no. Sample ID No./Fraction(s) and Analysis
c) Matrix spike recovery data reported and met for all samples for which it was requested?		✓	HE-019, HE-020, HE-021, HE-022 (PETN) MS %R not calculated. ②
6) Precision a) Laboratory control sample precision reported and met for all samples?		NA	LCS duplicate not analyzed with submitted samples ①
b) Matrix spike duplicate RPD data reported and met for all samples for which it was requested?		✓	HE-019, HE-020, HE-021, HE-022 (PETN) MSD %R and RPD not calculated. ②
7) Blank data a) Method or reagent blank data reported and met for all samples?	✓		
b) Sampling blank (e.g., field, trip, and equipment) data reported and met?	NA		Not applicable
8) Narrative included, correct, and complete?	✓		

2.0 COMMENTS: All items marked "No" above must be explained in this section. For each item, give SNL/NM ID No. and the analysis, if appropriate, of all samples affected by the finding.

① No laboratory control sample (LCS) or LCS duplicate was analyzed with submitted samples. Accuracy (%R) and Precision (RPD) was based on the results of the MS/MSD pair.

Reviewed by: Jeffrey J. Rabe

Date: 6/10/98

DATA QUALITY INDICATOR CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 2—DV2)

2.0 COMMENTS CONTINUATION SHEET

② Percent recovery (%R) could not be calculated for PETN in the MS and MSD samples due to a lack of a second source of PETN. Therefore accuracy and precision could not be calculated.

6/10/98 JR

Reviewed by: Jeffrey A. Rabe

Date: 6/10/98

DATA QUALITY INDICATOR CHECKLIST
(DATA VERIFICATION/VALIDATION LEVEL 2—DV2)

3.0 SUMMARY: Summarize the findings in the table below. List only samples/fractions for which deficiencies have been noted. Use the qualifiers given at the end of the table if possible. Explain any other qualifiers in the comments column.

Sample/ Fraction No.	Analysis	Qualifiers	Comments

see page 5 of 5

JK 6/10/98

Attach continuation sheet for additional samples

QUALIFIERS:

J = Estimated quantity (provide reason)
B = Contamination in blank (indicate which blank)
P = Laboratory precision does not meet criteria
R = Reporting units inappropriate
N = There is presumptive evidence of the presence of the material
UJ = The material was analyzed for but was not detected. The associated value is an estimate and may be inaccurate or imprecise.
Q = Quantitation limit does not meet criteria
A = Laboratory accuracy does not meet criteria
U = Analyte is undetected (indicate which analyte and reason for qualification)
NJ = There is presumptive evidence of the presence of the material at an estimated quantity.

Reviewed by: Jeffrey A. Rabe

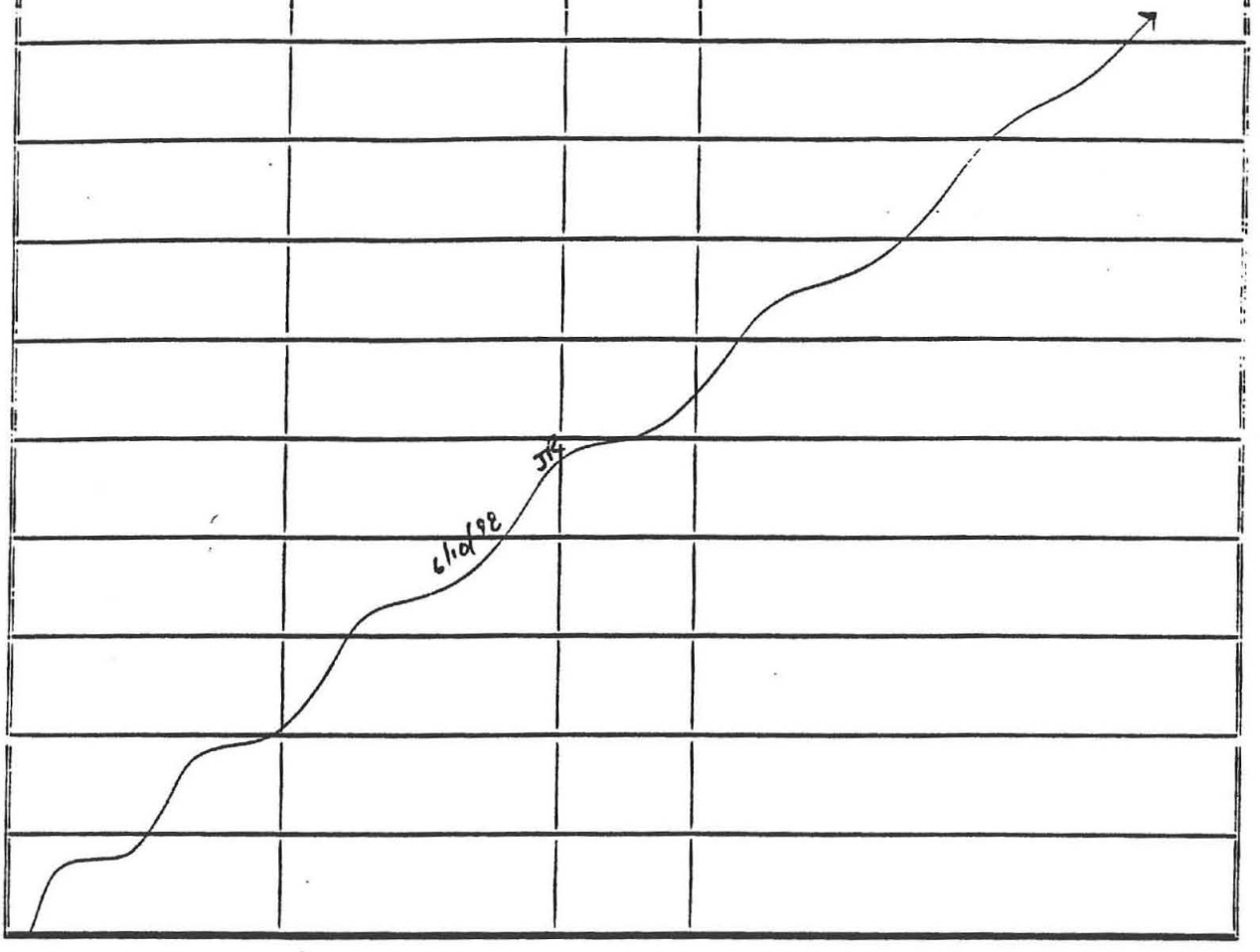
Date: 6/10/98

SAMPLE FINDINGS SUMMARY

Site: 65E HE Sampling

AR COC: 510602 Data Classification: DV-2

Sample Fraction No.	Analysis	DV Qualifiers	Comments
All submitted samples	78-11-5	UJ, A3, P2	(A3) Insufficient quality control data to determine laboratory accuracy.



Sample No.-Fraction No. - This value is located on the Chain of Custody in the ER Sample Id field.

Analysis - Use valid test methods provided below or if the result applies to an individual analyte within a test method. use the CAS number from the analytical data sheet.

DV Qualifiers - The entry will be taken from the list of valid qualifiers and associated comments. If other qualifiers not on the list are needed. contact Tina Sanchez to coordinate adding them to the list.

Comments - This is only to be used if a comment associated with the qualifier is not appropriate. needs modification because of an unusual circumstance. or additional clarification is warranted.

Test Methods - Anions_CE. EPA6010. EPA6020. EPA7470 I. EPA8015B. EPA8081. EPA8260. EPA8260-MB. EPA8270. HACH_ALK. HACH_NO2. HACH_NO3. MEKC_HE. PCBRISC

Reviewed by: Jeffrey A. Rale Date: 6/10/98

List of Data Qualifiers used in Data Validation and Associated Comment Responses

Qualifier	Comment
A	Laboratory accuracy and/or bias measurements for the associated Laboratory Control Sample (LCS) do not meet acceptance criteria.
A1	Laboratory accuracy and/or bias measurements for the associated Surrogate Spike do not meet acceptance criteria.
A2	Laboratory accuracy and/or bias measurements for the associated Matrix Spike (MS) do not meet acceptance criteria.
B	Analyte present in laboratory method blank
B1	Analyte present in trip blank.
B2	Analyte present in equipment blank.
B3	Analyte present in continuing calibration blank.
J	The associated value is an estimated quantity. (Note: this qualifier may be used in conjunction with other qualifiers (i.e., A,J)
J1	The method requirements for sample preservation/temperature were not met for the sample analysis. The associated value is an estimated quantity.
J2	The holding time was exceeded for the associated sample analysis. The associated value is an estimated quantity.
P	Laboratory precision measurements for the Laboratory Control Sample and duplicate (LCS/LCSD) do not meet acceptance criteria.
P1	Laboratory precision measurements for the Matrix Spike Sample and associated duplicate (MS/MSD) do not meet acceptance criteria.
P2	Insufficient quality control data to determine laboratory precision.
Q	Quantitation limit reported does not meet Data Quality Objective (DQO) requirements.
R	The data are unusable for their intended purpose (Note: Analyte may or may not be present.)
U	The analyte is a common laboratory contaminant. The associated result is less than ten times the concentration in any blank.
U1	The analyte was also detected in a blank. The associated result is less than five times the concentration in any blank.
UJ	The analyte was analyzed for but was not detected. The associated value is an estimate and may be inaccurate or imprecise.

* This is not a definitive list. Other qualifiers are potentially available, see TOP 94-03. Notify Tina Sanchez to revise list.

ANNEX 5-F
Risk Screening Assessment

TABLE OF CONTENTS

LIST OF TABLES

SWMU 65E: RISK SCREENING ASSESSMENT

I. Site Description and History

SWMU 65E is a subunit of SWMU 65, identified as the Lurance Canyon Explosives Test Site (LCETS), located on U.S. Air Force (USAF) land withdrawn from Bureau of Land Management (BLM) and permitted to the U.S. Department of Energy (DOE) (SNL/NM July 1994a). This site is situated on the canyon-floor alluvium in the upper reaches of the Lurance Canyon drainage. The Lurance Canyon drainage is surrounded by moderately steep sloping canyon walls, and the immediate topographic relief around the site is over 500 ft. A 25- to 50-ft-wide road is cut on the hill slopes as a firebreak and encircles the site. The canyon floor at the site is isolated by the canyon walls except for the western drainage into the Arroyo del Coyote. Coyote Springs Road follows this drainage and is the main access into the Lurance Canyon.

SWMU 65 was used from the late-1960s to the early 1990s for general explosives tests. The location of SWMU 65 is coincident with SWMU 94, Lurance Canyon Burn Site (LCBS), which is actively used for testing fire survivability of transportation equipment, storage equipment, simulated weapons, and satellite components. SWMU 94 activities began in the mid-1970s and continue to the present.

Based upon the location of detonations and the types of tests conducted at SWMU 65, the site has been divided into five subunits: SWMU 65A, Small Debris Mound; SWMU 65B, Primary Detonation Area; SWMU 65C, Secondary Detonation Area; SWMU 65D, Near Field Dispersion Area; and SWMU 65E, Far Field Dispersion Area. The SWMU 65 subunits are each addressed in separate risk screening assessments. SWMUs 65A, 65B, 65C, and 65D will be addressed in future NFA submittals.

SWMU 65E lies on approximately 77 acres of land at a mean elevation of 6,365 ft above sea level (SNL/NM April 1995). SWMU 65E represents the furthest extent (far-field) fragmentation area associated with the open detonation test at LCETS. The fragmentation area boundary was confirmed by the surface gamma radiation survey performed by RUST Geotech Inc. in December 1994 (RUST Geotech Inc. December 1994) and subsequent surveys performed in 1996 (SNL/NM September 1997a). No documented tests were conducted in this area, but the area is considered a dispersion area for general explosives testing activities in ER Sites 65B and 65C. The Lurance Canyon arroyo, which flows through the boundaries of SWMU 65E, may have also received materials from surface runoff and air dispersion.

Historical published information regarding the hydrogeology of Lurance Canyon has been summarized in the "RCRA [Resource Conservation Recovery Act] Facility Investigation (RFI) Work Plan for the OU 1333, Canyons Test Area" (SNL/NM September 1995). Since that time, additional bedrock wells and alluvial piezometers have been installed in the Lurance Canyon and data collected from the new bedrock wells have supported the hydrologic model of semiconfined to confined groundwater conditions at a depth of approximately 222 feet below ground surface (bgs) beneath the Lurance Canyon SWMUs. The data collected from the alluvial piezometers support the absence of alluvial groundwater. Hydrologic data has been based upon the Burn Site Well, CYN-MW1D, 12AUP01 (piezometer), and CYN-MW2S (piezometer).

In summary, the groundwater beneath the LCETS occurs at depths of at least 222 feet bgs under semiconfined to confined conditions in fractured metamorphic rock. There has been no record to date of shallow groundwater occurring in the alluvium overlying the bedrock.

Historical aerial photographs indicate that construction of LCETS had begun by October 1967; by 1971 the test site was in full operation, and several structures were visible (SNL/NM August 1994). A fire break road was constructed around the site between 1967 and mid-1971 to protect the surrounding area from accidental fires caused by detonation of explosives or burn testing (SNL/NM August 1994).

Interviews with past SNL/NM personnel have also been used to reconstruct historical operations at SWMU 65. SWMU 65 was established between 1967 (Larsen and Palmieri August 1994a) and 1969 (Palmieri December 1994a) as an explosives test area designed with a 10,000-foot dispersion radius to provide an adequate buffer for open detonations of up to 10,000 lb of high explosives (HE) (Gaither et al. May 1993, Author [unk] Date [unk], Larsen and Palmieri August 1994a, Larsen and Palmieri August 1994b). The majority of the open detonation explosives tests were conducted between 1967 and 1975. All open detonation explosives tests were concluded by the early 1980s (Larsen and Palmieri August 1994b). The frequency of testing at SWMU 65 between 1968 and 1980 has been estimated at 20 tests per year (Gaither et al. May 1993, Author [unk] Date [unk]). Based upon information provided in the interviews, open detonation explosives tests were conducted within the primary (SWMU 65B) and secondary (SWMU 65C) detonation areas.

In addition to open detonation explosives tests, fuel-fire burn tests of test units containing explosives were conducted at SWMU 65 using excavated pits from 1969 to 1979 (Littrell February 1969, Jercinovic et al. November 1994). Portable pans and engineered burn structures completely replaced burn pit tests by 1979 (Jercinovic et al. November 1994). From the mid-1970s, a variety of nonpetroleum-fuel-fire burn tests were conducted. These tests included slow-heat detonations (1983 to 1986) (Luna June 1983, Luna October 1985, Moore and Luna February 1982), Torch-Activated Burn System (TABS) tests (1975 to 1977) (Kurowski January 1979, Jercinovic et al. November 1994, Larsen August 1994), rocket propellant burn tests (1984 to 1993) (Palmieri December 1994b, Hickox and Abitz December 1994), liquid oxygen torch tests (1984 to 1985) (Hickox and Abitz December 1994), and wood crib fire tests (1988 to 1989) (Hickox and Abitz December 1994). Small explosive tests were also conducted in the former CON-CON Unit in 1982 (SNL/NM August 1986, Church March 1982).

A radiological Voluntary Corrective Measure (VCM) was completed in October 1996 at the site to remove all point source and area source gamma radiation anomalies (SNL/NM September 1997).

II. Comparison of Results to Data Quality Objectives

The confirmatory sampling conducted at SWMU 65E was designed to collect adequate samples to:

- Determine whether hazardous waste or hazardous constituents have been released at the site

- Characterize the nature and extent of any releases
- Provide sufficient quality of analytical data to support screening risk assessments.

Table 1 summarizes the sample location design for SWMU 65E. SWMU 65E is designated the field dispersion area and the primary source of COCs at SWMU 65E was general explosive tests and burn tests conducted on weapons and HE-containing devices at SWMU 65B and 65C. Following detonations, atmospheric fallout of test material shrapnel potentially released COCs to surface and near-surface soils at SWMU 65E. Based upon the surficial nature of the contaminant release mechanism at the site and the lack of industrial disturbance or development, no COCs are anticipated in the subsurface. Sampling activities were initially conducted in June 1996. However, because the on-site HE analysis of samples specified in the OU 1333 work plan (SNL/NM September 1995) was not executed on the samples, the site was resampled for HE compounds in March 1998.

The number and location of the samples collected was based upon historical information and the findings of previous investigations and remedial activities conducted at the site. Historical information was used to determine the potential impacts to surface and near-surface soils from test activities. Since the explosives tests did not result in any direction-specific release of potential COCs, SWMU 65E was gridded into approximately 100, 185- by 185-foot cells, and ten random sample locations were selected (SNL/NM September 1995). Six judgmental sample locations were selected on the six highest pre-VCM gamma radiation point or source area anomalies. Identification of a small debris mound in June 1996, resulted in additional sample locations (not specified in OU 1333 work plan) to investigate the mound contents and any potential release associated with the mound. Five sample locations were also selected within the Lurance Canyon main arroyo channel located in the LCETS Far-Field Dispersion Area. However, results from the Lurance Canyon arroyo sediment investigation have been excluded from the SWMU 65E assessment and will be addressed in subsequent SNL/NM site-wide surface water characterization activities (NMED May 1997 and NMED DOE OB February 1998).

Table 2 summarizes the analytical methods and data-quality requirements necessary (1) to adequately characterize hazardous waste or hazardous constituents associated with the materials used in tests conducted at Lurance Canyon Explosive Test Site and (2) to support risk screening assessments.

A total of 20 locations were sampled at SWMU 65E and analyzed by Sandia National Laboratories/New Mexico (SNL/NM) on-site laboratories. Approximately 15 percent of the samples collected were analyzed in replicate on site. In addition, all replicate samples were split for verification analysis of metals and HE compounds off site. The method detection limits (MDLs) for all on-site analyses of total metals exceeded the background concentration limits for arsenic, cadmium, mercury, selenium, and silver. However, the MDL for on-site analysis of mercury is very close to the background concentration limit. The on-site analysis MDL for mercury is 0.06 milligrams (mg)/kilogram (kg) as compared to the background concentration limit of 0.055 mg/kg. The off-site laboratories provided a lower MDL for metals analyses, with only a single exception. The MDL used by Lockheed Analytical Services for the analysis of mercury ranged from 0.095 to 0.10 mg/kg.

All gamma spectroscopy data were reviewed by SNL/NM Department 7713 (Radiation Protection Sample Diagnostic [RPSD] Laboratory) according to "Laboratory Data Review Guidelines," Procedure No. RPSD-02-11, Issue No. 02 (SNL/NM July 1996). On-site and

Table 1
Summary of Sampling Performed to Meet Data Quality Objectives

SWMU 65E Sampling Components	Potential COC Source	Number of Sampling Locations	Sample Density	Sampling Location Rationale
Random Grid	Test material shrapnel deposited onto surface and near-surface soil as a result of atmospheric fallout following detonation of test devices	10	Ten random sample locations selected from 100, 185- by 185-foot grid cells.	To assess the nature and extent of test material shrapnel dispersed over the site by collecting surface (0 to 6 inches) and near-surface (6 to 12 inches) samples from each random grid location.
Judgmental	Test material shrapnel deposited onto surface and near-surface soil as a result of atmospheric fallout following detonation of test devices	6	Six judgmental sample locations selected from six highest pre-VCM gamma radiation point source or area source anomalies.	To confirm remediation of gamma radiation point source and area source anomalies by collecting surface (0 to 6 inches) and near-surface (6 to 12 inches) samples from each judgmental location.
Debris Mound	Debris mound origin and contents unknown	4	Two sample locations on the mound surface; two sample locations underlying the mound.	To investigate the mound contents and any potential release from the mound.
Lurance Canyon Arroyo	Test material shrapnel deposited onto surface and near-surface arroyo sediments as a result of atmospheric fallout following detonation of test devices	5	Five judgmental sample locations spaced approximately 500 feet apart starting at the confluence of the southern tributary and ending just downstream from the SWMU 65E boundary.	To assess the nature and extent of test material shrapnel dispersed over the site and investigate the potential for surface-water transport of COCs.

COC = Constituent of concern.
SWMU = Solid waste management unit.
VCM = Voluntary corrective measure.

Table 2
Summary of Data Quality Requirements

Analytical Requirement	Data Quality Level	ER Chemistry Laboratory Department 6133 SNL/NM	Radiation Protection Sample Diagnostics Laboratory Department 7713 SNL/NM	Lockheed Analytical Services Las Vegas, Nevada
RCRA metals plus beryllium EPA Method 6010/7000[a]	Level 3	45 samples 3 (internal duplicates	Not applicable	4 samples (off-site split duplicates)
HE compounds EPA Method 8330[a] (or equivalent)	Level 3	45 samples 4 (internal duplicates)	Not applicable	4 samples (off-site split samples)
Gamma Spectroscopy	Level 2	Not Applicable	21 samples 3 (internal duplicates)	Not applicable
Gross Alpha/Gross Beta EPA Method 900.0[a] (arroyo sediment samples only)	Level 2	Not Applicable	10 samples 1 (internal duplicate)	Not Applicable

[a]EPA November 1986.
EPA = U.S. Environmental Protection Agency.
ER = Environmental restoration.
HE = High explosive.
RCRA = Resource Conservation Recovery Act.
SNL/NM = Sandia National Laboratories/New Mexico.

off-site laboratory results were reviewed and verified/validated according to "Data Verification/Validation Level 2—DV-2" in Attachment B or "Data Verification/Validation Level 3-DV3" in Attachment C of the Technical Operating Procedure 94-03, Rev. 0 (SNL/NM July 1994). The reviews performed confirmed that the data are acceptable for use in the No Further Action (NFA) proposal for SWMU 65E. The data quality objectives (DQOs) for SWMU 65E have been met.

III. Determination of Nature, Rate, and Extent of Contamination

III.1 Introduction

The determination of the nature, rate, and extent of contamination at SWMU 65E was based upon an initial conceptual model validated with confirmatory sampling at the site. The initial conceptual model was developed from historical background information including site inspections, personal interviews, historical photographs, and numerous field surveys. The

DQOs contained in the work plan for OU 1333 (SNL/NM September 1995), identified the sample locations, sample density, sample depth, and analytical requirements. The sample data collected were subsequently used to develop the final conceptual model for SWMU 65E, which is presented in Section 5.5 of the associated NFA proposal. However, the Lurance Canyon main arroyo channel has been excluded from the conceptual model for SWMU 65E and will be addressed in subsequent SNL/NM site-wide surface water characterization activities (SNL/NM in progress). The quality of the data specifically used to determine the nature, rate, and extent of contamination are described below (NMED May 1997 and NMED DOE OB February 1998).

III.2 Nature of Contamination

The nature of contamination at SWMU 65E was determined by analytical testing of soil media and the potential for degradation of relevant COCs (Section V). The analytical requirements included RCRA metals plus beryllium to characterize non-radiological inorganic constituents potentially released at the site. HE analyses were performed to characterize any potentially unreacted explosives materials that may have been released during the explosives and burn tests; however, no HE compounds were detected in the confirmatory samples collected at SWMU 65E. Gamma spectroscopy analyses were also performed to characterize any depleted uranium potentially released at the site. These analytes and methods are appropriate to characterize the COCs and potential degradation products associated with historical activities conducted at the Lurance Canyon Explosive Test Site.

III.3 Rate of Contaminant Migration

The Lurance Canyon Explosive Test Site is inactive; and therefore, all primary sources of COCs (explosive tests and burn tests) have been eliminated. As a result, only secondary sources of COCs remain at SWMU 65E in the form of adsorbed metals and radionuclides in the surface and near-surface soil. The rate of COC migration from surficial soil is, therefore, dependent predominantly upon site meteorological and surface hydrologic processes as described in Section V. Data available from the Site-Wide Hydrogeologic Characterization Project (published annually); numerous SNL/NM air, surface water, and radiological monitoring programs; biological surveys; and other governmental atmospheric monitoring at the KAFB (i.e., National Oceanographic and Atmospheric Administration [NOAA]) are adequate to characterize the rate of COCs migration at SWMU 65E.

III.4 Extent of Contamination

Surface and near-surface soil samples were collected from random locations across the approximate 77 acres comprising SWMU 65E. In addition, surface and near-surface samples were collected from the six highest pre-VCM gamma radiation point and area source anomalies to confirm post-remediation gamma activity. Soil samples were also collected from a single debris mound discovered at the site in June 1996. These sample locations are deemed appropriate to determine the lateral extent of COC migration.

The density of random grid sample locations was dependent on the size of SWMU 65E (approximately 77 acres), uniformity of the COC release mechanism (fallout from detonations during explosives and burn tests); and lack of physical surface disturbance to the site from historical activities. The density of judgmental sample locations was based upon the number of point and area source radiological anomalies greater than or equal to 1,000 counts per minute or 1,000,000 disintegrations per minute before remediation was conducted. The density of samples collected from the debris mound was based upon the mound size. The number of samples collected was deemed sufficient to establish the presence of residual COCs in surface and near-surface soils from fallout of test material shrapnel.

Because of the relatively low solubility of most metals and radionuclides, limited precipitation, and high evapotranspiration, the vertical rate of contamination migration is expected to be extremely low. Therefore, random grid and judgmental samples were collected from the ground surface to a depth of approximately 12 inches below the ground surface. Similarly, samples were collected from the natural soil immediately beneath the debris mound contents (approximately 1.5 to 2 feet below the mound surface. There is no historical information that any subsurface disturbance, testing, or disposal ever occurred at the site, which could mix surface soils beneath the 12-inch depth. Therefore, the 12-inch maximum sample depth is representative of the media potentially impacted and sufficient to determine the vertical extent of COC migration.

In summary, the design of the confirmatory sampling was appropriate and adequate to determine the nature, rate, and extent of contamination.

IV. Comparison of COCs to Background Screening Levels

Site history and characterization activities are used to identify potential COCs. The identification of COCs and the sampling to determine the concentration levels of those COCs across the site are described in the SWMU 65E NFA proposal. Generally, COCs evaluated in this risk assessment include all detected organics and radiological contaminants and all inorganic COCs that were analyzed for. If the detection limit of an organic compound was too high (could possibly cause an adverse effect to human health or the environment), the compound was retained. Nondetect organics that were not included in this assessment were determined to have sufficiently low detection limits to ensure protection of human health and the environment. In order to provide conservatism in this risk assessment, the calculation uses only the maximum concentration value of each COC determined for the entire site. The SNL/NM maximum background concentration (Dinwiddie September 1997, Zamorski December 1997) was selected to provide the background screen in Tables 3 and 4. Human health nonradiological COCs were also compared to SNL/NM proposed Subpart S action levels (Table 3) (IT July 1994).

Nonradiological inorganics that are essential nutrients such as iron, magnesium, calcium, potassium, and sodium are not included in this risk assessment (EPA 1989). Both radiological and nonradiological COCs are evaluated. The nonradiological COCs evaluated in this risk assessment include only inorganics since all high explosive compounds were nondetect.

Table 3 lists nonradiological COCs for Human Health and Ecological Risk Assessment at SWMU 65E. Radiological COCs are listed in Table 4. All tables show the associated SNL/NM

Table 3
Nonradiological COCs for Human Health and Ecological Risk Assessment at SWMU 65E with Comparison to the Associated SNL/NM Background Screening Value, BCF, Log K_{ow} and Subpart S Screening Value

COC Name	Maximum Concentration (mg/kg)	SNL/NM Background Concentration (mg/kg)[a]	Is Maximum COC Concentration Less Than or Equal to the Applicable SNL/NM Background Screening Value?	BCF (maximum aquatic)	Log K_{ow} (for organic COCs)	Is COC a Bioaccumulator?[b](BCF>40, log K_{ow}>4)	Subpart S Screening Value[c]	Is Individual COC less than 1/10 of the Action Level?
Arsenic	13[d]	9.8	**No**	44[e]	NA	**Yes**	0.5	**No**
Barium	150	246	Yes	170[f]	NA	**Yes**	6000	Yes
Beryllium	1.1	0.75	**No**	19[e]	NA	No	0.2	**No**
Cadmium	1.1[d]	0.64	**No**	64[e]	NA	**Yes**	80	Yes
Chromium, total[g]	25	18.8	**No**	16[e]	NA	No	400	Yes
Lead	20 B	18.9	**No**	49[e]	NA	**Yes**	--	--
Mercury	0.05[d]	0.055	Yes	5500[e]	NA	**Yes**	20	Yes
Selenium	80 J	3.0	**No**	800[h]	NA	**Yes**	400	**No**
Silver	0.9[d]	<0.5	**No**	0.5[e]	NA	No	400	Yes

[a]From Zamorski (December 1997) Canyons Areas.
[b]From NMED (March 1998).
[c]IT (July 1994).
[d]Parameter nondetect, concentration assumed to be one-half of detection limit.
[e]BCF and/or Log K_{ow} from Yanicak (March 1997).
[f]BCF from Neumann (1976).
[g]Assumed to be chromium VI for Subpart S screening procedure.
[h]BCF from Callahan et. al. (1979).

B = analyte was detected in the associated blank.
BCF = Bioconcentration factor.
COC = Constituent of concern.
J = Estimated concentration.
K_{ow} = Octanol-water partition coefficient.
mg/kg = Milligram(s) per kilogram.
Log = Logarithm (base 10).
NA = Not applicable.
SNL/NM = Sandia National Laboratories/New Mexico.
SWMU = Solid waste management unit.
-- = Information not available.

Table 4
Radiological COCs for Human Health and Ecological Risk Assessment at SWMU 65E with Comparison to the Associated SNL/NM Background Screening Value, BCF, and Log K_{ow}

COC Name	Maximum Concentration (pCi/g)	SNL/NM Background Concentration (pCi/g)[a]	Is Maximum COC Concentration Less Than or Equal to the Applicable SNL/NM Background[a] Screening Value?	BCF (maximum aquatic)	Is COC a Bioaccumulator? (BCF>40, log K_{ow}>4)
Cs-137	1.03	0.52	**No**	3000[b]	**Yes**[b]
Th-232	0.99	1.03	Yes	3000[c]	Yes[b]
U-234[d]	2.6	2.31	**No**	900[c]	**Yes**[c]
U-235	0.26	0.16	**No**	900[c]	**Yes**[c]
U-238	20.8	2.31	**No**	900[c]	**Yes**[c]

[a]From Dinwiddie September 1997, Upper Canyon.
[b]BCF from Yanicak (1997).
[c]From Baker and Soldat (1992).
[d]U-234 value was calculated using the U-238 concentration and assuming that the U-238 to U-234 ratio was equal to that detected during waste characterization of depleted uranium-contaminated soils generated during the radiological voluntary corrective measures project, where U-234=U-238/8 (Miller June 1998).

BCF = Bioconcentration factor.
COC = Constituent of concern.
K_{ow} = Octanol-water partition coefficient.
Log = Logarithm (base 10).
pCi/g = Picocurie(s) per gram.
SNL/NM = Sandia National Laboratories/New Mexico.
SWMU = Solid waste management unit.

maximum background concentration values (Dinwiddie September 1997, Zamorski December 1997). Discussion of Tables 3 and 4 is provided in Section VI.4 and Sections VII.2 and VII.3.

V. Fate and Transport

The primary release of COCs at SWMU 65E was to surface soil. Wind, water, and biota are natural mechanisms of COC transport from the primary release point. Both wind and surface water runoff can transport surface soil particles from the site, potentially carrying COCs with them. However, because the site is situated within the Lurance Canyon in the Manzanita Mountains and is within woodland vegetation, it is protected from strong winds at the ground surface. Therefore, wind is probably not a significant transport mechanism for surface soils.

Water at SWMU 65E is received as precipitation (rain or occasionally snow), which will either infiltrate or form runoff. Infiltration at the site is enhanced by the coarse texture of the canyon soils (Tesajo-Millett stony sandy loam and rock outcrop [USDA June 1977]), but the slopes at this site will produce runoff during intense rainfall events and during extended rainfall periods when soils are near saturation from previous rainfall. Surface runoff is to an ephemeral drainage, which is a tributary to the Arroyo del Coyote in the lower part of the canyon. Runoff may carry soil particles with adsorbed COCs. The distance of transport will depend upon the size of the particle and the velocity of the water. Because of the relatively steep slopes on and near the site and the tendency for precipitation to be received as intense downpours during the summer months, the transport of surface soil particles by runoff may be significant.

Water that infiltrates into the soil will continue to percolate through the soil until field capacity is reached. COCs desorbed from the soil particles into the soil solution may be leached farther into the subsurface soil with this percolation. None of the inorganic COCs at this site has a high potential for leaching in soil. Based upon observations made during the installation of a piezometer near the center of SWMU 65E (12AUP01), the alluvium above the bedrock is 58 feet in thickness. Moist soil was observed in the first 5 feet of alluvium, and the remaining 53 feet (to bedrock) were dry. The Burn Site Well along the east side of the site did not encounter groundwater until 222 feet bgs. The groundwater level subsequently rose to a depth of 68 feet bgs indicating semiconfined to confined groundwater conditions. Therefore, infiltration from the surface does not appear to be sufficient to contact groundwater in the area of the Lurance Canyon Burn Site, and it is highly unlikely that percolation will result in the leaching of COCs to groundwater.

Plant roots can take up COCs that are in the soil solution. These COCs may be transported to the aboveground tissues with the xylem stream and may then be consumed by herbivores or returned to the soil as litter. Aboveground litter is capable of transport by wind until consumed by decomposer organisms in the soil. Constituents in plant tissues that are consumed by herbivores may pass through the gut and be returned to the soil (at the site or transported from the site in the herbivore) in feces or may be absorbed and held in tissues, metabolized, or later excreted. The herbivore may be eaten by a primary carnivore or scavenger and the constituents still held in the consumed tissues will repeat the sequence of absorption, metabolization, excretion, and consumption by higher predators, scavengers, and decomposers. The potential for transport of the constituents within the food chain is dependent upon the mobility of the species that comprise the food chain and the potential for the constituent to be transferred across the links in the food chain. Although much of the central

part of the Lurance Canyon Explosive Test Site (SWMU 65B and 65C) has been highly disturbed by testing activity and remedial actions, intact natural vegetation occurs throughout SWMU 65E. Therefore, food chain uptake is a potential transport mechanism at SWMU 65E.

Degradation of COCs at SWMU 65E may result from biotic or abiotic processes. Inorganic COCs at this site are elemental in form and are, therefore, not considered to be degradable. Radiological COCs, however, undergo decay to stable isotopes or radioactive daughter elements. Other transformations of inorganics may include changes in valence (oxidation/reduction reactions) or incorporation into organic forms (e.g., the conversion of selenite or selenate from soil to seleno-amino acids in plants). Degradation processes for HE may include photolysis, hydrolysis, and biotransformation. Photolysis requires light and, therefore, takes place in the air, at the ground surface, or in surface water. Hydrolysis includes chemical transformations in water, and may occur in the soil solution. Biotransformation is the result of metabolic breakdown of the compound by plants, animals, and microorganisms.

Table 5 summarizes the fate and transport processes that may occur at SWMU 65E. COCs at this site include inorganics (metals and radionuclides) and HE in soil. Because the site is situated within the Lurance Canyon and is, therefore, sheltered by surrounding slopes and woodland vegetation, significant transport of COCs by wind is unlikely. Transport by surface water runoff, however, may be of greater significance because of the slopes found on the site. Subsurface migration of COCs caused by leaching is not significant and is highly unlikely to contact groundwater. For inorganic COCs, the potential for degradation and/or transformation is very low. For HE, the potential for degradation and/or biotransformation of HE is of greater significance, however, no HE compounds have been detected at SWMU 65E above the method detection limits ranging from 0.055 to 0.42 mg/kg. Decay of radiological COCs is insignificant due to their long half-lives.

Table 5
Summary of Fate and Transport at SWMU 65E

Transport and Fate Mechanism	Existence at Site	Significance
Wind	Yes	Low
Surface runoff	Yes	Moderate to high
Migration to groundwater	No	None
Food chain uptake	Yes	Low
Transformation/degradation	Yes	Low (inorganics and radionuclides)

SWMU = Solid waste management unit.

VI. Human Health Risk Screening Assessment

VI.1 Introduction

Human health risk screening assessment of this site includes a number of steps that culminate in a quantitative evaluation of the potential adverse human health effects caused by constituents located at the site. The steps to be discussed include the following:

Step 1.	Site data are described that provide information on the potential COCs, as well as the relevant physical characteristics and properties of the site.
Step 2.	Potential pathways are identified by which a representative population might be exposed to the COCs.
Step 3.	The potential intake of these COCs by the representative population is calculated using a tiered approach. The first component of the tiered approach includes two screening procedures. One screening procedure compares the maximum concentration of the COC to an SNL/NM maximum background screening value. COCs that are not eliminated during the first screening procedure are subjected to a second screening procedure that compares the maximum concentration of the COC to the SNL/NM proposed Subpart S action level.
Step 4.	Toxicological parameters are identified and referenced for COCs that are not eliminated during the screening steps.
Step 5.	Potential toxicity effects (specified as a Hazard Index [HI]) and excess cancer risks are calculated for nonradiological COCs and background. For radiological COCs, the incremental total effective dose equivalent (TEDE) and incremental estimated cancer risk are calculated by subtracting applicable background concentrations directly from maximum on-site contaminant values. This background subtraction only occurs when a radiological COC occurs as contamination and exists as a natural background radionuclide.
Step 6.	These values are compared with guidelines established by the U.S. Environmental Protection Agency (EPA) and U.S. Department of Energy (DOE) to determine whether further evaluation, and potential site clean-up, is required. Nonradiological COC risk values are also compared to background risk so that an incremental risk may be calculated.
Step 7.	Uncertainties in the previous steps are discussed.

VI.2 Step 1. Site Data

Section I provides the description and history for SWMU 65E. Section II presents a comparison of results to DQOs. Section III describes the determination of the nature, rate, and extent of contamination.

VI.3 Step 2. Pathway Identification

SWMU 65E has been designated a future land-use scenario of recreational (DOE et al. October 1995) (see Appendix 1 for default exposure pathways and parameters). Because of the location and the characteristics of the potential contaminants, the primary pathway for human exposure is considered to be soil ingestion for the nonradiological COCs and direct gamma exposure for the radiological COCs. The inhalation pathway for both nonradiological and radiological COCs is included because of the potential to inhale dust. Soil ingestion is included for the radiological COCs as well. No contamination at depth was determined, and therefore,

no water pathways to the groundwater are considered. Depth to groundwater at SWMU 65E is approximately 222 feet bgs. Because of the lack of surface water or other significant mechanisms for dermal contact, the dermal exposure pathway is considered not to be significant. No intake routes through plant, meat, or milk ingestion are considered appropriate for the recreational land-use scenario. However, plant uptake is considered for the residential land-use scenario.

Pathway Identification

Nonradiological Constituents	Radiological Constituents
Soil ingestion	Soil ingestion
Inhalation (dust)	Inhalation (dust)
Plant uptake (residential only)	Plant uptake (residential only)
	Direct gamma

VI.4 Step 3. COC Screening Procedures

This section discusses Step 3. This step includes two screening procedures. The first screening procedure is a comparison of the maximum COC concentration to the background screening level. The second screening procedure compares maximum COC concentrations to SNL/NM proposed Subpart S action levels. This second procedure is applied only to COCs that are not eliminated during the first screening procedure.

VI.4.1 Background Screening Procedure

VI.4.1.1 Methodology

Maximum concentrations of COCs are compared to the SNL/NM maximum screening level for this area (Dinwiddie September 1997, Zamorski December 1997). SNL/NM has been verbally informed that all the metals background values from the Canyons Study, with the exception of selenium will be approved (NMED May 1998). Samples have been collected to resolve the selenium issue. The SNL/NM maximum background concentration is selected to provide the background screen in Table 3 and is used to calculate risk attributable to background in Table 9. Only the COCs that are above their respective SNL/NM maximum background screening level or COCs that do not have a quantifiable background screening level are considered in further risk assessment analyses.

For radiological COCs that exceed the SNL/NM background screening levels, background values are subtracted from the individual maximum radionuclide concentrations. Those that do not exceed these background levels are carried no further in the risk assessment. This approach is consistent with DOE Order 5400.5, "Radiation Protection of the Public and the Environment" (DOE 1993). Radiological COCs that did not have a background value and were detected above the analytical minimum detectable activity were carried through the risk assessment at their maximum levels. The resultant radiological COCs remaining after this step are referred to as background-adjusted radiological COCs.

VI.4.1.2 Results

Tables 3 and 4 present SWMU 65E data that were compared to the SNL/NM maximum background values (Zamorski December 1997) for human health risk assessment. For the nonradiological COCs, seven constituents have maximum measured values greater than their respective background screening level.

The maximum concentration value for lead is 20 B mg/kg. The EPA intentionally provides no human health toxicological data on lead, and therefore, no risk parameter values can be calculated. However, EPA Region 6 guidance for the screening value for lead for an industrial land-use scenario is 2,000 mg/kg (EPA 1996a); for a residential land-use scenario, the EPA screening guidance value is 400 mg/kg (EPA July 1994). The maximum concentration value for lead at this site is less than both screening values, and therefore, lead is eliminated from further consideration in the human health risk assessment.

For the radiological COCs, four constituents had maximum measured activities slightly greater than their respective background (Cs-137, U-234, U-235, and U-238).

VI.4.2 Subpart S Screening Procedure

VI.4.2.1 Methodology

The maximum concentrations of nonradiological COCs not eliminated during the background screening process were compared with action levels (IT July 1994) calculated using methods and equations promulgated in the proposed RCRA Subpart S (EPA July 1990) and Risk Assessment Guidance for Superfund (RAGS) (EPA 1989). Accordingly, all calculations were based upon the assumption that receptor doses from both toxic and potentially carcinogenic compounds result most significantly from ingestion of contaminated soil. Because the samples were all taken from the surface or near-surface, this assumption is considered valid. If there were ten or fewer COCs, and each had a maximum concentration less than 1/10 of the action level, then the site would be judged to pose no significant health hazard to humans. If there were more than ten COCs, the Subpart S screening procedure was not performed.

VI.4.2.2 Results

Table 3 shows the COCs and the associated proposed Subpart S action level. The table compares the maximum concentration values to 1/10 of the proposed Subpart S action level. This methodology was guidance given to SNL/NM from the EPA Region 6 (EPA 1996b). Three COCs exceed 1/10 of the proposed Subpart S action level. Because of these COCs, the site fails the Subpart S screening criteria and a hazard quotient (HQ) and excess cancer risk value must be calculated for all the COCs.

Radiological COCs do not have predetermined action levels analogous to proposed Subpart S levels, and therefore, this step in the screening process is not performed for radiological COCs.

VI.5 Step 4. Identification of Toxicological Parameters

Tables 6 (nonradiological) and 7 (radiological) show the COCs retained in the risk assessment and the values for the available toxicological information. The toxicological values used for nonradiological COCs in Table 6 are from the Integrated Risk Information System (IRIS) (EPA 1998), and the EPA Region 9 (EPA 1996c) and EPA Region 3 (EPA 1997a) electronic databases. Dose conversion factors (DCF) used in determining the excess TEDE values for radiological COCs for the individual pathways were the default values provided in the RESRAD computer code (Yu et al. 1993a) as developed in the following documents:

- DCFs for ingestion and inhalation are taken from Federal Guidance Report No. 11, "Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion" (EPA 1988).

- DCFs for surface contamination (contamination on the surface of the site) were taken from DOE/EH-0070, "External Dose-Rate Conversion Factors for Calculation of Dose to the Public" (DOE 1988).

- DCFs for volume contamination (exposure to contamination deeper than the immediate surface of the site) were calculated using the methods discussed in "Dose-Rate Conversion Factors for External Exposure to Photon Emitters in Soil" (*Health Physics* 28:193-205 [Kocher 1983]), and ANL/EAIS-8, "Data Collection Handbook to Support Modeling the Impacts of Radioactive Material in Soil" (Yu et al. 1993b).

VI.6 Step 5. Exposure Assessment and Risk Characterization

Section VI.6.1 describes the exposure assessment for this risk assessment. Section VI.6.2 provides the risk characterization, including the HI value and the excess cancer risk, for both the potential nonradiological COCs and associated background for recreational and residential land uses. The incremental TEDE and incremental estimated cancer risk are provided for the background-adjusted radiological COCs for both recreational and residential land uses.

VI.6.1 Exposure Assessment

Appendix 1 shows the equations and parameter input values used in calculating intake values and subsequent HI and excess cancer risk values for the individual exposure pathways. The appendix shows parameters for both recreational and residential land-use scenarios. The equations for nonradiological COCs are based upon RAGS (EPA 1989). Parameters are based upon information from RAGS (EPA 1989) and other EPA guidance documents and reflect the reasonable maximum exposure (RME) approach advocated by the RAGS (EPA 1989). For radiological COCs, the coded equations provided in RESRAD computer code are used to estimate the incremental TEDE and cancer risk for individual exposure pathways. Further discussion of this process is provided in the *Manual for Implementing Residual Radioactive Material Guidelines Using RESRAD, Version 5.0* (Yu et al. 1993b).

Table 6
Toxicological Parameter Values for SWMU 65E Nonradiological COCs

COC Name	RfD_o (mg/kg-day)	Confidence[a]	RfD_{inh} (mg/kg-day)	Confidence[a]	SF_o $(mg/kg\text{-}day)^{-1}$	SF_{inh} $(mg/kg\text{-}day)^{-1}$	Cancer Class[b]
Arsenic	3E–4[c]	M	--	--	1.5E+0[c]	1.5E+1[c]	**A**
Beryllium	2E-3[c]	L to M	5.7E-6[c]	M	--	8.4E+0[c]	**B1**
Cadmium	5E-4[c]	H	5.7E-5[d]	--	--	6.3E+0[c]	**B1**
Chromium III	1E+0[c]	L	5.7E-7[e]	--	--	--	**--**
Chromium VI	5E-3[c]	L	--	--	--	4.2E+1[c]	**A**
Selenium	5E–3[c]	H	--	--	--	--	**D**
Silver	5E–3[c]	L	--	--	--	--	**D**

[a]Confidence associated with IRIS (EPA 1998) database values (L = low, M = medium, H = high).
[b]EPA weight-of-evidence classification system for carcinogenicity (EPA 1989) taken from IRIS (EPA 1998):

A—Human carcinogen.
B1—Probable human carcinogen. Limited human data are available.
D—Not classifiable as to human carcinogenicity.

[c]Toxicological parameter values from IRIS electronic database (EPA 1998a).
[d]Toxicological parameter values from EPA Region 9 (EPA 1996c).
[e]Toxicological parameter values from EPA Region 3 electronic database (EPA 1997a).

COC = Constituent of concern.
EPA = U.S. Environmental Protection Agency.
HEAST = Health Effects Assessment Summary Tables.
IRIS = Integrated Risk Information System.
mg/kg-day = Milligram(s) per kilogram day.
$(mg/kg\text{-}day)^{-1}$ = Per milligram per kilogram day.
RfD_o = Oral chronic reference dose.
RfD_{inh} = Inhalation chronic reference dose.
SF_o = Oral slope factor.
SF_{inh} = Inhalation slope factor.
SWMU = Solid waste management unit.
-- = Information not available.

Table 7
Radiological Toxicological Parameter Values for SWMU 65E COCs Obtained from RESRAD Risk Coefficients[a]

COC Name	SF_o (1/pCi)	Sf_{inh} (1/pCi)	SF_{ev} (g/pCi-yr)	Cancer Class[b]
Cs-137	3.20E-11	1.90E-11	2.10E-06	A
U-234	4.40E-11	1.40E-08	2.10E-11	A
U-235	4.70E-11	1.30E-08	2.70E-07	A
U-238	6.20E–11	1.20E–08	6.60E–08	A

[a]From Yu et al. (1993a).
[b]EPA weight-of-evidence classification system for carcinogenicity (EPA 1989): A - human carcinogen.
COC = Constituent of concern.
EPA = U.S. Environmental Protection Agency.
g/pCi-yr = Gram(s) per picocurie-year.
SF_o = Oral (ingestion) slope factor.
SF_{inh} = Inhalation slope factor.
SF_{ev} = External volume exposure slope factor.
1/pCi = One per picocurie.
SWMU = Solid waste management unit.

Although the designated land-use scenario is recreational for this site, risk and TEDE values for a residential land-use scenario are also presented. These residential risk and TEDE values are presented only to provide perspective of potential risk to human health under the more restrictive land-use scenario.

VI.6.2 Risk Characterization

Table 8 shows that for the SWMU 65E nonradiological COCs, the HI value is 0.00, and the excess cancer risk is 8E-7 for the designated recreational land-use scenario. The numbers presented included exposure from soil ingestion and dust inhalation for the nonradiological COCs. Table 9 shows that assuming the maximum background concentrations of the SWMU 65E associated background constituents, the HI is 0.00, and the excess cancer risk is 6E-7 for the designated recreational land-use scenario.

For the radioactive COCs, contribution from the direct gamma exposure pathway is included. For the recreational land-use scenario, a TEDE was calculated for a recreational person. This resulted in an incremental TEDE of 0.10 millirem per year (mrem/yr). In accordance with EPA guidance found in OSWER Directive No. 9200.4-18 (EPA August 1997c), an incremental TEDE of 15 mrem/yr is used for the probable land-use scenario (recreational in this case); the calculated dose value for SWMU 65E for the recreational land use is well below this guideline. The estimated excess cancer risk is 1.4E-6.

For the residential land-use scenario nonradiological COCs, the HI value increases to 30, and the excess cancer risk is 1E-4 (Table 8). The numbers presented included exposure from soil ingestion, dust inhalation, and plant uptake. Although EPA (1991) generally recommends that inhalation not be included in a residential land-use scenario, this pathway is included because

Table 8
Risk Assessment Values for SWMU 65E Nonradiological COCs

COC Name	Maximum Concentration (mg/kg)	Recreational Land-Use Scenario[a]		Residential Land-Use Scenario[a]	
		HI	Cancer Risk	HI	Cancer Risk
Arsenic	13[c]	0.00	8E-7	0.74	1E-4
Beryllium	1.1	0.00	3E-11	0.00	8E-10
Cadmium	1.1[c]	0.00	2E-11	0.90	6E-10
Chromium, total[b]	25	0.00	4E-9	0.02	9E-8
Selenium	80 J	0.00	--	28.14	--
Silver	0.9[c]	0.00	--	0.04	--
TOTAL		**0.00**	**8E-7**	**30**	**1E-4**

[a]From EPA (1989).
[b]Parameter reported as nondetect, concentration assumed to be 0.5 of the detection limit.
[c]Chromium, total assumed to be chromium VI (most conservative).
COC = Constituent of concern.
EPA = U.S. Environmental Protection Agency.
HI = Hazard index.
mg/kg = Milligram(s) per kilogram.
SWMU = Solid waste management unit.
J = Estimated concentration.
-- = Information not available.

Table 9
Risk Assessment Values for SWMU 65E Nonradiological Background Constituents

COC Name	Background Concentration[a] (mg/kg)	Recreational Land- Use Scenario[b]		Residential Land- Use Scenario[b]	
		Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Arsenic	9.8	0.00	6E-7	0.56	1E-4
Beryllium	0.75	0.00	2E-11	0.00	6E-10
Cadmium	0.64	0.00	1E-11	0.52	4E-10
Chromium, total[c]	18.8	0.00	--	0.01	--
Selenium	3	0.00	--	1.06	--
Silver	<0.5	--	--	--	--
TOTAL		**0.00**	**6E-7**	**2**	**1E-4**

[a]From Zamorski (December 1997), Canyons Areas.
[b]EPA (1989).
[c]Chromium, total assumed to be chromium III.
COC = Constituents of concern.
EPA = U.S. Environmental Protection Agency.
mg/kg = Milligram(s) per kilogram.
SWMU = Solid waste management unit.
-- = Information not available.

of the potential for soil in Albuquerque, New Mexico, to be eroded and, subsequently, for dust to be present in predominantly residential areas. Because of the nature of the local soil, other exposure pathways are not considered (see Appendix 1). Table 9 shows that for the SWMU 65E associated background constituents, the HI is 2, and the excess cancer risk is 1E-4.

For the radiological COCs, the incremental TEDE for the residential land-use scenario is 2.3 mrem/yr. The guideline being used is an excess TEDE of 75 mrem/yr (SNL/NM February 1998) for a complete loss of institutional controls (residential land use in this case); the calculated dose value for SWMU 65E for the residential land-use is well below this guideline. Consequently, SWMU 65E is eligible for unrestricted radiological release as the residential land-use scenario resulted in an incremental TEDE to the on-site receptor of less than 75 mrem/yr. The estimated excess cancer risk is 2.9E-5. The excess cancer risk from the nonradiological COCs and the radiological COCs is not additive, as noted in RAGS (EPA 1989).

VI.7 Step 6. Comparison of Risk Values to Numerical Guidelines.

The human health risk assessment analysis evaluated the potential for adverse health effects for both a recreational land-use scenario (the designated land-use scenario for this site) and a residential land-use scenario.

For the recreational land-use scenario nonradiological COCs, the HI calculated is 0.00 (much less than the numerical guideline of 1 suggested in RAGS [EPA 1989]). The excess cancer risk is estimated at 8E-7. Guidance from the NMED indicates that excess lifetime risk of developing cancer by an individual must be less than 1E-6 for Class A and B carcinogens and less than 1E-5 for Class C carcinogens (NMED March 1998). The excess cancer risk is driven by arsenic which is a Class A carcinogen. Thus, the total excess cancer risk for this site is below the suggested acceptable risk value of 1E-6. This risk assessment also determined risks considering background concentrations of the potential nonradiological COCs for both the recreational and residential land-use scenarios. For nonradiological COCs, assuming the recreational land-use scenario, the HI is 0.00. The excess cancer risk is estimated at 6E-7. Incremental risk is determined from subtracting risk associated with background from potential COC risk. These numbers are not rounded before the difference is determined and, therefore, may appear to be inconsistent with numbers presented in tables and within the text. There is no incremental HI. The incremental cancer risk is 2E-7 for the recreational land-use scenario. These incremental risk calculations indicate acceptable risk to human health from nonradiological COCs considering a recreational land-use scenario.

For radiological COCs of the recreational land-use scenario, the incremental TEDE is 0.10 mrem/yr, which is significantly less than the EPA's numerical guideline of 15 mrem/yr. The incremental estimated excess cancer risk is 1.4E-6.

For the residential land-use scenario nonradiological COCs, the calculated HI is 30 which is above the numerical guidance. The excess cancer risk is estimated at 1E-4. The excess cancer risk is driven by arsenic, cadmium, selenium, and silver, some of which are Class A or B carcinogens. Therefore, the total excess cancer risk for this site is above the suggested acceptable risk value of 1E-6. The HI for associated background for the residential land-use scenario is 2. The excess cancer risk is estimated at 1E-4. The incremental HI is 27.69, and

the incremental cancer risk is 9E-8 for the residential land-use scenario. The incremental HI indicates potentially significant contribution to human health risk from the COCs considering a residential land-use scenario.

The incremental TEDE for a residential land-use scenario from the radiological COCs is 2.3 mrem/yr, which is significantly less than the numerical guideline of 75 mrem/yr suggested in SNL/NM RESRAD Input Parameter Assumptions and Justification (SNL/NM February 1998). The estimated excess cancer risk is 2.9E-5.

VI.8 Step 7. Uncertainty Discussion

The determination of the nature, rate, and extent of contamination at SWMU 65E was based upon an initial conceptual model validated with confirmatory sampling conducted at the site. The confirmatory sampling was implemented in accordance with the RFI work plan for OU 1333 (SNL/NM September 1995). The DQOs contained in the RFI Work Plan are appropriate for use in screening risk assessments. The data collected, based upon sample location, density, and depth, are representative of the site. The analytical requirements and results satisfy the DQOs. Data quality were validated in accordance with SNL/NM procedures (SNL/NM July 1994 and SNL/NM July 1996). Therefore, there is no uncertainty associated with the data quality used to perform the screening risk assessment at SWMU 65E.

Because of the location, history of the site, and future land-use (DOE et al. October 1995), there is low uncertainty in the land-use scenario and the potentially affected populations that were considered in making the risk assessment analysis. Because the COCs are found in surface and near-surface soils and because of the location and physical characteristics of the site, there is little uncertainty in the exposure pathways relevant to the analysis.

An RME approach was used to calculate the risk assessment values. This means that parameter values used in the calculations are conservative and that calculated intakes are probably overestimates. Maximum measured values of the concentrations of the COCs are used to provide conservative results.

Table 6 shows the uncertainties (confidence) in nonradiological toxicological parameter values. There is a mixture of estimated values and values from IRIS (EPA 1998), and EPA Region 9 (EPA 1996c) and EPA Region 3 (EPA 1997a) electronic databases. Where values are not provided, information is not available from the Health Effects Assessment Summary Tables (HEAST) (EPA 1997c), IRIS (EPA 1998), or the EPA regions (EPA 1996c and 1997a). Because of the conservative nature of the RME approach, the uncertainties in toxicological values are not expected to be sufficiently high to change the conclusion from the risk assessment analysis.

Risk assessment values for nonradiological COCs are within the human health acceptable range for the recreational land-use scenario compared to established numerical guidance.

For radiological COCs, the conclusion of the risk assessment is that potential effects on human health, for both industrial and residential land-use scenarios are within guidelines and are a small fraction of the estimated 360 mrem/yr received by the average U.S. population (NCRP 1987).

The overall uncertainty in all of the steps in the risk assessment process is considered not significant with respect to the conclusion reached.

VI.9 Summary

SWMU 65E has identified COCs consisting of some inorganic and radiological compounds. Because of the location of the site, the designated recreational land-use scenario, and the nature of contamination, potential exposure pathways identified for this site included soil ingestion and dust inhalation for chemical constituents and soil ingestion, dust inhalation, and direct gamma exposure for radiological COCs. Plant uptake was included as an exposure pathway for the residential land-use scenario.

Using conservative assumptions and employing an RME approach to risk assessment, calculations for nonradiological COCs show that for the recreational land-use scenario the HI of 0.00 is significantly less than the accepted numerical guidance from the EPA. The total excess cancer risk of 8E-7 is below the acceptable risk value provided by the NMED for a recreational land use (NMED March 1998). There is no incremental HI and the incremental cancer risk is 2E-7 for the recreational land-use scenario. Risk calculations indicate acceptable risk to human health for a recreational land-use scenario.

The incremental TEDE and corresponding estimated cancer risk from radiological COCs are much less than EPA guidance values; the estimated TEDE is 0.10 mrem/yr for the recreational land-use scenario. This value is much less than the numerical guidance of 15 mrem/yr in EPA guidance (EPA August 1997b). The corresponding incremental estimated cancer risk value is 1.4E-6 for the recreational land-use scenario. Furthermore, the incremental TEDE for the residential land-use scenario that results from a complete loss of institutional control is only 2.3 mrem/year with an associated risk of 2.9E-5. The guideline for this scenario is 75 mrem/yr (SNL/NM February 1998). Therefore, SWMU 65E is eligible for unrestricted radiological release.

The uncertainties associated with the calculations are considered small relative to the conservativeness of risk assessment analysis. It is, therefore, concluded that this site does not have potential to affect human health under a recreational land-use scenario.

VII. Ecological Risk Screening Assessment

VII.1 Introduction

This section addresses the ecological risks associated with exposure to constituents of potential ecological concern (COPEC) in soils at SWMU 65E. A component of the NMED Risk-Based Decision Tree is to conduct an ecological screening assessment that corresponds with that presented in the EPA's Risk Assessment Guidance for Superfund (EPA 1991). The current methodology is tiered and contains an initial scoping assessment followed by a more detailed screening assessment. Initial components of NMED's decision tree (a discussion of DQOs, a data assessment, and evaluations of bioaccumulation and fate-and-transport potential) are

addressed in this report. Following the completion of the scoping assessment, a determination is made as to whether a more detailed examination of potential ecological risk is necessary. If deemed necessary, the scoping assessment proceeds to a screening assessment whereby a more quantitative estimate of ecological risk is conducted. Although this assessment incorporates conservatisms in the estimation of ecological risks, ecological relevance and professional judgment are also used as recommended by the EPA (1998b) to ensure that predicted exposures of selected ecological receptors reflect those reasonably expected to occur at the site.

VII.2 Scoping Assessment

The scoping assessment focuses primarily on the likelihood of exposure of biota at or adjacent to the site to be exposed to constituents associated with site activities. Included in this section are an evaluation of existing data and a comparison of maximum detected concentrations to background concentrations, examination of bioaccumulation potential, and fate and transport potential. A Scoping Risk Management Decision will involve a summary of the scoping results and a determination as to whether further examination of potential ecological impacts is necessary.

VII.2.1 Data Assessment

As indicated in Section IV (Tables 3 and 4), constituents in soil within the 0- to 5-foot-depth interval that exceeded background concentrations were as follows:

- Arsenic
- Beryllium
- Chromium (total)
- Lead
- Selenium
- Cs-137
- U-235
- U-234
- U-238.

In addition, cadmium and silver were reported as not detected with detection limits exceeding background concentrations. No organic analytes were detected in soil.

VII.2.2 Bioaccumulation

Among the COPECs listed in Section VII.2.1, the following were considered to have bioaccumulation potential in aquatic environments (Section IV, Tables 3 and 4):

- Arsenic
- Cadmium
- Lead
- Selenium

- Cs-137
- U-235
- U-234
- U-238.

It should be noted, however, that as directed by the NMED (NMED 1998), bioaccumulation for inorganics is assessed exclusively based upon maximum reported bioconcentration factors (BCF) for aquatic species. Because only aquatic BCFs are used to evaluate the bioaccumulation potential for metals, bioaccumulation in terrestrial species is likely to be overpredicted.

VII.2.3 Fate and Transport Potential

The potential for the COPECs to move from the source of contamination to other media or biota is discussed in Section V. As noted in Table 5 (Section V), surface-water runoff is expected to be of moderate to high significance, while wind dispersion, food chain uptake, transformation, and degradation are expected to be of low significance for the COPECs at this site. Migration to groundwater is not anticipated.

VII.2.4 Scoping Risk Management Decision

Based upon information gathered through the scoping assessment, it was concluded that complete ecological pathways may be associated with this SWMU and that COPECs also exist at the site. As a consequence, a screening assessment was deemed necessary to predict the potential level of ecological risk associated with the site.

VII.3 Screening Assessment

As concluded in Section VII.2.4, complete ecological pathways and COPECs are associated with this SWMU. The screening assessment performed for the site involves a quantitative estimate of current ecological risks using exposure models in association with exposure parameters and toxicity information obtained from the literature. The estimation of potential ecological risks is conservative to ensure ecological risks are not underpredicted.

Components within the screening assessment include:

- Problem Formulation—sets the stage for the evaluation of potential exposure and risk.
- Exposure Estimation—provides a quantitative estimate of potential exposure.
- Ecological Effects Evaluation—presents benchmarks used to gauge the toxicity of COPECs to specific receptors.
- Risk Characterization—characterizes the ecological risk associated with exposure of the receptors to environmental media at the site.

- Uncertainty Assessment—discusses uncertainties associated with the estimation of exposure and risk.
- Risk Interpretation—evaluates ecological risk in terms of HQs and ecological significance.
- Screening Assessment Scientific/Management Decision Point—presents the decision to risk managers based upon the results of the Screening Assessment.

VII.3.1 Problem Formulation

Problem Formulation is the initial stage of the screening assessment that provides the introduction to the risk evaluation process. Components that are addressed in this section include a discussion of ecological pathways and the ecological setting, identification of COPECs, and selection of ecological receptors. The conceptual model, ecological food webs, and ecological endpoints (other components commonly addressed in a screening assessment) are presented in the "Predictive Ecological Risk Assessment Methodology for SNL/NM ER [Environmental Restoration] Program" (IT July 1998) and are not duplicated here.

VII.3.1.1 Ecological Pathways and Setting

SWMU 65E is located in the upper part of the Lurance Canyon in the Manzanita Mountains. The site covers approximately 77 acres. The central part of the former Lurance Canyon Explosive Test Site (SWMUs 65B and 65C) is largely disturbed; however, SWMU 65E contains relatively undisturbed natural habitat which includes piñon-juniper woodland and riparian woodland vegetation. A biological and sensitive species survey of the Burn Site and surrounding areas was conducted in 1991, with no threatened, endangered, or sensitive species found (Biggs 1991a and 1991b).

Complete ecological pathways may exist at this site through the exposure of plants and wildlife to COPECs in surface and subsurface soil. Direct uptake of COPECs from soil was assumed to be the major route of exposure for plants, with exposure of plants to wind-blown soil assumed to be minor. Exposure modeling for the wildlife receptors was limited to the food and soil ingestion pathways. Because of the lack of perennial surface water at this site, exposure to COPECs through the ingestion of surface water was considered insignificant. Inhalation and dermal contact were also considered insignificant pathways with respect to ingestion (Sample and Suter 1994). Groundwater is not expected to be affected by COPECs at this site.

VII.3.1.2 COPECs

SWMU 65E represents the far field dispersion area for the Lurance Canyon Explosive Test Site (SWMU 65). The site was used from the late 1960's to the early 1990's for general explosives tests, burn pit tests, slow heat tests, cone tests (at the CON-CON Unit), and the Torch Activated Burn System (TABS) tests. Open detonation explosives tests at this site were conducted at the primary and secondary detonation areas (SWMUs 65 B and 65C) and were

completed by the early 1980's. SWMU 65E encompasses the dispersion area for these tests. Potential COPECs from these tests include metals, and radionuclides.

In order to provide conservatism in this ecological risk assessment, the assessment is based upon the maximum soil concentrations of the COPECs as measured in soil samples within the first 5 feet of soil. Both nonradiological and radiological COPECs are evaluated. The nonradiological COCs consist of inorganic analytes (i.e., metals). No organic analytes were detected in these soil samples. Inorganic analytes and radionuclides were screened against background concentrations, and those that exceeded the approved SNL/NM background screening levels (Dinwiddie September 1997, Zamorski December 1997) for the area were considered to be COPECs. Maximum COPEC concentrations are reported in Tables 3 and 4. Chemicals that are essential nutrients such as iron, magnesium, calcium, potassium, and sodium were not included in this risk assessment as set forth by the EPA (1989).

VII.3.1.3 Ecological Receptors

As described in detail in IT (July 1998), a nonspecific perennial plant was selected as the receptor to represent plant species at the site. Vascular plants are the principal primary producers at the site and are key to the diversity and productivity of the wildlife community associate with the site. A deer mouse (*Peromyscus maniculatus*) and burrowing owl (*Speotyto cunicularia*) were used to represent wildlife use. Because of its opportunistic food habits, the deer mouse was used to represent a mammalian herbivore, omnivore, and insectivore. Although not expected to occur in the woodland habitat of SWMU 65E, the burrowing owl was selected as the top predator. It is present in the grassland habitat at SNL/NM and is designated a species of management concern by the U.S. Fish and Wildlife Service in Region 2, which includes the state of New Mexico (USFWS September 1995). The burrowing owl is a small raptor and will, therefore, conservatively represent risk to other raptors potentially occurring in the woodland habitat, such as the western screech owl (*Otus kennicottii*).

VII.3.2 Exposure Estimation

Direct uptake of COPECs from the soil was considered the only significant route of exposure for terrestrial plants. Exposure modeling for the wildlife receptors was limited to food and soil ingestion pathways. Inhalation and dermal contact were considered insignificant pathways with respect to ingestion (Sample and Suter 1994). Drinking water was also considered an insignificant pathway because of the lack of perennial surface water at this site. The deer mouse was modeled under three dietary regimes: as an herbivore (100 percent of its diet as plant material), as an omnivore (50 percent of its diet as plants and 50 percent as soil invertebrates) and as an insectivore (100 percent of its diet as soil invertebrates). The burrowing owl was modeled as a strict predator on small mammals (100 percent of its diet as deer mice). Because the exposure in the burrowing owl from a diet consisting of equal parts of herbivorous, omnivorous, and insectivorous mice would be equivalent to the exposure consisting of only omnivorous mice, the diet of the burrowing owl was modeled with intake of omnivorous mice only. Both species were modeled with soil ingestion comprising 2 percent of the total dietary intake. Table 10 presents the species-specific factors used in modeling exposures in the wildlife receptors. Justification for use of the factors presented in this table is described in the ecological risk assessment methodology document (IT July 1998).

Table 10
Exposure Factors for Ecological Receptors at SWMU 65E

Receptor Species	Class/Order	Trophic Level	Body Weight (kg)[a]	Food Intake Rate (kg/day)[b]	Dietary Composition[c]	Home Range (acres)
Deer Mouse (*Peromyscus maniculatus*)	Mammalia/ Rodentia	Herbivore	2.39E-2[d]	3.72E-3	Plants: 100% (+ Soil at 2% of intake)	2.7E-1[e]
Deer Mouse (*Peromyscus maniculatus*)	Mammalia/ Rodentia	Omnivore	2.39E-2[d]	3.72E-3	Plants: 50% Invertebrates: 50% (+ Soil at 2% of intake)	2.7E-1[e]
Deer Mouse (*Peromyscus maniculatus*)	Mammalia/ Rodentia	Insectivore	2.39E-2[d]	3.72E-3	Invertebrates: 100% (+ Soil at 2% of intake)	2.7E-1[e]
Burrowing owl (*Speotyto cunicularia*)	Aves/ Strigiformes	Carnivore	1.55E-1[f]	1.73E-2	Rodents: 100% (+ Soil at 2% of intake)	3.5E+1[g]

[a]Body weights are in kilograms wet weight.
[b]Food intake rates are estimated from the allometric equations presented in Nagy (1987). Units are kilograms dry weight per day.
[c]Dietary compositions are generalized for modeling purposes. Default soil intake value of 2% of food intake.
[d]From Silva and Downing (1995).
[e]EPA (1993), based upon the average home range measured in semiarid shrubland in Idaho.
[f]From Dunning (1993).
[g]From Haug et al. (1993).
EPA = U.S. Environmental Protection Agency.
kg = Kilogram(s).
kg/day = Kilogram(s) per day.
SWMU = Solid waste management unit.

Although home range is also included in this table, exposures for this risk assessment were modeled using an area use factor of 1, implying that all food items and soil ingested are from the site being investigated. For both the deer mouse and burrowing owl, the estimated home ranges are less than the size of the site. The maximum measured COPEC concentrations from surface soil samples were used to conservatively estimate potential exposures and risks to plants and wildlife at this site.

For the radiological dose rate calculations, the deer mouse was modeled as an herbivore (100 percent of its diet as plants), and the burrowing owl was modeled as a strict predator on small mammals (100 percent of its diet as deer mice). Both were modeled with soil ingestion comprising 2 percent of the total dietary intake. Receptors are exposed to radiation both internally and externally from Cs-137, U-235, U-234, U-238. Internal and external dose rates to the deer mouse and burrowing owl are approximated using modified dose rate models from the *Hanford Site Risk Assessment Methodology* (DOE 1995) as presented in the ecological risk assessment methodology document for the SNL/NM ER Program (IT July 1998). Radionuclide-dependent data for the dose rate calculations were obtained from Baker and Soldat (1992). The external dose rate model examines the total-body dose rate to a receptor residing in soil exposed to radionuclides. The soil surrounding the receptor is assumed to be an infinite medium uniformly contaminated with gamma-emitting radionuclides. The external dose rate model is the same for both the deer mouse and the burrowing owl. The internal total-body dose rate model assumes that a fraction of the radionuclide concentration ingested by a receptor is absorbed by the body and concentrated at the center of a spherical body shape. This provides for a conservative estimate for absorbed dose. This concentrated radiation source at the center of the body of the receptor is assumed to be a "point" source. Radiation emitted from this point source is absorbed by the body tissues to contribute to the absorbed dose. Alpha and beta emitters are assumed to transfer 100 percent of their energy to the receptor as they pass through tissues. Gamma-emitting radionuclides only transfer a fraction of their energy to the tissues because gamma rays interact less with matter than do beta or alpha emitters. The external and internal dose rate results are summed to calculate a total dose rate due to exposure to radionuclides in soil.

Table 11 presents the transfer factors used in modeling the concentrations of COPECs through the food chain. Table 12 presents maximum concentrations in soil and derived concentrations in tissues of the various food-chain elements that are used to model dietary exposures for each of the wildlife receptors.

VII.3.3 Ecological Effects Evaluation

Benchmark toxicity values for the plant and wildlife receptors are presented in Table 13. For plants, the benchmark soil concentrations are based upon the lowest-observed-adverse-effect level. For wildlife, the toxicity benchmarks are based upon the no-observed-adverse-effect level (NOAEL) for chronic oral exposure in a taxonomically similar test species. Insufficient toxicity information was found to estimate the NOAELs for some COPECs for the burrowing owl.

Table 11
Transfer Factors Used in Exposure Models for
Constituents of Potential Ecological Concern at SWMU 65E

Constituent of Potential Ecological Concern	Soil-to-Plant Transfer Factor	Soil-to-Invertebrate Transfer Factor	Food-to-Muscle Transfer Factor
Inorganic			
Arsenic	4.0E-2[a]	1.0E+0[b]	2.0E-3[a]
Beryllium	1.0E-2[a]	1.0E+0[b]	1.0E-3[a]
Cadmium	5.5E-1[a]	6.0E-1[c]	5.5E-4[a]
Chromium (total)	4.0E-2[d]	1.3E-1[e]	3.0E-2[d]
Lead	9.0E-2[d]	4.0E-2[c]	8.0E-4[d]
Selenium	5.0E-1[d]	1.0E+0[b]	1.0E-1[d]
Silver	1.0E+0[d]	2.5E-1[c]	5.0E-3[d]

[a]From Baes et al. (1984).
[b]Default value.
[c]From Stafford et al. (1991).
[d]NCRP (January 1989).
[e]From Ma (1982).
SWMU = Solid waste management unit.

Table 12
Media Concentrations[a] for Constituents of
Potential Ecological Concern at SWMU 65E

Constituent of Potential Ecological Concern	Soil (maximum)	Plant Foliage[b]	Soil Invertebrate[b]	Deer Mouse Tissues[c]
Inorganic				
Arsenic	1.3E+0[d]	5.2E-1	1.3E+1	4.4E-2
Beryllium	1.1E+0	1.1E-2	1.1E+0	1.8E-3
Cadmium	1.1E+0[d]	6.1E-1	6.6E-1	1.1E-3
Chromium (total)	2.5E+1	1.0E+0	3.3E+0	2.5E-1
Lead	2.0E+1	1.8E+0	8.0E-1	4.3E-3
Selenium	8.0E+1	4.0E+1	8.0E+1	1.9E+1
Silver	9.0E-1[d]	9.0E-1	2.3E-1	9.1E-3

[a]In milligrams per kilogram. All are based upon dry weight of the media.
[b]Product of the soil concentration and the corresponding transfer factor.
[c]Based upon the deer mouse with an omnivorous diet. Product of the average concentration in food times the food-to-muscle transfer factor times the wet weight-dry weight conversion factor of 3.125 (from EPA 1993).
[d]Concentration is one-half of the maximum detection limit.
SWMU = Solid waste management unit.

Table 13
Toxicity Benchmarks for Ecological Receptors at SWMU 65E

Constituent of Potential Ecological Concern	Plant Benchmark[a,b]	Mammalian NOAELs			Avian NOAELs		
		Mammalian Test Species[c,d]	Test Species NOAEL[d,e]	Deer Mouse NOAEL[e,f]	Avian Test Species[d]	Test Species NOAEL[d,e]	Burrowing Owl NOAEL[e,g]
Inorganic							
Arsenic	10	Mouse	0.126	0.13	Mallard	5.14	5.14
Beryllium	10	Rat	0.66	1.29	---[h]	---	---
Cadmium	3	Rat[i]	1.0	1.9	Mallard	1.45	1.45
Chromium (total)	1	Rat	2,737	5,354	Black duck	1.0	1.0
Lead	50	Rat	8.0	15.7	American kestrel	3.85	3.85
Selenium	1	Rat	0.20	0.39	Screech owl	0.44	0.44
Silver	2	Rat	17.8	34.8	---	---	---

[a]In milligrams per kilogram soil.

[b]From Will and Suter (1995).

[c]Body weights (in kilograms) for the no-observed-adverse-effect level (NOAEL) conversion are as follows: lab mouse, 0.030; lab rat, 0.350 (except where noted).

[d]From Sample et al. (1996), except where noted.

[e]In milligrams per kilogram body weight per day.

[f]Based upon NOAEL conversion methodology presented in Sample et al. (1996), using a deer mouse body weight of 0.0239 kilogram and a mammalian scaling factor of 0.25.

[g]Based upon NOAEL conversion methodology presented in Sample et al. (1996). The avian scaling factor of 0.0 was used, making the NOAEL independent of body weight.

[h]--- designates insufficient toxicity data.

[i]Body weight: 0.303 kilogram.

SWMU = Solid waste management unit.

The benchmark used for exposure of terrestrial receptors to radiation was 0.1 rad/day. This value has been recommended by the International Atomic Energy Agency (IAEA 1992) for the protection of terrestrial populations. Because plants and insects are less sensitive to radiation than vertebrates (Whicker and Schultz 1982), the dose of 0.1 rad per day should also offer sufficient protection to other components within the terrestrial habitat of SWMU 65E.

VII.3.4 Risk Characterization

Maximum concentrations in soil and estimated dietary exposures were compared to plant and wildlife benchmark values, respectively. Results of these comparisons are presented in Table 14. HQs are used to quantify the comparison with benchmarks for plants and wildlife exposure.

Analytes with HQs exceeding unity for plants were arsenic, chromium (total), and selenium. The only analyte with an HQ exceeding unity for all three modeled diets of the deer mouse was selenium. Arsenic also resulted in an HQ greater than 1.0 for the omnivorous and insectivorous deer mouse. No analytes resulted in an HQ greater than 1.0 for the burrowing owl, although HQs for the burrowing owl could not be determined for beryllium and silver due to insufficient toxicity data. As directed by the NMED, HIs were calculated for each of the receptors (the HI is the sum of chemical-specific HQs for all pathways for a given receptor). Plants and deer mice had HIs greater than unity, with a maximum HI of 110 for plants.

Tables 15 and 16 summarize the internal and external dose rate model results for the four radionuclides. The total radiation dose rate to the deer mouse was predicted to be 3.7E-4 rad/day. Total dose rate to the burrowing owl was predicted to be 2.1E-4 rad/day. The internal dose rate from exposure to these radionuclides for both receptors is the primary contributor to the total dose rate. The dose rates for the deer mouse and the burrowing owl are considerably less than the benchmark of 0.1 rad/day.

VII.3.5 Uncertainty Assessment

Many uncertainties are associated with the characterization of ecological risks at SWMU 65E. These uncertainties result from assumptions used in calculating risk that may overestimate or underestimate true risk presented at a site. For this risk assessment, assumptions are made that are more likely to overestimate exposures and risk rather than to underestimate them. These conservative assumptions are used to be more protective of the ecological resources potentially affected by the site. Conservatisms incorporated into this risk assessment include; the use of maximum measured analyte concentrations in soil to evaluate risk, the use of wildlife toxicity benchmarks based upon NOAEL values, the incorporation of strict herbivorous and strict insectivorous diets for predicting the extreme HQ values for the deer mouse, and the use of 1.0 as the area use factor for wildlife receptors regardless of seasonal use. Each of these uncertainties, which are consistent among each of the SWMU-specific ecological risk assessments, is discussed in greater detail in the uncertainty section of the ecological risk assessment methodology document for the SNL/NM ER Program (IT July 1998).

Table 14
Hazard Quotients for Ecological Receptors at SWMU 65E

Constituent of Potential Ecological Concern	Plant HQ[a]	Deer Mouse HQ (Herbivorous)[a]	Deer Mouse HQ (Omnivorous)[a]	Deer Mouse HQ (Insectivorous)[a]	Burrowing Owl HQ[a]
Inorganic					
Arsenic	**1.3E+0**	9.1E-1	**8.2E+0**	**1.6E+1**	6.6E-3
Beryllium	1.1E-1	4.0E-3	7.0E-2	1.4E-1	---[b]
Cadmium	3.7E-1	5.2E-2	5.4E-2	5.6E-2	1.8E-3
Chromium (total)	**2.5E+1**	4.4E-5	7.6E-5	1.1E-4	8.3E-2
Lead	4.0E-1	2.2E-2	1.7E-2	1.2E-2	1.2E-2
Selenium	**8.0E+1**	**1.7E+1**	**2.5E+1**	**3.3E+1**	5.3E-1
Silver	4.5E-1	1.4E-2	2.6E-3	1.1E-3	---
HI[c]	**1.1E+2**	**1.8E+1**	**3.3E+1**	**4.9E+1**	6.3E-1

[a]**Bold** text indicates HQ or HI exceeds unity.

[b]--- designates insufficient toxicity data available for risk estimation purposes.

[c]The HI is the sum of individual hazard quotients using the value for organic mercury as a conservative estimate of the HI.

SWMU = Solid waste management unit.

HI = Hazard index.

HQ = Hazard quotient.

Table 15
Internal and External Dose Rates for
Deer Mice Exposed to Radionuclides at SWMU 65E

Radionuclide	Maximum Concentration (pCi/g)	Internal Dose (rad/day)	External Dose (rad/day)	Total Dose (rad/day)
Cs-137	1.0E+0	3.2E-5	4.7E-5	7.9E-5
U-234[a]	2.6	3.0E-5	2.9E-7	3.0E-5
U-235	2.6E-1	2.8E-6	4.2E-6	7.0E-6
U-238	2.1E+1	2.1E-4	4.2E-5	2.5E-4
Total		2.7E-4	9.3E-5	3.7E-4

[a] The U-234 value was calculated using the U-238 concentration and assuming that the U-238 to U-234 ratio was equal to that detected during waste characterization of depleted uranium-contaminated soils generated during the radiological voluntary corrective measures project, where U-234=U-238/8 (Miller June 1998).
pCi/g = Picocurie(s) per gram.
SWMU = Solid waste management unit.

Table 16
Internal and External Dose Rates for
Burrowing Owls Exposed to Radionuclides at SWMU 65E

Radionuclide	Maximum Concentration (pCi/g)	Internal Dose (rad/day)	External Dose (rad/day)	Total Dose (rad/day)
Cs-137	1.0E+0	2.1E-5	4.7E-5	6.8E-5
U-234[a]	2.6	1.2E-5	2.9E-7	1.2E-5
U-235	2.6E-1	1.1E-6	4.2E-6	5.3E-6
U-238	2.1E+1	8.6E-5	4.2E-5	1.3E-4
Total		1.2E-4	9.3E-5	2.1E-4

[a]The U-234 value was calculated using the U-238 concentration and assuming that the U-238 to U-234 ratio was equal to that detected during waste characterization of depleted uranium-contaminated soils generated during the radiological voluntary corrective measures project, where U-235=U-238/8 (Miller June 1998).
pCi/g = Picocurie(s) per gram.
SWMU = Solid waste management unit.

Uncertainties associated with the estimation of risk to ecological receptors following exposure to Cs-137, U-235, U-234, and U-238 are primarily related to those inherent in the radionuclide-specific data. Radionuclide-dependent data are measured values that have their associated errors, which are typically negligible. The dose rate models used for these calculations are based upon conservative estimates on receptor shape, radiation absorption by body tissues, and intake parameters. The goal is to provide a realistic but conservative estimate of a receptor's exposure to radionuclides in soil, both internally and externally.

One large uncertainty associated with the prediction of ecological risks at this site is the use of the maximum measured concentrations in soil to evaluate risk. This results in a conservative exposure scenario that does not necessarily reflect actual site conditions. This is also true with regard to the use of detection limits in the estimation of risk. One-half of the detection limit value was used in the estimation of potential risk associated with exposure to arsenic, cadmium, and silver.

Analytical data were examined more closely to assess variability within the data. Of the 41 soil samples analyzed for arsenic, only 3 contained detectable concentrations of arsenic (5.2, 7.4, and 7.9 mg/kg). The detection limit associated with the other samples was 26 mg/kg. Half of this value was used in the estimation of risk. Chromium was detected in 35 of the 41 soil samples. These concentrations ranged from an estimated value of 5 J to 25 mg/kg with an average detected concentration of 10.2 mg/kg. This average concentration would, however, result in an HQ of 10.2 for plants. Only 3 of the 41 soil samples collected contained detectable concentrations of selenium. These concentrations ranged from estimated concentrations of 55 J to 80 J mg/kg. A comparison of samples sent to both laboratories indicate that samples reported as not detected for selenium at 50 mg/kg by the on-site laboratory were reported as not detected at values of 0.79 mg/kg or less (samples CY65E-GR-006-0-SD, CY65E-GR-012-0-SD, and CY65E-GR-016-0-SD). The lower detection limit would not result in HQs greater than unity for the ecological receptors. In addition, the sample with an estimated selenium concentration of 55 J mg/kg (CY65E-GR-006-0-SS) (analyzed on site) was also analyzed as an on site duplicate and off-site split duplicate. The on-site laboratory reported a selenium concentration of not detected at 50 mg/kg for the duplicate sample, whereas the off-site laboratory reported a not detected value of 0.79 mg/kg. All three detected values at the site were reported in association with a J qualifier indicating the reported concentration is estimated. In addition, all values had a very high practical quantitation limit (191 mg/kg) associated with them. This indicates that the three detected concentrations reported are of questionable quality and are possibly at or close to the analytical detection limit reported by the off-site laboratory. The average selenium concentration in soil at the site (within the 0- to 5-foot depth interval and based upon existing data) is expected to be within the range of the off-site analytical detection limit. This concentration is not expected to result in adverse ecological risks.

In the estimation of ecological risk, background concentrations are included as a component of maximum on-site concentrations. Table 17 illustrates risk estimates associated with exposure of each of the receptors to background concentrations of the metal COPECs. With respect to the plant, an HQ greater than one was obtained for chromium (total) and selenium. HQs greater than unity were also obtained for the omnivorous and insectivorous deer mouse exposed to arsenic. Selenium also resulted in an HQ greater than 1.0 for the insectivorous diet of the deer mouse. No HQs greater than 1.0 were reported for the burrowing owl from background exposure. Seventy-five (75) percent of maximum on-site arsenic concentration

Table 17
HQs for Ecological Receptors Exposed to Background Concentrations for SWMU 65E

Constituent of Potential Ecological Concern	Plant HQ[a]	Deer Mouse HQ (Herbivorous)[a]	Deer Mouse HQ (Omnivorous)[a]	Deer Mouse HQ (Insectivorous)[a]	Burrowing Owl HQ[a]
Inorganic					
Arsenic	9.8E-1	6.9E-1	**6.2E+0**	**1.2E+1**	5.0E-3
Beryllium	7.5E-2	2.7E-3	4.8E-2	9.2E-2	---[b]
Cadmium	2.1E-1	3.0E-2	3.1E-2	3.3E-2	1.0E-3
Chromium (total)	**1.9E+1**	3.3E-5	5.7E-5	8.2E-5	6.3E-2
Lead	3.8E-1	2.1E-2	1.6E-2	1.1E-2	1.1E-2
Selenium	**3.0E+0**	6.2E-1	9.2E-1	**1.2E+0**	2.0E-1
Silver	1.3E-1	1.1E-3	7.2E-4	3.0E-4	---
HI[c]	**2.3E+1**	**1.4E+0**	**7.2E+0**	**1.3E+1**	2.8E-1

[a]**Bold** text indicates HQ or HI exceeds unity.

[b]--- designates insufficient toxicity data available for risk estimation purposes.

[c]The HI is the sum of individual HQs using the value for organic mercury as a conservative estimate of the HI.

HI = Hazard index.
HQ = Hazard quotient.
SWMU = Solid waste management unit.

was associated with background. The same is true for total chromium. Only 3 percent of the maximum on-site total selenium concentration was, however, associated with background. It should be noted, however, that the background value of 3 mg/kg for selenium has been questioned by NMED and efforts are currently underway to better characterize background selenium concentrations in the canyons area (NMED May 1998) (see SWMU 65E NFA, Section 5.4.4.2.2). Because of the uncertainties associated with exposure and toxicity, it is unlikely that arsenic and chromium, with exposure concentrations largely attributable to background, present significant ecological risk.

Based upon this uncertainty analysis, ecological risks at SWMU 65E are expected to be very low. HQs greater than unity were initially predicted for arsenic, chromium, and selenium; however, closer examination of the exposure assumptions revealed an overestimation of risk primarily attributed to exposure concentration, background risk, quality of analytical data, and the utilization of detection limits as exposure concentrations.

VII.3.6 Risk Interpretation

Ecological risks associated with SWMU 65E were estimated through a screening assessment that incorporated site-specific information when available. Overall, ecological risks to plants are expected to be low due to the fact that predicted risks associated with exposure to arsenic, chromium (total), and selenium are based upon calculations using maximum detected values or detection limits (one-half the reporting limit). With respect to the deer mouse, risk is also expected to be very low. Predicted risks from exposure to arsenic and selenium were attributed to using either one-half the detection limit or maximum detected values, respectively. In addition, average arsenic and chromium concentrations at the site were within the range of background concentrations. Risks initially predicted for selenium are based upon the poor quality of the analytical data from the on-site laboratory. No ecological risks were predicted to occur for the burrowing owl. Based upon this final analysis, ecological risks associated with SWMU 65E are expected to be very low.

VII.3.7 Screening Assessment Scientific/Management Decision Point

Once potential ecological risks associated with the site have been assessed, a decision is made as whether the site should be recommended for NFA or additional data collected to assess actual ecological risk at the site more thoroughly. With respect to this site, ecological risks were predicted to be very low. The scientific/management decision is to recommend this site for NFA.

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APPENDIX 1
EXPOSURE PATHWAY DISCUSSION FOR CHEMICAL AND RADIONUCLIDE CONTAMINATION

Sandia National Laboratories (SNL/NM) proposes that a default set of exposure routes and associated default parameter values be developed for each future land-use designation being considered for SNL/NM Environmental Restoration (ER) project sites. This default set of exposure scenarios and parameter values would be invoked for risk assessments unless site-specific information suggested other parameter values. Because many SNL/NM solid waste management units (SWMU) have similar types of contamination and physical settings, SNL/NM believes that the risk assessment analyses at these sites can be similar. A default set of exposure scenarios and parameter values will facilitate the risk assessments and subsequent review.

The default exposure routes and parameter values suggested are those that SNL/NM views as resulting in a Reasonable Maximum Exposure (RME) value. Subject to comments and recommendations by the U.S. Environmental Protection Agency (EPA) Region VI and New Mexico Environment Department (NMED), SNL/NM proposes that these default exposure routes and parameter values be used in future risk assessments.

At SNL/NM, all SWMUs exist within the boundaries of the Kirtland Air Force Base (KAFB). Approximately 157 potential waste and release sites have been identified where hazardous, radiological, or mixed materials may have been released to the environment. Evaluation and characterization activities have occurred at all of these sites to varying degrees. Among other documents, the SNL/NM ER draft Environmental Assessment (DOE 1996) presents a summary of the hydrogeology of the sites, the biological resources present and proposed land-use scenarios for the SNL/NM SWMUs. At this time, all SNL/NM SWMUs have been tentatively designated for either industrial or recreational future land use. The NMED has also requested that risk calculations be performed based upon a residential land-use scenario. All three land-use scenarios will be addressed in this document.

The SNL/NM ER project has screened the potential exposure routes and identified default parameter values to be used for calculating potential intake and subsequent Hazard index (HI), risk and dose values. The EPA (EPA 1989a) provides a summary of exposure routes that could potentially be of significance at a specific waste site. These potential exposure routes consist of:

- Ingestion of contaminated drinking water
- Ingestion of contaminated soil
- Ingestion of contaminated fish and shell fish
- Ingestion of contaminated fruits and vegetables
- Ingestion of contaminated meat, eggs, and dairy products
- Ingestion of contaminated surface water while swimming
- Dermal contact with chemicals in water
- Dermal contact with chemicals in soil
- Inhalation of airborne compounds (vapor phase or particulate)

- External exposure to penetrating radiation (immersion in contaminated air; immersion in contaminated water and exposure from ground surfaces with photon-emitting radionuclides).

Based upon the location of the SNL/NM SWMUs and the characteristics of the surface and subsurface at the sites, we have evaluated these potential exposure routes for different land-use scenarios to determine which should be considered in risk assessment analyses (the last exposure route is pertinent to radionuclides only). At SNL/NM SWMUs, there does not currently occur any consumption of fish, shell fish, fruits, vegetables, meat, eggs, or dairy products that originate on site. Additionally, no potential for swimming in surface water is present due to the high-desert environmental conditions. As documented in the RESRAD computer code manual (ANL 1993), risks resulting from immersion in contaminated air or water are not significant compared to risks from other radiation exposure routes.

For the industrial and recreational land-use scenarios, SNL/NM ER has, therefore, excluded the following four potential exposure routes from further risk assessment evaluations at any SNL/NM SWMU:

- Ingestion of contaminated fish and shell fish
- Ingestion of contaminated fruits and vegetables
- Ingestion of contaminated meat, eggs, and dairy products
- Ingestion of contaminated surface water while swimming.

That part of the exposure pathway for radionuclides related to immersion in contaminated air or water is also eliminated.

For the residential land-use scenario, we will include ingestion of contaminated fruits and vegetables because of the potential for residential gardening.

Based upon this evaluation, for future risk assessments, the exposure routes that will be considered are shown in Table 1. Dermal contact is included as a potential exposure pathway in all land use scenarios. However, the potential for dermal exposure to inorganics is not considered significant and will not be included. In general, the dermal exposure pathway is generally considered to not be significant relative to water ingestion and soil ingestion pathways but will be considered for organic components. Because of the lack of toxicological parameter values for this pathway, the inclusion of this exposure pathway into risk assessment calculations may not be possible and may be part of the uncertainty analysis for a site where dermal contact is potentially applicable.

Equations and Default Parameter Values for Identified Exposure Routes

In general, SNL/NM expects that ingestion of compounds in drinking water and soil will be the more significant exposure routes for chemicals; external exposure to radiation may also be significant for radionuclides. All of the above routes will, however, be considered for their appropriate land use scenarios. The general equations for calculating potential intakes via these routes are shown below. The equations are from the Risk Assessment Guidance for Superfund (RAGS): Volume 1 (EPA 1989a, 1991). These general equations also apply to calculating potential intakes for radionuclides. A more in-depth discussion of the equations

Table 1
Exposure Pathways Considered for Various Land Use Scenarios

Industrial	Recreational	Residential
Ingestion of contaminated drinking water	Ingestion of contaminated drinking water	Ingestion of contaminated drinking water
Ingestion of contaminated soil	Ingestion of contaminated soil	Ingestion of contaminated soil
Inhalation of airborne compounds (vapor phase or particulate)	Inhalation of airborne compounds (vapor phase or particulate)	Inhalation of airborne compounds (vapor phase or particulate)
Dermal contact	Dermal contact	Dermal contact
External exposure to penetrating radiation from ground surfaces	External exposure to penetrating radiation from ground surfaces	Ingestion of fruits and vegetables
		External exposure to penetrating radiation from ground surfaces

used in performing radiological pathway analyses with the RESRAD code may be found in the RESRAD Manual (ANL 1993). Also shown are the default values SNL/NM ER suggests for use in RME risk assessment calculations for industrial, recreational, and residential scenarios, based upon EPA and other governmental agency guidance. The pathways and values for chemical contaminants are discussed first, followed by those for radionuclide contaminants. RESRAD input parameters that are left as the default values provided with the code are not discussed. Further information relating to these parameters may be found in the RESRAD Manual (ANL 1993).

Generic Equation for Calculation of Risk Parameter Values

The equation used to calculate the risk parameter values (i.e., hazard quotients/hazard index [HI], excess cancer risk, or radiation total effective dose equivalent [dose]) is similar for all exposure pathways and is given by:

Risk (or Dose) = Intake x Toxicity Effect (either carcinogenic, noncarcinogenic, or radiological)

$$= C \times (CR \times EFD/BW/AT) \times \text{Toxicity Effect} \quad (1)$$

where

C = contaminant concentration (site specific)
CR = contact rate for the exposure pathway
EFD= exposure frequency and duration
BW = body weight of average exposure individual
AT = time over which exposure is averaged.

The total risk/dose (either cancer risk or HI) is the sum of the risks/doses for all of the site-specific exposure pathways and contaminants.

The evaluation of the carcinogenic health hazard produces a quantitative estimate for excess cancer risk resulting from the constituents of concern (COC) present at the site. This estimate

is evaluated for determination of further action by comparison of the quantitative estimate with the potentially acceptable risk range of 10^{-4} to 10^{-6}. The evaluation of the noncarcinogenic health hazard produces a quantitative estimate (i.e., the HI) for the toxicity resulting from the COCs present at the site. This estimate is evaluated for determination of further action by comparison of this quantitative estimate with the EPA standard HI of unity (1). The evaluation of the health hazard due to radioactive compounds produces a quantitative estimate of doses resulting from the COCs present at the site.

The specific equations used for the individual exposure pathways can be found in RAGS (EPA 1989a) and the RESRAD Manual (ANL 1993). Table 2 shows the default parameter values suggested for used by SNL/NM at SWMUs, based upon the selected land use scenario. References are given at the end of the table indicating the source for the chosen parameter values. The intention of SNL/NM is to use default values that are consistent with regulatory guidance and consistent with the RME approach. Therefore, the values chosen will, in general, provide a conservative estimate of the actual risk parameter. These parameter values are suggested for use for the various exposure pathways based upon the assumption that a particular site has no unusual characteristics that contradict the default assumptions. For sites for which the assumptions are not valid, the parameter values will be modified and documented.

Summary

SNL/NM proposes the described default exposure routes and parameter values for use in risk assessments at sites that have an industrial, recreational or residential future land-use scenario. There are no current residential land-use designations at SNL/NM ER sites, but this scenario has been requested to be considered by the NMED. For sites designated as industrial or recreational land-use, SNL/NM will provide risk parameter values based upon a residential land-use scenario to indicate the effects of data uncertainty on risk value calculations or in order to potentially mitigate the need for institutional controls or restrictions on SNL/NM ER sites. The parameter values are based upon EPA guidance and supplemented by information from other government sources. The values are generally consistent with those proposed by Los Alamos National Laboratory, with a few minor variations. If these exposure routes and parameters are acceptable, SNL/NM will use them in risk assessments for all sites where the assumptions are consistent with site-specific conditions. All deviations will be documented.

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DOE, see U.S. Department of Energy.

EPA, see U.S. Environmental Protection Agency.

Table 2
Default Parameter Values for Various Land Use Scenarios

Parameter	Industrial	Recreational	Residential
General Exposure Parameters			
Exposure frequency (day/yr)	***	***	***
Exposure duration (yr)	30[a,b]	30[a,b]	30[a,b]
Body weight (kg)	70[a,b]	56[a,b]	70 adult[a,b] 15 child
Averaging Time (days) for carcinogenic compounds (= 70 y x 365 day/yr) for noncarcinogenic compounds (= ED x 365 day/yr)	25550[a] 10950	25550[a] 10950	25550[a] 10950
Soil Ingestion Pathway			
Ingestion rate	100 mg/day[c]	6.24 g/yr[d]	114 mg-yr/kg-day[a]
Inhalation Pathway			
Inhalation rate (m^3/yr)	5000[a,b]	146[d]	5475[a,b,d]
Volatilization factor (m^3/kg)	chemical specific	chemical specific	chemical specific
Particulate emission factor (m^3/kg)	1.32E9[a]	1.32E9[a]	1.32E9[a]
Water Ingestion Pathway			
Ingestion rate (L/day)	2[a,b]	2[a,b]	2[a,b]
Food Ingestion Pathway			
Ingestion rate (kg/yr)	NA	NA	138[b,d]
Fraction ingested	NA	NA	0.25[b,d]
Dermal Pathway			
Surface area in water (m^2)	2[b,e]	2[b,e]	2[b,e]
Surface area in soil (m^2)	0.53[b,e]	0.53[b,e]	0.53[b,e]
Permeability coefficient	chemical specific	chemical specific	chemical specific

***The exposure frequencies for the land use scenarios are often integrated into the overall contact rate for specific exposure pathways. When not included, the exposure frequency for the industrial land use scenario is 8 hr/day for 250 day/yr; for the recreational land use, a value of 2 hr/wk for 52 wk/yr is used (EPA 1989b); for a residential land use, all contact rates are given per day for 350 day/yr.

[a]RAGS, Vol 1, Part B (EPA 1991).

[b]Exposure Factors Handbook (EPA 1989b)

[c]EPA Region VI guidance.

[d]For radionuclides, RESRAD (ANL 1993) is used for human health risk calculations; default parameters are consistent with RESRAD guidance.

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Statement of Basis
Approval of No Further Action

January 2000

Solid Waste Management Unit 65E
Operable Unit 1333
Round 11

RSI Originally Submitted September 1999

Site-Specific Comments

ER Site 65E, Far Field Dispersion Area

ER Site 65E is appropriate for NFA.

Page 5-7, Section 5.2.1, 6th paragraph – Although the rate of ground water discharge at Burn Site Spring is small, the spring is perennial, not ephemeral.

Response: The wording has been changed. See Attachment H.

Attachment H

ATTACHMENT H

ER SITE 65E
REVISED PAGE 5-7, SECTION 5.2.1, PARAGRAPH 6

SWMU 65 is presently an inactive site. It was used from the late-1960s to the early 1990s for general explosives tests. Its location is coincident with SWMU 94, Lurance Canyon Burn Site (LCBS), which is used for testing fire survivability of transportation equipment, storage equipment, simulated weapons, and satellite components. SWMU 94 activities began in the mid-1970s and continue to the present.

SWMU 65E lies on approximately 77 acres of land at a mean elevation of 6,365 feet above sea level (SNL/NM April 1995). The site represents the farthest extent (far-field) of the fragmentation area associated with the open-detonation tests at LCETS. The fragmentation area boundary was confirmed by the surface gamma radiation survey performed by RUST Geotech Inc. in December 1994 (RUST Geotech Inc. December 1994) and in subsequent surveys performed in 1996 (SNL/NM September 1997a). No documented tests were conducted at SWMU 65E, but the area is considered a dispersion area for general explosives testing activities in ER Sites 65B and 65C. The Lurance Canyon arroyo, which flows through the boundaries of SWMU 65E, may have received materials from surface runoff and air dispersion.

Historical published information regarding the hydrogeology of Lurance Canyon has been summarized in the "RFI Work Plan for the OU 1333, Canyons Test Area" (SNL/NM September 1995). Since that time, additional bedrock wells and alluvial piezometers have been installed in the Lurance Canyon and data collected from the new bedrock wells have supported the hydrologic model of semiconfined to confined groundwater conditions at a depth of approximately 222 feet below ground surface (bgs) beneath the Lurance Canyon SWMUs. The data collected from the alluvial piezometers support the absence of alluvial groundwater. Hydrologic data have been collected from the Burn Site Well, CYN-MW1D, 12AUP01 (piezometer), and CYN-MW2S (piezometer). The remainder of this section summarizes the hydrologic conditions at each monitoring well location.

The Burn Site well was drilled in February 1986 to a total depth of 350 feet bgs and is shown on Figure 5.2.1-1. A total of 74 feet of clay, silt, and shale units were encountered overlying the bedrock identified as metamorphic shists and fractured granite. Water-bearing bedrock was encountered at a depth of 222 to 350 feet bgs (New Mexico State Engineers Office Well Record RG-44986). Following well completion, the water level rose to 68 feet bgs.

A shallow underflow piezometer was installed in November 1996 in SWMU 12A located within the SWMU 65E boundary (Figure 5.2.1-1). The NFA proposal for SWMU 12A has been submitted to the New Mexico Environment Department (NMED) for an NFA decision (SNL/NM May 1997). The piezometer was installed in conformance with an understanding between SNL/NM and the NMED Oversight Bureau (OB) (Dawson August 1996). The subsurface geology at the site is comprised of approximately 55 feet of alluvial sand, silt, and gravel overlying metamorphic phyllite to schist bedrock. The piezometer was completed to a depth of approximately 58 feet bgs and was identified as 12AUP01. Moist soil was encountered in the first 5 feet of alluvium. The remaining 53 feet to bedrock were dry. No groundwater was encountered during drilling. The piezometer was instrumented in February 1997 and has been collecting data since that time. In addition, manual checks have been conducted for the presence of water as a verification procedure. No water has been recorded in the piezometer subsequent to its installation.

The Burn Site Spring (Figure 5.2.1-1) is a perennial ~~an ephemeral~~ spring or, more accurately, a seep located approximately 1,200 feet northeast of SWMU 65E. The seep discharges small quantities of water from fractures and/or bedding plane permeability within the carbonate rocks