4-1-2000

Justification for Class III Permit Modification April 2000 Solid Waste Management Unit 94E Operable Unit 1333 Round 13

Sandia National Laboratories/NM

Justification for Class III Permit Modification

April 2000

Solid Waste Management Unit 94E
Operable Unit 1333
Round 13

(RCRA Permit No. NM5890110518)

NFA Originally Submitted August 31, 1999

NFA

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Solid Waste Management Unit 94E
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7.0 SWMU 94E

7.0 SOLID WASTE MANAGEMENT UNIT 94E, SMALL SURFACE IMPOUNDMENT, LURANCE CANYON EXPLOSIVES TEST SITE

7.1 Summary

Sandia National Laboratories/New Mexico (SNL/NM) is proposing a risk-based no further action (NFA) decision for Solid Waste Management Unit (SWMU) 94E, Small Surface Impoundment, Operable Unit (OU) 1333. SWMU 94E is located at the Lurance Canyon Burn Test Site (LCBS) approximately 250 feet southeast of Bunker 9830 (SNL/NM August 1994) and east of the camera bunker. The impoundment was used for several fuel-fire burn tests and may have received wastewater from some portable pan burn tests. The impoundment also receives some surface-water runoff from the graded area. Review and analysis of all relevant data for SWMU 94E indicate that concentrations of constituents of concern (COC) at this site are less than applicable risk assessment action levels. Thus, SWMU 94E is proposed for an NFA decision based upon confirmatory sampling data demonstrating that COCs that could have been released from the SWMU into the environment pose an acceptable level of risk under current and projected future land uses, 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).

7.2 Description and Operational History

Section 7.2 describes SWMU 94E and discusses its operational history.

7.2.1 Site Description

SWMU 94E is a subunit of SWMU 94, which was identified as the LCBS, on the Resource Conservation and Recovery Act (RCRA) Hazardous and Solid Waste Amendment permit. SWMU 94E is located on U.S. Air Force land withdrawn from the Bureau of Land Management and permitted to the U.S. Department of Energy (DOE) (SNL/NM July 1994a). The site is located on the canyon floor alluvium in the closed upper reaches of the Lurance Canyon drainage. This drainage is surrounded by moderately steep sloping canyon walls, and the immediate topographic relief around the site is over 500 feet (Figure 7.2.1-1). A 25- to 50-foot-wide road cut on the hillsides as a firebreak 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 road into the Lurance Canyon (Figure 7.2.1-1).

The LCBS is currently used for testing fire survivability of transportation containers, weapons components, simulated weapons, and satellite components (Author [unk] Date [unk], Martz November 1985, SNL/NM May 1986). Only a few of the permanent engineered structures currently at the site are active today. The location of SWMU 94 coincides with SWMU 65 (Lurance Canyon Explosives Test Site), an inactive site used for high explosives (HE) tests and for liquid and solid propellant burn tests.

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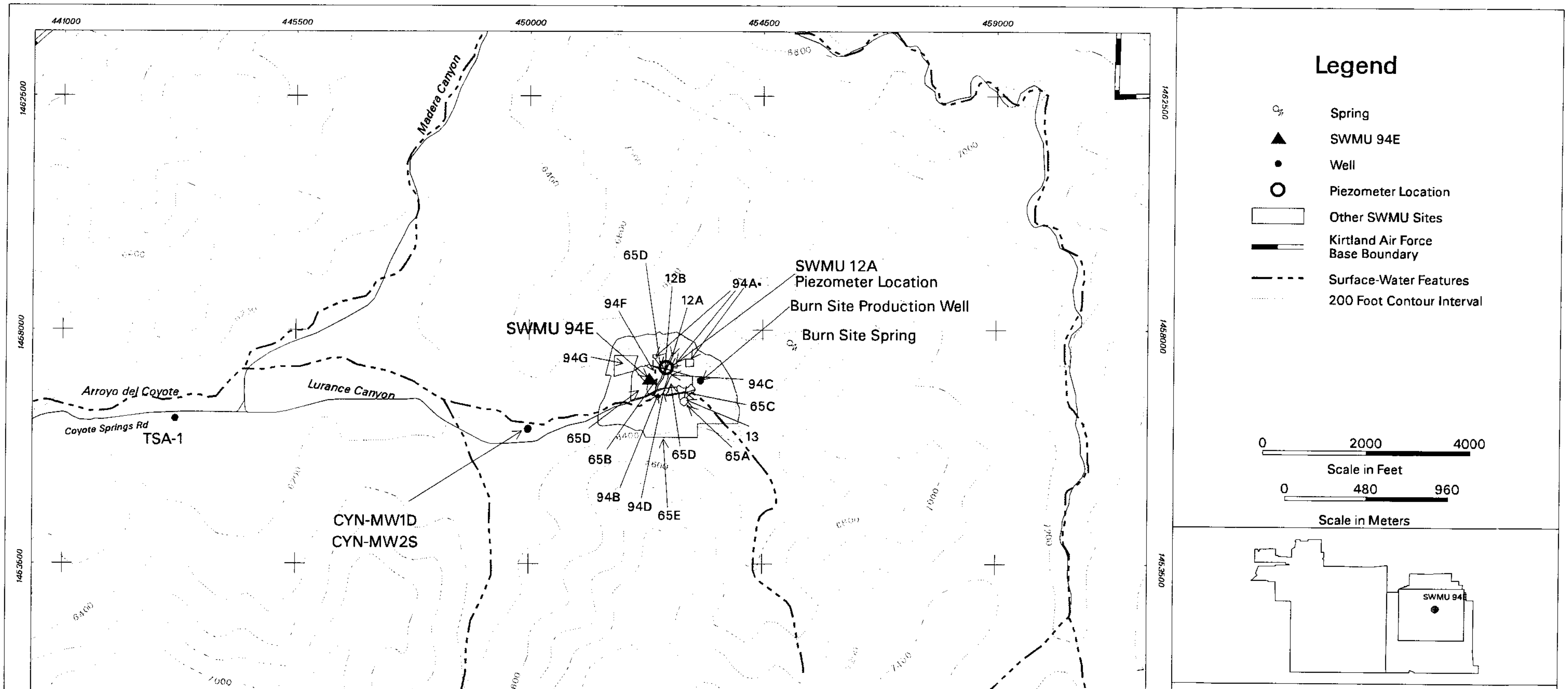

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Figure 7.2.1-1
Location of SWMU 94E
Small Surface Impoundment
within Operable Unit 1333

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

	1:24000	MAPID=990566a
Unclassified		SNL GIS ORG. 6804
D. Helfrich	dr990566a.aml	05/27/99

In order to facilitate site characterization, SWMU 94 has been subdivided into seven subunits where hazardous constituents could have been released (Figure 7.2.1-2): SWMU 94A (Aboveground Tanks), SWMU 94B (Debris/Soil Mound Area), SWMU 94C (Bomb Burner Area and Discharge Line), SWMU 94D (Bomb Burner Discharge Pit), SWMU 94E (Small Surface Impoundment), SWMU 94F (Light Airtransport Accident Resistant Container [LAARC] Discharge Pit), and SWMU 94G (Scrap Yard). All of these subunits are inactive except for SWMU 94G (Scrap Yard) and SWMU 94A, which contains both active and inactive tanks. This NFA addresses historical releases from the small surface impoundment. Table 7.2.1-1 contains the rationale for subunit designation or omission. Each SWMU 94 subunit is addressed in a separate NFA proposal. The NFA proposal for SWMU 94A was submitted in September 1998 (SNL/NM September 1998) and that for SWMU 94D was submitted in June 1999 (SNL/NM June 1999). SWMUs 94B, 94C, 94F, and 94G will be addressed in future NFA submittals.

SWMU 94E, which occupies 0.2 acre (SNL/NM April 1995), consists of an open-surface depression with no visible surface debris or soil discoloration (Figure 7.2.1-2). The mean elevation of this subunit is 6,338 feet above sea level (SNL/NM April 1995).

Historical published information regarding the hydrogeology of the Lurance Canyon was summarized in the "RCRA 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 have been based upon 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 (located approximately 1000 feet east-northeast of SWMU 94E) was drilled in February 1986 to a total depth of 350 feet bgs (Figure 7.2.1-1). A total of 74 feet of clay, silt, and shale units were encountered overlying the bedrock identified as metamorphic schists 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 [April 1986]). Following well completion, the water level rose to 68 feet bgs.

A shallow underflow piezometer was installed in November 1996 in SWMU 12A approximately 300 feet northeast of SWMU 94E (Figure 7.2.1-1). The piezometer was installed in conformance with a document of understanding between SNL/NM and the New Mexico Environment Department (NMED)/DOE 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, identified as 12AUP01, was completed to a depth of approximately 58 feet bgs. 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 monitored 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.

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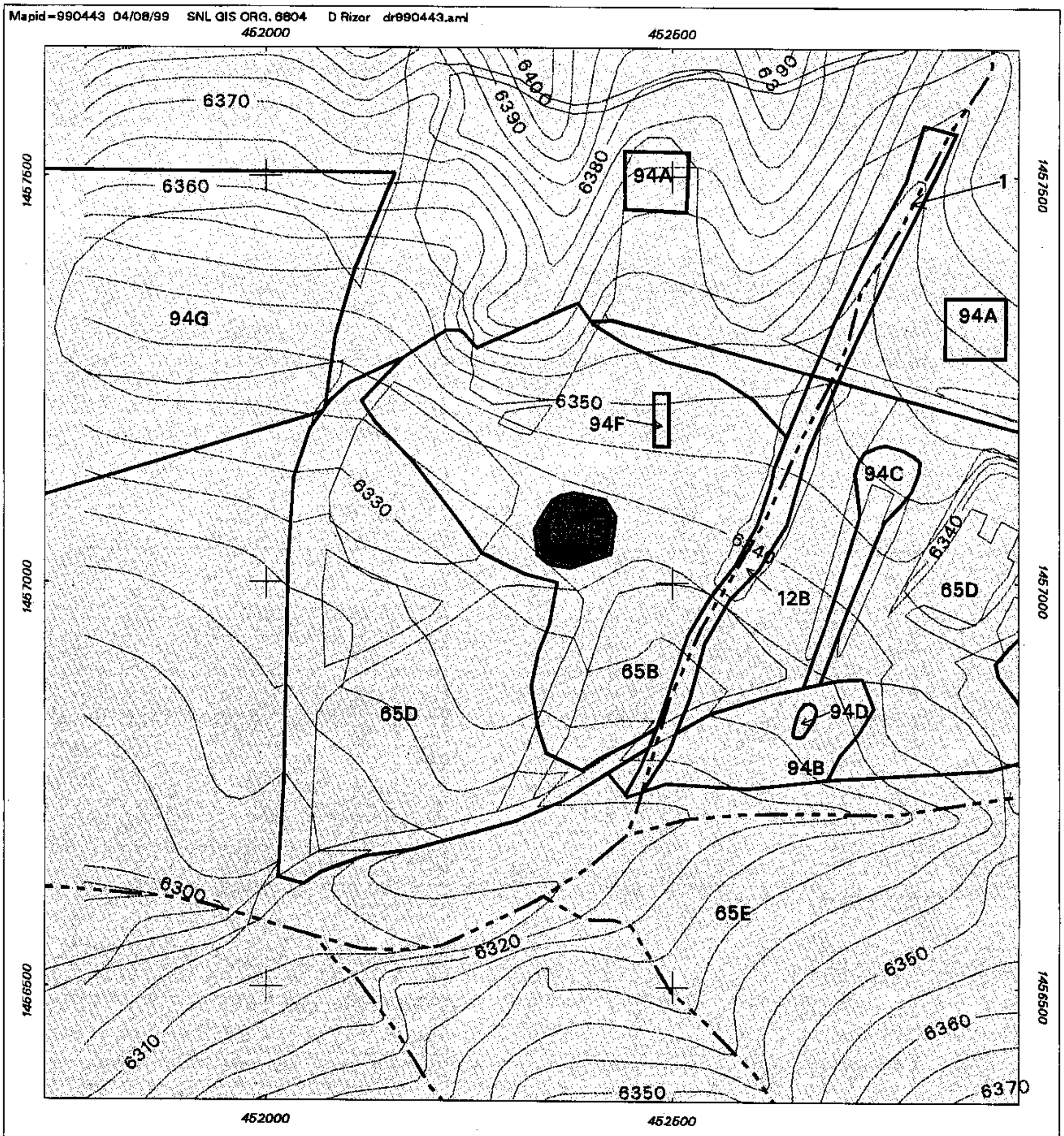

Legend

Road

5 Foot Contour

Surface Drainage

SWMU 94E

Other SWMUs

Figure 7.2.1-2
Site Map
of SWMU 94E

0 100 200
Scale in Feet

0 24 48
Scale in Meters

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Table 7.2.1-1
Correlation of Burn Testing Structures and Associated Features to SWMU 94 Subunits

Burn Unit/Structure	Designated Subunit for Site Characterization	Type/Nature of Operational Release	Rationale for Characterization
Portable Pans	None	Detonations (HE, gun propellant, radionuclides)	Nature of operational release covered in sampling plans for SWMUs 65B and 65D
	SWMU 94E	Wastewater	No operational historical releases in most tests; some documented releases to Small Surface Impoundment
Small Surface Impoundment	SWMU 94E	Wastewater (JP-4 fuel and water mixture)	Documented releases and burn test in the Small Surface Impoundment
LOBP (30 x 60 feet)	None	Wastewater (JP-4 fuel and water mixture)	Only operational historical releases to SWMU 13, no documented historical releases from accidental spills
SOBP (20 x 20 feet)	None	Wastewater (JP-4 fuel and water mixture)	No operational historical releases and no documented historical releases from accidental spills
LAARC Unit	None	Wastewater (JP-4 fuel and water mixture)	No documented historical releases within LAARC Unit from accidental spills
LAARC Discharge Pit	SWMU 94F	Wastewater (JP-4 fuel and water mixture)	Operational historical releases to discharge pit
Bomb Burner Unit and Trench	SWMU 94C	Detonations (HE, radionuclides, metals) and wastewater (JP-4 fuel and water mixture)	Documented operational historical releases inside and near the Bomb Burner Unit, removed in D&D activities in 1997
		Detonations (HE, radionuclides, metals)	Documented detonations in Bomb Burner Unit trench
Bomb Burner Discharger Pit	SWMU 94E	Wastewater (JP-4 fuel and water mixture)	Documented operational historical releases to discharge pit
SWISH Unit	None	None (wastewater recirculated, i.e., never disposed of)	No operational historical releases and no documented historical releases from accidental spills
SMERF	None	None (wastewater recirculated)	No operational historical releases

Table 7.2.1-1 (Concluded)
Correlation of Burn Testing Structures and Associated Features to
SWMU 94 Subunits

Burn Unit/Structure	Designated Subunit for Site Characterization	Type/Nature of Operational Release	Rationale for Characterization
Bunker 9830	None	None	No operational historical releases outside structure; historical releases within structure covered in future D&D activities
Aboveground Tanks	SWMU 94A	Accidental spills of JP-4 fuel on soil	Documented historical releases from accidental spills
Debris/Soil Mounds	SWMU 94B	Metals or radionuclides leachate	Mounds have no documented history and contain radiological anomalies
Scrap Yard	SWMU 94G	Accidental spills of hydraulic oils on soil	Documented release of hydraulic oil

D&D = Decontamination and decommissioning.
HE = High explosive(s).
JP-4 = Jet fuel composition 4.
LAARC = Light Airtransport Accident Resistant Container.
LOBP = Large Open Burn Pool.
SMERF = Smoke Emission Reduction Facility.
SOBP = Small Open Burn Pool.
SWISH = Small Wind-Shielded.
SWMU = Solid Waste Management Unit.

The Burn Site Spring (Figure 7.2.1-1) is an ephemeral spring or, more accurately described, a seep, located approximately 2,900 feet northeast of SWMU 94E. The seep discharges small quantities of water from fractures and/or bedding plane permeability within the carbonate rocks (Goodrich [Month Unk.] 1993). It is believed that the source of the water is 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 of (downgradient from) the LCBS (Figure 7.2.1-1). The groundwater wells were installed in conformance with the documents of understanding between SNL/NM and the NMED/DOE OB (SNL/NM July 1997, SNL/NM September 1997a). The monitoring 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, which is fractured. No water was encountered while drilling activities were conducted in the alluvium, and no water has been recorded at CYN-MW2S since its installation. Groundwater was first encountered in CYN-MW1D 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 7.2.1-1).

In summary, the groundwater beneath the LCBS 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 94E, refer to the RFI Work Plan for OU 1333 (SNL/NM September 1995).

7.2.2 Operational History

Historical aerial photographs indicate that the transition of testing activities from predominantly open-detonation explosives testing and jet fuel composition 4 (JP-4) fuel fires in excavated pits (SWMU 65) to open burning of test units with JP-4 fuel fires in portable pans (SWMU 94) occurred between 1971 and 1982 (SNL/NM August 1994). Based upon test reports and interviews, open burning with JP-4 fuel fires in portable burn pans began around 1975. By 1980 the first permanent engineered burn unit (the LAARC) was constructed on the former location of the Primary Detonation Area (SWMU 65B) and was in operation (Annex 7-A). The scrap yard (SWMU 94G) was established in the northwestern portion of the site within the former location of the Far-Field Dispersion Area (SWMU 65E) (Larson and Palmieri October 1994). The scrap yard has historically been used to store spare materials used in explosives and burn tests and is still in use today for storing nonliquid materials and used equipment.

By 1983 most of SWMU 94 had been constructed, with a total of six permanent engineered burn units (the Large Open Burn Pool, the Small Open Burn Pool, the LAARC Unit, the Bomb Burner Unit, the Small Wind-Shielded [SWISH] Unit, and the Conical Container [CON-CON] Unit) placed on the graded area that was formerly the location of the Primary Detonation Area (SWMU 65B) and the Near-Field Dispersion Area (SWMU 65D) (SNL/NM August 1994) (Figure 7.2.2-1). Two of the burn units (the SWISH Unit [and later the Smoke Emissions Reduction Facility (SMERF) Unit]) were constructed to provide testing facilities that would eliminate wind effects and provide accurate temperature control and instrumentation for test

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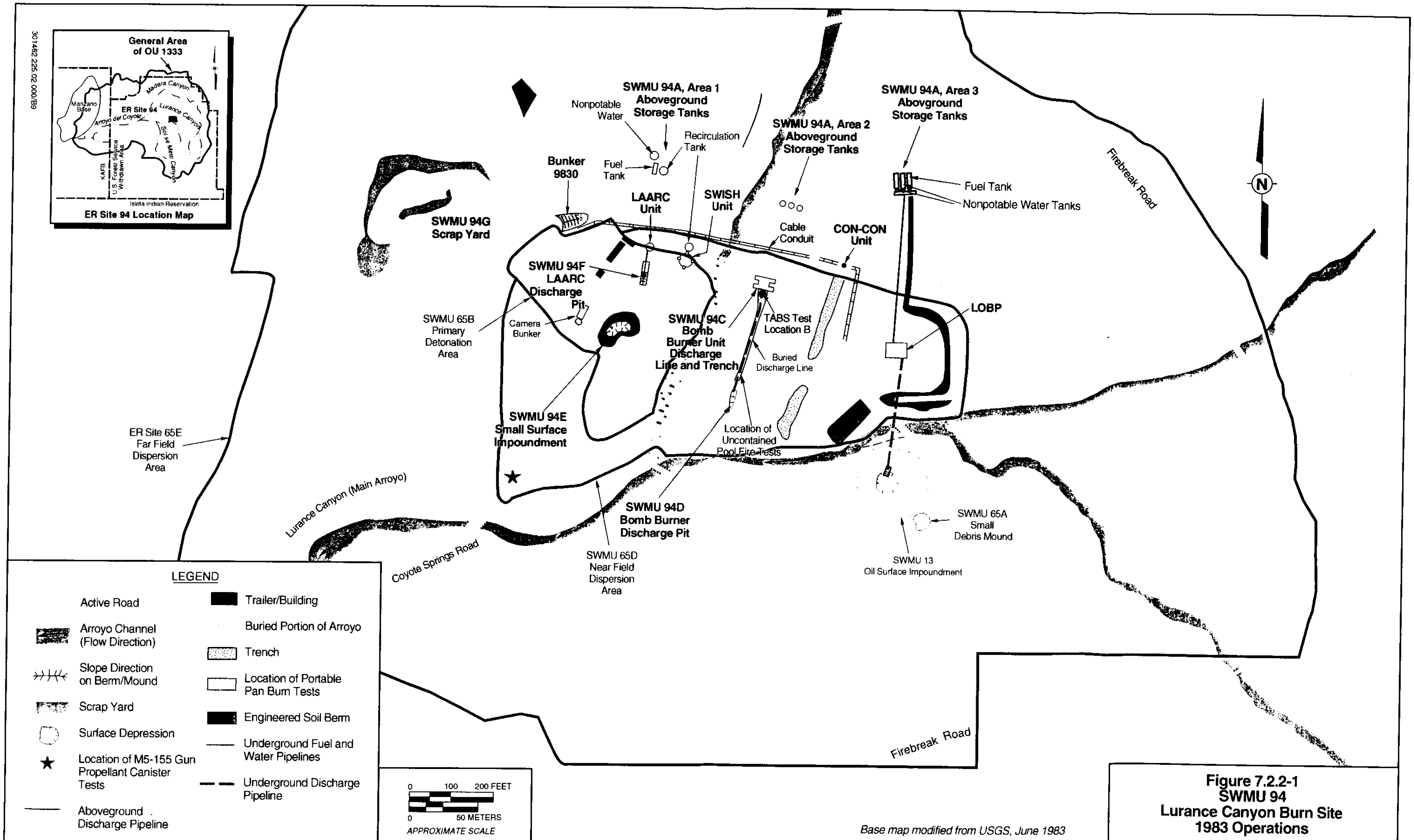

Figure 7.2.2-1
SWMU 94
Lurance Canyon Burn Site
1983 Operations

monitoring (Palmieri April 1995a). A small surface impoundment (SWMU 94E) is also visible southeast of Bunker 9830. Engineered soil berms had been constructed by 1983 in the southeastern portion of the site for flood protection from the main arroyo in the Lurance Canyon.

By 1992 the site contained all the current permanent engineered burn units (Figure 7.2.2-2). The CON-CON Unit, identified in the 1983 historical aerial photograph, was dismantled prior to 1989, and by 1992 a new burn unit (SMERF) had been constructed in the same location (SNL/NM August 1994). Prior to 1992, a debris/soil mound area (SWMU 94B) had been created in the southern portion of SWMU 94, directly north of the main arroyo in the Lurance Canyon (Figure 7.2.2-2). This debris/soil mound could be associated with ongoing grading activities at the site. Northeast of the debris/soil mound area (SWMU 94B) is a second soil mound that had been created during remediation of a wastewater spill from the SMERF on March 20, 1992 (Figure 7.2.2-2).

Burn testing at the LCBS has always been conducted with JP-4 fuel pool fires in open portable pans or contained within the permanent engineered structures (Jercinovic et al. November 1994). Pool fires provide the closest simulation of accidents involving flammable liquids (Author [unk] Date [unk]). For the tests, the pans are filled with approximately 1 to 2 feet of water, and an average 8-inch layer of JP-4 fuel is placed on the water. A test unit such as a transportation container is placed on a stand above the fuel. The fuel is ignited, and the fire typically burns until the JP-4 fuel is consumed. The length of the test is controlled by the volume (thickness) of the JP-4 fuel layer. After a burn test is completed, test units are retrieved and salvageable materials are collected and stored in the scrap yard located in the northwestern portion of the site (Figure 7.2.2-2). Any test object residue (e.g., metal slag) is recovered with the test unit and is removed from the site by the testing group. It is possible that only small residue particulates were left in the water following the burn test (Larson and Palmieri October 1994). While no testing is currently conducted on components containing radioactive materials, SWMU 94 is classified as a radiological materials management area (RMMA) because of the presence of residual depleted uranium (DU) in the soil from earlier burn tests (Gaither December 1993) and from former explosives testing activities associated with SWMU 65 (Gaither January 1994). Annex 7-A presents tabulated data from SWMU 94 testing activities documented in test logs since 1979.

7.3 Land Use

Section 4.3 discusses the current and future/proposed land use for SWMU 94E.

7.3.1 Current

SWMU 94E is located within the boundaries of Kirtland Air Force Base (KAFB) (Figure 7.3.1-1) within the active industrial LCBS.

7.3.2 Future/Proposed

The future/proposed land use for SWMU 94E is recreational (DOE et al. October 1995).

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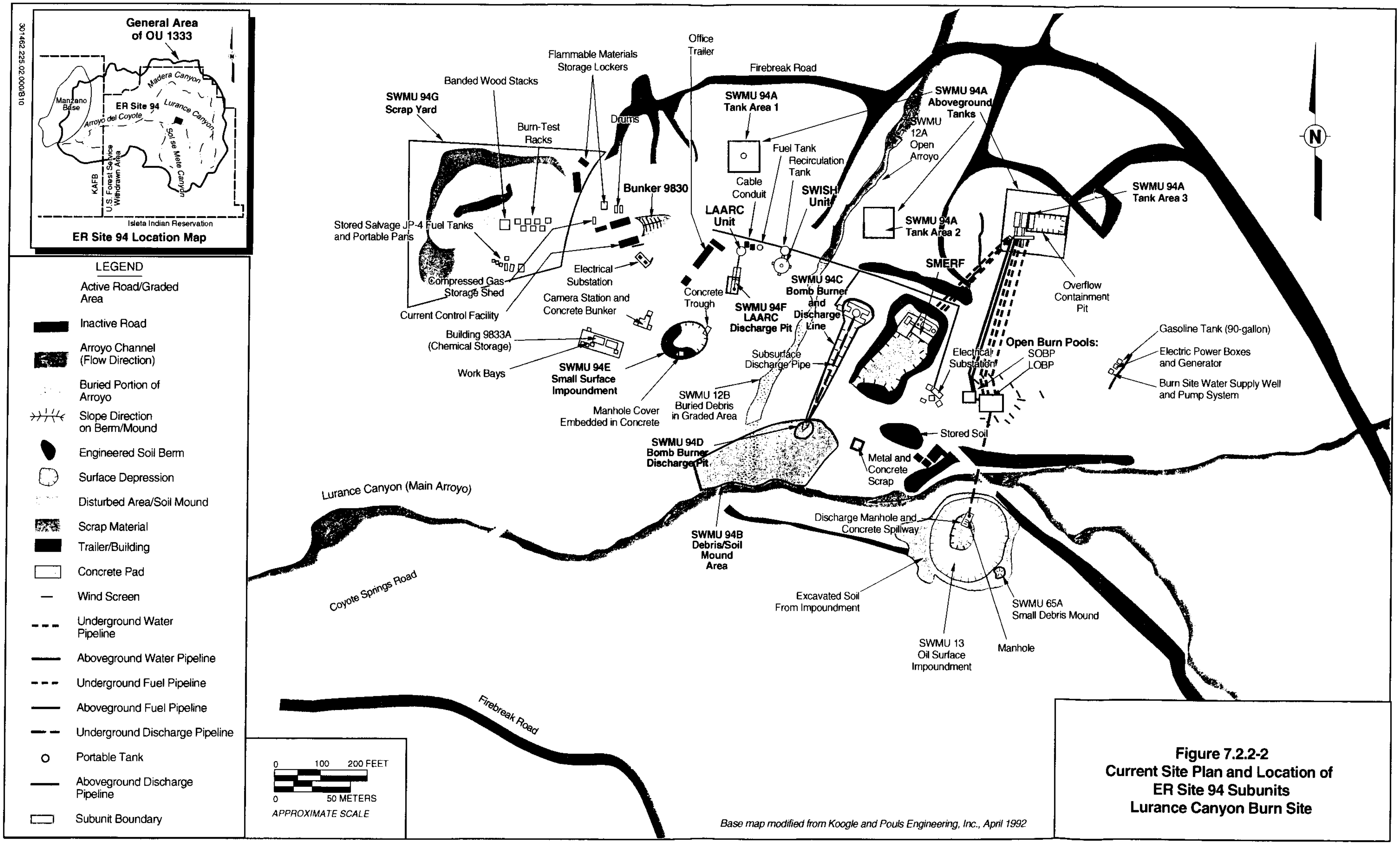

Figure 7.2.2-2
Current Site Plan and Location of ER Site 94 Subunits Lurance Canyon Burn Site

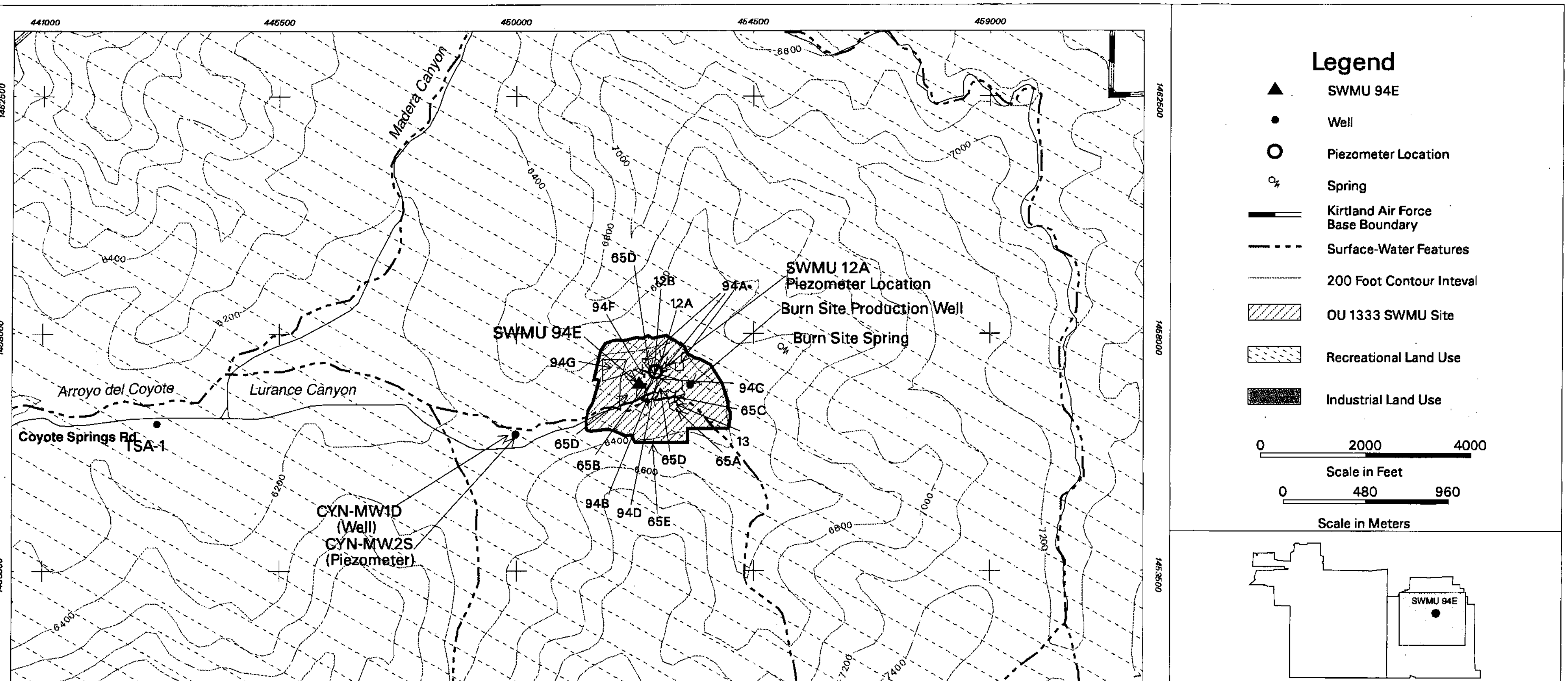

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Figure 7.3.1-1
SWMU 94E, OU1333 SWMU Sites and Associated Land Uses within KAFB Boundary & Vicinity

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

	1:24000	MAPID=990760a
Unclassified		SNL GIS ORG. 6804
S Morrison	sm990760a.aml	08/10/99

7.4 Investigatory Activities

SWMU 94E has been investigated in a series of three investigations. Section 7.4 discusses these activities.

7.4.1 Summary

SWMU 94E was originally 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). In 1998 a passive soil vapor survey (SVS) and confirmatory soil sampling were conducted (Investigation #3).

7.4.2 Investigation #1—CEARP and RCRA Facility Assessment

7.4.2.1 Nonsampling Data Collection

SWMU 94 was evaluated during investigations conducted under the CEARP (DOE September 1987) and the RCRA Facility Assessment (RFA) (EPA April 1987). The CEARP Phase I report stated that SWMU 94 had been constructed in the late 1970s and is currently used for studying the effects of fire on a variety of test units (e.g., weapons components and transportation containers). JP-4 is the standard fuel burned, but propellants and nitromethane were also used. Current test activities may release metallic particulates and other materials into the environment.

The RFA report (EPA April 1987) noted only that scrap metal, old equipment, empty drums, and empty tanks used in impact experiments are contained in a 3- to 5-acre area (SWMU 94G [Scrap Yard]). The storage of liquids was not noted during the visual site inspection.

7.4.2.2 Sampling Data Collection

No sampling activities were conducted at SWMU 94E as part of the CEARP.

7.4.2.3 Data Gaps

Insufficient information was available to calculate a hazard ranking system (HRS) and modified HRS migration mode scores.

7.4.2.4 *Results and Conclusions*

The CERCLA finding under the CEARP was uncertain for RCRA-regulated hazardous waste.

7.4.3 Investigation #2—SNL/NM Environmental Restoration Preliminary Investigations

7.4.3.1 *Nonsampling Data Collection*

This section describes the nonsampling data collected at SWMU 94E.

7.4.3.1.1 *Background Review*

A background review was conducted in order to collect available and relevant information regarding SWMU 94E. Background information sources included interviews with SNL/NM staff and contractors familiar with the site's operational history and reviews of 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 7.4.3-1 lists the information sources that were used to assist in evaluating SWMU 94E.

7.4.3.1.2 *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 94 in conjunction with SWMUs 65, 12, and 13. The survey identified one trip flare as live ordnance and one slap flare and one rifle-propelled illuminator round as ordnance debris. The survey report also documented that metal fragments were found in the hills surrounding these sites (Young September 1994).

7.4.3.1.3 *Radiological Survey(s) and VCM*

SWMU 94 is classified as an RMMA because it is co-located with the SWMU 65 RMMA (SNL/NM November 1994), the presence of residual DU in the soil from earlier burn tests (Gaither December 1993), and from former explosives testing activities associated with SWMU 65 (Gaither January 1994). On April 30 and May 4, 1993, the SNL/NM Radiation Protection Office personnel conducted contamination surveys of several sections of road in the Coyote Canyon area. Adhesive swipes that had been placed on the underside of the vehicle collected samples of dust from the air behind the vehicle as it was moving. Analysis yielded no contamination, 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 surface gamma radiation survey of SWMU 94 in conjunction with SWMUs 65, 12, and 13

Table 7.4.3-1
Summary of Background Information Review for SWMU 94E

Information Source	Reference	
Technical test reports and project log books	Hill [Date unk.] Kervin April 1981 Moore September 1981 Moore June 1982 Gill November 1982 Moore and Luna February 1983 Luna March 1983	Hooper May 1983 Luna and Moore June 1983 Mata December 1983 Cocke May 1984 Stevenson December 1985 SNL/NM November 1994
Engineering drawings "Burn Site" (Drawing Number T95597)	SNL/NM 1983	
Site inspections (field notes, aerial photograph review, site photographs, radiological, UXO/HE, biological, and cultural resource surveys)	Gaither [Date unk.] Luna October 1985 Gaither October 1992 Oldewage May 1993 Karas June 1983	Oldewage December 1993a Oldewage December 1993b Oldewage February 1994 SNL/NM August 1994 Young September 1994
Employee interviews, 24 interviews with 11 facility personnel (current and retired)	Martz September 1985 Martz November 1985 Brouillard June 1994 Larson and Palmieri August 1994 Palmieri September 1994a Palmieri September 1994b Palmieri and Larson 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 January 1995 Palmieri March 1995 Jercinovic April 1995 Palmieri April 1995a Palmieri April 1995b Palmieri August 1995

HE = High explosive(s).
SWMU = Solid Waste Management Unit.
UXO = Unexploded ordnance.

(RUST Geotech Inc. December 1994). The gamma scan survey was performed at 6-foot centers (100-percent coverage) over the surface of the graded portion of the site (SWMU 65D), which included the area of SWMU 94E. One surface gamma radiation anomaly was detected within the boundaries of SWMU 94E (SNL/NM September 1997b). Based upon this survey, voluntary corrective measure (VCM) activities were conducted during May, June, and October 1996. In May and June 1996 the anomaly at 94E was cleaned up and a verification sample was collected (see Table 7.4.3-2). Because of the size of the anomaly a backhoe was used to finish the clean up. The final excavation was 23 feet long by 14 feet wide by 4 feet deep. Approximately 50 cubic feet of soil were removed, containerized, and disposed of as radioactive waste. Results of the verification soil sample analyzed on site using gamma spectroscopy are shown below. Only uranium-238 was elevated relative to background values (15.7 versus 2.31 picocuries [pCi]/gram [g]), indicating that some residual DU contamination remains at the site.

7.4.3.1.4 Cultural-Resources Survey

A cultural-resources survey of SWMU 94 was conducted as part of the assessment of the LCBS. Seven cultural-resources sites were identified at the LCBS (Hoagland and Dello-Russo February 1995). However, none of the cultural-resource sites are within 100 feet of the SWMU 94E boundaries, and SWMU 94E sampling activities have not affected the cultural resources.

7.4.3.1.5 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 during this survey (IT February 1995). The site is active and no undisturbed habitat remains in the graded portion of the LCBS.

7.4.3.1.6 Geophysical Survey(s)

No geophysical surveys were performed in the vicinity of SWMU 94E.

7.4.3.2 Sampling Data Collection

In July 1995 SWMU 94E was investigated as part of a sitewide scoping sampling program. The purpose of this effort was to obtain preliminary analytical data to support the Environmental Restoration (ER) Project site ranking and prioritization. Two sampling locations were selected within the boundary of SWMU 94E. A surface sample (0 to 6 inches) and a subsurface sample (1.5 to 2 feet) were collected at each location. The SNL/NM ER Chemistry Laboratory analyzed the four environmental samples for RCRA metals (plus beryllium) using modified EPA Method 6010 (EPA November 1986), for total petroleum hydrocarbons (TPH) using an immunoassay method, and for HE using high-performance liquid chromatography. In addition, the Radiation Protection Sample Diagnostics (RPSD) Laboratory analyzed the samples for gamma-emitting radionuclides using gamma spectroscopy.

Table 7.4.3-2
Surface Radiation VCM Verification Sample from the Single Area Source in 94E (collected 6/17/96)

Sample Attributes			Gamma Spectroscopy Activity (pCi/g)							
			Uranium-238		Thorium-232		Uranium-235		Cesium-137	
Record Number[a]	ER Sample ID	Sample Depth (ft)	Result	Error[b]	Result	Error[b]	Result	Error[b]	Result	Error[b]
05457	94E8-SS	3.75-4	**15.7**	4.77	0.630	0.331	ND (0.173)	--	ND (0.0487)	--
Background Soil Concentrations—Upper Canyons[c]			2.31	NA	1.03	NA	0.16	NA	0.515	NA

[a]Analysis request/chain of custody.
[b]Two standard deviations above the mean detected activity.
[c]Dinwiddie September 1997.
ER = Environmental Restoration.
ft = Foot (feet).
ID = Identification.
NA = Not analyzed.
ND = Not detected.
pCi/g = Picocurie(s) per gram.
SS = Subsurface soil sample.
-- = Error not calculated for nondetectable results.

7.4.3.3 Data Gaps

Information gathered through process knowledge, from a review of historical files, and from personnel interviews aided in identifying the most likely COCs at SWMU 94E and in selecting the types of analyses to be performed on soil samples. However, the preliminary scoping data are not adequate to define organic COCs or support a risk screening assessment.

7.4.3.4 Results and Conclusions

One surface sample had a TPH detection between 10 and 100 parts per million (ppm); the rest were nondetect at the method detection limit (MDL) of 10 ppm. Of the RCRA-regulated metals (plus beryllium), only barium, mercury, and lead were detected in the soil samples. Barium concentrations were below the background limit of 246 milligrams (mg)/kilogram (kg). Mercury was detected in two samples at 0.07 J mg/kg and 0.24 mg/kg, above the background limit of 0.055 mg/kg. Lead concentrations ranged between 18 J mg/kg and 73 J mg/kg, and three of the four samples exceeded the background limit of 18.9 mg/kg. Selenium, arsenic, cadmium, chromium, beryllium, and silver were not detected. The MDLs ranged from 0.2 mg/kg (for mercury) to 50 mg/kg (for arsenic and selenium) and exceeded the background limits. No HE compounds were detected in any of the soil samples at MDLs ranging from 30 to 150 mg/kg. No duplicate samples were analyzed.

Uranium-235 was 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 pCi/g. Uranium-238 was also not detected above the MDA; however the MDA exceeded the background activity limit of 2.31 pCi/g for all four analyses, ranging from 5.73 to 9.0 pCi/g. Thorium-232 was detected in two samples at levels slightly above the background activity limit of 1.03 pCi/g (1.32 and 1.12 pCi/g). Cesium-137 was not detected in any samples above the background activity limit of 0.515.

7.4.4 Investigation #3—SNL/NM ER Passive SVS and Confirmatory Sampling

7.4.4.1 Nonsampling Data Collection

No nonsampling data collection activities were associated with Investigation #3 of SWMU 94E.

7.4.4.2 Sampling Data Collection

This section discusses the passive SVS and confirmatory soil sampling at SWMU 94E.

7.4.4.2.1 Passive SVS

SNL/NM conducted a passive SVS of the entire LCBS in February 1998. All SVS activities were implemented in accordance with the rationale and procedures described in the sampling and analysis plan (SAP) for "Soil Vapor Surveys at Lurance Canyon Burn Site" (SNL/NM February 1998a). The SAP combined the investigation activities proposed in the RFI Work Plan for OU 1333 (SNL/NM September 1995) with the comment responses to the request for supplemental information relating to the OU 1333 RFI Work Plan (SNL/NM December 1997). In addition, the SAP was reviewed by the NMED and includes SNL/NM and NMED/DOE OB agreed-upon recommendations. SVS samplers were installed approximately 18 to 36 inches bgs. The samplers were retrieved after approximately 16 days. The manufacturer-recommended installation depth and residence time are 18 inches bgs minimum and 14 days minimum, respectively.

Within the boundaries of SWMU 94E, the survey was designed to determine the presence of volatile organic compounds (VOC) and semivolatile organic compounds (SVOC) associated with historical testing and resulting discharges to the surface impoundment. One passive soil vapor sampler was installed in the central area of the impoundment. After approximately 16 day's residence time, the samplers were retrieved for off-site analysis at W.L. Gore & Associates, Inc., in Elkton, Maryland. The samplers were analyzed for target VOCs (benzene, toluene, ethylbenzene, and xylene) using a modified EPA Method 8260 (EPA November 1986) and for target SVOCs using a modified EPA Method 8270 (EPA November 1986). These modified analytical methods involve thermal desorption, gas chromatography, and mass selective detection.

No detections above the reporting limits were observed at the one sampling location. The reporting limits are based upon the maximum contaminant level observed in the field on trip blanks. The results of the passive SVS are summarized in a separate report previously submitted to the NMED (SNL/NM February 1998a).

7.4.4.2.2 Confirmatory Sampling

SNL/NM conducted confirmatory soil sampling at SWMU 94E in November 1998 to determine whether potential COCs were present at levels exceeding background limits at the site and/or were 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) and the associated Field Implementation Plan (FIP) addendum to the work plan (SNL/NM November 1998), as reviewed by the NMED. SNL/NM chain-of-custody and sample documentation procedures were followed for all samples collected. Figure 7.4.4-1 shows the confirmatory sample locations associated with SWMU 94E and the surface radiation anomaly that was cleaned up in June 1996.

During the confirmatory sampling field effort, a visual inspection of the manhole, located on the embankment along the south side of the impoundment, was performed to verify that it is not a potential conduit for contaminant migration. The manhole is approximately 8 feet deep and has a 4- by 5-foot rectangular floor. The interior is sealed off from the surrounding soil, and was dry at the time of the inspection (November 1998 and again in April 1999). It does not appear to collect water, nor are there any connecting conduits to the manhole that could facilitate

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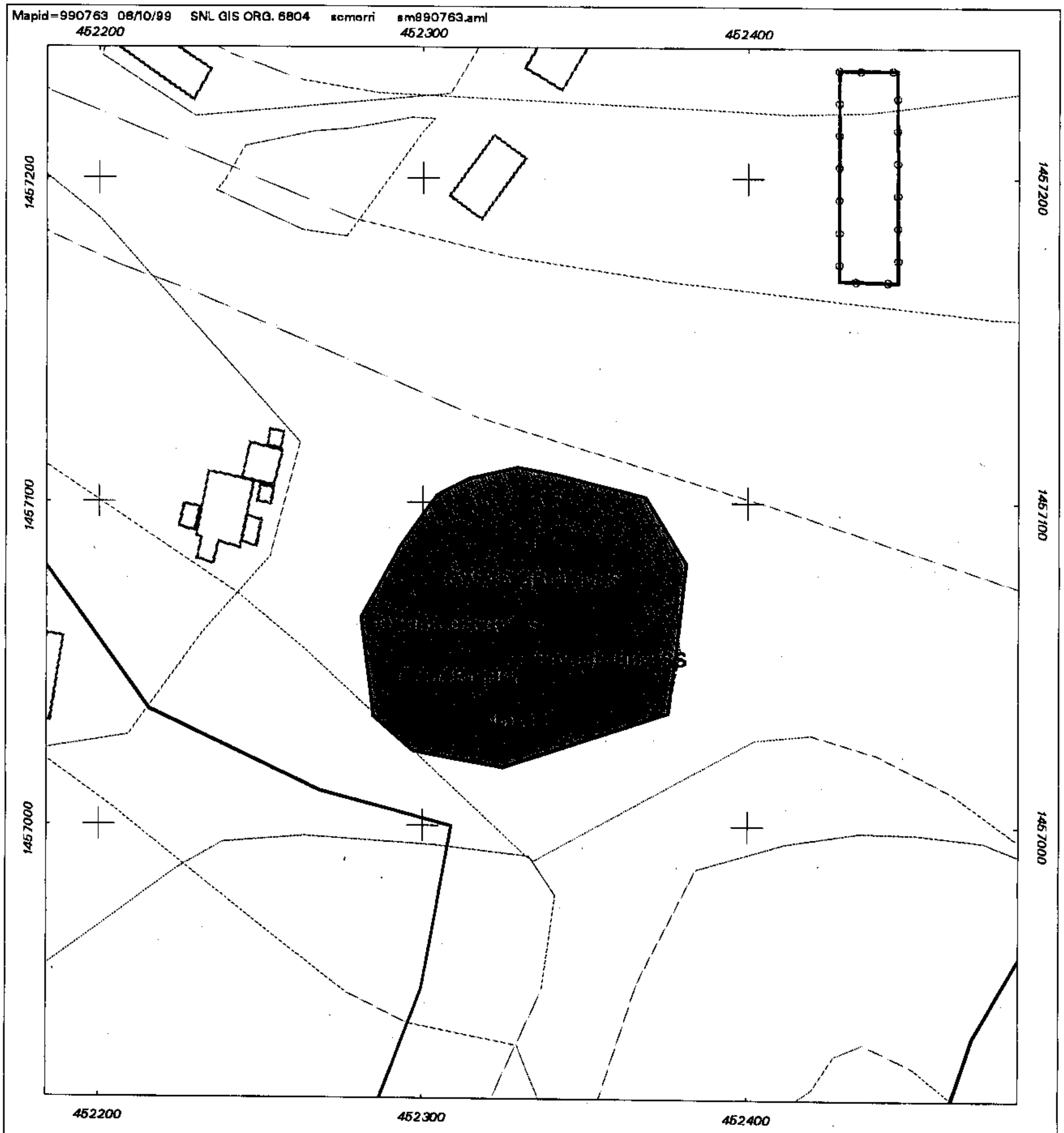

Legend

- ● Soil Gas Sample
- ▲ Proposed Borehole
- ▼ Optional Borehole
- ◆ Sediment Sample
- 5 Foot Contour
- Other ER Site Boundary
- Building / Structure
- Road
- Fence
- ER Site 94E
- Radiation Anomaly Area Source

0 25 50 Scale in Feet

0 6 12 Scale in Meters

Figure 7.4.4-1 Confirmatory Sample Locations at SWMU 94E

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

migration of contaminated water. It is a former instrument manhole that had been used to protect equipment associated with the historic fuel-fire burn tests conducted in the impoundment.

In November 1998 surface soil samples (at 0 to 0.5 foot bgs) were collected from three locations within the small surface impoundment. In addition, a single soil boring located near the lowest point in the small surface impoundment was installed and sampled. The intended total depth of the boring was 25 feet bgs, but refusal was encountered because of shallow bedrock at 10 feet bgs. Another attempt was made after moving the Geoprobe system over a few feet, but again refusal occurred at 10 feet bgs. The subsurface samples were collected in acetate liner sleeves using a Geoprobe system. Sample recovery was poor because of rocky soil, making collection of a representative duplicate sample impossible.

All soil samples, with the exception of samples collected for gamma spectroscopy analysis and gross alpha and gross beta activity, were analyzed off site for RCRA metals plus beryllium, HE, SVOCs, and VOCs. Two soil samples from the borehole and one surface sample location were also analyzed off site for gross alpha and gross beta activity. In addition, one surface and one subsurface sample were analyzed on site using gamma spectroscopy. The trip blank was analyzed off site for VOCs only. GEL Laboratories Inc. analyzed the samples for RCRA metals plus beryllium using EPA Methods 6010/7000 (EPA November 1986), for HE using EPA Method 8330 (EPA November 1986), for VOCs using EPA Method 8260 (EPA November 1986), for SVOCs using EPA Method 8270 (EPA November 1986), and for gross alpha and gross beta activities using EPA Method 900.0 (EPA November 1986). SNL/NM Department 7713, RPSD Laboratory, analyzed two samples for radionuclides using gamma spectroscopy to permit the off-site transport of samples to GEL Laboratories Inc. and to characterize radionuclide activities at the site.

Table 7.4.4-1 summarizes the samples collected at the site and the corresponding laboratory analyses.

7.4.4.3 Data Gaps

Analytical data from confirmatory sampling are sufficient to characterize the nature and extent of historical releases of COCs at the site. There are no further data gaps regarding characterization of the SWMU 94E.

7.4.4.4 Results and Conclusions

In November 1998 soil samples were collected from three locations on the surface and from a boring installed in the subsurface at SWMU 94E in conformance with the RFI Work Plan (SNL/NM September 1995) and the FIP (SNL/NM November 1998). Tables 7.4.4-2, 7.4.4-3, 7.4.4-4, 7.4.4-5, 7.4.4-6, and 7.4.4-7 summarize the metals, HE, VOCs, SVOCs, and radionuclides (i.e., gamma spectroscopy [gross alpha/gross beta]) analytical results, respectively, for all of the confirmatory soil samples collected at SWMU 94E. Annex 7-B contains complete results for the gamma spectroscopy analyses. A surface sample and composite sample representing the total depth of the boring (0- to 10-foot interval) were

Table 7.4.4-1
Summary of Sample Information

Sample Number	Sample Depth (in ft)	Laboratory Analyses
CY94E-GR-001-SS	0–0.5	RCRA metals (+ Be), VOCs, SVOCs, HE, gamma spectroscopy and gross alpha/beta
CY94E-GR-002-SS	0–0.5	RCRA metals (+ Be), VOCs, SVOCs, HE
CY94E-GR-003-SS	0–0.5	RCRA metals (+ Be), VOCs, SVOCs, HE
Borehole Location Samples		
CY94E-BH1-5'-SS	5	VOCs
CY94E-BH1-6'-SS	6	RCRA metals (+Be), HE, SVOCs
CY94E-BH1-7'-SS	7	Gross alpha/beta
CY94E-BH1-8.5'-SS	8.5	VOCs
CY94E-BH1-9'-SS	9	RCRA metals (+Be), HE, SVOCs
CY94E-BH1-10'-SS	10	Gross alpha/beta
CY94E-BH1-0'-10'-SS	0–10	Gamma spectroscopy
CY94E-BH1-S	0–0.5	Gamma spectroscopy and gross alpha/beta
CY94E-TB	Not applicable	VOCs (trip blank)

BH = Borehole.
CY = Canyon.
ft = Foot (feet).
GR = Grab sample.
HE = High explosive.
RCRA = Resource Conservation and Recovery Act.
S = Surface soil sample.
SS = Subsurface soil sample.
SVOC = Semivolatile organic compound.
TB = Trip blank.
VOC = Volatile organic compound.

Table 7.4.4-2
Summary of SWMU 94E Confirmatory Soil Sampling Metals Analytical Results, November 1998
(Off-Site Laboratory)

Sample Attributes			Metals (EPA 6010/7000[a]) (mg/kg)								
Record Number[b]	ER Sample ID (Figure 7.4.4-1)	Sample Depth (ft)	Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
601194	CY94E-GR-001-SS	0–0.5	3.41	62.0	0.395	ND (0.511)	7.67	7.13	0.00731	0.575	ND (0.511)
601194	CY94E-GR-002-SS	0–0.5	6.46	230	**1.13**	0.327J	**19.9**	**25.4**	0.0282	0.696	ND (0.031)
601194	CY94E-GR-003-SS	0–0.5	5.49	216	**0.977**	0.0979J	17.8	**23.5**	0.0228	1.12	ND (0.619)
601186	CY94E-BH1-6-SS	6	5.61	**316**	**1.07**	ND (0.592)	**21.2**	12.7	0.0128	1.21	ND (0.592)
601186	CY94E-BH1-9-SS	8.5	6.88	**610**	0.396	ND (0.578)	**24.8**	3.45	0.0445	0.662	ND (0.578)
Background Soil Concentrations—Canyons Area[c]			9.8	246	0.75	0.64	18.8	18.9	0.055	2.7	<0.5

Note: **Bold** indicates concentration above background soil concentration for the Canyons Area.
[a]EPA November 1986.
[b]Analysis request/chain of custody.
[c]SNL/NM December 1997.

BH = Borehole.
CY = Canyon.
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, shown in parenthesis.
mg/kg = Milligram(s) per kilogram.
ND ( ) = Not detected above the MDL, shown in parenthesis.
SNL/NM = Sandia National Laboratories/New Mexico.
SS = Subsurface soil sample.
SWMU = Solid Waste Management Unit.

Table 7.4.4-3
Summary of HE Analysis Detection Limits
Used for SWMU 94E Confirmatory Soil Sampling, November 1998
(Off-Site Laboratory)

Compounds	Off-Site Analyses Using EPA Method 8330[a] (µg/kg)
sym-trinitrobenzene	6.6
m-dinitrobenzene	4.1
2,4,6-trinitrotoluene	5.7
2,4-dinitrotoluene	6.2
2,6-dinitrotoluene	6.5
2-amino-4,6-dinitrotoluene	6.6
m-nitrotoluene	11
o-nitrotoluene	7.8
4-amino-2,6-dinitrotoluene	5.5
p-nitrotoluene	11
HMX	5.3
Nitrobenzene	5.2
RDX	9.7
Tetryl	7.5

[a]EPA November 1986.
EPA = U.S. Environmental Protection Agency.
HE = High explosive(s).
HMX = 1,3,5,7-tetranitro-1,3,5,7-tetrazacyclooctane.
µg/kg = Microgram(s) per kilogram.
RDX = 1,3,5-trinitro-1,3,5-triazacyclohexane.
SWMU = Solid Waste Management Unit.

Table 7.4.4-4
Summary of VOC Analytical Detection Limits
Used for SWMU 94E Confirmatory Soil Sampling, November 1998
(Off-Site laboratory)

Analyte	MDL (µg/kg)
Acetone	2.2
Benzene	0.25
Bromoform	0.27
2-butanone	2.1
Carbon disulfide	2.2
Carbon tetrachloride	0.22
Chlorobenzene	0.25
Chloroethane	0.72
Chloroform	0.24
Dichlorobromomethane	0.24
1,1-dichloroethane	0.2
1,2-dichloroethane	0.23
1,1-dichloroethene	0.25
Cis-1,2-dichloroethene	0.25
Trans-1,2-dichloroethene	0.19
1,2-dichloropropane	0.23
Cis-1,3-dichloropropene	0.25
Trans-1,3-dichloropropene	0.22
Ethylbenzene	0.23
2-hexanone	4.4
4-methyl-2-pentanone	2.9
Methyl bromide	0.67
Methyl chloride	0.43
Methylene chloride	0.25
Styrene	0.22
1,1,2,2-tetrachloroethane	0.46
Tetrachloroethene	0.23
Toluene	0.22
Trichloroethylene	0.27
1,1,1-trichloroethane	0.18
1,1,2-trichloroethane	0.24
Vinyl acetate	1.8
Vinyl chloride	0.4
Xylenes (total)	0.62

MDL = Method detection limit.
µg/kg = Microgram(s) per kilogram.
SWMU = Solid Waste Management Unit.
VOC = Volatile organic compound.

Table 7.4.4-5
Summary of Semivolatile Organic Compound Analytical Detection Limits
Used for SWMU 94E Confirmatory Soil Sampling, November 1998
(Off-Site Laboratory)

Analyte	MDL (µg/kg)
1,2,4-trichlorobenzene	10
1,2-dichlorobenzene	10
1,3-dichlorobenzene	10
1,4-dichlorobenzene	10
2,4,5-trichlorphenol	10
2,4,6-trichlorophenol	10
2,4-dichlorophenol	10
2,4-dimethylphenol	10
2,4-dinitrophenol	20
2,4-dinitrotoluene	10
2,6-dinitrotoluene	10
2-chloronaphthalene	10
2-chlorophenol	10
2-methyl-4,6-dinitrophenol	10
2-methylnaphthalene	10
2-methylphenol (o-cresol)	10
o-nitroaniline (2)	10
2-nitrophenol	10
3,3-dichlorobenzidine	20
m-nitroaniline (3)	10
4-bromophenyl phenyl ether	10
4-chloro-3-methylphenol	10
4-chloroaniline	20
4-chlorophenyl phenyl ether	10
4-methylphenol (m,p-Cresol)	10
p-nitroaniline (4)	10
4-nitrophenol	10
Acenaphthene	10
Acenaphthylene	10
Anthracene	10
Benzo(a)anthracene	10
Benzo(a)pyrene	10
Benzo(b)fluoranthene	10
Benzo(g,h,i)perylene	10
Benzo(k)fluoranthene	10
Benzoic acid	50
Benzyl alcohol	10
Bis(2-chloroethoxy) methane	10
Bis(2-chloroethyl) ether	10

Refer to footnotes at end of table.

Table 7.4.4-5 (Concluded)
Summary of Semivolatile Organic Compound Analytical Detection Limits
Used for SWMU 94E Confirmatory Soil Sampling, November 1998
(Off-Site Laboratory)

Analyte	MDL (µg/kg)
Bis(2-chloroisopropyl) ether	10
Bis(2-ethylhexyl)phthalate	10
Butylbenzylphthalate	10
Chrysene	10
Dibenzo(a,h)anthracene	10
Dibenzofuran	10
Diethylphthalate	10
Dimethylphthalate	10
Di-n-butylphthalate	10
Di-n-octylphthalate	10
Fluoranthene	10
Fluorene	10
Hexachlorobenzene	10
Hexachlorobutadiene	10
Hexachlorocyclopentadiene	10
Hexachloroethane	10
Indeno(1,2,3-cd)pyrene	10
Isophorone	10
Naphthalene	10
Nitrobenzene	10
N-nitrosodi-n-propylamine	10
N-nitrosodiphenylamine	10
Pentachlorophenol	20
Phenanthrene	10
Phenol	10
Pyrene	10

MDL = Method detection limit.
µg/kg = Microgram(s) per kilogram.
SWMU = Solid Waste Management Unit.

Table 7.4.4-6
Summary of SWMU 94E Confirmatory Soil Sampling Gamma Spectroscopy Analytical Results, November 1998
(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 7.4.4-1)	Sample Depth (ft)	Result	Error[b]	Result	Error[b]	Result	Error[b]	Result	Error[b]
601185	CY94E-GR-001-SS	0-0.5	0.963	0.494	0.731	0.383	ND (0.225)	--	ND (0.0314)	--
601185	CY94E-BH1-S	0-0.5	**3.55**	0.981	**1.16**	0.590	ND (0.311)	--	0.109	0.0414
601187	CY94E-BH1-0'-10'-SS	0-10	1.06	0.540	0.448	0.302	ND (0.154)	--	0.00909	0.0167
Surface Radiation VCM Verification Sample From the One Area Source in 94E (collected 6/17/96)										
05457	94E8-SS	3.75-4	**15.7**	4.77	0.630	0.331	ND (0.173)	--	ND (0.0487)	--
Background Soil Concentrations—Upper Canyons[c]			2.31	NA	1.03	NA	0.16	NA	0.515	NA

Note: **Bold** indicates concentration above background soil concentration for the Canyons Area.
[a]Analysis request/chain of custody.
[b]Two standard deviations above the mean detected activity.
[c]Dinwiddie September 1997.
BH = Borehole.
CY = Canyon.
ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab sample.
ID = Identification.
NA = Not applicable.
ND ( ) = Not detected above the minimum detectable activity, shown in parenthesis.
pCi/g = Picocurie(s) per gram.
S = Surface soil sample.
SS = Subsurface soil sample.
SWMU = Solid Waste Management Unit.
VCM = Voluntary corrective measure.
-- = Error not calculated for nondetectable results.

Table 7.4.4-7
Summary of SWMU 94E Confirmatory Soil Sampling Gross Alpha and Gross Beta Analytical Results, November 1998
(Off-Site and On-Site Laboratory)

Sample Attributes			Gamma Spectroscopy Activity (pCi/g)			
Record Number[a]	ER Sample ID (Figure 7.4.4-1)	Sample Depth (ft)	Gross Alpha		Gross Beta	
			Result	Error[b]	Result	Error[b]
601185	CY94E-GR-001-SS (on-site laboratory)	0–0.5	2.80	1.24	5.46	3.06
601185	CY94E-BH1-S (on-site laboratory)	0–0.5	0.180	0.949	1.88	2.92
601186	CY94E-BH1-7'-SS (off-site laboratory)	7	**20.6**	4.79	28.3	4.19
601186	CY94E-BH1-10'-SS (off-site laboratory)	10	6.59	3.08	14.9	3.6
Background Soil Activity—Canyons Area[c]			18.3	NA	52.7	NA

Note: **Bold** indicates concentration above background soil concentrations for the Canyons Area.
[a]Analysis request/chain of custody
[b]Two standard deviations above the mean detected activity.
[c]Tharp July 1998.

BH = Borehole.
CY = Canyon.
ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab sample.
ID = Identification.
NA = Not applicable.
pCi/g = Picocurie(s) per gram.
S = Surface soil sample.
SS = Subsurface soil sample.
SWMU = Solid Waste Management Unit.

collected from the boring location and analyzed for gross alpha and gross beta activity using gamma spectroscopy at the on site laboratory. A sample fraction from surface sample CY94E-GR-001-SS was also analyzed using gamma spectroscopy at the on-site laboratory. Additional borings were planned if VOC contamination was detected during field screening of the core retrieved from the boring BH1; however, no elevated reading were detected. This section briefly describes the results of confirmatory sampling at SWMU 94E.

Each sample identification (ID) in the ER Sample ID column of the data summary tables identifies the sample location and type. For example, CY94E-BH1- 8.5'-SS refers to the sample collected from SWMU 94E within the Canyons Test Area of SNL/NM (CY94E), from borehole number one (BH1), from the depth of 8.5 feet bgs, which implies a subsurface sample type (S). Sample CY94E-GR-001-SS refers to the sample collected from SWMU 94E within the Canyons Test Area of SNL/NM (CY94E), a surface grab sample from "location 1"(GR-001), which is a surface soil sample type (SS). The remainder of this section describes the results of confirmatory sampling at SWMU 94E.

Metals

Table 7.4.4-2 summarizes the off-site metals analysis results for the three surface soil samples and two subsurface soil samples from SWMU 94E.

Arsenic concentrations ranged from 3.41 to 6.88 mg/kg. All samples yield arsenic at levels below the NMED approved background concentration limit of 9.8 mg/kg.

Barium concentrations ranged from 62.0 to 610 mg/kg. Barium concentrations in the two samples from the borehole (CYN94E-BH1-6-SS and CYN94E-BH1-9-SS) exceeded the NMED approved background concentration of 246 mg/kg. All three surface samples yielded levels below background concentrations.

Beryllium concentrations ranged from 0.395 to 1.13 mg/kg. In four of the five samples beryllium exceeded the NMED approved concentration limit of 0.75 mg/kg.

Cadmium concentrations ranged from 0.0979J to 0.592 mg/kg. No samples yielded levels exceeding the NMED approved background concentration of 0.64 mg/kg. Three samples (one surface and two subsurface yielded no cadmium. The other two samples yield cadmium at levels above the MDL but below the practical quantitation limit, resulting in the value being estimated (noted by a J qualifier).

Chromium concentrations ranged from 7.67 to 24.8 mg/kg. Three of the five samples (one surface and two subsurface) yielded chromium at levels higher than the NMED approved background limit of 18.8 mg/kg.

Lead concentrations ranged from 3.45 to 25.4 mg/kg. Two surface samples yielded lead at levels higher than the NMED approved background limit of 18.9 mg/kg.

Mercury concentrations ranged from 0.00731 to 0.045 mg/kg. No samples yielded levels exceeding the NMED approved background limit of 0.055 mg/kg.

Selenium concentrations ranged from 0.575 to 1.21 mg/kg. No samples yielded levels exceeding the NMED approved background limit of 3.0 mg/kg.

Silver was not detected in any of the samples. The MDL ranged from 0.031 to 0.619 mg/kg. The NMED approved background limit for silver is defined as <0.5 mg/kg. All of the detection limits except one (CYN94E-GR-002-SS) exceeded the background limit.

HE

Because there are no background concentrations for HE compounds in soil, any detectable HE compounds could indicate contamination. However, no HE compounds were detected in any of the surface or subsurface soil samples collected at SWMU 94E. Table 7.4.4-3 summarizes the detection limits revealed through off-site laboratory analysis for HE compounds.

VOCs

Because there are no background concentrations for VOCs in soil, any detectable VOCs could indicate contamination. However, no VOCs were detected in the surface or subsurface soil samples collected at SWMU 94E. Table 7.4.4-4 summarizes the detection limits revealed through off-site laboratory analysis for VOCs.

Methylene chloride was detected in three soil samples and in the trip blank but was qualified nondetect through the validation process because of blank contamination. Methylene chloride is a common laboratory contaminant.

SVOCs

Because there are no background concentrations for SVOCs in soil, any detectable SVOCs could indicate contamination. However, no SVOCs were detected in the soil samples collected at SWMU 94E. Table 7.4.4-5 summarizes the detection limits revealed through off-site laboratory analysis for SVOCs.

Radionuclides

Table 7.4.4-6 summarizes the on-site gamma spectroscopy analysis results for two surface soil samples and for two subsurface samples collected at SWMU 94E. Subsurface sample 94E8-SS was collected and analyzed as part of the Surface Radiation VCM Project. In two of the four samples, no gamma activity was detected above the background activity limits. The surface sample CY94E-BH1-S yielded uranium-238 and thorium-232 at levels above background (3.55 and 1.16 pCi/g, respectively). As noted in Section 4.4.3.1.3, the verification sample collected after the cleanup of the single radiation anomaly that had been detected within the SWMU boundaries exceeded background activity for uranium-238 (15.7 pCi/g). The MDA used for the analysis of uranium-235 exceeded the background limit in three of the four samples. Although this situation inhibits any comparison to background, uranium-238 and uranium-235 results can be compared because both coexist in DU. Therefore, 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 do not show corresponding elevated activities in the results for uranium-238, except for samples CY94E-BH1-S and CY94E8-SS.

Gross Alpha and Gross Beta

Table 7.4.4-7 summarizes the on-site gross alpha/gross beta analysis results for two surface soil samples as well as the off-site results for two subsurface samples taken from SWMU 94E. Gross alpha activity was slightly elevated relative to background in only one sample (sample CY94E-BH1-7'-SS, at 20.6 versus 18.3 pCi/g), and gross beta activity was detected below the corresponding background activity in all four samples.

QA/QC Results

Limited quality assurance (QA)/quality control (QC) samples were collected as part of the confirmatory sampling program at SWMU 94E. The trip blank was the only field QA/QC sample. As mentioned in Section 7.4.4.2.2, collection of a representative duplicate soil sample in the boring was complicated by poor sample recovery. The collection of an equipment blank and a duplicate sample at one of the three surface locations was planned, but an oversight by the field crew prevented this from happening. The lack of an equipment blank does not compromise the data because dedicated acetate liners were used to collect samples from the boring and trowel decontamination procedures were documented and followed for the three surface sample locations. The trip blank sample was analyzed off site for VOCs. Only methylene chloride was detected at a concentration of 3.5 micrograms per liter.

Matrix spike/matrix spike duplicate samples were run in the laboratory along with laboratory method blanks and laboratory control samples. The analysis results were reported appropriately and are suitable for use in this NFA proposal.

7.4.4.5 Data Validation

All off-site laboratory results were reviewed and verified/validated according to "Data Verification/Validation Level 3—DV-3" in Attachment C of the Technical Operating Procedure 94-03 (SNL/NM July 1994b). In addition, 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). Annex 7-C contains the off-site data validation results. The verification/validation process confirmed that the data are acceptable for use in this NFA proposal for SWMU 94E.

During data validation, qualifications were applied to VOC sample data because of blank contamination, continuing calibration acceptance criteria failure, and internal standard and surrogate blank recovery acceptance criteria failure. Methylene chloride detections in three of the five samples were qualified nondetects as a result of trip blank contamination. Other issues noted in the validation report affected non-COCs that were not detected (see Annex 7-C for more information).

7.5 Site Conceptual Model

The site conceptual model for SWMU 94E is based upon the residual COCs identified in the soil samples from the surface and subsurface of the Small Surface Impoundment. This section summarizes the nature and extent of contamination and the environmental fate of COCs.

7.5.1 Nature and Extent of Contamination

The primary COCs at SWMU 94E are metals related to several fuel-fire burn tests and wastewater from portable pan burn tests conducted in the area. Gamma activities detected above background in a few samples are probably related to historic SWMU 65 explosives testing involving DU. Metal and radionuclide COCs were determined by comparing sample results to background concentrations and to activities established for the Canyons Area (Dinwiddie September 1997, Zamorski December 1997). Any metal or radionuclide found to exceed background in any sample was considered a potential COC for the site. Because the MDLs for silver and the MDAs for uranium-235 analyses exceeded background concentration/activity limits, nondetect sample results are also considered in identifying potential COCs. In the case of radionuclides, the MDA is used for comparison to background; in the case of metals, the MDL is used. COCs include barium, beryllium, chromium, lead, and silver. Radionuclide COCs include uranium-238, uranium-235, and thorium-232. Table 7.5.1-1 lists the COCs and the sample locations where they were detected.

In most cases the COCs detected in confirmatory samples at SWMU 94E are only slightly elevated compared to background concentrations or activity limits specified for the Canyons Area (Dinwiddie September 1997, Zamorski December 1997). The distribution of the various COCs is consistent with minor, residual hot spot contamination, as opposed to widespread contamination of the impoundment. No VOC, SVOC, or HE compounds were detected in SWMU 94E samples except for methylene chloride, which was qualified through the data validation process as nondetect because of blank contamination (see Annex 7-C).

7.5.1.1 Environmental Fate

The primary source of the COCs for SWMU 94E are the burn tests conducted in the impoundment with a water and JP-4 fuel mixture. The primary release mechanism of COCs is seepage of the fuel-fire wastewater directly into the base of the surface impoundment. Table 7.5.1-1 contains a summary of the potential COCs for SWMU 94E. Based upon the results of the confirmatory sampling (Section 7.4.4.4), uranium-238, thorium-232, barium, beryllium, chromium, and lead were detected at concentrations higher than background concentrations. Silver and uranium-235 are considered potential COCs because their respective detection limits were above background levels in some cases. All potential COCs were retained in the conceptual model and evaluated in the human health and ecological risk assessments.

Table 7.5.1-1
Summary of COCs for SWMU 94E

COC Type	Number of Samples	COCs Detected in Soil Samples	Maximum Concentration (µg/kg)	Average Concentration[a] (µg/kg)	Sampling Locations Where COCs are Detected
Metals	5 environmental	Barium	610	286.8	CY94E-BH1-6-SS CY94E-BH1-9-SS
		Beryllium	1.13	0.7936	CY94E-GR-002-SS CY94E-GR-003-SS CY94E-BH1-6-SS CY94E-BH1-9-SS
		Chromium	24.8	18.274	CY94E-GR-002-SS CY94E-BH1-6-SS CY94E-BH1-9-SS
		Lead	25.4	14.436	CY94E-GR-002-SS CY94E-GR-003-SS
		Silver	ND (0.619)	0.4662	CY94E-GR-001-SS CY94E-GR-002-SS CY94E-GR-003-SS CY94E-BH1-6-SS CY94E-BH1-9-SS
Radionuclides	4 environmental[b]	U-238	15.7 pCi/g	5.32 pCi/g	CY94E-BH1-S 94E8-SS
		Th-232	1.16 pCi/g	0.742 pCi/g	CY94E-BH1-S
		U-235	ND (0.311 pCi/g)	0.216 pCi/g	CY94E-GR-001-SS CY94E-BH1-S CY94E-BH1-0'-10'-SS 94E8-SS

[a]Average concentration includes all samples, duplicates, and splits. For nondetect results, the detection limit is used to calculate the average.
[b]Verification sample from Rad VCM clean up included; sample identification "94E8-SS".

BH = Borehole.
COC = Constituent of concern.
CY = Canyon.
GR = Grab sample.
J ( ) = The reported value is greater than or equal to the MDL but is less than the practical quantitation limit, shown in parenthesis.
µg/kg = Microgram(s) per kilogram.
MDA = Minimum detectable activity.
MDL = Method detection limit.
ND ( ) = Constituent not detected, MDL in parentheses
pCi/g = Picocurie(s) per gram.
S = Surface soil sample.
SS = Subsurface soil sample.
SWMU = Solid Waste Management Unit.
VCM = Voluntary corrective measure.
VOC = Volatile organic compound.

Because fuel-fire tests are no longer conducted in the small surface impoundment, only secondary sources of COCs remain at the site in the surface and subsurface soil. The secondary release mechanisms at SWMU 94E are the suspension and/or dissolution of the COCs in surface-water runon and percolation to the vadose zone, VOC vapor emanations, dust emissions, and the uptake of the COCs in the soil by biota (Figure 7.5.1-1). However, the depth to groundwater at the site at approximately 222 feet bgs precludes the migration of the 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 (within the surface impoundment), soil water, air, and soil. Biota are also a pathway through food chain transfers. Section V, Annex 7-D, provides additional discussion of the fate and transport of the COCs at SWMU 94E.

The current land use for SWMU 94E is industrial. However, because the future/proposed land use for SWMU 94E is designated 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 ingestion of soil 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 ingestion of soil is considered the major exposure route for biota in addition to the ingestion of the COCs through food chain transfers or the direct uptake of the COCs. Section V, Annex 7-D, provides additional discussion of the exposure routes and receptors at SWMU 94E.

7.6 Site Assessments

The site assessment process for SWMU 94E includes risk screening assessments followed by risk baseline assessments (as required) for both human health and ecological risk. This section summarizes the site assessment results. Annex 7-D provides details of the site assessment.

7.6.1 Summary

The site assessment concludes that SWMU 94E 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 94E were found to be extremely low. Section 7.6.2 briefly describes and Annex 7-D provides details of the site screening assessments.

7.6.2 Screening Assessments

Risk screening assessments were performed for both human health risk and ecological risk for SWMU 94E. This section briefly summarizes the results.

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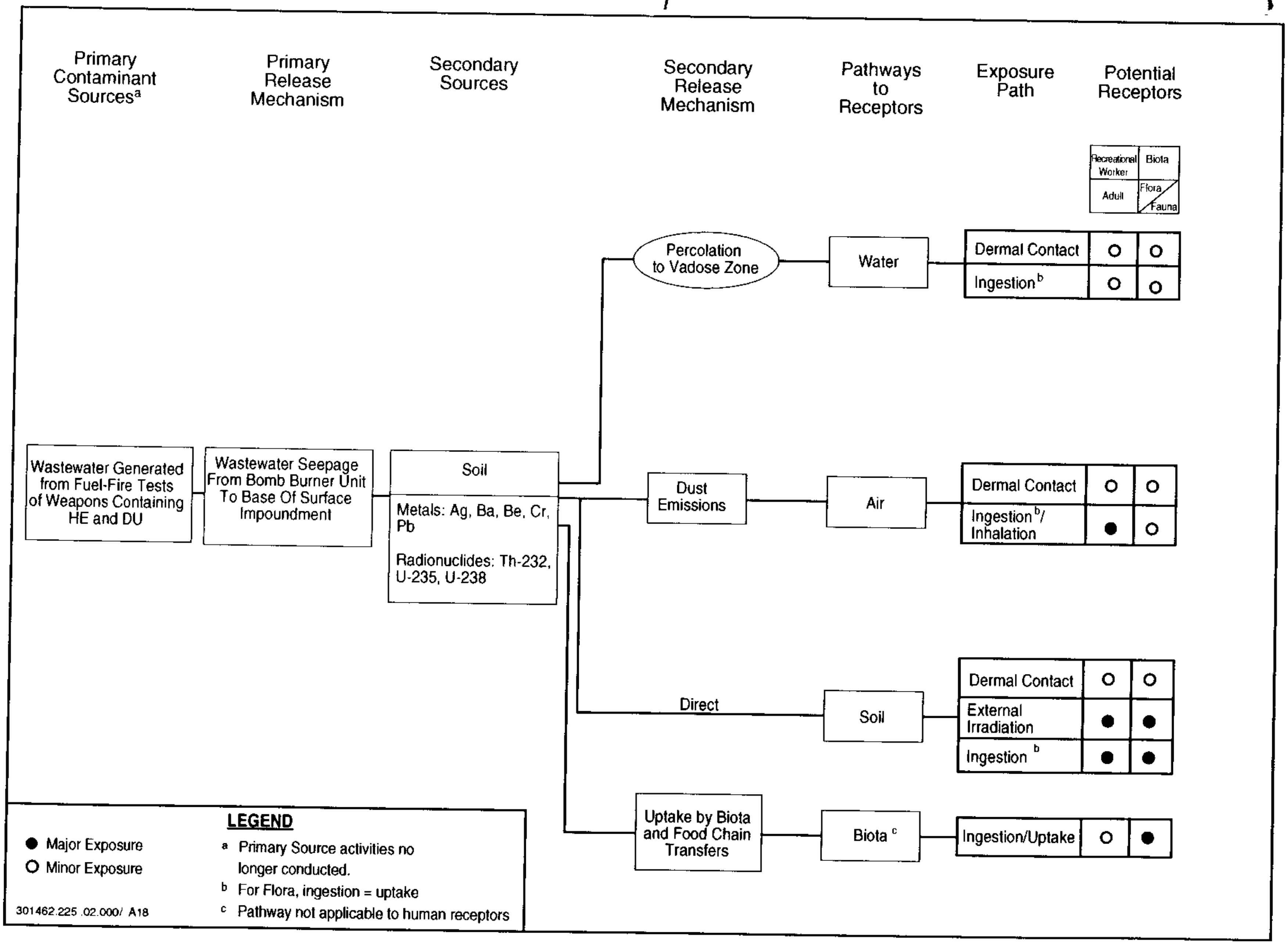

Figure 7.5.1-1

Conceptual Model Flow Diagram for SWMU 94E, Small Surface Impoundment

7.6.2.1 Human Health

SWMU 94E has been recommended for recreational land use (DOE et al. October 1995). Annex 7-D provides a complete discussion of the risk assessment process, results, and uncertainties. Because the COCs were present in concentrations or activities greater than background levels, it was necessary to perform a health risk assessment analysis for the site. This assessment included any organic compounds detected above their reporting limits and any radionuclide COCs and metals 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 soil at the site. 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 94E 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 COC risk. The incremental HI is 0.00. The excess cancer risk for SWMU 94E nonradiological COCs is 4E-9 for a recreational land-use setting. 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). Thus, the excess cancer risk for this site is below the suggested acceptable risk value of 1E-6. The incremental excess cancer risk is 4.01E-9.

The incremental total effective dose equivalent for radionuclides for a recreational land-use setting for SWMU 94E is 8.4E-2 millirems (mrem)/year (yr), which is well below the recommended dose limit of 15 mrem/yr found in the EPA's OSWER Directive No. 9200.4-18 and reflected in a document entitled "RESRAD Input Parameter Assumptions and Justification" (SNL/NM February 1998b). The incremental excess cancer risk for radionuclides is 1.3E-6 for the 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 7-D). The report concludes that SWMU 94E does not have potential to affect human health under a recreational land-use scenario.

7.6.2.2 Ecological

An ecological screening assessment that corresponds with the screening procedures in the EPA's Ecological Risk Assessment Guidance for Superfund (EPA 1997) was performed as set forth by the NMED Risk-Based Decision Tree (NMED March 1998). An early step in the evaluation is comparing COC concentrations and identifying potentially bioaccumulative constituents (see Annex 7-D, Sections V, VII.2, and VII.3). 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 the SNL/NM ER Program (IT July 1998) and will not be duplicated here. The screening also includes the estimation of exposure and ecological risk.

Tables 16, 17, and 18 of Annex 7-D present the results of the ecological risk assessment screen. Site-specific information was incorporated into the screening assessment when such data were available. Chromium was the only analyte with a hazard quotient (HQ) exceeding unity (for plants). HQs associated with exposures to background are greater than 1.0 for chromium. Background could account for as much as 94 percent of the HQs for chromium at this site. Furthermore, the HQ for chromium is based upon the maximum measured soil concentration. The mean concentration (15.1 mg/kg) is below the background screening value. Therefore, it is unlikely that chromium (with exposure concentrations largely attributable to background) presents significant ecological risk to plants. All other COC concentrations were below the plant screening benchmarks and no risks were predicted for wildlife receptors. Risks are not expected in those cases where HQs would not be determined because of insufficient toxicity information. Based upon this final analysis, ecological risks associated with SWMU 94E are expected to be very low.

7.6.3 Baseline Risk Assessments

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

7.6.3.1 Human Health

Based upon the fact that human health results of the screening assessment summarized in Section 7.6.2.1 indicate that SWMU 94E 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 94E.

7.6.3.2 Ecological

Based upon the fact that ecological results of the screening assessment summarized in Section 7.6.2.2 indicate that SWMU 94E has very low ecological risk, a baseline ecological risk assessment is not required for SWMU 94E.

7.6.4 Other Applicable Assessments

No other applicable assessments have been conducted at SWMU 94E.

7.7 No Further Action Proposal

7.7.1 Rationale

Based upon field investigation data and the human health risk assessment analysis, an NFA is being recommended for SWMU 94E for the following reason: no COCs were present in concentrations considered hazardous to human health for a recreational land-use scenario.

7.7.2 Criterion

Based upon the evidence provided above, SWMU 94E is proposed for an NFA decision in conformance with Criterion 5 (NMED March 1998), which states, "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 7-A

ANNEX 7-A
Summary of Testing Activities at SWMU 94
Lurance Canyon Burn Site

The Lurance Canyon Bum Site (LCBS) was used for testing fire survivability of transportation containers, weapons components, simulated weapons, and satellite components. Testing programs at the LCBS can be grouped into the following six categories related to bum structures:

- Portable pan bum tests
- Small surface impoundment (Solid Waste Management Unit [SWMU] 94E)
- Large Open Burn Pool (LOBP)
- Small Open Burn Pool (SOBP)
- Light Airtransport Accident Resistant Container (LAARC) Unit (Discharge Pit, SWMU 94F)
- Bomb Burner Unit (Lines at Discharge Pit, SWMUs 94C and 94D)
- Small Wind-Shielded (SWISH) Unit
- Smoke Emissions Reduction Facility (SMERF)
- Bunker 9830 and Support Buildings
- Aboveground tanks (SWMU 94A)
- Debris/soil mounds (SWMU 94B)
- Scrap Yard (SWMU 94G).

Table 7A-1 summarizes the burn testing structures and associated features at SWMU 94. This annex describes the historical operations at each of these structures and locations are shown on Figures 7A-1 and 7A-2.

A.1 PORTABLE PAN BURN TESTS

The test log for SWMU 94 records 65 bum tests involving seven testing programs that took place in portable pans (Table 7A-1) (SNL/NM November 1994), but additional tests may have taken place prior to the first 1979 entry. Portable pan bum tests were conducted from approximately 1975 to 1991 (Palmieri April 1995a). Bum tests requiring a similar testing environment are now conducted in the SOBP. Round portable pans, 6 to 10 feet in diameter and 2 to 3 feet deep (Figure 7A-3), were set up with or without temporary chimneys in at least five locations within SWMU 94 (Gill November 1982, Hickox and Abitz December 1994, Palmieri April 1995a). These sites are just north and just south of the Small Surface Impoundment (SWMU 93E), south of the SWISH Unit in the Bomb Burner Unit trench and at the current-day location of the SOBP (Palmieri April 1995b). Following a test, water remaining in the portable pans was typically left to evaporate (Jercinovic et al. November 1994). However, some wastewater from the portable pans may have been discharged into the Small Surface

Table 7A-1
Summary of Burn Testing and Associated Operations at SWMU 94, Lurance Canyon Burn Site

Test Unit/Structure	Test Type/ Operation	Test Date	Number of Recorded Tests (SNL/NM November 1994)	Test/Operational Release Location	Test Materials/ Operational Release	Reference
Portable Pans	Open Burning	1975 to March 1991 1985 to 1987 (none conducted)	65 (minimum)	Primary Detonation Area (SWMU 65B) and Near Field Dispersion Area (SWMU 65D)	Detonations (HE, gun propellant, radionuclides)	SNL/NM November 1994 Moore September 1981 Larson and Palmieri October 1994 Caregeorges January 1994 Hickox end Abitz December 1994 Palmieri December 1994e Palmieri April 1995a
				None (most evaporated) Small Surface Impoundment	Wastewater (JP-4 fuel and water mixture)	
Small Surface Impoundment	Open Burning	pre-1979 to 1980	4	Subsurface infiltration	Wastewater (JP-4 fuel and water mixture)	SNL/NM November 1994
LOBP (30 x 60 feet)	Open Burning	1977 to present	53 (includes Railcar Burn Test)	1977 test (evaporated) 1977 to 1983 (inactive) 1983 to 1987 (SWMU 13) 1988 to present (City of Albuquerque POTW via trucking)	Wastewater (JP-4 fuel and water mixture, radionuclides)	Appendix J Palmieri October 1994
SOBP (20 x 20 feet)	Open Burning	1992 to present	23	1992 to present (City of Albuquerque POTW via trucking; connected to the LOBP)	Wastewater (JP-4 fuel and water mixture)	SNL/NM November 1994 Palmieri October 1994
LAARC Unit	Enclosed Burning	June 1980 to August 1987	63	Unlined discharge pit	Wastewater (JP-4 fuel and water mixture)	SNL/NM November 1994
Bomb Burner Unit	Enclosed Burning	September 1982 to January 1988	23	Within Bomb Burner Unit	Detonations (HE radionuclides, metals)	SNL/NM November 1994
				Unlined discharge pit	Wastewater (JP-4 fuel and water mixture)	
			1 TABS Test	Bomb Burner Unit trench	Detonation (HE, radionuclides, metals)	

Refer to footnotes at end of table.

Table 7A-1 (Concluded)
Summary of Burn Testing and Associated Operations at SWMU 94, Lurance Canyon Burn Site

Test Unit/Structure	Test Type/ Operation	Test Date	Number of Recorded Tests [SNL/NM November 1994)	Test/Operational Release Location	Test Materials/Operational Release	Reference
SWISH Unit	Enclosed Burning	January 1983 to April 1990	61	None (never disposed of wastewater)	None [wastewater recirculated, never disposed)	SNL/NM November 1994 Author [unk] Date [unk]c Palmieri October 1994 Palmieri December 1994d
SMERF	Enclosed Burning	August 1992 to present	27	1992 to present (City of Albuquerque POTW via trucking)	None (wastewater recirculated)	
Bunker 9830	Enclosed Burning	1967 to present (Control Bunker/Storage) 1975 to 1988 (Burn Testing)	Cable testing 10 (fire suppressant)	None (contained within the bunker]	None	Larson and Palmieri August 1994 Palmieri November 1994a
Aboveground Tanks	Supply Water, JP-4 Fuel, and Coolant for Burn Testing	1980 to present	NA	Subsurface infiltration	Accidental spills of JP-4 fuel on soil	Hickox November 1994 Larson and Palmieri October 1994
Debris/Soil Mounds	Grading	pre-1992 to present	NA	Subsurface infiltration or surface runoff	Metals or radionuclides leachate	Palmieri April 1995b
Scrap Yard	Storage of surplus test materials	1980 to present	NA	Subsurface infiltration	Accidental spills of hydraulic oils on soil	Hickox November 1994 Larson and Palmieri October 1994 Palmieri November 1994a

HE= High explosive.
LAARC = Light Airtransport Accident Resistant Container.
LOBP = Large Open Burn Pool.
NA= Not applicable.
POTW = Publicly Owned Treatment Works.
SMERF = Smoke Emission Reduction Facility.
SNL/NM = Sandia National Laboratories/New Mexico.
SOBP = Small Open Burn Pool.
SWISH = Small Wind-Shielded (Unit).
SWMU = Solid waste management unit.
TABS = Torch Activated Burn System.

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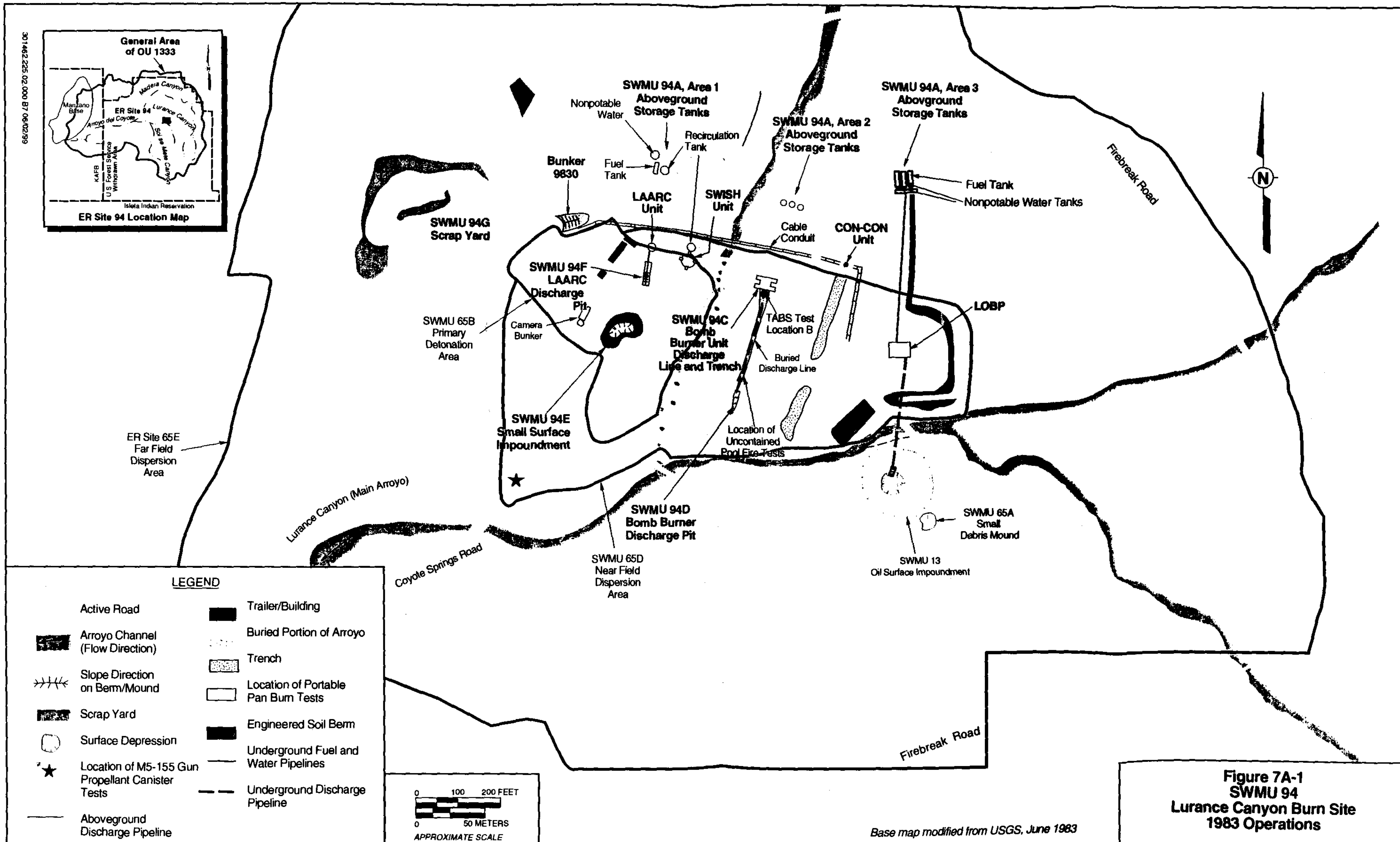


Figure 7A-1
SWMU 94
Lurance Canyon Burn Site
1983 Operations

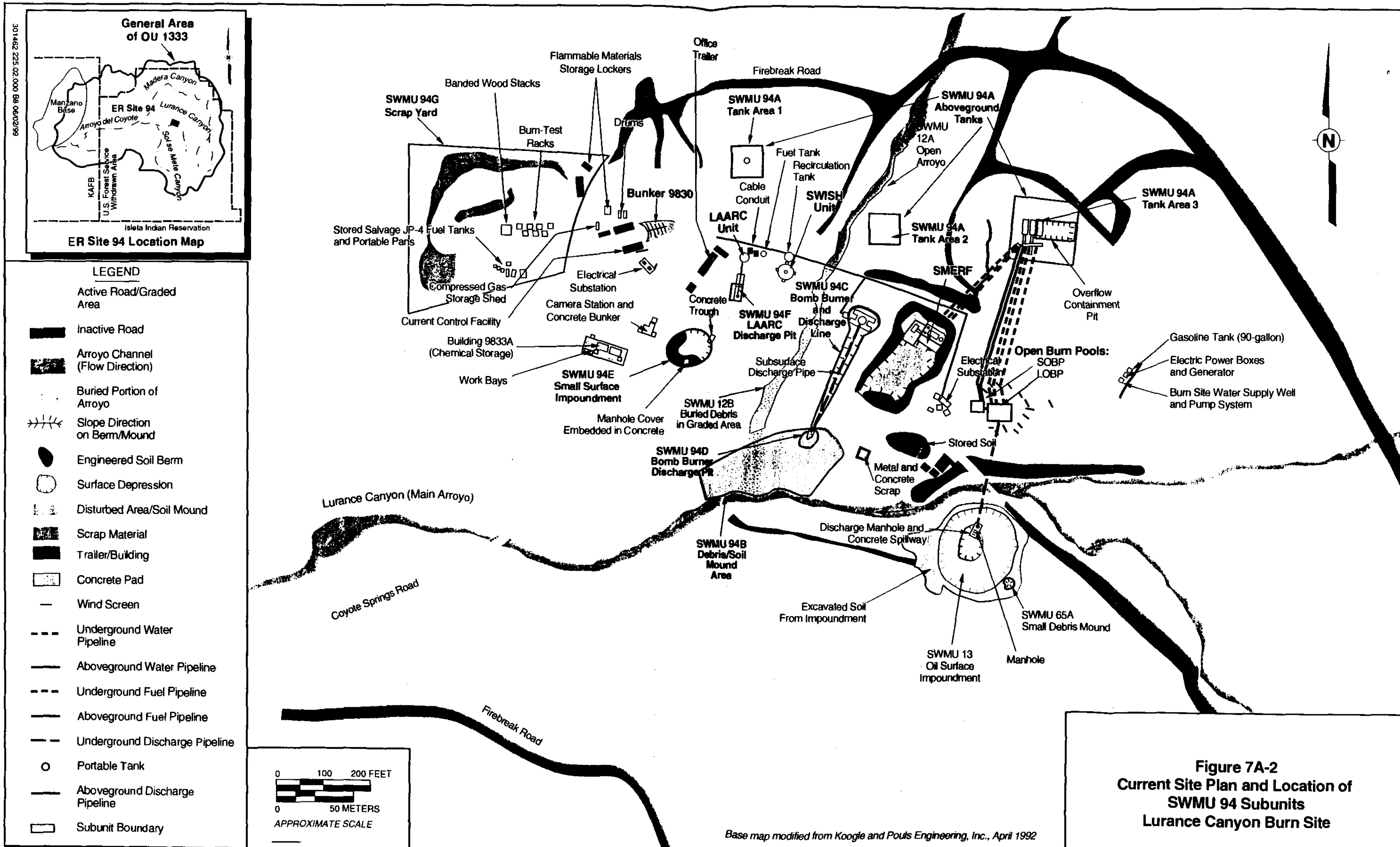
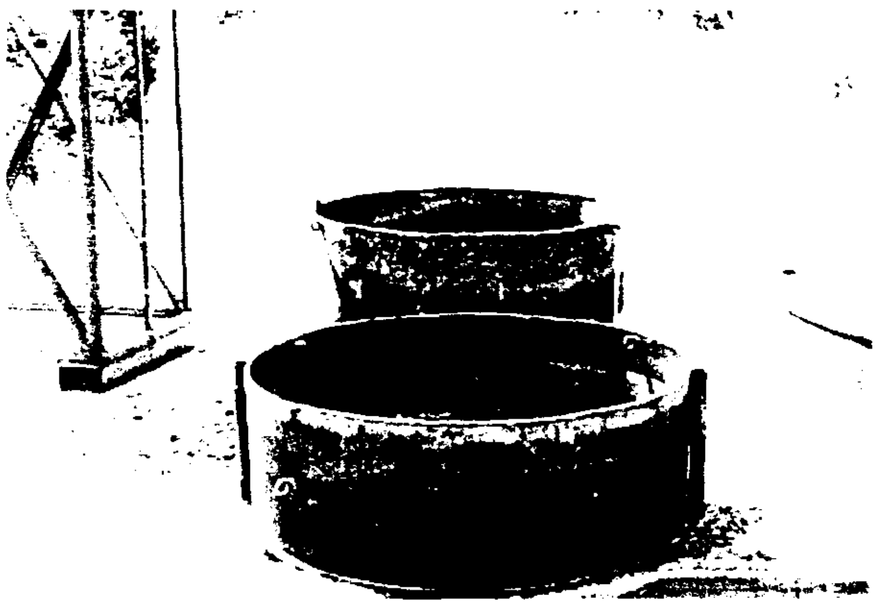


Figure 7A-2
Current Site Plan and Location of SWMU 94 Subunits Lurance Canyon Burn Site



Photograph of portable pans in the southern portion of the scrap yard in April 1995. The pans held JP-4 fuel and water used in small-scale burn tests at SWMU 94.

Figure 7A-3
Photograph of Portable Pan

impoundment fuel fire at a minimum temperature of 1,850 degrees Fahrenheit (°F) (Caregeorges January 1994). After completing the test, the test unit was swipe tested to determine whether uranium dioxide was released (Larson and Palmieri October 1994). No radioactivity was found on the swipe samples.

Uncontained Pool-Fire Tests

In September 1981, five tests of uncontained pool fires were conducted in the area of the Bomb Burner Unit trench (SWMU 94C) to investigate the size of a fire produced from fuel leaking from an aircraft wing. Jet fuel composition 4 (JP-4) fuel was pumped from a 55-gallon tank onto a steel plate that rested on a pan, which was then covered with a concrete pad. A portable chimney was placed over the pan. The JP-4 fuel was pumped onto the steel plate at varying rates to control the size of the burn pool. No other materials were burned (Moore September 1981, Hickox and Abitz December 1994). These tests occurred prior to the first portable pan entry in the log book.

Gun-Propellant Canister Tests

In October 1982, five burn tests involving exposure of M5-155 gun-propellant canisters to JP-4 fuel fires were performed at SWMU 94 (Gill November 1982, Palmieri December 1994e, SNL/NM November 1994) in a portable pan located near the entrance to the site (Figure 7A-1). Gun and rocket propellants are composed primarily of nitrocellulose, but they differ in that gun propellant does not contain aluminum or potassium perchlorate (Hickox and Abitz December 1994). The purpose of the 11-minute burn tests was to observe and record the behavior of gun-propellant canisters in a fully engulfing fire representative of an accidental fire situation. A portable pan (6 feet in diameter and 2 feet deep) with an air curtain system was used for the tests. The air curtain, produced by a fan rated at 14,000 cubic feet per minute to blow air through an annular area around the lip of the burn pan, protected the fire from wind effects. In three of the tests, the M5-155 gun-propellant canister was breached in approximately 100 seconds, as evidenced by a brilliant flash associated with the ignition of the gun propellant. An accelerated burning of the fire ensued for about 15 to 20 seconds, presumably corresponding to the consumption of the gun propellant. In two of the tests, the accelerated burning stage was followed by an igniter explosion, which is not considered a large explosion (Hickox and Abitz December 1994). The igniter consisted of a mild detonating fuse surrounded by barium nitrate. No detailed information is available for two of the five tests.

Slow-Heat Tests

The vented slow-heat tests conducted in 1983 (Mata December 1983) were designed to investigate whether the combustion products of burning PBX-9502 (TATB-95 percent, Kel-F 800-5 percent) (Dobratz and Crawford January 1995) explosive would vent from the test unit without reaching critical internal pressure that would cause an explosion. A corrugated culvert chimney was placed over a portable burn pan in the Bomb Burner Unit trench, and a hole was cut in the side for a large water-cooled lever arm. The lever arm portion inside the corrugated culvert chimney extended over the portable pan. A mock weapon containing high explosives (HE) was placed on the end of the lever arm that extended over the burn pool, and the other end of the lever arm was attached to a piston-like instrument that determined the change in mass of the HE inside the weapon as a function of burn time (Hickox and Abitz December 1994). Two burn tests were conducted to demonstrate the successful operation of the water-cooling system. On October 4, 1983, a third test with a vented stainless steel casing containing insensitive (i.e., nonshockwave initiated) HE was conducted in a JP-4 fuel fire at a nominal temperature of 2,000°F for approximately 60 minutes (Mata December 1983, Hickox and Abitz December 1994). The HE inside the weapon was completely burned without an explosion.

Nitromethane Calibration Tests

Thirty-eight nitromethane calibration tests were conducted at SWMU 94 between September and October 1984 (SNL/NM November 1994). The tests involved filling test units with nitromethane and exposing them to a JP-4 fuel fire. The purpose of these tests was to calibrate detonation velocity using liquid nitromethane and Composition-1 (C-1) and Composition-7 explosives (Palmieri December 1994e). The tests were conducted in the Bomb Burner Unit trench. A trial test was conducted in August 1984 using gasoline rather than nitromethane. Neither the trial test using gasoline nor the first two nitromethane tests completely detonated the C-1 explosives. The remaining 36 tests were high-order detonations (see SNL/NM November 1994 for additional information on these tests).

A.2 SMALL SURFACE IMPOUNDMENT

SWMU 94E, Small Surface Impoundment is approximately 60 feet long, 25 feet wide, and less than 2 feet deep (Figure 7A-1) (Palmieri December 1994b, SNL/NM August 1994). The inactive impoundment is surrounded by low soil berms on the south and west sides (Larson and Palmieri October 1994) (Figures 7A-4a and 7A-4b). A crude concrete trough approximately 3 feet long is located at the northeastern edge of the impoundment, and a manhole is on the southern edge of the impoundment (Hickox November 1994, Palmieri December 1994b) (Figure 7A-4a). The exact use of the manhole is not known (Hickox November 1994, Palmieri December 1994b). It is believed that the small surface impoundment was used once to burn JP-4 fuel as a test demonstration (Jercinovic et al. November 1994). The first three log book entries (from October 1979 through February 1980) reference the "old facility" and the "culvert facility," which refer to portable chimney setups in the small surface impoundment (Palmieri April 1995a, SNL/NM November 1994). These tests consisted only of JP-4 fuel fires and investigated the effectiveness of controlling the flames with portable chimneys. The impoundment currently receives storm runoff from the northwestern portion of the site and may have received liquids from the portable pans (Jercinovic et al. November 1994).

A.3 THE LARGE OPEN BURN POOL

The LOBP is an active burn unit located approximately 200 feet southeast of the SMERF (SNL/NM August 1994) (Figure 7A-2). The pool is formed by a rectangular concrete basin 30 by 60 feet and 3 feet deep (Figure 7A-5a) and is concrete/fiber-ceramic-lined (Palmieri October 1994, Larson and Palmieri October 1994). Fire tests at the LOBP were primarily performed on a variety of shipping containers, most of which burned in the LOBP and contained

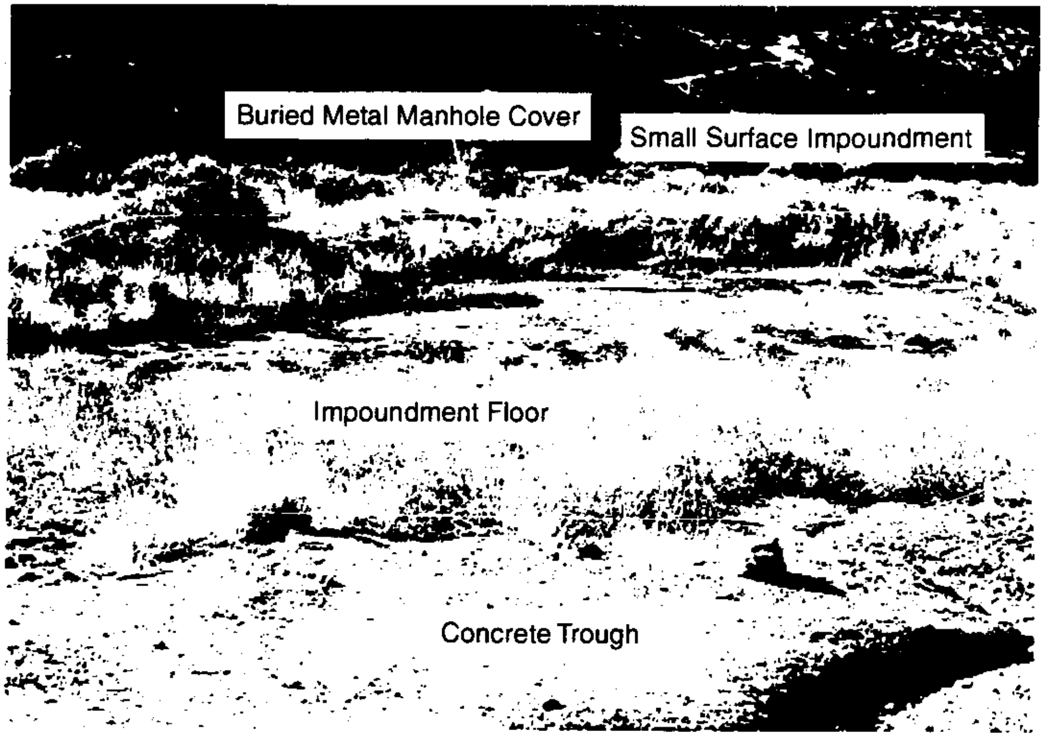


Figure 7A-4a Photograph of the small surface impoundment (SWMU 94E) in December 1994. The impoundment is located east of the camera bunker. View is to the southwest.

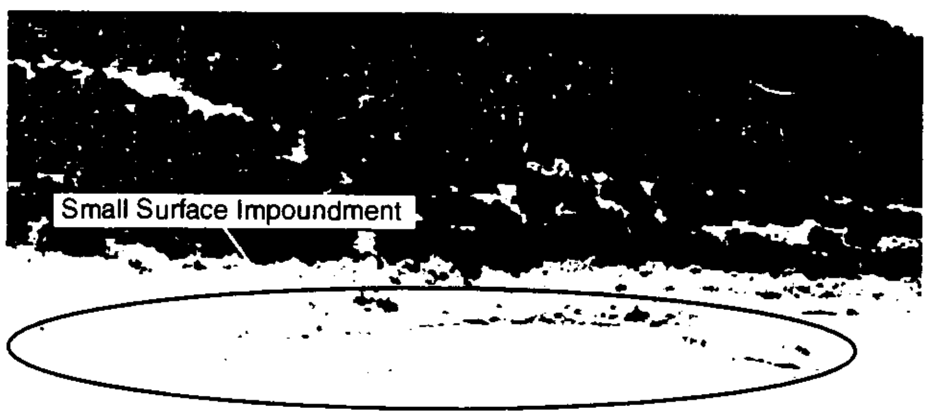


Figure 7A-4b Photograph of the small surface impoundment (SWMU 94E) in April 1995. Photograph was taken from the direction of surface runoff. View is to the southwest.

Figure 7A-4
Photographs of SWMU 94E, Small Surface Impoundment

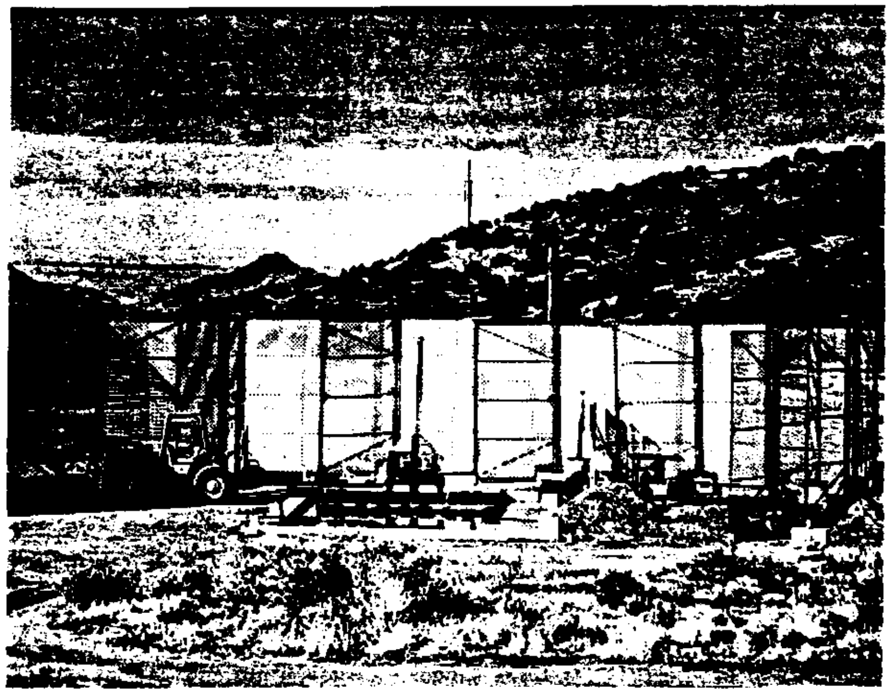


Figure 7A-5a Photograph of the LOBP under construction at SWMU 94 in 1977. View is to the northwest.

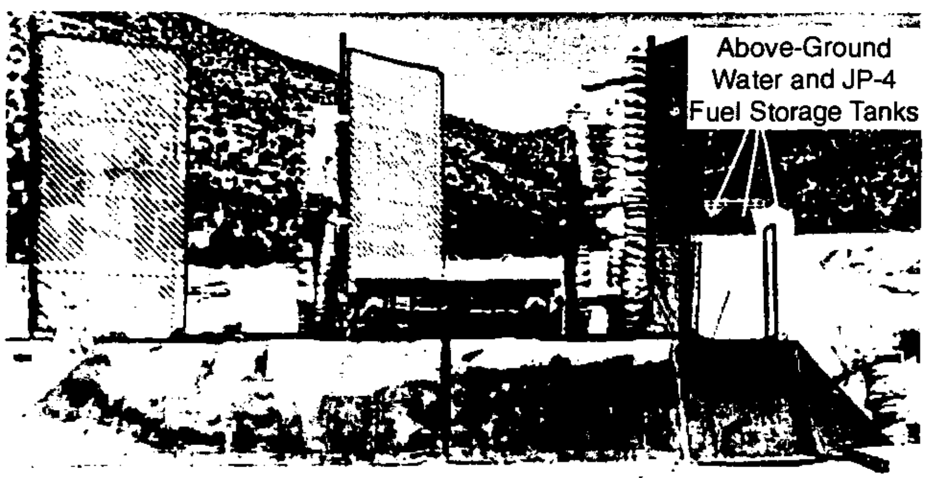


Figure 7A-5b Photograph of the SOBP at SWMU 94 in April 1995. View is to the north.

Figure 7A-5
Photographs of Large Open Burn Pool and Small Open Burn Pool

no radioactive materials (Palmieri October 1994). However, one test in 1991 involved an H1501 accident-resistant container unit that did contain uranium-238 and beryllium (SNL/NM November 1994).

The LOBP was built in 1977 in order to conduct the Railcar Burn Test (synonymous with the Yankee Cask Test) (Palmieri October 1994, Jercinovic et al. November 1994, Palmieri November 1994b). Wastewater from this burn test was left in the LOBP to evaporate. Following the Railcar Burn Test in 1977, the LOBP was inactive until testing resumed in June 1983 (Jercinovic et al. November 1994, Palmieri December 1994e, SNL/NM November 1994).

In 1983 a drain was installed in the LOBP (Jercinovic et al. November 1994) in order to facilitate test unit access following a burn test. The drain was connected to the Oil Surface Impoundment (SWMU 13) with 24-inch-diameter corrugated culvert pipe. The Oil Surface Impoundment is located approximately 200 feet south of the LOBP (Figure 7A-2) (Palmieri October 1994, Jercinovic et al. November 1994).

Fifty-two burn tests have been conducted in the LOBP from June 1983, when burn testing resumed, to the present. From 1984 to 1987, the operational practice was to discharge the water and residual JP-4 fuel from the LOBP to the Oil Surface Impoundment after the JP-4 fuel burned out. Nine tests in the LOBP discharged wastewater to the impoundment through the underground corrugated piping system during this time period (Larson and Palmieri October 1994, Jercinovic et al. November 1994). In 1987 waste-water discharges to the impoundment ceased (Palmieri October 1994, Larson and Palmieri October 1994), and a closed-loop, recirculation system was constructed between the LOBP and the aboveground tanks (SWMU 94A) north of the LOBP. All wastewater associated with the burn testing is currently recycled to these tanks for reuse in subsequent burn tests. Recycled wastewater is periodically tested and pumped into tanker trucks, removed from the site, and released to the City of Albuquerque publicly owned treatment works under the Sandia National Laboratories/New Mexico (SNL/NM) allotment of 1 million gallons per year (Palmieri November 1994b). Nonhazardous solid waste such as damaged ceramic insulation was disposed of at the Kirtland Air Force Base landfill (Author [unk] Date [unk]a, Martz September 1985, Author [unk] Date [unk]d). The personnel conducting the tests are responsible for the disposal of solid residues remaining in the bottom of the LOBP (Larson and Palmieri October 1994).

A.4 THE SMALL OPEN BURN POOL

The SOBP (an active bum unit) is located approximately 8 feet west of the LOBP (Figure 7A-2). The SOBP was built in 1992 in order to reduce the amount of fuel required to perform the same length test in the LOBP and, thereby, reduce the total smoke emissions (Palmieri October 1994). Since its construction, 23 bum tests have been conducted in the SOBP on transportation containers and weapons components (SNL/NM November 1994). The pool is formed by a square concrete basin 20 by 20 feet and 3 feet deep and is lined with sheet steel (Figure 7A-5b). Metal sheets have been welded together and to the metal pan, so that a skirt is formed around the pan at a 45-degree angle. A metal mesh drain is located in the northeastem corner of the SOBP and is connected to the LOBP with a 2-inch-diameter underground pipeline. Wastewater is drained from the SOBP to the LOBP in order to recirculate it back to the aboveground storage tanks to the north (Figure 7A-2) (Palmieri April 1995a). Two aboveground 3.5-inch-diameter galvanized metal pipes supply water and fuel to the SOBP from the aboveground tanks. These pipes connect into a single 3-inch-diameter pipe that enters the SOBP. All testing in the SOBP was completely contained, and there have been no documented historical releases of hazardous constituents to the environment.

A.5 THE LAARC UNIT

The LAARC Unit is an inactive burn unit located approximately 200 feet east of Bunker 9830 (SNL/NM August 1994) (Figures 7A-2 and 7A-6a). This unit was the first permanent structure constructed at the site. The unit was constructed in approximately 1980 and was used for 63 fire tests of small transportation containers and mock weapons (Moore June 1982, Cocke May 1984, Luna and Moore June 1983, Moore and Luna February 1983, Palmieri October 1994, Jercinovic et al. November 1994, Larson and Palmieri August 1994). The LAARC Unit was last used in August 1987 (SNL/NM November 1994; Author [unk], January 1993; Palmieri December 1994d) under an assurance of discontinuance with the City of Albuquerque Air Pollution Bureau (Palmieri October 1994).

The burn pan located inside the unit is approximately 10 feet in diameter (Moore and Luna February 1983) (Figure 7A-7). The LAARC received water and JP-4 fuel through an underground pipeline from aboveground tanks located approximately 200 feet north of the unit (Figure 7A-1) (Palmieri April 1995a). Wastewater was discharged from the bum pan through a 12-inch-diameter aboveground pipe to the LAARC Discharge Pit (SWMU 94F) located approximately 50 feet south of the unit (Figure 7A-6b).

The wastewater was released into a 55-gallon drum in the bottom of the unlined discharge pit (Figures 7A-6b and 7A-7) (Martz November 1985). The drum functioned as a flame arrestor, sealing off and extinguishing any burning JP-4 fuel discharged with the wastewater (Jercinovic et al. November 1994). As much as 1,500 gallons of wastewater per test may have been discharged into the pit.

A.6 THE BOMB BURNER UNIT

The Bomb Burner Unit (also referred to as the Corrugated Facility) was removed in 1997 under the SNL/NM decontamination and decommissioning program. The Bomb Bumer Unit was constructed of corrugated galvanized steel and mantled by a concrete platform (Figure 7A-8a). It is located approximately 200 feet southeast of the SWISH Unit (SNL/NM August 1994) (Figure 7A-2). The Bomb Burner Unit was constructed in 1982 (Palmieri October 1994, Jercinovic et al. November 1994). Between 1982 and its shutdown in 1988, it was used for 23 burn tests involving the exposure of weapons (some containing depleted uranium) and components to abnormal environments (Hooper May 1983, Stevenson December 1985, Mata December 1983, Palmieri October 1994). The Bomb Burner Unit was built inexpensively as an expendable duplicate of the LAARC Unit for conducting bum tests on weapons to avoid risking damage to the LAARC Unit through a possible weapons detonation (Jercinovic et al. November 1994). The Bomb Bumer Unit was closed in 1988 under an assurance of discontinuance agreement with the City of Albuquerque Air Pollution Bureau (Palmieri October 1994). The "RCRA [Resource Conservation Facility Investigation (RFI) Work Plan for OU 1333, Canyons Test Area" (SNL/NM September 1995) summarizes the tests conducted at the Bomb Bumer Unit.

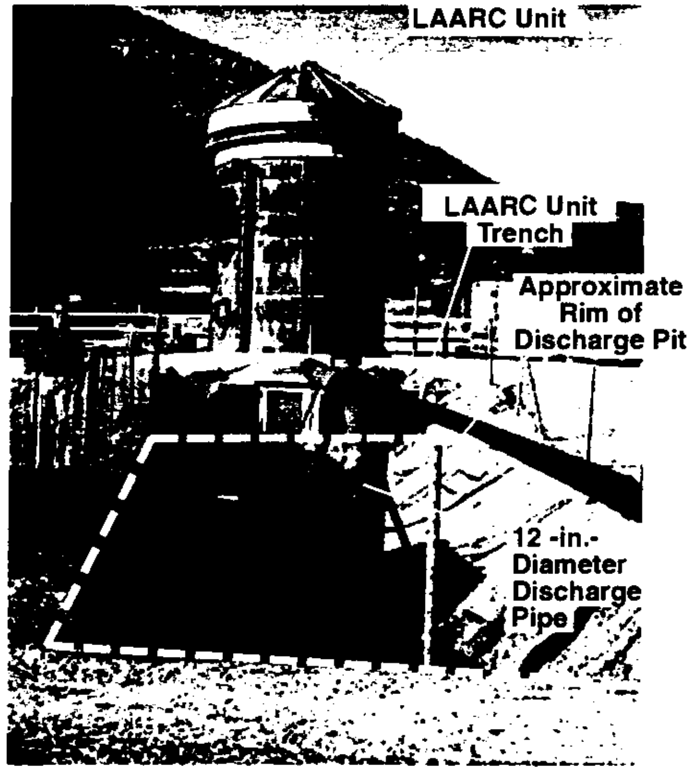


Figure 7A-6a February 1993 photograph of the LAARC Unit trench and discharge pit (SWMU 94F) showing the wastewater management system. Dashed lines show approximate location of the discharge pit rim. View is to the north.

Figure 7A-6b Photograph of LAARC Unit discharge pit (SWMU 94F). The wastewater is discharged through the 12 in.-diameter pipe into a 55-gal drum. The wastewater subsequently overflows into the pit.

Figure 7A-6
Photographs of LAARC Unit and
SWMU 94F, LAARC Unit Discharge Pit

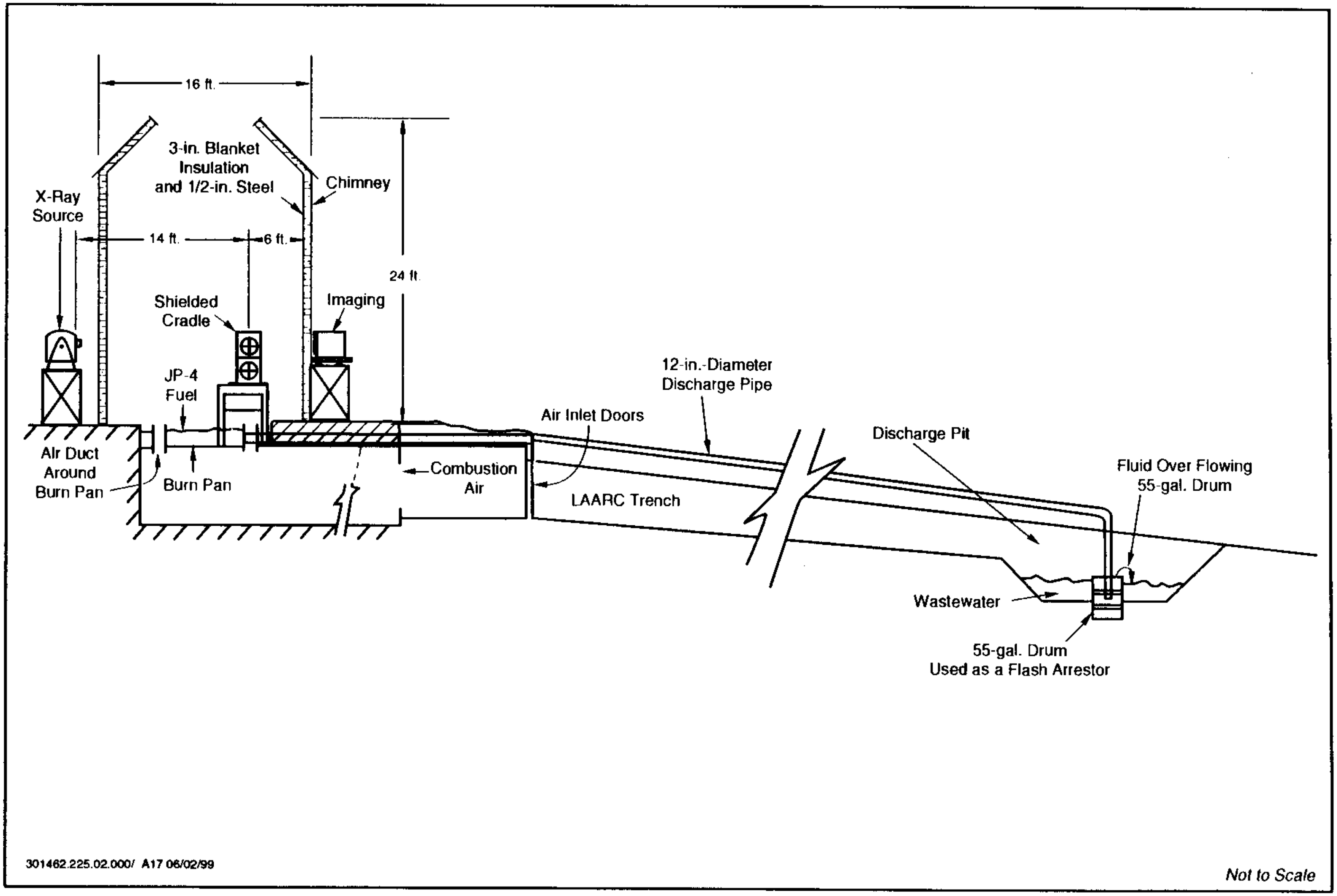


Figure 7A-7
Cross Section of LAARC Unit Showing Aboveground Burn Pan Test and Wastewater System

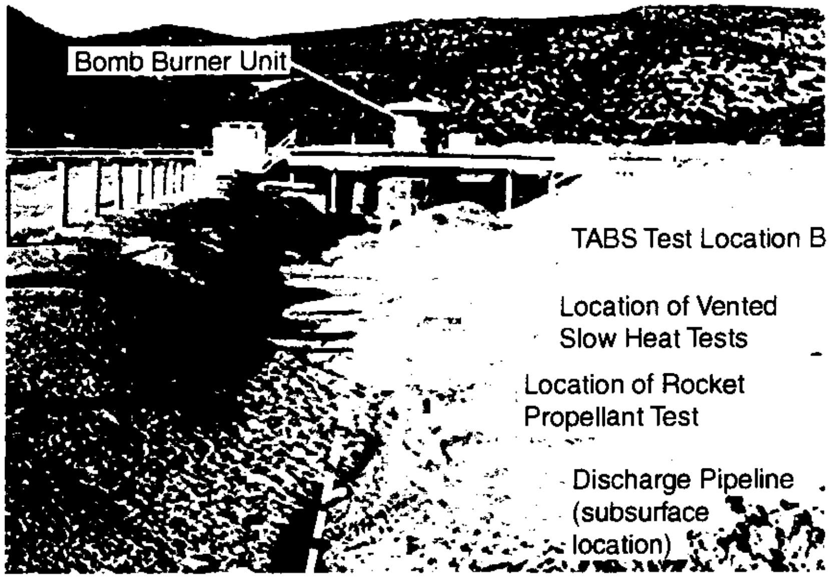


Figure 7A-8a Photograph of the Bomb Burner area and discharge line (SWMU 94C) in February 1993. Approximate locations of the discharge pipeline, TABS Test, Location B rocket propellant test, and vented slow-heat tests are indicated. The approximate location of the uncontained pool-fire tests, which were conducted at the southernmost end of the trench, is not pictured. View is to the north.

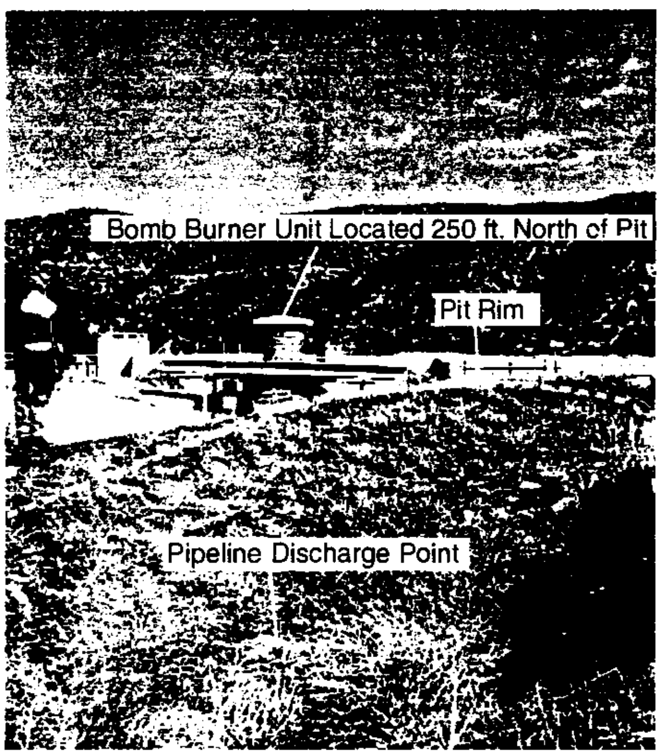


Figure 7A-8b Photograph of Bomb Burner discharge pit (SWMU 94D) in December 1994. The pit is approximately 10 ft wide x 25 ft long x 8 ft deep. View is to the north.

Figure 7A-8
Photographs of SWMU 94C, Bomb Burner Area and Discharge Line, and SWMU 94D, Bomb Burner Discharge Pit

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The Bomb Burner Unit was constructed below ground level to contain potential explosions that might have occurred during burn tests. A shallow, open trench extending southward from the Bomb Burner Unit was constructed to provide vehicle and equipment access to the unit (Figure 7A-8a). Engineering drawings and maps suggest that fuel and water were supplied to the burn unit from three aboveground tanks formerly located approximately 200 feet north of the unit (Figure 7A-1) (SNL/NM 1983). These aboveground tanks have since been removed from the site. The burn pan used in the Bomb Burner Unit is 10 feet in diameter (Hooper May 1983, Mata December 1983). A 12-inch-diameter corrugated pipe connects the burn pan to the Bomb Burner Discharge Pit (SWMU 94D) located approximately 250 feet south of the Bomb Burner Unit (Figure 7A-1) (Palmieri October 1994, Jercinovic et al. November 1994). The discharge pit is approximately 25 feet long, 10 feet wide and 8 feet deep (Figure 7A-8b) (Palmieri December 1994b). Following tests that involved radionuclides, wastewater from the Bomb Burner Unit was screened for radiological activity before being released into the discharge pit (Palmieri October 1994). As many as 1,500 gallons of wastewater per test may have been discharged into the pit.

Test reports document a number of the tests at the Bomb Burner Unit (Hooper May 1983, Stevenson December 1985, Hill Date [unk], Mata December 1983) and describe the test set up and materials involved. The Bomb Burner Area and Discharge Line are designated as SWMU 94C. The remainder of this section describes two reported tests that are representative of the testing conducted in the Bomb Burner Unit.

In September 1982, a burn test was conducted on a W-69 warhead used in the SRAM missile (Hooper May 1983). Aluminum, steel, HE, and insulation materials were exposed to a JP-4 fuel fire in order to determine the response of the W-69 to an accidental fuel fire. The fuel fire was performed at a temperature of approximately 1,800°F for a total burn time of 95 minutes. The warhead remained in place on the test stand and, as expected, all aluminum and organic components melted (Hooper May 1983). The PBX-9404 HE did not detonate and was consumed in a nonviolent manner, and no warhead materials were expelled from the unit.

On March 9, 1983, a W-80 warhead was subjected to a high-intensity JP-4 fuel fire at a nominal temperature of 2,000°F for approximately 30 minutes (Hill Date [unk], Luna March 1983, SNL/NM November 1994). The purpose of the test was to determine the behavior of internal HE components and the inherent safety of the weapon when exposed to an accidental fuel fire. The test unit configuration consisted of the warhead external aluminum case, binary parts, live insensitive HE material, and a mass simulated canned subassembly placed 3.5 feet above the surface of the fuel. Test unit thermocouples were wrapped with cera-blanket insulation, shielded in a steel pipe, and then wrapped with additional insulation. The HE burned successfully without any explosive incident. Real-time radiography and video coverage of the warhead burn test was observed at Bunker 9830 (Hill Date [unk]).

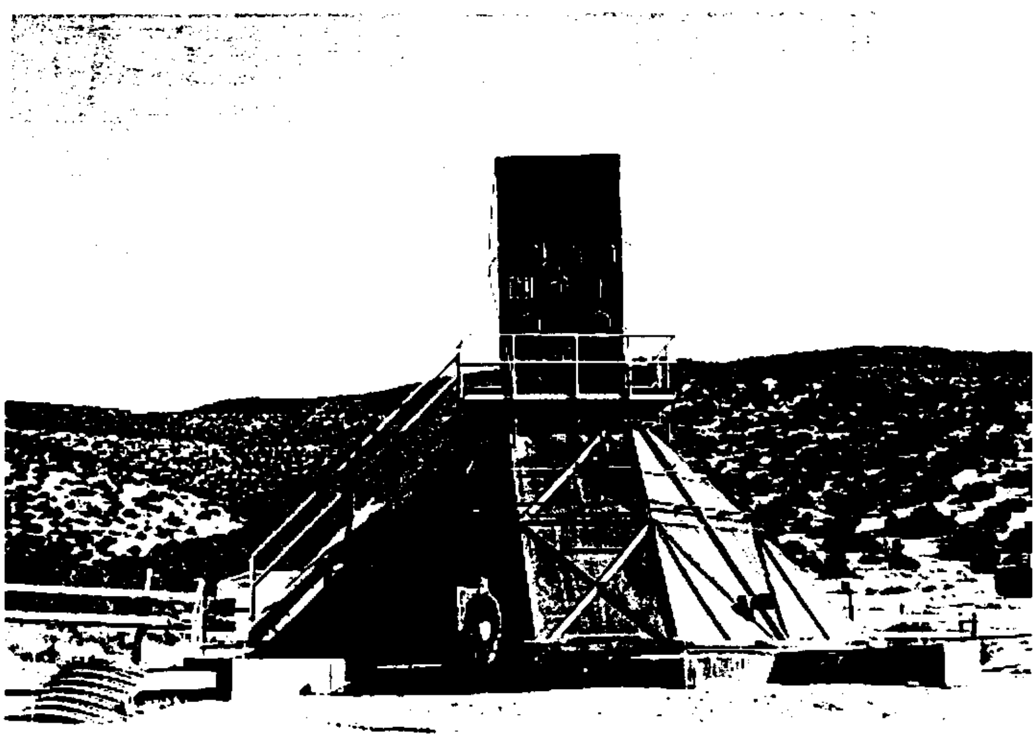
Several burn tests have been conducted in the Bomb Burner Unit trench since 1982, including portable pan burn tests such as the vented slow-heat tests and uncontained pool fires. Fuel-fire burn testing conducted in the trench includes the Torch Activated Burn System (TABS) test Location B (Figure 7A-1) and one series of rocket propellant tests. The TABS test Location B resulted in detonation within the trench.

A.7 THE SWISH UNIT

The SWISH Unit (Figure 7A-9) is located approximately 300 feet east of Bunker 9830 (Figure 7A-2) (SNL/NM August 1994). This active unit was constructed in 1983 and is currently used to study the potential for protecting large pool burns from the wind (Author [unk] Date [unk]c, Palmieri October 1994, Palmieri December 1994d). The SWISH Unit is the prototype for meeting air-quality requirements while conducting burn tests. To request an exemption from opacity requirements, testimony was given before the City of Albuquerque and Bernalillo County Joint Air Quality Board on September 13, 1995. Approval for the requested exemption is expected in October 1995. This unit has been used in 61 tests where large explosives fragments or blast overpressures were not expected. Typical tests require small volumes (of up to 150 gallons) of JP-4 fuel and involve test units such as hazardous materials shipping containers, small weapon components and weapons mockups containing insensitive HE. Burn pools, typically ranging from 6 feet up to 9 feet in diameter and 3 feet in depth were placed in the center of the SWISH Unit floor, which is about 25 by 25 feet (Author [unk] Date [unk]c, Jercinovic et al. November 1994). The base of the structure tapers to a stack assembly 3 by 6 feet by 13 feet tall (Figure 7A-9). The stack is insulated and contains baffles to mix the flow and to reduce the visible air emissions. JP-4 fuel was delivered to the SWISH Unit using portable tanks (Hickox November 1994). Other records indicate that the small brown tank stationed between the SWISH and LAARC Units (Figure 7A-2) was used to store fuel for burn tests at either the SWISH or the LAARC Units (Palmieri December 1994b). The tank is portable, may have been supported by wheels, and holds approximately 100 gallons of fuel (Palmieri December 1994b). Wastewater from bum tests conducted in the SWISH Unit is not discharged but is allowed to evaporate (Palmieri December 1994a). There have been no documented historical releases of hazardous constituents to the environment. An external sprinkler system cools the walls of the SWISH Unit. Water circulation pipes and spray nozzles are situated at numerous points on the outside structure. Cooling water that does not evaporate is captured in a shallow trough at the base and is routed to an underground tank for storage and reuse. Burn tests at the SWISH Unit are primarily performed on shipping containers, although lithium batteries have also been burned in the facility (SNL/NM November 1994).

A.8 THE SMERF

The SMERF (Figure 7A-10a and 7A-10b) is an active bum unit located approximately 150 feet east of the Bomb Bumer Unit (Figure 7A-2). This facility was constructed after the removal of the CON-CON Unit in 1988 as a scale-up of the SWISH Unit (Author [unk] Date [unk]c, Palmieri October 1994, Larson and Palmieri October 1994). The first recorded test at the SMERF was conducted in August 1992. This burn unit was built to test hazardous materials shipping containers, transportation systems, weapons mockups, and associated materials under actual fire accident conditions (Kent July 1994). Soil removed to enlarge the CON-CON Unit site for the SMERF was bermed to direct surface-water flow away from the burn site facilities into the main arroyo of the Lurance Canyon (Engineered Soil Berms, Figure 7A-2) (Larson and Palmieri October 1994). To date, the only burns conducted in the SMERF have been performance tests with JP-4 fuel (SNL/NM November 1994) to demonstrate compliance with the City of Albuquerque Air Pollution Bureau regulations (Kent July 1994). To request an exemption from opacity requirements, testimony was given before the City of Albuquerque and Bemalillo County Joint Air Quality Board on September 13, 1995. Pending approval for the requested exemption is expected in October 1995.



Photograph of the SWISH Unit at SWMU 94 in December 1994.
View is to the north.

Figure 7A-9
Photograph of SWISH Unit

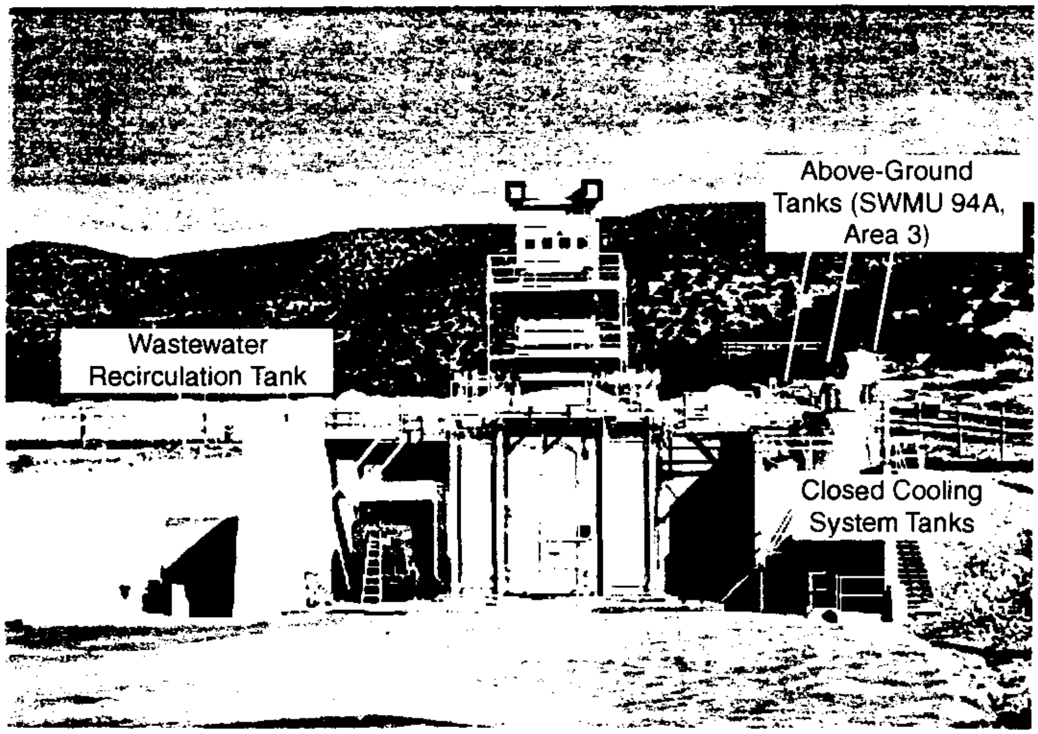


Figure 7A-10a Photograph of the SMERF at SWMU 94 in December 1994. View is to the north.

Figure 7A-10b Photograph of the SMERF conducting performance tests at SWMU 94 in December 1994. View is to the northeast.

Figure 7A-10
Photographs of SMERF

The SMERF is accessed by a shallow, open trench that rises southward to the entry road (SNL/NM August 1994). The unit consists of a cubical test chamber approximately 20 by 20 feet. The chamber contains a 10- by 10-foot-square burn pan (Author [unk] Date [unk]c) that can be reduced to an 8- or 7-foot-square configuration (SNL/NM November 1994).

A 20-foot-tall stack houses a passive afterburner to reduce smoke emissions (Author [unk] Date [unk]c, Kent July 1994). Underground pipelines connect the unit to two of the three aboveground tanks located north of the LOBP (SWMU 94A, Area 3). Two of the lines recirculate a glycol/water cooling mixture between the vertical walls, roof panels, and the storage tank. A third line supplies fuel from the JP-4 fuel tank. The underground pipes join the SMERF at a valve box on the northern side of the unit. The valves are marked "fuel," "water," and "water return." Three additional aboveground tanks are located inside a concrete berm enclosure on the eastern side of the SMERF. These tanks are connected to the incoming pipelines by 8- and 3-inch lines. The tanks are part of the water recirculation system. Two of these aboveground tanks are labeled "nonpotable water," and the third is labeled "water/glycol." These tanks are part of a closed recirculation system. Propylene glycol is used for active cooling of the walls and roof panels in the SMERF (Larson and Palmieri October 1994).

A.9 BUNKER 9830 AND SUPPORT BUILDINGS

Bunker 9830, located approximately 200 feet northwest of the LAARC Unit (Figure 7A-1), was constructed in 1967 to house instrumentation for SWMU 65 activities. The eastern half of Bunker 9830 was used from 1975 though 1980 for fire tests on nuclear reactor control cables (Larson and Palmieri August 1994, Palmieri November 1994a). These tests were conducted as part of the reactor safety program in response to the Browns Ferry Reactor fire. In the initial test, a mockup of a nuclear reactor cable assembly was constructed in Bunker 9830 and was ignited to simulate the incident (Brouillard June 1994). The tests used heptane as a fuel source. The number of tests conducted is unknown. Fire suppression tests were conducted in Bunker 9830 from 1975 to 1980. A series of ten fire tests on cable insulation were conducted using propane gas (Palmieri and Larson October 1994). The bunker is not involved in current SWMU 94 burn operations (Palmieri December 1994b) and is used to store equipment. All testing in Bunker 9830 was completely contained, and there have been no documented historical releases of hazardous constituents to the environment.

Several small trailers northwest of Bunker 9830 store equipment, tools, parts, insulation, cable, television monitors, instrumentation, and data systems (Larson and Palmieri October 1994). Several trailers are marked by placards indicating the storage of hazardous chemicals. According to interviewees, these designations are inaccurate for all but one identified trailer, because there actually is no chemical storage in these trailers (Larson and Palmieri October 1994, Palmieri December 1994b). Currently, all chemicals are stored in Building 9833A, which is located about 200 feet southwest of Bunker 9830 (Figure 7A-2) (Larson and Palmieri October 1994).

The control and instrumentation point for the Lurance Canyon Explosives Test Site during explosives testing was Building 9831 at SWMU 81 (New Aerial Cable Site). By 1979, the control facility was moved to what is now the lunch trailer (Palmieri April 1995a) located 30 feet from Bunker 9830. Currently, the control facility is set up in a trailer located off the southwest corner of Bunker 9830 (Figure 7A-1) (Larson and Palmieri August 1994). Cables radiate from each of the previous control facilities to the various burn site units (Larson and Palmieri October 1994).

A.10 ABOVEGROUND TANKS

Aboveground tanks (SWMU 94A) have been used to supply water, JP-4 fuel, and coolant for burn testing at all of the engineered structures. There are three storage tank locations at SWMU 94 that served the LAARC Unit, the Bomb Burner Unit, the SMERF, the SOBP, and the LOBP. The aboveground tank locations include an area north of the LAARC Unit, north of the Bomb Burner Unit, and the current tank location north of the LOBP (Figure 7A-1). These three aboveground tank locations are discussed below.

North of the LAARC Unit (Area 1)

An aboveground tank labeled "nonpotable water" is currently located north of the LAARC Unit and was used to supply water to the unit (Figure 7A-1 and 7A-11a) (Hickox November 1994). Two aboveground tanks were also formerly used for fuel storage at this location (Kervin April 1981). These two tanks have since been removed.

North of the Bomb Burner Unit (Area 2)

The 1983 historical aerial photograph shows that three aboveground tanks were formerly located north of the Bomb Burner Unit (Figures 7A-1 and 7A-11b) (SNL/NM 1983). These aboveground tanks were used to supply JP-4 fuel and water for testing at the Bomb Burner Unit. The tanks are no longer present at the site, and no documentation exists that describes the installation and removal of the tanks. No physical evidence exists at the site to identify their former locations.

North of the LOBP (Area 3)

Three aboveground tanks are now located approximately 400 feet north of the LOBP: One contains JP-4 fuel, another contains nonpotable water, and the third contains glycol/water (Figures 7A-2 and 7A-11c). Prior to 1992, when the nonpotable water and glycol/water tanks were installed, there were two nonpotable water tanks in addition to a JP-4 fuel tank at the same location (Figure 7A-2) (Hickox November 1994). The current nonpotable water and JP-4 fuel tanks provide water and fuel for burn tests conducted at the LOBP, the SOBP, and the SMERF. The glycol/water is used as a coolant for the SMERF. A plastic-lined, earthen, secondary overflow containment pit is installed around the aboveground tank containing JP-4 fuel (Figure 7A-11d) (Larson and Palmieri October 1994).

Two underground pipelines connect the LOBP to the JP-4 fuel tank and to the nonpotable water tank. Two aboveground 3.5-inch-diameter galvanized metal pipelines connect the SOBP to the JP-4 fuel tank and to the nonpotable water tank. Three underground pipelines run from the tanks to the SMERF: One connects to the JP-4 fuel tank, and the other two provide glycol/water

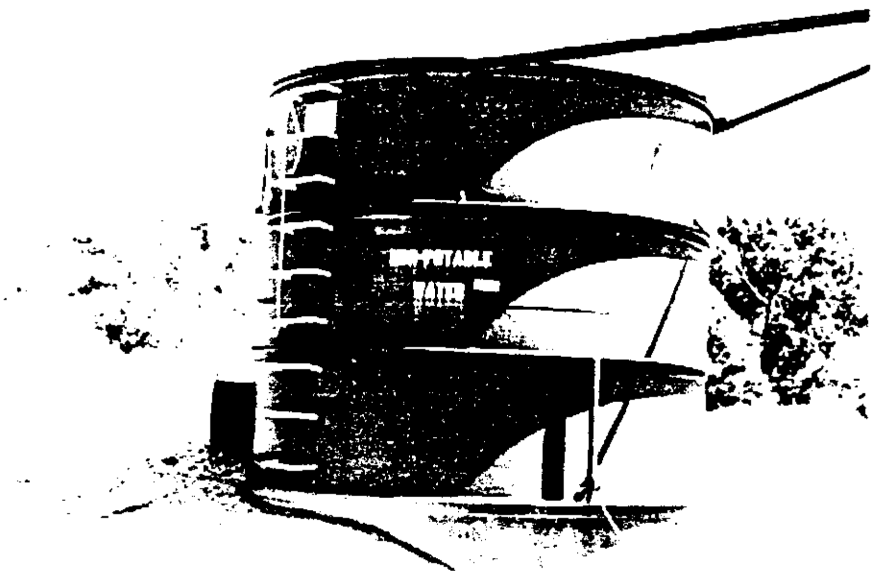


Figure 7A-11a Photograph of the above ground tank (SWMU 94A, Area 1) north of the LAARC Unit in April 1995. Additional above ground tanks storing fuel were located here when the LAARC was active. View is to the northeast.

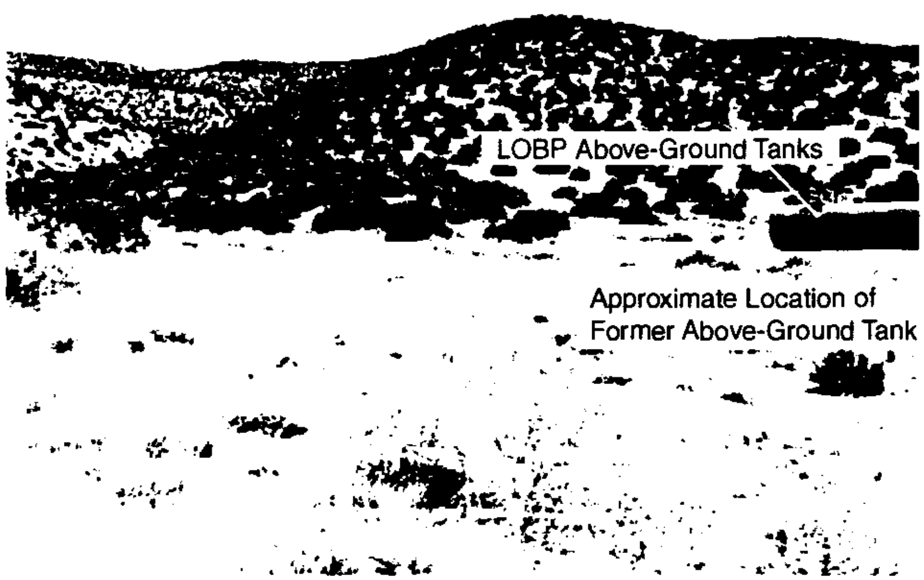


Figure 7A-11b Photograph of the former above ground tank location (SWMU 94A, Area 2) north of the Bomb Burner Unit in April 1995. The above ground tanks north of the LOBP are visable in the background. View is to the northeast.

Figure 7A-11

Photographs of SWMU 94A, Aboveground Tank North of LAARC Unit and Location of Former Aboveground Tank North of Bomb Burner Unit

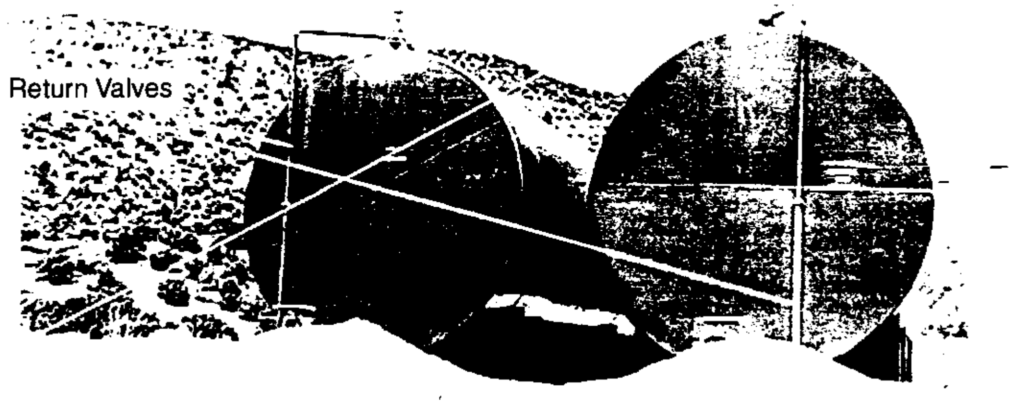


Figure 7A-11c Photograph of the aboveground tanks north of the LOBP (SWMU 94A, Area 3) in April 1995. The aboveground tanks provide the recirculation system for the LOBP, SOBP, and for the SMERF. Nonpotable water is recirculated back to the labeled tank following testing. View is to the north.

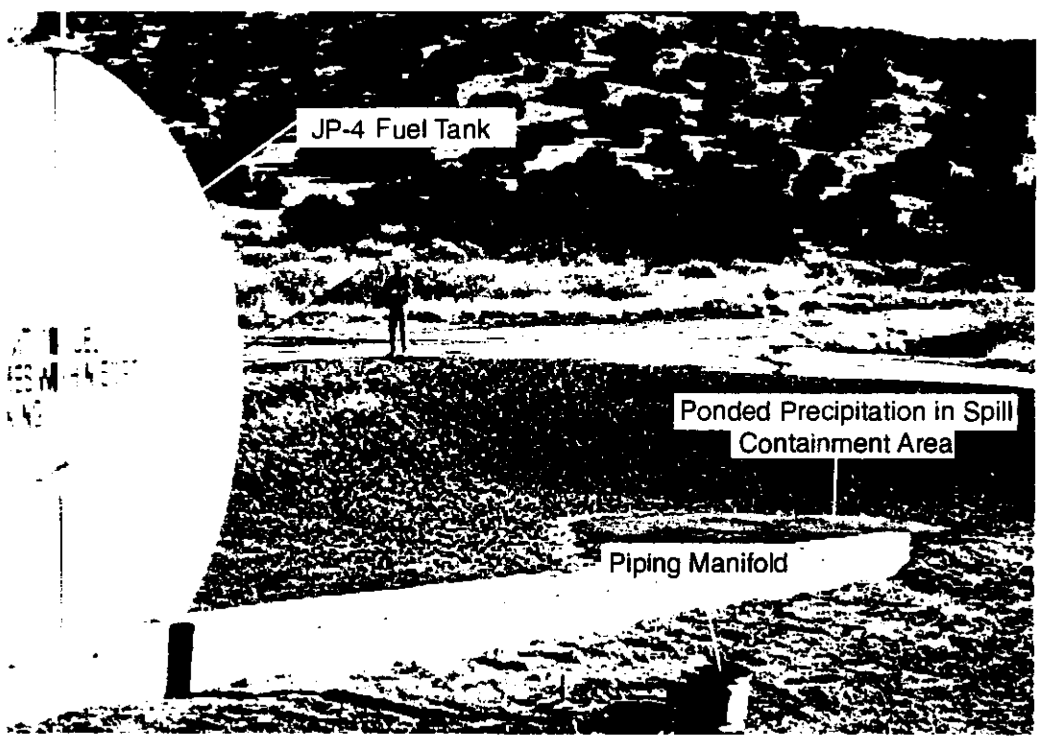


Figure 7A-11d Photograph of the spill containment area surrounding the JP-4 fuel aboveground tank (SWMU 94A, Area 3) north of the LOBP in December 1994. The spill containment area is constructed of soil overlying a plastic liner. View is to the northeast.

Figure 7A-11 (concluded)
Photographs of SWMU 94A, Aboveground Tanks North of LOBP

coolant for circulation between the vertical walls and roof panels of the SMERF. A recirculation system currently routes wastewater back to the water and water/glycol tanks for storage and reuse (Hickox November 1994, Larson and Palmieri October 1994).

A.11 Debris/Soil Mounds

A Debris/Soil Mound Area (SWMU 94B) is located on the southern portion of SWMU 94, north of the main arroyo in the Lurance Canyon (Figures 7A-2 and 7A-12). There is little documentation for the origination of the debris/soil mound area, but this site appears to be the product of grading and soil redistribution during the evolution of SWMU 94 since 1983. The mounds, which range in height from about 3 to 6 feet, are not clearly defined but merge together. The only apparent debris in the soil mound area is concrete fragments, electrical cables, and wood (Figure 7A-12). Several radiological anomalies have been identified in the debris/soil mound area. The radiological anomalies may be associated with past activities at SWMU 65.

A.12 SCRAP YARD

The Lurance Canyon Burn Site Scrap Yard (SWMU 94G) was started in 1980 in the northwestern portion of the site (Figures 7A-2 and 7A-13a) (Palmieri November 1994). The scrap yard contains unused test equipment, portable generators, fiber/ceramic insulation, pipes, pump motors, cinder blocks, test stands, cables, wood, portable pans, empty tanks labeled JP-4, empty drums, and scrap metal (Figure 7A-13a and 7A-13b) (Hickox November 1994, Larson and Palmieri October 1994). In approximately 1990, hydraulic oil leaked onto the soil in the equipment/scrap yard (Larson and Palmieri October 1994). This is the only documented release of liquid at the scrap yard. The affected soil was placed in 55-gallon drums and removed (Larson and Palmieri October 1994). No other containerized fluids have ever been (nor are expected to be) stored in the scrap yard.

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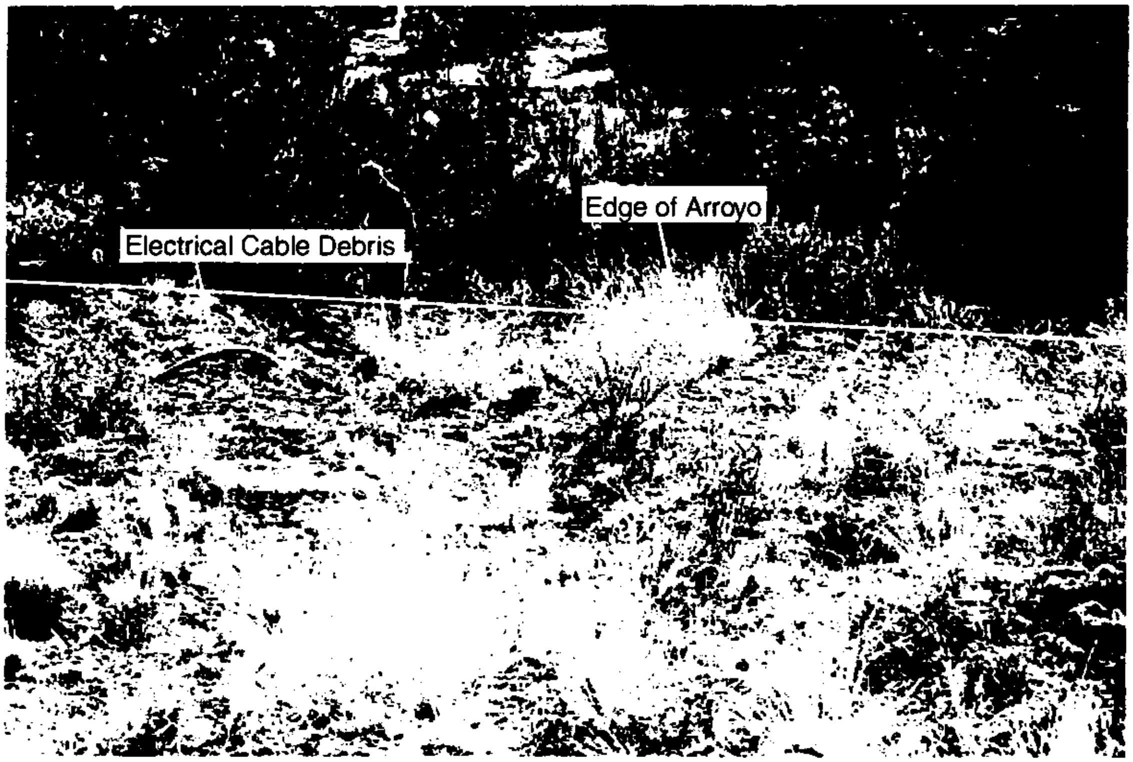

Photograph of part of the debris/soil mound area (SWMU 94B) in December 1994. Visible debris is identified. View is to the south.

Figure 7A-12
Photograph of SWMU 94B, Debris/Soil Mound Area

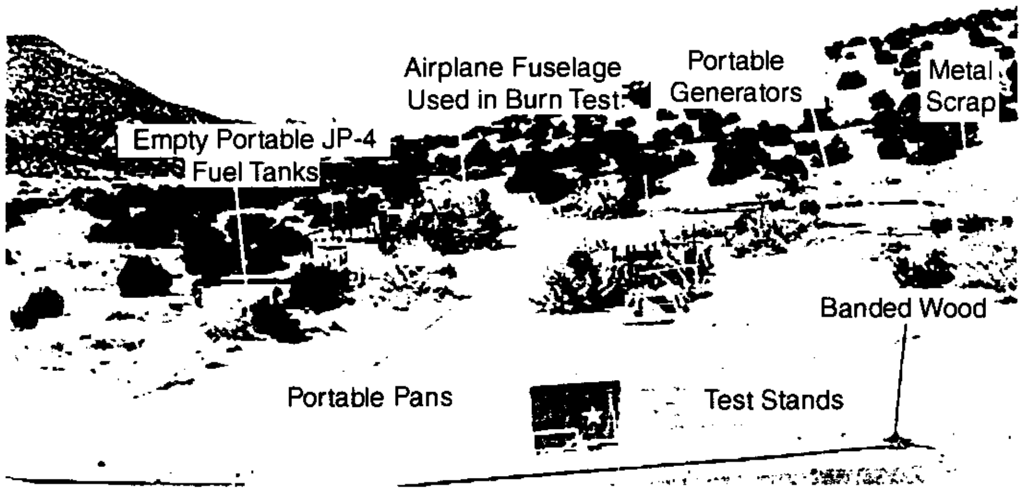

Figure 7A-13a Photograph of the scrap yard (SWMU 94G) in April 1995. Stored inventory is indicated. View is to the west.

Figure 7A-13b Photograph of empty drums in the northern portion of the scrap yard (SWMU 94G) in April 1995. View is to the north.

Figure 7A-13
Photographs of SWMU 94G, Scrap Yard

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Annex 7-B

ANNEX 7-B
Gamma Spectroscopy Results

ANALYSIS REQUEST AND CHAIN OF CUSTODY

COC (6/95)

Internal Lab Batch No. 630135

PAGE 1 OF 1

AR/COC- 05457

Dept. No./Mail Stop: 7585 / 1148
Project/Task Manager: C. Lojek / K. Lambert
Project Name: Surface Rad VCA
Record Center Code: ER/SR/VCA/1333/94/DAT
Logbook Ref No: NA
Service Order No.: NA

Date Samples Shipped:
Carrier/Waybill No.:
Lab Contact: Amir M.
Lab Destination: 7715 Lab
SMO Contact/Phone: Mike Gonzales/848-0404
Send Report to SMO: Kevin Lambert /MS 1148

Contract No.: NA
Case No.: 3321.120
SMO Authorization: [signature]
Bill to: Sandia National Laboratories
Supplier Services Department
P.O. Box 5800 MS 8154
Albuquerque, NM 87185-0154

Location Tech Area NA
Building NA Room NA

Reference LOV (available at SMO)

Parameter & Method Requested: Gamma Spec.

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
① -	94E63A-SS	3/12	94	06/17/96 AM	Soil	P	500ml	None	G	SA	✓	
① -	94E8-SS	45/12	94	06/17/96 AM	Soil	P	500ml	None	G	SA	✓	

SJL 6/17/96

RMMA ☒ Yes ☐ No Ref. No. 94

Sample Disposal ☒ Return to Client ☐ Disposal by lab

Turnaround Time ☒ Normal ☐ Rush Required Report Date

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

Sample Team Members: Name	Signature	Init	Company/Organization/Phone
Stephen J. Lindholm	[signature]	SJL	RUST Geotech

Special Instructions/QC Requirements
Gamma Spec.
① Disposed as Rad Waste Drum # VCMSAMPLES 62596-1

Abnormal Conditions on Receipt

		Org.	Date	Time
1. Relinquished by	[signature]	RUST	6/17/96	1230
1. Received by	[signature]	7714	6/17/96	1230
2. Relinquished by	[signature]	7714	6/17/96	1700
2. Received by	[signature]	7713	6/18/96	1700
3. Relinquished by	[signature]	7713	6/19/96	1100
3. Received by	KM Bolin	7714	6/19/96	1100
4. Relinquished by	[signature] ①	7714	6/25/96	208
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

Survey #: ____________

Sandia National Laboratories
Radiation Protection Sample Diagnostics Program [TA-V Laboratory]
6-19-96 10:22:19 AM

Analyzed by: MCS 6/19/96 Reviewed by: [signature] 6/19/96

Customer : K.BABILON (7714)
Customer Sample ID : 94E8
Lab Sample ID : 63013502

Sample Description : MARINELLI OF SOIL
Sample Quantity : 1.01E+03 gram
Sample Date/Time : 6-17-96 12:00:00 PM
Acquire Start Date/Time : 6-18-96 10:35:41 AM
Detector Name : LAB1
Elapsed Live/Real Time : 6000 / 6001 seconds

Comments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	1.57E+01	4.77E+00	1.89E+00
TH-234	1.53E+01	3.11E+00	6.69E-01
RA-226	4.81E+00	1.60E+00	5.85E-01
PB-214	5.89E-01	1.38E-01	7.71E-02
BI-214	5.66E-01	2.78E-01	5.77E-02
TH-232	6.30E-01	3.31E-01	1.66E-01
RA-228	6.06E-01	3.03E-01	2.48E-01
AC-228	6.28E-01	2.10E-01	1.16E-01
TH-228	7.62E-01	2.93E-01	5.92E-01
RA-224	6.13E-01	2.85E-01	9.81E-02
PB-212	6.81E-01	2.07E-01	4.50E-02
BI-212	6.48E-01	4.56E-01	3.86E-01
TL-208	6.90E-01	1.69E-01	9.11E-02
U-235	Not Detected	---------	1.73E-01
TH-231	Not Detected	---------	3.15E+00
PA-231	Not Detected	---------	1.77E+00
TH-227	Not Detected	---------	3.55E-01
RA-223	Not Detected	---------	2.14E-01
RN-219	Not Detected	---------	5.00E-01
PB-211	Not Detected	---------	1.13E+00
TL-207	Not Detected	---------	2.18E+01
AM-241	Not Detected	---------	4.01E-01
PU-239	Not Detected	---------	4.69E+02
NP-237	Not Detected	---------	2.59E-01
PA-233	Not Detected	---------	7.22E-02
TH-229	Not Detected	---------	3.15E-01

Survey #:______________

[Summary Report] - Sample ID: : 63013502

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
AG-110m	Not Detected	---------	4.36E-02
AU-198	Not Detected	---------	4.30E-02
BA-133	Not Detected	---------	6.35E-02
BE-7	Not Detected	---------	3.28E-01
CD-109	Not Detected	---------	8.92E-01
CD-115	Not Detected	---------	9.92E-02
CE-139	Not Detected	---------	3.46E-02
CE-141	Not Detected	---------	4.00E-02
CE-144	Not Detected	---------	2.61E-01
CO-56	Not Detected	---------	4.85E-02
CO-57	Not Detected	---------	3.32E-02
CO-58	Not Detected	---------	4.55E-02
CO-60	Not Detected	---------	4.91E-02
CR-51	Not Detected	---------	2.91E-01
CS-134	Not Detected	---------	5.70E-02
CS-137	Not Detected	---------	4.87E-02
EU-152	Not Detected	---------	3.23E-01
EU-154	Not Detected	---------	2.34E-01
EU-155	Not Detected	---------	1.49E-01
FE-59	Not Detected	---------	9.65E-02
GD-153	Not Detected	---------	1.75E-01
HG-203	Not Detected	---------	3.57E-02
I-133	Not Detected	---------	8.61E-02
I-131	Not Detected	---------	3.97E-02
I-132	Not Detected	---------	3.80E+01
IR-192	Not Detected	---------	3.38E-02
K-40	1.03E+01	1.72E+00	4.36E-01
MN-54	Not Detected	---------	4.76E-02
MN-56	Not Detected	---------	2.11E+01
MO-99	Not Detected	---------	4.66E-01
NA-22	Not Detected	---------	5.63E-02
NA-24	Not Detected	---------	1.39E-01
NB-95	Not Detected	---------	1.98E-01
ND-147	Not Detected	---------	2.88E-01
NI-57	Not Detected	---------	9.47E-02
RU-103	Not Detected	---------	3.80E-02
RU-106	Not Detected	---------	4.26E-01
SB-122	Not Detected	---------	6.92E-02
SB-124	Not Detected	---------	5.73E-02
SB-125	Not Detected	---------	1.07E-01
SR-85	Not Detected	---------	4.28E-02
TA-182	Not Detected	---------	1.86E-01
TA-183	Not Detected	---------	3.91E-01
TC-99m	Not Detected	---------	4.52E-01
TL-201	Not Detected	---------	1.71E-01
W-187	Not Detected	---------	2.89E-01
XE-133	Not Detected	---------	1.96E-01
Y-88	Not Detected	---------	4.64E-02
ZN-65	Not Detected	---------	1.24E-01
ZR-95	~~2.43E-02~~	~~1.66E-02~~ Not Detected	4.85E-02

6/19/94

Internal Lab

ANALYSIS REQUEST AND CHAIN OF CUSTODY

Batch No.

SAR/WR No.

AR/COC 601185

pt. No./Mail Stop: 6133 MS 1147	Date Samples Shipped:	SMO Use	Contract No.:
ject/Task Manager: Paul Freshour	Carrier/Waybill No.		Case No.: 7214.221K8
ject Name: 94E waste characterization	Lab Contact: Ferlindo Dominguez		SMD Authorization:
cord Center Code: ER/1333/94F/DAT	Lab Destination: AMIR		Bill To: Sandia National Laboratories
book Ref. No.: ER-012	SMO Contact/Phone: D.Salm 4-3110		Supplier Services dept.:
vica Order No. CF-06676	Send Report to SMO:		P.O. Box 5800 MS 0154
cation / Tech Area NA			
iding NA / Room NA			

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	Parameter & Method Requested	Lab Use: Lab Sample ID
043652-003	CY94E-GR-001-SS	0	94E	111998/1415	S	M	500ml	NA	Grab	SA	Gamma Spec + Gross A/B	
043655-003	CY94E-BH1-S	0	94-E	111998/1400	S	M	500ml	N/A	Grab	SA	Gamma Spec + Gross A/B	

MMA ☒ Yes ☐ No Ref. No.

mple Disposal ☐ Return to Client ☒ Disposal by lab

rnaround Time ☒ Normal ☐ Rush

Required Report Date

Sample Tracking / SMO Use: Date Entered (mm/dd/yy), Entered by, QC inits

Special Instructions/QC Requirements

EDD ☒ Yes ☐ No

Raw Data Package ☒ Yes ☐ No

THIS ARCOC 601185 WILL RELEASE ARCOC 601186 TO GEL AND ~~ARCOC 601184 TO GFO~~ CC 11.23.98

Please list as separate report.

Abnormal Conditions on Receipt

Sample Team Members: Name	Signature	Init	Company/Organization/Phone
Chris Catechis	C. Catechis	CC	MDM/6131/881-3196
Concetta Calliato	Concetta Calliato	CC	MDM/6131/284-3301

Relinquished by [signature]	Org. 6131	Date 11/23/98	Time 1100	4. Relinquished by	Org.	Date	Time
Received by [signature] SMO	Org. 7577	Date 11/23/98	Time 1100	4. Received by	Org.	Date	Time
Relinquished by	Org.	Date	Time	5. Relinquished by	Org.	Date	Time
Received by	Org.	Date	Time	5. Received by	Org.	Date	Time
Relinquished by	Org.	Date	Time	6. Relinquished by	Org.	Date	Time
Received by	Org.	Date	Time	6. Received by	Org.	Date	Time

Sandia National Laboratories
Radiation Protection Sample Diagnostics ARCOC# 601185

Sample Analysis Request Form
Page 1 of 1

To be completed by Customer

Shaded areas are for RPSD use only

Customer: Paul Freshour
Organization: 6133 MS 1147
Project Location: FUFRESITE 94-E
Phone: 845-3108
Date Results Needed: Rush
Suspect Isotopes:
Other Information: cc page 1-888-553-6102

Hazards/Special Instructions:
THIS WILL RELEASE ARCOC# 601186
Rlumut NOTD.
100 MIN COUNT
RUSH

Batch Log Number: 8002446
Logged By:
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
043652-005	Soil	111998/1415	500 ml	Gamma Spec/AB	01	<300	752g	P1(.5,)
043655-003	Soil	111998/1400	500 ml	Gamma Spec/AB	02	<300	503g	
LCS					03			

Relinquished by [signature] Date 11-23-98 Time 1410 Received by [signature] Date 11-23-98 Time 1420
Relinquished by [signature] Date 11/24/98 Time 0105 Received by [signature] Date 11-24-98 Time 0105
Relinquished by C. Carrugato Date 11/24/98 Time 6 5 Received by [signature] Date 11/24/98 Time 1050
Relinquished by [signature] Date 12-2-98 Time 10:45 Received by [signature] Date 12-2-98 Time 10:45

Sandia National Laboratories
Radiation Protection Sample Diagnostics Program [806 Laboratory]
11-23-98 4:15:11 PM

Analyzed by: K.G. 11/24/98　　　Reviewed by: S.B. Obota 11/24/98

Customer : P.FRESHOUR/D.PERRY (6133)
Customer Sample ID : 043652-003
Lab Sample ID : 80244601

Sample Description : SOIL MARINELLI SAMPLE
Sample Quantity : 752.000 gram
Sample Date/Time : 11-19-98 2:15:00 PM
Acquire Start Date/Time : 11-23-98 2:32:25 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	9.63E-01	4.94E-01	6.01E-01
RA-226	1.27E+00	4.77E-01	5.47E-01
PB-214	6.97E-01	1.05E-01	4.13E-02
BI-214	6.47E-01	1.27E-01	4.36E-02
PB-210	Not Detected	---------	3.35E+01
TH-232	7.31E-01	3.83E-01	1.39E-01
RA-228	7.46E-01	2.27E-01	1.38E-01
[illegible] 228	7.44E-01	1.65E-01	7.45E-02
[illegible]-228	9.00E-01	2.53E-01	4.29E-01
RA-224	8.06E-01	2.52E-01	6.74E-02
PB-212	7.36E-01	7.47E-01	3.68E-02
BI-212	7.52E-01	3.31E-01	2.91E-01
TL-208	6.25E-01	8.28E-01	6.40E-02
U-235	Not Detected	---------	2.25E-01
TH-231	Not Detected	---------	2.19E+00
PA-231	Not Detected	---------	3.74E+00
TH-227	Not Detected	---------	3.27E-01
RA-223	Not Detected	---------	2.38E-01
RN-219	Not Detected	---------	3.50E-01
PB-211	Not Detected	---------	7.87E-01
TL-207	Not Detected	---------	1.38E+01
AM-241	Not Detected	---------	4.40E-01
PU-239	Not Detected	---------	4.40E+02
NP-237	Not Detected	---------	3.69E-01
PA-233	Not Detected	---------	5.70E-02
TH-229	Not Detected	---------	2.46E-01

Note: Ra-226 and U-235 gamma peaks interfere. Either isotope may be over-estimated.

[Summary Report] - Sample ID: : 80244601

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)	
A 108m	Not Detected	----------	3.77E-02	
AG-110m	Not Detected	----------	3.03E-02	
BA-133	Not Detected	----------	6.44E-02	
BE-7	1.30E-01	1.27E-01	1.42E-01	
CD-109	~~1.46E+00~~	~~5.65E-01~~	8.57E-01	NOT DETECTED KGT 11/24/98
CD-115	Not Detected	----------	2.16E-01	
CE-139	Not Detected	----------	2.93E-02	
CE-141	Not Detected	----------	5.49E-02	
CE-144	Not Detected	----------	2.46E-01	
CO-56	Not Detected	----------	3.30E-02	
CO-57	Not Detected	----------	2.92E-02	
CO-58	Not Detected	----------	3.10E-02	
CO-60	Not Detected	----------	3.72E-02	
CR-51	Not Detected	----------	2.44E-01	
CS-134	Not Detected	----------	4.41E-02	
CS-137	Not Detected	----------	3.14E-02	
EU-152	Not Detected	----------	8.74E-02	
EU-154	Not Detected	----------	1.74E-01	
EU-155	Not Detected	----------	1.46E-01	
FE-59	Not Detected	----------	7.48E-02	
GD-153	Not Detected	----------	1.02E-01	
HG-203	Not Detected	----------	3.23E-02	
I-131	Not Detected	----------	3.79E-02	
IR-192	Not Detected	----------	2.76E-02	
K-40	2.08E+01	3.02E+00	5.28E-01	
KR-85	Not Detected	----------	7.73E+00	
MN-52	Not Detected	----------	4.51E-02	
M 54	Not Detected	----------	3.45E-02	
N 99	Not Detected	----------	6.30E-01	
NA-22	Not Detected	----------	4.45E-02	
NA-24	Not Detected	----------	3.00E+00	
NB-95	Not Detected	----------	3.27E-01	
ND-147	Not Detected	----------	2.37E-01	
NI-57	Not Detected	----------	3.08E-01	
NP-239	Not Detected	----------	1.30E-01	
RU-103	Not Detected	----------	2.85E-02	
RU-106	Not Detected	----------	2.67E-01	
SB-122	Not Detected	----------	9.95E-02	
SB-124	Not Detected	----------	2.79E-02	
SB-125	Not Detected	----------	7.79E-02	
SN-113	Not Detected	----------	3.47E-02	
TA-182	Not Detected	----------	1.50E-01	
TA-183	Not Detected	----------	6.50E-01	
TC-99m	Not Detected	----------	2.03E+03	
TL-201	Not Detected	----------	4.33E-01	
XE-133	Not Detected	----------	4.78E-01	
Y-88	Not Detected	----------	2.25E-02	
ZN-65	Not Detected	----------	1.02E-01	
ZR-95	Not Detected	----------	5.59E-02	

Sandia National Laboratories
Radiation Protection Sample Diagnostics Program [806 Laboratory]
11-23-98 6:00:08 PM

Analyzed by: 11/24/98 Reviewed by: S.B. Obara 11/24/98

Customer	:	P.FRESHOUR/D.PERRY (6133)
Customer Sample ID	:	043655-003
Lab Sample ID	:	80244602
Sample Description	:	SOIL MARINELLI SAMPLE
Sample Quantity	:	503.000 gram
Sample Date/Time	:	11-19-98 2:00:00 PM
Acquire Start Date/Time	:	11-23-98 4:17:19 PM
Detector Name	:	LAB02
Elapsed Live/Real Time	:	6000 / 6002 seconds

Comments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	3.55E+00	9.81E-01	8.71E-01
RA-226	3.12E+00	1.26E+00	8.01E-01
PB-214	9.72E-01	1.76E-01	6.39E-02
BI-214	8.52E-01	1.68E-01	5.33E-02
PB-210	Not Detected	---------	4.73E+01
TH-232	1.16E+00	5.90E-01	1.85E-01
RA-228	1.10E+00	2.96E-01	1.90E-01
228	1.24E+00	1.06E+00	1.06E-01
TH-228	1.25E+00	1.02E+00	5.95E-01
RA-224	1.28E+00	4.07E-01	9.42E-02
PB-212	1.22E+00	1.01E+00	5.18E-02
BI-212	1.40E+00	5.11E-01	3.80E-01
TL-208	1.13E+00	2.42E-01	8.83E-02
U-235	Not Detected	---------	3.11E-01
TH-231	Not Detected	---------	3.11E+00
PA-231	Not Detected	---------	5.32E+00
TH-227	Not Detected	---------	5.08E-01
RA-223	Not Detected	---------	3.52E-01
RN-219	Not Detected	---------	4.92E-01
PB-211	Not Detected	---------	1.11E+00
TL-207	Not Detected	---------	1.72E+01
AM-241	Not Detected	---------	6.44E-01
PU-239	Not Detected	---------	6.15E+02
NP-237	Not Detected	---------	4.06E-01
PA-233	Not Detected	---------	7.57E-02
TH-229	Not Detected	---------	3.45E-01

Note: Ra-226 and U-235 gamma peaks interfere. Either isotope may be over-estimated.

[Summary Report] - Sample ID: : 80244602

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)	
AG-108m	Not Detected	---------	5.56E-02	
AG-110m	Not Detected	---------	5.32E-02	
BA-133	Not Detected	---------	9.41E-02	
BE-7	2.18E-01	1.89E-01	2.26E-01	
~~CD-109~~	~~2.20E+00~~	~~7.49E-01~~	~~1.28E+00~~	Not Detected FE 11/24
CD-115	Not Detected	---------	3.28E-01	
CE-139	Not Detected	---------	4.04E-02	
CE-141	Not Detected	---------	7.62E-02	
CE-144	Not Detected	---------	3.21E-01	
CO-56	Not Detected	---------	4.32E-02	
CO-57	Not Detected	---------	3.98E-02	
CO-58	Not Detected	---------	4.39E-02	
CO-60	Not Detected	---------	4.65E-02	
CR-51	Not Detected	---------	3.37E-01	
CS-134	Not Detected	---------	6.20E-02	
CS-137	1.09E-01	4.14E-02	3.06E-02	
EU-152	Not Detected	---------	1.19E-01	
EU-154	Not Detected	---------	2.58E-01	
EU-155	Not Detected	---------	2.00E-01	
FE-59	Not Detected	---------	9.57E-02	
GD-153	Not Detected	---------	1.46E-01	
HG-203	Not Detected	---------	4.38E-02	
I-131	Not Detected	---------	5.54E-02	
IR-192	Not Detected	---------	3.66E-02	
K-40	1.50E+01	2.40E+00	7.99E-01	
KR-85	Not Detected	---------	1.16E+01	
MN-52	Not Detected	---------	6.24E-02	
MN-54	Not Detected	---------	4.51E-02	
MO-99	Not Detected	---------	8.57E-01	
NA-22	Not Detected	---------	5.10E-02	
NA-24	Not Detected	---------	3.94E+00	
NB-95	Not Detected	---------	5.17E-01	
ND-147	Not Detected	---------	3.34E-01	
NI-57	Not Detected	---------	2.07E-01	
NP-239	Not Detected	---------	1.79E-01	
RU-103	Not Detected	---------	4.00E-02	
RU-106	Not Detected	---------	3.74E-01	
SB-122	Not Detected	---------	1.46E-01	
SB-124	Not Detected	---------	3.90E-02	
SB-125	Not Detected	---------	1.09E-01	
SN-113	Not Detected	---------	4.97E-02	
TA-182	Not Detected	---------	2.06E-01	
TA-183	Not Detected	---------	9.57E-01	
TC-99m	Not Detected	---------	3.55E+03	
TL-201	Not Detected	---------	6.23E-01	
XE-133	Not Detected	---------	7.29E-01	
Y-88	Not Detected	---------	3.52E-02	
ZN-65	Not Detected	---------	1.39E-01	
ZR-95	Not Detected	---------	8.09E-02	

Sandia National Laboratories
Radiation Protection Sample Diagnostics Program [806 Laboratory]
11-24-98 7:13:42 AM

Analyzed by: [illegible] 11/24/98   Reviewed by: S. B. Chase 11/24/98

Customer : P.FRESHOUR/D.PERRY (6133)
Customer Sample ID : LAB CONTROL SAMPLE USING CG134
Lab Sample ID : 80244603

Sample Description : MIXED_GAMMA_STANDARD_CG134
Sample Quantity : 1.000 Each
Sample Date/Time : 11-01-90 12:00:00 PM
Acquire Start Date/Time : 11-24-98 7:01:48 AM
Detector Name : LAB02
Elapsed Live/Real Time : 600 / 604 seconds

Comments:

Nuclide Name	Activity (pCi/Each)	2-sigma Error	MDA (pCi/Each)
U-238	Not Detected	---------	4.53E+03
RA-226	Not Detected	---------	6.16E+03
PB-214	Not Detected	---------	7.02E+02
BI-214	Not Detected	---------	6.18E+02
PB-210	Not Detected	---------	2.75E+05
TH-232	Not Detected	---------	2.22E+03
[illegible]-228	Not Detected	---------	2.49E+03
[illegible]-228	Not Detected	---------	1.46E+03
TH-228	Not Detected	---------	1.25E+05
RA-224	Not Detected	---------	9.63E+02
PB-212	1.71E+03	7.40E+02	3.63E+03
BI-212	Not Detected	---------	7.81E+04
TL-208	Not Detected	---------	1.73E+04
U-235	Not Detected	---------	1.69E+03
TH-231	Not Detected	---------	2.06E+04
PA-231	Not Detected	---------	3.51E+04
TH-227	Not Detected	---------	2.54E+03
RA-223	Not Detected	---------	1.00E+26
RN-219	Not Detected	---------	5.83E+03
PB-211	Not Detected	---------	1.32E+04
TL-207	Not Detected	---------	2.13E+05
AM-241	7.74E+04	1.46E+04	3.08E+03
PU-239	Not Detected	---------	3.15E+06
NP-237	Not Detected	---------	2.37E+03
PA-233	Not Detected	---------	6.10E+02
TH-229	Not Detected	---------	1.74E+03

[Summary Report] - Sample ID: : 80244603

Nuclide Name	Activity (pCi/Each)	2-sigma Error	MDA (pCi/Each)
AG-108m	Not Detected	---------	3.21E+02
AG-110m	Not Detected	---------	5.84E+06
BA-133	Not Detected	---------	7.52E+02
BE-7	Not Detected	---------	1.50E+20
CD-109	Not Detected	---------	6.33E+05
CD-115	Not Detected	---------	1.00E+26
CE-139	Not Detected	---------	6.20E+08
CE-141	Not Detected	---------	1.00E+26
CE-144	Not Detected	---------	2.28E+06
CO-56	Not Detected	---------	1.13E+14
CO-57	Not Detected	---------	3.98E+05
CO-58	Not Detected	---------	1.05E+15
CO-60	8.03E+04	1.09E+04	4.48E+02
CR-51	Not Detected	---------	1.00E+26
CS-134	Not Detected	---------	4.24E+03
CS-137	7.12E+04	1.06E+04	2.58E+02
EU-152	Not Detected	---------	9.95E+02
EU-154	Not Detected	---------	2.71E+03
EU-155	Not Detected	---------	3.45E+03
FE-59	Not Detected	---------	1.00E+26
GD-153	Not Detected	---------	3.34E+06
HG-203	Not Detected	---------	3.08E+21
I-131	Not Detected	---------	1.00E+26
IR-192	Not Detected	---------	2.88E+14
K-40	Not Detected	---------	1.54E+03
KR-85	Not Detected	---------	1.17E+05
MN-52	Not Detected	---------	1.00E+26
MN-54	Not Detected	---------	2.33E+05
MO-99	Not Detected	---------	1.00E+26
NA-22	Not Detected	---------	1.75E+03
NA-24	Not Detected	---------	1.00E+26
NB-95	Not Detected	---------	1.00E+26
ND-147	Not Detected	---------	1.00E+26
NI-57	Not Detected	---------	1.00E+26
NP-239	Not Detected	---------	9.28E+02
RU-103	Not Detected	---------	1.00E+26
RU-106	Not Detected	---------	7.40E+05
SB-122	Not Detected	---------	1.00E+26
SB-124	Not Detected	---------	1.48E+17
SB-125	Not Detected	---------	8.40E+03
SN-113	Not Detected	---------	2.21E+10
TA-182	Not Detected	---------	5.69E+10
TA-183	Not Detected	---------	1.00E+26
TC-99m	Not Detected	---------	1.00E+26
TL-201	Not Detected	---------	1.00E+26
XE-133	Not Detected	---------	1.00E+26
Y-88	Not Detected	---------	2.84E+10
ZN-65	Not Detected	---------	3.55E+06
ZR-95	Not Detected	---------	3.62E+16

Sandia National Laboratories
Radiation Protection Sample Diagnostics Program
Quality Assurance Report

Report Date	:	11-24-98 7:14:21 AM
QA File	:	C:\GENIEPC\CAMFILES\LCS2.QAF
Analyst	:	KIC
Sample ID	:	80244603
Sample Quantity	:	1.00 Each
Sample Date	:	11-01-90 12:00:00 PM
Measurement Date	:	11-24-98 7:01:48 AM
Elapsed Live Time	:	600 seconds
Elapsed Real Time	:	604 seconds

Parameter	Mean	1S Error	New Value	< LU : SD : UD : BS :
AM-241 Activity	8.206E-02	4.153E-03	7.737E-02	< : : : >
CS-137 Activity	7.051E-02	2.006E-03	7.123E-02	< : : : >
CO-60 Activity	7.846E-02	2.192E-03	8.032E-02	< : : : >

F. _s Key: LU = Boundary Test (Ab = Above , Be = Below)
SD = Sample Driven N-Sigma Test (In = Investigate, Ac = Action)
UD = User Driven N-Sigma Test (In = Investigate, Ac = Action)
BS = Measurement Bias Test (In = Investigate, Ac = Action)

Reviewed by: KS 11/24/98

```
***********************************************************************
* Sandia Radioactive Sample Diagnostics Program              3-23-1999 *
***********************************************************************
 3C Analysis Program - version 5.3
```

Batch Number : 80244601
Count Protocol : 23
Client : BURNSITE 94E (P. FRESHOUR 6133) 80244601
Laboratory ID : 806-3 (S/N 419272)
Count Date : 24-Nov-98
Protocol Name : H3AB -- SOIL
Region of Interest : 0-12
Count Time : 100.0 minutes
Background cpm : 16.19 +- 0.99
Background tSIE : 146.7
Background Eff : 0.116
Systematic Error : 12.90%
Sample Aliquot : 0.500 g

H-3 MDA = 1.48E+01 pCi/g
H-3 CL = 7.29E+00 pCi/g

H-3 Efficiency = 0.9740 - exp(-0.00047*tSIE^1.1600)

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.

Analyzed by: [signature] 3/23/99 Reviewed by: S.B. Ebara 3/23/99

S#	RPSD ID	Client ID	cpm	Error	tSIE	Eff	H-3 Activity pCi/g	Error	Flag
2	001	43652-3	1.87E+01	9.15E-01	212	0.183	1.25E+01	1.10E+01	>CL
3	002	43655-3	1.74E+01	8.72E-01	137	0.106	1.03E+01	1.72E+01	@CL

```
**********************************************************************
* Sandia Radioactive Sample Diagnostics Program              3-23-1999 *
**********************************************************************
```

SC Analysis Program - version 5.3

Batch Number	: 80244601
Count Protocol	: 23
Client	: BURNSITE 94E (P. FRESHOUR 6133) 80244601
Laboratory ID	: 806-3 (S/N 419272)
Count Date	: 24-Nov-98
Protocol Name	: H3AB -- SOIL
Region of Interest	: 20-600
Count Time	: 100.0 minutes
Background cpm	: 6.61 +- 0.51
Background tSIE	: 146.7
Background Eff	: 1.010
Systematic Error	: 8.90%
Sample Aliquot	: 0.500 g

Alpha MDA = 1.09E+00 pCi/g
Alpha CL = 5.35E-01 pCi/g

Alpha Efficiency = 1.0390 - exp(-0.00990*tSIE^1.1780)

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	Alpha Activity pCi/g	Error	Flag
2	001	43652-3	9.83E+00	6.27E-01	212	1.035	2.80E+00	1.24E+00	>CL
3	002	43655-3	6.81E+00	5.22E-01	137	1.001	1.80E-01	9.49E-01	<CL

```
****************************************************************************
* Sandia Radioactive Sample Diagnostics Program                  3-23-1999 *
****************************************************************************
 ?C Analysis Program - version 5.3

Batch Number         : 80244601
Count Protocol       : 23
Client               : BURNSITE 94E (P. FRESHOUR 6133)          80244601
Laboratory ID        : 806-3 (S/N 419272)
Count Date           : 24-Nov-98
Protocol Name        : H3AB -- SOIL
Region of Interest   : 12-2000
Count Time           : 100.0 minutes
Background cpm       : 37.02 +- 1.22
Background tSIE      : 146.7
Background Eff       : 0.802
Systematic Error     :  6.30%
Sample Aliquot       : 0.500 g

Beta MDA =  3.21E+00 pCi/g
Beta CL  =  1.59E+00 pCi/g

Beta Efficiency = 0.8410 - exp(-0.01319*tSIE^1.1040)

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

S#	RPSD ID	Client ID	cpm	Error	tSIE	Eff	Beta Activity pCi/g	Beta Activity Error	Flag
2	001	43652-3	4.21E+01	1.30E+00	212	0.833	5.46E+00	3.06E+00	>CL
3	002	43655-3	3.87E+01	1.25E+00	137	0.792	1.88E+00	2.92E+00	@CL

Internal Lab

ANALYSIS REQUEST AND CHAIN OF CUSTODY

Page 1 of

Batch No. 802415

SAR/WR No. 11/23/98

AR/COC 601867 (CC 11/23/98)

Dept. No./Mail Stop: 6133 MS 1147	Date Samples Shipped: / SMO Use	Contract No.: N/A	
Project/Task Manager: Paul Freshour	Carrier/Waybill No.	Case No.: 7214.2218	
Project Name: 94E Waste Characterization	Lab Contact: Fernando Dominguez	SMO Authorization: [signature]	
Record Center Code: ER/1333/94E/DAT	Lab Destination: RPSD	Bill To: Sandia National Laboratories	
Logbook Ref. No.: ER-012	SMO Contact/Phone: D.Salmi 4-3110	Supplier Services dept.:	
Service Order No. CF0666	Send Report to SMO:	P.O. Box 5800 MS 0154	
Location	Tech Area 3 CTA		
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	Parameter & Method Requested	Lab Use: Lab Sample ID
043655-001	CY94E-BH1-0'-10'-SS	0'-10'	94 (94E)	11/20/98 1005	S	M	500 ml	None	C GR	SA	Gamma Spec	

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

Sample Tracking / SMO Use: Date Entered(mm/dd/yy) / Entered by: / QC inits.

Special Instructions/QC Requirements

EDD ☒ Yes ☐ No

Raw Data Package ☒ Yes ☐ No

THIS SAMPLE DOES NOT RELEASE ANY OTHER COC.

Please list as separate report.

Abnormal Conditions on Receipt / Lab Use

Sample Team Members: Name	Signature	Init	Company/Organization/Phone
Chris Catechis	[signature]	CC	MDM/6131/881-3196
Karen DeWees	[signature]	KD	MDM/6133/263-2100

		Org.	Date	Time
1.Relinquished by	[signature]	6131	11/23/98	1105
1. Received by	[signature] SMO 7577	7577	11/23/98	1105
2.Relinquished by	[signature] SMO	7577	11/23/98	
2. Received by	[signature]	7578	11/23/98	
3.Relinquished by		7578	11/24/98	0907
3. Received by	[signature]	6131	11-24-98	0907
4.Relinquished by				
4. Received by				
5.Relinquished by				
5. Received by				
6.Relinquished by				
6. Received by				

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: Paul Freshour
Organization: 6133 MS 1147
Project Location: 94E
Phone: 845-3108
Date Results Needed:
Suspect Isotopes:
Other Information: cc Page 1-888-552-6102

Hazards/Special Instructions: RMMA 100 min count

Batch Log Number: 802445
Logged By: [signature]
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
043655-007	soil	112098/1005	500 ml	Gamma Spec	01	<300	~~500ml~~ 856g	

Relinquished by [signature] Date 11/23/98 Time 1410 Received by [signature] Date 11-23-98 Time 1410
Relinquished by [signature] Date 11/24/98 Time 0907 Received by Date Time
Relinquished by [signature] Date Time Received by [signature] Date 11-24-98 Time 0907
Relinquished by Date Time Received by Date Time

Survey Number: S13809

RADIOLOGICAL SURVEY FORM

Page 1 of 2

Location	Requester/Dept	Date	Time	Duration
BR Site #94E	Paul Freshour #6133	111998	1430	N/A

Purpose	Request #	RWP #	RPIR #
Release the exterior of soil samples for analysis.	N/A	RWP0309	N/A

Instrument and Probe Type and Serial Number		Surveyor(s) Printed Name	Surveyor(s) Signature
ASP-1/HP-260/#2230	N/A	John P. Kilbane	[signature]
Bicron Micro Rem #B973D	N/A	N/A	N/A
N/A	N/A	N/A	N/A

#	Item Description/Location	BETA-GAMMA CONTAMINATION Counting Data Attached ☒ Yes ☐ No %Eff. 20 cpm	Bkg cpm	/Radionuclide dpm/100 cm² (1)	DU (2) T/R/F	ALPHA CONTAMINATION Counting Data Attached ☒ Yes ☐ No %Eff N/A cpm	Bkg cpm	/Radionuclide dpm/100 cm² (1)	DU (2) T/R/F	RADIATION SURVEY Bkg. 7μrem/hr μrem/hr (3)	Distance
1	Sample #043653-002	≤80	80	ND	T				R	≤7	Contact
2	Sample #043652-002	≤80	80	ND	T				R	≤7	Contact
3	Sample #043654-002	≤80	80	ND	T				R	≤7	Contact
4	Sample #043653-001	≤80	80	ND	T				R	≤7	Contact
5	Sample #043652-001	≤80	80	ND	T				R	≤7	Contact
6	Sample #043654-001	≤80	80	ND	T				R	≤7	Contact
7	Sample #043655-003	≤80	80	ND	T				R	≤7	Contact
8	Sample #043652-003	≤80	80	ND	T				R	≤7	Contact
						N A					

Note (1): If area other than 100 cm², record as dpm/probe or dpm/LAW. Note (2): Total/Removable/Fixed. Note (3): Indicate type, of other than gamma (i.e., n or β).

Remarks

Reviewed by: Date:

COPY

Survey No. S13809

Radiation Protection Sample Diagnostics (7578) TA-III 6921
Smear Analysis IAW Procedure RPSD-09-02

Date: 11/20/98
Counting Unit Id: 1 (SNL# S674561)
Data file name: C:\LBXL\UNIT1\83634602.XLD
Batch Ended: 11/20/98 10:15
Crosstalk Correction: Applied
ANALYZED BY R. T. PRESTON
REVIEWED BY: R T Preston 11/20/98
Batch ID: ER 94E SAMPLES 11/19/98, J. P. KILBANE (7523)

Alpha activity action level (DPM): 20.00
Beta activity action level (DPM): 1000.00
Certainty level for MDA and flags: 95.00%
High Voltage Setting: 1360
Application Revision: 3
Application Version: Standard

Alpha efficiency log file: pu235ab
Alpha Efficiency: 49.14%
Alpha to Beta Crosstalk: 10.16%
Alpha Background (CPM): 0.4
Alpha Correction Factor: 1.000
Beta efficiency log file: cl35ab
Beta Efficiency: 54.98%
Beta into Alpha Crosstalk: 1.36%
Beta Background (CPM): 2.9
Beta Correction Factor: 1.000

ID	Alpha Activity				Beta Activity				count	Alpha	Beta	Time
	DPM	σ	flags	MDA	DPM	σ	flags	MDA	Time	CPM	CPM	Complt
1	-1.07	1.82	<MDA	9.05	2.11	3.10	<MDA	11.98	1.50	-0.40	1.10	10:03
2	-0.98	1.78	<MDA	8.7	-2.81	1.98	<MDA	11.68	1.50	-0.40	-1.57	10:05
3	-0.98	1.78	<MDA	8.7	-2.81	1.88	<MDA	11.68	1.50	-0.40	-1.57	10:07
4	0.72	1.79	<MDA	8.79	-1.72	2.25	<MDA	12.09	1.50	0.27	-0.90	10:08
5	-1.07	1.82	<MDA	9.05	2.11	3.10	<MDA	11.98	1.50	-0.40	1.10	10:10
6	-1.00	1.78	<MDA	8.80	-1.58	2.25	<MDA	11.98	1.50	-0.40	-0.90	10:12
7	-1.07	1.82	<MDA	9.05	2.11	3.10	<MDA	11.98	1.50	-0.40	1.10	10:13
8	-1.14	1.84	<MDA	9.28	5.81	3.78	<AL	11.97	1.50	-0.40	3.10	10:15

COPY

```
*************************************************************************
*                     Sandia National Laboratories                      *
*    Radiation Protection Sample Diagnostics Program [806 Laboratory]   *
*                       11/23/98  5:59:52 PM                            *
*************************************************************************
*                                                                       *
* Analyzed by: [signature] 11/24/98        Reviewed by: S.B. Ebara 11/24/98 *
*************************************************************************
```

Customer : P.FRESHOUR/D.PERRY (6133)
Customer Sample ID : 043655-007
Lab Sample ID : 80244501

Sample Description : SOIL MARINELLI SAMPLE
Sample Quantity : 856.000 gram
Sample Date/Time : 11/20/98 10:05:00 AM
Acquire Start Date/Time : 11/23/98 4:19:39 PM
Detector Name : LAB04
Elapsed Live/Real Time : 6000 / 6003 seconds

Comments:

****

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	1.06E+000	5.40E-001	3.32E-001
RA-226	1.26E+000	6.85E-001	4.05E-001
PB-214	5.55E-001	1.09E-001	3.62E-002
BI-214	5.01E-001	3.63E-001	2.94E-002
PB-210	Not Detected	---------	7.30E+000
TH-232	4.48E-001	3.02E-001	9.89E-002
RA-228	4.76E-001	1.90E-001	9.89E-002
AC-228	4.88E-001	1.49E-001	6.04E-002
TH-228	5.70E-001	1.88E-001	3.05E-001
RA-224	5.67E-001	3.84E-001	5.16E-002
PB-212	4.84E-001	9.77E-002	2.85E-002
BI-212	5.02E-001	4.17E-001	1.95E-001
TL-208	4.57E-001	1.11E-001	4.85E-002
U-235	Not Detected	---------	1.54E-001
TH-231	Not Detected	---------	7.36E+000
PA-231	Not Detected	---------	1.03E+000
TH-227	Not Detected	---------	2.49E-001
RA-223	Not Detected	---------	1.43E-001
RN-219	Not Detected	---------	2.74E-001
PB-211	Not Detected	---------	6.11E-001
TL-207	Not Detected	---------	9.77E+000
AM-241	Not Detected	---------	1.67E-001
PU-239	Not Detected	---------	2.72E+002
NP-237	Not Detected	---------	1.64E-001
PA-233	Not Detected	---------	4.29E-002
TH-229	Not Detected	---------	1.53E-001

Note: Ra-226 and U-235 gamma peaks interfere. Either isotope may be over-estimated.

[Summary Report] - Sample ID: : 80244501

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)	
AG-108m	Not Detected	---------	2.77E-002	
AG-110m	Not Detected	---------	2.05E-002	
BA-133	Not Detected	---------	5.01E-002	
BE-7	Not Detected	---------	1.73E-001	
CD-109	~~1.24E+000~~	~~5.32E-001~~	5.58E-001	NOT DETECTED [initials] 11/24/94
CD-115	Not Detected	---------	1.28E-001	
CE-139	Not Detected	---------	2.09E-002	
CE-141	Not Detected	---------	3.55E-002	
CE-144	Not Detected	---------	1.51E-001	
CO-56	Not Detected	---------	2.24E-002	
CO-57	Not Detected	---------	1.99E-002	
CO-58	Not Detected	---------	2.34E-002	
CO-60	Not Detected	---------	2.45E-002	
CR-51	Not Detected	---------	1.85E-001	
CS-134	Not Detected	---------	3.69E-002	
CS-137	9.09E-003	1.67E-002	1.26E-002	
EU-152	Not Detected	---------	5.95E-002	
EU-154	Not Detected	---------	1.28E-001	
EU-155	Not Detected	---------	8.98E-002	
FE-59	Not Detected	---------	5.11E-002	
GD-153	Not Detected	---------	6.54E-002	
HG-203	Not Detected	---------	2.31E-002	
I-131	Not Detected	---------	2.70E-002	
IR-192	Not Detected	---------	2.09E-002	
K-40	1.08E+001	1.77E+000	1.02E+000	
MN-52	Not Detected	---------	3.54E-002	
MN-54	Not Detected	---------	2.40E-002	
MO-99	Not Detected	---------	3.67E-001	
NA-22	Not Detected	---------	2.80E-002	
NA-24	Not Detected	---------	8.33E-001	
NB-95	Not Detected	---------	2.14E-001	
ND-147	Not Detected	---------	1.70E-001	
NI-57	Not Detected	---------	1.60E-001	
RU-103	Not Detected	---------	2.07E-002	
RU-106	Not Detected	---------	2.05E-001	
SB-122	Not Detected	---------	6.28E-002	
SB-124	Not Detected	---------	2.28E-002	
SB-125	Not Detected	---------	5.84E-002	
SN-113	Not Detected	---------	2.62E-002	
SR-85	Not Detected	---------	2.76E-002	
TA-182	Not Detected	---------	1.08E-001	
TA-183	Not Detected	---------	2.22E-001	
TC-99m	Not Detected	---------	1.66E+002	
TL-201	Not Detected	---------	1.87E-001	
XE-133	Not Detected	---------	2.43E-001	
Y-88	Not Detected	---------	1.64E-002	
ZN-65	Not Detected	---------	7.46E-002	
ZR-95	Not Detected	---------	4.05E-002	

```
**********************************************************************
*                    Sandia National Laboratories                    *
*   Radiation Protection Sample Diagnostics Program [806 Laboratory] *
*                      11/24/98  7:38:06 AM                          *
**********************************************************************
*                                                                    *
* Analyzed by: [signature] 11/24/98     Reviewed by: S.B. Ebara 11/24/98 *
**********************************************************************
```

Customer : P.FRESHOUR/D.PERRY (6133)
Customer Sample ID : LAB CONTROL SAMPLE USING CG134
Lab Sample ID : 80244502

Sample Description : MIXED_GAMMA_STANDARD_CG134
Sample Quantity : 1.000 Each
Sample Date/Time : 11/01/90 12:00:00 PM
Acquire Start Date/Time : 11/24/98 7:27:51 AM
Detector Name : LAB04
Elapsed Live/Real Time : 600 / 606 seconds

Comments:

****

Nuclide Name	Activity (pCi/Each)	2-sigma Error	MDA (pCi/Each)
U-238	Not Detected	---------	3.24E+003
RA-226	Not Detected	---------	5.20E+003
PB-214	Not Detected	---------	6.42E+002
BI-214	Not Detected	---------	5.54E+002
PB-210	Not Detected	---------	8.26E+004
TH-232	Not Detected	---------	2.02E+003
RA-228	Not Detected	---------	2.32E+003
AC-228	Not Detected	---------	1.39E+003
TH-228	Not Detected	---------	1.14E+005
RA-224	Not Detected	---------	3.17E+003
PB-212	Not Detected	---------	8.24E+003
BI-212	Not Detected	---------	7.08E+004
TL-208	Not Detected	---------	1.60E+004
U-235	Not Detected	---------	1.35E+003
TH-231	Not Detected	---------	5.26E+004
PA-231	Not Detected	---------	1.27E+004
TH-227	Not Detected	---------	2.22E+003
RA-223	Not Detected	---------	1.00E+026
RN-219	Not Detected	---------	5.34E+003
PB-211	Not Detected	---------	1.21E+004
TL-207	Not Detected	---------	1.98E+005
AM-241	8.57E+004	1.44E+004	1.43E+003
PU-239	Not Detected	---------	2.31E+006
NP-237	Not Detected	---------	1.59E+003
PA-233	Not Detected	---------	5.77E+002
TH-229	Not Detected	---------	1.33E+003

[Summary Report] - Sample ID: : 80244502

Nuclide Name	Activity (pCi/Each)	2-sigma Error	MDA (pCi/Each)
AG-108m	Not Detected	---------	2.97E+002
AG-110m	Not Detected	---------	5.58E+006
BA-133	Not Detected	---------	6.88E+002
BE-7	Not Detected	---------	1.30E+020
CD-109	Not Detected	---------	4.33E+005
CD-115	Not Detected	---------	1.00E+026
CE-139	Not Detected	---------	5.08E+008
CE-141	Not Detected	---------	1.00E+026
CE-144	Not Detected	---------	1.70E+006
CO-56	Not Detected	---------	1.02E+014
CO-57	Not Detected	---------	3.10E+005
CO-58	Not Detected	---------	9.41E+014
CO-60	8.08E+004	1.10E+004	3.91E+002
CR-51	Not Detected	---------	1.00E+026
CS-134	Not Detected	---------	3.91E+003
CS-137	7.25E+004	9.61E+003	2.51E+002
EU-152	Not Detected	---------	7.68E+002
EU-154	Not Detected	---------	2.50E+003
EU-155	Not Detected	---------	2.45E+003
FE-59	Not Detected	---------	1.00E+026
GD-153	Not Detected	---------	2.50E+006
HG-203	Not Detected	---------	2.69E+021
I-131	Not Detected	---------	1.00E+026
IR-192	Not Detected	---------	2.75E+014
K-40	Not Detected	---------	1.44E+003
MN-52	Not Detected	---------	1.00E+026
MN-54	Not Detected	---------	2.24E+005
MO-99	Not Detected	---------	1.00E+026
NA-22	Not Detected	---------	1.65E+003
NA-24	Not Detected	---------	1.00E+026
NB-95	Not Detected	---------	1.00E+026
ND-147	Not Detected	---------	1.00E+026
NI-57	Not Detected	---------	1.00E+026
RU-103	Not Detected	---------	1.00E+026
RU-106	Not Detected	---------	6.81E+005
SB-122	Not Detected	---------	1.00E+026
SB-124	Not Detected	---------	1.37E+017
SB-125	Not Detected	---------	7.75E+003
SN-113	Not Detected	---------	2.05E+010
SR-85	Not Detected	---------	1.56E+016
TA-182	Not Detected	---------	5.31E+010
TA-183	Not Detected	---------	1.00E+026
TC-99m	Not Detected	---------	1.00E+026
TL-201	Not Detected	---------	1.00E+026
XE-133	Not Detected	---------	1.00E+026
Y-88	Not Detected	---------	3.03E+010
ZN-65	Not Detected	---------	3.34E+006
ZR-95	Not Detected	---------	3.48E+016

Sandia National Laboratories
Radiation Protection Sample Diagnostics Program
Quality Assurance Report

Report Date	:	11/24/98 7:38:07 AM
QA File	:	C:\GENIE2K\CAMFILES\LCS4.QAF
Analyst	:	KIC
Sample ID	:	80244502
Sample Quantity	:	1.00 Each
Sample Date	:	11/01/90 12:00:00 PM
Measurement Date	:	11/24/98 7:27:51 AM
Elapsed Live Time	:	600 seconds
Elapsed Real Time	:	606 seconds

Parameter	Mean	1S Error	New Value	< LU : SD : UD : BS >
AM-241 Activity	8.746E-002	1.341E-003	8.573E-002	< : : : >
CS-137 Activity	7.129E-002	1.665E-003	7.254E-002	< : : : >
CO-60 Activity	7.976E-002	1.890E-003	8.019E-002	< : : : >

Flags Key:

LU = Boundary Test	(Ab = Above	, Be = Below)
SD = Sample Driven N-Sigma Test	(In = Investigate,	Ac = Action)
UD = User Driven N-Sigma Test	(In = Investigate,	Ac = Action)
BS = Measurement Bias Test	(In = Investigate,	Ac = Action)

Reviewed by: ________ 11/24/98

Annex 7-C

ANNEX 7-C
Data Validation Results

DATA VALIDATION SUMMARY:

SITE/PROJECT: 94E CASE #: ____

ARCOC #: 601185 601194

LABORATORY: GEL

LABORATORY REPORT #: 9811830

\# OF SAMPLES: 9 MATRIX: soil / water

LAB SAMPLE IDs: 9811830-010

ANALYSIS/ QC ELEMENT	VOC	SVOC	PEST/ PCB	HPLC (HE)	ICP/AES	GFAA/ AA	CVAA (Hg)	CN	RAD	OTHER
1. HOLDING TIMES/ PRESERVATION	✓	✓		✓	✓		✓		✓	
2. CALIBRATIONS	UJ/R	✓		✓	✓		✓		✓	
3. METHOD BLANKS	~~J/UJ~~ mil OK	✓		✓	✓		✓		✓	
4. MS/MSD	✓	✓		✓	✓		✓		✓	
5. LABORATORY CONTROL SAMPLES	✓	UJ		✓	✓		✓		✓	
6. REPLICATES					—		—		✓	
7. SURROGATES	UJ	✓		✓						
8. INTERNAL STDS	UJ	✓								
9. TCL COMPOUND IDENTIFICATION	✓	✓								
10. ICP INTERFERENCE CHECK SAMPLE					✓					
11. ICP SERIAL DILUTION					—					
12. CARRIER/CHEM TRACER RECOVERIES									✓	
13. OTHER QC	✓ n/a	n/a		n/a	n/a					

CHECK MARK (√) – ACCEPTABLE
J – ESTIMATED
U – NOT DETECTED

SHADED CELLS – NOT APPLICABLE
UJ – NOT DETECTED, ESTIMATED
R – UNUSABLE

REVIEWED BY: [signature] DATE: 3/4/99

ORGANICS

SAMPLE FINDINGS SUMMARY

COC: 601185
601194

Sample Number	VOC	chloromethane (74-87-3)	bromomethane (74-83-9)	vinyl chloride (75-01-4)	chloroethane (75-00-3)	methylene chloride (75-09-2)	acetone (67-64-1)	carbon disulfide (75-15-0)	1,1-dichloroethene (75-35-4)	1,1-dichloroethane (75-34-3)	chloroform (67-66-3)	1,2-dichloroethane (107-06-2)	2-butanone (78-93-3)	1,1,1-trichloroethane (71-55-6)	carbon tetrachloride (56-23-5)	dichlorobromomethane (75-27-4)	1,2-dichloropropane (78-87-5)	cis-1,3-dichloropropene (10061-01-5)	trichloroethene (79-01-6)	dibromochloromethane (124-48-1)	1,1,2-trichloroethane (79-00-5)	benzene (71-43-2)	trans-1,3-dichloropropene (10061-02-	bromoform (75-25-2)
CY94E-BH1-5'-SS		UJ	UJ	UJ	UJ	UJ	R	R	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ
CY94E-BH1-6'-SS							R	R																
CY94E-BH1-8.5'-SS						U	R	R																
CY94E-BH1-9'-SS							R	R																
CY94E-TB							R	R																
CY94E-GR-001-SS							R	R																
CY94E-GR-002-SS						U	R	R						UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ
CY94E-GR-003-SS						6.25U	R	R						UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ

ORGANICS

SAMPLE FINDINGS SUMMARY

correct 4/6/99

COC: 601186
601194

Sample Number	SVOC	phenol (108-95-2)	bis(2-chloroehtyl)ether (111-44-4)	2-chlorphenol (95-57-8)	1,3-dichlorobenzene (541-73-1)	1,4-dichlorobenzene (106-46-7)	1,2-dichlorobenzene (95-50-1)	2-methylphenol (95-48-7)	bis(2-chloroisopropyl)ether (108-60-	4-methylphenol (106-44-5)	n-nitroso-di-n-propylamine (621-64-7	hexachloroethane (67-72-1)
CY94E-BH1-5'-SS		UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ
CY94E-BH1-6'-SS		UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ
CY94E-BH1-8.5'-SS		UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ
CY94E-BH1-9'-SS		UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ
CY94E-TB		UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ
CY94E-GR-001-SS		UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ
CY94E-GR-002-SS		UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ
CY94E-GR-003-SS		UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ

4/6/99

MEMORANDUM

corrected 4/6/00 MH

Date: 03/04/99

To: File

From: Marcia Hilchey

Subject: Radiometric Data Review and Validation
Site: 94E
AR/COC: 601186,601194
Case: 7214.2218
Laboratory: GEL
SDG: 9811830

See the attached Data Assessment Summary Forms for supporting documentation on the data review and validation.

Summary

All samples were prepared and analyzed with accepted procedures and specified methods (gross alpha/beta EPA 900.0). All components were successfully analyzed.

No problems were identified with the data package that result in the qualification of data.

Holding Times

The samples were analyzed within the prescribed holding times.

Calibration

Calibration met acceptance criteria.

Laboratory Control Sample Analyses

The LCS met acceptance criteria.

Blanks

No target analytes were detected above the reporting limits in the method blank.

Matrix Spike Analysis

The matrix spike sample met acceptance criteria.

Replicate

The laboratory duplicate met the RER acceptance criteria.

Other QC

No field QC samples were submitted with this data package.

No other specific issues were identified which affect data quality.

Please contact me if you have any questions of comments regarding the review of this package.

Memorandum

Date: 03/04/99

To: File

From: Marcia Hilchey

Subject: Inorganic Data Review and Validation
Site: 94E
AR/COC: 601186,601194
Case: 7214.2218
Laboratory: GEL
SDG: 9811830

corrected 4/6/99
MH

See attached Data Assessment Summary Forms for supporting documentation on the data review and validation.

Summary

All samples were prepared and analyzed with accepted procedures and with specified methods (ICP EPA6010, CVAA EPA7430). All components were successfully analyzed.

No qualifications were applied to data from either method.

Holding Times

The samples were analyzed within the prescribed holding times.

Calibration

Initial and continuing calibration met QC acceptance criteria for both the ICP and CVAA methods.

Blanks

Initial and continuing calibration blanks were free of target analytes above reporting limits in both ICP and CVAA analyses.

The method blank run for the mercury analysis (CVAA) detected no mercury above reporting limits.

Matrix Spike Analysis

The MS/MSD samples for ICP analysis were from a different SDG. The narrative states that the MS/MSD met acceptance criteria.

The CVAA MS/MSD samples met acceptance criteria.

Laboratory Control/Laboratory Control Duplicate Samples

The LCS/LCSD samples met QC acceptance criteria for both methods.

ICP Interference check sample (ICS) Analysis

The ICS met all QC acceptance criteria.

Laboratory Replicate Analysis

No replicate analyses were run with this data package. No data are qualified as a result.

Other QC

No field QC samples were submitted with this data package.

No other specific issues were identified which affect data quality.

Please contact me if you have any questions or comments regarding the review of this package.

3/4/99

Memorandum

Date: 03/04/99

To: File

From: Marcia Hilchey

corrected 4/6/99
MH

Subject: Organic Data Review and Validation
Site: 94E
AR/COC: 601186, 601194
Case: 7214.2218
Laboratory: GEL
SDG: 9811830

See attached Data Assessment Summary Forms for supporting documentation on the data review and validation.

Summary

All samples were prepared and analyzed with accepted procedures and with specified methods (VOC EPA8260, SVOC EPA8270, HE EPA8330). All compounds were successfully analyzed.

Qualifications were applied to VOC sample data due to: blank contamination; continuing calibration acceptance criteria failure; and internal standard and surrogate recovery acceptance criteria failure.

Qualifications were applied to SVOC sample data due to LCS recovery acceptance criteria failure.

No qualifications were applied to HE sample data.

Holding Times

The samples were analyzed within the prescribed holding times.

Calibration

Initial and continuing calibration met acceptance criteria for SVOC and HE.

The continuing calibration RPD for acetone and carbon disulfide were very high (144 and 73, respectively). All sample results for these analytes for the soil VOC analyses were rejected (R-qualified).

Blanks

No target analytes were detected above the reporting limit in the method blanks.

The trip blank (CY94E-TB) contained methylene chloride, resulting in the qualification of sample results for: CY94E-BH1-8.5'-SS, CY94E-GR-002-SS, and CY94E-GR-003-SS.

Surrogates

All surrogate recoveries met acceptance criteria for SVOC and HE analyses.

VOC surrogate #2 (dibromofluoromethane) had low recovery in sample CY94E-BH1-5'-SS. See section below on internal standards for qualification information.

Matrix Spike/Matrix Spike Duplicates (MS/MSD)

MS/MSD sample analysis met acceptance criteria for all organic methods. The MS/MSD samples for the water VOC analysis were run on a different SDG. The case narrative stated that acceptance criteria were met.

Internal Standards

Internal standard recovery criteria were met for the SVOC analyses.

Percent recovery for VOC internal standards #1 (bromochloromethane) and #2 (1,4-difluorobenzene) were slightly low for sample CY94E-BH1-5'-SS. The sample was rerun with similar results, so the first analysis data were reported. The associated analyte data were qualified UJ. Internal standard #2 %R for samples CY94E-GR-002-SS and CY94E-GR-003-SS was slightly low. The samples were rerun with similar results, so the first analysis data were reported. The associated analyte data were qualified UJ.

Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD)

VOC and HE LCS/LCSD samples met all acceptance criteria.

SVOC LCS %R was low for 2-chlorophenol and 1,4-dichlorobenzene. All results from associated analytes were qualified UJ.

Other QC

No field QC samples other than the trip blank were submitted with this data package.

No other specific issues were identified which affect data quality.

Please contact me if you have any questions or comments regarding the review of this package.

3/4/99

HIGH EXPLOSIVES:
SW846 Method 8330

SITE/PROJECT: 94E ARCOC #: 601185, 601194
LABORATORY: GEL LABORATORY REPORT #: 9811830

NAME	CAS #	Intercept	Curve R^2	CCV RPD	Method Blks	LCS	LCSD	LCS RPD	MS	MSD	MS RPD	Field Dup RPD (n/a)	Eq. Blks (n/a)	Field Blks (n/a)		
			.99	20%	U			20%			20%		U	U		
HMX	2691-41-0	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
RDX	121-82-4	✓	✓													
1,3,5-Trinitrobenzene	99-35-4	✓	✓													
1,3-dinitrobenzene	99-64-0	✓	✓													
Nitrobenzene	98-95-3	✓	✓													
Tetryl	479-45-8	✓	✓													
2,4,6-trinitrotoluene	118-96-7	✓	✓													
2-amino-4,6-dinitrotoluene	35572-78-2	✓	✓													
4-amino-2,6-dinitrotoluene	1946-51-0	✓	✓													
2,4-dinitrotoluene	121-14-2	✓	✓													
2,6-dinitrotoluene	606-20-2	✓	✓													
2-nitrotoluene	88-72-2	✓	✓													
4-nitrotoluene	99-99-0	✓	✓													
3-nitrotoluene	99-08-1	✓	✓													
PETN	78-11-5															

Sample	SMC %REC	SMC RT		Sample	SMC %REC	SMC RT
		OK				

Comments:

Confirmation

Sample	CAS #	RPD > 25%		Sample	CAS #	RPD > 25%

REVIEWED BY: [signature] DATE: 3/4/99

INORGANIC METALS:

SITE/PROJECT: 94E ARCOC #: 601185-601194
LABORATORY: GEL LABORATORY REPORT #: 9811850
METHODS: ICP, CVAA

QC Element/ Analyte	ICV	CCV	ICB	CCB	Method Blks	LCS	LCSD	LCSD RPD	MS	MSD	MSD RPD	REP RPD	ICS AB	Serial Dilution	Field Dup RPD	Eq. Blks	Field Blks			
				mg/l					✓	✓	✓	n/a		✓	n/a	n/a	n/a			
7429-90-5 Al																				
7440-39-3 Ba	✓	✓	✓	✓	✓	✓	✓						✓							
7440-41-7 Be	✓	✓	✓	✓	✓	✓	✓	✓					✓							
7440-43-9 Cd	✓	✓	✓	✓	✓	✓	✓	✓					✓							
7440-70-2 Ca																				
7440-47-3 Cr	✓	✓	✓	✓	✓	✓	✓	✓					✓							
7440-48-4 Co																				
7440-50-8 Cu																				
7439-89-6 Fe																				
7439-95-4 Mg																				
7439-96-5 Mn																				
7440-02-0 Ni																				
7440-09-7 K																				
7440-22-4 Ag	✓	✓	✓	✓	✓	✓	✓	✓					✓							
7440-23-5 Na																				
7440-62-2 V																				
7440-66-6 Zn																				
7439-92-1 Pb	✓	✓	✓	✓	✓	✓	✓	✓					✓							
7782-49-2 Se	✓	✓	✓	✓	✓	✓	✓	✓					✓							
7440-38-2 As	✓	✓	✓	✓	✓	✓	✓	✓					✓							
7440-36-0 Sb																				
7440-28-0 Tl																				
7439-97-6 Hg	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓							
Cyanide CN																				

Comments:

REVI[illegible] [signature] DATE: 3/4/99

RADIOCHEMISTRY:

SITE/PROJECT: 94E ARCOC #: 601185, 601194
LABORATORY: GEL LABORATORY REPORT #: 9811830
METHODS: EPA 9000

QC Element/ Analyte	Method Blks	LCS	MS	Rep RER	n/a Eq. Blks	n/a Field Dup RER	n/a Field Blks	-	Sample ID	Isotope	IS/Trace	Sample	Isotope	IS/Trace			
CRITERIA	U	20%	25%	<1.0	U	<1.0	U	-			50-105			50-105			
H3								-									
U-238																	
U-234																	
U-235/236								-									
Th-232																	
Th-228																	
Th-230								-									
Pu-239/240																	
Gross Alpha	✓	✓	✓	✓				-									
Nonvolatile Beta	✓	✓	✓	✓													
Ra226								-									
Ra228								-									
Gamma Spec								-									
Ni-63								-									
								-									
								-									

Parameter	Method	Typical Tracer	Typical Carrier
Iso-U	Alpha spec	U-232	NA
Iso-Pu	Alpha spec	Pu-242	NA
Iso-Th	Alpha spec	Th-229	NA
Am-241	Alpha spec	Am-242	NA
Sr-90	Beta	Y ingrowth	NA
Ni-63	Beta	NA	Ni by ICP
Ra-226	Deamination	NA	NA
Ra-226	Alpha spec	Ba-133 or Ra-225	NA
Ra-228	Gamma spec	Ba-133	NA

Comments:

Gamma spec LCS contains: Am-241, Cs-137, and Co-60

REVIEWED BY: DATE: 3/4/99

VOLATILE ORGANICS:
SW-846 - Method 8260

SITE/PROJECT: 94E ARCOC #: 601185 water
LABORATORY: GEL LABORATORY REPORT #: 9811830

IS	GC/MS		Min RF	Intercept	Calib RF	Calib RSD / R²	CCV RPD	Method Blks	LCS	LCSD	LCS RPD	MS ✓	MSD ✓	MS ~~RPD~~ ✓	Field Dup RPD n/a	Eq. Blks n/a	Trip Blks n/a			
	Name	CAS #			>.05	<20% / 0.99	<20%	✓												
1	Chloromethane	74-87-3	0.10		✓	✓	34.0													
1	Bromomethane	74-83-9	0.10		✓	✓	✓													
1	**vinyl chloride**	75-01-4	0.10		✓	✓														
1	Chloroethane	75-00-3	0.01		✓	✓	33.0													
1	methylene chloride (10xblk)	75-09-2	0.01		✓	✓	✓													
1	**acetone(10xblk)**	67-64-1	0.01		✓	✓														
1	carbon disulfide	75-15-0	0.10		✓	✓														
1	**1,1-dichloroethene**	75-35-4	0.20		✓	✓			✓	✓	✓									
1	**1,1-dichloroethane**	75-34-3	0.10		✓	✓														
1	**Chloroform**	67-66-3	0.20		✓	✓														
1	**1,2-dichloroethane**	107-06-2	0.10		✓	✓														
1	**2-butanone(10xblk)**	78-93-3	0.01		✓	✓														
2	1,1,1-trichloroethane	71-55-6	0.10		✓	✓														
2	**carbon tetrachloride**	56-23-5	0.10		✓	✓														
2	Bromodichloromethane	75-27-4	0.20		✓	✓														
2	**1,2-dichloropropane**	78-87-5	0.01		✓	✓														
2	cis-1,3-dichloropropene	10061-01-5	0.20		✓	✓														
2	**Trichloroethene**	79-01-6	0.30		✓	✓			✓	✓	✓									
2	Dibromochloromethane	124-48-1	0.10		✓	✓														
2	1,1,2-trichloroethane	79-00-5	0.10		✓	✓														
2	**Benzene**	71-43-2	0.50		✓	✓			✓	✓	✓									
2	trans-1,3-dichloropropene	10061-02-6	0.10		✓	✓														
2	Bromoform	75-25-2	0.10		✓	✓														
3	4-methyl-2-pentanone	108-10-1	0.10		✓	✓														
3	2-hexanone	591-78-6	0.01		✓	✓														
3	**Tetrachloroethene**	127-18-4	0.20		✓	✓														
3	1,1,2,2-tetrachloroethane	79-34-5	0.30		✓	✓														
3	toluene(10xblk)	108-88-3	0.40		✓	✓			✓	✓	✓									
3	**Chlorobenzene**	108-90-7	0.50		✓	✓			✓	✓	✓									
3	Ethylbenzene	100-41-4	0.10		✓	✓														
3	Styrene	100-42-5	0.30		✓	✓														
3	xylenes(total)	1330-20-7	0.30		✓	✓														
	1,2-dichloroethylene(total)	540-59-0	0.01		✓	✓														
	~~2-chloroethyl vinyl ether~~	~~110-75-8~~			✓	✓	165.4													

Comments:

REVIEWED BY: [signature] DATE: 3/4/99

VOLATILE ORGANICS: page 2
SW-846 - Method 8260

SITE/PROJECT: 94E ARCOC #: 601185 Water
LABORATORY: GEL LABORATORY REPORT #: 9811830

Surrogate Recovery and Internal Standard Outliers

Sample	SMC 1	SMC 2	SMC 3	IS 1-area	IS 1-RT	IS 2-area	IS 2-RT	IS 3- area	IS 3- RT			
						OK						

SMC 1: 4-Bromofluorobenzene
SMC 2: 1,2-Dichloroethane-d4
SMC 3: Toluene-d8

IS 1: Bromochloromethane
IS 2: 1,4-Difluorobenzene
IS 3: Chlorobenzene-d5

Comments:

REVIEWED BY [signature] DATE: 3/4/99

VOLATILE ORGANICS:
SW-846 - Method 8260

SITE/PROJECT: 94 E/X ARCOC #: 601185, 601194 soils
LABORATORY: GEL LABORATORY REPORT #: 9811830A/B

IS	GC/MS Name	CAS #	Min RF	Intercept	Calib RF >.05	Calib RSD / R² <20% / 0.99	CCV RPD <20%	Method Blks	LCS	LCSD	LCS RPD	MS	MSD	MS RPD	Field Dup RPD (n/a)	Eq. Blks (n/a)	Trip Blks (ug/l)			
1	Chloromethane	74-87-3	0.10		✓	✓	✓	✓	✓	✓	✓	✓								
1	Bromomethane	74-83-9	0.10		✓	✓	✓										ND			
1	**vinyl chloride**	75-01-4	0.10		✓	✓														
1	Chloroethane	75-00-3	0.01		✓	✓	33.3													
1	methylene chloride (10xblk)	75-09-2	0.01		✓	✓	32.4													
1	**acetone(10xblk)**	67-64-1	0.01		✓	✓	144										3.5			
1	carbon disulfide	75-15-0	0.10		✓	✓	-72.8										ND			
1	**1,1-dichloroethene**	75-35-4	0.20		✓	✓														
1	**1,1-dichloroethane**	75-34-3	0.10		✓	✓			✓	✓	✓	✓	✓	✓						
1	**Chloroform**	67-66-3	0.20		✓	✓														
1	**1,2-dichloroethane**	107-06-2	0.10		✓	✓														
1	**2-butanone(10xblk)**	78-93-3	0.01		✓	✓	36.5													
2	1,1,1-trichloroethane	71-55-6	0.10		✓	✓	✓													
2	**carbon tetrachloride**	56-23-5	0.10		✓	✓														
2	Bromodichloromethane	75-27-4	0.20		✓	✓	✓													
2	**1,2-dichloropropane**	78-87-5	0.01		✓	✓	✓													
2	cis-1,3-dichloropropene	10061-01-5	0.20		✓	✓	✓													
2	**Trichloroethene**	79-01-6	0.30		✓	✓	✓		✓	✓	✓	✓	✓	✓						
2	Dibromochloromethane	124-48-1	0.10		✓	✓	✓													
2	1,1,2-trichloroethane	79-00-5	0.10		✓	✓	✓													
2	**Benzene**	71-43-2	0.50		✓	✓	✓		✓	✓	✓	✓	✓	✓						
2	trans-1,3-dichloropropene	10061-02-6	0.10		✓	✓	✓													
2	Bromoform	75-25-2	0.10		✓	✓	✓													
3	4-methyl-2-pentanone	108-10-1	0.10		✓	✓	✓													
3	2-hexanone	591-78-6	0.01		✓	✓	27.7													
3	**Tetrachloroethene**	127-18-4	0.20		✓	✓	✓													
3	1,1,2,2-tetrachloroethane	79-34-5	0.30		✓	✓	✓													
3	toluene(10xblk)	108-88-3	0.40		✓	✓	✓		✓	✓	✓	✓	✓	✓						
3	**Chlorobenzene**	108-90-7	0.50		✓	✓	✓		✓	✓	✓	✓	✓	✓						
3	Ethylbenzene	100-41-4	0.10		✓	✓	✓													
3	Styrene	100-42-5	0.30		✓	✓	✓													
3	xylenes(total)	1330-20-7	0.30		✓	✓	✓													
	1,2-dichloroethylene(total)	540-59-0	0.01		✓	✓	✓													
	2-chloroethyl vinyl ether	110-75-8			✓	✓	36.7													

Comments:

REVIEWED BY: [illegible] DATE: 3/4/99

VOLATILE ORGANICS: page 2
SW-846 - Method 8260

SITE/PROJECT: 94 E ARCOC #: 601185 601194 soils
LABORATORY: GEL LABORATORY REPORT #: 9811830A/B

Surrogate Recovery and Internal Standard Outliers

Sample	SMC 1	SMC 2	SMC 3	IS 1-area	IS 1-RT	IS 2-area	IS 2-RT	IS 3- area	IS 3- RT			
CY94E-GR-002-SS						127570						
CY94E-GR-003-SS						118077						
CY94E-BH1-5'-SS		62.5		271746		113635						

SMC 1: 4-Bromofluorobenzene
SMC 2: ~~1,2-Dichloroethane-d4~~
SMC 3: Toluene-d8

IS 1: Bromochloromethane
IS 2: 1,4-Difluorobenzene
IS 3: Chlorobenzene-d5

Comments: SMC used by lab: dibromofluoromethane

REVIEWED BY [signature] DATE: 3/4/99

SEMI-VOLATILE ORGANICS:
SW-846 - Method 8270

SITE/PROJECT: 94E ARCOC #: 601185, 601194
LABORATORY: GEL LABORATORY REPORT #: 9811830

IS	BNA	CAS #	NAME	Min RF	Intercept	Calib RF	Calib RSD / R^2	CCV RPD	Method Blks	LCS	LCSD n/a	LCS RPD n/a	MS	MSD	MS RPD	Field Dup RPD n/a	Eq. Blks n/a	Field Blks n/a			
						>.05	<20% / 0.99	<20%													
1	A	108-95-2	Phenol	0.80		✓	✓	✓	✓	✓			✓	✓	✓						
1	BN	111-44-4	bis(2-Chloroethyl)ether	0.70																	
1	A	95-57-8	2-Chlorophenol	0.80						46.1			✓	✓	✓						
1	BN	541-73-1	1,3-Dichlorobenzene	0.60																	
1	BN	106-46-7	1,4-Dichlorobenzene	0.50						94.0											
1	BN	95-50-1	1,2-Dichlorobenzene	0.40																	
1	A	95-48-7	2-Methylphenol	0.70																	
1	BN	108-60-1	bis(2-chloroisopropyl)ether	0.01																	
1	A	106-44-5	4-Methylphenol	0.60																	
1	BN	621-64-7	N-Nitroso-di-n-propylamine	0.50						✓			✓	✓	✓						
1	BN	67-72-1	Hexachloroethane	0.30		✓															
2	BN	98-95-3	Nitrobenzene	0.20		✓															
2	BN	78-59-1	Isophorone	0.40		✓															
2	A	88-75-5	2-Nitrophenol	0.10																	
2	A	105-67-9	2,4-Dimethylphenol	0.20																	
2	BN	111-91-1	bis(2-Chloroethoxy)methane	0.30																	
2	A	120-83-2	2,4-Dichlorophenol	0.20																	
2	BN	120-82-1	1,2,4-Trichlorobenzene	0.20						✓			✓	✓	✓						
2	BN	91-20-3	Naphthalene	0.70																	
2	BN	106-47-8	4-Chloroaniline	0.01																	
2	BN	87-68-3	Hexachlorobutadiene	0.01																	
2	A	59-50-7	4-Chloro-3-methylphenol	0.20						✓			✓	✓	✓						
2	BN	91-57-6	2-Methylnaphthalene	0.40																	
3	BN	77-47-4	Hexachlorocyclopentadiene	0.01				25.9													
3	A	88-06-2	2,4,6-Trichlorophenol	0.20				✓													
3	A	95-95-4	2,4,5-Trichlorophenol	0.20				✓													

Comments:

REVIEWED BY: [signature] DATE: 3/4/99

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SW 846 - Method 8270

SITE/PROJECT: 94E ARCOC #: 600185 601194
LABORATORY: GEL LABORATORY REPORT #: 9811830

IS	BNA	CAS #	NAME	Min RF	Intercept	Calib RF	Calib RSD / R²	CCV RPD	Method Blks	LCS	LCSD n/a	LCS RPD n/a	MS	MSD	MS RPD	Field Dup RPD n/a	Eq. Blks n/a	Field Blks n/a			
						>.05	<20% / 0.99	<20%													
3	BN	91-58-7	2-Chloronaphthalene	0.80		✓	✓	✓	✓												
3	BN	88-74-4	2-Nitroaniline	0.01																	
3	BN	131-11-3	Dimethylphthalate	0.01																	
3	BN	208-96-8	Acenaphthylene	0.90						✓											
3	BN	606-20-2	2,6-Dinitrotoluene	0.20																	
3	BN	99-09-2	3-Nitroaniline	0.01				24.6													
3	BN	83-32-9	Acenaphthene	0.90				✓		✓			✓	✓	✓						
3	A	51-28-5	2,4-Dinitrophenol	0.01			40.4	✓													
3	A	100-02-7	4-Nitrophenol	0.01			22.8	24.0		✓			✓	✓	✓						
3	BN	132-64-9	Dibenzofuran	0.80			✓	✓													
3	BN	121-14-2	2,4-Dinitrotoluene	0.20						✓			✓	✓	✓						
3	BN	84-66-2	Diethylphthalate	0.01																	
3	BN	7005-72-3	4-Chlorophenyl-phenylether	0.40																	
3	BN	86-73-7	Fluorene	0.90																	
3	BN	100-01-6	4-Nitroaniline	0.01																	
4	A	534-52-1	4,6-Dinitro-2-methylphenol	0.01																	
4	BN	86-30-6	N-Nitrosodiphenylamine (1)	0.01																	
4	BN	101-55-3	4-Bromophenyl-phenylether	0.10																	
4	BN	118-74-1	Hexachlorobenzene	0.10				25.5													
4	A	87-86-5	Pentachlorophenol	0.05				✓		✓			✓	✓	✓						
4	BN	85-01-8	Phenanthrene	0.70			22.5														
4	BN	120-12-7	Anthracene	0.70			✓														
4	BN	86-74-8	Carbazole	0.01			✓														
4	BN	84-74-2	Di-n-butylphthalate	0.01			27.9														
4	BN	206-44-0	Fluoranthene	0.60																	
5	BN	129-00-0	Pyrene	0.60						✓			✓	✓	✓						
5	BN	85-68-7	Butylbenzylphthalate	0.01																	
5	BN	91-94-1	3,3'-Dichlorobenzidine	0.01																	
5	BN	56-55-3	Benzo(a)anthracene	0.80																	

Comments:

REVIEWED BY: [signature] DATE: 3/4/99

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SW 846 - Method 8270

SITE/PROJECT: 94E ARCOC #: 601185, 601194
LABORATORY: GEL LABORATORY REPORT #: 9811850

IS	BNA	CAS #	NAME	Min RF	Intercept	Calib RF	Calib RSD / R²	CCV RPD	Method Blks	LCS	LCSD	LCS RPD	MS	MSD	MS RPD	Field Dup RPD	Eq. Blks	Field Blks			
											n/a	n/a				n/a	n/a	n/a			
						>.05	<20% / 0.99	<20%													
5	BN	218-01-9	Chrysene	0.70		✓	✓	✓	✓												
5	BN	117-81-7	bis(2-Ethylhexyl)phthalate	0.01																	
6	BN	117-84-0	Di-n-octylphthalate	0.01																	
6	BN	205-99-2	Benzo(b)fluoranthene	0.70																	
6	BN	207-08-9	Benzo(k)fluoranthene	0.70																	
6	BN	50-32-8	Benzo(a)pyrene	0.70																	
6	BN	193-39-5	Indeno(1,2,3-cd)pyrene	0.50																	
6	BN	53-70-3	Dibenz(a,h)anthracene	0.40																	
6	BN	191-24-2	Benzo(g,h,i)perylene	0.50																	

Surrogate Recovery Outliers

Sample	SMC 1	SMC 2	SMC 3	SMC 4	SMC 5	SMC 6	SMC 7	SMC 8
			n/a					

Comments:

SMC 1: Nitrobenzene-d5 (BN)
SMC 2: 2-Fluorobiphenyl (BN)
SMC 3: p-Terphenyl-d14 (BN)
SMC 4: Phenol-d5 (A)
SMC 5: 2-Fluorophenol (A)
SMC 6: 2,4,6-Tribromophenol (A)
SMC 7: 2-2-Chlorophenol-d4 (A)
SMC 8: 1,2-Dichlorobenzene-d4 (BN)

Internal Standard Outliers

Sample	IS 1-area	IS 1-RT	IS 2-area	IS 2-RT	IS 3-area	IS 3-RT	IS 4-area	IS 4-RT	IS 5-area	IS 5-RT	Is 6-area	IS 6-RT
				n/a								

IS 1: 1,4-Dichlorobenzene-d4 (BN)
IS 2: Naphthalene-d8 (BN)
IS 3: Acenaphthene-d10 (BN)
IS 4: Phenathrene-d10 (BN)
IS 5: Chrysene-d12 (BN)
IS 6: Perylene-d12 (BN)

REVI[illegible]D BY: [signature] DATE: 3/4/99

Annex 7-D

ANNEX 7-D
Risk Screening Assessment

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SWMU 94E: RISK SCREENING ASSESSMENT

I. Site Description and History

Solid Waste Management Unit (SWMU) 94E is a subunit of SWMU 94, which was identified as the Lurance Canyon Bum Site (LCBS) on the Resource Conservation and Recovery Act (RCRA) Hazardous and Solid Waste Amendments permit. SWMU 94 is located on U.S. Air Force land withdrawn from the Bureau of Land Management and permitted to the U.S. Department of Energy (DOE) (SNL/NM July 1994a). The site is located on the canyon floor alluvium in the closed upper reaches of the Lurance Canyon drainage. This drainage is surrounded by moderately steep sloping canyon walls and the immediate topographic relief around the site is over 500 feet. A 25- to 50-foot-wide road is cut on the hillsides 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 road into the Lurance Canyon.

The LCBS is currently used for testing fire survivability of transportation containers, weapons components, simulated weapons, and satellite components (Author [unk] Date [unk], Martz November 1985, SNL/NM May 1986). The location of SWMU 94 coincides with SWMU 65 (Lurance Canyon Explosives Test Site) an inactive site used for high explosives (HE) tests and for liquid and solid propellant burn tests. Only a few of the permanent engineered structures present at the site are active today.

In order to facilitate site characterization, SWMU 94 has been subdivided into seven subunits where hazardous constituents could have been released: SWMU 94A (Aboveground Tanks), SWMU 94B (Debris/Soil Mound Area), SWMU 94C (Bomb Burner Area and Discharge line), SWMU 94D (Bomb Burner Discharge Pit), SWMU 94E (Small Surface Impoundment), SWMU 94F (Light Airtransport Accident Resistant Container [LAARC] Discharge Pit), SWMU 94G (Scrap Yard). All of these subunits are inactive except for SWMU 94G (Scrap Yard), and SWMU 94E, which contains both active and inactive tank areas. This no further action (NFA) proposal/risk screening assessment addresses historical releases from SWMU 94E (Small Surface Impoundment). The SWMU 94 subunits are each addressed in separate NFA proposals. SWMUs 94B, 94C, and 94F will be addressed in future NFA submittals.

For a detailed discussion regarding the local setting at SWMU 94E, refer to the "RCRA Facility Investigation [RFI] Work Plan for Operable Unit [OU] 1333, Canyons Test Area" (SNL/NM September 1995).

Historical aerial photographs indicate that the transition of testing activities from predominantly open detonation explosives testing and jet petroleum-4 (JP-4) fuel fires in excavated pits (SWMU 65) to open burning of test units with JP-4 fuel fires in portable pans (SWMU 94) occurred between 1971 and 1982 (SNL/NM August 1994). Based upon test reports and interviews, open burning with JP-4 fuel fires in portable burn pans began by 1975. By 1980, the first permanent engineered burn unit was constructed on the former location of the SWMU 65B (Primary Detonation Area) and was in operation. The scrap yard was established in the northwestern portion of the site within the former location of the SWMU 65E (Far-Field Dispersion Area) **(94-141)**. The scrap yard has historically been used to store spare materials used in explosives and burn tests and is still in use today for storing nonliquid materials and used equipment.

By 1983 most of SWMU 94 was constructed with a total of five permanent engineered burn units (the Large Open Burn Pool, the Small Open Burn Pool, the LAARC Unit, the Bomb Burner Unit, the Small Wind-Shielded (SWISH) unit, and the Conical Containment [CON-CON]) placed on the graded area that was the former location of the SWMU 65B (Primary Detonation Area), and SWMU 65D (Near-Field Dispersion Area) (SNL/NM August 1994). Two of the burn units (the SWISH Unit [and later the Smoke Emissions Reduction Facility (SMERF) Unit]) were constructed to provide testing facilities that would eliminate wind effects and provide accurate temperature control and instrumentation for test monitoring (**94-163**). A small surface impoundment is also visible southeast of Bunker 9830. Engineered soil berms had been constructed by 1983 in the southeastern portion of the site for flood protection from the main arroyo in the Lurance Canyon.

By 1992, the site contained all the current permanent engineered bum units. The CON-CON Unit (Section 5.1.1.3), identified in the 1983 historical aerial photograph, was dismantled prior to 1989, and by 1992 a new bum unit (SMERF) had been constructed in the same location (SNL/NM August 1994). Prior to 1992 a debris/soil mound area was created in the southern portion of SWMU 94, directly north of the main arroyo in the Lurance Canyon. This debris/soil mound may be associated with ongoing grading activities at the site. Located to the northeast of the debris/soil mound area is a soil mound that was created during the remediation of a wastewater spill from the SMERF on March 20, 1992 (Section 5.3.1.3).

Burn testing at the LCBS has always been conducted with JP-4 fuel pool fires in open portable pans or contained within the permanent engineered structures (**94-125**). Pool fires provide the closest simulation of accidents involving flammable liquids (**94-15**). For the tests, the pans are filled with approximately 1 to 2 feet of water, and an average 8-inch layer of JP-4 fuel is placed on the water. A test unit such as a transportation container is placed on a stand above the fuel. The fuel is ignited, and the fire typically burns until the JP-4 fuel is consumed. The length of the test is controlled by the volume (thickness) of the JP-4 fuel layer. After burn tests are completed, test units are retrieved and salvageable materials are collected and stored in the scrap yard located in the northwestern portion of the site. Any test object residue (e.g., metal slag) is recovered with the test unit and removed from the site by the group conducting the tests. It is possible that small residue particulates are left in the water following the burn tests (**94-126**). While no testing is currently conducted on components containing radioactive materials, SWMU 94 is currently classified as an RMMA because of the presence of residual depleted uranium (DU) in the soil from past burn tests (**94-60**) and from former explosives testing activities associated with SWMU 65 (**94-61**).

SWMU 94E (Small Surface Impoundment) (Figures 5-22, 5-28a, and 5-28b) is located approximately 250 feet southeast of Bunker 9830 (SNL/NM August 1994) and east of the camera bunker in the graded area of the LCBS. The site occupies 0.2 acre and lies at a mean elevation of 6,338 feet above sea level (SNL/NM April 1995).

SWMU 94E consists of an open surface depression with no visible surface debris or soil discoloration. SWMU 94E was reportedly used for burn testing and received wastewater from portable pans (Figures 5-22, 5-28a, and 5-28b). Testing in the surface impoundment was stopped in 1980, and the exact number of tests is unknown. This subunit currently receives surface-water runoff from the northwestern portion of the graded area. There is no visible surface debris in SWMU 94E. Standing water may be present in the impoundment following some precipitation events.

II. Data Quality Objectives

The confirmatory sampling conducted at SWMU 94E was designed to collect adequate samples in order 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 risk screening assessments

Table 1 summarizes the sample location design for SWMU 94E. The primary source of constituents of concem (COCs) at SWMU 94E are volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs) from JP-4 fuel-fire test wastewater, residual HE and DU from historic open detonation testing in the vicinity, and possible metals. Potential releases could have occurred as a result of fuel-fire testing in the impoundment and wastewater from small portable burn pan tests. Because the impoundment is not lined, any release would have been directly to the soil. Although fuel-fire testing ceased in the impoundment in 1980, it continued to receive surface runoff from the local area. Radionuclides could also be COCs for SWMU 94E because the site is located within an RMMA and is co-located with SWMU 65E (the far-field dispersion area for explosives tests conducted at the Lurance Canyon Explosives Test Site).

The number and location of the samples collected depended upon historical information regarding the types of testing conducted at the site but more importantly upon the size and configuration of the surface impoundment. A soil vapor survey conducted at the LCBS in February and March 1998 (W. L. Gore & Associates, Inc., May 1998) also provided some preliminary data on the possible nature and extent of fuel-related compounds in the shallow subsurface. To assess the extent of lateral contamination at SWMU 94E, surface samples were collected at each sample location between 0 to 0.5 foot below ground surface (bgs). Similarly, the vertical extent of contamination was determined by collecting subsurface samples from one boring location at the deepest part of the impoundment. Subsurface samples were collected at depth intervals of 5 to 7 feet and 8.5 to 10 feet bgs. The boring was intended to proceed to a depth of 25 feet bgs. However, refusal occurred at 10 feet bgs probably because of shallow bedrock.

Table 1
Summary of Sampling Performed to Meet Data Quality Objectives

SWMU 94E Sampling Areas	Potential COC Source	Number of Sampling Locations	Sample Density	Sampling Location Rationale
Surface samples	Soil contaminated from releases JP-4 fuel-fire test wastewater, small bum pan wastewater, and/or surface runoff from graded area to north	4	4 samples/0.2 acre; 3 locations selected in central area of impoundment; 1 borehole location.	Sample locations based upon areas of the impoundment that would have concentrated potential contaminated material in wastewater or runoff.
Subsurface samples	Soil contaminated from releases JP-4 fuel-fire test wastewater, small bum pan wastewater, and/or surface runoff from graded area to north	1	Seven subsurface samples collected beneath deepest part of impoundment where contaminants would most likely concentrate.	Sample locations based upon areas of the impoundment that would have concentrated potential contaminated material in wastewater or runoff

COC = Constituent of concem.
JP-4 = Jet fuel composition 4.
SWMU = Solid Waste Management Unit.

Table 2 summarizes the analytical methods and data quality requirements necessary (1) to provide adequate characterization of hazardous waste or hazardous constituents associated with fuel-fire test wastewater and portable burn pan test wastewater discharged to the impoundment and (2) to support screening risk assessments.

A total of four locations were sampled at the small surface impoundment. All soil samples were analyzed off site for RCRA metals plus beryllium, HE, SVOCs, and VOCs. The soil samples from the borehole were also analyzed off site for gross alpha and gross beta activity. In addition, one surface and one subsurface sample were analyzed on site for gross alpha/gross beta activity and by gamma spectroscopy. The trip blank was analyzed off site for VOCs only.

All off-site laboratory results were reviewed and verified/validated according to "Data Verification/Validation Level 3—DV-3" in Attachment C of the Technical Operating Procedure 94-03, Rev. 0 (SNL/NM July 1994b). 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). The reviews confirmed that the data are acceptable for use in the NFA proposal for SWMU 94E. The data quality objectives (DQO) for SWMU 94E have been met.

Table 2
Summary of Data Quality Requirements

Analytical Requirement	Data Quality Level	Radiation Protection Sample Diagnostics Laboratory Department 7713 SNL/NM	GEL Laboratories Inc.[b]
VOCs EPA Method 8260[a]	Level 3	NA	5 soil samples 1 trip blank (water)
HE EPA Method 8330[a]	Level 3	NA	5 soil samples
SVOCs EPA Method 8270[a]	Level 3	NA	5 soil samples
RCRA metals EPA Method 6010/700[a]	Level 3	NA	5 soil samples
Gamma spectroscopy EPA Method 901.1[a]	Level 2	3 soil samples	NA
Gross alpha gross beta EPA Method 900.0[a]	Level 3	2 soil samples	2 soil samples

[a]EPA November 1986.
[b]Charleston, South Carolina.
EPA = U.S. Environmental Protection Agency.
HE = High explosive(s).
NA = Not applicable.
RCRA = Resource Conservation and Recovery Act.
SNL/NM = Sandia National Laboratories/New Mexico.
SVOC = Semivolatile organic compound.
VOC = Volatile organic compound.

III. Determination of Nature, Rate, and Extent of Contamination

III.1 Introduction

The determination of the nature, rate, and extent of contamination at SWMU 94E 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, historical operating records, and radiological surveys. The DQOs contained in the work plan for OU 1333 (SNL/NM September 1995) and Field Implementation Plan (FIP) addendum to the work plan (SNL/NM November 1998) 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 94E, which is presented in Section 6.5 of the associated NFA proposal. The quality of the data specifically used to determine the nature, rate, and extent of contamination is described below.

III.2 Nature of Contamination

The nature of contamination at SWMU 94E was determined by soil vapor surveys, analytical testing of soil media, and the potential for degradation of relevant COCs (Section V). The analytical requirements included RCRA metals, HE, VOC, and SVOC analyses. The analytical results were used to characterize potential JP-4, wastewater, or local runoff releases to the site that could have occurred during the operational period of the site (through 1980) or after that period (from 1980 to the present). Gamma spectroscopy and gross alpha/gross beta analyses were also performed to verify that no radioactive contamination remains at the site. These analytes and methods are appropriate to characterize the COCs and potential degradation products associated with the historical activities conducted at SWMU 94E.

III.3 Rate of Contaminant Migration

The small surface impoundment has been inactive since 1980; however, it still receives runoff from the graded area to the north. As a result, all primary sources of COCs (fuel-fire testing and burn pan wastewater) have been eliminated. Currently, only secondary sources of COCs remain at the site in the form of residual metals (uranium-238 and thorium-234 are very close to background levels). The rate of COC migration is dependent predominantly upon site meteorological and surface hydrologic processes as described in Section V. Data available from SNL/NM's 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 Kirtland Air Force Base (i.e., National Oceanographic and Atmospheric Administration) are adequate to characterize the rate of the migration of COCs at SWMU 94E.

III.4 Extent of Contamination

Surface soil samples were collected at three locations from the surface impoundment. A boring was installed to 10 feet (until refusal) and two subsurface samples were collected at another location. These sample locations are deemed appropriate to determine the lateral extent of the migration of COCs.

The surface soil sample density at SWMU 94E was judgmental, based upon the shape and size of the impoundment. In addition, subsurface samples were collected to determine potential impacts on soil from wastewater or surface water that percolated down into the subsurface. The number of samples collected was deemed sufficient to establish the presence of detectable COCs from JP-4 fuel-fire test wastewater, burn pan wastewater, and surface-water runoff from the local area. The sample location density was four per 0.2 acre (including subsurface samples and not including two samples run for radionuclides only), which is consistent with comparable U.S. Environmental Protection Agency (EPA) Remedial Investigation/Feasibility Study (RI/FS) studies (Selman et al. 1994).

Because the primary release mechanism of COCs to SWMU 94E was in the form of discharges to the soil during burn testing and the pooling of wastewater and surface-water runoff in the impoundment, there is potential for vertical migration of contamination. However, the rate of vertical migration of COCs is expected to be limited by the relatively low solubility of most organic and inorganic compounds and by the high evapotranspiration rate for the area. Subsurface samples were collected from one location in the impoundment (the deepest point in the central area) to investigate the vertical extent of contamination. Subsurface soil samples were collected from depth intervals of 5 to 7 feet bgs and 8.5 to 10 feet bgs. Refusal due to bedrock occurred at 10 feet. Therefore, the sample collection depths yielded representative samples of the media potentially affected by site activities and are sufficient to determine the vertical extent of the migration of COCs.

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 SWMU 94E NFA proposal describes the identification of COCs and the sampling that was conducted in order to determine the concentration levels of those COCs across the site. Generally, COCs evaluated in this risk assessment include all detected organics and radiological COCs and all inorganic COCs for which samples were analyzed. If the detection limit of an organic compound was too high (i.e., could possibly cause an adverse effect to human health or the environment), the compound was retained. Nondetect organics 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 used only the maximum concentration value of each COC found for the entire site. The SNL/NM maximum background concentration (Dinwiddie September 1997, Zamorski December 1997) was selected to provide the background screen listed in Tables 3 through 6. 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 were not included in this risk assessment (EPA 1989). Both radiological and nonradiological COCs were evaluated. Nonradiological COCs that were evaluated was limited to inorganics as all VOCs were reported as nondetect.

Table 3 lists nonradiological COCs for the human health risk assessment at SWMU 94E; Table 4 lists nonradiological COCs for the ecological risk assessment. Tables 5 and 6, respectively, list radiological COCs for human health and ecological risk assessment. All tables show the associated SNL/NM maximum background concentration values (Dinwiddie September 1997, Zamorski December 1997). Section VI.4 discusses Tables 3 and 5. Sections VII.2 and VII.3 discuss Tables 4 and 6.

Table 3
Nonradiological COCs for Human Health Risk Assessment at SWMU 94E 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)	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	6.88	9.8	Yes	44[d]	NA	Yes	0.5	No
Barium	610	246	No	170[e]	NA	Yes	6000	No
Beryllium	1.13	0.75	No	19[d]	NA	No	0.2	No
Cadmium	0.327	0.64	Yes	64[d]	NA	Yes	80	Yes
Chromium, total[f]	24.8	18.8	No	16[d]	NA	No	400	Yes
Lead	25.4	18.9	No	49[d]	NA	Yes	--	--
Mercury	0.0445	0.055	Yes	5500[d]	NA	Yes	20	Yes
Selenium	1.21	2.7	Yes	800[g]	NA	Yes	400	Yes
Silver	0.3095[h]	<0.5	Unknown	0.5[d]	NA	No	400	Yes

Note: **Bold** indicates the COCs that failed the background screening and/or the Subpart S screening procedures and/or are bioaccumulators.
[a]From Zamorski (December 1997) Canyon Area Soils.
[b]NMED (March 1998).
[c]IT Corporation (July 1994).
[d]Yanicak (March 1997).
[e]Neumann (1976).
[f]Assumed to be chromium VI for Subpart S screening procedure.
[g]Callahan et al. (1979).
[h]Parameter nondetect, concentration assumed to be 0.5 of detection limit.
BCF = Bioconcentration factor.
COC = Constituent of concern.
K_{ow} = Octanol-water partition coefficient.
Log = Logarithm (base 10).
mg/kg = Milligram(s) per kilogram.
NA = Not applicable.
NMED = New Mexico Environment Department.
SNL/NM = Sandia National Laboratories/New Mexico.
SWMU = Solid Waste Management Unit.
-- = Information not available.

Table 4
Nonradiological COCs for Ecological Risk at SWMU 94E with Comparison to the Associated SNL/NM Background Screening Value, BCF, and Log K_{ow}

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)	Bioaccumulator?[b] (BCF>40, log K_{ow}>4)
Arsenic	6.46	9.8	Yes	44[c]	NA	**Yes**
Barium	230	246	Yes	170[d]	NA	**Yes**
Beryllium	1.13	0.75	**No**	19[c]	NA	No
Cadmium	0.327 J	0.64	Yes	64[c]	NA	**Yes**
Chromium, total	19.9	18.8	**No**	16[c]	NA	No
Lead	25.4	18.9	**No**	49[c]	NA	**Yes**
Mercury	0.0282	0.055	Yes	5500[c]	NA	**Yes**
Selenium	1.12	2.7	Yes	800[e]	NA	**Yes**
Silver	0.3095[f]	<0.5	**Unknown**	0.5[c]	NA	No

Note: **Bold** indicates the COCs that failed the background screening and/or are bioaccumulators.
[a]From Zamorski (December 1997) Canyon Area Soils.
[b]NMED (March 1998).
[c]Yanicak (March 1997).
[d]Neumann (1976).
[e]Callahan et al. (1979).
[f]Parameter nondetect, concentration assumed to be 0.5 of detection limit.

BCF = Bioconcentration factor.
COC = Constituent of concern.
K_{ow} = Octanol-water partition coefficient.
Log = Logarithm (base 10).
mg/kg = Milligram(s) per kilogram.
NA = Not applicable.
NMED = New Mexico Environment Department.
SNL/NM = Sandia National Laboratories/New Mexico.
SWMU = Solid Waste Management Unit.

Table 5
Radiological COCs for Human Health Risk Assessment at SWMU 94E with Comparison to the Associated SNL/NM Background Screening Value and BCF

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 Screening Value?	BCF (maximum aquatic)	Bioaccumulator?[b] (BCF>40)
Cs-137	0.11	0.52	Yes	3000[c]	**Yes**
Th-232	1.16	1.03	**No**	3000[d]	No[e]
U-234	1.96[f]	2.31	Yes	900[d]	**Yes**
U-235	0.21[g]	0.16	**No**	900[d]	**Yes**
U-238	15.7	2.31	**No**	900[d]	**Yes**

Note: **Bold** indicates the COCs that failed the background screening procedure and/or are bioaccumulators.
[a]From Dinwiddie (September 1997), Canyons Background.
[b]NMED (March 1998).
[c]Whicker and Schultz (1982).
[d]Baker and Soldat (1992).
[e]Yanicak (March 1997).
[f]U-234 values were 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 DU-contaminated soils generated during the radiological voluntary corrective measures project where U-234 = U-238/8 (Miller June 1998).
[g]Result was not detected, concentration calculated from U-238 value based upon historical data.

BCF = Bioconcentration factor.
COC = Constituent of concern.
DU = Depleted uranium.
NMED = New Mexico Environment Department.
pCi/g = Picocurie(s) per gram.
SNL/NM = Sandia National Laboratories/New Mexico.
SWMU = Solid Waste Management Unit.

Table 6
Radiological COCs for Ecological Risk Assessment at SWMU 94E with Comparison to the Associated SNL/NM Background Screening Value and BCF

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 Screening Value?	BCF (maximum aquatic)	Bioaccumulator?[b] (BCF>40)
Cs-137	0.11	0.52	Yes	3000[c]	**Yes**
Th-232	1.16	1.03	**No**	3000[d]	No[e]
U-234	1.96[f]	2.31	Yes	900[d]	**Yes**
U-235	0.21[g]	0.16	**No**	900[d]	**Yes**
U-238	15.7	2.31	**No**	900[d]	**Yes**

Note: **Bold** indicates the COCs that failed the background screening procedure and/or are bioaccumulators.
[a]From Dinwiddie (September 1997), Canyons Background.
[b]NMED (March 1998).
[c]Whicker and Schultz (1982).
[d]Baker and Soldat (1992).
[e]Yanicak (March 1997).
[f]U-234 values were 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 DU-contaminated soils generated during the radiological voluntary corrective measures project where U-234 = U-238/8 (Miller June 1998).
[g]Result was not detected, concentration calculated from U-238 value based upon historical data.
BCF = Bioconcentration factor.
COC = Constituent of concern.
DU = Depleted uranium.
NMED = New Mexico Environment Department.
pCi/g = Picocurie(s) per gram.
SNL/NM = Sandia National Laboratories/New Mexico.
SWMU = Solid Waste Management Unit.

V. Fate and Transport

The primary releases of COCs at SWMU 94E were to surface soil. Wind, water, and biota are natural mechanisms of COC transport from the primary release point. Wind can transport surface soil particles from the site, potentially carrying COCs with them. However, because the site is within the Lurance Canyon and surrounded by slopes of the Manzanita Mountains, it is sheltered from strong winds at the ground surface. Therefore, wind is probably not a significant transport mechanism for surface soils.

Water at SWMU 94E is received as precipitation (rain or occasionally snow). Because the site is a depression, it collects some runoff from the graded area to the north during intense rainfall events and could (on very rare occasions) reach capacity and overflow. Infiltration in the depression is enhanced by the coarse texture of the canyon soils (Tesajo-Millett stony sandy loam and rock outcrop [USDA 1977]); therefore, although standing surface water is not permanent, it could last for days after intense rains. If the impoundment were to overflow, surface runoff would flow to the drainage along the south side of the LCBS, which flows west through the canyon and becomes the Arroyo del Coyote in the lower part of the canyon. This runoff from the site could carry very fine soil particles with adsorbed COCs. However, the depression would act as a trap for most sediments suspended in the surface runoff. Therefore, the transport of surface soil particles by runoff is not expected to 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 could be leached deeper into the subsurface soil with this percolation. None of the inorganic COCs at this site have a high potential for leaching into the soil. Based upon observations made during the installation of a piezometer north (upgradient) of SWMU 94E (in the arroyo channel directly above SWMU 12B), the alluvium above the bedrock is 57 feet thick. Moist soil was observed in the first 5 feet of alluvium, and the remaining 52 feet (to bedrock) were dry. The Burn Site Well, along the east side of the site, did not encounter groundwater until 230 feet bgs. The depth to groundwater at SWMU 94E is approximately 222 feet bgs. Infiltration from the surface does not appear to be sufficient to contact groundwater in the area of the LCBS, and it is 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 could be transported to the aboveground tissues with the xylem stream and could then be consumed by herbivores or returned to the soil as litter. Aboveground litter could be transported by wind until it is consumed by decomposer organisms in the soil. Constituents in plant tissues that are consumed by herbivores could pass through the gut and be returned to the soil in feces either at the site or far from the site, or they could be absorbed and held in tissues, metabolized, or later excreted. The herbivore could be eaten by a primary carnivore or scavenger and any constituents still held in the consumed tissues would 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. Much of SWMU 94E has been highly disturbed by testing activity and by associated construction of roads and buildings. Some ruderal vegetation occurs within the depression and around the outer margin of the site. Therefore, food chain uptake is a potential transport mechanism at SWMU 94E.

Table 7 summarizes the fate and transport processes that could occur at SWMU 94E. Because the site is situated within the Lurance Canyon and is, therefore, sheltered by surrounding slopes and on-site vegetation, significant transport of COCs by wind is unlikely. Transport by surface-water runoff is also of low significance because the depression acts as an impoundment for surface runoff and as a sediment trap. Subsurface migration of COCs from leaching is not expected to be significant and is highly unlikely to contact groundwater. The potential for food chain uptake is present, but because the site is very small (0.2 acre) and is within an actively used facility, the biota of the site represent a minor transport mechanism for COCs. All COCs at SWMU 94E are inorganic and elemental in form. Therefore, they are not considered to be degradable. Radiological COCs, however, undergo decay to stable isotopes or radioactive daughter elements. Decay of radiological COCs is insignificant because of their long half lives.

Table 7
Summary of Fate and Transport at SWMU 94E

Transport and Fate Mechanism	Existence at Site	Significance
Wind	Yes	Low
Surface runoff	Yes	Low
Migration to groundwater	No	None
Food chain uptake	Yes	Low
Transformation/degradation	Yes	Low

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 were 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 EPA and the DOE to determine whether further evaluation, and potential site cleanup, is required. Nonradiological COC risk values are also compared to background risk so that an incremental risk can be calculated.
Step 7.	Uncertainties of the above steps are addressed.

VI.2 Step 1. Site Data

Section I provides the description and history for SWMU 94E. 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 94E 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 the potential exists to inhale dust. Soil ingestion is included for the radiological COCs as well. No water pathways to the groundwater are considered. Depth to groundwater at SWMU 94E 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 and the two screening procedures. The first screening procedure compared the maximum COC concentration to the background screening level. The second screening procedure compared maximum COC concentrations to SNL/NM proposed Subpart S action levels. This second procedure was applied only to COCs that were not eliminated during the first screening procedure.

VI.4.1 Background Screening Procedure

VI.4.1.1 Methodology

Maximum concentrations of nonradiological COCs were compared to the approved SNL/NM maximum screening level for this area. The SNL/NM maximum background concentration was selected to provide the background screen in Table 3 and was used to calculate risk attributable to background in Table 11. Only the COCs that were detected above their respective SNL/NM maximum background screening levels or did not have a quantifiable background screening level were considered in further risk assessment analyses.

For radiological COCs that exceeded the SNL/NM background screening levels, background values were subtracted from the individual maximum radionuclide concentrations. Those that did not exceed these background levels were not carried any 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 5 present SWMU 94E maximum COC concentrations that were compared to the SNL/NM maximum background values (Dinwiddie September 1997, Zamorski December 1997) for the human health risk assessment. For the nonradiological COCs, four constituents were measured at concentrations greater than their respective background. One nonradiological COC had no quantifiable background concentration, so it is not known whether that COC exceeded background.

The maximum concentration value for lead is 25.4 milligrams (mg) per kilogram (/kg). The EPA intentionally does not provide any human health toxicological data on lead; therefore, no risk parameter values could be calculated. However, EPA Region 6 guidance for the screening value for lead for the industrial land-use scenario is 2,000 mg/kg (EPA 1996a); for the 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; therefore, lead is eliminated from further consideration in the human health risk assessment.

For the radiological COCs, three constituents were detected at maximum measured activity concentrations greater than their respective backgrounds (uranium-238, uranium-235, and thorium-232).

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 1990) and Risk Assessment Guidance for Superfund (RAGS) (EPA 1989) documentation. 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 and near surface, this assumption was considered valid. If there were ten or fewer COCs and each had a maximum concentration of less than 1/10 the action level, then the site was judged to pose no significant health hazard to humans. If there were more than ten COCs, then 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 the proposed Subpart S action level. This methodology was guidance given to SNL/NM from the EPA (EPA 1996b). Two COCs that failed the background screen (barium and beryllium) are above 1/10 the Subpart S action level. Therefore, all constituents with maximum concentrations above background were carried forward in the risk assessment process, and a hazard quotient (HQ) and excess cancer risk value were calculated.

Radiological COCs have no predetermined action levels analogous to proposed Subpart S levels; therefore, this step in the screening process was not performed for radiological COCs.

VI.5 Step 4. Identification of Toxicological Parameters

Tables 8 (nonradiological) and 9 (radiological) list the COCs retained in the risk assessment and the values for the available toxicological information. The toxicological values used for nonradiological COCs in Table 8 were from the Integrated Risk Information System (IRIS) (EPA 1998a), and from the Region 9 (EPA 1996c) and Region 3 (EPA 1997b) 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).

based upon information from the 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* (Yu et al. 1993a).

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 10 shows an HI of 0.00 for the SWMU 94E nonradiological COCs and an excess cancer risk of 4E-9 for the designated recreational land-use scenario. The numbers presented included exposure from soil ingestion and dust inhalation for nonradiological COCs. Table 11 shows an HI of 0.00 and an excess cancer risk of 2E-11 assuming the maximum background concentrations of the SWMU 94E associated background constituents for the designated recreational land-use scenario.

For the radiological COCs, contribution from the direct gamma exposure pathway is included. For the recreational land-use scenario, a TEDE was calculated for an individual who spends 4 hours per week on the site. This resulted in an incremental TEDE of 8.4E-02 millirems (mrem)/year (yr). In accordance with EPA guidance found in Office of Solid Waste and Emergency Response Directive No. 9200.4-18 (EPA 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 94E for the recreational land use is well below this guideline. The estimated excess cancer risk is 1.3E-06.

For the residential land-use scenario nonradioactive COCs, the HI is 0.1, and the excess cancer risk is 9E-8 (Table 10). The numbers in the table included exposure from soil ingestion, dust inhalation, and plant uptake. Although the EPA (1991) generally recommends that inhalation not be included in a residential land-use scenario, this pathway is included because 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 11 shows that for the SWMU 94E associated background constituents, the HI is 0.05 and the excess cancer risk is 6E-10.

For the radiological COCs, the incremental TEDE for the residential land-use scenario is 1.6E+0 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 94E for the residential land-use scenario is well below this guideline. Consequently, SWMU 94E is eligible for unrestricted radiological release because the residential land-use scenario resulted in an incremental TEDE of less than 75 mrem/yr to the on-site receptor. The estimated excess cancer risk is 2.1E-05. The excess cancer risk

Table 10
Risk Assessment Values for SWMU 94E Nonradiological COCs

COC Name	Maximum Concentration (mg/kg)	Recreational Land-Use Scenario[a]		Residential Land-Use Scenario[a]	
		Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Barium	610	0.00	--	0.09	--
Beryllium	1.13	0.00	3E-11	0.00	8E-10
Chromium,total[b]	24.8	0.00	4E-9	0.02	9E-8
Silver	0.3095[c]	0.00	--	0.01	--
Total		**0.00**	**4E-9**	**0.1**	**9E-8**

[a]From EPA (1989).
[b]Total chromium assumed to be chromium VI (most conservative).
[c]Parameter nondetect, concentration assumed to be 0.5 of detection limit.
COC = Constituent of concem.
EPA = U.S. Environmental Protection Agency.
mg/kg = Milligram(s) per kilogram.
SWMU = Solid Waste Management Unit.
-- = Information not available.

Table 11
Risk Assessment Values for SWMU 94E 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
Barium	246	0.00	--	0.04	--
Beryllium	0.75	0.00	2E-11	0.00	6E-10
Chromium, total[c]	18.8	0.00	--	0.01	--
Silver	<0.5	--	--	--	--
Total		**0.00**	**2E-11**	**0.05**	**6E-10**

[a]From Zamorski (December 1997), Canyons Area.
[b]From EPA (1989).
[c]Total chromium assumed to be chromium III (most conservative).
COC = Constituents of concern.
EPA = U.S. Environmental Protection Agency.
mg/kg = Milligram(s) per kilogram.
SWMU = Solid Waste Management Unit.
-- = Information not available.

Table 8
Toxicological Parameter Values for SWMU 94E Nonradiological COCs

COC Name	RfD_o (mg/kg-d)	Confidence[a]	RfD_{inh} (mg/kg-d)	Confidence[a]	SF_o $(mg/kg\text{-}day)^{-1}$	SF_{inh} $(mg/kg\text{-}day)^{-1}$	Cancer Class[b]
Barium	7E-2[c]	M	1.4E-4[d]	--	--	--	--
Beryllium	2E-3[c]	L to M	5.7E-6[c]	M	--	8.4E+0[c]	B1
Chromium III	1E+0[c]	L	5.7E-7[e]	--	--	--	--
Chromium VI	5E-3[c]	L	--	--	--	4.2E+1[c]	A
Silver	5E-3[c]	L	--	--	--	--	D

[a]Confidence associated with IRIS (EPA 1998a) database values. Confidence—L = low, M = medium.
[b]EPA weight-of-evidence classification system for carcinogenicity (EPA 1989) taken from IRIS (EPA 1998a):
- A = Human carcinogen.
- B1 = Probable human carcinogen. Limited human data 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 electronic database (EPA 1996c)
[e]Toxicological parameter values from EPA Region 3 electronic database (EPA 1997c)

COC = Constituent of concern.
EPA = U.S. Environmental Protection Agency.
IRIS = Integrated Risk Information System.
mg/kg-day = Milligram(s) per kilogram day.
$(mg/kg\text{-}day)^{-1}$ = Per milligram per kilogram day.
RfD_{inh} = Inhalation chronic reference dose.
RfD_o = Oral chronic reference dose.
SF_{inh} = Inhalation slope factor.
SF_o = Oral slope factor.
SWMU = Solid Waste Management Unit.
-- = Information not available.

Table 9
Radiological Toxicological Parameter Values for SWMU 94E 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]
U-235	4.70E-11	1.30E-08	2.70E-07	A
U-238	6.20E-11	1.20E-08	6.60E-08	A
Th-232	3.30E-11	1.90E-08	2.00E-11	A

[a]From Yu et al. (1993a).
[b]EPA weight-of-evidence classification system for carcinogenicity (EPA 1989): A—human carcinogen.
1/pCi = One per picocurie.
COC = Constituent of concern.
EPA = U.S. Environmental Protection Agency.
g/pCi-yr = Gram(s) per picocurie-year.
SF_{ev} = External volume exposure slope factor.
SF_{inh} = Inhalation slope factor.
SF_o = Oral (ingestion) slope factor.
SWMU = Solid Waste Management Unit.

- 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" (Kocher 1983) and in 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 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 the RAGS (EPA 1989). Parameters are

VI.9 Summary

SWMU 94E 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 radionuclides. Plant uptake was included as an exposure pathway for the residential land-use scenario.

Using conservative assumptions and an RME approach to risk assessment, calculations for nonradiological COCs show that for the recreational land-use scenario the HI (0.00) is significantly less than the accepted numerical guidance from the EPA. Excess cancer risk (4E-9) is also below the acceptable risk value provided by the NMED for a recreational land use scenario (NMED March 1998). The incremental HI is 0.00, and the incremental cancer risk is 4.01E-9 for the recreational land-use scenario. Incremental risk calculations indicate insignificant risk to human health for the recreational land-use scenario.

Incremental TEDE and corresponding estimated cancer risk from radiological COCs are much less than EPA guidance values; the estimated TEDE is 8.4E-02 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 1997c). The corresponding incremental estimated cancer risk value is 1.3E-06 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 1.6E+0 mrem/yr with an associated risk of 2.1E-05. The guideline for this scenario is 75 mrem/yr (SNL/NM February 1998). Therefore, SWMU 94E is eligible for unrestricted radiological release.

Uncertainties associated with the calculations are considered small relative to the conservativeness of risk assessment analysis. It is, therefore, concluded that this site poses insignificant risk to human health under the 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 94E. A component of the NMED Risk-Based Decision Tree (March 1998) is to conduct an ecological screening assessment that corresponds with that presented in EPA's Ecological Risk Assessment Guidance for Superfund (EPA 1997d). The current methodology is tiered and contains an initial scoping assessment followed by a more detailed screening assessment. Initial components of the NMED's decision tree (a discussion of DQOs, a data assessment, and evaluations of bioaccumulation and fate-and-transport potential) are addressed in previous sections of 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

Among the COPECs listed in Section IV (Tables 4 and 6), the following inorganic constituents within the 0- to 5-foot depth interval exceeded background concentrations:

- Beryllium
- Chromium (total)
- Lead
- Thorium-232
- Uranium-235
- Uranium-238

Silver does not have a quantifiable background concentration. Thus, it is unknown if the maximum silver concentration exceeded the background screening level. Therefore, silver is included in the risk analysis for conservatism. No organic analytes were detected in the soil at this site.

VII.2.2 Bioaccumulation

Among the COPECs listed in Section VII.1.1, the following were considered to have bioaccumulation potential in aquatic environments (Section IV, Tables 3 and 4):

- Lead
- Uranium-235
- Uranium-238

It should be noted, however, that as directed by the NMED (March 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.

from the nonradiological COCs and the radiological COCs is not additive, as noted in the 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 the recreational land-use scenario (the designated land-use scenario for this site) and the residential land-use scenario.

For the recreational land-use scenario nonradiological COCs, the HI is 0.00 (less than the numerical guideline of 1 suggested in the RAGS [EPA 1989]). Excess cancer risk is estimated at 4E-9. Guidance from the New Mexico Environment Department (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 total chromium. Total chromium is conservatively assumed to be chromium VI which is a Class A carcinogen. Thus, the excess cancer risk for this site is below the suggested acceptable risk value (1E-6). This assessment also determined risks considering background concentrations of the potential nonradiological COCs for both the recreational and residential land-use scenarios. Assuming the recreational land-use scenario for nonradiological COCs, the HI is 0.00 and the excess cancer risk is 2E-11. Incremental risk is determined by 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. For conservatism, the background constituent that does not have a quantified background concentration (silver) is assumed to have an HQ of 0.00. Incremental HI is 0.00 and incremental cancer risk is 4.01E-9 for the recreational land-use scenario. These incremental risk calculations indicate insignificant risk to human health from nonradiological COCs considering a recreational land-use scenario.

For radiological COCs in the recreational land-use scenario, incremental TEDE is 8.4E-02 mrem/yr, which is significantly less than the EPA's numerical guideline of 15 mrem/yr. Incremental estimated excess cancer risk is 1.3E-06.

The calculated HI for the residential land-use scenario nonradiological COCs is 0.1, which is below the numerical guidance. Excess cancer risk is estimated at 9E-8. Excess cancer risk is driven by total chromium. Total chromium is conservatively assumed to be chromium VI which is a Class A carcinogen. Therefore, the excess cancer risk for this site is below the suggested acceptable risk value (1E-6). The HI for associated background for the residential land-use scenario is 0.05; the excess cancer risk is estimated at 6E-10. The incremental HI is 0.07 and the incremental cancer risk is 9.02E-8 for the residential land-use scenario. These incremental risk calculations indicate insignificant contribution to human health risk from the COCs considering the residential land-use scenario.

The incremental TEDE for the residential land-use scenario from the radiological components is 1.6E+0 mrem/yr, which is significantly less than the numerical guideline of 75 mrem/yr suggested in the SNL/NM RESRAD Input Parameter Assumptions and Justification (SNL/NM February 1998). The estimated excess cancer risk is 2.1E-05.

VI.8 Step 7. Uncertainty Discussion

The determination of the nature, rate, and extent of contamination at SWMU 94E 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) and the FIP addendum to the work plan (SNL/NM November 1998), with the exception of the collection of two soil sample duplicates and an equipment blank. The DQOs contained in the RFI work plan and the FIP addendum 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 was validated in accordance with SNL/NM procedures (SNL/NM July 1994b). Therefore, any uncertainty associated with the data quality used to perform the screening risk assessment at SWMU 94E is small and should not adversely affect the screening risk assessment.

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 performing 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 the parameter values in the calculations are conservative and that calculated intakes are probably overestimates. Maximum measured values of COC concentrations are used to provide conservative results.

Table 8 shows the uncertainties (confidence) in nonradiological toxicological parameter values. There is a mixture of estimated values and values from the IRIS (EPA 1998a), EPA Region 9 (EPA 1996c) and EPA Region 3 (EPA 1997b) electronic databases. Where values are not provided, information is not available from the HEAST (EPA 1997a), the IRIS (EPA 1998a), or the EPA regions (EPA 1996c, 1997b). Because of the conservative nature of the RME approach, uncertainties in toxicological values are not expected 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 recreational 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.

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 7 (Section V), wind, surface water, and food chain uptake are expected to be of low significance as transport mechanisms for COPECs at this site. Migration to groundwater is not anticipated. Degradation/transformation for the inorganic COPECs (including the radionuclides) is expected to be of low significance.

VII.2.4 Scoping Risk Management Decision

Based upon information gathered through the scoping assessment, it was concluded that complete ecological pathways could 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.1.4, 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 that ecological risks are not underpredicted.

Components within the screening assessment include the following:

- 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 Environmental Restoration [ER] Program" (IT July 1998) and are not duplicated here.

VII.3.1.1 Ecological Pathways and Setting

SWMU 94E is approximately 0.2 acre in size. The site, located in Lurance Canyon, is dominated by woodland habitat; however, the habitat at this site has been highly disturbed during its active use and during other activities conducted at the LCBS. The site does contain ruderal vegetation and wildlife could occasionally use the area. However, because it is a very small site within an actively used facility and is surrounded by graded roadways and open ground, wildlife use is not expected to be significant, and therefore, transfers of COPECs through the food chain pathway are also not expected to be significant. Biological and sensitive species surveys of the entire LCBS were conducted in 1991 (Biggs May 1991, August 1991). No sensitive species were reported to occur at this facility.

Complete ecological pathways could 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 and external radiation. Because surface water at this site is temporary and the potential for partitioning of the COPECs from soil to water are generally low, 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

In order to provide conservatism in this ecological risk assessment, the assessment is based upon the maximum soil concentrations of the COPECs measured at this site. Tables 4 and 6 reported maximum COPEC concentrations. Both radiological and nonradiological COPECs were evaluated for this assessment. The nonradiological COPECs potentially included both inorganic and organic analytes. Although any organic analyte detected would have been considered a COPEC, none was detected at the site. Inorganic analytes and radionuclides were screened against background concentrations, and those that exceeded the approved SNL/NM background screening levels (Dinwiddie September 1997) for the area were considered to be COPECs. Nonradiological inorganics 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

In an earlier report (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. The deer mouse (*Peromyscus maniculatus*) and the 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. The burrowing owl was selected to represent a top predator at this site. Although burrowing owls are not expected to occur in the woodland habitat at SWMU 94E, it is used to conservatively represent exposure and risk to other small predatory birds such as the western screech owl (*Otus kennicottii*) that could inhabit this site. The burrowing owl is present 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).

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 surface water is very temporary 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). Exposure in the burrowing owl from a diet of equal parts herbivorous, omnivorous, and insectivorous mice would be the same as exposure from a diet of only omnivorous mice. Therefore, its diet was modeled with intake entirely of omnivorous mice. Both species were modeled with soil ingestion comprising 2 percent of the total dietary intake. Table 12 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).

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. The maximum measured COPEC concentrations from surface soil samples were used to provide a conservative estimate of 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 thorium-232 and uranium-238. Internal and external dose rates to the deer mouse and the 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).

Table 12
Exposure Factors for Ecological Receptors at SWMU 94E

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.

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 from exposure to each of the radionuclides, and these are summed to calculate the total dose to the receptor.

Table 13 presents the transfer factors used in modeling the concentrations of COPECs through the food chain. Table 14 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

Table 15 presents benchmark toxicity values for the plant and wildlife receptors. For plants, the benchmark soil concentration is 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 beryllium and silver for the burrowing owl.

The benchmark used for exposure of terrestrial receptors to radiation was 0.1 rad per day (rad/day). This value has been recommended by the International Atomic Energy Agency (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/day should also offer sufficient protection to other components within the terrestrial habitat of SWMU 94E.

VII.3.4 Risk Characterization

Maximum concentrations in soil and estimated dietary exposures were compared to plant and wildlife benchmark values, respectively. Table 16 presents results of these comparisons. HQs are used to quantify the comparison with benchmarks for plants and wildlife exposure.

Chromium was the only analyte with an HQ exceeding unity (for plants). 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). Only plants had an HI greater than unity (HI = 21), with chromium accounting for over 95 percent of this sum.

Table 13
Transfer Factors Used in Exposure Models for Constituents of Potential Ecological Concern at SWMU 94E

Constituent of Potential Ecological Concern	Soil-to-Plant Transfer Factor	Soil-to-Invertebrate Transfer Factor	Food-to-Muscle Transfer Factor
Beryllium	1.0E-2[a]	1.0E+0[b]	1.0E-3[a]
Chromium (total)	4.0E-2[c]	1.3E-1[d]	3.0E-2[c]
Lead	9.0E-2[c]	4.0E-2[e]	8.0E-4[c]
Silver	1.0E+0[c]	2.5E-1[e]	5.0E-3[c]

[a]From Baes et al. (1984).
[b]Default value.
[c]From NCRP (January 1989).
[d]From IAEA (1994).
[e]From Stafford et al. (1991).
IAEA = International Atomic Energy Agency.
NCRP = National Council for Radiation Protection and Measurements.
SWMU = Solid Waste Management Unit.

Table 14
Media Concentrations[a] for Constituents of Potential Ecological Concern at SWMU 94E

Constituent of Potential Ecological Concern	Soil (maximum)[a]	Plant Foliage[b]	Soil Invertebrate[b]	Deer Mouse Tissues[c]
Beryllium	1.1E+0	1.1E-2	1.1E+0	1.9E-3
Chromium (total)	2.0E+1	8.0E-1	2.6E+0	2.0E-1
Lead	2.5E+1	2.3E+0	1.0E+0	5.4E-3
Silver	3.1E-1	3.1E-1	7.7E-2	3.1E-3

[a]In milligram(s) 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 (EPA 1993).
SWMU = Solid Waste Management Unit.

Table 15
Toxicity Benchmarks for Ecological Receptors at SWMU 94E

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]
Beryllium	10	Rat	0.66	1.29	---	---	---
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
Silver	2	Rat	17.8[h]	34.8	---	---	---

[a] In milligrams per kilogram soil.
[b] From Efroymson et al. (1997).
[c] Laboratory rat body weight for the no-observed-adverse-effect level (NOAEL) conversion is 0.350 kilograms.
[d] From Sample et al. (1996), except where noted.
[e] In milligram(s) 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] Based upon a rat lowest-observed-adverse-effect-level of 89 mg/kg/d (EPA 1998a) and an uncertainty factor of 0.2.
SWMU = Solid Waste Management Unit.
--- = Insufficient toxicity data.

Table 16
Hazard Quotients for Ecological Receptors at SWMU 94E

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]
Beryllium	1.1E-1	4.1E-3	7.2E-2	1.4E-1	---
Chromium (total)	**2.0E+1**	3.5E-5	6.1E-5	8.7E-5	6.6E-2
Lead	5.1E-1	2.8E-2	2.2E-2	1.5E-2	1.5E-2
Silver	1.6E-1	1.4E-3	8.9E-4	3.7E-4	---
HI[b]	**2.1E+1**	3.3E-2	9.4E-2	1.6E-1	8.1E-2

[a]**Bold** text indicates HQ or HI exceeds unity.
[b]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.
--- = Insufficient toxicity data available for risk estimation purposes.

Tables 17 and 18 summarize the internal and external dose rate model results for thorium-232, uranium-235, and uranium-238. The total radiation dose rate to the deer mouse was predicted to be 4.1E-4 rad/day. Total dose rate to the burrowing owl was predicted to be 3.2E-4 rad/day. In both cases, the external dose rate accounted for most of the total. 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 94E. These uncertainties result from assumptions used in calculating risk that could 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 provide more protection to 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 or home range size. 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).

Uncertainties associated with the estimation of risk to ecological receptors following exposure to thorium-232, uranium-235, and uranium-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.

In the estimation of ecological risk, background concentrations are included as a component of maximum on-site concentrations. For several inorganic COPECs, conservatisms in the modeling of exposure and risk result in the prediction of risk to ecological receptors when exposed at background concentrations. As shown in Table 19, HQs associated with exposures to background are greater than 1.0 for chromium. Background could account for as much as 94 percent of the HQs for chromium at this site. Furthermore, the HQ for chromium is based upon the maximum measured soil concentration. The mean concentration (15.1 mg/kg) is below the background screening value. Therefore, it is unlikely that chromium (with exposure concentrations largely attributable to background) presents significant ecological risk to plants.

Based upon this uncertainty analysis, ecological risks at SWMU 94E are expected to be very low. One HQ greater than unity was initially predicted; however, closer examination of the exposure assumptions revealed an overestimation of risk primarily attributed to conservative exposure concentration and background risk.

Table 17
Internal and External Dose Rates for Deer Mice Exposed to Radionuclides at SWMU 94E

Radionuclide	Maximum Concentration (pCi/g)	Internal Dose (rad/day)	External Dose (rad/day)	Total Dose (rad/day)
Th-232	1.2E+0	4.6E-7	2.2E-4	2.2E-4
U-235[a]+D	2.1E-1	2.2E-6	3.4E-6	5.6E-6
U-238+D	1.6E+1	1.6E-4	3.2E-5	1.9E-4
Total	-	1.6E-4	2.5E-4	4.1E-4

[a]U-235 was estimated as 1/80 of U-238.
D = Daughters.
pCi/g = Picocurie(s) per gram.
rad/day = Rad per day.
SWMU = Solid Waste Management Unit.
\- = Not applicable.

Table 18
Internal and External Dose Rates for Burrowing Owls Exposed to Radionuclides at SWMU 94E

Radionuclide	Maximum Concentration (pCi/g)	Internal Dose (rad/day)	External Dose (rad/day)	Total Dose (rad/day)
Th-232	1.2E+0	6.8E-7	2.2E-4	2.2E-4
U-235[a]+D	2.1E-1	8.4E-7	3.4E-6	4.3E-6
U-238+D	1.6E+1	6.4E-5	3.2E-5	9.6E-5
Total	-	6.0E-5	2.5E-4	3.2E-4

[a]U-235 was estimated as 1/80 of U-238.
D = Daughters.
pCi/g = Picocurie(s) per gram.
rad/day = Rad per day.
SWMU = Solid Waste Management Unit.
\- = Not applicable.

Table 19
HQs for Ecological Receptors Exposed to Background Concentrations for SWMU 94E

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					
Beryllium	7.5E-2	2.7E-3	4.8E-2	9.2E-2	---
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
Silver	1.3E-1	1.1E-3	7.2E-4	3.0E-4	---
HI[c]	**2.0E+1**	2.5E-2	6.4E-2	1.0E-1	7.4E-2

[a]**Bold** text indicates HQ or HI exceeds unity.
[b]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.
--- = Insufficient toxicity data available for risk estimation purposes.

VII.3.6 Risk Interpretation

Ecological risks associated with SWMU 94E were estimated through a screening assessment that incorporated site-specific information when available. Overall, risks to ecological receptors are expected to be low because the predicted risk to plants associated with exposure to chromium is based upon calculations using the maximum detected value. The average chromium concentration at the site was within the range of background concentrations. All other COPEC concentrations were below the plant screening benchmarks and no risks were predicted for wildlife receptors. Based upon this final analysis, ecological risks associated with SWMU 94E 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 to whether the site should be recommended for NFA or whether additional data should be collected to provide more thorough assessment of actual ecological risk at the site. With respect to this site, ecological risks were predicted to be 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

Introduction

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), excess cancer 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 airbome 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 1E-6 for Class A and B carcinogens and 1E-5 for Class C carcinogens. 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.

Table 2
Default Parameter Values for Various Land-Use Scenarios

Parameter	Industrial	Recreational	Residential
General Exposure Parameters			
Exposure frequency (day/yr)	***	***	***
Exposure duration (yr)	25[a,b]	30[a,b]	30[a,b]
Body weight (kg)	70[a,b]	70 adult[a,b] 15 child	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] 9125	25550[a] 10950	25550[a] 10950
Soil Ingestion Pathway			
Ingestion rate	100 mg/day[c]	200 mg/day child 100 mg/day adult	200 mg/day child 100 mg/day adult
Inhalation Pathway			
Inhalation rate (m^3/yr)	5000[a,b]	260[d]	7000[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.

[e]Dermal Exposure Assessment (EPA 1992).

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