

Sandia National Laboratories/New Mexico

**PROPOSALS FOR NO FURTHER ACTION
ENVIRONMENTAL RESTORATION PROJECT
SWMUs 98, 82, 60, 81A, 81B, 81D, 81E,
81F, 9, AND 117**

September 2000

Environmental
Restoration
Project



United States Department of Energy
Albuquerque Operations Office

EXECUTIVE SUMMARY

Sandia National Laboratories/New Mexico (SNL/NM) is proposing a risk-based no further action (NFA) decision for Solid Waste Management Units (SWMUs) 98, 82, 60, 81A, 81B, 81D, 81E, 81F, 9, and 117. These SWMUs are proposed for an NFA decision based upon baseline and confirmatory sampling data demonstrating that constituents of concern (COCs) that could have been released from the SWMUs into the environment pose an acceptable level of risk under current and projected future land use, as set forth by the 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 land use" (NMED March 1998). This executive summary briefly describes each SWMU and the basis for the NFA proposal.

- SWMU 98 (Building 863 TCA [trichloroethane] and Photochemical Release in Operable Unit [OU] 1302) was constructed in 1950 and in 1951 became the motion picture production and film processing division for SNL/NM. The site was listed as a SWMU because of silver recovery processes and for releases of TCA from a film-cleaning machine. SWMU 98 was characterized through a series of four investigations: 1) a Comprehensive Environmental Assessment and Response Program (CEARP) (1987), 2) an Environmental Restoration (ER) Preliminary Investigation in 1993, 3) a RCRA Facility Investigation (RFI) in 1995, and 4) an Additional RFI Field Investigation in 1999. The four investigations included a background review, a cultural resources survey, a sensitive species survey, and sampling data collection. The building was decontaminated, decommissioned, and demolished in 1999. Based upon field investigation data and the human health and ecological risk screening assessments, NFA is recommended for the site because no COCs (metals, volatile organic compounds [VOCs], semivolatile organic compounds [SVOCs]) were present in concentrations considered hazardous to human health or site ecological receptors for an industrial land-use scenario.
- SWMU 82 (Old Aerial Cable Site in OU 1332) was constructed in 1968 to study problems in an experimental Fuel-Air Explosive weapon. Phillips Laboratories currently uses the site as a High Energy Research Test Facility. SWMU 82 was characterized through a series of four investigations: 1) a CEARP in 1997, 2) an ER Preliminary Investigation in 1992, 3) an ER RFI between 1995 and 1999, and 4) a Voluntary Corrective Action (VCA) conducted in 1999. The four investigations included visual inspections of the site, a background review, radiological surveys, unexploded ordnance (UXO)/high explosives (HE) surveys, a cultural resources survey, and sampling data collection. Based upon field investigation data and the human health and ecological risk screening assessments, NFA is recommended for the site because no COCs (metals, VOCs, SVOCs, HE, or radionuclides) were present in concentrations or activity levels considered hazardous to human health or site ecological receptors for a recreational land use scenario.
- SWMU 60 (Bunker Area in OU 1333) was a supply bunker and control bunker. The control bunker was destroyed during explosive testing in 1979. During the explosive test two mock weapons containing HE, depleted uranium, and beryllium

were detonated, and the control bunker was destroyed. SWMU 60 was characterized through three investigations: 1) a CEARP in 1985, 2) an ER Preliminary Investigation from 1989 to 1994, and 3) a VCA conducted in 1999. The site investigations included a Phase I site investigation, a background review, a UXO/HE survey, a radiation survey, a cultural resource survey, and a sensitive species survey. The VCA was conducted in 1999 and included radiological surveys to characterize depleted uranium contamination present on remaining structures and debris, demolition and removal of this material, and confirmatory sampling. Based upon field investigation data and the human health and ecological risk screening assessments, NFA is recommended for the site because no COCs (metals, HE, radionuclides) were present in concentrations or activity levels considered hazardous to human health or site ecological receptors for a recreational land use scenario.

- SWMU 81A (Catcher Box/Sled Track in OU 1333) was constructed in 1970 and is an active subunit of SWMU 81 (New Aerial Cable Facility). The site was constructed to support impact testing on weapons and other test units that could be subject to detonation at SWMU 81. SWMU 81A was characterized through three investigations: 1) a CEARP conducted in the mid-1980s, 2) an ER Preliminary Investigation in 1993, and 3) baseline sampling in 1998. The three investigations included a Phase I investigation, a background review of the site, a UXO/HE survey, a radiological survey, a cultural resource survey, a sensitive-species survey, and sampling data collection. Based upon field investigation data and the human health and ecological risk screening assessments, NFA is recommended for the site because no COCs (metals, VOCs, SVOCs, radionuclides) were present in concentrations or activity levels considered hazardous to human health or site ecological receptors for a recreational land use scenario.
- SWMU 81B (Impact Pad in OU 1333) was constructed in 1970 and is an active subunit of SWMU 81 (New Aerial Cable Facility). The pad was designed to provide an “unyielding surface” for testing the impact of weapons and transportation containers that are designed to house nuclear materials. SWMU 81B was characterized through three investigations: 1) a CEARP conducted in the mid-1980s, 2) an ER Preliminary Investigation in 1993, and 3) baseline sampling in 1998. The three investigations included a Phase I investigation, a background review of the site, a UXO/HE survey, a radiological survey, a cultural resource survey, a sensitive-species survey, and sampling data collection. Based upon field investigation data and the human health and ecological risk screening assessments, NFA is recommended for the site because no COCs (metals, VOCs, HE, radionuclides) were present in concentrations or activity levels considered hazardous to human health or site ecological receptors for a recreational land use scenario.
- SWMU 81D (Northern Cable Area in OU 1333) was constructed in 1984-1985 and is an active subunit of SWMU 81 (New Aerial Cable Facility). The site was constructed to provide a dedicated area for antiarmor tests. SWMU 81D was characterized through three investigations: 1) a CEARP conducted in the mid-1980s, 2) an ER Preliminary Investigation in 1993, and 3) baseline sampling

in 1998. The three investigations included a Phase I investigation, a background review of the site, a UXO/HE survey, a radiological survey, a cultural resource survey, a sensitive-species survey, and sampling data collection. Based upon field investigation data and the human health and ecological risk screening assessments, NFA is recommended for the site because no COCs (metals, VOCs, radionuclides) were present in concentrations or activity levels considered hazardous to human health or site ecological receptors for a recreational land use scenario.

- SWMU 81E (Gun Impact Area in OU 1333) is an inactive subunit of SWMU 81 (New Aerial Cable Facility). The site is the area impacted from the projectiles shot from portable guns in SWMUs 81A and 81B. SWMU 81E was characterized through three investigations: 1) a CEARP conducted in the mid-1980s, 2) an ER Preliminary Investigation in 1993, and 3) baseline sampling in 1998. The three investigations included a Phase I investigation, a background review of the site, a UXO/HE survey, a radiological survey, a cultural resource survey, a sensitive-species survey, and sampling data collection. Based upon field investigation data and the human health and ecological risk screening assessments, NFA is recommended for the site because no COCs (metals, radionuclides) were present in concentrations or activity levels considered hazardous to human health or site ecological receptors for a recreational land use scenario.
- SWMU 81F (Scrap Yard in OU 1333) is an active subunit of SWMU 81 (New Aerial Cable Facility). The site was constructed in 1970 and has been used for storage of test equipment associated with SWMU 81 subunits. SWMU 81E was characterized through three investigations: 1) a CEARP conducted in the mid-1980s, 2) an ER Preliminary Investigation in 1993, and 3) baseline sampling in 1998. The three investigations included a Phase I investigation, a background review of the site, a UXO/HE survey, a radiological survey, a cultural resource survey, a sensitive-species survey, and sampling data collection. Based upon field investigation data and the human health and ecological risk screening assessments, NFA is recommended for the site because no COCs (metals, VOCs, SVOCs, HE, radionuclides) were present in concentrations or activity levels considered hazardous to human health or site ecological receptors for a recreational land use scenario.
- SWMU 9 (Burial Site/Open Dump [Schoolhouse Mesa] in OU 1334) is an inactive debris disposal area. SWMU 9 was characterized through a series of four investigations: 1) a CEARP in the mid-1980s, 2) an ER Preliminary Investigation in 1992, 3) preliminary RFI sampling in 1991, and 4) a radiological voluntary corrective measure (VCM) to excavate and remove buried materials between 1996 and 1998 followed by confirmatory sampling in 1999. The four investigations included a background review, a UXO/HE survey, radiological surveys and VCM excavations, a cultural resource survey, a sensitive species survey, and soil sampling data collection. Based on the field investigation data and the human health and ecological risk screening assessments, NFA is recommended for the site because no COCs (metals, VOCs, SVOCs, HE, radionuclides) were present in concentrations or activity levels considered hazardous to human health or site ecological receptors for an industrial land use scenario.

- SWMU 117 (Trenches [Building 9939] in OU 1335) were disposal trenches that were dug to receive water runoff and reaction products resulting from water sprayed on residual solidified sodium metal in concrete test crucibles. Some solid waste items were also disposed of in one of the trenches. SWMU 117 was characterized through a series of three investigative stages: 1) a CEARP conducted in 1987, 2) ER Preliminary Investigations in 1994, 1995, 1997, and 1998, and 3) a VCA Remediation in 1999/2000. The three investigation stages included a background review, a UXO/HE survey, a radiological survey, a cultural resource survey, a sensitive-species survey, a geophysical survey, and sampling data collection. Based upon field investigation data and the human health and ecological risk screening assessments, NFA is recommended for the site because no COCs (metals, SVOCs, radionuclides) were present in concentrations or activity levels considered hazardous to human health or the environment for an industrial land use scenario.

REFERENCES

New Mexico Environment Department (NMED), March 1998. "RPMP Document requirement Guide," Hazardous and Radioactive Materials Bureau, RCRA Permits Management Program, New Mexico Environment Department, Santa Fe, New Mexico.

1.0 INTRODUCTION

Sandia National Laboratories/New Mexico (SNL/NM) is proposing No Further Action (NFA) recommendations for ten Environmental Restoration Solid Waste Management Units (SWMU). The following SWMUs are listed in the Hazardous and Solid Waste Amendments Module IV of the SNL/NM Resource Conservation and Recovery Act Hazardous Waste Management Facility Permit (NM5890110518) (EPA August 1993). Proposals for each SWMU are located in this document as follows:

Operable Unit 1302

- SWMU 98, Building 863 TCA and Photochemical Release

Operable Unit 1332

- SWMU 82, Old Aerial Cable Site

Operable Unit 1333

- SWMU 60, Bunker Area
- SWMU 81A, Catcher Box/Sled Track
- SWMU 81B, Impact Pad
- SWMU 81D, Northern Cable Area
- SWMU 81E, Gun Impact Area
- SWMU 81F, Scrap Yard

Operable Unit 1334

- SWMU 9, Burial Site/Open Dump (Schoolhouse Mesa)

Operable Unit 1335

- SWMU 117, Trenches (Building 9939)

These proposals each provide a site description, history, summary of investigatory activities, and the rationale for the NFA decision, as determined from assessments predicting acceptable levels of risk under current and projected future land use.

REFERENCES

U.S. Environmental Protection Agency (EPA), August 1993. "Module IV of RCRA Permit No. NM5890110518-1," EPA Region VI, issued to Sandia National Laboratories, Albuquerque, New Mexico.

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2.0 SOLID WASTE MANAGEMENT UNIT 98, BUILDING 863 TCA AND PHOTOCHEMICAL RELEASE

2.1 Summary

Sandia National Laboratories/New Mexico (SNL/NM) is proposing a risk-based no further action (NFA) decision for Environmental Restoration (ER) Solid Waste Management Unit (SWMU) 98, Building 863 Trichloroethane (TCA) and Photochemical Release, Operable Unit 1302 on Kirtland Air Force Base (KAFB). Review and analysis of all relevant data for SWMU 98 indicate that concentrations of constituents of concern (COCs) at this site are less than applicable risk assessment action levels. Thus, SWMU 98 is proposed for an NFA decision based upon confirmatory sampling data demonstrating that COCs that may have been released from this SWMU into the environment pose an acceptable level of risk under current and projected future land use, as set forth by NFA Criterion 5. NFA Criterion 5 states that "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).

2.2 Description and Operational History

Section 2.2 describes the site and provides the operational history of SWMU 98.

2.2.1 Site Description

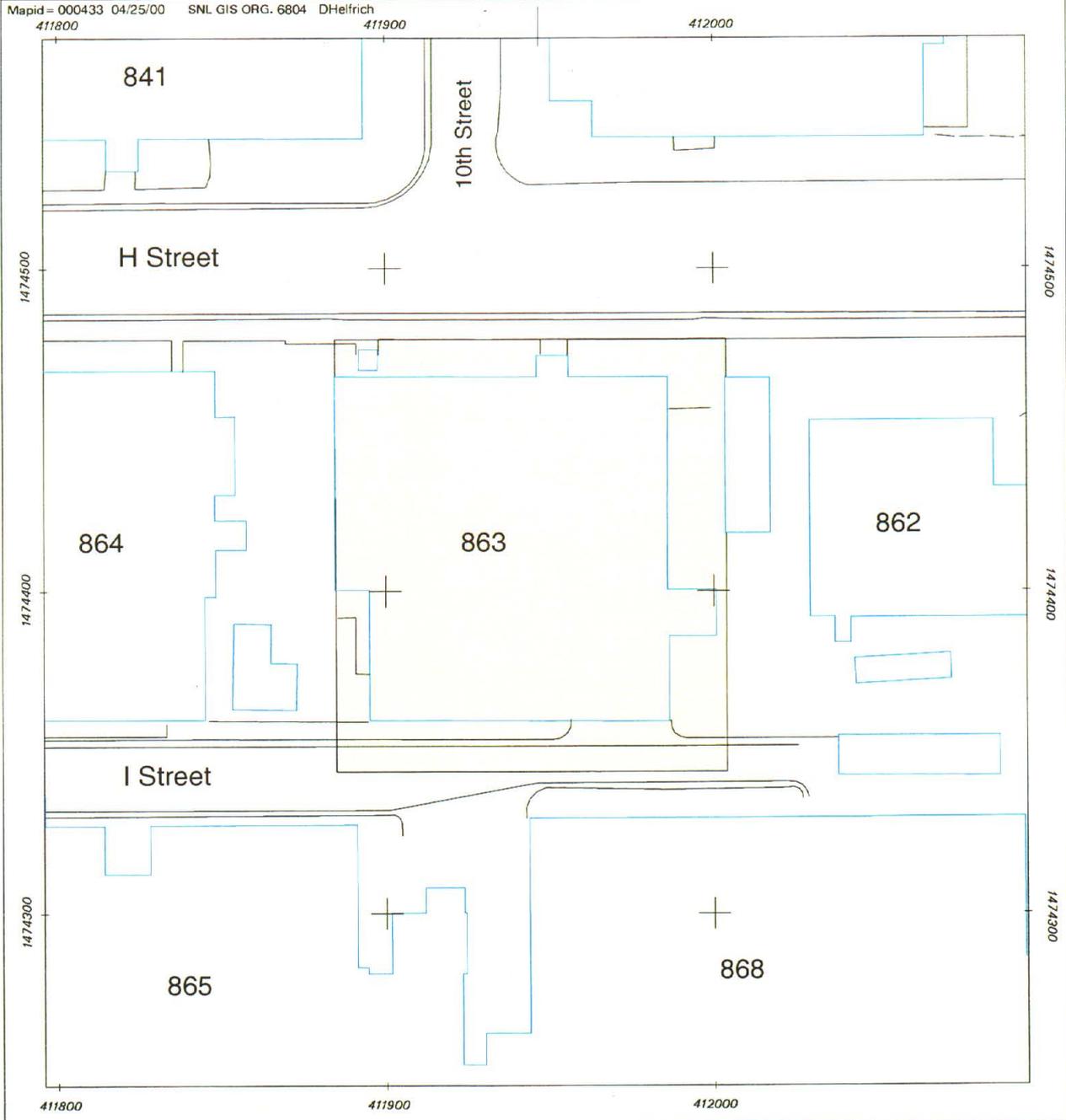
Building 863 was located in the north central portion of Technical Area (TA) I in KAFB on H Street between 9th and 10th Streets (Figure 2.2.1-1). Building 863 was constructed in 1950 as a document vault. In 1951, the building became the motion picture production and film processing division for SNL/NM. The building was decontaminated, decommissioned, and demolished in 1999. The building lot remains vacant at the time of this report.

The topographic relief has a gradual slope to the west of less than 2 percent. The closest drainage feature in the vicinity of TA-I is the Tijeras Arroyo, which drains to the west and is approximately one mile south of SWMU 98. The surface water from the site is routed through the TA-I Storm Drain System to the Tijeras Arroyo.

The soil type for SWMU 98 is identified as the Tijeras series. The Tijeras series is a gravelly fine sandy loam, consisting of deep, well-drained, moderately alkaline soil. Permeability is moderate (0.6 to 2.0 inches/hour).

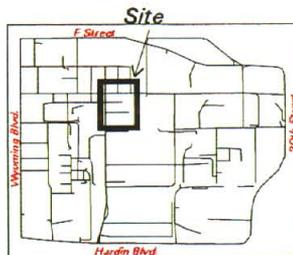
TA-I and SWMU 98 are located between two north-south trending faults of the Albuquerque Basin: the Sandia Fault and the Rio Grande Fault. The site lies on a partially dissected bajada formed by coalescing multiple alluvial fan complexes. The surficial thickness of these Holocene and Pleistocene deposits are approximately 10 feet. Basin-fill deposits of Miocene underlie these deposits and younger interbedded gravels, sands, silts, and clays of the Santa Fe Group, which are estimated to be greater than 5,200 feet thick beneath TA-I. The groundwater is approximately 500 feet below ground surface (bgs), with the potential for some perched water

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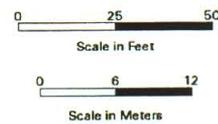


Legend

-  SWMU 98
-  Road
-  Building



**Figure 2.2.1-1
 SWMU 98
 Location Map**



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zones at shallower depths (~300 feet bgs). With the current and future land use being industrial, the area around SWMU 98 is mostly paved over, and that impedes surface water infiltration.

For a detailed discussion regarding the local setting at SWMU 98, refer to TA-I Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Work Plan (SNL/NM February 1995).

2.2.2 Operational History

Building 863 was listed as SWMU 98 because of silver recovery processes and releases of TCA from a film-cleaning machine. Silver was extracted from waste solutions and then was recycled. TCA was piped to a film-cleaning machine through holes drilled in the exterior wall from a 55-gallon drum outside the building. The waste TCA then was piped out through the wall to another 55-gallon drum. This second drum had drain holes in its base, and the waste TCA drained to the underlying soil. Employee interviews suggest that the amount of TCA disposed in this manner ranged from 2300 to 3600 gallons. This practice, which began in the early 1970s, was discontinued in 1986 when a new film-cleaning tank was installed. Film processing operation ceased in 1989. The building office space was occupied until 1998. Building 863 and its equipment were decontaminated and decommissioned in 1999.

2.3 Land Use

Section 2.3 discusses the current and future land use scenarios for SWMU 98.

2.3.1 Current Land Use

The current land use classification for SWMU 98 is industrial (DOE and USAF September 1995).

2.3.2 Future/Proposed Land Use

The future/projected land use classification for SWMU 98 is industrial (DOE and USAF September 1995).

2.4 Investigatory Activities

SWMU 98 has been characterized in a series of four investigation activities. This section discusses those activities.

2.4.1 Summary

SWMU 98 was investigated under the U.S. Department of Energy's (DOE's) Comprehensive Environmental Assessment and Response Program (CEARP) in the mid-1980s in compliance

with the Comprehensive Environmental Response, Compensation, and Liability Act. The report identified a silver recovery operation as a potential problem (Investigation #1).

ER Preliminary Investigations included conducting employee interviews, evaluating site history through reports and facility site maps, and site inspections (Investigation #2).

SWMU 98 was included in the TA-I RFI Work Plans. This investigation included developing/producing work plans, fieldwork activities, and a data evaluation report (Investigation #3).

An additional field investigation was conducted in August and September 1999, based on the analytical findings from the RFI field investigation (Investigation #4).

2.4.2 Investigation #1—CEARP

2.4.2.1 *Nonsampling Data Collection*

A silver recovery unit was located in Building 863. Silver was recovered from waste solutions and recycled. The waste solution was discharged to the acid waste line (SWMU 226).

2.4.2.2 *Sampling Data Collection*

No sampling activities were conducted at SWMU 98 for the CEARP investigation.

2.4.2.3 *Results and Conclusions*

The CEARP report could not determine if the silver recovery unit would be regulated under RCRA, and insufficient information was available to calculate a Hazard Ranking System score for this SWMU. Sandia then decided to evaluate this treatment facility under RCRA, and no further action was planned under CEARP (DOE September 1987).

2.4.3 Investigation #2—ER Preliminary Investigation

2.4.3.1 *Nonsampling Data Collection*

This section describes the nonsampling data collection activities conducted for SWMU 98.

2.4.3.1.1 *Background Review*

A background review was initiated for the RFI Work Plans. This included conducting SNL/NM staff and contractor interviews and reviewing site operational history through site records and reports (e.g., building drawings). The interviews were conducted in 1993 (Personal Communication 1993). The waste disposal operation for TCA was discovered at this time. The

information used for developing the work plans for SWMU 98 are described below (Section 2.4.4).

2.4.3.1.2 Unexploded Ordnance/High Explosives Survey

No unexploded ordnance (UXO)/high explosives (HE) survey was conducted for SWMU 98.

2.4.3.1.3 Radiological Survey

No radiological survey was conducted for SWMU 98.

2.4.3.1.4 Cultural Resources Survey

A cultural resources survey was conducted at SWMU 98 as part of the overall TA-I survey; no cultural resources were identified at the site (Hoagland August 1990).

2.4.3.1.5 Sensitive-Species Survey

SWMU 98 is located in the fenced area of TA-I and has been a major industrial area for 50 years. Diversity or abundance of nonhuman species is unlikely given the industrial nature of the area/site. Relevant information of the area/site can be found in the National Environmental Policy Act compliance document (SNL/NM 1992).

2.4.3.1.6 Geophysical Survey

No geophysical survey was conducted at SWMU 98.

2.4.3.2 Sampling Data Collection

No sampling data were collected at SWMU 98.

2.4.3.3 Data Gaps

The preliminary investigation and the CEARP report identified the COCs, the locations of potential COC releases, and the types of sampling and analyses to be performed on soils; thus, there were no data gaps.

2.4.3.4 Results and Conclusions

UXO/HE and radiological materials were not used or stored at SWMU 98. No cultural resources or sensitive species were identified at the site. The potential COCs identified during the CEARP

and this preliminary investigation are volatile organic compounds (VOCs) (TCA), semivolatile organic compounds (SVOCs), and metals (silver). SWMU 98 was included in the TA-I RFI Work Plan for further characterization.

2.4.4 Investigation #3—RFI Field Investigation

2.4.4.1 *Nonsampling Data Collection*

No additional nonsampling data collection was completed as part of Investigation #3.

2.4.4.2 *Sampling Data Collection*

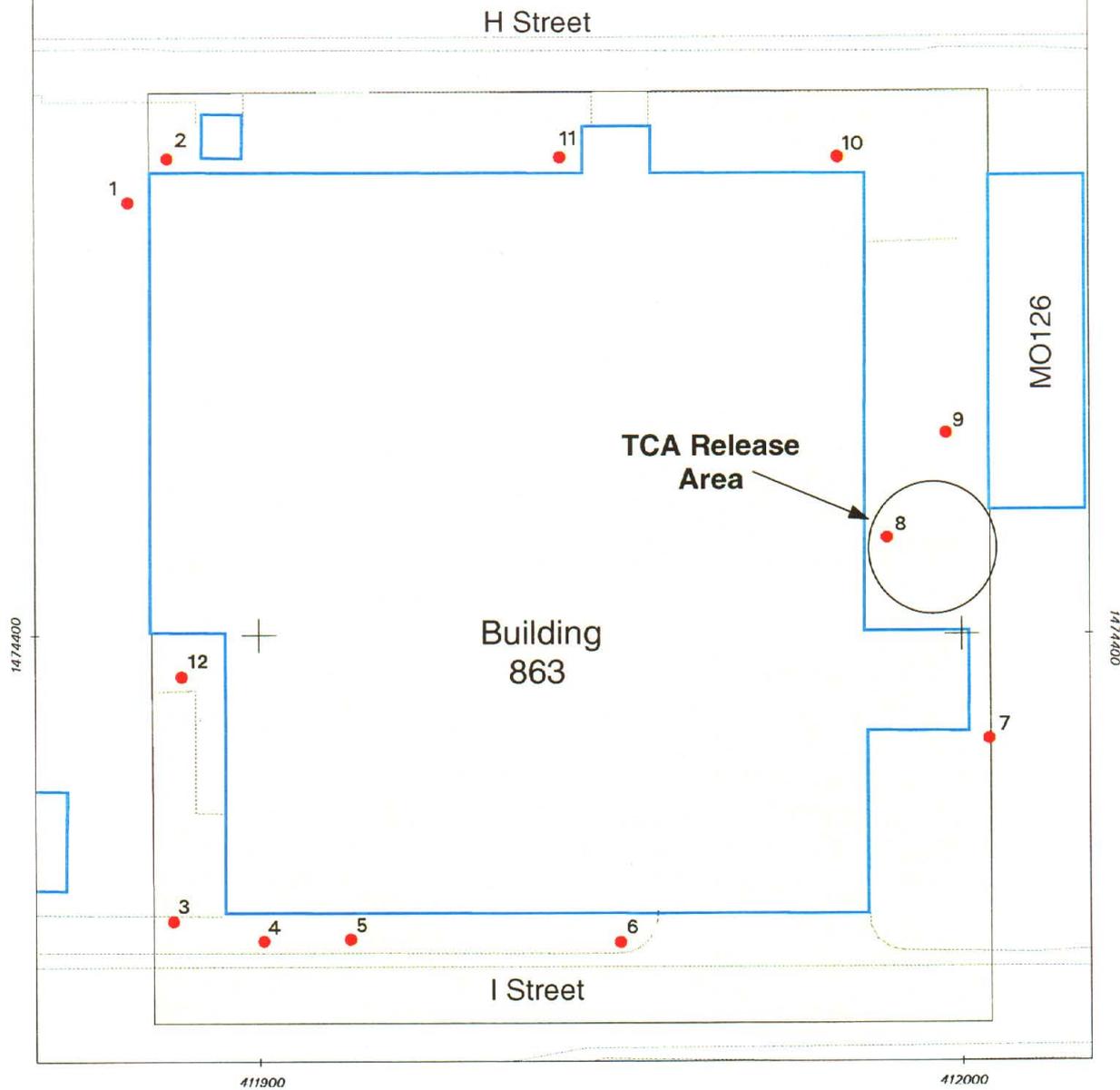
The RFI field investigation was conducted in two stages: collecting soil and soil-gas samples and analyzing the sampling data.

2.4.4.2.1 *Fieldwork Activities*

The field investigation began March 27, 1995, and was completed April 6, 1995. The field activities included:

- Drilling boreholes,
- Screening soil and soil-gas samples for VOCs with a flame ionization detector (FID) and photoionization detector (PID),
- Collecting surface, subsurface soil, and subsurface soil-gas samples for chemical analysis,
- Collecting waste samples for chemical and radionuclide analysis,
- Managing the waste generated during drilling, and
- Surveying soil borehole locations.

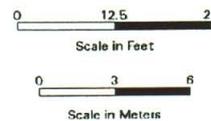
The drilling program was conducted using a truck-mounted Geoprobe drill rig. A total of eleven soil boreholes (TI098-GP-001 to TI098-GP-011) were drilled with the Geoprobe rig around Building 863 (Figure 2.3.4-1). Soil borehole TI098-GP-012 was located under an outside stairwell and a borehole was drilled with a portable auger rig. Soil borehole T1098-GP-008 was located over the TCA release area.



Legend

-  SWMU 98
-  Building
-  Soil/SOV Sampling Locations

Figure 2.4.4-1
SWMU 98 Soil/SOV
Boring Location Map, 1995



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2.4.4.2.2 *Sampling Collection Data*

Sample types collected during the field investigation were surface soil, soil-gas, and subsurface soil samples. The detailed sampling strategy for SWMU 98 is discussed in the TA-I Work Plan, Section 5.5.5.

Twelve surface soil samples (TI098-GR-001 to TI098-GR-012) were collected at each of the twelve borehole locations (Figure 2.4.4-1). Sample numbers TI098-GR-013 and TI098-GR-014 were used to identify duplicate soil samples. The samples were sent to Quanterra Laboratory for VOCs, SVOCs, and target analyte list (TAL) metals analyses. Quanterra Laboratory analyzed the soil samples by the following U.S. Environmental Protection Agency (EPA) Methods: 8240/8260 for VOCs, 8270 for SVOCs, 6010 for TAL metals, and 7471/7470 for mercury. In addition, each sample was field screened for its pH value. The samples collected and the analyses performed are provided in Table 2.4.4-1. The sample identification number represent the following: TI = TA-I, 098 = SWMU 98, GR = grab sample, and 001 = soil boring location.

Soil-gas samples TI098-SVS-001 to TI098-SVS-012 were collected at 5-foot intervals at each location using the Geoprobe rig. Soil-gas samples were field screened for VOCs using an FID and/or a PID. Upon completion of the screening, soil-gas samples were collected and shipped on site to the ER Chemical Laboratory (ERCL) for VOC analysis. These soil-gas samples were analyzed by criteria described in EPA Methods 8240/8260. In addition, confirmation samples were collected in Summa canisters and shipped off site to Quanterra Laboratory for VOC analysis using EPA Method TO-14. The number of soil-gas samples collected included 67 samples screened using the FID/PID, 34 samples sent to the on-site laboratory, and 7 samples sent to the off-site laboratory to confirm the on-site laboratory results. The samples collected and analyses performed are provided in Table 2.4.4-1. The sample ID number represents the following: TI = TA-I, 098 = SWMU 98, SVS = soil vapor sample, and 001 = soil boring location.

Subsurface soil samples TI098-GP-001 to TI098-GP-012 were collected at 5-foot intervals at each borehole location to a total depth of 30 feet. Sample numbers TI098-GP-015 and TI098-GP-016 were used to identify duplicate subsurface soil samples. Thirty-four subsurface soil samples were collected and sent to the ERCL for VOC analysis using EPA Methods 8240/8260. To confirm the field screening and ERCL analytical results, a total of ten confirmatory soil samples were collected (duplicates) and sent to Quanterra Laboratory for VOC analysis using EPA Methods 8240/8260. The samples collected and the analyses performed are provided in Table 2.4.4-1. The sample ID number represents the following: TI = TA-I, 098 = SWMU 98, GP = geoprobe, and 001 = soil boring locations.

Four types of field quality control (QC) samples were collected and shipped for analyses: field duplicate soil, equipment rinsate blank, soil and water trip blank, and field blank soil samples. Sample number, date/time, location, and analyses performed are presented in Table 2.4.4-1.

2.4.4.3 *Data Gaps*

At the conclusion of Investigation #3, and in consultation with the New Mexico Environment Department (NMED), it was determined that further characterization of SWMU 98 was warranted. The additional characterization focused on the TCA release area. These additional characterization activities are described in Section 2.4.5.

Table 2.4.4-1
 Listing of Samples Collected and Analyses Performed for SWMU 98
 RFI Field Investigation
 1995

Sample Attributes			Field Screening		On-Site Laboratory Analyses	Off-Site Laboratory Analyses			
Record Number ^a	Date Sampled	ER Sample ID (Figures 2.4.4-1 and 2.4.5-1)	Soil pH	VOCs	VOCs ^b	TAL Metals	Mercury	VOCs ^c	SVOCs ^d
Surface Soil									
03100	3/28/95	TI098-GR-001-0.5-SS	X					X	
03100	3/28/95	TI098-GR-001-0.5-SS				X	X		X
03100	3/28/95	TI098-GR-002-000-SS	X					X	
03100	3/28/95	TI098-GR-002-000-SS				X	X		X
02325	3/29/95	TI098-GR-003-0.5-SS	X					X	
02325	3/29/95	TI098-GR-003-0.5-SS				X	X		X
02326	3/30/95	TI098-GR-004-001-SS	X					X	
02326	3/30/95	TI098-GR-004-001-SS				X	X		X
02326	3/30/95	TI098-GR-005-001-SS	X					X	
02326	3/30/95	TI098-GR-005-001-SS				X	X		X
02903	3/31/95	TI098-GR-006-001-SS	X					X	
02903	3/31/95	TI098-GR-006-001-SS				X	X		X
02904	4/3/95	TI098-GR-007-001-SS	X					X	
02904	4/3/95	TI098-GR-007-001-SS				X	X		X
02904	4/3/95	TI098-GR-008-001-SS	X					X	
02904	4/3/95	TI098-GR-008-001-SS				X	X		X
02905	4/4/95	TI098-GR-009-0.5-SS	X					X	
02905	4/4/95	TI098-GR-009-0.5-SS				X	X		X
02956	4/5/95	TI098-GR-010-001-SS	X					X	
02956	4/5/95	TI098-GR-010-001-SS				X	X		X
02956	4/5/95	TI098-GR-011-001-SS	X					X	
02956	4/5/95	TI098-GR-011-001-SS				X	X		X
02959	4/6/95	TI098-GR-012-0.5-SS	X					X	
02959	4/6/95	TI098-GR-012-0.5-SS				X	X		X
Subsurface Soil									
03100/509224	3/28/95	TI098-GP-001-025-S		X	X			X	
509224	3/28/95	TI098-GP-001-030-S		X	X				
	3/29/95	TI098-GP-002-010-S		X					
	3/29/95	TI098-GP-002-015-S		X					
509226	3/29/95	TI098-GP-002-020-S		X	X				
509226	3/29/95	TI098-GP-002-027-S		X	X				
	3/29/95	TI098-GP-002-031-S		X					
509226	3/29/95	TI098-GP-003-005-S		X	X				

Refer to footnotes at end of table.

Table 2.4.4-1 (Continued)
 Listing of Samples Collected and Analyses Performed for SWMU 98
 RFI Field Investigation
 1995

Sample Attributes			Field Screening		On-Site Laboratory Analyses	Off-Site Laboratory Analyses			
Record Number ^a	Date Sampled	ER Sample ID (Figures 2.4.4-1 and 2.4.5-1)	Soil pH	VOCs	VOCs ^b	TAL Metals	Mercury	VOCs ^c	SVOCs ^d
02325/509226	3/29/95	TI098-GP-003-010-S		X	X			X	
	3/29/95	TI098-GP-003-015-S		X					
	3/29/95	TI098-GP-003-020-S		X					
	3/30/95	TI098-GP-003-025-S		X					
	3/30/95	TI098-GP-003-030-S		X					
509227	3/30/95	TI098-GP-004-006-S		X	X				
509227	3/30/95	TI098-GP-004-011-S		X	X				
02326/509227	3/30/95	TI098-GP-004-016-S		X	X			X	
	3/30/95	TI098-GP-004-021-S		X					
	3/30/95	TI098-GP-004-025-S		X					
02328/509228	3/30/95	TI098-GP-004-030-S		X	X			X	
509228	3/30/95	TI098-GP-005-006-S		X	X				
509229	3/30/95	TI098-GP-005-011-S		X	X				
	3/30/95	TI098-GP-005-016-S		X					
	3/31/95	TI098-GP-005-020-S		X					
509330	3/31/95	TI098-GP-005-025-S		X	X				
02903/509230	3/31/95	TI098-GP-005-030-S		X	X			X	
509231	3/31/95	TI098-GP-006-005-S		X	X				
509231	3/31/95	TI098-GP-006-010-S		X	X				
	3/31/95	TI098-GP-006-015-S		X					
	3/31/95	TI098-GP-006-020-S		X					
	3/31/95	TI098-GP-006-025-S		X					
509231	3/31/95	TI098-GP-006-030-S		X	X				
509232	4/3/95	TI098-GP-007-005-S		X	X				
02904/509232	4/3/95	TI098-GP-007-011-S		X	X			X	
	4/3/95	TI098-GP-007-016-S		X					
	4/3/95	TI098-GP-007-021-S		X					
509232	4/3/95	TI098-GP-007-026-S		X	X				
509233	4/3/95	TI098-GP-008-006-S		X	X				
02904/509233	4/3/95	TI098-GP-008-011-S		X	X			X	
	4/4/95	TI098-GP-008-015-S		X					
	4/4/95	TI098-GP-008-020-S		X					
509234	4/4/95	TI098-GP-008-025-S		X	X				

Refer to footnotes at end of table.

Table 2.4.4-1 (Continued)
Listing of Samples Collected and Analyses Performed for SWMU 98
RFI Field Investigation
1995

Sample Attributes			Field Screening		On-Site Laboratory Analyses	Off-Site Laboratory Analyses			
Record Number ^a	Date Sampled	ER Sample ID (Figures 2.4.4-1 and 2.4.5-1)	Soil pH	VOCs	VOCs ^b	TAL Metals	Mercury	VOCs ^c	SVOCs ^d
509234	4/4/95	TI098-GP-008-030-S		X	X				
509234	4/4/95	TI098-GP-009-005-S		X	X				
509234	4/4/95	TI098-GP-009-010-S		X	X				
	4/4/95	TI098-GP-009-015-S		X					
	4/4/95	TI098-GP-009-020-S		X					
02905/509235	4/4/95	TI098-GP-009-025-S		X	X			X	
509235	4/4/95	TI098-GP-009-030-S		X	X				
02956	4/5/95	TI098-GP-010-005-S		X				X	
509236	4/5/95	TI098-GP-010-006-S		X	X				
509236	4/5/95	TI098-GP-010-011-S		X	X				
	4/5/95	TI098-GP-010-015-S		X					
	4/5/95	TI098-GP-010-020-S		X					
	4/5/95	TI098-GP-010-025-S		X					
509236	4/5/95	TI098-GP-010-030-S		X	X				
509237	4/5/95	TI098-GP-011-005-S		X	X				
02956/509237	4/5/95	TI098-GP-011-010-S		X	X			X	
	4/5/95	TI098-GP-011-015-S		X					
	4/5/95	TI098-GP-011-020-S		X					
	4/5/95	TI098-GP-011-025-S		X					
	4/5/95	TI098-GP-011-030-S		X					
509238	4/6/95	TI098-GP-012-005-S		X	X				
Soil-gas									
509222	3/28/95	TI098-SVS-001-006-SV		X	X				
509222	3/28/95	TI098-SVS-001-011-SV		X	X				
509224	3/28/95	TI098-SVS-001-016-SV		X	X				
509224	3/28/95	TI098-SVS-001-022-SV		X	X				
509224	3/28/95	TI098-SVS-001-027-SV		X	X				
03100/509224	3/28/95	TI098-SVS-001-031-SV		X	X			X	
509225	3/28/95	TI098-SVS-002-005-SV		X	X				
509225	3/28/95	TI098-SVS-002-010-SV		X	X				
	3/29/95	TI098-SVS-002-016-SV		X					
	3/29/95	TI098-SVS-002-022-SV		X					
509226	3/29/95	TI098-SVS-002-027-SV		X	X				

Refer to footnotes at end of table.

Table 2.4.4-1 (Continued)
 Listing of Samples Collected and Analyses Performed for SWMU 98
 RFI Field Investigation
 1995

Sample Attributes			Field Screening		On-Site Laboratory Analyses	Off-Site Laboratory Analyses			
Record Number ^a	Date Sampled	ER Sample ID (Figures 2.4.4-1 and 2.4.5-1)	Soil pH	VOCs	VOCs ^b	TAL Metals	Mercury	VOCs ^c	SVOCs ^d
509226	3/29/95	TI098-SVS-002-032-SV		X	X				
509226	3/29/95	TI098-SVS-003-006-SV		X	X				
	3/29/95	TI098-SVS-003-011-SV		X					
	3/29/95	TI098-SVS-003-016-SV		X					
	3/29/95	TI098-SVS-003-021-SV		X					
	3/30/95	TI098-SVS-003-026-SV		X					
02327/509227	3/30/95	TI098-SVS-003-032-SV		X	X			X	
509227	3/30/95	TI098-SVS-004-006-SV		X	X				
	3/30/95	TI098-SVS-004-011-SV		X					
	3/30/95	TI098-SVS-004-016-SV		X					
	3/30/95	TI098-SVS-004-021-SV		X					
	3/30/95	TI098-SVS-004-026-SV		X					
509228	3/30/95	TI098-SVS-004-032-SV		X	X				
509228	3/30/95	TI098-SVS-005-006-SV		X	X				
	3/30/95	TI098-SVS-005-011-SV		X					
	3/30/95	TI098-SVS-005-016-SV		X					
	3/31/95	TI098-SVS-005-021-SV		X					
509230	3/31/95	TI098-SVS-005-026-SV		X	X				
509230	3/31/95	TI098-SVS-005-031-SV		X	X				
509231	3/31/95	TI098-SVS-006-006-SV		X	X				
	3/31/95	TI098-SVS-006-011-SV		X					
	3/31/95	TI098-SVS-006-016-SV		X					
	3/31/95	TI098-SVS-006-021-SV		X					
	3/31/95	TI098-SVS-006-026-SV		X					
509231	3/31/95	TI098-SVS-006-032-SV		X	X				
509232	4/3/95	TI098-SVS-007-006-SV		X	X				
	4/3/95	TI098-SVS-007-011-SV		X					
	4/3/95	TI098-SVS-007-016-SV		X					
02955/509232	4/3/95	TI098-SVS-007-021-SV		X	X			X	
509232	4/3/95	TI098-SVS-007-026-SV		X	X				
509233	4/3/95	TI098-SVS-008-006-SV		X	X				
	4/3/95	TI098-SVS-008-11.5-SV		X					
	4/4/95	TI098-SVS-008-016-SV		X					
	4/4/95	TI098-SVS-008-021-SV		X					

Refer to footnotes at end of table.

Table 2.4.4-1 (Continued)
 Listing of Samples Collected and Analyses Performed for SWMU 98
 RFI Field Investigation
 1995

Sample Attributes			Field Screening		On-Site Laboratory Analyses	Off-Site Laboratory Analyses			
Record Number ^a	Date Sampled	ER Sample ID (Figures 2.4.4-1 and 2.4.5-1)	Soil pH	VOCs	VOCs ^b	TAL Metals	Mercury	VOCs ^c	SVOCs ^d
509234	4/4/95	TI098-SVS-008-026-SV		X	X				
509234	4/4/95	TI098-SVS-008-031-SV		X	X				
509234	4/4/95	TI098-SVS-009-006-SV		X	X				
	4/4/95	TI098-SVS-009-011-SV		X					
	4/4/95	TI098-SVS-009-016-SV		X					
	4/4/95	TI098-SVS-009-021-SV		X					
509234	4/4/95	TI098-SVS-009-026-SV		X	X				
509234	4/4/95	TI098-SVS-009-031-SV		X	X				
02957/509236	4/5/95	TI098-SVS-010-006-SV		X	X			X	
	4/5/95	TI098-SVS-010-011-SV		X					
	4/5/95	TI098-SVS-010-016-SV		X					
	4/5/95	TI098-SVS-010-021-SV		X					
	4/5/95	TI098-SVS-010-026-SV		X					
02957/509236	4/5/95	TI098-SVS-010-031-SV		X	X			X	
02957/509237	4/5/95	TI098-SVS-011-006-SV		X	X			X	
	4/5/95	TI098-SVS-011-011-SV		X					
	4/5/95	TI098-SVS-011-016-SV		X					
	4/5/95	TI098-SVS-011-021-SV		X					
	4/5/95	TI098-SVS-011-026-SV		X					
509237	4/5/95	TI098-SVS-011-031-SV		X	X				
02958/509238	4/6/95	TI098-SVS-012-005-SV		X	X			X	
509238	4/6/95	TI098-SVS-012-008-SV		X	X				
Duplicates									
02903	3/31/95	TI098-GR-013-001-SS (Duplicate of GR-006-001)		X		X	X	X	
02905	4/4/95	TI098-GR-014-0.5-SS (Duplicate of GR-009-0.5)		X		X	X	X	
02903/509230	3/31/95	TI098-GP-015-030-S (Duplicate of GP-005-030)					X		
02956/509236	4/5/95	TI098-GP-016-005-S (Duplicate of GP-10-005)					X		
Equipment Blanks									
02326	3/30/95	TI098-EB-001-000-W					X		
02956	4/5/95	TI098-EB-002-000-W					X		

Refer to footnotes at end of table.

Table 2.4.4-1 (Concluded)
 Listing of Samples Collected and Analyses Performed for SWMU 98
 RFI Field Investigation
 1995

Sample Attributes			Field Screening		On-Site Laboratory Analyses	Off-Site Laboratory Analyses			
Record Number ^a	Date Sampled	ER Sample ID (Figures 2.4.4-1 and 2.4.5-1)	Soil pH	VOCs	VOCs ^b	TAL Metals	Mercury	VOCs ^c	SVOCs ^d
02956	4/5/95	TI098-EB-003-000-W					X		
Field Blanks									
02903	3/31/95	TI098-FB-001-000-S					X		
02956	4/5/95	TI098-FB-002-000-S					X		
02959	4/6/95	TI098-FB-003-000-S					X		
Trip Blanks									
03100	3/28/95	TI098-TB-001-SS					X		
02325	3/29/95	TI098-TB-002-000-SS					X		
02326	3/30/95	TI098-TB-004-000-SS					X		
02326	3/30/95	TI098-TB-005-000-SS					X		
02903	3/31/95	TI098-TB-006-000-S					X		
02904	4/3/95	TI098-TB-007-000-S					X		
02905	4/4/95	TI098-TB-008-000-S					X		
02956	4/5/95	TI098-TB-009-000-S					X		
02956	4/5/95	TI098-TB-010-000-W					X		
02959	4/6/95	TI098-TB-011-000-S					X		
02966	4/20/95	TI098-TB-012-000-W					X		

^aAnalysis request/chain-of-custody record.

^bEPA Method 8240/8260.

^cEPA Method 8240/8260, T0-14.

^dEPA Method 8270.

DR = Drum.

EB = Equipment blank.

ER = Environmental Restoration.

FB = Field blank.

GP = Geoprobe.

GR = Grab sample.

ID = Identification.

RFI = RCRA Facility Investigation.

S = Soil sample.

SS = Soil sample.

SV = Soil vapor.

SVOC = Semivolatile organic compound.

SVS = Soil vapor survey.

SWMU = Solid Waste Management Unit.

TAL = Target analyte list.

TB = Trip blank.

VOC = Volatile organic compound.

W = Water sample.

2.4.4.4 *Results and Conclusions*

This section discusses the analytical results of the soil gas and soil samples. The conclusions are based on these results.

Soil Gas Results

The FID/PID field screening results were recorded on the Soil-Gas Monitoring Logs (Annex 2-A). The complete soil-gas results from the ERCL are provided in Annex 2-B. Table 2.4.4-2 contains a summary of those VOCs that were detected in soil-gas samples sent to the off-site laboratory for analyses. This section summarizes the soil-gas sampling results.

Field Screening Results

The field screening results ranged from 1 to 20 parts per million for 21 of 67 soil-gas samples. The remaining 46 screening results were nondetect.

On-Site Laboratory Results

There were 23 sample intervals in which VOCs were detected in the on-site samples (Annex 2-B). Trichloroethene was detected in seven sample intervals with values ranging from 2.7 to 11 parts per billion by volume (ppbv). 1,1-Dichloroethene (1,1-DCE) was detected in 16 sample intervals with values ranging from 23 to 220 ppbv. 1,1,1-Trichloroethene was detected in 23 sample intervals with values ranging from 3.4 to 1100 ppbv. Benzene was detected in 13 sample intervals with values ranging from 4.1 to 310 ppbv. Toluene was detected in 16 sample intervals with values ranging from 3.2 to 11 ppbv. In addition, the following VOC compounds were detected in minor amounts: chloroform, ethylbenzene, styrene, xylene, and 1,1,2-trichloroethane (1,1,2-TCA).

Off-Site Laboratory Results

There were seven sample intervals in which VOCs were detected in the off-site samples (Table 2.4.4-2). Trichloroethene had elevated values of 9.7 and 11 ppbv in two samples. 1,1,1-Trichloroethane (1,1,1-TCA) had elevated values from 2.4 to 68 ppbv in four samples. 1,1-DCE had values ranging from 58 to 290 ppbv in three samples. Benzene had a value of 2.2 ppbv in one sample. Toluene had values ranging from 2.4 to 22 ppbv in four samples. Ethylbenzene had a value 6 ppbv in one sample. Xylene had elevated values ranging from 2.0 to 34 ppbv in four samples.

In the same seven sample intervals (as above), three Freon compounds (dichlorodifluoromethane [Freon 112, 5.3 to 25 ppbv]; trichlorofluoromethane [Freon 11, 5.5 to 6.4 ppbv]; and 1,1,2-trichloro-1,2,2-trifluoroethane [Freon 113, 5.5 to 37 ppbv]) were detected at the site.

The following four potential common laboratory contaminants were detected: acetone (16 to 210 ppbv), 2-hexanone (4.6 ppbv), 4-methyl-2-pentanone (4.5 and 5.3 ppbv), and methylene chloride (2.8 and 6.1 ppbv).

Table 2.4.4-2
 Summary of SWMU 98 VOC Soil-gas Analytical Results
 March-April 1995
 (Off-Site Laboratory)

Sample Attributes				Analyte (EPA Method 8260) ^a (ppbv)						
Record Number ^b	ER Sample ID (Figure 2.4.4-1)	Date Sampled	Sample Depth (ft)	Acetone	Benzene	1,1-Dichloroethene	Dichlorodifluoromethane	Ethylbenzene	2-Hexanone	Methylene chloride
03100	T1098-SVS-001-031-SV	03/28/95	31	210	2.2	290	7	ND (2.0)	ND (4.0)	2.8
02327	T1098-SVS-003-032-SV	03/30/95	32	16	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (4.0)	ND (2.0)
02955	T1098-SVS-007-021-SV	04/03/95	21	68	ND (2.0)	58	25	ND (2.0)	ND (4.0)	ND (2.0)
02957	T1098-SVS-010-006-SV	04/05/95	6	49	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (4.0)	ND (2.0)
02957	T1098-SVS-010-031-SV	04/05/95	31	50	ND (2.0)	260	5.3	ND (2.0)	4.6	6.1
02957	T1098-SVS-011-006-SV	04/05/95	6	32	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (4.0)	ND (2.0)
02958	T1098-SVS-012-005-SV	04/06/95	5	41	ND (2.0)	ND (2.0)	ND (2.0)	6	ND (4.0)	ND (2.0)

Sample Attributes				Analyte (EPA Method 8260) ^a (ppbv)						
Record Number ^b	ER Sample ID (Figure 2.4.4-1)	Date Sampled	Sample Depth (ft)	4-Methyl-2-pentanone	Toluene	Trichloroethene	1,1,1-Trichloroethane	1,1,2-Trichloro-1,2,2-trifluoroethane	Trichlorofluoromethane	Xylene
03100	T1098-SVS-001-031-SV	03/28/95	31	ND (4.0)	2.4	11	67	37	6.4	2
02327	T1098-SVS-003-032-SV	03/30/95	32	ND (4.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)
02955	T1098-SVS-007-021-SV	04/03/95	21	ND (4.0)	22	ND (2.0)	22	5.5	ND (2.0)	6.9
02957	T1098-SVS-010-006-SV	04/05/95	6	ND (4.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)
02957	T1098-SVS-010-031-SV	04/05/95	31	5.3	2.6	9.7	68	26	5.5	3.6
02957	T1098-SVS-011-006-SV	04/05/95	6	ND (4.0)	ND (2.0)	ND (2.0)	2.4	ND (2.0)	ND (2.0)	ND (2.0)
02958	T1098-SVS-012-005-SV	04/06/95	5	4.5	7.7	ND (2.0)	ND (2.0)	ND (2.0)	ND (2.0)	34

Note: Values in **bold** represent detected VOCs.

^aEPA November 1986.

^bAnalysis request/chain-of-custody record.

EPA = U.S. Environmental Protection Agency.

ER = Environmental Restoration.

ft = Foot (feet).

ID = Identification.

ND () = Not detected above the reporting limit, shown in parentheses.

ppbv = Parts per billion by volume.

RCRA = Resource Conservation and Recovery Act.

RFI = RCRA Facility Investigation.

SV = Soil vapor.

SVS = Soil vapor survey.

SWMU = Solid Waste Management Unit.

VOC = Volatile organic compound.

Surface Soil Results

The analytical results from surface soil samples analyzed at the off-site laboratory are summarized for TAL metals, VOCs, and SVOCs in Tables 2.4.4-3, 2.4.4-4, and 2.4.4-5, respectively. Tables 2.4.4-6, 2.4.4-7, and 2.4.4-8 contain the method detection limits (MDLs) for the TAL metals, VOC, and SVOC analyses, respectively. The pH values are provided in Annex 2-C.

Metals

Arsenic concentrations ranged from 3.4 to 6.7 milligrams (mg)/kilogram (kg). Arsenic concentrations in nine samples exceeded the NMED-approved background concentration of 4.4 mg/kg (Dinwiddie September 1997).

Barium concentrations ranged from 140 to 516 mg/kg. Barium concentration in ten samples exceeded the NMED-approved background concentration of 200 mg/kg.

Beryllium concentrations ranged from nondetect (ND) to 0.63 mg/kg. Beryllium concentrations did not exceed the NMED-approved background concentration of 0.80 mg/kg.

Cadmium concentrations ranged from ND to 0.94 mg/kg. Only one cadmium concentration was above the NMED-approved background concentration of 0.9 mg/kg.

Chromium (total) concentrations ranged from 4.3 to 30 mg/kg. One chromium concentration was above the NMED-approved background concentration of 17.3 mg/kg.

Cobalt concentrations ranged from 2.64 to 16.6 mg/kg. Cobalt concentrations in four samples exceeded the NMED-approved background concentration of 7.1 mg/kg.

Copper concentrations ranged from 6.2 to 44.3 mg/kg. Copper concentrations in two samples exceeded the NMED-approved background concentration of 17 mg/kg.

Lead concentrations ranged from ND to 89.9 mg/kg. One lead concentration was above the NMED-approved background concentration of 39.0 mg/kg.

Mercury concentrations ranged from ND to 0.15 mg/kg. All samples yielded mercury at levels below the NMED-approved background concentration limit of less than 0.25 mg/kg.

Selenium concentrations were ND. No selenium concentrations were above the NMED-approved background.

Silver concentrations were ND to 13.8 mg/kg. Seven silver concentrations were above the NMED-approved background concentration of less than 1 mg/kg. One ND sample had a detection limit above background.

Thallium concentrations were ND to 2.1 mg/kg. Two thallium concentrations were above the NMED-approved background concentration of less than 1.1 mg/kg. One thallium concentration was above the background limit. This sample was ND, but the detection limit was above the background concentration level.

Table 2.4.4-3
 Summary of SWMU 98 RFI Surface Soil Sampling Metals Analytical Results
 March–April 1995
 (Off-Site Laboratory)

Sample Attributes				Metals (EPA Methods 7470/T-6010/T-7471) ^a (mg/kg)					
Record Number ^b	ER Sample ID (Figure 2.4.4-1)	Date Sampled	Sample Depth (ft)	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt
03100	T1098-GR-001-0.5-SS	03/28/95	0.5	4.9	282	0.16 J (0.4)	0.94	9.2	16.6
03100	T1098-GR-002-000-SS	03/28/95	0.5	5.4	303	ND (0.2)	ND (0.49)	5.2	2.8
02325	T1098-GR-003-0.5-SS	03/29/95	0.5	3.7	241	ND (0.2)	0.86	30	2.6
02326	T1098-GR-004-001-SS	03/30/95	1.0	3.4	300	0.4	ND (0.49)	10.2	7.6
02326	T1098-GR-005-001-SS	03/30/95	1.0	3.8	330	0.27	ND (0.49)	7.8	4.5
02903	T1098-GR-006-001-SS	03/31/95	1.0	4	311	0.26	ND (0.49)	7.8	4.0
02904	T1098-GR-007-001-SS	04/03/95	1.0	6.5	449	0.37	ND (0.49)	4.5	4.0
02904	T1098-GR-008-001-SS	04/03/95	1.0	4.7	162	0.62	ND (0.49)	7.1	5.2
02905	T1098-GR-009-0.5-SS	04/04/95	0.5	5.2	195	0.57	ND (0.49)	5.9	5.4
02956	T1098-GR-010-001-SS	04/05/95	1.0	6.7	516	0.37	ND (0.49)	4.3	3.9
02956	T1098-GR-011-001-SS	04/05/95	1.0	4.8	140	0.54	ND (0.49)	7.4	6.2
02959	T1098-GR-012-0.5-SS	04/06/95	0.5	5	316	0.4	ND (0.49)	6.4	10
02903	T1098-GR-013-001-SS ^c	03/31/95	1.0	4	302	0.26	ND (0.49)	8.2	3.6
02905	T1098-GR-014-0.5-SS ^d	04/14/95	0.5	4.6	174	0.63	ND (0.49)	8	7.2
Quality Assurance/Quality Control Sample (mg/L)									
02956	T1098-EB-003-000-W	04/05/95	NA	ND (0.003)	ND (0.002)	ND (0.002)	ND (0.0049)	ND (0.003)	ND (0.003)
Background Soil Concentrations—North Area ^e				4.4	200	0.8	0.9	17.3	7.1

Refer to footnotes at end of table.

Table 2.4.4-3 (Concluded)
 Summary of SWMU 98 RFI Surface Soil Sampling Metals Analytical Results
 March–April 1995
 (Off-Site Laboratory)

Sample Attributes				Metals (EPA Methods 7470/T-6010/T-7471) ^a (mg/kg)						
Record Number ^b	ER Sample ID (Figure 2.4.4-1)	Date Sampled	Sample Depth (ft)	Copper	Lead	Mercury	Selenium	Silver	Thallium	Zinc
03100	T1098-GR-001-0.5-SS	03/28/95	0.5	44.3	36.6	0.15	ND (0.5)	1.2	ND (1.0)	191
03100	T1098-GR-002-000-SS	03/28/95	0.5	6.2	37.4	ND (0.02)	ND (0.5)	ND (2.0)	2.0	24.1
02325	T1098-GR-003-0.5-SS	03/29/95	0.5	43.8	89.9	0.091 J (0.1)	ND (0.5)	13.8	2.1	128
02326	T1098-GR-004-001-SS	03/30/95	1.0	8.4	10.4	ND (0.02)	ND (0.5)	1.5	ND (1.0)	34.7
02326	T1098-GR-005-001-SS	03/30/95	1.0	7.5	14.7	ND (0.02)	ND (0.77)	2	1.1	33.4
02903	T1098-GR-006-001-SS	03/31/95	1.0	10	20.8	ND (0.02)	ND (0.5)	4	1.0	56
02904	T1098-GR-007-001-SS	04/03/95	1.0	8.3	8.2	ND (0.02)	ND (0.5)	ND (0.3)	ND (1.0)	47.8
02904	T1098-GR-008-001-SS	04/03/95	1.0	12.1	9	ND (0.02)	ND (0.5)	ND (0.3)	ND (1.0)	40.2
02905	T1098-GR-009-0.5-SS	04/04/95	0.5	11.8	4.7 J (5)	ND (0.02)	ND (0.5)	ND (0.3)	ND (1.0)	38.2
02956	T1098-GR-010-0.5-SS	04/05/95	0.5	7.6	5.8	ND (0.02)	ND (0.5)	ND (0.3)	ND (1.0)	48.8
02956	T1098-GR-011-001-SS	04/05/95	1.0	10.4	ND (3.1)	ND (0.02)	ND (0.5)	ND (0.3)	0.86 J (1.0)	29.5
02959	T1098-GR-012-0.5-SS	04/06/95	0.5	11.7	12.2	ND (0.02)	ND (0.5)	3.5	ND (1.0)	68.6
02903	T1098-GR-013-001-SS ^c	03/31/95	1.0	10.4	15.8	ND (0.02)	ND (0.64)	4.1	ND (1.0)	124
02905	T1098-GR-014-0.5-SS ^d	04/14/95	0.5	12.7	5.9	ND (0.02)	ND (0.5)	ND (0.3)	0.86 J (1.0)	46.3
Quality Assurance/Quality Control Sample (mg/L)										
02956	T1098-EB-003-000-W	04/05/95	NA	ND (0.002)	ND (0.031)	ND (0.04)	ND (0.005)	ND (0.003)	ND (0.01)	ND (0.0049)
Background Soil Concentrations—North Area ^e				17	39.0	< 0.25	< 1.0	< 1.0	< 1.1	76.0

Note: Values in **bold** exceed background soil concentrations.

^aEPA November 1986.

^bAnalysis request/chain-of-custody record.

^cT1098-GR-013-001-SS is a duplicate of T1098-GR-006-001-SS.

^dT1098-GR-014-0.5-SS is a duplicate of T1098-GR-010-0.5-SS.

^eFrom Dinwiddie September 1997.

EB = Equipment blank.

EPA = U.S. Environmental Protection Agency.

ER = Environmental Restoration.

ft = Foot (feet).

GR = Grab sample.

ID = Identification.

J () = The reported value is greater than or equal to the method detection limit but is less than the reporting limit, shown in parentheses.

mg/kg = Milligram(s) per kilogram.

mg/L = Milligram(s) per liter.

NA = Not applicable.

ND () = Not detected above the method detection limit, shown in parentheses.

RCRA = Resource Conservation and Recovery Act.

RFI = RCRA Facility Investigation.

SS = Surface soil sample.

SWMU = Solid Waste Management Unit.

W = Water sample.

Table 2.4.4-4
Summary of SWMU 98 RFI Soil Sampling VOC Analytical Results
March–April 1995
(Off-Site Laboratory)

Sample Attributes				Analyte (EPA Method 8260) ^a (µg/kg)					
Record Number ^b	ER Sample ID (Figure 2.4.5-1)	Date Sampled	Sample Depth (ft)	Acetone	Ethylbenzene	Methylene chloride	Toluene	1,1,1-Trichloroethane	Xylene
Surface Soils									
03100	T1098-GR-001-0.5-SS	03/28/95	0.5	12	ND (0.91)	8.6	1.2 J (5)	ND (1.02)	ND (1.58)
03100	T1098-GR-002-000-SS	03/28/95	0.5	ND (1.75)	ND (0.91)	6.3	ND (1.56)	ND (1.02)	ND (1.58)
02325	T1098-GR-003-0.5-SS	03/29/95	0.5	ND (1.75)	ND (0.91)	3.1 J (5)	ND (1.56)	ND (1.02)	ND (1.58)
02326	T1098-GR-004-001-SS	03/30/95	1.0	12	ND (0.91)	1.9 J (5)	ND (1.56)	ND (1.02)	ND (1.58)
02326	T1098-GR-005-001-SS	03/30/95	1.0	ND (1.75)	ND (0.91)	2.4 J (5)	ND (1.56)	ND (1.02)	ND (1.58)
02903	T1098-GR-006-001-SS	03/31/95	1.0	ND (1.75)	1.7 J (5)	ND (1.04)	26	2 J (5.0)	9.4
02903	T1098-GR-013-001-SS	03/31/95	1.0	ND (1.75)	1.6 J (5)	ND (1.04)	24	ND (1.02)	10
02904	T1098-GR-007-001-SS	04/03/95	1.0	4.7 J (10)	ND (0.91)	ND (1.04)	ND (1.56)	ND (1.02)	ND (1.58)
02904	T1098-GR-008-001-SS	04/03/95	1.0	6.7 J (10)	ND (0.91)	ND (1.04)	7.3	ND (1.02)	2.1 J (5)
02905	T1098-GR-009-0.5-SS	04/04/95	0.5	ND (1.75)	ND (0.91)	ND (1.04)	2.7 J (5)	ND (1.02)	ND (1.58)
02905	T1098-GR-014-0.5-SS	04/04/95	0.5	ND (1.75)	ND (0.91)	ND (1.04)	2.5 J (5)	ND (1.02)	ND (1.58)
02956	T1098-GR-010-001-SS	04/05/95	1.0	ND (1.75)	1.3 J (5)	3.3 J (5)	18	ND (1.02)	8
02956	T1098-GR-011-001-SS	04/05/95	1.0	ND (1.75)	ND (0.91)	1.3 J (5)	4.6 J (5)	ND (1.02)	3.7 J (5)
02959	T1098-GR-012-0.5-SS	04/06/95	0.5	ND (1.75)	1.7 J (5)	ND (1.04)	23	ND (1.02)	9.7
Subsurface Soils									
02325	T1098-GP-003-010-S	03/29/95	10	ND (1.75)	ND (0.91)	2.2 J (5)	ND (1.56)	ND (1.02)	ND (1.58)
02326	T1098-GP-004-016-S	03/30/95	16	14	ND (0.91)	1.7 J (5)	ND (1.56)	ND (1.02)	ND (1.58)
02326	T1098-GP-004-030-S	03/30/95	30	13	ND (0.91)	ND (1.04)	ND (1.56)	ND (1.02)	ND (1.58)
02903	T1098-GP-005-030-S	03/31/95	30	ND (1.75)	ND (0.91)	ND (1.04)	ND (1.56)	ND (1.02)	ND (1.58)
02903	T1098-GP-015-030-S	03/31/95	30	ND (1.75)	ND (0.91)	ND (1.04)	ND (1.56)	ND (1.02)	ND (1.58)
02904	T1098-GP-007-011-S	04/03/95	11	5.8 J (10)	ND (0.91)	ND (1.04)	ND (1.56)	ND (1.02)	ND (1.58)
02904	T1098-GP-008-011-S	04/03/95	11	8.3 J (10)	ND (0.91)	ND (1.04)	ND (1.56)	ND (1.02)	ND (1.58)

Refer to footnotes at end of table.

Table 2.4.4-4 (Concluded)
 Summary of SWMU 98 RFI Soil Sampling VOC Analytical Results
 March-April 1995
 (Off-Site Laboratory)

Sample Attributes				Analyte (EPA Method 8260) ^a (µg/kg)					
Record Number ^b	ER Sample ID (Figure 2.4.5-1)	Date Sampled	Sample Depth (ft)	Acetone	Ethylbenzene	Methylene chloride	Toluene	1,1,1-Trichloroethane	Xylene
02905	T1098-GP-009-025-S	04/04/95	25	4.9 J (10)	ND (0.91)	ND (1.04)	ND (1.56)	ND (1.02)	ND (1.58)
02956	T1098-GP-010-005-S	04/05/95	05	ND (1.75)	ND (0.91)	2.4 J (5)	ND (1.56)	ND (1.02)	ND (1.58)
02956	T1098-GP-011-010-S	04/05/95	10	ND (1.75)	ND (0.91)	2.7 J (5)	ND (1.56)	ND (1.02)	ND (1.58)
02956	T1098-GP-016-005-S	04/05/95	5	7 J (10)	ND (0.91)	2.2 J (5)	ND (1.56)	ND (1.02)	ND (1.58)
03100	T1098-GP-001-025-S	03/28/95	25	ND (1.75)	ND (0.91)	4.1 J (5)	ND (1.56)	ND (1.02)	ND (1.58)
Quality Assurance/Quality Control Samples (µg/kg)									
02326	T1098-EB-001-000-W ^c	03/30/95	NA	ND (1.75)	ND (0.91)	ND (1.04)	ND (1.56)	ND (1.02)	ND (1.58)
02956	T1098-EB-002-000-W ^c	04/05/95	NA	ND (1.75)	ND (0.91)	ND (1.04)	ND (1.56)	ND (1.02)	ND (1.58)
02956	T1098-EB-003-000-W ^c	04/05/95	NA	ND (1.75)	ND (0.91)	ND (1.04)	ND (1.56)	ND (1.02)	ND (1.58)
02956	T1098-FB-002-000-S	04/05/95	NA	ND (1.75)	ND (0.91)	4.0 J (5)	ND (1.56)	ND (1.02)	ND (1.58)
02325	T1098-TB-002-000-SS	03/29/95	NA	89	ND (0.91)	6	2.8 J (5)	ND (1.02)	1.1 J (5)
02326	T1098-TB-004-000-SS	03/30/95	NA	60	ND (0.91)	4.5 J (5.0)	1.7 J (5)	ND (1.02)	1.5 J (5)
02326	T1098-TB-005-00-SS	03/30/95	NA	ND (1.75)	ND (0.91)	7	ND (1.56)	ND (1.02)	ND (1.58)
02903	T1098-TB-006-000-S	03/31/95	NA	ND (1.75)	ND (0.91)	ND (1.04)	ND (1.56)	ND (1.02)	ND (1.58)
02904	T1098-TB-007-000-S	04/3/95	NA	5.3 J (10)	ND (0.91)	ND (1.04)	ND (1.56)	ND (1.02)	ND (1.58)
02905	T1098-TB-008-000-S	04/4/95	NA	ND (1.75)	ND (0.91)	ND (1.04)	ND (1.56)	ND (1.02)	ND (1.58)
02956	T1098-TB-009-000-S	04/5/95	NA	ND (1.75)	ND (0.91)	2.4 J (5)	ND (1.56)	ND (1.02)	ND (1.58)
02956	T1098-TB-010-000-W ^c	04/5/95	NA	ND (1.75)	ND (0.91)	ND (1.04)	ND (1.56)	ND (1.02)	ND (1.58)
02959	T1098-TB-011-000-S	04/6/95	NA	ND (1.75)	ND (0.91)	ND (1.04)	ND (1.56)	ND (1.02)	ND (1.58)
03100	T1098-TB-001-SS	03/28/95	NA	110	ND (0.91)	8.6	2.6 J (5)	ND (1.02)	2.4 J (5)

Note: Values in bold represent detected VOCs.

^aEPA November 1986.

^bAnalysis request/chain-of-custody record.

^cUnit of measure is µg/L.

µg/kg = Microgram(s) per kilogram.

µg/L = Microgram(s) per liter.

EB = Equipment blank.

EPA = U.S. Environmental Protection Agency.

ER = Environmental Restoration.

FB = Field blank.

ft = Foot (feet).

GP = Geoprobe.

GR = Grab sample.

ID = Identification.

J () = The reported value is greater than or equal to the method detection limit but is less than the reporting limit, shown in parentheses.

NA = Not applicable.

ND () = Not detected above the method detection limit, shown in parentheses.

RCRA = Resource Conservation and Recovery Act.

RFI = RCRA Facility Investigation.

S = Soil sample.

SS = Surface soil sample.

SWMU = Solid Waste Management Unit.

TB = Trip blank.

VOC = Volatile organic compound.

W = Water sample.

Table 2.4.4-5
 Summary of SWMU 98 RFI Soil Sampling SVOC Analytical Results
 March–April 1995
 (Off-Site Laboratory)

Sample Attributes				Analyte (EPA Method 8270) ^a (µg/kg)					
Record Number ^b	ER Sample ID (Figure 2.4.4-1)	Date Sampled	Sample Depth (ft)	Acenaphthene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene
03100	T1098-GR-001-0.5-SS	03/28/95	0.5	390 J (660)	ND (44)	2100	1700	ND (46)	1100
03100	T1098-GR-002-000-SS	03/28/95	0.5	ND (41)	ND (44)	270 J (330)	260 J (330)	520	170 J (330)
02325	T1098-GR-003-0.5-SS	03/29/95	0.5	1200 J (1300)	1700	6100	4500	7100	3300
02326	T1098-GR-004-001-SS	03/30/95	1.0	ND (47)	ND (26)	42 J (330)	ND (21)	ND (96)	ND (225)
02326	T1098-GR-005-001-SS	03/30/95	1.0	ND (47)	ND (26)	35 J (330)	ND (21)	ND (96)	ND (225)
02903	T1098-GR-006-001-SS	03/31/95	1.0	41 J (330)	83 J (330)	450	400	790	260 J (330)
02904	T1098-GR-007-001-SS	04/03/95	1.0	75 J (330)	94 J (330)	320 J (330)	350	470	240 J (330)
02904	T1098-GR-008-001-SS	04/03/95	1.0	790	1900	5300	4200	7400	2600
02905	T1098-GR-009-0.5-SS	04/04/95	0.5	ND (47)	ND (26)	90 J (330)	92 J (330)	120 J (330)	57 J (330)
02956	T1098-GR-010-001-SS	04/05/95	1.0	ND (47)	ND (26)	230 J (330)	250 J (330)	310 J (330)	120 J (330)
02956	T1098-GR-011-001-SS	04/05/95	1.0	96 J (330)	180 J (330)	520	540	810	ND (225)
02959	T1098-GR-012-0.5-SS	04/06/95	0.5	39 J (330)	55 J (330)	270 J (330)	240 J (330)	360	160 J (330)
02903	T1098-GR-013-001-SS	03/31/95	1.0	35 J (330)	82 J (330)	590	520	1200	280 J (330)
02905	T1098-GR-014-0.5-SS	04/04/95	0.5	ND (47)	ND (26)	73 J (330)	70 J (330)	130 J (330)	40 J (330)
Quality Assurance/Quality Control Sample (µg/L)									
02956	T1098-EB-003-000-W	04/05/95	NA	ND (1.4)	ND (0.8)	ND (0.6)	ND (0.6)	ND (2.9)	ND (6.8)

Refer to footnotes at end of table.

Table 2.4.4-5 (Continued)
 Summary of SWMU 98 RFI Soil Sampling SVOC Analytical Results
 March–April 1995
 (Off-Site Laboratory)

Sample Attributes				Analyte (EPA Method 8270) ($\mu\text{g}/\text{kg}$)					
Record Number ^a	ER Sample ID (Figure 2.4.4-1)	Date Sampled	Sample Depth (ft)	Benzo(k) fluoranthene	Butylbenzyl phthalate	Carbazole	Chrysene	Di-n-butyl phthalate	Di-n-octyl phthalate
03100	T1098-GR-001-0.5-SS	03/28/95	0.5	2200	ND (45)	380 J (660)	290 J (660)	74 J (660)	ND (44)
03100	T1098-GR-002-000-SS	03/28/95	0.5	ND (54)	ND (45)	53 J (330)	34 J (330)	ND (61)	ND (44)
02325	T1098-GR-003-0.5-SS	03/29/95	0.5	ND (64)	790 J (1300)	1000 J (1300)	5700	ND (28)	ND (51)
02326	T1098-GR-004-001-SS	03/30/95	1.0	47 J (330)	ND (44)	ND (22)	40 J (330)	ND (28)	65 J (330)
02326	T1098-GR-005-001-SS	03/30/95	1.0	35 J (330)	ND (44)	ND (22)	34 J (330)	ND (28)	82 J (330)
02903	T1098-GR-006-001-SS	03/31/95	1.0	ND (54)	ND (45)	69 J (330)	510	ND (61)	93 J (330)
02904	T1098-GR-007-001-SS	04/03/95	1.0	210 J (330)	ND (44)	76 J (330)	440	ND (28)	ND (51)
02904	T1098-GR-008-001-SS	04/03/95	1.0	ND (64)	ND (44)	1900	5500	ND (28)	ND (51)
02905	T1098-GR-009-0.5-SS	04/04/95	0.5	76 J (330)	ND (44)	ND (22)	110 J (330)	ND (28)	51 J (330)
02956	T1098-GR-010-001-SS	04/05/95	1.0	200 J (330)	ND (44)	ND (22)	290 J (330)	ND (28)	ND (51)
02956	T1098-GR-011-001-SS	04/05/95	1.0	ND (64)	ND (44)	130 J (330)	620	ND (28)	44 J (330)
02959	T1098-GR-012-0.5-SS	04/06/95	0.5	ND (64)	ND (44)	53 J (330)	340	ND (28)	46 J (330)
02903	T1098-GR-013-001-SS	03/31/95	1.0	ND (54)	ND (45)	82 J (330)	690	ND (61)	53 J (330)
02905	T1098-GR-014-0.5-SS	04/04/95	0.5	ND (64)	ND (44)	ND (22)	92 J (330)	ND (28)	61 J (330)
Quality Assurance/Quality Control Sample ($\mu\text{g}/\text{L}$)									
02956	T1098-EB-003-000-W	04/05/95	NA	ND (1.9)	ND (1.3)	ND (0.7)	ND (0.6)	ND (0.8)	ND (1.5)

Refer to footnotes at end of table.

Table 2.4.4-5 (Continued)
 Summary of SWMU 98 RFI Soil Sampling SVOC Analytical Results
 March–April 1995
 (Off-Site Laboratory)

Sample Attributes				Analyte (EPA Method 8270) ^a (µg/kg)					
Record Number ^b	ER Sample ID (Figure 2.4.4-1)	Date Sampled	Sample Depth (ft)	Dibenz(a,h)anthracene	Dibenzofuran	bis(2-Ethylhexyl)phthalate	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene
03100	T1098-GR-001-0.5-SS	03/28/95	0.5	ND (37)	140 J (660)	190 J (660)	3500	260 J (660)	1200
03100	T1098-GR-002-000-SS	03/28/95	0.5	79 J (330)	ND (25)	ND (233)	590	ND (29)	180 J (330)
02325	T1098-GR-003-0.5-SS	03/29/95	0.5	1600	410 J (1300)	290 J (1300)	8900	960 J (1300)	3300
02326	T1098-GR-004-001-SS	03/30/95	1.0	ND (24)	ND (21)	ND (80)	71 J (330)	ND (26)	ND (22)
02326	T1098-GR-005-001-SS	03/30/95	1.0	ND (24)	ND (21)	ND (80)	62 J (330)	ND (26)	ND (22)
02903	T1098-GR-006-001-SS	03/31/95	1.0	80 J (330)	ND (25)	ND (233)	740	34 J (330)	240 J (330)
02904	T1098-GR-007-001-SS	04/03/95	1.0	ND (24)	ND (21)	ND (80)	840	47 J (330)	230 J (330)
02904	T1098-GR-008-001-SS	04/03/95	1.0	ND (24)	450 J (660)	96 J (660)	10000	920	2500
02905	T1098-GR-009-0.5-SS	04/04/95	0.5	37 J (330)	ND (21)	64 J (330)	210 J (330)	ND (26)	46 J (330)
02956	T1098-GR-010-001-SS	04/05/95	1.0	ND (24)	ND (21)	46 J (330)	560	ND (26)	130 J (330)
02956	T1098-GR-011-001-SS	04/05/95	1.0	230 J (330)	42 J (330)	ND (80)	1500	79 J (330)	250 J (330)
02959	T1098-GR-012-0.5-SS	04/06/95	0.5	ND (24)	ND (21)	33 J (330)	660	ND (26)	150 J (330)
02903	T1098-GR-013-001-SS	03/31/95	1.0	84 J (330)	ND (25)	ND (233)	1000	ND (29)	270 J (330)
02905	T1098-GR-014-0.5-SS	04/04/95	0.5	ND (24)	ND (21)	ND (80)	200 J (330)	ND (26)	35 J (330)
Quality Assurance/Quality Control Sample (µg/L)									
02956	T1098-EB-003-000-W	04/05/95	NA	ND (0.7)	ND (0.6)	2.5 J (10)	ND (0.8)	ND (0.8)	ND (0.7)

Refer to footnotes at end of table.

Table 2.4.4-5 (Concluded)
 Summary of SWMU 98 RFI Soil Sampling SVOC Analytical Results
 March–April 1995
 (Off-Site Laboratory)

Sample Attributes				Analyte (EPA Method 8270) ^a (µg/kg)				
Record Number ^b	ER Sample ID (Figure 2.4.4-1)	Date Sampled	Sample Depth (ft)	2-Methyl-naphthalene	Naphthalene	Penta-chlorophenol	Phenanthrene	Pyrene
03100	T1098-GR-001-0.5-SS	03/28/95	0.5	ND (40)	140 J (660)	ND (271)	2900	3500
03100	T1098-GR-002-000-SS	03/28/95	0.5	ND (40)	ND (30)	ND (271)	360	560
02325	T1098-GR-003-0.5-SS	03/29/95	0.5	ND (44)	390 J (1300)	ND (43)	6900	8300
02326	T1098-GR-004-001-SS	03/30/95	1.0	ND (44)	ND (41)	ND (43)	44 J (330)	59 J (330)
02326	T1098-GR-005-001-SS	03/30/95	1.0	ND (44)	ND (41)	ND (43)	40 J (330)	52 J (330)
02903	T1098-GR-006-001-SS	03/31/95	1.0	ND (40)	ND (30)	42 J (1600)	410	740
02904	T1098-GR-007-001-SS	04/03/95	1.0	ND (44)	ND (41)	ND (43)	600	640
02904	T1098-GR-008-001-SS	04/03/95	1.0	100 J (660)	260 J (660)	ND (43)	7500	8200
02905	T1098-GR-009-0.5-SS	04/04/95	0.5	ND (44)	ND (41)	ND (43)	110 J (330)	180 J (330)
02956	T1098-GR-010-0.5-SS	04/05/95	0.5	ND (44)	ND (41)	ND (43)	230 J (330)	360
02956	T1098-GR-011-001-SS	04/05/95	1.0	ND (44)	50 J (330)	ND (43)	1000	960
02959	T1098-GR-012-0.5-SS	04/06/95	0.5	ND (44)	ND (41)	ND (43)	360	680
02903	T1098-GR-013-001-SS ^c	03/31/95	1.0	ND (40)	ND (30)	ND (271)	500	930
02905	T1098-GR-014-0.5-SS ^d	04/04/95	0.5	ND (44)	ND (41)	ND (43)	140 J (330)	160 J (330)
Quality Assurance/Quality Control Sample (µg/L)								
02956	T1098-EB-003-000-W	04/05/95	NA	ND (1.3)	ND (1.2)	ND (1.3)	ND (0.7)	ND (0.7)

Note: Values in **bold** represent detected SVOCs.

^aEPA November 1986.

^bAnalysis request/chain-of-custody record.

^cT1098-GR-013-001-SS is a duplicate of T1098-GR-006-001-SS.

^dT1098-GR-014-0.5-SS is a duplicate of T1098-GR-010-0.5-SS.

EB = Equipment blank.

EPA = U.S. Environmental Protection Agency.

ER = Environmental Restoration.

ft = Foot (feet).

GR = Grab sample.

ID = Identification.

J () = The reported value is greater than or equal to the method detection limit but is less than the reporting limit, shown in parentheses.

µg/kg = Microgram(s) per kilogram.

µg/L = Microgram(s) per liter.

NA = Not applicable.

ND () = Not detected above the method detection limit, shown in parentheses.

RCRA = Resource Conservation and Recovery Act.

RFI = RCRA Facility Investigation.

SS = Surface soil sample.

SVOC = Semivolatile organic compound.

SWMU = Solid Waste Management Unit.

W = Water sample.

Table 2.4.4-6
 Metals Analytical Method Detection Limits Used for SWMU 98 RFI Soil Sampling
 March–April 1995
 (Off-Site Laboratory)

Analyte	Method Detection Limit (mg/kg)
Aluminum	1.3
Antimony	2.1
Arsenic	0.3
Barium	0.2
Beryllium	0.2
Cadmium	0.49
Calcium	13
Chromium	0.3
Cobalt	0.4
Copper	0.4
Iron	2.6
Lead	3.1
Magnesium	2.8
Manganese	0.5
Mercury	0.02
Nickel	0.6
Potassium	27
Selenium	0.5–0.77
Silver	0.3
Sodium	105
Thallium	1
Vanadium	0.4
Zinc	1.6

mg/kg = Milligram(s) per kilogram.
 RCRA = Resource Conservation and Recovery Act.
 RFI = RCRA Facility Investigation.
 SWMU = Solid Waste Management Unit.

Table 2.4.4-7
 VOC Analytical Method Detection Limits Used for SWMU 98 RFI Soil Sampling
 March–April 1995
 (Off-Site Laboratory)

Analyte	Method Detection Limit ($\mu\text{g}/\text{kg}$)
1,1,1-Trichloroethane	1.02
1,1,2,2-Tetrachloroethane	1.17
1,1,2-Trichloroethane	1.37
1,1-Dichloroethane	0.88
1,1-Dichloroethene	1.7
1,2-Dichloroethane	0.88
1,2-Dichloroethene	2.28
1,2-Dichloropropane	1.15
2-Butanone	6.12
2-Hexanone	1.79
4-Methyl-2-pentanone	1.51
Acetone	1.75
Benzene	1.32
Bromodichloromethane	0.92
Bromoform	1.26
Bromomethane	1.49
Carbon disulfide	1.67
Carbon tetrachloride	1.13
Chlorobenzene	1
Chloroethane	2.42
Chloroform	1.03
Chloromethane	3.33
Dibromochloromethane	1
Ethylbenzene	0.91
Methylene chloride	1.04
Styrene	0.85
Tetrachloroethene	1.19
Toluene	1.56
Trichloroethene	0.93
Vinyl acetate	1.53
Vinyl chloride	2.25
Xylene	1.58
cis-1,3-Dichloropropene	1.09
trans-1,3-Dichloropropene	0.95

$\mu\text{g}/\text{kg}$ = Microgram(s) per kilogram.
 RCRA = Resource Conservation and Recovery Act.
 RFI = RCRA Facility Investigation.
 SWMU = Solid Waste Management Unit.
 VOC = Volatile organic compound.

Table 2.4.4-8
SVOC Analytical Method Detection Limits Used for SWMU 98 RFI Soil Sampling
March–April 1995
(Off-Site Laboratory)

Analyte	Method Detection Limit (µg/kg)
1,2,4-Trichlorobenzene	30–37
1,2-Dichlorobenzene	46–51
1,3-Dichlorobenzene	41–48
1,4-Dichlorobenzene	32–59
2,4,5-Trichlorophenol	39–49
2,4,6-Trichlorophenol	32–35
2,4-Dichlorophenol	27–37
2,4-Dimethylphenol	46–62
2,4-Dinitrophenol	216–419
2,4-Dinitrotoluene	28–29
2,6-Dinitrotoluene	29–38
2-Chloronaphthalene	46–49
2-Chlorophenol	28–43
2-Methylnaphthalene	40–44
2-Nitroaniline	32–39
2-Nitrophenol	31–53
3,3'-Dichlorobenzidine	32–103
3-Nitroaniline	23–112
4-Bromophenyl phenyl ether	26–61
4-Chloro-3-methylphenol	41–45
4-Chlorobenzamine	20–139
4-Chlorophenyl phenyl ether	28–42
4-Methylphenol	33–58
4-Nitroaniline	31–39
4-Nitrophenol	68–305
Acenaphthene	41–47
Acenaphthylene	32
Anthracene	26–44
Benzo(a)anthracene	21–52
Benzo(a)pyrene	21–48
Benzo(b)fluoranthene	46–96
Benzo(g,h,i)perylene	83–225
Benzo(k)fluoranthene	54–64
Benzoic acid	813
Benzyl alcohol	36–40
Butylbenzyl phthalate	44–45
Carbazole	22–122
Chrysene	19–21
Di-n-butyl phthalate	28–61
Di-n-octyl phthalate	44–51
Dibenz(a,h)anthracene	24–37
Dibenzofuran	21–25
Diethylphthalate	14–60
Dimethylphthalate	37–40
Dinitro-o-cresol	28–393

Refer to footnotes at end of table.

Table 2.4.4-8 (Concluded)
 SVOC Analytical Method Detection Limits Used for SWMU 98 RFI Soil Sampling
 March–April 1995
 (Off-Site Laboratory)

Analyte	Method Detection Limit ($\mu\text{g}/\text{kg}$)
Fluoranthene	26–40
Fluorene	26–29
Hexachlorobenzene	25–87
Hexachlorobutadiene	40–56
Hexachlorocyclopentadiene	108
Hexachloroethane	49–62
Indeno(1,2,3-c,d)pyrene	22–67
Isophorone	39–52
Naphthalene	30–41
Nitrobenzene	36–39
Pentachlorophenol	43–271
Phenanthrene	23–28
Phenol	37–60
Pyrene	25–62
bis(2-Chloroethoxy)methane	36–45
bis(2-Chloroethyl)ether	26–61
bis(2-Ethylhexyl)phthalate	80–233
bis-Chloroisopropyl ether	37–39
n-Nitrosodiphenylamine	39–40
n-Nitrosodipropylamine	37–48
o-Cresol	29–49

$\mu\text{g}/\text{kg}$ = Microgram(s) per kilogram.
 RCRA = Resource Conservation and Recovery Act.
 RFI = RCRA Facility Investigation.
 SVOC = Semivolatile organic compound.
 SWMU = Solid Waste Management Unit.

Zinc concentrations were 124 to 191 mg/kg. Zinc concentrations in three samples exceeded the NMED approved background concentration of 76.0 mg/kg.

VOCs

All samples were ND and/or J (estimated) values for VOCs except for acetone, methylene chloride, toluene, and xylene (Table 2.4.4-4). Acetone had four detects ranging from 4.7 J to 12 parts per billion (ppb). Methylene chloride had seven detects from 1.3 J to 8.6 ppb. Toluene had nine detects ranging from 1.2 J to 26 ppb. Xylene had six detects ranging from 2.1 J to 10 ppb. The additional compounds with J values only were ethylbenzene and 1,1,1-TCA (refer to Table 2.4.4-4).

SVOCs

Twenty-four SVOCs were detected in the surface soil samples. The detected values for each of these compounds are provided in Table 2.4.4-5.

Subsurface Soil Results

VOCs

The analytical results are summarized for VOCs in Table 2.4.4-4.

The VOC analytical results from the ERCL were ND for all samples. The confirmatory VOC analytical results from the off-site laboratory were ND and/or J values, except for acetone. The acetone concentrations were 13 and 14 ppb.

QA/QC Results

Data quality was assessed by reviewing the field quality assurance (QA)/quality control (QC) results. This section summarizes the data quality assessment.

Tables 2.4.4-3, 2.4.4-4, and 2.4.4-5 show the QA/QC sample analytical results for the TAL metals, VOCs, and SVOCs collected during the sampling. QA/QC samples consisted of eleven (nine soil and one water) trip blank, three field soil blank, four field duplicate, and three equipment rinsate blank samples. The trip and field blank samples were analyzed for VOCs. The field duplicates and equipment rinsate blank samples were analyzed for VOCs, TAL metals, and SVOCs.

The trip blank samples were ND or J values for all VOCs except acetone (60 to 110 ppb), 2-butanone (11 to 35 ppb), and methylene chloride (6 to 8.6 ppb). The field blank sample was either ND or J values for VOCs.

The equipment rinsate blank sample was either ND or J values for VOCs and SVOCs. TAL metals were either ND or below approved background levels.

Data Validation

The data summary (Certificate of Analysis) reports were reviewed for completeness and accuracy as required by the SNL/NM Technical Operating Procedure 94-03 (SNL/NM October 1994). Data verification (DV) was performed using the SNL/NM DV Level 1 and Level 2 checklists. The RFI data were not validated. Instead, the ERCL data were confirmed by duplicate samples analyzed by the off-site laboratory.

2.4.5 Investigation # 4—Additional RFI Field Investigation

2.4.5.1 *Nonsampling Data Collection*

No additional nonsampling data collection was completed as part of Investigation # 4.

2.4.5.2 *Sampling Data Collection*

The additional RFI field activities were conducted in two stages: collecting soil and soil-gas samples and analyzing the sampling data.

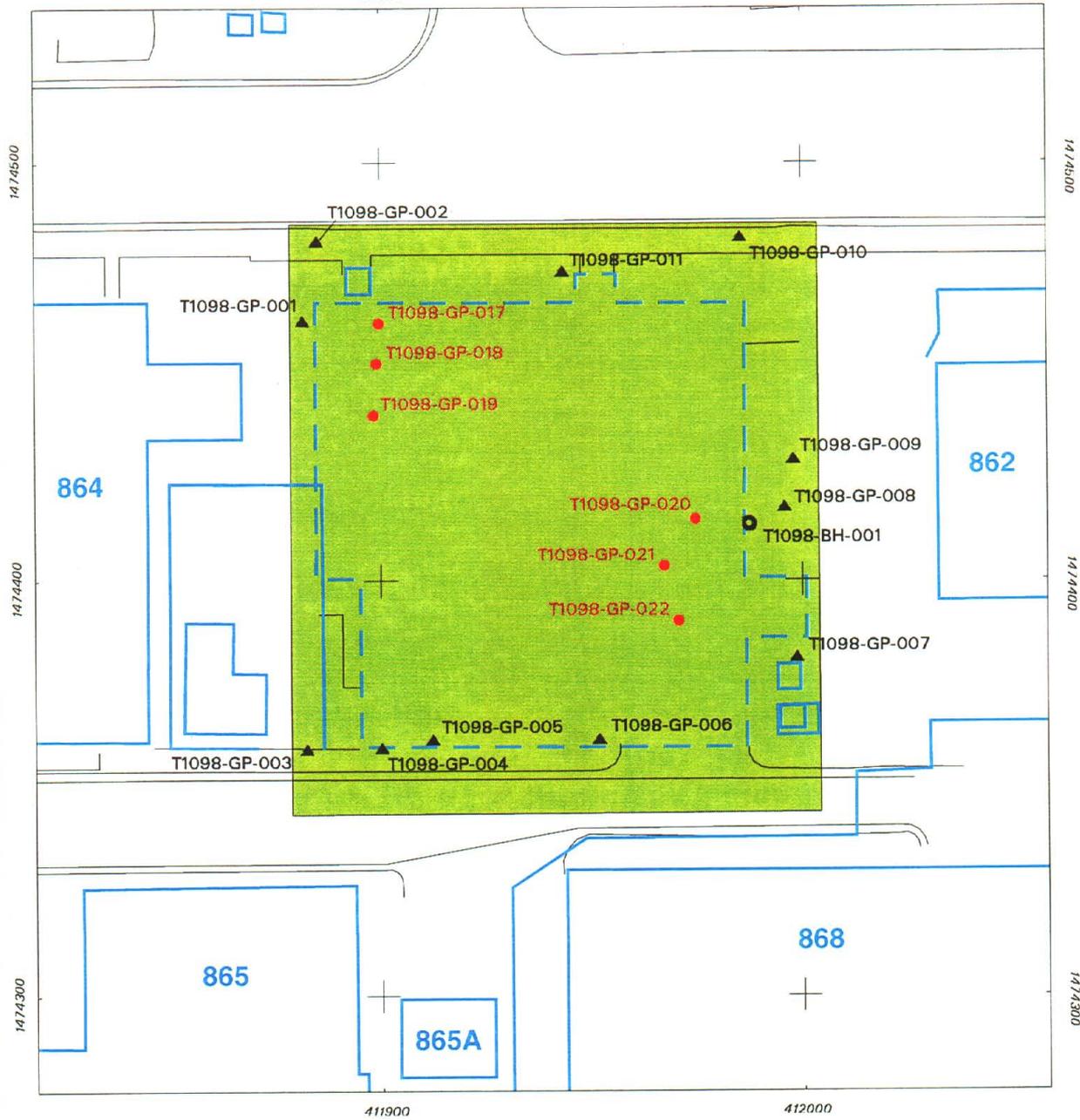
2.4.5.2.1 *Fieldwork Activities*

The fieldwork was conducted in two phases: in phase one, soil samples were collected from near-surface locations; in phase two, a deep borehole was drilled and sampled. On July 29, 1999, the six surface soil samples (T1098-GP-017 through T1098-GP-022) were collected with a Geoprobe drill rig (Figure 2.4.5-1). Samples collected from T1098-GP-017, -018, and -019 are not in this report but will be included in the Acid Waste Line (SWMU 226) investigation; these samples were collected along a lateral pipe connected to the Old Acid Waste Line.

On August 19, 1999, the borehole T1098-BH-001 was drilled with a CME 75 hollow-stem auger rig (Figure 2.4.5-1). This borehole was located next to T1098-GP-008 (RFI Investigation #3) at the TCA release area. The original plan called for drilling to 150 feet bgs. Because of the difficult drilling, the field geologist discontinued drilling at 140 feet bgs. BH-001 is an extension of T1098-GP-008, which was drilled to 30 feet bgs. Soil-gas and soil samples were collected every 10 feet, starting at 30 feet bgs, with the soil-gas sample collected first, followed by the soil sample.

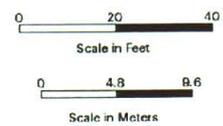
2.4.5.2.2 *Sample Collection Data*

Sample types collected during the additional field investigation were surface soil, soil-gas, and subsurface soil samples. The samples collected and the analyses performed are listed in Table 2.4.5-1.



- Legend**
- Borehole Location
 - Surface Soil Sample Location
 - ▲ 1995 Sample Location
 - - - Road
 - - - Former Building 863
 - ▭ Other Buildings
 - SWMU 98

Figure 2.4.5-1
SWMU 98
Surface Sample and
Borehole Locations



Sandia National Laboratories, New Mexico
Environmental Geographic Information System

Table 2.4.5-1
 Listing of Samples Collected and Analyses Performed for SWMU 98
 RFI Field Investigation
 July–August 1999

Sample Attributes			On-Site Laboratory Analyses	Off-Site Laboratory Analyses		
Record Number ^a	Date Sampled	ER Sample ID (Figure 2.4.5-1)	VOCs ^b	TAL Metals ^c	VOCs ^b	SVOCs ^d
Surface Soil						
602188	7/29/99	T1098-GP-020-1-S		X	X	X
602188	7/29/99	T1098-GP-021-1-S		X	X	X
602188	7/29/99	T1098-GP-022-1-S		X	X	X
602188	7/29/99	T1098-GP-023-1-S (duplicate)		X	X	X
Subsurface Soil						
602752	8/19/99	T1098-BH-001-030-S		X	X	
602752	8/19/99	T1098-BH-001-040-S		X	X	
602752	8/19/99	T1098-BH-001-050-S		X	X	
602752	8/19/99	T1098-BH-001-060-S			X	
602752	8/19/99	T1098-BH-001-070-S		X	X	
602752	8/19/99	T1098-BH-001-080-S		X	X	
602752	8/19/99	T1098-BH-001-090-S		X	X	
602752	8/19/99	T1098-BH-001-090-SD (duplicate)		X	X	
602752	8/19/99	T1098-BH-001-100-S		X	X	
602752	8/20/99	T1098-BH-001-110-S		X	X	
602752	8/20/99	T1098-BH-001-120-S		X	X	
602752	8/20/99	T1098-BH-001-130-S		X	X	
Soil Gas						
602753	8/19/99	T1098-BH-001-030-SV	X			
602753	8/19/99	T1098-BH-001-040-SV	X			
602753	8/19/99	T1098-BH-001-050-SV	X			
602753	8/19/99	T1098-BH-001-060-SV	X			
602753	8/19/99	T1098-BH-001-070-SV	X			
602754	8/19/99	T1098-BH-001-080-SV	X			
602754	8/19/99	T1098-BH-001-090-SV	X			
602754	8/19/99	T1098-BH-001-090-SVD (duplicate)	X			
602754	8/19/99	T1098-BH-001-100-SV	X			
602754	8/20/99	T1098-BH-001-110-SV	X			
602754	8/20/99	T1098-BH-001-130-SV	X			
602754	8/20/99	T1098-BH-001-140-SV	X			
Equipment Blanks						
602188	7/29/99	T1098-EB-004-000-W		X	X	X
602752	8/19/99	T1098-EB-005-000-W		X	X	

Refer to footnotes at end of table.

Table 2.4.5-1 (Concluded)
 Listing of Samples Collected and Analyses Performed for SWMU 98
 RFI Field Investigation
 July–August 1999

Sample Attributes			On-Site Laboratory Analyses	Off-Site Laboratory Analyses		
Record Number ^a	Date Sampled	ER Sample ID (Figure 2.4.5-1)	VOCs ^b	TAL Metals ^c	VOCs ^b	SVOCs ^d
Trip Blanks						
602188	7/29/99	T1098-TB-013-000-W			X	
602752	8/19/99	T1098-TB-014-000-W			X	

^aAnalysis request/chain-of-custody record.

^bEPA Method 8260.

^cEPA Method 6010/7471.

^dEPA Method 8270.

BH = Borehole.

EB = Equipment blank.

ER = Environmental Restoration.

GP = Geoprobe.

ID = Identification.

RCRA = Resource Conservation and Recovery Act.

RFI = RCRA Facility Investigation.

S = Soil sample.

SD = Soil sample duplicate.

SV = Soil vapor.

SVD = Soil vapor duplicate.

SVOC = Semivolatile organic compound.

SWMU = Solid Waste Management Unit.

TB = Trip blank.

VOC = Volatile organic compound.

W = Water sample.

The surface soil samples were collected at 1 foot bgs at each location. Three soil samples (T1098-GP-020 through T1098-GP-022), one field duplicate (T1098-GP-23), and one equipment rinsate blank sample were analyzed for VOCs, SVOCs, and TAL metals. The samples were sent off site to General Engineering Laboratory (GEL). The samples were analyzed by criteria described in EPA Method 8260 for VOCs, EPA Method 8270 for SVOCs, and EPA Methods 6010 and 7471 for TAL metals.

The soil-gas samples were collected at each 10-foot interval (from 30 to 140 feet bgs) except at 120 feet bgs. There were not enough sample bulbs available to collect a soil-gas sample at 120 feet bgs, so this interval was not sampled. Twelve soil-gas samples were collected and analyzed for VOCs by the ERCL. The samples were analyzed by criteria described in EPA Method 8260 for VOCs.

In the borehole, subsurface soil samples were collected at each 10-foot interval (from 30 to 140 feet bgs) except at 60 and 140 feet bgs. At 60 feet bgs, the sampler did not collect enough soil for metal analysis. At 140 feet bgs, the soil sampler would not penetrate the formation, so no sample was collected. Twelve soil samples (T1098-BH-001-030 through T1098-BH-001-130) were collected and analyzed for VOCs and TAL metals by GEL. The samples were analyzed by criteria described in EPA Method 8260 for VOCs and EPA Methods 6010B and 7471A for TAL metals.

2.4.5.2.3 Data Gaps

The analytical data from confirmatory sampling was reviewed by the HRMB. The data are sufficient to characterize the nature and extent of COCs at this site (see Section 2.4.5.2.4). Further characterization of SWMU 98 will not be required based on the data.

2.4.5.2.4 Results and Conclusions

This section discusses the analytical results of the surface soil, soil-gas, and subsurface soil samples. The conclusions are based on these results.

Surface Soil Results

The analytical results for RCRA metals, beryllium, and any TAL metal above background and DOE/Oversight Bureau (OB) Maximum Background Levels are provided in Table 2.4.5-2. The metals results were either ND or below approved background levels except for arsenic, barium, and vanadium. Three arsenic results (4.61 to 9.15 mg/kg) were above the background level of 4.4 mg/kg. Four barium results (302 to 605 mg/kg) were above the background level of 200 mg/kg. Two vanadium results (52.9 and 53.1 mg/kg) were above the background level of 33 mg/kg. These results are provided in Table 2.4.5-2. Analytical results for silver (a COC) were all below the background level of <1.0 mg/kg (Table 2.4.5-2). A summary of the metals MDLs is provided in Table 2.4.5-3.

The VOC and SVOC analytical results were ND for all samples. A summary of the VOC and SVOC MDLs are provided in Tables 2.4.5-4 and 2.4.5-5, respectively.

Table 2.4.5-2
Summary of SWMU 98 RFI Soil Sampling Metals Analytical Results
July–August 1999
(Off-Site Laboratory)

Sample Attributes				Metals (EPA Methods 6010A/7470/7470A/7471/7471A) ^a (mg/kg)					
Record Number ^b	ER Sample ID (Figure 2.4.5-1)	Date Sampled	Sample Depth (ft)	Arsenic	Barium	Beryllium	Cadmium	Chromium	Copper
602188	T1098-GP-020-1-S	07/02/99	1.0	4.61	558	0.268 J (0.481)	0.0697 J (0.481)	5.42	4.05
602188	T1098-GP-021-1-S	07/02/99	1.0	6.45	302	0.387 J (0.49)	0.0418 J (0.49)	6.77	6.34
602188	T1098-GP-022-1-S	07/02/99	1.0	9.15	328	0.345 J (0.49)	0.0734 J (0.49)	6	6.06
602188	T1098-GP-023-1-S ^c	07/02/99	1.0	4.07	605	0.353 J (0.485)	0.0716 J (0.485)	6.25	5.48
602752	T1098-BH-001-030-S	08/19/99	30	1.53	49.9	0.286 J (0.459)	ND (0.0349)	3.2	9.75
602752	T1098-BH-001-040-S	08/19/99	40	2.35	90.5	0.444 J (0.476)	ND (0.0362)	7.26	11.9
602752	T1098-BH-001-050-S	08/19/99	50	1.84	138	0.25 J (0.49)	ND (0.0373)	4.29	15.4
602752	T1098-BH-001-070-S	08/19/99	70	2.03	43.7	0.379 J (0.5)	ND (0.038)	5.86	9.29
602752	T1098-BH-001-080-S	08/19/99	80	3.14	206	0.737	ND (0.038)	9.91	19.3
602752	T1098-BH-001-090-S	08/19/99	90	3.6	202	0.736	ND (0.0373)	11.3	15.7
602752	T1098-BH-001-090-SD	08/19/99	90	2.2	45.4	0.391 J (0.495)	ND (0.0376)	6.07	9.46
602752	T1098-BH-001-100-S	08/19/99	100	1.58	16	0.28 J (0.5)	ND (0.038)	4.23	11
602752	T1098-BH-001-110-S	08/20/99	110	2.96	50.8	0.559	ND (0.0358)	9.19	12
602752	T1098-BH-001-120-S	08/20/99	120	3.44	261	0.611	ND (0.0376)	8.51	10.2
602752	T1098-BH-001-130-S	08/20/99	130	4.28	62.1	0.77	ND (0.0369)	12	21.4
Quality Assurance/Quality Control Samples (µg/L)									
602188	T1098-EB-004-000-W	07/22/99	NA	ND (0.00451)	0.006	ND (0.00026)	ND (0.00044)	0.00236 J (0.005)	ND (0.00451)
602752	T1098-EB-005-000-W	08/19/99	NA	ND (0.00451)	0.0032 J (0.005)	0.00027 J (0.005)	ND (0.00044)	0.0016 J (0.005)	ND (0.00451)
Background Soil Concentrations—North Area ^d				4.4	200	0.8	0.9	17.3	17

Refer to footnotes at end of table.

Table 2.4.5-2 (Concluded)
 Summary of SWMU 98 RFI Soil Sampling Metals Analytical Results
 July–August 1999
 (Off-Site Laboratory)

Sample Attributes				Metals (EPA Methods 6010A/7470/7470A/7471/7471A) ^a (mg/kg)					
Record Number ^b	ER Sample ID (Figure 2.4.4-1)	Date Sampled	Sample Depth (ft)	Lead	Mercury	Selenium	Silver	Thallium	Vanadium
602188	T1098-GP-020-1-S	07/02/99	1.0	3.87	ND (0.0022)	ND (0.135)	0.44 J (0.481)	ND (0.0221)	27.1
602188	T1098-GP-021-1-S	07/02/99	1.0	5.53	ND (0.0022)	ND (0.135)	0.38 J (0.49)	ND (0.0221)	52.9
602188	T1098-GP-022-1-S	07/02/99	1.0	5.45	ND (0.0022)	ND (0.135)	0.375 J (0.49)	ND (0.0221)	53.1
602188	T1098-GP-023-1-S ^c	07/02/99	1.0	4.91	ND (0.0022)	ND (0.135)	0.287 J (0.485)	ND (0.0221)	26.8
602752	T1098-BH-001-030-S	08/19/99	30	2.98	0.00692 J (0.0304)	ND (0.248)	0.115 J (0.459)	ND (0.41)	13.4
602752	T1098-BH-001-040-S	08/19/99	40	6.1	0.0094 J (0.0306)	ND (0.257)	0.142 J (0.476)	ND (0.42)	17.3
602752	T1098-BH-001-050-S	08/19/99	50	4.47	0.00607 J (0.0321)	ND (0.265)	0.135 J (0.49)	ND (0.43)	14.4
602752	T1098-BH-001-070-S	08/19/99	70	4.99	ND (0.0021)	ND (0.27)	0.136 J (0.5)	ND (0.44)	13.9
602752	T1098-BH-001-080-S	08/19/99	80	8.39	0.0139 J (0.0319)	ND (0.27)	0.139 J (0.5)	ND (0.44)	17.1
602752	T1098-BH-001-090-S	08/19/99	90	10.6	0.0144 J (0.0316)	ND (0.265)	0.139 J (0.49)	ND (0.43)	29.1
602752	T1098-BH-001-090-SD	08/19/99	90	5.54	0.00611 J (0.0301)	ND (0.267)	0.153 J (0.495)	ND (0.44)	16.1
602752	T1098-BH-001-100-S	08/19/99	100	3.48	0.00752 J (0.0311)	ND (0.27)	0.125 J (0.5)	ND (0.44)	11
602752	T1098-BH-001-110-S	08/20/99	110	7.77	0.0061 J (0.0325)	ND (0.255)	0.163 J (0.472)	0.44 J (1.0)	21.8
602752	T1098-BH-001-120-S	08/20/99	120	8.37	0.0163 J (0.0321)	ND (0.267)	0.162 J (0.495)	ND (0.44)	20.4
602752	T1098-BH-001-130-S	08/20/99	130	12.5	0.0123 J (0.0276)	ND (0.262)	0.181 J (0.485)	0.53 J (1.0)	36
Quality Assurance/Quality Control Samples (µg/L)									
602188	T1098-EB-004-000-W	07/22/99	NA	ND (0.00159)	ND (0.00004)	ND (0.00271)	ND (0.00073)	ND (0.003)	0.006
602752	T1098-EB-005-000-W	08/19/99	NA	ND (0.00159)	ND (0.00004)	ND (0.00271)	ND (0.00073)	ND (0.003)	0.0032 J (0.005)
Background Soil Concentrations—North Area ^d				39	< 1.25	< 1.0	< 1.0	< 1.1	33

Note: Values in **bold** exceed background soil concentrations.

^aEPA November 1986.

^bAnalysis request/chain-of-custody record.

^cT1098-GP-023-001-S is a duplicate of T1098-GP-020-01-S.

^dFrom Dinwiddie 1997.

BH = Borehole.

EB = Equipment blank.

EPA = U.S. Environmental Protection Agency.

ER = Environmental Restoration.

ft = Foot (feet).

GP = Geoprobe.

ID = Identification.

J () = The reported value is greater than or equal to the method detection limit but is less than the reporting limit, shown in parentheses.

mg/kg = Milligram(s) per kilogram.

µg/L = Microgram(s) per liter.

NA = Not applicable.

ND () = Not detected above the method detection limit, shown in parentheses.

RCRA = Resource Conservation and Recovery Act.

RFI = RCRA Facility Investigation.

S = Soil sample.

SD = Duplicate soil sample.

SWMU = Solid Waste Management Unit.

W = Water sample.

Table 2.4.5-3
 Metal Analytical Method Detection Limits Used for SWMU 98 RFI Soil Sampling
 July–August 1999
 (Off-Site Laboratory)

Analyte	Method Detection Limit (mg/kg)
Aluminum	0.591–1.18
Antimony	0.191–0.381
Arsenic	0.228–0.455
Barium	0.027–0.054
Beryllium	0.012–0.024
Cadmium	0.019–0.038
Calcium	3.49–32.9
Chromium	0.038–0.076
Cobalt	0.017–0.033
Copper	0.067–0.134
Iron	5–10
Lead	0.079–0.157
Magnesium	0.254–0.507
Manganese	0.355–0.709
Mercury	0.00186–0.0022
Mercury	0.00225
Nickel	0.032–0.063
Potassium	1.42–2.84
Selenium	0.135–0.27
Silver	0.031–0.06
Sodium	3.21–6.42
Thallium	0.221–0.441
Vanadium	0.027–0.053
Zinc	0.185–0.37

mg/kg = Milligram(s) per kilogram.
 RCRA = Resource Conservation and Recovery Act.
 RFI = RCRA Facility Investigation.
 SWMU = Solid Waste Management Unit.

Table 2.4.5-4
 VOC Analytical Method Detection Limits Used for SWMU 98 RFI Soil Sampling
 July–August 1999
 (Off-Site Laboratory)

Analyte	Method Detection Limit ($\mu\text{g}/\text{kg}$)
1,1,1-Trichloroethane	0.1
1,1,2,2-Tetrachloroethane	0.6
1,1,2-Trichloroethane	0.3
1,1-Dichloroethane	0.1
1,1-Dichloroethene	0.3
1,2-Dichloroethane	0.2
1,2-Dichloropropane	0.2
2-Butanone	3.2
2-Hexanone	2.8
4-Methyl-2-pentanone	3.1
Acetone	10.3
Benzene	0.5
Bromodichloromethane	0.1
Bromoform	0.3
Bromomethane	0.3
Carbon disulfide	0.3
Carbon tetrachloride	0.5
Chlorobenzene	0.3
Chloroethane	0.3
Chloroform	0.1
Chloromethane	0.2
Dibromochloromethane	0.2
Ethyl benzene	0.3
Methylene chloride	1.4
Styrene	0.3
Tetrachloroethene	0.4
Toluene	0.9
Trichloroethene	0.3
Vinyl acetate	2.1
Vinyl chloride	0.4
Xylene	0.7
cis-1,2-Dichloroethene	0.1
cis-1,3-Dichloropropene	0.2
trans-1,2-Dichloroethene	0.1
trans-1,3-Dichloropropene	0.3

$\mu\text{g}/\text{kg}$ = Microgram(s) per kilogram.
 RCRA = Resource Conservation and Recovery Act.
 RFI = RCRA Facility Investigation.
 SWMU = Solid Waste Management Unit.
 VOC = Volatile organic compound.

Table 2.4.5-5
 SVOC Analytical Method Detection Limits Used for SWMU 98 RFI Soil Sampling
 July–August 1999
 (Off-Site Laboratory)

Analyte	Method Detection Limit ($\mu\text{g}/\text{kg}$)
1,2,4-Trichlorobenzene	186
1,2-Dichlorobenzene	171
1,2-Diphenylhydrazine	57
1,3-Dichlorobenzene	129
1,4-Dichlorobenzene	61
2,4,5-Trichlorophenol	154
2,4,6-Trichlorophenol	77
2,4-Dichlorophenol	176
2,4-Dimethylphenol	109
2,4-Dinitrophenol	368
2,4-Dinitrotoluene	117
2,6-Dinitrotoluene	140
2-Chloronaphthalene	173
2-Chlorophenol	157
2-Methylnaphthalene	204
2-Nitroaniline	67
2-Nitrophenol	181
3,3'-Dichlorobenzidine	278
3-Nitroaniline	83
4-Bromophenyl phenyl ether	118
4-Chloro-3-methylphenol	128
4-Chlorobenzenamine	155
4-Chlorophenyl phenyl ether	146
4-Nitroaniline	103
4-Nitrophenol	109
Acenaphthene	160
Acenaphthylene	147
Anthracene	88
Benzo(a)anthracene	68
Benzo(a)pyrene	72
Benzo(b)fluoranthene	142
Benzo(g,h,i)perylene	81
Benzo(k)fluoranthene	132
Benzoic acid	893
Benzyl alcohol	230
Butylbenzyl phthalate	90
Chrysene	55
Di-n-butyl phthalate	73
Di-n-octyl phthalate	174
Dibenz(a,h)anthracene	83
Dibenzofuran	134
Diethylphthalate	76
Dimethylphthalate	109
Dinitro-o-cresol	101
Fluoranthene	65

Refer to footnotes at end of table.

Table 2.4.5-5 (Concluded)
 SVOC Analytical Method Detection Limits Used for SWMU 98 RFI Soil Sampling
 July–August 1999
 (Off-Site Laboratory)

Analyte	Method Detection Limit ($\mu\text{g}/\text{kg}$)
Fluorene	114
Hexachlorobenzene	70
Hexachlorobutadiene	153
Hexachlorocyclopentadiene	193
Hexachloroethane	132
Indeno(1,2,3-c,d)pyrene	80
Isophorone	146
Naphthalene	157
Nitrobenzene	132
Pentachlorophenol	57
Phenanthrene	60
Phenol	57
Pyrene	72
bis(2-Chloroethoxy)methane	169
bis(2-Chloroethyl)ether	53
bis(2-Ethylhexyl)phthalate	299
bis-Chloroisopropyl ether	105
m,p-Cresol	153
n-Nitrosodiphenylamine	21
n-Nitrosodipropylamine	129
o-Cresol	63

$\mu\text{g}/\text{kg}$ = Microgram(s) per kilogram.
 RCRA = Resource Conservation and Recovery Act.
 RFI = RCRA Facility Investigation.
 SVOC = Semivolatile organic compound.
 SWMU = Solid Waste Management Unit.

Soil-gas Results

The analytical results with MDLs are provided in Table 2.4.5-6 and the ERCL analytical data sheets are provided in Annex 2-D. The VOCs were ND except for 1,1,1-TCA, 1,1-DCE, 1,1,2-TCA, trichloroethene, benzene, and toluene. Figure 2.4.5-2 is a schematic of T1098-BH-001 with the associated VOC analytical results at each depth.

Subsurface Soil Results

The analytical results for RCRA metals, beryllium, and TAL metals above background levels and the DOE/OB Maximum Background Levels are shown in Table 2.4.5-2. The metals results were either ND or below background levels except for barium, copper, lead, and vanadium. Three barium results (202 to 261 mg/kg) were above the background level of 200 mg/kg. Two copper results (19.3 and 21.4 mg/kg) were above the background level of 17.0 mg/kg. One vanadium result (53.1 mg/kg) was above the background level of 33.0 mg/kg. Analytical results for silver (a COC) were all below the background level of <1.0 mg/kg.

The VOC analytical results were ND for all compounds. A summary of the VOC MDLs is provided in Table 2.4.5-4.

QA/QC Results

Two equipment rinsate and two trip blank QC samples were collected and analyzed. The equipment rinsate blanks were analyzed for VOCs, SVOCs, and TAL metals. The VOC and SVOC results were ND except for one acetone value (6.8 B micrograms [μg]/liter [L]), and the metal results were either ND or below approved soil background levels. The trip blanks were analyzed for VOCs. The VOC results were ND for VOCs except for one acetone value (4.0 B $\mu\text{g/L}$), one chloroform value (0.83 $\mu\text{g/L}$), and one methylene chloride value (1.3 J $\mu\text{g/L}$).

Two pairs of duplicate samples were collected as part of the confirmatory sampling effort and were analyzed by the off-site laboratory for VOCs and TAL metals. The primary sample (TI098-GP-020-1-S) and the duplicate sample (TI098-GP-023-1-S) were both ND for VOCs. The primary sample (TI098-BH-001-090-S) and the duplicate sample (TI098-BH-001-090-SD) were both ND for VOCs.

Relative percent differences (RPDs) were calculated for the metals detected in the primary and duplicate samples. The RPDs were within the acceptable RPD limit of 20 percent for all metals analyzed except beryllium, copper, lead, silver (Table 2.4.5-7). For the sample pair TI098-BH-001-090-S/TI098-BH-001-090-SD, TAL metals analysis yielded RPDs that exceeded the acceptable RPD limit of 20 percent except for beryllium and silver (Table 2.4.5-7). Although the RPDs presented in Table 2.4.5-7 exceed the RPD limit for most metals, they are typical of the heterogeneous, uncontaminated soil at SNL/NM and are, therefore, acceptable.

Table 2.4.5-6
Summary of SWMU 98 VOC Soil-gas Analytical Results, BH-001
August 1999

Sample Attributes				Analyte (EPA Method 8260) ^a (ppmv)					
Record Number ^b	ER Sample ID (Figure 2.4.5-1)	Date Sampled	Sample Depth (ft)	Benzene	1,1-Dichloroethene	Toluene	Trichloroethene	1,1,1-Trichloroethane	1,1,2-Trichloroethane
602753	T1098-BH-001-30-SV	8/19/99	30	ND (0.018)	ND (0.015)	ND (0.016)	ND (0.011)	ND (0.011)	ND (0.011)
602753	T1098-BH-001-40-SV	8/19/99	40	ND (0.018)	ND (0.015)	ND (0.016)	ND (0.011)	ND (0.011)	ND (0.011)
602753	T1098-BH-001-50-SV	8/19/99	50	0.22	5.0	0.17	ND (0.011)	0.28	0.16
602753	T1098-BH-001-60-SV	8/19/99	60	ND (0.018)	15.0	ND (0.016)	0.17	0.77	ND (0.011)
602753	T1098-BH-001-70-SV	8/19/99	70	ND (0.018)	19.0	ND (0.016)	0.25	0.89	0.14
602754	T1098-BH-001-80-SV	8/19/99	80	ND (0.018)	10	ND (0.016)	ND (0.011)	0.32	ND (0.011)
602754	T1098-BH-001-90-SV	8/19/99	90	ND (0.018)	7.7	ND (0.016)	ND (0.011)	0.22	ND (0.011)
602754	T1098-BH-001-90-SVD	8/19/99	90	ND (0.018)	8.8	ND (0.016)	ND (0.011)	0.25	ND (0.011)
602754	T1098-BH-001-100-SV	8/19/99	100	ND (0.018)	18.0	ND (0.016)	0.25	0.5	ND (0.011)
602754	T1098-BH-001-110-SV	8/20/99	110	ND (0.018)	0.5	ND (0.016)	ND (0.011)	ND (0.011)	ND (0.011)
602754	T1098-BH-001-130-SV	8/20/99	130	ND (0.018)	3.1	ND (0.016)	0.21	ND (0.011)	ND (0.011)
602754	T1098-BH-001-140-SV	8/20/99	140	ND (0.018)	0.18	ND (0.016)	ND (0.011)	ND (0.011)	ND (0.011)

Note: Values in **bold** represent detected VOCs.

^aEPA November 1986.

^bAnalysis request/chain-of-custody record.

BH = Borehole.

EPA = U.S. Environmental Protection Agency.

ER = Environmental Restoration.

ID = Identification.

ND () = Not detected above the method detection limit, shown in parentheses.

ppmv = Parts per million by volume.

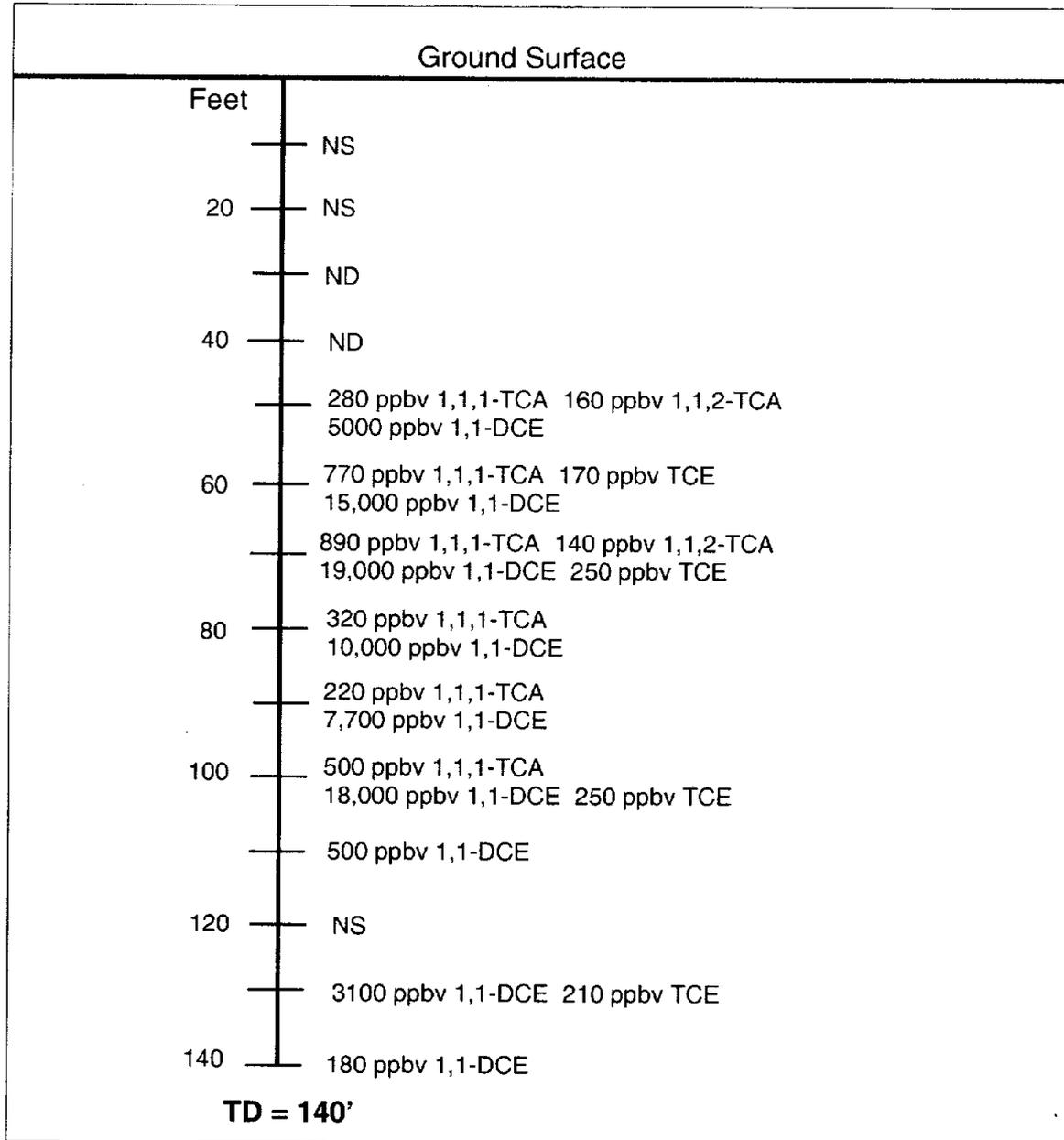
SV = Soil vapor.

SWMU = Solid Waste Management Unit.

VOC = Volatile organic compound.

SVD = Soil vapor duplicate.

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Legend

1,1,1-TCA: 1,1,1-Trichloroethane
 1,1-DCE: 1,1-Dichloroethane
 1,1,2-TCA: 1,1,2-Trichloroethane
 TCE: Trichloroethene
 TD: Total Depth
 ND: Non Detect
 NS: Not Sampled
 ppbv: parts per billion / vapor

**Figure 2.4.5-2
 Soil Gas Detections for
 T1098-BH-001**



Sandia National Laboratories, New Mexico
 Environmental Geographic Information System



Table 2.4.5-7
Summary of SWMU 98 Field-Duplicate Relative Percent Differences

Sample Attributes			Relative Percent Difference									
Record Number ^a	ER Sample ID (Figure 2.4.4-1)	Sample Depth (ft)	Arsenic	Barium	Beryllium	Cadmium	Chromium	Copper	Lead	Mercury	Silver	Vanadium
602188	T1098-GP-020-1-S T1098-GP-023-1-S (duplicate)	1.0	12.4	8.1	27.4	2.7	14.2	30.0	23.7	NC	42.1	1.1
602752	T1098-BH-001-090-S, T1098-BH-001-090-SD (duplicate)	90	48.3	126.6	0.14	NC	60.2	49.6	62.7	82.4	9.6	57.5

^aAnalysis request/chain-of-custody record.

- BH = Borehole.
- ER = Environmental Restoration.
- ft = Foot (feet).
- GP = Geoprobe.
- ID = Identification.
- NC = Not calculated for nondetect results.
- S = Soil.
- SD = Soil duplicate.
- SWMU = Solid Waste Management Unit.

2.4.5.3 Data Validation

All off-site laboratory results were reviewed and verified according to the "Procedure for Chemical and Radiochemical Data (AOP 00-03) (SNL/NM December 1999). Annex 2-E contains the off-site data validation results. All samples were prepared and analyzed with accepted procedures and specified methods except for the following problems.

During data validation, qualifications were applied to VOC sample data because of method blank contamination, initial calibration response factors, and matrix spike (MS) percent recovery. Qualifications were applied to SVOC sample data because of matrix spike duplicate percent recovery. Qualifications were applied to metal sample data because of initial calibration blank, method and equipment blank contamination, MS percent recovery, serial dilution RPDs, and replicate analysis RPDs.

2.5 Site Conceptual Model

The site conceptual model for SWMU 98 is based upon the residual COCs identified in the soil and soil-gas samples from the surface and subsurface area around former Building 863. This section summarizes the nature and extent of contamination and the environmental fate of COCs.

2.5.1 Nature and Extent of Contamination

The primary COCs at SWMU 98 are VOCs (TCA), SVOCs, and metals (silver) related to the TCA release area and silver recovery unit. The extent of contamination was mostly limited to areas outside of the building (e.g., TCA release area). During the additional field investigation (#4), three locations under the slab near the TCA release area were also sampled.

Although VOCs were detected in the soil-gas samples, the soil samples were ND except for a few compounds with J values and slightly elevated values for toluene, xylene, and acetone. Any VOCs detected (including J values) were considered COCs.

SVOCs were detected in the surface soil samples during the RFI activities. The extent of SVOC contamination is related to areas of cement/concrete walkways and pads around the perimeter of the building. Any SVOCs detected (including J values) were considered COCs.

Metal COCs were determined by comparing sample results to approved background concentrations established for the SNL North Area Group (Dinwiddie September 1997). Any metal found to exceed background in any sample was considered a potential COCs for the site.

2.5.2 Environmental Fate

The primary source of potential COCs is the TCA release area. The primary transport mechanism of COCs is seepage of the TCA directly into the soil and migration into the groundwater. Forty-four potential COCs are associated with SWMU 98, including six VOCs, twenty-three SVOCs, and twelve metals. Table 2.5.2-1 contains a summary of the potential

Table 2.5.2-1
Summary of COCs for SWMU 98

COC Type	Number of Samples ^a	COCs Greater Than Background	Maximum Background Limit/North Area Supergroup ^b (mg/kg)	Maximum Concentration (mg/kg)	Average Concentration ^c (mg/kg, except where noted)	Sampling Locations Where Background Concentration Exceeded ^d
Metals	23 environmental, 4 duplicates	Arsenic	4.4	9.2	5.1	T1098-GR-001-0.5 T1098-GR-002-000 T1098-GR-007-001 T1098-GR-008-001 T1098-GR-009-0.5 T1098-GR-010-001 T1098-GR-011-001 T1098-GR-012-0.5 T1098-GR-014-0.5 T1098-GP-020-1 T1098-GP-021-1 T1098-GP-022-1
		Barium	200	605	323	T1098-GR-001-0.5 T1098-GR-002-000 T1098-GR-003-0.5 T1098-GR-004-001 T1098-GR-005-001 T1098-GR-006-001 T1098-GR-007-001 T1098-GR-010-001 T1098-GR-012-0.5 T1098-GR-013-001 T1098-GP-020-1 T1098-GP-021-1 T1098-GP-022-1 T1098-GP-023-1 T1098-BH-001-080 T1098-BH-001-120 T1098-BH-001-190
		Cadmium	<1	0.94	NA	T1098-GR-001-0.5
		Chromium	12.8	30	NA	T1098-GR-003-0.5

Refer to footnotes at end of table.

Table 2.5.2-1 (Continued)
Summary of COCs for SWMU 98

COC Type	Number of Samples ^a	COCs Greater Than Background	Maximum Background Limit/North Area Supergroup ^b (mg/kg)	Maximum Concentration (mg/kg)	Average Concentration ^c (mg/kg, except where noted)	Sampling Locations Where Background Concentration Exceeded ^d
Metals (Cont.)		Cobalt	7.1	264	24.6	T1098-GR-001-0.5 T1098-GR-003-0.5 T1098-GR-004-001 T1098-GR-012-0.5 T1098-GR-014-0.5
		Copper	17	44.3	12.8	T1098-GR-001-0.5 T1098-GR-003-0.5 T1098-BH-001-080 T1098-BH-001-130
		Lead	11.2	89.9	17.1	T1098-GR-003-0.5
		Selenium	<1.0	0.6 ^d	NA	T1098-GR-005-001
		Silver	<1.0	13.8	2.9	T1098-GR-001-0.5 T1098-GR-003-0.5 T1098-GR-004-001 T1098-GR-005-001 T1098-GR-006-001 T1098-GR-012-0.5 T1098-GR-013-001
		Thallium	<1.1	2.1	1.4	T1098-GR-002-000 T1098-GR-003-0.5 T1098-GR-005-001
		Vanadium	33	53.1	24.4	T1098-GP-021-1 T1098-GP-022-1 T1098-BH-001-130
		Zinc	76	191	55.9	T1098-GR-001-0.5 T1098-GR-003-0.5 T1098-GR-013-001

Refer to footnotes at end of table.

Table 2.5.2-1 (Continued)
Summary of COCs for SWMU 98

COC Type	Number of Samples ^a	COCs Greater Than Background	Maximum Background Limit/North Area Supergroup ^b (mg/kg)	Maximum Concentration (mg/kg)	Average Concentration ^c (mg/kg, except where noted)	Sampling Locations Where Background Concentration Exceeded ^d
VOCs	67 environmental, 7 duplicates	Acetone	NA	0.014 B	0.009	T1098-GR-001-0.5 T1098-GR-004-001 T1098-GR-007-001 T1098-GR-008-001 T1098-GP-004-016 T1098-GP-004-030 T1098-GP-007-011 T1098-GP-008-011 T1098-GP-009-025 T1098-GP-016-005
		Ethylbenzene	NA	0.0017 J	0.002	T1098-GR-006-001 T1098-GR-010-001 T1098-GR-012-0.5 T1098-GR-013-001
		Methylene chloride	NA	0.0086 B	0.003	T1098-GR-001-0.5 T1098-GR-002-000 T1098-GR-003-0.5 T1098-GR-004-001 T1098-GR-005-001 T1098-GR-010-001 T1098-GR-011-001 T1098-GP-001-025 T1098-GP-003-010 T1098-GP-004-016 T1098-GP-010-005 T1098-GP-011-010 T1098-GP-016-005

Refer to footnotes at end of table.

Table 2.5.2-1 (Continued)
Summary of COCs for SWMU 98

COC Type	Number of Samples ^a	COCs Greater Than Background	Maximum Background Limit/North Area Supergroup ^b (mg/kg)	Maximum Concentration (mg/kg)	Average Concentration ^c (mg/kg, except where noted)	Sampling Locations Where Background Concentration Exceeded ^d
VOCs (Cont.)		Toluene	NA	0.026	0.01 ($\mu\text{g}/\text{kg}$)	T1098-GR-001-0.5 T1098-GR-006-001 T1098-GR-008-001 T1098-GR-009-0.5 T1098-GR-010-001 T1098-GR-011-001 T1098-GR-012-0.5 T1098-GR-013-001 T1098-GR-014-0.5
		1,1,1-Trichloroethane	NA	0.002 J	NA	T1098-GR-006-001
		Xylene	NA	0.010	0.007	T1098-GR-006-001 T1098-GR-008-001 T1098-GR-010-001 T1098-GR-011-001 T1098-GR-012-0.5 T1098-GR-013-001
SVOCs	12 environmental, 3 duplicates	Acenaphthene	NA	1.2 J	0.3	T1098-GR-001-0.5 T1098-GR-003-0.5 T1098-GR-006-001 T1098-GR-007-001 T1098-GR-008-001 T1098-GR-011-001 T1098-GR-012-001 T1098-GR-013-001
		Anthracene	NA	1.9	0.6	T1098-GR-003-0.5 T1098-GR-006-001 T1098-GR-007-001 T1098-GR-008-001 T1098-GR-011-001 T1098-GR-012-0.5 T1098-GR-013-001

Refer to footnotes at end of table.

Table 2.5.2-1 (Continued)
Summary of COCs for SWMU 98

COC Type	Number of Samples ^a	COCs Greater Than Background	Maximum Background Limit/North Area Supergroup ^b (mg/kg)	Maximum Concentration (mg/kg)	Average Concentration ^c (mg/kg, except where noted)	Sampling Locations Where Background Concentration Exceeded ^d
SVOCs (Cont.)		Benzo(a)anthracene	NA	6.1	1.2	T1098-GR-001-0.5 T1098-GR-002-000 T1098-GR-003-0.5 T1098-GR-004-001 T1098-GR-005-001 T1098-GR-006-001 T1098-GR-007-001 T1098-GR-008-001 T1098-GR-009-0.5 T1098-GR-010-001 T1098-GR-011-001 T1098-GR-012-001 T1098-GR-013-001 T1098-GR-014-0.5
		Benzo(a)pyrene	NA	4.5	1.1	T1098-GR-001-0.5 T1098-GR-002-000 T1098-GR-003-0.5 T1098-GR-006-001 T1098-GR-007-001 T1098-GR-008-001 T1098-GR-009-0.5 T1098-GR-010-001 T1098-GR-011-001 T1098-GR-012-0.5 T1098-GR-013-001 T1098-GR-014-0.5

Refer to footnotes at end of table.

Table 2.5.2-1 (Continued)
Summary of COCs for SWMU 98

COC Type	Number of Samples ^a	COCs Greater Than Background	Maximum Background Limit/North Area Supergroup ^b (mg/kg)	Maximum Concentration (mg/kg)	Average Concentration ^c (mg/kg, except where noted)	Sampling Locations Where Background Concentration Exceeded ^d
SVOCs (Cont.)		Benzo(b)fluoranthene	NA	7.4	1.7	T1098-GR-002-000 T1098-GR-003-0.5 T1098-GR-006-001 T1098-GR-007-001 T1098-GR-008-001 T1098-GR-009-0.5 T1098-GR-010-001 T1098-GR-011-001 T1098-GR-012-0.5 T1098-GR-013-001 T1098-GR-014-0.5
		Benzo(g,h,i)perylene	NA	3.3	0.8	T1098-GR-001-0.5 T1098-GR-002-000 T1098-GR-003-0.5 T1098-GR-006-001 T1098-GR-007-001 T1098-GR-008-001 T1098-GR-009-0.5 T1098-GR-010-001 T1098-GR-012-0.5 T1098-GR-013-001 T1098-GR-014-0.5
		Benzo(k)fluoranthene	NA	2.2	0.5	T1098-GR-001-0.5 T1098-GR-004-001 T1098-GR-005-001 T1098-GR-007-001 T1098-GR-009-0.5 T1098-GR-010-001

Refer to footnotes at end of table.

Table 2.5.2-1 (Continued)
Summary of COCs for SWMU 98

COC Type	Number of Samples ^a	COCs Greater Than Background	Maximum Background Limit/North Area Supergroup ^b (mg/kg)	Maximum Concentration (mg/kg)	Average Concentration ^c (mg/kg, except where noted)	Sampling Locations Where Background Concentration Exceeded ^d		
SVOCs (Cont.)		Bis(2-Ethylhexyl)phthalate	NA	0.29 J	0.1 J	T1098-GR-001-0.5 T1098-GR-003-0.5 T1098-GR-008-001 T1098-GR-009-0.5 T1098-GR-010-001 T1098-GR-012-0.5		
			NA	0.79 J	NA	T1098-GR-003-0.5		
			NA	1.9	0.4	T1098-GR-001-0.5 T1098-GR-002-000 T1098-GR-003-0.5 T1098-GR-006-001 T1098-GR-007-001 T1098-GR-008-001 T1098-GR-011-001 T1098-GR-012-0.5 T1098-GR-013-001		
			NA	5.7	1.1	T1098-GR-001-0.5 T1098-GR-002-000 T1098-GR-003-0.5 T1098-GR-004-001 T1098-GR-005-001 T1098-GR-006-001 T1098-GR-007-001 T1098-GR-008-001 T1098-GR-009-0.5 T1098-GR-010-001 T1098-GR-011-001 T1098-GR-012-001 T1098-GR-013-001 T1098-GR-014-0.5		
			NA	0.074 J	NA	T1098-GR-001-0.5		
		Chrysene			NA			
					NA			
					NA			
		Di-n-butylphthalate			NA			
					NA			

Refer to footnotes at end of table.

Table 2.5.2-1 (Continued)
Summary of COCs for SWMU 98

COC Type	Number of Samples ^a	COCs Greater Than Background	Maximum Background Limit/North Area Supergroup ^b (mg/kg)	Maximum Concentration (mg/kg)	Average Concentration ^c (mg/kg, except where noted)	Sampling Locations Where Background Concentration Exceeded ^d		
SVOCs (Cont.)		Di-n-octylphthalate	NA	0.093 J	0.1	T1098-GR-004-001		
						T1098-GR-005-001		
						T1098-GR-006-001		
								T1098-GR-009-0.5
								T1098-GR-011-001
								T1098-GR-012-0.5
		Dibenz(a,h)anthracene			NA	1.6	0.4	T1098-GR-013-001
								T1098-GR-014-0.5
								T1098-GR-002-000
		Dibenzofuran			NA	0.45 J	0.3	T1098-GR-003-0.5
								T1098-GR-006-001
								T1098-GR-009-0.5
		Fluoranthene			NA	10	2.1	T1098-GR-011-001
								T1098-GR-013-001
								T1098-GR-001-0.5
						T1098-GR-002-000		
						T1098-GR-003-0.5		
						T1098-GR-004-001		
						T1098-GR-005-001		
						T1098-GR-006-001		
						T1098-GR-007-001		
						T1098-GR-008-001		
						T1098-GR-009-0.5		
						T1098-GR-010-001		
						T1098-GR-011-001		
						T1098-GR-012-001		
						T1098-GR-013-001		
						T1098-GR-014-0.5		

Refer to footnotes at end of table.

Table 2.5.2-1 (Continued)
Summary of COCs for SWMU 98

COC Type	Number of Samples ^a	COCs Greater Than Background	Maximum Background Limit/North Area Supergroup ^b (mg/kg)	Maximum Concentration (mg/kg)	Average Concentration ^c (mg/kg, except where noted)	Sampling Locations Where Background Concentration Exceeded ^d
SVOCs (Cont.)		Fluorene	NA	0.96 J	0.4	T1098-GR-001-0.5
						T1098-GR-003-0.5
		Indeno(1,2,3-d)pyrene	NA	3.3	0.7	T1098-GR-006-001
						T1098-GR-007-001
						T1098-GR-008-001
						T1098-GR-011-001
						T1098-GR-001-0.5
						T1098-GR-002-000
		2-Methylnaphthalene Naphthalene	NA	0.1 J	NA	T1098-GR-003-0.5
						T1098-GR-008-001
						T1098-GR-003-0.5
						T1098-GR-008-001
						T1098-GR-011-001

Refer to footnotes at end of table.

Table 2.5.2-1 (Continued)
Summary of COCs for SWMU 98

COC Type	Number of Samples ^a	COCs Greater Than Background	Maximum Background Limit/North Area Supergroup ^b (mg/kg)	Maximum Concentration (mg/kg)	Average Concentration ^c (mg/kg, except where noted)	Sampling Locations Where Background Concentration Exceeded ^d
SVOCs (Cont.)		Pentachlorophenol	NA	0.042 J	NA	T1098-GR-006-001
		Phenanthrene	NA	7.5	1.5	T1098-GR-001-0.5 T1098-GR-002-000 T1098-GR-003-0.5 T1098-GR-004-001 T1098-GR-005-001 T1098-GR-006-001 T1098-GR-007-001 T1098-GR-008-001 T1098-GR-009-0.5 T1098-GR-010-001 T1098-GR-011-001 T1098-GR-012-001 T1098-GR-013-001 T1098-GR-014-0.5
		Pyrene	NA	8.3	1.8	T1098-GR-001-0.5 T1098-GR-002-000 T1098-GR-003-0.5 T1098-GR-004-001 T1098-GR-005-001 T1098-GR-006-001 T1098-GR-007-001 T1098-GR-008-001 T1098-GR-009-0.5 T1098-GR-010-001 T1098-GR-011-001 T1098-GR-012-001 T1098-GR-013-001 T1098-GR-014-0.5

^aNumber of samples does not include background samples.

^bFrom Garcia November 1998 (for metals). The minimum background concentration/activity between surface and subsurface is reported.

^cAverage concentration includes all samples, excluding background. For nondetect results, the detection limit is used to calculate the average.

^dMetal samples include nondetect results where the MDL exceeds the approved background concentration. Organic samples include all detected results.

Table 2.5.2-1 (Concluded)
Summary of COCs for SWMU 98

B = Detected in method blank.
COC = Constituent of concern.
J = Estimated value.
MDL = Method detection limit.
 $\mu\text{g}/\text{kg}$ = Microgram(s) per kilogram.
 mg/kg = Milligram(s) per kilogram.
NA = Not applicable.
SVOC = Semivolatile organic compound.
SWMU = Solid Waste Management Unit.
VOC = Volatile organic compound.

COCs. All potential COCs were retained in the conceptual model and evaluated in the human and ecological risk assessments.

All operations associated with Building 863 ceased with the removal of the building in 1999; thus, only secondary sources of COCs remain at the site in surface and subsurface soil (Figure 2.5.2-1). The secondary release mechanisms are the suspension and/or dissolution of the COCs in surface water percolation to the vadose zone, VOC vapor emanations, and dust emissions. However, the depth to groundwater at approximately 500 feet bgs makes the migration of the COCs to the aquifer extremely unlikely. The pathways to receptors are surface water (within the site boundaries), soil water, air, and soil. Biota (plants) are not present on the site. Section VII.2.3, Annex 2-F provides additional discussion of the fate and transport of the COCs at SWMU 98.

Section VII.3.1, Annex 2-F provides additional discussion of the exposure routes and receptors at SWMU 98.

2.6 Site Assessments

The site assessment process for SWMU 98 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 2-F provides details of the site assessment.

2.6.1 Summary

The site assessment concludes that SWMU 98 does not have the potential to affect human health under an industrial land-use scenario. After considering the uncertainties associated with the available data and modeling assumptions, ecological risks associated with SWMU 98 were found to be extremely low. Section 2.6.2 briefly describes and Annex 2-F provides details of the site screening assessments.

2.6.2 Screening Assessments

This section briefly summarizes the results of both the human health and the ecological risk assessments for SWMU 98.

2.6.2.1 Human Health

Because COCs were present in concentrations greater than background levels, it was necessary to perform a health risk assessment analysis, which included any organic compounds detected above their reporting limits and J values and any metals detected above background levels. The risk assessment process provides a quantitative evaluation of the potential adverse human health effects caused by constituents in soil at the site by calculating the hazard index (HI) and the excess cancer risk for the recommended industrial land-use setting (DOE et al. October 1995). Annex 2-F provides a complete discussion of the risk assessment process, results, and uncertainties.

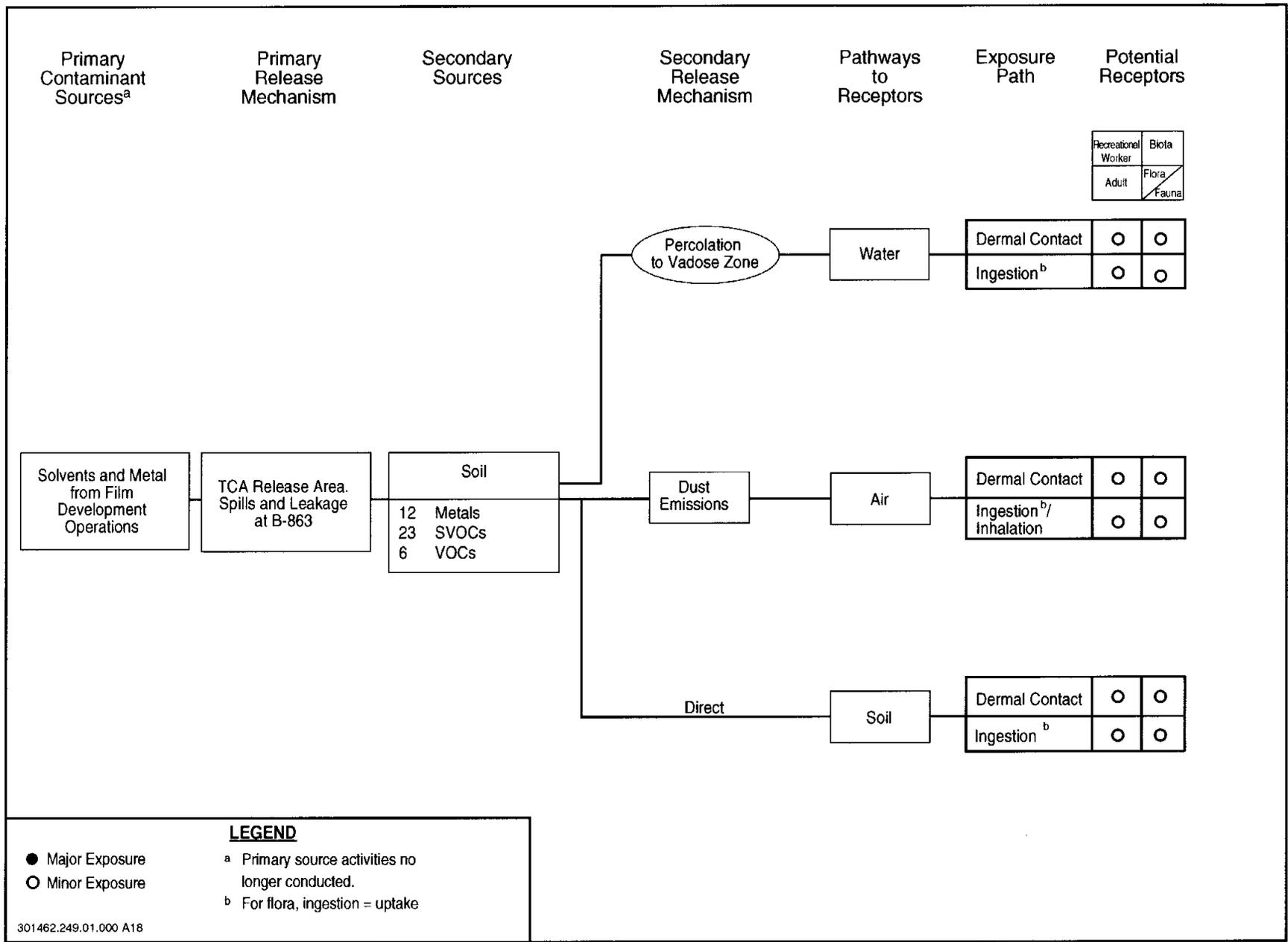


Figure 2.5.2-1
Conceptual Model Flow Diagram for SWMU 98



Conservative assumptions and a reasonable maximum exposure approach to risk assessment were used. Calculations for the COCs show that, for the industrial land-use scenario, the HI (0.09) is significantly less than the accepted numerical guidance from the EPA. Excess cancer risk ($3E-05$) is above the acceptable risk value provided by the NMED for an industrial land-use scenario (NMED March 1998). The incremental HI is 0.08, and the incremental cancer risk is $3.00E-05$ for the industrial land-use scenario. Although the excess cancer risk was above proposed guidelines, the excess cancer risk was conservatively estimated by using maximum concentrations of the detected COCs.

Because the site was adequately characterized, average concentrations would be more representative of actual site conditions. If the upper 95% confidence limit of the mean concentration (all in mg/kg) for arsenic (4.8), benzo(a)anthracene (1.7), benzo(a)pyrene (1.3), benzo(b)fluoranthene (2.0), benzo(g,h,i)perylene (0.9), dibenz(a,h)anthracene (0.3), and indeno(1,2,3-c,d)pyrene (0.87) are used in place of their respective maximum concentrations, the total excess cancer risk is reduced to $9.56E-06$, and the incremental excess cancer risk is calculated to be $7.26E-06$. Although these values are above the NMED guideline for Class A and B carcinogens, it should be noted that the incremental contribution from arsenic is $2E-07$.

The majority of the excess cancer risk is from the organics, all of which are polycyclic aromatic hydrocarbons (PAHs), which are common constituents in asphalt. SWMU 98 is in the heavily industrialized TA-1, and some of the samples were actually collected from underneath asphalt. The PAHs are assumed to be from asphalt and thus are indicative of contamination. Removal of the PAHs from the risk screening assessment and using the upper 95% confidence limit of the mean concentration for arsenic produces an incremental excess cancer risk of $3.64E-07$, which is within NMED guidelines.

The Risk Screening Assessment (Annex 2-F) contains, for comparison only, a risk assessment for residential land-use scenarios.

2.6.2.2 *Ecological*

An ecological screening assessment that corresponds to the screening procedures in the EPA's Ecological Risk-Based 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 2-F, Section VII.2.2). 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 14 and 15 of Annex 2-F present the results of the ecological risk screening assessment. Site-specific information was incorporated into the screening assessment when such data were available. Hazard Quotients (HQs) greater than 1 were originally predicted; however, a closer examination of the exposure assumption revealed an overestimation of risk primarily attributable to (a) using maximum measured analyte concentrations in soil to evaluate risk, (b) using wildlife toxicity benchmarks based upon no-observed-adverse-effect level values, (c) incorporating strict herbivorous and strict insectivorous diets for predicting the extreme HQ values for the deer mouse, and (d) the use of 1.0 as the area use factor for wildlife

receptors, regardless of seasonal use or home range size. Based upon an evaluation of these assumptions, ecological risks associated with this site are expected to be very low.

2.6.3 Baseline Risk Assessments

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

2.6.3.1 *Human Health*

Based upon the fact that human health results of the screening assessment summarized in Section 2.6.2.1 indicate that SWMU 98 does not have potential to affect human health under an industrial land-use setting, a baseline human health risk assessment is not required for SWMU 98.

2.6.3.2 *Ecological*

Based upon the fact that ecological results of the screening assessment summarized in Section 2.6.2.2 indicate that SWMU 98 has very low ecological risk, a baseline ecological risk assessment is not required for SWMU 98.

2.6.4 Other Applicable Assessments

A Surface Water Site Assessment was conducted at the site on April 2000. Los Alamos National Laboratory and the NMED Surface Water Quality Bureau developed the surface water assessment guidance. The assessment evaluated the potential for erosion from SWMU 98. The site received a score of 22.3, which indicates low erosion potential (Annex 2-G).

2.7 No Further Action Proposal

2.7.1 Rationale

Based upon field investigation data and the human health and ecological risk assessments, an NFA is being recommended for SWMU 98 because no COCs were present in concentrations considered hazardous to human health for an industrial land-use scenario.

2.7.2 Criterion

Based upon the evidence provided above, SWMU 98 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 2-F
Risk Screening Assessment

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SWMU 98: RISK SCREENING ASSESSMENT REPORT**I. Site Description and History**

Building 863 was listed as Solid Waste Management Unit (SWMU) 98 because of potential releases of trichloroethane (TCA) over a 16-year period. The building housed Sandia National Laboratories/New Mexico (SNL/NM) motion picture film processing activities for approximately 40 years. In addition to the TCA releases, there were several potential sources of contamination stemming from past activities. Possible sources include the original chemical mixing room and the film processing rooms.

Building 863 is located in the north central portion of Technical Area (TA) I on H Street between 9th and 10th Streets. The building was constructed in 1950 as a document vault. In 1951, the motion picture production and film processing division for SNL/NM moved into the building. Two additions were constructed: one in 1958 to expand film processing operations and one in 1971 for chemical storage.

The release of TCA was centered on the film cleaning machine installed in the early 1970s near the east side of the building. TCA piped to the machine through holes drilled in the exterior was from a 55-gallon drum outside the building. Waste TCA was piped back through to a second 55-gallon drum. The waste drum had holes drilled into its base that allowed the TCA to drain into the underlying soil. Waste TCA was managed in this way until a new film cleaning tank was installed in 1986. The total volume of TCA discharged to the soil may have ranged from 2,300 to 3,600 gallons.

There were several other areas of potential concern in Building 863. These areas have visible chemical residue and evidence of chemical spills. The types of waste generated and the duration of use have caused severe corrosion of the piping and concrete foundation in several spots. From 1951 to the mid-1960s, residues from chemical mixing and spent chemicals were discharged either to the acid waste or to the sanitary sewer system. Discharge to the acid waste line was discontinued in the mid-1960s and rerouted to the sewer system. Any potential releases from these systems are being evaluated separately under the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) for SWMUs 187 (Sanitary Sewer System) and 226 (Acid Waste Line).

Film processing activities ceased in 1989. The film processing areas were not occupied again. All equipment was cleaned. Some of the equipment was removed, but most remained in the building. The chemical inventory was also removed. Several offices and rooms (e.g., document vault) were used for dubbing and sound mixing by the video department. This department was moved from Building 863 in 1998, and decontamination and decommissioning (D&D) were conducted at the building in 1999. The building equipment and materials were removed under the guidelines of the Facilities Assessment, Decontamination, and Disposal Oversight Committee programs. The RFI (SNL/NM February 1995) for SWMU 98 addresses the potentially contaminated soil at the site of the former building.

RFI field activities were conducted in 1995 and 1999. The results of these investigations are presented in this no further action (NFA).

The annual precipitation, as measured at the Albuquerque International Sunport Airport, is 8.1 inches. No springs or perennial surface-water bodies are located near the site. The surface-water drainage from rainfall events is controlled by the TA-I storm drain system. The storm drain system drains into Tijeras Arroyo approximately 2 miles south of the site.

Groundwater monitoring for the area surrounding SWMU 98 is conducted as part of the Sandia North Groundwater Investigation. One monitoring well (TA1-W-05) is located approximately 1,200 feet north of the site. Two water-bearing zones, the shallow groundwater system, and the regional aquifer underlie TA-I. The regional aquifer is approximately 571 feet below ground surface (bgs). The shallow water-bearing zone has not been found in the northern portion of TA-I, in which SWMU 98 is located. Both the City of Albuquerque and Kirtland AFB (KAFB) use the regional aquifer for water supply. The nearest water supply well is KAFB-1, which is located approximately 1 mile west of the site.

II. Data Quality Objectives

The Data Quality Objectives (DQOs) presented in the SWMU 98 RFI identified the site-specific confirmatory sample locations, sample depths, sampling procedures, and analytical requirements. The DQOs outlined the quality control (QC)/quality assurance (QA) requirements necessary for producing verified and validated data suitable for risk assessment purposes. The DQOs for the SWMU 98 RFI include the following:

- Confirming whether any TCA and/or other volatile organic compounds (VOCs) are present in the soils adjacent to Building 863 at concentrations detectable by an active soil gas survey
- Confirming whether any TCA, trichloroethene, or degradation products are present in the soils adjacent to Building 863 by conducting surface and subsurface soil sampling
- Confirming whether any acids/bases released to the surface soil have lowered/elevated the soil pH
- Characterizing the vertical and horizontal extent of potentially contaminated soil through analyzing samples taken from subsurface boreholes
- Collecting sufficient information to determine whether contaminants have migrated to a depth that indicates the need for the installation of a monitoring well.

Data of adequate quality will be produced for 20 percent of deep borehole samples in order to conduct an accurate risk assessment and to evaluate corrective measures. This DQO was modified for the deep borehole sampling completed in 1999. All of the samples (rather than only 20 percent) were verified and validated for risk the assessment report associated with this NFA.

Table 1 summarizes the rationale for designing the sample pattern. The main source of potential constituents of concern (COCs) at SWMU 98 was the release of TCA to the soil outside Building 863.

The RFI activities revealed no contamination from operations associated with SWMU 98.

The RFI samples were collected to confirm the presence/absence of COCs in the surface and subsurface soils around Building 863 especially at the TCA release area. The confirmatory soil samples were collected at 16 locations. Table 2 summarizes the sampling design for the confirmatory soil sampling effort. The soil samples were collected using the procedures detailed in the TA-I RFI.

The SWMU 98 soil samples were analyzed for VOCs (100 percent), semivolatile organic compounds (SVOCs) (21 percent), and metals (37 percent). Three analytical laboratories analyzed the samples: SNL/NM Environmental Restoration Chemistry Laboratory (ERCL), Quanterra, and General Engineering Laboratories (GEL). Table 3 summarizes the analytical methods and the data quality requirements from the SWMU 98 RFI.

Twenty-five QA/QC samples were collected during the sampling effort according to the Environmental Restoration (ER) Project QA Project Plan. The QA/QC samples consisted of 7 duplicates, 13 trip blanks, and 5 equipment rinse blanks. No significant QA/QC problems were identified in the QA/QC samples.

The 1995 confirmatory soil sample ERCL/Quanterra results were verified by SNL/NM. The Quanterra results were collected as split samples and were used to verify the ERCL results. The data were reviewed to conform with "Verification and Validation for Chemical and Radiochemical Data" TOP 94-03, Rev. 0 (SNL/NM July 1994).

The 1999 confirmatory soil sampling analysis results from GEL were verified and validated by SNL/NM. The data were reviewed to conform with "Data Validation Procedure for Chemical and Radiochemical Data" SNL/NM ER Project, AOP 00-03, Rev. 0 (SNL/NM December 1999). These reviews confirm that the analytical data are acceptable for use in the NFA proposal for SWMU 98. The DQOs for the SWMU have been met.

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

III.1 Introduction

The determination of the nature, migration rate, and extent of contamination at SWMU 98 was based upon an initial conceptual model validated with confirmatory sampling at the site. The initial model was developed from archival research, soil vapor sampling, and soil sampling. The DQOs contained in the SWMU 98 RFI Plan identified the sampling locations, sample density, sample depth, and analytical requirements. The sampling data were subsequently used to develop the final conceptual model for SWMU 98, which is presented in Section 2.5 of the associated NFA proposal. This section describes the quality of the data specifically used to determine the nature, migration rate, and extent of contamination.

Table 1
Summary of Sampling Performed to Meet Data Quality Objectives

SWMU 98 Sampling Areas	Potential COC Source	Number of Sampling Locations	Sample Density	Sampling Location Rationale
Perimeter of B-863	Surface soil: TCA, SVOCs, TAL metals, and pH	12	Approximately every 35 feet around perimeter of B-863	Confirm that no significant levels of COCs are present in the surface soil
Perimeter of B-863	Subsurface soil vapor: VOCs	41 ^a	Approximately every 35 feet around perimeter of B-863. At each location sampled at 5-foot intervals to 30 feet bgs	Confirm the presence and/or absence of soil vapor in the subsurface soils
Perimeter of B-863	Subsurface soil: VOCs and TAL metals	42 ^a	Approximately every 35 feet around perimeter of B-863. At each location sampled at 5-foot intervals to 30 feet bgs	Confirm that no significant levels of COCs are present in the subsurface soil
TCA release area	Surface soil: VOCs, SVOCs, and RCRA metals	3	Each location 20 feet apart, west of the TCA release area	Confirm that no significant levels of COCs are present in the surface soil
TCA release area	Subsurface soil vapor: VOCs	1	Deep borehole, sample every 10-foot interval from 30 to 140 feet bgs	Confirm the presence and/or absence of soil vapor in the subsurface soil
TCA release area	Subsurface soil: VOCs and RCRA metals	10	Deep borehole, sample every 10-foot interval from 30 to 140 feet bgs	Confirm that no significant levels of COCs are present in the subsurface soil

^aRationale for the number of samples analyzed for SWMU 98 is discussed in Section 5.5.5.2 of the RFI Work Plan.

bgs = Below ground surface.

COC = Constituent of concern.

RCRA = Resource Conservation and Recovery Act.

SVOC = Semivolatile organic compound.

SWMU = Solid Waste Management Unit.

TAL = Target Analyte List.

TCA = Trichloroethane.

VOC = Volatile organic compound.

**Table 2
Number of Confirmatory Soil Samples Collected During the SWMU 98 RFI**

Sample Type	Number of Samples	VOCs	SVOCs	TAL/RCRA Metals
Confirmatory	67	67	12	23
Duplicates	7	7	3	4
Trip blanks	13	13	NA	NA
Equipment blanks	5	5	2	3
Total samples	92	92	17	30
Analytical laboratory	SNL/NM ERCL, Quanterra, and GEL	SNL/NM ERCL, Quanterra, and GEL	Quanterra and GEL	Quanterra and GEL

ERCL = Environmental Restoration Chemistry Laboratory.
 GEL = General Engineering Laboratories.
 NA = Not applicable.
 RCRA = Resource Conservation and Recovery Act.
 RFI = RCRA Facility Investigation.
 SNL/NM = Sandia National Laboratories/New Mexico.
 SVOC = Semivolatile organic compound.
 SWMU = Solid Waste Management Unit.
 TAL = Target Analyte List.
 VOC = Volatile organic compound.

**Table 3
Summary of Data Quality Requirements**

Analytical Requirement	Data Quality Level	SNL/NM ERCL ^a	Quanterra/GEL ^a
VOC EPA Methods 8240/8260 Modified ^b	Definitive	34	33
SVOC EPA Method 8270 ^b	Definitive	NA	12
TAL Metals EPA Methods 6010 and 7471/7470 ^b	Definitive	NA	12
RCRA Metals EPA Method 6020 ^b	Definitive	NA	11

^aThe number of samples does not include QA/QC samples.

^bEPA (November 1986).

EPA = U.S. Environmental Protection Agency.
 ERCL = Environmental Restoration Chemistry Laboratory.
 GEL = General Engineering Laboratories.
 NA = Not applicable.
 QA = Quality assurance.
 QC = Quality control.
 RCRA = Resource Conservation and Recovery Act.
 SNL/NM = Sandia National Laboratories/New Mexico.
 SVOC = Semivolatile organic compound.
 TAL = Target Analyte List.
 VOC = Volatile organic compound.

III.2 Nature of Contamination

Both the nature of contamination and the potential for the degradation of COCs at SWMU 98 were evaluated using laboratory analyses of the soil samples (see Section V). The analytical requirements included analyses for VOCs, SVOCs, Target Analyte List metals, and RCRA metals. The analyses characterized any potential contaminants remaining in the soil after the film laboratory discontinued operations. The analytes and methods listed in Tables 2 and 3 are appropriate to characterize the COCs and any potential degradation products at SWMU 98.

III.3 Rate of Contaminant Migration

SWMU 98 is an inactive site. Film laboratory operations ceased in 1989 and D&D were conducted at Building 863 in 1999. Therefore, all primary sources of COCs have been eliminated. Only secondary sources of COCs potentially remain in soil in the form of adsorbed COCs. The rate of COC migration from surficial soil is, therefore, dependent predominantly upon precipitation and occasional surface-water flow (if any) as described in Section V.

III.4 Extent of Contamination

Surface confirmatory soil samples were collected from around the perimeter and from under the slab of Building 863. Subsurface confirmatory soil samples were also taken from around the perimeter of the building, including a deep soil borehole at the TCA release area. The confirmatory soil samples were collected using the sampling density listed in Table 1. The sampling density provided the data needed to evaluate the potential for soil contamination. The confirmatory surface soil samples were collected from the ground surface to 6 inches bgs. The majority of confirmatory subsurface soil samples were collected from 5 feet to a maximum depth of 30 feet bgs. In addition, confirmatory soil samples were collected from a single borehole from 30 to 130 feet bgs.

The vertical rate of possible contamination migration was expected to be extremely low because of the low precipitation, high evapotranspiration, and concrete surface (industrial site). Therefore, the confirmatory soil samples are representative of soil potentially contaminated with COCs and are sufficient to determine the vertical extent of any COCs.

In summary, the confirmatory sampling was appropriate and adequate to determine the nature, migration rate, and extent of residual COCs in surface and subsurface soils at SWMU 98.

IV. Comparison of COCs to Background Screening Levels

Site history and characterization activities are used to identify potential COCs. The SWMU 98 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 that were evaluated in this risk assessment included all detected organics 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 determined for the entire site. The SNL/NM maximum background concentration (Dinwiddie September 1997) was selected to provide the background screen listed in Tables 4 and 5. Human health COCs were also compared to SNL/NM proposed Subpart S action levels, if applicable (IT July 1994).

Nonradiological COCs were evaluated as part of this risk assessment and included both inorganic and organic compounds. Inorganics that are essential nutrients such as iron, magnesium, calcium, potassium, and sodium were not included in this risk assessment (EPA 1989).

Table 4 lists the COCs for the human health risk assessment at SWMU 98. Table 5 lists the COCs for the ecological risk assessment at SWMU 98. All tables show the associated SNL/NM maximum background concentration values (Dinwiddie September 1997). Section VI.4 discusses Table 4; Sections VII.2 and VII.3 discuss Table 5.

V. Fate and Transport

The primary releases of COCs at SWMU 98 were to the surface and subsurface soils as a result of leakages and spills of solvents and other chemicals in and around Building 863. This building has since been removed. Wind and surface-water runoff are potential natural mechanisms of COC transport from the exposed surface soil; however, because the site is expected to be developed, most of the soil will be covered by pavement, buildings, and xeric landscaping, therefore, these are not expected to be potentially significant transport mechanisms at this site in the future.

The site receives approximately 8 inches of precipitation annually. Pavement and other impermeable surface features will cause most of this water to be shed as runoff without contacting the soil. Some soil erosion can occur where the soil is exposed; however, because of the flat terrain and the small area of the site, the potential for loss of COCs with surface-water runoff is low. Water that infiltrates into the soil and percolates through the soil may leach COCs into the subsurface soil with it. Because groundwater at this site is approximately 276 feet bgs (USDA June 1977), the potential for COCs to reach groundwater through the unsaturated zone above the water table is very small. As water from the surface evaporates, the direction of COC movement may be reversed with capillary rise of the soil water.

The site is essentially unvegetated at this time; however, ruderal plants (weeds) may become established before the site is redeveloped. Plant roots can take up COCs that are in the soil. These COCs can then be transported to the above-ground tissues with the xylem stream. Above-ground tissues can also take up constituents from direct contact with dust particles. Volatilized COCs can be taken up by plants directly from the air; however, volatile COCs within the plant tissues can also be lost to the air. Organic COCs in plant tissues can be metabolized or undergo other types biotransformations. Those that remain in the tissue can enter the food chain through the consumption of the plant tissue by herbivores and through consumption of the herbivore by a carnivore or scavenger. However, because of the urbanized nature of the habitat around the site and the high degree of soil disturbance at the site, the potential for significant uptake by biota and transfers through the food chain is very low.

Table 4
COCs for Human Health Risk Assessment at SWMU 98 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	9.2	4.4	No	44 ^c	NA	Yes
Barium	605	200	No	170 ^d	NA	Yes
Beryllium	0.63	0.80	Yes	19 ^c	NA	No
Cadmium	0.94	<1	Unknown	64 ^c	NA	Yes
Chromium	30	12.8	No	16 ^c	NA	No
Cobalt	264	7.1	No	10,000 ^e	NA	Yes
Copper	44.3	17	No	6 ^c	NA	No
Lead	89.9	11.2	No	49 ^c	NA	Yes
Mercury	0.15	<0.1	No	5500 ^c	NA	Yes
Nickel	16.1	25.4	Yes	47 ^c	NA	Yes
Selenium	0.6 ^f	<1	Unknown	800 ^g	NA	Yes
Silver	13.8	<1	No	0.5 ^c	NA	No
Thallium	2.1	<1.1	No	119 ^c	NA	Yes
Vanadium	53.1	33	No	3000 ^d	NA	Yes
Zinc	191	76	No	47 ^c	NA	Yes
Acenaphthene	1.2 J	NA	NA	389 ^h	3.92 ^h	Yes
Acetone	0.014 B	NA	NA	0.69 ⁱ	-0.24 ⁱ	No
Anthracene	1.9	NA	NA	917 ^c	4.45 ^c	Yes
Benzo(a)anthracene	6.1	NA	NA	10,000 ^h	5.61 ^h	Yes
Benzo(a)pyrene	4.5	NA	NA	3000 ^c	6.04 ^c	Yes
Benzo(b)fluoranthene	7.4	NA	NA	6.124 ^h	6.124 ^h	Yes
Benzo(ghi)perylene	3.3	NA	NA	58,884 ^h	6.58 ^h	Yes
Benzo(k)fluoranthene	2.2	NA	NA	93,325 ^h	6.84 ^h	Yes
bis(2-Ethylhexyl)phthalate	0.29 J	NA	NA	851 ⁱ	7.6 ^h	Yes
Butylbenzylphthalate	0.79 J	NA	NA	663 ⁱ	4.77 ^h	Yes
Carbazole	1.9	NA	NA			Insufficient data
Chrysene	5.7	NA	NA	18,000 ^h	5.91 ^h	Yes
Di-n-butylphthalate	0.074 J	NA	NA	6761 ⁱ	4.61 ^h	Yes
Di-n-octylphthalate	0.093 J	NA	NA	9334 ^h	5.22 ^h	Yes

Refer to footnotes at end of table.

Table 4 (Concluded)
COCs for Human Health Risk Assessment at SWMU 98 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)
Dibenz(a,h)anthracene	1.6	NA	NA	51,000 ^h	6.50 ^h	Yes
Dibenzofuran	0.45 J	NA	NA	2800 ^h	4.12 ^h	Yes
Ethylbenzene	0.0017 J	NA	NA	15.5 ⁱ	3.15 ⁱ	No
Fluoranthene	10	NA	NA	12,302 ^h	4.90 ^h	Yes
Fluorene	0.96 J	NA	NA	2239 ^h	4.18 ^h	Yes
Indeno(1,2,3-c,d)pyrene	3.3	NA	NA	59,407 ^h	6.58 ^h	Yes
Methylene chloride	0.0086 B	NA	NA	5	1.25 ⁱ	No
2-methylnaphthalene	0.1 J	NA	NA	2800 ^h	3.86 ^h	Yes
Naphthalene	0.39 J	NA	NA	1000 ^h	3.30 ^h	Yes
Pentachlorophenol	0.042 J	NA	NA	776 ^k	5.09 ^h	Yes
Phenanthrene	7.5	NA	NA	23,800 ^c	4.63 ^c	Yes
Pyrene	8.3	NA	NA	36,300 ^c	5.32 ^h	Yes
Toluene	0.026	NA	NA	10.7 ^c	2.69 ^c	No
1,1,1-trichloroethane	0.002 J	NA	NA	8.9 ⁱ	2.48 ^h	No
Xylene	0.010	NA	NA	23.4 ⁱ	1.5 ^h	No

Note: **Bold** indicates the COCs that failed the background screening procedure and/or are bioaccumulators.

^aFrom Dinwiddie (September 1997) TA-I Soils.

^bNMED (March 1998).

^cYanicak (March 1997).

^dNeumann (1976).

^eVanderploeg et al. (1975).

^fParameter was nondetect. Concentration is 0.5 of detection limit.

^gCallahan et al. (1979).

^hMicromedex, Inc (1998).

ⁱHoward (1990).

^jHoward (1989).

^kHoward (1991).

B = COC identified in associated blank.

BCF = Bioconcentration factor.

COC = Constituent of concern.

J = Estimated concentration.

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
COCs for Ecological Risk Assessment at SWMU 98 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	9.2	4.4	No	44 ^d	NA	Yes
Barium	605	200	No	170 ^d	NA	Yes
Beryllium	0.63	0.80	Yes	19 ^c	NA	No
Cadmium	0.94	<1	Unknown	64 ^c	NA	Yes
Chromium	30	12.8	No	16 ^c	NA	No
Cobalt	264	7.1	No	10,000 ^e	NA	Yes
Copper	44.3	17	No	6 ^c	NA	No
Lead	89.9	11.2	No	49 ^c	NA	Yes
Mercury	0.15	<0.1	No	5500 ^c	NA	Yes
Nickel	16.1	25.4	Yes	47 ^c	NA	Yes
Selenium	0.6 ^f	<1	Unknown	800 ^b	NA	Yes
Silver	13.8	<1	No	0.5 ^c	NA	No
Thallium	2.1	<1.1	No	119 ^c	NA	Yes
Vanadium	30.3	33	Yes	3000 ^d	NA	Yes
Zinc	191	76	No	47 ^c	NA	Yes
Acenaphthene	1.2 J	NA	NA	389 ^h	3.92 ^h	Yes
Anthracene	1.9	NA	NA	917 ^c	4.45 ^c	Yes
Benzo(a)anthracene	6.1	NA	NA	10,000 ^h	5.61 ^h	Yes
Benzo(a)pyrene	4.5	NA	NA	3000 ^c	6.04 ^c	Yes
Benzo(b)fluoranthene	7.4	NA	NA	6,124 ^h	6.124 ^h	Yes
Benzo(ghi)perylene	3.3	NA	NA	58,884 ^h	6.58 ^h	Yes
Benzo(k)fluoranthene	2.2	NA	NA	93,325 ^h	6.84 ^h	Yes
Bis(2-ethylhexyl)phthalate	0.29 J	NA	NA	851 ⁱ	7.6 ^h	Yes
Butylbenzylphthalate	0.79 J	NA	NA	663 ^j	4.77 ^h	Yes
Carbazole	1.9	NA	NA			Insufficient data
Chrysene	5.7	NA	NA	18,000 ^h	5.91 ^h	Yes
Di-n-butylphthalate	0.074 J	NA	NA	6761 ⁱ	4.61 ^h	Yes
Di-n-octylphthalate	0.093 J	NA	NA	9334 ^h	5.22 ^h	Yes
Dibenz(a,h)anthracene	1.6	NA	NA	51,000 ^h	6.50 ^h	Yes

Refer to footnotes at end of table.

Table 5 (Concluded)
COCs for Ecological Risk Assessment at SWMU 98 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)
Dibenzofuran	0.45 J	NA	NA	2800 ^h	4.12 ^h	Yes
Ethylbenzene	0.0017 J	NA	NA	15.5 ⁱ	3.15 ⁱ	No
Fluoranthene	10	NA	NA	12,302 ^h	4.90 ^h	Yes
Fluorene	0.96 J	NA	NA	2239 ^h	4.18 ^h	Yes
Indeno(1,2,3-c,d)pyrene	3.3	NA	NA	59,407 ^h	6.58 ^h	Yes
2-methylnaphthalene	0.1 J	NA	NA	2800 ^h	3.86 ^h	Yes
Naphthalene	0.39 J	NA	NA	1000 ^h	3.30 ^h	Yes
Pentachlorophenol	0.042 J	NA	NA	776 ^k	5.09 ^h	Yes
Phenanthrene	7.5	NA	NA	23,800 ^c	4.63 ^c	Yes
Pyrene	8.3	NA	NA	36,300 ^c	5.32 ^h	Yes
Toluene	0.026	NA	NA	10.7 ^c	2.69 ^c	No
1,1,1-trichloroethane	0.002 J	NA	NA	8.9 ^j	2.48 ^h	No
Xylene	0.010	NA	NA	23.4 ^l	1.5 ^h	No

Note: **Bold** indicates the COCs that failed the background screening procedure and/or are bioaccumulators.

^aFrom Dinwiddie (September 1997) TA-I Soils.

^bNMED (March 1998).

^cYanicak (March 1997).

^dNeumann (1976).

^eVanderploeg et al. (1975).

^fParameter was nondetect. Concentration is 0.5 of detection limit.

^gCallahan et al. (1979).

^hMicromedex, Inc (1998).

ⁱHoward (1989).

^jHoward (1990).

^kHoward (1991).

BCF = Bioconcentration factor.

COC = Constituent of concern.

J = Estimated concentration.

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.

Degradation of COCs at SWMU 98 can result from biotic or abiotic processes. COCs that are inorganic and elemental in form are not considered to be degradable. Transformations of inorganics could include changes in valence (oxidation/reduction reactions) or incorporation into organic forms (e.g., the conversion of selenite or selenate from soil to seleno-amino acids in plants). Degradation processes for organic COCs could include photolysis, hydrolysis, and biotransformation. Photolysis requires light and, therefore, takes place in the air, at the ground surface, or in surface water. Hydrolysis includes chemical transformations in water and can occur in the soil solution. Biotransformation (i.e., transformation caused by plants, animals, and microorganisms) can occur; however, biological activity may be limited by the aridity of the environment at this site.

Table 6 summarizes the fate and transport processes that can occur at SWMU 98. COCs at this site include both inorganics and organics in soil. Because this site is in a highly urbanized area of TA-I, the potential for transport of COCs by wind or surface water is low. Significant leaching of COCs into the subsurface soil is unlikely and leaching to the groundwater at this site is also unlikely. Because of the highly disturbed nature of the habitat at this site, the potential for uptake of COCs into the food chain is considered low. For inorganic COCs, the potential for degradation is low. Degradation and/or biotransformation of organics and their loss by volatilization could be of greater significance.

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 estimated excess cancer risks are calculated for the COCs and background.
Step 6.	These values are compared with guidelines established by the U.S. Environmental Protection Agency (EPA) to determine whether further evaluation, and potential site cleanup, is required. 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 discussed.

**Table 6
Summary of Fate and Transport at SWMU 98**

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 (inorganics) Low to moderate (organics)

SWMU = Solid Waste Management Unit.

VI.2 Step 1. Site Data

Section I provides the description and history for SWMU 98. Section II presents DQOs. Section III describes the determination of the nature, rate, and extent of contamination.

VI.3 Step 2. Pathway Identification

SWMU 98 has been designated a future land use scenario of industrial (DOE et al. September 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. The inhalation pathway is included because of the potential to inhale dust and volatiles. No water pathways to the groundwater are considered. Depth to groundwater at SWMU 98 is approximately 500 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 industrial land use scenario. However, plant uptake is considered for the residential land use scenario.

Pathway Identification

Nonradiological Constituents
Soil ingestion
Inhalation (dust and volatiles)
Plant uptake (residential only)

VI.4 Step 3. COC Screening Procedures

Step 3 is discussed in this section and includes two screening procedures. The first compares the maximum COC concentration to the background screening level. The second compares 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 the 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 4 and was used to calculate risk attributable to background in Table 9. Only the COCs that were detected above their respective SNL/NM maximum background screening levels or did not have either a quantifiable or calculated background screening level were considered in further risk assessment analyses.

VI.4.1.2 Results

Table 4 presents SWMU 98 maximum COC concentrations that were compared to the SNL/NM maximum background values (Dinwiddie September 1997) for the human health risk assessment. Eleven constituents were measured at concentrations greater than their respective background. Two constituents did not have quantified background screening levels; thus, it is unknown whether they exceeded background. Twenty-nine COCs were organic compounds and did not have background screening levels.

The maximum concentration value for lead is 89.9 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.

VI.4.2 Subpart S Screening Procedure

VI.4.2.1 Methodology

The maximum concentrations of the 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 is 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

Because the SWMU 98 sample set had more than ten COCs that continued beyond the first screening level (including COCs that did not have background screening values), the proposed Subpart S screening process was not performed. All COCs that were not eliminated during the background screening process for SWMU 98 had a calculated hazard quotient (HQ) and excess cancer risk value.

VI.5 Step 4. Identification of Toxicological Parameters

Table 7 lists the COCs retained in the risk assessment and the values for the available toxicological information. The toxicological values used for the COCs in Table 7 were from the Integrated Risk Information System (IRIS) (EPA 1998a), the Health Effects Assessment Summary Tables (HEAST) (EPA 1997a), and the Region 3 (EPA 1997c) and Region 9 (EPA 1996b) electronic databases.

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 COCs and associated background for both industrial 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 industrial and residential land use scenarios. The equations for the COCs are based upon the RAGS (EPA 1989). Parameters are 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).

Although the designated land use scenario is industrial for this site, risk values for a residential land use scenario are also presented. These residential risk values are presented only to provide perspective of potential risk to human health under the more restrictive land use scenario.

VI.6.2 Risk Characterization

Table 8 shows a HI of 0.09 for the SWMU 98 COCs and an estimated excess cancer risk of $3E-5$ for the designated industrial land use scenario. The numbers presented included exposure from soil ingestion and dust and volatile inhalation for the COCs. Table 9 shows an HI of 0.01 and an excess cancer risk of $2E-6$ assuming the maximum background concentrations of the SWMU 98 associated background constituents for the designated industrial land use scenario.

Table 7
Toxicological Parameter Values for SWMU 98 COCs

COC Name	RfD _o (mg/kg-d)	Confidence ^a	RfD _{inh} (mg/kg-d)	Confidence ^a	SF _o (mg/kg-day) ⁻¹	SF _{inh} (mg/kg-day) ⁻¹	Cancer Class ^b
Arsenic	3E-4 ^c	M	-	-	1.5E+0 ^c	1.5E+1 ^c	A
Barium	7E-2 ^c	M	1.4E-4 ^d	-	-	-	-
Cadmium	5E-4 ^c	H	5.7E-5 ^d	-	-	6.3E+0 ^c	B1
Chromium III	1E+0 ^c	L	5.7E-7 ^e	-	-	-	-
Chromium VI	5E-3 ^c	L	-	-	-	4.2E+1 ^c	A
Cobalt	6E-2 ^d	-	2.9E-4 ^d	-	-	-	-
Copper	3.7E-2 ^d	-	-	-	-	-	D
Mercury	3E-4 ^f	-	8.6E-5 ^c	M	-	-	D
Selenium	5E-3 ^c	H	-	-	-	-	D
Silver	5E-3 ^c	L	-	-	-	-	D
Thallium ^g	8E-5 ^c	L	-	-	-	-	D
Vanadium	7E-3 ^f	-	-	-	-	-	-
Zinc	3E-1 ^c	M	-	-	-	-	D
Acenaphthene	6E-2 ^c	L	6E-2 ^d	-	-	-	-
Acetone	1E-1 ^c	L	1E-1 ^d	-	-	-	D
Anthracene	3E-1 ^c	L	3E-1 ^d	-	-	-	D
Benzo(a) anthracene	-	-	-	-	7.3E-1 ^d	7.3E-1 ^d	-
Benzo(a) pyrene	-	-	-	-	7.3E+0 ^c	7.3E+0 ^d	B2
Benzo(b) fluoranthene	-	-	-	-	7.3E-1 ^d	7.3E-1 ^d	B2
Benzo(ghi) perylene ^h	-	-	-	-	7.3E+0 ^d	7.3E+0 ^d	B2
Benzo(k) fluoranthene	-	-	-	-	7.3E-2 ^d	7.3E-2 ^d	B2
Bis(2-ethylhexyl) phthalate	2E-2 ^d	-	2.2E-2 ^d	-	1.4E-2 ^d	1.4E-2 ^d	-
Butylbenzyl phthalate	2E-1 ^c	L	2E-1 ^d	-	-	-	C
Carbazole	-	-	-	-	2E-2 ^f	2E-2 ^d	B2
Chrysene	-	-	-	-	7.3E-3 ^d	7.3E-3 ^d	B2
Di-n-butylphthalate	1E-1 ^c	L	1E-1 ^d	-	-	-	D
Di-n-octylphthalate	2E-2 ^f	-	2E-2 ^f	-	-	-	-
Dibenz(a,h) anthracene	-	-	-	-	7.3E+0 ^d	7.3E+0 ^d	B2
Dibenzofuran	4E-3 ^d	-	4E-3 ^d	-	-	-	D
Ethylbenzene	1E-1 ^c	L	2.9E-1 ^c	L	-	-	D
Fluoranthene	4E-2 ^c	L	4E-2 ^d	-	-	-	D
Fluorene	4E-2 ^c	L	4E-2 ^d	-	-	-	D
Indeno(1,2,3-c,d) pyrene	-	-	-	-	7.3E-1 ^d	7.3E-1 ^d	B2
Methylene chloride	6E-2 ^c	M	8.6E-1 ^f	-	7.5E-3 ^c	1.7E-3 ^c	B2

Refer to footnotes at end of table.

Table 7 (Concluded)
Toxicological Parameter Values for SWMU 98 COCs

COC Name	RfD _o (mg/kg-d)	Confidence ^a	RfD _{inh} (mg/kg-d)	Confidence ^a	SF _o (mg/kg-day) ⁻¹	SF _{inh} (mg/kg-day) ⁻¹	Cancer Class ^b
2-methyl-naphthalene ⁱ	4E-2 ^d	–	4E-2 ^d	–	–	–	D
Naphthalene	4E-2 ^d	–	4E-2 ^d	–	–	–	D
Pentachlorophenol	3E-2 ^c	M	3E-2 ^d	–	1.2E-1 ^c	1.2E-1 ^d	B2
Phenanthrene ^j	3E-1 ^c	L	3E-1 ^d	–	–	–	D
Pyrene	3E-2 ^c	L	3E-2 ^d	–	–	–	D
Toluene	2E-1 ^c	M	1.1E-1 ^c	M	–	–	D
1,1,1-trichloroethane	3.5E-2 ^d	–	2.9E-1 ^d	–	–	–	D
Xylene ^k	2E+0 ^c	M	2E-1 ^d	–	–	–	D

^aConfidence associated with IRIS (EPA 1998a) database values. Confidence: L = low, M = medium, H = high.

^bEPA weight-of-evidence classification system for carcinogenicity (EPA 1989) taken from IRIS (EPA 1998a) except for carbazole which is taken from HEAST (EPA 1997a).

A = Human carcinogen.

B1 = Probable human carcinogen. Limited human data available.

B2 = Probable human carcinogen. Sufficient evidence in animals and inadequate or no evidence in humans.

C = Possible human carcinogen.

D = Not classifiable as to human carcinogenicity.

^cToxicological parameter values from IRIS electronic database (EPA 1998a).

^dToxicological parameter values from EPA Region 9 electronic database (EPA 1996b).

^eToxicological parameter values from EPA Region 3 electronic database (EPA 1997c).

^fToxicological parameter values from HEAST database (EPA 1997a).

^gThallium does not have toxicological parameter values. Thallium sulfate was used as a surrogate.

^hBenzo(ghi) perylene does not have toxicological parameter values. Dibenz(a,h) anthracene was used as a surrogate.

ⁱ2-Methylnaphthalene does not have toxicological parameter values. Naphthalene was used as a surrogate.

^jPhenanthrene does not have toxicological parameter values. Anthracene was used as a surrogate.

^kToxicological parameter values are for xylene, mixture.

COC = Constituent of concern.

EPA = U.S. Environmental Protection Agency.

HEAST = Health Effects Assessment Summary Tables.

IRIS = Integrated Risk Information System.

mg/kg-d = Milligram(s) per kilogram day.

(mg/kg-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 8
Risk Assessment Values for SWMU 98 COCs

COC Name	Maximum Concentration (mg/kg)	Industrial Land-Use Scenario ^a		Residential Land-Use Scenario ^a	
		Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Arsenic	9.2	0.03	5E-6	0.53	1E-4
Barium	605	0.01	–	0.09	–
Cadmium	0.94	0.00	3E-10	0.77	5E-10
Chromium, total ^b	30	0.01	7E-8	0.02	1E-7
Cobalt	264	0.00	–	0.07	–
Copper	44.3	0.00	–	0.21	–
Mercury	0.15	0.00	–	0.64	–
Selenium ^c	0.6	0.00	–	0.21	–
Silver	13.8	0.00	–	0.57	–
Thallium	2.1	0.03	–	0.10	–
Vanadium	53.1	0.01	–	0.04	–
Zinc	191	0.00	–	0.35	–
Acenaphthene	1.2 J	0.00	–	0.00	–
Acetone	0.014 B	0.00	–	0.00	–
Anthracene	1.9	0.00	–	0.00	–
Benzo(a) anthracene	6.1	0.00	2E-6	0.00	2E-5
Benzo(a) pyrene	4.5	0.00	1E-5	0.00	1E-4
Benzo(b) fluoranthene	7.4	0.00	2E-6	0.00	2E-5
Benzo(ghi) perylene	3.3	0.00	8E-6	0.00	1E-4
Benzo(k) fluoranthene	2.2	0.00	6E-8	0.00	5E-7
Bis(2-ethylhexyl) phthalate	0.29 J	0.00	1E-9	0.00	1E-8
Butylbenzyl phthalate	0.79 J	0.00	–	0.00	–
Carbazole	1.9	0.00	1E-8	0.00	9E-4
Chrysene	5.7	0.00	2E-8	0.00	2E-7
Di-n-butylphthalate	0.074 J	0.00	–	0.00	–
Di-n-octylphthalate	0.093 J	0.00	–	0.00	–
Dibenz(a,h) anthracene	1.6	0.00	4E-6	0.00	6E-5
Dibenzofuran	0.45 J	0.00	–	0.02	–
Ethylbenzene	0.0017 J	0.00	–	0.00	–
Fluoranthene	10	0.00	–	0.01	–
Fluorene	0.96 J	0.00	–	0.00	–
Indeno(1,2,3-c,d) pyrene	3.3	0.00	8E-7	0.00	6E-6
Methylene chloride	0.0086 B	0.00	6E-10	0.00	7E-8

Refer to footnotes at end of table.

Table 8 (Concluded)
Risk Assessment Values for SWMU 98 COCs

COC Name	Maximum Concentration (mg/kg)	Industrial Land-Use Scenario ^a		Residential Land-Use Scenario ^a	
		Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
2-methyl-naphthalene	0.1 J	0.00	–	0.00	–
Naphthalene	0.39 J	0.00	–	0.00	–
Pentachlorophenol	0.042 J	0.00	2E-9	0.00	4E-8
Phenanthrene	7.5	0.00	–	0.00	–
Pyrene	8.3	0.00	–	0.00	–
Toluene	0.026	0.00	–	0.00	–
1,1,1-trichloroethane	0.002 J	0.00	–	0.00	–
Xylene	0.010	0.00	–	0.00	–
Total		0.09	3E-5	3	1E-3

^aFrom EPA (1989).

^bChromium, total assumed to be chromium VI (most conservative).

^cParameter was nondetect. Concentration assumed to be 0.5 of detection limit.

B = COC identified in associated blank.

J = Estimated concentration.

COC = Constituent of concern.

EPA = U.S. Environmental Protection Agency.

mg/kg = Milligram(s) per kilogram.

SWMU = Solid Waste Management Unit.

– = Information not available.

Table 9
Risk Assessment Values for SWMU 98 Background Constituents

COC Name	Background Concentration ^a (mg/kg)	Industrial Land-Use Scenario ^b		Residential Land-Use Scenario ^b	
		Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Arsenic	4.4	0.01	2E-6	0.25	5E-5
Barium	200	0.00	–	0.03	–
Cadmium	<1	–	–	–	–
Chromium, total ^c	12.8	0.00	–	0.00	–
Cobalt	7.1	0.00	–	0.00	–
Copper	17	0.00	–	0.08	–
Mercury	<0.1	–	–	–	–
Selenium	<1	–	–	–	–
Silver	<1	–	–	–	–
Thallium	<1.1	–	–	–	–
Vanadium	33	0.00	–	0.03	–
Zinc	76	0.00	–	0.14	–
Total		0.01	2E-6	0.5	5E-5

^aFrom Dinwiddie (September 1997), TA-1 Area soils.

^bFrom EPA (1989).

^cChromium, total assumed to be chromium III (most conservative).

COC = Constituent of concern.

EPA = U.S. Environmental Protection Agency.

mg/kg = Milligram(s) per kilogram.

SWMU = Solid Waste Management Unit.

– = Information not available.

For the residential land use scenario COCs, the HI is 3, and the excess cancer risk is $1E-3$ (Table 8). The numbers in the table included exposure from soil ingestion, dust and volatile 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 9 shows that for the SWMU 98 associated background constituents, the HI is 0.5 and the excess cancer risk is $5E-5$.

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 industrial land use scenario (the designated land use scenario for this site) and the residential land use scenario.

For the industrial land use scenario COCs, the HI is 0.09 (less than the numerical guideline of 1 suggested in the RAGS [EPA 1989]). Excess cancer risk is estimated at $3E-5$. 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 arsenic and several organics. Arsenic is a Class A carcinogen; the organics are Class B2 carcinogens. Thus, the excess cancer risk for this site is above the suggested acceptable risk value ($1E-6$). This assessment also determined risks considering background concentrations of the potential COCs for both the industrial and residential land use scenarios. Assuming the industrial land use scenario, the HI is 0.01 and the excess cancer risk is $2E-6$. 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 constituents that do not have a quantified background concentration are assumed to have an HQ of 0.00. The incremental HI is 0.08 and estimated incremental cancer risk is $3.00E-5$ for the industrial land use scenario. The incremental excess cancer risk to human health from the COCs is above guidelines considering an industrial land use scenario.

The calculated HI for the residential land use scenario COCs is 3, which is above the numerical guidance. Excess cancer risk is estimated at $1E-3$. The excess cancer risk is driven by arsenic and several organics. Arsenic is a Class A carcinogen; the organics are Class B2 carcinogens. Therefore, the excess cancer risk for this site is above the suggested acceptable risk value ($1E-6$). The HI for associated background for the residential land use scenario is 0.5; the excess cancer risk is estimated at $5E-5$. The incremental HI is 2.72 and the estimated incremental cancer risk is $1.26E-3$ for the residential land use scenario. Both the incremental HI and estimated excess cancer risk are above NMED guidelines considering the residential land use scenario.

VI.8 Step 7. Uncertainty Discussion

The determination of the nature, rate, and extent of contamination at SWMU 98 was based upon an initial conceptual model that was validated with confirmatory sampling conducted

around the site. The confirmatory sampling was implemented as set forth by the SWMU 98 RFI Plan (SNL/NM February 1995). The DQOs contained in the RFI Plan are appropriate for use in risk screening assessments. The data collected, based upon sample location, density, and depth, are representative of the site. The analytical requirements and results satisfy the DQOs. The 1995 data quality was verified and the 1999 data quality was verified and validated against appropriate SNL/NM procedures (SNL/NM July 1994, July 1996). Therefore, there is no uncertainty associated with the data quality used to perform the risk screening assessment at SWMU 98.

Because of the location, history of the site, and future land use (DOE et al. September 1995), there is low uncertainty in the land use scenario and for 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 7 shows the uncertainties (confidence) in toxicological parameter values. There is a mixture of estimated values and values from the IRIS (EPA 1998a), the HEAST (EPA 1997a), EPA Region 3 (EPA 1997c) and EPA Region 9 (EPA 1996b) electronic databases. Where values are not provided, information is not available from the HEAST (EPA 1997a), IRIS (EPA 1998a), or the EPA regions (EPA 1996b, 1997c). 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.

Total and incremental HI values for the COCs are below human health guidelines for the industrial land use scenario compared to established numerical guidance. Although the excess cancer risk was above proposed guidelines, the excess cancer risk was conservatively estimated through the use of maximum concentrations of the detected COCs. Because the site was adequately characterized, average concentrations would be more representative of actual site conditions. If the upper 95th confidence limit of the mean concentration (all mg/kg) for arsenic (4.8), benzo(a) anthracene (1.7), benzo(a) pyrene (1.3), benzo(b) fluoranthene (2.0), benzo (ghi) perylene (0.9), dibenz(a,h) anthracene (0.3), and indeno (1,2,3-c,d) pyrene (0.87) are used in place of their respective maximum concentrations, the total excess cancer risk is reduced to $9.56E-6$ and the incremental excess cancer risk is calculated to be $7.26E-6$. Although these values are above the NMED guideline for Class A and B carcinogens, it should be noted that the incremental contribution from arsenic is $2E-7$. The majority of the excess cancer risk is from the organics, all of which are polyaromatic hydrocarbons (PAH). PAHs are common constituents in asphalt (NIOSH 1997). SWMU 98 is in the heavily industrialized TA-1. Some of the samples were actually collected from underneath asphalt. Therefore, the PAHs are determined to be from asphalt and are not indicative of contamination. Removal of the PAHs from the risk screening assessment and using the upper 95th confidence limit of the mean concentration for arsenic produces an incremental excess cancer risk of $3.64E-7$, which is within NMED guidelines.

The overall uncertainty in all of the steps in the risk assessment process is considered not significant with respect to the conclusion reached.

VI.9 Summary

SWMU 98 has identified COCs consisting of some inorganic and organic compounds. Because of the location of the site, the designated industrial land use scenario, and the nature of contamination, potential exposure pathways identified for this site included soil ingestion and dust and volatile inhalation for the COCs. 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 the COCs show that for the industrial land use scenario the HI (0.09) is significantly less than the accepted numerical guidance from the EPA. Excess cancer risk ($3E-5$) is above the acceptable risk value provided by the NMED for an industrial land use scenario (NMED March 1998). The incremental HI is 0.08, and the incremental cancer risk is $3.00E-5$ for the industrial land use scenario. Although the excess cancer risk was above proposed guidelines, the excess cancer risk was conservatively estimated by using maximum concentrations of the detected COCs. Because the site was adequately characterized, average concentrations would be more representative of actual site conditions. If the upper 95th confidence limit of the mean concentration (all mg/kg) for arsenic (4.8), benzo(a) anthracene (1.7), benzo(a) pyrene (1.3), benzo(b) fluoranthene (2.0), benzo (ghi) perylene (0.9), dibenz(a,h) anthracene (0.3), and indeno (1,2,3-c,d) pyrene (0.87) are used in place of their respective maximum concentrations, the total excess cancer risk is reduced to $9.56E-6$ and the incremental excess cancer risk is calculated to be $7.26E-6$. Although these values are above the NMED guideline for Class A and B carcinogens, it should be noted that the incremental contribution from arsenic is $2E-7$. The majority of the excess cancer risk is from the organics, all of which are PAHs. PAHs are common constituents in asphalt (NIOSH 1997). SWMU 98 is in the heavily industrialized TA-1. Some of the samples were actually collected from underneath asphalt. Therefore, the PAHs are determined to be from asphalt and are not indicative of contamination. Removal of the PAHs from the risk screening assessment and using the upper 95th confidence limit of the mean concentration for arsenic produces an incremental excess cancer risk of $3.64E-7$, which is within NMED guidelines.

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 industrial 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 98. 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 RAGS (EPA 1997c). 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 conservatism 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 (Section VII.2.4) involves summarizing the scoping results and determining whether further examination of potential ecological impacts is necessary.

VII.2.1 Data Assessment

As indicated in Section IV (Table 5), inorganic constituents in soil within the 0- to 5-foot depth interval that exceeded background concentrations were as follows:

- Arsenic
- Barium
- Chromium
- Cobalt
- Copper
- Lead
- Mercury
- Silver
- Thallium
- Zinc.

Two constituents do not have quantified background concentrations. Therefore it is unknown if these constituents exceed background. These two constituents are:

- Cadmium
- Selenium.

Organic analytes detected in soil were as follows:

- Acenaphthene
- Anthracene
- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(g,h,i)perylene
- Benzo(k)fluoranthene
- Bis(2-ethylhexyl)phthalate
- Butylbenzylphthalate
- Carbazole
- Chrysene
- Di-n-butylphthalate
- Di-n-octylphthalate
- Dibenz(a,h)anthracene
- Dibenzofuran
- Ethylbenzene
- Fluoranthene
- Fluorene
- Indeno(1,2,3-cd)pyrene
- 2-methylnaphthalene
- Naphthalene
- Pentachlorophenol
- Phenanthrene
- Pyrene
- Toluene
- 1,1,1-trichloroethane
- Xylenes.

VII.2.2 Bioaccumulation

Among the COPECs listed in Section VII.2.1, the following were considered to have bioaccumulation potential in aquatic environments (Section IV, Tables 4 and 5):

- Arsenic
- Barium
- Cadmium
- Cobalt
- Lead
- Mercury
- Selenium
- Thallium
- Zinc

- Acenaphthene
- Anthracene
- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(g,h,i)perylene
- Benzo(k)fluoranthene
- Bis(2-ethylhexyl)phthalate
- Butylbenzylphthalate
- Chrysene
- Di-n-butylphthalate
- Di-n-octylphthalate
- Dibenz(a,h)anthracene
- Dibenzofuran
- Fluoranthene
- Fluorene
- Indeno(1,2,3-cd)pyrene
- 2-methylnaphthalene
- Naphthalene
- Pentachlorophenol
- Phenanthrene
- Pyrene.

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.

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 6 (Section V), wind and surface-water runoff are expected to be of low significance as a transport mechanisms for COPECs at this site. Migration to groundwater is not anticipated. Food chain uptake is expected to be of low significance. Transformation for the inorganic COPECs is expected to be of low significance, but may be of moderate significance for the organic COPECs. Volatilization may be a mechanism of loss for volatile organic COPECs.

VII.2.4 Scoping Risk Management Decision

Based upon information gathered through the scoping assessment, it was concluded that complete ecological pathways may be associated with this SWMU and that COPECs also exist at the site. As a consequence, a screening assessment was deemed necessary to predict the potential level of ecological risk associated with the site.

VII.3 Screening Assessment

As concluded in Section VII.2.4, complete ecological pathways and COPECs are associated with this SWMU. The screening assessment performed for the site involves a quantitative estimate of current ecological risks using exposure models in association with exposure parameters and toxicity information obtained from the literature. The estimation of potential ecological risks is conservative to ensure 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 ER Program” (IT July 1998) and are not duplicated here.

VII.3.1.1 *Ecological Pathways and Setting*

SWMU 98 occupies an area of less than 0.5 acre. The area that had been occupied by Building 863 consists of exposed highly disturbed soil. The area around this building site is urbanized. The site contains no natural habitat and wildlife use is essentially negligible

(probably limited to cosmopolitan species such as house sparrows [*Passer domesticus*], house finches [*Carpodacus mexicanus*], and possibly house mice [*Mus musculus*]). No threatened, endangered, or other sensitive species are expected to occur at this SWMU.

Although unlikely because of a lack of receptors, complete ecological pathways may exist at this site through the exposure of plants and wildlife to COPECs in the soil. It was assumed that direct uptake of COPECs from soil would be the primary route of exposure for plants and that exposure of plants to airborne COPECs would be minor. Exposure modeling for the wildlife receptors was limited to the food and soil ingestion pathways. Because of the lack of surface water at this site, exposure to COPECs through the ingestion of surface water was considered insignificant. Inhalation and dermal contact were also considered insignificant pathways with respect to ingestion (Sample and Suter 1994). Groundwater is not expected to be affected by COCs at this site.

VII.3.1.2 COPECs

1,1,1-trichloroethane and other chemicals leaked or spilled in and around Building 863 was the primary source of the COPECs associated with the soils at this site. Inorganic and organic COPECs identified for SWMU 98 are listed in Section VII.1.1. The inorganic analytes 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. 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). All detected organic analytes were considered to be COPECs for the site. In order to provide conservatism, this ecological risk assessment was based upon the maximum soil concentrations of the COPECs measured in the surface soil at this site. Table 5 presents maximum concentrations for the COPECs at SWMU 98.

VII.3.1.3 Ecological Receptors

As described in detail in an IT Corporation report (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 associated 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. 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). Although both the deer mouse and burrowing owl are common to the natural and partially disturbed grassland habitats around TA-I, it is unlikely that either of these species occupy or use SWMU 98 under current habitat conditions. However, these species are used here to evaluate potential ecological risk associated with the soil at this site.

VII.3.2 Exposure Estimation

Direct uptake from the soil was considered the only significant route of exposure for terrestrial plants. Exposure modeling for the wildlife receptors was limited to the food and soil ingestion pathways. Inhalation and dermal contact were considered insignificant pathways with respect to ingestion (Sample and Suter 1994). Drinking water was also considered an insignificant pathway because of the lack of surface water at this site. The deer mouse was modeled under three dietary regimes: as an herbivore (100 percent of its diet as plant material), as an omnivore (50 percent of its diet as plants and 50 percent as soil invertebrates), and as an insectivore (100 percent of its diet as soil invertebrates). The burrowing owl was modeled as a strict predator on small mammals (100 percent of its diet as deer mice). Because the exposure in the burrowing owl from a diet consisting of equal parts of herbivorous, omnivorous, and insectivorous mice would be equivalent to the exposure consisting of only omnivorous mice, the diet of the burrowing owl was modeled with intake of omnivorous mice only. Both species were modeled with soil ingestion comprising 2 percent of the total dietary intake. Table 10 presents the species-specific factors used in modeling exposures in the wildlife receptors. Justification for use of the factors presented in this table is described in the ecological risk assessment methodology document (IT July 1998).

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.

Table 11 presents the transfer factors used in modeling the concentrations of COPECs through the food chain. Table 12 presents maximum concentrations in soil and derived concentrations in tissues of the various food chain elements that are used to model dietary exposures for each of the wildlife receptors.

VII.3.3 Ecological Effects Evaluation

Table 13 shows benchmark toxicity values for the plant and wildlife receptors. For plants, the benchmark soil concentrations are based upon the lowest-observed-adverse-effect level (LOAEL). 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 LOAELs or NOAELs for some COPECs.

VII.3.4 Risk Characterization

Maximum concentrations in soil and estimated dietary exposures were compared to plant and wildlife benchmark values, respectively. Table 14 presents results of these comparisons. HQs are used to quantify the comparison with benchmarks for plants and wildlife exposure.

HQs for plants exceeded unity for barium, total chromium, cobalt, lead, silver, thallium, and zinc. Because of a lack of sufficient toxicity information, HQs could not be determined for nine of the organic COPECs. HQs exceeded unity for all three dietary regimes in the

Table 10
Exposure Factors for Ecological Receptors at SWMU 98

Receptor Species	Class/Order	Trophic Level	Body Weight (kg) ^a	Food Intake Rate (kg/day) ^b	Dietary Composition ^c	Home Range (acres)
Deer mouse (<i>Peromyscus maniculatus</i>)	Mammalia/ Rodentia	Herbivore	2.39E-2 ^d	3.72E-3	Plants: 100% (+ soil at 2% of intake)	2.7E-1 ^e
Deer mouse (<i>Peromyscus maniculatus</i>)	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 (<i>Peromyscus maniculatus</i>)	Mammalia/ Rodentia	Insectivore	2.39E-2 ^d	3.72E-3	Invertebrates: 100% (+ soil at 2% of intake)	2.7E-1 ^e
Burrowing owl (<i>Speotyto cunicularia</i>)	Aves/ Strigiformes	Carnivore	1.55E-1 ^f	1.73E-2	Rodents: 100% (+ soil at 2% of intake)	3.5E+1 ^g

^aBody weights are in kg wet weight.

^bFood intake rates are estimated from the allometric equations presented in Nagy (1987). Units are kg dry weight per day.

^cDietary compositions are generalized for modeling purposes. Default soil intake value of 2% of food intake.

^dFrom Silva and Downing (1995).

^eEPA (1993), based upon the average home range measured in semiarid shrubland in Idaho.

^fFrom Dunning (1993).

^gFrom Haug et al. (1993).

EPA = U.S. Environmental Protection Agency.

kg = Kilogram(s).

kg/day = Kilogram(s) per day.

SWMU = Solid Waste Management Unit.

Table 11
Transfer Factors Used in Exposure Models for
Constituents of Potential Ecological Concern at SWMU 98

Constituent of Potential Ecological Concern	Soil-to-Plant Transfer Factor	Soil-to-Invertebrate Transfer Factor	Food-to-Muscle Transfer Factor
Inorganic			
Arsenic	4.0E-2 ^a	1.0E+0 ^b	2.0E-3 ^a
Barium	1.5E-1 ^a	1.0E+0 ^b	2.0E-4 ^c
Cadmium	5.5E-1 ^a	6.0E-1 ^d	5.5E-4 ^a
Chromium (total)	4.0E-2 ^c	1.3E-1 ^e	3.0E-2 ^c
Cobalt	4.0E-1 ^c	1.0E+0 ^b	3.0E-2 ^c
Copper	8.0E-1 ^f	2.5E-1 ^d	1.0E-2 ^a
Lead	9.0E-2 ^c	4.0E-2 ^d	8.0E-4 ^c
Mercury (organic)	1.0E+0 ^c	1.0E+0 ^b	2.5E-1 ^a
Mercury (inorganic)	1.0E+0 ^c	1.0E+0 ^b	2.5E-1 ^a
Selenium	5.0E-1 ^c	1.0E+0 ^b	1.0E-1 ^c
Silver	1.0E+0 ^c	2.5E-1 ^d	5.0E-3 ^c
Thallium	4.0E-3 ^a	1.0E+0 ^b	4.0E-2 ^a
Zinc	1.5E+0 ^a	3.0E-1 ^d	1.0E-1 ^a
Organic^g			
Acenaphthene	2.1E-1	2.1E+1	2.1E-4
Anthracene	1.0E-1	2.2E+1	7.3E-4
Benzo(a)anthracene	2.2E-2	2.5E+1	1.2E-2
Benzo(a)pyrene	1.1E-2	2.7E+1	3.8E-2
Benzo(b)fluoranthene	6.2E-3	2.8E+1	1.1E-1
Benzo(g,h,i)perylene	6.1E-3	2.8E+1	1.2E-1
Benzo(k)fluoranthene	4.3E-3	2.9E+1	2.1E-1
Bis(2-ethylhexyl)phthalate	1.6E-3	3.2E+1	1.3E+0
Butyl benzyl phthalate	6.8E-2	2.3E+1	1.6E-3
Carbazole	3.9E+1	1.3E+1	1.8E-8
Chrysene	1.5E-2	2.6E+1	2.3E-2
Di-n-butyl phthalate	8.4E-2	2.2E+1	1.1E-3
Di-n-octyl phthalate	3.7E-2	2.4E+1	4.5E-3
Dibenzo(a,h)anthracene	6.8E-3	2.8E+1	9.5E-2
Dibenzofuran	1.6E-1	2.1E+1	3.3E-4
Ethylbenzene	5.9E-1	1.9E+1	3.3E-5
Fluoranthene	5.7E-2	2.3E+1	2.1E-3
Fluorine	1.5E-1	2.1E+1	3.8E-4
Ideno(1,2,3-cd)pyrene	6.1E-3	2.8E+1	1.2E-1
2-methylnaphthalene	2.3E-1	2.1E+1	1.8E-4
Naphthalene	4.8E-1	1.9E+1	4.7E-5
Pentachlorophenol	4.4E-2	2.4E+1	3.3E-3

Refer to footnotes at end of table.

Table 11 (Concluded)
Transfer Factors Used in Exposure Models for
Constituents of Potential Ecological Concern at SWMU 98

Constituent of Potential Ecological Concern	Soil-to-Plant Transfer Factor	Soil-to-Invertebrate Transfer Factor	Food-to-Muscle Transfer Factor
Phenanthrene	8.9E-2	2.2E+1	9.6E-4
Pyrene	3.3E-2	2.4E+1	5.8E-3
Toluene	1.0E+0	1.8E+1	1.3E-5
1,1,1-trichloroethane	1.4E+0	1.8E+1	6.7E-6
Xylenes	5.5E-2	1.9E+1	3.7E-5

^aFrom Baes et al. (1984).

^bDefault value.

^cFrom NCRP (January 1989).

^dFrom Stafford et al. (1991).

^eMa (1982).

^fFrom IAEA (1994).

^gSoil-to-plant and food-to-muscle transfer factors from equations developed in Travis and Arms (1988). Soil-to-invertebrate transfer factors from equations developed in Connell and Markwell (1990). All three equations based upon relationship of the transfer factor to the log K_{ow} value of compound.

IAEA = International Atomic Energy Agency.

K_{ow} = Octanol-water partition coefficient.

Log = Logarithm (base 10).

NCRP = National Council on Radiation Protection and Measurements.

SWMU = Solid Waste Management Unit.

Table 12
Media Concentrations^a for Constituents of
Potential Ecological Concern at SWMU 98

Constituent of Potential Ecological Concern	Soil (maximum) ^a	Plant Foliage ^b	Soil Invertebrate ^b	Deer Mouse Tissues ^c
Inorganic				
Arsenic	9.2E+0	3.7E-1	9.2E+0	3.1E-2
Barium	6.1E+2	9.1E+1	6.1E+2	2.3E-1
Cadmium	9.4E-1	5.2E-1	5.6E-1	9.6E-4
Chromium (total)	3.0E+1	1.2E+0	3.9E+0	3.0E-1
Cobalt	2.6E+2	1.1E+2	2.6E+2	1.8E+1
Copper	4.4E+1	3.5E+1	1.1E+1	7.5E-1
Lead	9.0E+1	8.1E+0	3.6E+0	1.9E-2
Mercury (organic)	1.5E-1	1.5E-1	1.5E-1	1.2E-1
Mercury (inorganic)	1.5E-1	1.5E-1	1.5E-1	1.2E-1
Selenium	6.0E-1 ^d	3.0E-1	6.0E-1	1.4E-1
Silver	1.4E+1	1.4E+1	3.5E+0	1.4E-1
Thallium	2.1E+0	8.4E-3	2.1E+0	1.4E-1
Zinc	1.9E+2	2.9E+2	5.7E+1	5.5E+1
Organic				
Acenaphthene	1.2E+0 ^e	2.5E-1	2.5E+1	8.1E-3
Anthracene	1.9E+0	2.0E-1	4.2E+1	4.8E-2
Benzo(a)anthracene	6.1E+0	1.4E-1	1.5E+2	2.8E+0
Benzo(a)pyrene	4.5E+0	5.1E-2	1.2E+2	7.1E+0
Benzo(b)fluoranthene	7.4E+0	4.6E-2	2.1E+2	3.7E+1
Benzo(g,h,i)perylene	3.3E+0	2.1E-2	9.3E+1	1.7E+1
Benzo(k)fluoranthene	2.2E+0	9.5E-3	6.4E+1	2.1E+1
Bis(2-ethylhexyl)phthalate	2.9E-1 ^e	4.6E-4	9.2E+0	1.9E+1
Butyl benzyl phthalate	7.9E-1 ^e	5.4E-2	1.8E+1	4.4E-2
Carbazole	1.9E+0	7.4E+1	2.5E+1	2.8E-6
Chrysene	5.7E+0	8.5E-2	1.5E+2	5.4E+0
Di-n-butyl phthalate	7.4E-2 ^e	6.2E-3	1.7E+0	2.8E-3
Di-n-octyl phthalate	9.3E-2 ^e	3.5E-3	2.2E+1	1.6E-2
Dibenzo(a,h)anthracene	1.6E+0	1.1E-2	4.5E+1	6.6E+0
Dibenzofuran	4.5E-1 ^e	7.2E-2	9.5E+0	5.0E-3
Ethylbenzene	1.7E-3 ^e	1.0E-3	3.2E-2	1.7E-6
Fluoranthene	1.0E+1	5.7E-1	2.3E+2	7.7E-1
Fluorene	9.6E-1 ^e	1.4E-1	2.0E+1	1.2E-2
Ideno(1,2,3-cd)pyrene	3.3E+0	2.0E-2	9.3E+1	1.7E+1
2-methylnaphthalene	1.0E-1 ^e	2.3E-2	2.1E+0	5.8E-4

Refer to footnotes at end of table.

Table 12 (Concluded)
Media Concentrations^a for Constituents of
Potential Ecological Concern at SWMU 98

Constituent of Potential Ecological Concern	Soil (maximum)^a	Plant Foliage^b	Soil Invertebrate^b	Deer Mouse Tissues^c
Naphthalene	3.9E-1 ^e	1.9E-1	7.5E+0	5.7E-4
Pentachlorophenol	4.2E-2 ^e	1.9E-3	9.9E-1	5.2E-3
Phenanthrene	7.5E+0	6.7E-1	1.7E+2	2.5E-1
Pyrene	8.3E+0	2.7E-1	2.0E+2	1.8E+0
Toluene	2.6E-2	2.6E-2	4.7E-1	9.9E-6
1,1,1-trichloroethane	2.0E-3 ^e	2.9E-3	3.5E-2	4.0E-7
Xylenes	1.0E-2	5.5E-3	1.9E-1	1.1E-5

^aIn milligram(s) per kilogram. All biotic media are based upon dry weight of the media. Soil concentration measurements are assumed to have been based upon dry weight. Values have been rounded to two significant digits after calculation.

^bProduct of the soil concentration and the corresponding transfer factor.

^cBased upon the deer mouse with an omnivorous diet. Product of the average concentration ingested in food and soil times the food-to-muscle transfer factor times a wet weight-dry weight conversion factor of 3.125 (EPA 1993).

^dParameter was nondetect. Concentration is 0.5 of detection limit.

^eBased upon an estimated concentration.

EPA = U.S. Environmental Protection Agency.

SWMU = Solid Waste Management Unit.

**Table 13
Toxicity Benchmarks for Ecological Receptors at SWMU 98**

Constituent of Potential Ecological Concern	Plant Benchmark ^{a,b}	Mammalian NOAELs			Avian NOAELs			Burrowing Owl NOAEL ^{e,g}
		Mammalian Test Species ^{c,d}	Test Species NOAEL ^{d,e}	Deer Mouse NOAEL ^{e,f}	Avian Test Species ^d	Test Species NOAEL ^{d,e}		
Inorganic								
Arsenic	10	Mouse	0.126	0.133	Mallard	5.14	5.14	5.14
Barium	500	Rat ^h	5.1	10.5	Chicken	20.8	20.8	20.8
Cadmium	3	Rat ⁱ	1.0	1.9	Mallard	1.45	1.45	1.45
Chromium (total)	1	Rat	2,737	5,354	Black duck	1.0	1.0	1.0
Cobalt	20	-	-	-	-	-	-	-
Copper	100	Mink	11.7	29.8	Chicken	47	47	47
Lead								
	50	Rat	8.0	15.7	American kestrel	3.85	3.85	3.85
Mercury (organic)	0.3	Rat	0.032	0.063	Mallard	0.0064	0.0064	0.0064
Mercury (inorganic)	0.3	Mouse	13.2	14.0	Japanese quail	0.45	0.45	0.45
Selenium	1	Rat	0.20	0.39	Screech owl	0.44	0.44	0.44
Silver	2	Rat	17.8 ⁱ	34.8	-	-	-	-
Thallium	1	Rat ^k	0.0074	0.015	-	-	-	-
Zinc	50	Rat	160	313	Chicken	14.5	14.5	14.5
Organic								
Acenaphthene	18 ^l	Mouse	17.5 ^m	18.5	-	-	-	-
Anthracene	18 ^l	Mouse	100 ⁿ	106	-	-	-	-
Benzo(a)anthracene	18 ^l	Mouse	1.0 ^o	1.1	-	-	-	-
Benzo(a)pyrene	18 ^l	Mouse	1.0 ^o	1.1	-	-	-	-
Benzo(b)fluoranthene	18 ^l	Mouse	1.0 ^o	1.1	-	-	-	-
Benzo(g,h,i)perylene	18 ^l	Mouse	1.0 ^o	1.1	-	-	-	-
Benzo(k)fluoranthene	18 ^l	Mouse	1.0 ^o	1.1	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	Mouse	18.3	19.4	Ringed dove	1.1	1.1	1.1
Butyl benzyl phthalate	-	Rat	159 ^o	311	-	-	-	-
Carbazole	-	-	-	-	-	-	-	-
Chrysene	18 ^l	Mouse	1.0 ^o	1.1	-	-	-	-

Refer to footnotes at end of table.

Table 13 (Continued)
Toxicity Benchmarks for Ecological Receptors at SWMU 98

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}
I-n-butyl phthalate	200	Mouse	550	582	-	0.11	0.11
Di-n-octyl phthalate	-	Mouse	79.4 ^g	84.0	-	-	-
Dibenzo(a,h)anthracene	18'	Mouse	1.0 ^o	1.1	-	-	-
Dibenzofuran	-	-	-	-	-	-	-
Ethylbenzene	-	Rat	291 ^p	569	-	-	-
Fluoranthene	18'	Mouse	12.5'	13.2	-	-	-
Fluorene	18'	Mouse	12.5'	13.2	-	-	-
Ideno(1,2,3-cd)pyrene	18'	Mouse	1.0 ^o	1.1	-	-	-
2-methylnaphthalene	18'	Rat	2.45 ^s	4.79	-	-	-
Naphthalene	18'	Mouse	5.0'	5.3	-	-	-
Pentachlorophenol	-	Rat	0.24	0.47	-	-	-
Phenanthrene	18'	Mouse	1.0 ^o	1.1	-	-	-
Pyrene	18'	Mouse	7.5 ^u	7.9	-	-	-
Toluene	200	Mouse	26	28	-	-	-
1,1,1-trichloroethane	-	Mouse	1,000	1,058	-	-	-
Xylenes	-	Mouse	2.1	2.2	-	-	-

^aIn milligram(s) per kilogram soil dry weight.

^bFrom Efroymson et al. (1997).

^cBody weights (in kilogram[s]) for the NOAEL conversion are as follows: lab mouse, 0.030; lab rat, 0.350 (except where noted).

^dFrom Sample et al. (1996), except where noted.

^eIn milligram(s) per kilogram body weight per day.

^fBased 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.

^gBased 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.

^hBody weight: 0.435 kilogram.

ⁱBody weight: 0.303 kilogram.

Table 13 (Concluded)
Toxicity Benchmarks for Ecological Receptors at SWMU 98

- ^lBased upon a rat LOAEL of 89 mg/kg/d (EPA 1998a) and an uncertainty factor of 0.2.
- ^kBody weight: 0.365 kilogram.
- ⁱFrom Sims and Overcash (1983).
- ^mBased upon a subchronic mouse LOAEL of 175 mg/kg/d (EPA 1998a) and an uncertainty factor of 0.1.
- ⁿBased upon a subchronic NOAEL of 1000 mg/kg/d (EPA 1998a) and an uncertainty factor of 0.1.
- ^oNo data available. Toxicity value based upon NOAEL for benzo(a)pyrene.
- ^pFrom EPA (2000).
- ^qBased upon a mouse NOAEL for bis(2-ethylhexyl)phthalate and the ratio of LD₅₀ values for bis(2-ethylhexyl)phthalate and di-n-octyl phthalate (Micromedex 1998).
- ^rBased upon a subchronic mouse NOAEL of 125 mg/kg/d (EPA 1998a) and an uncertainty factor of 0.1.
- ^sBased upon a chronic rat NOAEL for pyrene of 4.1 mg/kg/d, scaled from the chronic mouse NOAEL for pyrene, and the ratio of LD₅₀ values for rats for pyrene and 2-methylnaphthalene (Micromedex 1998).
- ^tBased upon chronic mouse NOAEL for pyrene and the ratio of LD₅₀ values for pyrene and naphthalene (Micromedex 1998).
- ^uBased upon a subchronic mouse NOAEL of 75 mg/kg/d (EPA 1998a) and an uncertainty factor of 0.1.
- EPA = U.S. Environmental Protection Agency.
- LD₅₀ = Acute lethal dose to 50 percent of the test population.
- LOAEL = Lowest-observed-adverse-effect level.
- mg/kg/d = Milligrams per kilogram per day.
- NOAEL = No-observed-adverse-effect level.
- SWMU = Solid waste management unit.
- = Insufficient toxicity data.

Table 14
Hazard Quotients for Ecological Receptors at SWMU 98

Constituent of Potential Ecological Concern	Plant HQ	Deer Mouse HQ (Herbivorous)	Deer Mouse HQ (Omnivorous)	Deer Mouse HQ (Insectivorous)	Burrowing Owl HQ
Inorganic					
Arsenic	9.2E-1	6.4E-1	5.8E+0	1.1E+1	4.7E-3
Barium	1.2E+0	1.5E+0	5.3E+0	9.1E+0	6.6E-2
Cadmium	3.1E-1	4.4E-2	4.6E-2	4.8E-2	1.5E-3
Chromium (total)	3.0E+1	5.2E-5	9.2E-5	1.3E-4	10.0E-2
Cobalt	1.3E+1	-	-	-	-
Copper	4.4E-1	1.9E-1	1.3E-1	6.3E-2	3.9E-3
Lead	1.8E+0	9.8E-2	7.6E-2	5.4E-2	5.3E-2
Mercury (organic)	5.0E-1	3.8E-1	3.8E-1	3.8E-1	2.1E+0
Mercury (inorganic)	5.0E-1	1.7E-3	1.7E-3	1.7E-3	3.0E-2
Selenium	6.0E-1	1.2E-1	1.8E-1	2.4E-1	4.0E-2
Silver	6.9E+0	6.3E-2	4.0E-2	1.7E-2	-
Thallium	2.1E+0	5.4E-1	1.2E+1	2.3E+1	-
Zinc	3.8E+0	1.4E-1	8.7E-2	3.0E-2	4.5E-1
Organic					
Acenaphthene	6.7E-2	2.3E-3	1.1E-1	2.1E-1	-
Anthracene	1.1E-1	3.5E-4	3.1E-2	6.1E-2	-
Benzo(a)anthracene	3.4E-1	3.8E-2	1.1E+1	2.3E+1	-
Benzo(a)pyrene	2.5E-1	2.1E-2	8.8E+0	1.8E+1	-
Benzo(b)fluoranthene	4.1E-1	2.9E-2	1.5E+1	3.1E+1	-
Benzo(g,h,i)perylene	1.8E-1	1.3E-2	6.8E+0	1.4E+1	-
Benzo(k)fluoranthene	1.2E-1	7.9E-3	4.7E+0	9.4E+0	-
Bis(2-ethylhexyl)phthalate	-	5.0E-5	3.7E-2	7.4E-2	1.9E+0
Butyl benzyl phthalate	-	3.5E-5	4.5E-3	9.0E-3	-
Carbazole	-	-	-	-	-
Chrysene	3.2E-1	2.9E-2	1.1E+1	2.2E+1	-
Di-n-butyl phthalate	3.7E-4	2.1E-6	2.2E-4	4.4E-4	4.3E-3

Refer to footnotes at end of table.

**Table 14 (Concluded)
Hazard Quotients for Ecological Receptors at SWMU 98**

Constituent of Potential Ecological Concern	Plant HQ	Deer Mouse HQ (Herbivorous)	Deer Mouse HQ (Omnivorous)	Deer Mouse HQ (Insectivorous)	Burrowing Owl HQ
Di-n-octyl phthalate	-	9.9E-6	2.1E-3	4.1E-3	-
Dibenzo(a,h)anthracene	8.9E-2	6.3E-3	3.3E+0	6.5E+0	-
Dibenzofuran	-	-	-	-	-
Ethylbenzene	-	2.8E-7	4.5E-6	8.8E-6	-
Fluoranthene	5.6E-1	9.1E-3	1.4E+0	2.7E+0	-
Fluorene	5.3E-2	1.9E-3	1.2E-1	2.4E-1	-
Ideno(1,2,3-cd)pyrene	1.8E-1	1.3E-2	6.8E+0	1.4E+1	-
2-methylnaphthalene	5.6E-3	8.0E-4	3.4E-2	6.7E-2	-
Naphthalene	2.2E-2	5.7E-3	1.1E-1	2.2E-1	-
Pentachlorophenol	-	9.0E-4	1.7E-1	3.3E-1	-
Phenanthrene	4.2E-1	1.2E-1	1.2E+1	2.5E+1	-
Pyrene	4.6E-1	8.6E-3	2.0E+0	4.0E+0	-
Toluene	1.3E-4	1.5E-4	1.4E-3	2.7E-3	-
1,1,1-trichloroethane	-	4.3E-7	2.8E-6	5.2E-6	-
Xylenes	-	4.0E-4	6.9E-3	1.3E-2	-
HI ^a	6.6E+1	4.1E+0	1.1E+2	2.1E+2	4.8E+0

Note: **Bold** text indicates HQ or HI exceeds unity.

^aThe 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.

deer mouse for barium. HQs for both the omnivorous and insectivorous deer mice exceeded unity for arsenic, thallium, and all PAHs except acenaphthene, anthracene, fluorine, 2-methylnaphthalene, and naphthalene. HQs for the deer mouse could not be determined for cobalt, carbazole, and dibenzofuran because of a lack of sufficient toxicity information. For the burrowing owl, the only HQs that exceeded unity were those from exposures to mercury when the mercury was assumed to be entirely in organic form and from exposures to bis(2-ethylhexyl)phthalate. HQs for cobalt, silver, thallium, and all organic COPECs except bis(2-ethylhexyl)phthalate and di-n-butylphthalate could not be determined for the burrowing owl because of a lack of sufficient toxicity information. 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). All receptors had total HIs greater than unity, with a maximum HI of 212 for the insectivorous deer mouse.

VII.3.5 Uncertainty Assessment

Many uncertainties are associated with the characterization of ecological risks at SWMU 98. 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 are used to be more protective of the ecological resources potentially affected by the site. Conservatisms incorporated into this risk assessment include the use of maximum measured analyte concentrations in soil to evaluate risk, the use of wildlife toxicity benchmarks based upon NOAEL values, the incorporation of strict herbivorous and strict insectivorous diets for predicting the extreme HQ values for the deer mouse, and the use of 1.0 as the area use factor for wildlife receptors regardless of seasonal use 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 Project (IT July 1998).

The assumption of an area use factor of 1.0 is a source of uncertainty for the burrowing owl. Because SWMU 98 is less than 0.5 acre in size, an area use factor of 0.014 or less would be justified for this receptor. This is sufficient to reduce the HQs for organic mercury and bis(2-ethylhexyl)phthalate to values of approximately 0.03.

In the estimation of ecological risk, background concentrations are included as a component of maximum on-site concentrations. Conservatisms in the modeling of exposure and risk can result in the prediction of risk to ecological receptors when exposed at background concentrations. As shown in Table 15, HQs associated with exposures to background are greater than 1.0 for arsenic, barium, chromium, and thallium. Background may account for a significant fraction of the HQs for these COPECs (between approximately 25 and 50 percent). Because the background concentrations for these COPECs were found to result in HQs greater than unity, based upon the current exposure models and toxicity benchmarks, it is likely that the risks to ecological receptors from the measured concentrations of these COPECs are overestimated by the HQs calculated in this screening assessment. This overestimation is the result of conservatisms incorporated into the exposure assessment and in the toxicity benchmarks for these COPECs (e.g., the use of NOAELs for wildlife receptors).

Table 15
HQs for Ecological Receptors Exposed to Background Concentrations at SWMU 98

Constituent of Potential Ecological Concern	Plant HQ	Deer Mouse HQ (Herbivorous)	Deer Mouse HQ (Omnivorous)	Deer Mouse HQ (Insectivorous)	Burrowing Owl HQ
Arsenic	4.4E-1	3.1E-1	2.8E+0	5.2E+0	2.2E-3
Barium	4.0E-1	5.0E-1	1.8E+0	3.0E+0	2.2E-2
Cadmium	1.7E-1	2.4E-2	2.5E-2	2.6E-2	8.1E-4
Chromium	1.3E+1	2.2E-5	3.9E-5	5.6E-5	4.3E-2
Cobalt	3.6E-1	-	-	-	-
Copper	1.7E-1	7.3E-2	4.9E-2	2.4E-2	1.5E-3
Lead	2.2E-1	1.2E-2	9.5E-3	6.7E-3	6.6E-3
Mercury (inorganic)	1.7E-1	5.7E-4	5.7E-4	5.7E-4	1.0E-2
Mercury (organic)	1.7E-1	1.3E-1	1.3E-1	1.3E-1	7.1E-1
Selenium	5.0E-1	1.0E-1	1.5E-1	2.0E-1	3.3E-2
Silver	2.5E-1	2.3E-3	1.4E-3	6.0E-4	-
Thallium	5.5E-1	1.4E-1	3.1E+0	6.0E+0	-
Zinc	1.5E+0	5.7E-2	3.5E-2	1.2E-2	1.8E-1
HI ^a	1.8E+1	1.4E+0	8.0E+0	1.5E+1	1.0E+0

Note: **Bold** text indicates HQ or HI exceeds unity.

^aThe 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.

A significant source of uncertainty associated with the prediction of ecological risks at this site is the use of the maximum measured concentrations to evaluate risk. This results in a conservative exposure scenario that does not necessarily reflect actual site conditions. To assess the potential degree of overestimation caused by using the maximum measured soil concentrations in the exposure assessment, average soil concentrations were calculated for the COPECs with HQs greater than unity to determine whether these HQs can be accounted for by the magnitude of the extreme measurement. The mean concentrations of chromium and zinc, for example, were determined to be 8.13 and 55.9 mg/kg, respectively, which are below the corresponding background screening concentrations for these elements. The mean concentrations for lead (17.1 mg/kg), mercury (0.12 mg/kg), bis(2-ethylhexyl)phthalate (0.125 mg/kg), fluoranthene (2.06 mg/kg), and pyrene (1.81 mg/kg) were all sufficiently below the maximums to reduce all receptor HQs to values less than unity. With the exception of thallium exposure in the insectivorous deer mouse, the average concentrations of the other COPECs in the soils at SWMU 98 reduced the HQs to values less than 10. For thallium, the average concentration resulted in a maximum HQ (for the insectivorous deer mouse) of approximately 15. Therefore, a significant degree of the predicted risk at this site can be explained by the use of the maximum measured soil concentrations as the exposure point concentration.

Because of the current habitat conditions at this site (highly urbanized), it is unlikely that ecological receptors exist at this site or would use it to a significant degree. The small area where exposure to soils occurs also greatly reduces the potential for exposures to ecological receptors. In addition, no natural vegetation occurs at the site. This risk assessment was based upon highly conservative assumptions of complete exposure pathways; however, under the current site conditions, such pathways are probably insignificant.

Based upon this uncertainty analysis, potential ecological risks at SWMU 98 are expected to be very low. HQs greater than unity were initially predicted; however, closer examination of the exposure assumptions revealed an overestimation of risk primarily attributed to exposure concentration, conservatively assumed wildlife use factors, and the contribution of background risk. Finally, this risk assessment was based upon the highly conservative assumption that complete ecological exposure pathways exist at this site; however, under the current site habitat conditions and predicted future conditions, such pathways are probably insignificant.

VII.3.6 Risk Interpretation

Ecological risks associated with SWMU 98 were estimated through a screening assessment that incorporated site-specific information when available. Overall, risks to ecological receptors are expected to be low because predicted risks associated with exposure to COPECs are based upon calculations using maximum detected values. Also, because the site is located in a highly urbanized location in TA-I, the existence of complete ecological exposure pathways is unlikely. Based upon this final analysis, ecological risks associated with SWMU 98 are expected to be low.

VII.3.7 Screening Assessment Scientific/Management Decision Point

After potential ecological risks associated with the site have been assessed, a decision is made regarding whether the site should be recommended for NFA or whether additional data should be collected to assess actual ecological risk at the site more thoroughly. With respect to this site, ecological risks are 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/New Mexico (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 airborne compounds (vapor phase or particulate)
- External exposure to penetrating radiation (immersion in contaminated air; immersion in contaminated water and exposure from ground surfaces with photon-emitting radionuclides).

Based upon the location of the SNL/NM SWMUs and the characteristics of the surface and subsurface at the sites, we have evaluated these potential exposure routes for different land use scenarios to determine which should be considered in risk assessment analyses (the last exposure route is pertinent to radionuclides only). At SNL/NM SWMUs, there does not currently occur any consumption of fish, shell fish, fruits, vegetables, meat, eggs, or dairy products that originate on site. Additionally, no potential for swimming in surface water is present due to the high-desert environmental conditions. As documented in the RESRAD computer code manual (ANL 1993), risks resulting from immersion in contaminated air or water are not significant compared to risks from other radiation exposure routes.

For the industrial and recreational land use scenarios, SNL/NM ER has, therefore, excluded the following four potential exposure routes from further risk assessment evaluations at any SNL/NM SWMU:

- Ingestion of contaminated fish and shell fish
- Ingestion of contaminated fruits and vegetables
- Ingestion of contaminated meat, eggs, and dairy products
- Ingestion of contaminated surface water while swimming.

That part of the exposure pathway for radionuclides related to immersion in contaminated air or water is also eliminated.

For the residential land use scenario, we will include ingestion of contaminated fruits and vegetables because of the potential for residential gardening.

Based upon this evaluation, for future risk assessments, the exposure routes that will be considered are shown in Table 1. Dermal contact is included as a potential exposure pathway in all land use scenarios. However, the potential for dermal exposure to inorganics is not considered significant and will not be included. In general, the dermal exposure pathway is generally considered to not be significant relative to water ingestion and soil ingestion pathways but will be considered for organic components. Because of the lack of toxicological parameter values for this pathway, the inclusion of this exposure pathway into risk assessment calculations may not be possible and may be part of the uncertainty analysis for a site where dermal contact is potentially applicable.

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

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 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 use 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	8 hr/day for 250 day	4 hr/wk for 52 wk/yr	350 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)	25,550 ^a	25,550 ^a	25,550 ^a
for noncarcinogenic compounds (= ED x 365 day/yr)	9,125	10,950	10,950
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)	5,000 ^{a,b}	260 ^d	7,000 ^{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 (liter/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

^aRisk Assessment Guidance for Superfund, Vol. 1, Part B (EPA 1991).

^bExposure Factors Handbook (EPA 1989b).

^cEPA Region VI guidance.

^dFor radionuclides, RESRAD (Argonne National Laboratory, 1993. *Manual for Implementing Residual Radioactive Material Guidelines Using RESRAD*, Version 5.0, ANL/EAD/LD-2, Argonne National Laboratory, Argonne, IL. 1993) is used for human health risk calculations; default parameters are consistent with RESRAD guidance.

^eDermal Exposure Assessment (EPA 1992).

ED = Exposure duration.

EPA = U.S. Environmental Protection Agency.

hr = Hour.

kg = Kilogram(s).

m = Meter(s).

mg = Milligram(s).

NA = Not available.

wk = Week.

yr = Year.

References

ANL, see Argonne National Laboratory.

Argonne National Laboratory (ANL), 1993. *Manual for Implementing Residual Radioactive Material Guidelines Using RESRAD*, Version 5.0, ANL/EAD/LD-2, Argonne National Laboratory, Argonne, IL.

DOE, see U.S. Department of Energy.

EPA, see U.S. Environmental Protection Agency.

U.S. Department of Energy (DOE), 1996. "Environmental Assessment of the Environmental Restoration Project at Sandia National Laboratories/New Mexico," U.S. Department of Energy, Kirtland Area Office.

U.S. Environmental Protection Agency (EPA), 1989a. "Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual," EPA/540-1089/002, U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, D.C.

U.S. Environmental Protection Agency (EPA), 1989b. *Exposure Factors Handbook*, EPA/600/8-89/043, U.S. Environmental Protection Agency, Office of Health and Environmental Assessment, Washington, D.C.

U.S. Environmental Protection Agency (EPA), 1991. "Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part B)," EPA/540/R-92/003, U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, D.C.

U.S. Environmental Protection Agency (EPA), 1992. "Dermal Exposure Assessment: Principles and Applications," EPA/600/8-91/011B, Office of Research and Development, Washington, D.C.

U.S. Environmental Protection Agency (EPA), 1996. "Soil Screening Guidance: Technical Background Document," EPA/540/1295/128, Office of Solid Waste and Emergency Response, Washington, D.C.

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