3-1-2006

Justification for Class III permit Modification march 2006 SWMU 46 Operable Unit 1309 Old Acid Waste Line Outfall

Sandia National Laboratories/NM

Sandia National Laboratories

Justification for Class III Permit Modification

March 2006

SWMU 46
Operable Unit 1309
Old Acid Waste Line Outfall

NFA Submitted August 1995
NOD Response Submitted October 1996
NOD Response Submitted January 2000
NOD Response Submitted November 2004
RSI Response Submitted May 2005
RSI Response Submitted August 2005

Environmental
Restoration
Project

United States Department of Energy
Sandia Site Office

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

This work supported by the
United States Department of Energy
under contract DE-AC04-94I85000.

SWMU 46
Old Acid Waste Line Outfall
(Poster 1 of 2)

Environmental Restoration Project

Site History

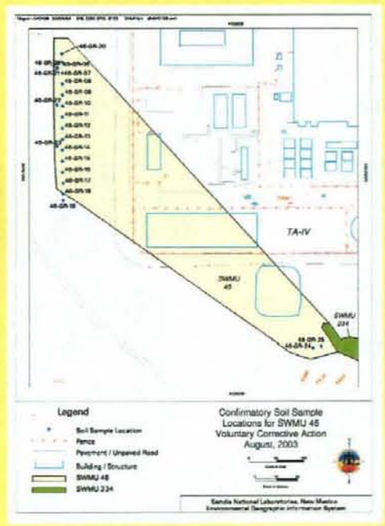
- SWMU 46, the Old Acid Waste Line Outfall, is at the southwest corner of TA IV. The site covers approximately 2.25 acres on the northern rim of Tijeras Arroyo.
- SWMU 46 was the discharge point for the Old Acid Waste Line (SWMU 226) that was connected to several TA-I buildings including research laboratories, machine shops, a paint shop, an electroplating shop, a foundry, and a photographic processing laboratory. In the late 1960s, an estimated 130,000 gpd of TA-I waste water discharged at the SWMU 46 outfall ditches.

Depth to Groundwater

- The regional aquifer is approximately 500 ft bgs, and a perched aquifer (not a source of drinking water) is approximately 300 ft bgs.

Constituents of Concern

- VOCs
- SVOCs
- PCBs
- Metals
- HE compounds
- Radionuclides

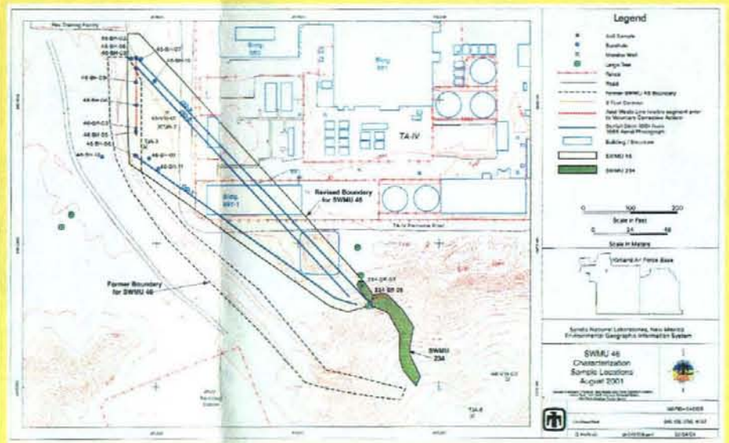


Investigations

- In September 1994, soil samples were collected from a nearby storm-water ditch. A review of historical aerial photographs conducted in 2000 determined that this ditch had been constructed in 1977 for storm water runoff from TA-IV; therefore, it was not associated with the acid waste line discharge and the results of this sampling were not used in the risk assessment.
- In 1994 and 2001, SWMU 46 was surveyed for UXO/HE and radiological material; none were found.
- In August 1998, soil-vapor samples were collected from four Geoprobe boreholes. Samples were collected at depths of 10, 20, and 30 ft bgs. Low concentrations of 16 VOCs were detected in soil-vapor samples collected near the confluence of the outfall ditches. TCE had the maximum concentration at 55 ppbv. VOCs were not detected in Boreholes BH-1 and BH-2, which were located approximately 700 and 300 ft south of the confluence, respectively.
- In October 1999, passive soil-vapor samples were collected. The sampling area covered approximately 7 acres and focused on the surface-water ditch, which at the time was the suspected waste-waster discharge location. After being buried for 30 days at shallow depths ranging from approximately 0.5 to 1 ft bgs, the collectors were retrieved and analyzed for VOCs and TPH. Low concentration levels of 17 VOCs were detected.
- In 2000, a historical review of aerial photographs from 1951 to 1993 and personnel interviews identified that three outfall ditches had been located at SWMU 46. (None of these were the storm-water ditch that had been sampled in 1994.) The first outfall ditch was constructed about 1948. The ditch was approximately 700 ft long and extended from the waste-line outfall to the arroyo rim. A parallel ditch was constructed about 1950, and a third ditch was constructed in the mid-1960s. Each of the three outfall ditches were unlined (earthen) ditches approximately 3 ft deep and 5 ft wide. Nearly the entire length of each outfall ditch was filled with soil during TA IV construction in the mid-1980s.
- In July 2000, a field investigation found that 60-ft long segments for two of the outfall ditches were still present on the steep northern rim of the arroyo. In addition, a 110-ft long segment of the old acid waste line (SWMU 226) was found at the northern end of the site. The waste line was composed of 8-inch diameter vitrified clay pipe.
- From April 2001 through March 2002, soil-vapor samples were collected from monitoring wells 46-VW-01 and 46-VW-02 for five quarters. The sampling ports for monitoring well 46-VW-01 were set at 15, 65, 115, 165, 215, and 265 ft bgs, and the sampling ports for monitoring well 46-VW-02 were set at 46, 96, 146, 196, 246 and 296 ft bgs. For the five quarters, the maximum TCE concentration from monitoring well 46-VW-01 was 46,000 ppbv, collected from 115 ft bgs; the maximum TCE concentration at the lowest sampling port at 265 ft bgs was 350 ppbv. Monitoring well 46-VW-02 had a maximum TCE concentration of 650 ppbv at 96 ft bgs, and the maximum TCE soil-vapor concentration was 480 ppbv near the bottom of hole at 246 ft bgs.
- In January 2001, one deep borehole, TJA-6, near the south end of the site was advanced as a groundwater monitoring well and soil samples were collected at 45, 95, 145, and 245 ft bgs. In March 2001, a second deep borehole, 46-VW-01, was advanced as a soil-vapor monitoring well and samples were collected at 45, 95, 145, 195, 245, and 295 ft bgs. The samples were analyzed for metals, VOCs, SVOCs, PCBs, HE compounds, and radionuclides. Five metals (beryllium, cadmium, chromium, selenium, and thallium) were detected with concentrations above background values. Four VOCs (acetone, 2-butanone, methylene chloride, and toluene) and two SVOCs [bis(2-ethylhexyl)phthalate and phenol] were detected. The radionuclide, Th-232 was detected above background value, and U-235 had two samples with MDAs greater than the background value. No PCBs or HE compounds were detected. The groundwater monitoring well, TJA-6, is part of the TAG monitoring well system and is routinely sampled.
- In April 2001, soil samples were collected from three locations at the northern end of the site and one location at the southeast end of the site. The samples were analyzed for VOCs, SVOCs, PCBs, HE compounds, metals, and radionuclides. Two of the samples had PCB concentrations above 1 mg/kg, and several metals had concentrations above background values. This area was included in the August 2003 VCA. None of the April 2001 samples were used in the risk assessment.
- In June 2001, soil samples were collected from two locations at the southeastern end of SWMU 46 as part of the characterization of SWMU 234, but are applicable to SWMU 46. Samples were collected at the surface and 5 ft bgs (with a backhoe), and analyzed for metals, VOCs, SVOC, and radionuclides. Two metals (chromium and silver) were detected slightly above background values. No VOCs were detected above MDLs. Seventeen SVOCs were detected. No radionuclides were detected above background activities.
- In August 2001, a Geoprobe was used to collect soil samples from 11 boreholes (a 12th borehole was started but abandoned with no sampling) to a depth of 18 ft near the visible portion of the acid waste line at the northern end of the site. The soil samples were analyzed for VOCs, SVOCs, PCBs, metals, cyanide, HE compounds and radionuclides. Nine metals had concentrations that exceeded background values. Total PCBs were not detected greater than 1 mg/kg. Cyanide was detected. Four VOCs (acetone, 2-butanone, methylene chloride, and toluene) and 26 SVOCs were detected. One HE compound (2-nitrotoluene) was detected in one soil sample. Two radionuclides, U-235 and U-238, were detected at activities slightly above background values.
- In August 2003, a VCA was conducted to remove soil that contained total PCBs in excess of 1 mg/kg (the EPA screening level). A 275-ft long trench was excavated at the northern end of the site. The trench was 2.5-ft wide with a depth of 0.8 ft to 2 ft becoming shallower at the southern end of the site. Approximately 50 cu yd of contaminated soil and pieces of the waste line were disposed of at an off-site facility. Confirmatory soil samples were collected from the floor of the trench, from four undisturbed areas outside the trench, and at the confluence of the Outfalls 1 and 2. The samples were analyzed for PCBs, metals, chromium VI, VOCs, and SVOCs. The maximum sample depth was 10 ft bgs. None of the soil samples contained total PCB concentrations greater than 1 mg/kg. Eleven metals were detected at concentrations above background values. Three VOCs and 14 SVOCs also were detected; most were J-qualified.
- In February 2004, the VCA trench was backfilled with clean soil.

Summary of Data Used for NFA Justification

- A total of 327 confirmatory soil samples were used in the human health risk assessment.
- The soil samples used in the risk assessments include the soil samples collected from the Geoprobe investigation at the north end of the site, the soil samples from the monitoring wells, (46-VW-01 and TJA-01), the backhoe soil samples at the south end of the site that are also associated with SWMU 234, and the VCA confirmatory soil samples.
- The soil-vapor sampling results indicated that no further monitoring of soil-vapor was necessary.



This work supported by the United States Department of Energy under contract DE-AC04-94185000.

SWMU 46
Old Acid Waste Line Outfall
(Poster 2 of 2)

Environmental Restoration Project

Recommended Future Land Use

- Industrial land use was established for this site.

Results of Risk Analysis

- Risk assessment results for the residential scenario are calculated per NMED risk assessment guidance in 2003 as presented in the "Supplemental Risk Document Supporting Class 3 Permit Modification Process" (SNL/NM October 2004).
- Because COCs were present in concentrations or activities greater than background-screening levels or because constituents were present that did not have background-screening levels, it was necessary to perform a risk assessment for the site. The risk assessment analysis evaluated the potential for adverse health effects for the residential land-use scenario.
- The maximum concentration value for lead was 66.8 mg/kg; this value exceeds the background value. The EPA intentionally does not provide any human health toxicological data on lead; therefore, no risk parameter values could be calculated. The NMED guidance for lead screening concentrations for construction and industrial land-use scenarios are 750 and 1,500 mg/kg, respectively. The EPA screening guidance value for a residential land-use scenario is 400 mg/kg. The maximum concentration for lead at this site is less than all the screening values; therefore, lead was eliminated from further consideration in the human health risk assessment.
- The total human health HI was 6.72 for the residential land-use scenario, which is greater than the NMED guideline of 1. The total estimated excess cancer risk was 3E-5 for the residential land-use scenario, which is above the NMED guideline of 1E-5. Using the UCLs of the mean concentrations for the main contributors to risk [arsenic, cadmium, nickel, thallium, benzo(a)pyrene, and benzo(ghi)perylene], the total HI was reduced to 1.61 and the total estimated excess cancer risk was reduced to 4E-6. The incremental HI and excess cancer risk are 1.45 and 4E-6. In addition, only cadmium had an individual HQ for noncarcinogens that exceed 1.0 under these conditions. The cadmium HQ (1.03) was only slightly greater than 1.0. Thus, the total HI and estimated excess cancer risk are below or approximately equal to the NMED guidelines for a residential land-use scenario.
- The human health incremental TEDE for a residential land-use scenario was 5.5 mrem/yr, which is below the EPA numerical guideline of 75 mrem/yr. The human health incremental TEDE for an industrial land-use scenario was 2.1 mrem/yr, which is below the EPA numerical guideline of 15 mrem/yr. Therefore, SWMU 46 is eligible for unrestricted radiological release.
- Using the SNL ecological risk assessment methodology, the ecological risk for SWMU 46 is predicted to be low.
- In conclusion, human health risk under a residential land-use scenario and ecological risk are acceptable per NMED guidance. Thus, SWMU 46 is proposed for CAC without institutional controls.

Confirmatory soil sampling at the SWMU 46 confluence. Technician is measuring depth of soil sample at outfall ditch OD-2. Outfall Ditch OD-1 is visible in left corner of photograph. View to northwest, August 2003.

VCA remediation trench at SWMU 46. Roll-off bins for waste (contaminated soil and pipe pieces) are located along east side of trench. View to south, August 2003.

Low-altitude oblique aerial photograph showing construction of TA-IV in 1978. Storm water ditch is visible at lower left corner of photograph. The three SWMU 46 outfall ditches are faintly visible and are located between the storm-water ditch and Buildings 980 and 981. View to North, 1978.

Human Health Risk Assessment Values for SWMU 46 Nonradiological COCs

COC	Maximum/ UCL Concentration (mg/kg)	Residential Land-Use Scenario[a] (Maximum Concentrations) Hazard Index	Residential Land-Use Scenario[a] (Maximum Concentrations) Cancer Risk	Residential Land-Use Scenario[a] (UCL Concentrations) Hazard Index	Residential Land-Use Scenario[a] (UCL Concentrations) Cancer Risk
Inorganic					
Arsenic	5.23 / **2.8**	0.24	1E-5	Below Background[b]	Below Background[b]
Barium	572	0.11	–	0.11	–
Beryllium	0.891	0.01	8E-10	0.01	8E-10
Cadmium	213 / **40.6**	5.46	1E-7	1.03	1E-7
Chromium VI	2.08	0.01	1E-8	0.01	1E-8
Chromium-total	120	0.00	–	0.00	–
Copper	133 J	0.05	–	0.05	–
Cyanide-total	12.7	0.01	–	0.01	–
Mercury	0.0766	0.00	–	0.00	–
Nickel	379 / **87.5**	0.25	–	0.03	–
Selenium	1.28	0.00	–	0.00	–
Silver	16.2	0.04	–	0.04	–
Thallium	2.19 / **1.1**	0.44	–	0.22	–
Vanadium	46.5	0.09	–	0.09	–
Zinc	149 J	0.01	–	0.01	–
Organic					
Acenaphthene	0.00626 J	0.00	–	0.00	–
Acenaphthylene	0.00406 J	0.00	–	0.00	–
Acetone	0.0132	0.00	–	0.00	–
Anthracene	0.0212 J	0.00	–	0.00	–
Benzo(a)anthracene	0.258	0.00	4E-7	0.00	4E-7
Benzo(a)pyrene	0.435/ **0.06**	0.00	7E-6	0.00	1E-6
Benzo(b)fluoranthene	0.506	0.00	8E-7	0.00	8E-7
Benzo(ghi)perylene	0.309 / **0.05**	0.00	5E-6	0.00	8E-7
Benzo(k)fluoranthene	0.471	0.00	8E-8	0.00	8E-8
2-Butanone	0.107	0.00	–	0.00	–
Butylbenzylphthalate	0.0565 J	0.00	–	0.00	–
Carbazole	0.0182 J	0.00	6E-10	0.00	6E-10
2-Chlorophenol	0.00835 J	0.00	–	0.00	–
Chrysene	0.435	0.00	7E-9	0.00	7E-9
Di-n-butylphthalate	0.0495 J	0.00	–	0.00	–
Di-n-octylphthalate	0.0102 J	0.00	–	0.00	–
Diethylphthalate	0.0877 J	0.00	–	0.00	–
Dibenzofuran	0.0094 J	0.00	–	0.00	–
1,2-Dichlorobenzene	0.00451 J	0.00	–	0.00	–
1,3-Dichlorobenzene	0.00486 J	0.00	–	0.00	–
Diphenylamine	0.0073 J	0.00	–	0.00	–
bis(2-Ethylhexyl) phthalate	2.04	0.00	5E-8	0.00	5E-8
Fluoranthene	0.450	0.00	–	0.00	–
Fluorene	0.014 J	0.00	–	0.00	–
Hexachlorobenzene	0.0057 J	0.00	2E-8	0.00	2E-8
Indeno(1,2,3-c,d)pyrene	0.345 J	0.00	6E-7	0.00	6E-7
Methylene chloride	0.00385 J	0.00	5E-8	0.00	5E-8
Naphthalene	0.00345 J	0.00	–	0.00	–
Phenanthrene	0.139	0.00	–	0.00	–
Phenol	1.59	0.00	–	0.00	–
Pyrene	0.603	0.00	–	0.00	–
2-Nitrotoluene	0.0152	0.00	–	0.00	–
Toluene	0.017	0.00		0.00	
	Total	**6.72**	**3E-5**	**1.61**	**4E-6**
	NMED Guidance	*<1*	*<1E-5*	*<1*	*<1E-5*

Note: UCLs are calculated only for risk drivers. UCL concentrations are in **bold**.
[a]EPA 1989
[b]UCL concentration was below background screening level. Therefore, risk was not calculated.

For More Information Contact

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Sandia National Laboratories

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Department of Energy
Albuquerque Operations Office
Kirtland Area Office
P. O. Box 5400
Albuquerque, New Mexico 87185-5400

AUG 28 1995

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

Mr. David Neleigh, Chief
New Mexico and Federal Facilities Section
RCRA Permits Branch
U. S. Environmental Protection Agency, Region VI
1445 Ross Avenue, Suite 1200
Dallas, TX 75202-2733

Dear Mr. Neleigh:

Enclosed are copies of the second set of No Further Action (NFA) proposals for 23 solid waste management units (SWMUs) from the Resource Conservation and Recovery Act (RCRA) Hazardous and Solid Waste Amendments (HSWA) Final Permit for Sandia National Laboratories/New Mexico (SNL/NM), ID No. NM5890110518.

Copies of these proposals are also being submitted for comment to the New Mexico Environment Department (NMED), Hazardous and Radioactive Materials Bureau. The Class 3 permit modification process will be initiated after regulatory comments are addressed.

If you have any questions, please contact John Gould at (505) 845-6089 or Mark Jackson at (505) 845-6288.

Sincerely,

George K. Lasker

for Michael J. Zamorski
Acting Area Manager

Enclosures

cc w/enclosures:
T. Trujillo, AL, ERD
L. Aker, AIP (2 copies)
W. Cox, SNL, MS 1147

cc w/o enclosures:
M. Jackson, KAO
J. Johnsen, KAO-AIP
C. Soden, AL, EPD
N. Morlock, EPA, Region VI
T. Roybal, SNL, MS 1147
M. Davis, SNL, MS 1147
T. Vandenberg, SNL, MS 0141
E. Krauss, SNL, MS 0141

Sandia National Laboratories / New Mexico

PROPOSAL FOR NO FURTHER ACTION ENVIRONMENTAL RESTORATION PROJECT SITE 46, OLD ACID WASTE LINE OUTFALL SITE OPERABLE UNIT 1309

June 1995

Environmental
Restoration
Project

United States Department of Energy
Albuquerque Operations Office

PROPOSAL FOR NO FURTHER ACTION

Site 46, Old Acid Waste Line Outfall Site
Operable Unit 1309

SANDIA NATIONAL LABORATORIES/NEW MEXICO

1. Introduction

1.1 ER Site Identification Number and Name

Sandia National Laboratories/New Mexico (SNL/NM) is proposing a risk-based no further action (NFA) decision for Environmental Restoration (ER) Site 46, Old Acid Waste Line Outfall Site, Operable Unit (OU) 1309. ER Site 46 is listed in the Hazardous and Solid Waste Amendment (HSWA) Module IV (EPA August 1993) of the SNL/NM Resource Conservation and Recovery Act (RCRA) Hazardous Waste Management Facility Permit (NM5890110518) (EPA August 1992).

1.2 SNL/NM Risk-Based NFA Process

This proposal for a determination of a risked-based NFA decision has been prepared using the criteria presented in Section 4.5.3 of the SNL/NM Program Implementation Plan (PIP) (SNL/NM February 1994). Specifically, this proposal will "contain information demonstrating that there are no releases of hazardous waste (including hazardous constituents) from solid waste management units (SWMU) at the facility that may pose a threat to human health or the environment" (as proposed in the code of Federal Regulations [CFR], Section 40 Part 264.51[a] [2]) (EPA July 1990). The HSWA Module IV contains the same requirements for an NFA demonstration:

> Based on the results of the RFI [RCRA Facility Investigation] and other relevant information, the Permittee may submit an application to the Administrative Authority for a Class III permit modification under 40 CFR 270.42(c) to terminate the RFI/CMS [corrective measures study] process for a specific unit. This permit modification application must contain information demonstrating that there are no releases of hazardous waste including hazardous constituents from a particular SWMU at the facility that pose threats to human health and/or the environment, as well as additional information required in 40 CFR 270.42(c) (EPA August 1993).

For a risk-based proposal, an SWMU is eligible for an NFA determination if the NFA criterion established by the SNL/NM permit is met. This criterion, found in Section M.1 of the permit, is as follows: "[T]here are no releases of hazardous waste including hazardous constituents...that pose threats to human health and/or the environment..." This risk-base proposal contains information needed to make the NFA determination.

This proposal is using the technical approach which is the foundation for the SNL/NM corrective action process. The details of the SNL/NM technical approach are provided in Appendix C of the SNL/NM Program Implementation Plan (SNL/NM 1994). The first step in the technical approach is the data qualitative review step (the same step used to determine whether the SWMU is eligible for administrative NFA). Should significant uncertainities remain, the assessment of the SWMU continues with data collection.

At this site, sufficient data were not available to compare to established action levels or to develop site-specific action levels. Background soil samples were collected and analyzed to

develop upper tolerance limits (UTLs) for metals. Site-specific data were collected to compare to existing soil action levels (proposed Subpart S Action Levels) and UTLs. If site-specific concentrations exceeded the proposed Subpart S Action Levels or UTLs, then risk was analyzed. Site-specific soil concentrations were compared to the derived risk assessment action levels. Concentrations less than these action levels, either proposed Subpart S action levels, background UTLs, or derived risk-based values, triggered this NFA proposal for Site 46.

1.3 Local Setting

SNL/NM occupies 2,829 acres of land owned by the Department of Energy (DOE), with an additional 14,920 acres of land provided by land-use permits with Kirtland Air Force Base (KAFB), the United States Forest Service, the State of New Mexico, and the Isleta Indian Reservation. SNL/NM has been involved in nuclear weapons research, component development, assembly, testing, and other nuclear activities since 1945.

ER Site 46 (Figure 1) is located on land owned by DOE. The site is situated west and south of the Technical Area (TA) IV fence in a slight depression on top of the escarpment northwest of Tijeras Arroyo.

Surficial deposits in the SNL/KAFB area lie within four geomorphic provinces, which in turn contain nine geomorphic subprovinces. Site 46 lies within the Tijeras Arroyo subprovince. The Tijeras Arroyo subprovince is characterized by broad, west-sloping alluvial surfaces and the 50-meter-deep Tijeras Arroyo. The Tijeras Arroyo subprovince contains deposits derived from many sources, including granitic and sedimentary rocks of the Sandia Mountains, sedimentary and metamorphic rocks of the Manzanita Mountains, and sediments of the Upper Santa Fe Group.

2. History of the SWMU

2.1 Sources of Supporting Information

In support of this request for a risk-based NFA decision for ER Site 46, a background study was conducted to collect available and relevant site information. Interviews were conducted with SNL/NM staff and contractors familiar with site operational history.

The following information sources were available for the use in the evaluation of ER Site 46:

- Confirmatory-sampling program conducted in September 1994
- Risk analysis for three metals and three radionuclides
- One surface radiation survey
- One unexploded ordnance/high explosives (UXO/HE) survey
- Interviews and personnel correspondence
- Historical aerial photographs spanning 40 years
- Personal breathing zone air sampling for metals

2.2 Previous Audits, Inspections, and Findings

ER Site 46 was first listed as a potential release site based on the Comprehensive Environmental Assessment and Response Program (CEARP) interviews in 1985 (DOE September 1987). The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) finding was uncertain for Federal Facility Site Discovery and Identification Findings (FFSDIF), Preliminary Assessment and Site Inspection; therefore, no Hazard Ranking System or Modified Hazard Ranking System migration mode scores were calculated for the SWMU (DOE September 1987). Site 46 was included in the Environmental Protection Agency (EPA) RCRA Facility Assessment (RFA) in 1987 (EPA April 1987).

2.3 Historical Operations

The Old Acid Waste Line carried wastes from several buildings in TA-I. It was installed between 1948 and 1950. The site begins as a north-south trending, 750-foot long open trench in a grassy field northwest of Building 981-1 in TA-IV. No pipe opening is visible at the "head" of the trench. As the trench crosses the field, it turns to the southeast and continues to an unengineered spillway above the Tijeras Arroyo floodplain. The spillway lies on a bank (40 to 50 feet of relief) composed of compacted alluvial sediment. Historical aerial photographs show vegetation, presumably supported by the discharge, growing southeast of the spillway to the active arroyo channel (about 200 feet distance from the spillway). The site is not restricted and is easily accessible.

During use, discharged effluent averaged an estimated 130,000 gallons per day. Use of the line was discontinued in the mid-to-late 1960s. The line received wastes from plating, etching, and photo processing operations; and cooling tower "blow down." Acids and metals are target contaminants. Chromic acid and ferric chloride are mentioned specifically in the site history, and ferric chloride was found in one soil sample collected during the RFA. Various radionuclides, possibly including tritium, uranium, and plutonium also were used in TA-I.

Building 863 (ER Site 98) was a source of discharge to the acid line. The information sheet for Site 98 indicates the presence of trichloromethane, silver, and photo processing chemicals with an ammonia-like odor. The waste solution from the silver recovery unit reportedly was discharged to the old acid waste line, which is the only specific information about chemical discharges.

3. Evaluation of Relevant Evidence

3.1 Unit Characteristics

The Old Acid Waste Drainage Outfall is confined to the downstream natural drainage. All releases would be contained in this limited area. Most of the potential contamination resulting from discharged effluent would have most likely settled at or before the furthest extent of visible erosion/scour.

3.2 Operating Practices

The Old Acid Waste Drainage Outfall discharged industrial waste from TA-I from approximately 1948 until the mid-to-late 1960s. It has not been used since then.

3.3 Presence or Absence of Visual Evidence

The approximately 750-foot long trench is the only physical evidence of the outfall system. No discoloration of soils was observed during site reconnaissance and soil sampling activities.

3.4 Results of Previous Sampling/Surveys

In 1994, the site was visually surveyed for surface indications of UXO/HE. No UXO/HE were found (SNL/NM 1994a). Also, in 1994 a surface radiation survey was conducted on the entire site using an Eberline ESP-2 portable scaler, with an Eberline SPA-8 (2 inch X 2 inch sodium iodide) detector. A 30-second integrated count was performed at each proposed sample location, while scanning the detector over an area approximately 2 feet in radius around the sample location. The alarm was set at 1.3 times the background count rate. No alarms occurred during the survey. No surface anomalies were detected (SNL/NM 1994b).

3.5 Assessment of Gaps in Information

No environmental sampling data existed for Site 46. If contamination was present, potential constituents of concern (metals, radioactive constituents), would be expected at shallow depths. Metals and radioactive constituents generally adsorb on soil and precipitate rather than remaining soluble. A surface (0-6 inches deep) and shallow subsurface (6-36 inches deep) soil sampling program was developed and implemented in September 1994.

3.6 Confirmatory Sampling

The Confirmatory Sampling and Analysis Plan (SAP) can be found in Appendix A. Those soil sample results exceeding an action level are summarized in Table 1. A complete list of "hits" or detections and quality assurance (QA) results can be found in Appendix B.

For health and safety purposes, a photoionization detector, OVM, was used throughout the field program. The OVM measured no anomalous vapor concentrations.

Surface and shallow subsurface soil samples were collected at the most likely locations of contamination. Four samples were collected at the head of the site outfall (by the fire extinguisher training area west of TA-IV) and four samples were collected by the spillway into the Tijeras Arroyo drainage (Figure 1). Every sample was analyzed for metals[1], chromium[+6], total Kjeldahl nitrogen (TKN), and nitrate/nitrite. The four subsurface samples

[1] Although the total analyte list (TAL) metal analytes include calcium, magnesium, potassium, and sodium, these nontoxic, major cations are not included in the evaluation. They do not pose a significant environmental or human health risk regardless of concentration.

also were analyzed for volatile organic compounds (VOCs). Four samples were analyzed for semivolatile organic compounds (SVOCs). As a general check for radioactive constituents, all the samples were analyzed for tritium, four samples were analyzed for isotopic uranium, and isotopic plutonium and all eight samples were screened in-house and two samples were screened off-site with gamma spectroscopy.

3.6.1 Background Samples for Metals and Radioactive Constituents

UTLs for background metals were calculated from analyses of 24 samples collected in the vicinity of the 11 sites discussed in the SAP (Appendix A). UTLs or background 95th percentiles for background radionuclides were calculated from samples collected throughout KAFB (IT 1994). A discussion of background calculations and supporting data and analyses are included in Appendices C and D.

3.6.2 Organic Compounds

No organic compounds were detected without qualification. Nitrate/nitrite was detected in seven of eight samples with concentrations ranging from 150 to 1400 milligrams per kilogram (mg/kg). TKN was detected in all eight samples, with concentrations ranging from 120 to 470 mg/kg. The main environmental or human health hazard pertaining to reduced nitrogen (as measured in TKN) is that it oxidizes to either nitrate or nitrite. Therefore, it is valid and conservative to compare TKN concentrations to action levels for nitrate and nitrite. The proposed Resource Conservation and Recovery Act (RCRA) Subpart S action levels for nitrate and nitrite are 100,000 mg/kg and 8,000 mg/kg, respectively. Cyanide was detected in two of eight samples, 46-01-B and 46-04-B, with concentrations of 0.16 and 0.18 mg/kg, respectively. The proposed Subpart S action level for cyanide is 2000 mg/kg. These results indicate no significant human health or environmental hazard because organic compounds only were detected tentatively and TKN, nitrate/nitrite and cyanide were detected at concentrations much lower than action levels.

3.6.3 Metals

Personal breathing zone air sampling was used at Site 46 to monitor airborne particulate contamination for metals. No airborne metal contamination was detected. Selenium, mercury, and chromium^{+6} were not detected at Site 46. Silver was detected in two out of eight samples at concentrations of 0.59 and 0.58 mg/kg in Samples 46-01-B and 46-04-B, respectively. Silver was not detected in background samples. The proposed Subpart S action level is 400 mg/kg. Both tests comparing the site beryllium data to local background data indicated no contamination. The maximum local background value for beryllium was 0.53 mg/kg. Beryllium was not detected above 0.53 mg/kg at Site 46.

All other site metal concentrations, except for one analysis for cadmium, iron, and lead, were below the UTLs. For cadmium, Sample 46-01-B had a concentration of 4.0 mg/kg compared to a UTL of 3.82 mg/kg. The proposed Subpart S action level for cadmium in soils is 80 mg/kg. Sample 46-01-B had a concentration of 15 mg/kg for chromium, just exceeding the UTL of 14.3 mg/kg. However, the Subpart S action level for chromium is 80,000 mg/kg. For lead, Sample 46-04-B had a concentration of 27 mg/kg compared to a UTL of 23.1

mg/kg. A Subpart S action level was not proposed for lead. However, a memorandum from an EPA assistant administrator to EPA regional division directors does supply a risk-based action level for lead in soils, 400 ppm (mg/kg) (EPA 1994). This risk-based action level presumes that lead be considered individually rather than in conjunction with other metals. This action level of 400 mg/kg far exceeds the concentration in Sample 46-04-B of 27 mg/kg. For iron, Sample 46-02-A had a concentration of 17,000 mg/kg compared to a UTL of 16,962 mg/kg.

3.6.4 Radionuclides

Potassium-40 was detected in two samples at activities of 16.4 and 22.3 picocuries per gram (pCi/g), compared with the base-wide background UTL of 25.34 pCi/g. Lead-212 was detected in Sample 46-03-A at an activity of 0.89 pCi/g, compared to a base-wide background UTL of 1.0795 pCi/g (IT 1994). Plutonium-239/240 and plutonium-238 were not detected above the minimum detectable activity (MDA) in Site 46 samples. Uranium-238, uranium-235/236, and uranium-234 were detected in four samples at low activities below the base-wide background UTL and the maximum activity of six local background analyses. Thallium was not detected at Site 46. These constituents require no further evaluation.

Lead-214 was detected in Sample 46-03-A at an activity of 0.93 pCi/g, compared with the base-wide background UTL of 0.90 pCi/g. Radium-226 was detected in Samples 46-02-B, 46-03-B and 46-04-B with activities of 2.74, 2.14, and 2.06 pCi/g , respectively. The base-wide background UTL for radium-226 is 1.94 pCi/g (IT 1994). Additional off-site radiological analyses for radium-226 were requested for Samples 46-01-A, 46-01-B, 46-02-B, 46-03-B, and 46-04-B. These results indicated activities less than 2.74 pCi/g. Tritium was detected in all eight samples at activities ranging from 0.023 to 0.17 pCi/g; tritium was not detected above the MDA in local background samples.

3.6.5 Quality Assurance Results

As discussed in the Confirmatory Sampling and Analysis Plan (Appendix A), quality assurance samples, including field duplicates, trip blanks and rinsates, were collected as part of the 11 site sampling program. Analyses indicate that the field soil duplicates were comparable to the original soil sample results. The trip blanks and rinsates indicated no significant sampling contamination. QA results can be found in Appendix B. Level I and Level II data verification was conducted on all data, as described in the PIP (SNL/NM 1994).

3.7 Risk Analysis

To further evaluate the data for metals with concentrations greater than background UTLs, a risk assessment was performed for a combination of cadmium, iron, and silver, assuming the maximum detected concentrations. To further evaluate the site data for radionuclides with activities above background UTLs or those without background UTLs, a risk analysis was performed for the combination of lead-214, tritium, and radium-226, assuming the maximum detected activities.

The risk calculations were designed to produce conservatively large estimates of hazard index and radioactive dose to counter uncertainties in the soil data. This approach facilitates the following decision regarding future activities at Site 46:

- If the conservative estimates based on the soil data result in an unacceptable hazard index (greater than 1) or dose (greater than 10 mrem/year), further investigation and/or remediation will be needed; or

- If the hazard index and dose estimates are acceptable, the potential for health hazards at the site is extremely low, and further actions will not be needed.

Hazard indices and radionuclide doses were computed using methods and equations promulgated in proposed RCRA Subpart S documentation (EPA 1990). Accordingly, all calculations were based on the assumption that receptor doses from both toxic metals and radionuclides result from ingestion of contaminated soil.

Calculation of hazard indices required values of oral reference doses (oral RfDs) for each of the metals. The RfD values for cadmium and silver were taken from EPA's IRIS database (IRIS 1994). The RfD for iron is a provisional value provided by EPA Region VI personnel.

Similarly, calculation of radionuclide doses required values of dose conversion factors, which are used to convert radionuclide intakes (in units of pCi/year) into effective dose equivalents (in units of mrem/year). Published values of dose conversion factors (Eckerman et al., 1988 and Gilbert et al., 1989) exist for lead-214, tritium, and radium-226.

To assure that the computed hazard indices and doses were conservatively large, only the maximum observed concentration of each constituent at a site was employed. To consider combined effects, a hazard index was calculated as the sum of the individual metal hazard quotients and a radiological dose was calculated as the sum of the individual doses.

Following proposed Subpart S methodology, the equation and parameter values used to calculate the summed hazard index for toxic metals were:

$$HI = \sum_i [HSR(i) \times S(i)] \qquad (1)$$

where:

HI	=	total hazard index (dimensionless),
HSR(I)	=	hazard index-to-soil concentration ratio for the i^{th} metal (kg/mg)

$$= \frac{I \times A}{RfD(i) \times W} \times \frac{0.001\ g}{mg}$$

S(I)	=	soil concentration of the i^{th} metal (mg/kg),
I	=	soil ingestion rate = 0.2 g/day,
A	=	absorption factor (dimensionless) = 1,
W	=	body weight = 16 kg, and
RfD(I)	=	oral reference dose for the i^{th} metal (mg/kg-day).

Risk assessment guidance, prepared by the EPA (EPA 1989), recommends that the total hazard index be less than one in order for a site to be considered a non-threat to human health.

Following proposed Subpart S methodology, the equation and parameter values used to calculate the summed radioactive dose were:

$$DOSE = \sum_i [DSR(i) \times S(i)] \qquad (2)$$

where:

DOSE	=	total effective dose equivalent (mrem/yr);
DSR(I)	=	dose-to-soil concentration ratio for the i^{th} radionuclide (mrem/yr)/(pCi/g), = I X DCF(I);
S(I)	=	soil concentration of the i^{th} radionuclide (pCi/g);
I	=	soil ingestion rate = 0.2 g/day = 73 g/yr; and
DCF(I)	=	dose conversion factor for the i^{th} radionuclide (mrem/pCi).

The PIP stipulates that, for the purpose of computing media action levels, the total radioactive dose at a site should not be greater than 10 mrem/year (DOE 1994), which corresponds to a cancer risk of less that 10^{-6} excess deaths.

The input and results of the risk calculations are presented in Tables 2 and 3. The summed hazard index for metals is less than 1 and the summed radioactive dose is less than 10 mrem/year. Therefore, the site is considered to be risk-free in terms of metals and radionuclide contamination.

3.8 Rationale for Pursuing a Risk-Based NFA Decision

In September, 1994, surface soil and shallow subsurface soil samples were collected at the "head" of the trench (where the flow spills into the natural drainage) and at the furthest extent of visible erosion/scour where the discharged effluent would have most likely settled. These

two areas are the most likely areas for contamination. SNL/NM is proposing a risk-based NFA because representative soil samples from ER Site 46 have concentrations less than action levels; either proposed Subpart S action levels, background UTLs, background 95th percentiles, or derived risk-based values.

In addition

- A site visit in 1993 by ER personnel confirmed the presence of a confined natural drainage with no discoloration in the soils.

- In June 1994, a UXO/HE visual survey was conducted by KAFB Explosive Ordnance Division (EOD) and found no UXO/HE ordnance debris at Site 46 (SNL/NM 1994a).

- In September, 1994, as part of the surface soil sampling effort at Site 46, a surface radiation survey was conducted (SNL/NM 1994b). No surface anomalies were detected at Site 46.

- In September 1994, as part of the surface soil sampling effort at Site 46, particulate metal contamination was monitored with Personal Breathing Zone Air Sampling. No airborne contamination was detected.

4. Conclusion

Based upon the evidence cited above, ER Site 46 has no releases of hazardous waste or hazardous constituents that pose a threat to human health and/or the environment. Therefore, ER Site 46 is recommended for an NFA determination.

5. References

5.1 ER Site References

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5.2 Reference Documents

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Sandia National Laboratories/New Mexico (SNL/NM), August 1994. Environmental Restoration Project Information Sheet for Site 46, Storm Drain System Outfall, Sandia National Laboratories, Albuquerque, New Mexico.

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5.3 Aerial Photographs

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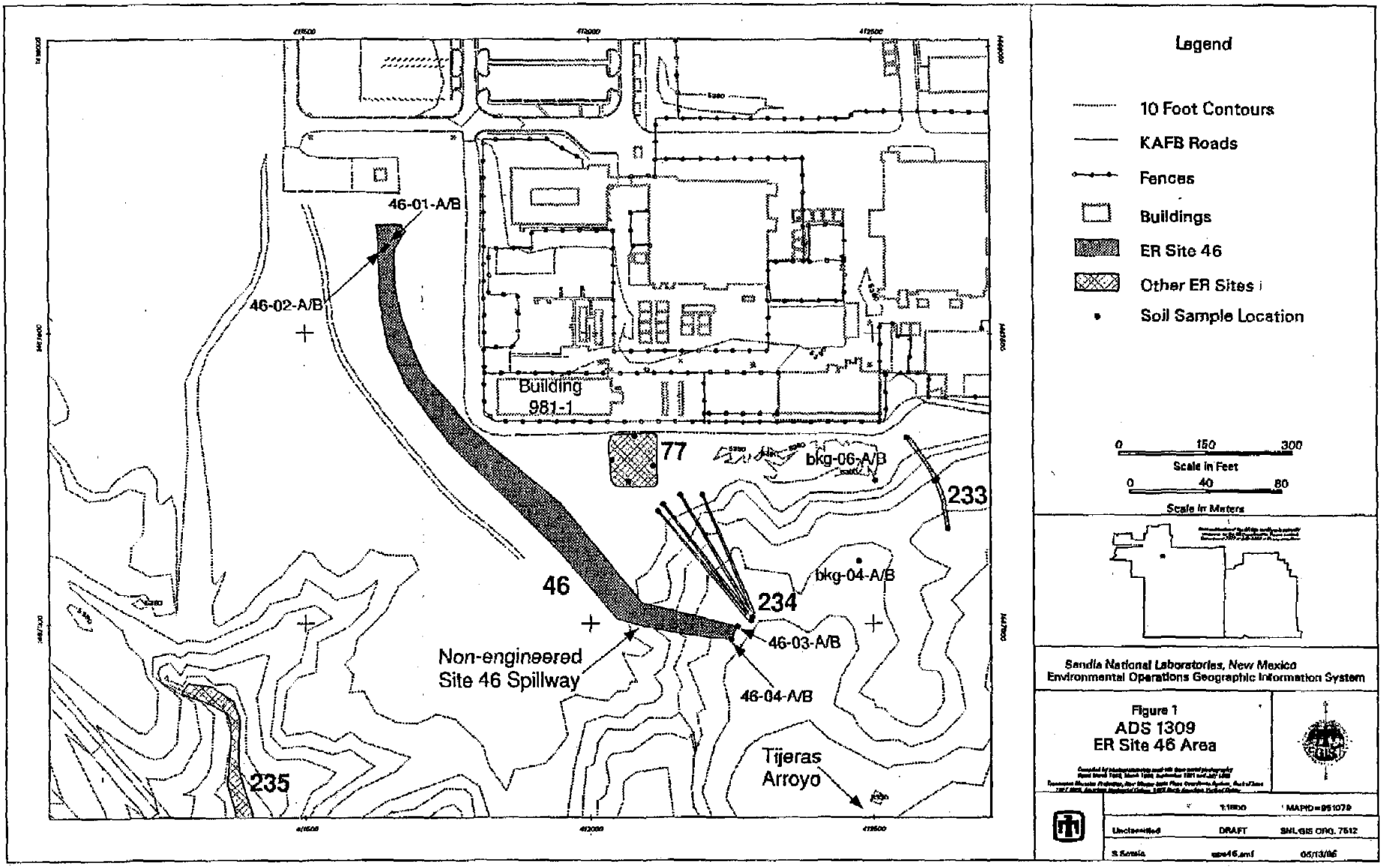

Figure 1. Old Acid Waste Line Outfall Site 46.

Table 1. Site 46 - Results of Shallow Soil Sampling and Analysis

Sample Identifier	Analytical Method	Constituent	Concentration (mg/kg)	Qualifier(s)	Background (mg/kg)	Action Level(s) (mg/kg)
46-01-B	VOCs (8240)	2-butanone	0.003	JB		
46-02-B	VOCs (8240)	2-butanone	0.005	JB		
46-03-B	VOCs (8240)	2-butanone	0.005	JB		
46-04-B	VOCs (8240)	2-butanone	0.004	JB		
46-01-B	SVOCs (8270)	Di-n-butyl phthalate	0.066	J		
46-01-B	TAL Metals (6010)	Cadmium	4.		3.82	80/5.1*
46-02-A	TAL Metals (6010)	Iron	17000.		16,962	21500*
46-01-B	TAL Metals (6010)	Silver	0.59			400/7.5*
46-01-B	TAL Metals (6010)	Silver	0.58			400/7.5*
46-01-B	TAL Metals (6010)	Chromium	15		14.3	80,000
46-04-B	TAL Metals (6010)	Lead	27		23.1	400**
46-01-B	Cyanide (acid digestion)	Cyanide	0.16			2,000
46-04-B	Cyanide (acid digestion)	Cyanide	0.18			2,000
46-01-A	TKN (acid digestion)	TKN	310.			100,000/8,000
46-01-B	TKN (acid digestion)	TKN	380.			100,000/8,000
46-02-A	TKN (acid digestion)	TKN	360.			100,000/8,000
46-02-B	TKN (acid digestion)	TKN	470.			100,000/8,000
46-03-A	TKN (acid digestion)	TKN	120.			100,000/8,000
46-03-B	TKN (acid digestion)	TKN	130.			100,000/8,000
46-04-A	TKN (acid digestion)	TKN	160.			100,000/8,000
46-04-B	TKN (acid digestion)	TKN	190.			100,000/8,000
46-01-A	NO3/NO2 (353.2)	NO3/NO2	1000.			100,000/8,000
46-01-B	NO3/NO2 (353.2)	NO3/NO2	1230.			100,000/8,000
46-02-A	NO3/NO2 (353.2)	NO3/NO2	1300.			100,000/8,000
46-02-B	NO3/NO2 (353.2)	NO3/NO2	1200.			100,000/8,000
46-03-A	NO3/NO2 (353.2)	NO3/NO2	1400.			100,000/8,000
46-03-B	NO3/NO2 (353.2)	NO3/NO2	150.			100,000/8,000
46-04-A	NO3/NO2 (353.2)	NO3/NO2	410.			100,000/8,000
46-03-A	Gamma Spec (Off-site)	Lead-214	0.93 pCi/g		0.9 pCi/g	42.2 pCi/g*
46-01-A	Tritium (600 906.0)	Tritium	0.038 pCi/g			7.7 pCi/g*
46-01-B	Tritium (600 906.0)	Tritium	0.038 pCi/g			7.7 pCi/g*
46-02-A	Tritium (600 906.0)	Tritium	0.044 pCi/g			7.7 pCi/g*
46-02-B	Tritium (600 906.0)	Tritium	0.039 pCi/g			7.7 pCi/g*
46-03-A	Tritium (600 906.0)	Tritium	0.023 pCi/g			7.7 pCi/g*
46-03-B	Tritium (600 906.0)	Tritium	0.04 pCi/g			7.7 pCi/g*
46-04-A	Tritium (600 906.0)	Tritium	0.026 pCi/g			7.7 pCi/g*
46-04-B	Tritium (600 906.0)	Tritium	0.17 pCi/g			7.7 pCi/g*
46-02-B	Gamma Spec (In-house)	Radium-226	2.74 pCi/g		1.94 pCi/g	124 pCi/g*
46-03-B	Gamma Spec (In-house)	Radium-226	2.14 pCi/g		1.94 pCi/g	124 pCi/g*
46-04-B	Gamma Spec (In-house)	Radium-226	2.06 pCi/g		1.94 pCi/g	124 pCi/g*

Table 1. Site 46- Results of Shallow soil Sampling and Analysis (Concluded)

Notes

"J" qualifier means detected at a concentration below the laboratory reporting limit.

"B" qualifier means detected in the associated blank sample.

For the metals, background is the 95 percent upper tolerance level for the local background data.

For lead-214 and radium-226, background is the 95 percent upper tolerance level for the base-wide background data.

Action levels without an asterisk are proposed Subpart S Action Levels.

Proposed Subpart S action levels for nitrate and nitrite are 100,000 and 8,000 mg/kg, respectively.

Action levels followed by one asterisk are calculated risk-based levels.

Table 2. Metal Risk Calculations for Site 46

Constituent	Concentration (mg/kg)	RfD(I) (mg/kg-day)	Individual HI	Source of RfD
Iron	17000.	3.00E-01	7.08E-01	Provisional RfD provided by EPA Region VI.
Cadmium	4.00E+00	1.00E-03	5.00E-02	IRIS
Silver	5.90E-01	5.00E-03	1.48E-03	IRIS
Summed HI			7.60E-01	

Table 3. Radionuclide Risk Calculations for Site 46

Constituent	Activity (pCi/g)	DCF(I) (mrem/pCi)	Individual Dose (mrem/year)	Source of DCF
Lead-214	9.30E-01	7.80E-06	5.30E-04	Eckerman et al., 1988
Radium-226	2.74E+00	1.10E-03	2.20E-01	Gilbert et al., 1989
Tritium	1.70E-01	6.30E-08	7.82E-07	Gilbert et al., 1989
Summed Dose			2.21E-01	

APPENDIX A

Confirmatory Sampling and Analysis Plan

APPENDIX B

Analytical Results

APPENDIX C

Background Calculations for Metals and Radionuclides

APPENDIX D

Probability Plots, Local Background UTL Calculations, and Base-wide Background UTLs for Radionuclides

Appendix A
Confirmatory Sampling and Analysis Plan

SAMPLING AND ANALYSIS PLAN FOR ELEVEN SITES IN TIJERAS ARROYO OPERABLE UNIT SANDIA NATIONAL LABORATORIES/ NEW MEXICO

Sampling and Analysis Plan for Eleven Sites in Tijeras Arroyo Operable Unit

Introduction

The purpose of the sampling and analysis described in this plan is to determine the appropriate way to proceed toward closure of 11 (of the 17) sites in the Tijeras Arroyo Operable Unit. Based on the surface and shallow subsurface soil samples and analyses for the constituents of concern (COCs), one of three approaches will be pursued for each site:

1. A petition for "No Further Action" (NFA) will be produced for regulatory consideration;
2. A voluntary corrective measure (VCM) will be designed and implemented, hopefully followed by an NFA petition; or
3. The site assessment and eventual closure will follow the standard RFI/CMS path

Most of the sites covered by this Sampling and Analysis Plan (SAP) are outfalls from the storm water and sanitary sewer systems emanating from Sandia Technical Areas (TAs) I, II, and IV. The general sampling program for the outfalls will be to collect four samples at the head of the outfall, two samples of surface soil (0 to 6 inches deep) and two samples of shallow subsurface soil (18 to 36 inches deep) and four samples (two surface soil and two shallow subsurface soil) at the furthest extent of channel erosion and scour. The analytes for most of the samples are volatile organic compounds, semi-volatile organic compounds (BNAs), metals, chromium^{+6}, for samples where chromium is found in a metals analysis, total petroleum hydrocarbon (TPH), explosives, Total Kjeldahl Nitrogen (TKN), nitrate/nitrite, and Gamma Spectroscopy for radionuclides, isotopic uranium, isotopic plutonium, tritium, and chlorodiphenyls (PCBs).

Sampling Procedures and Volumes

Surface soil samples will be collected with a stainless steel scoopula or trowel and placed in a stainless steel bowl. After at least 1000 ml[1] of soil has been collected, the soil will be thoroughly mixed in the bowl and transferred to two or three 500-ml sample bottles with a stainless steel scoopula. Sample bottles will be labeled accordingly and the appropriate sample information (sample depth, collection date and time, etc.) will be documented on the chain-of custody (COC) after each sample is collected. Samples will then be packaged and cooled to 4 degrees Celsius.

Shallow subsurface soil samples (18-36 inches) will be collected with a 2-inch (minimum) hand auger. A soil sample is collected by turning the auger clockwise and advancing it into the ground until the bucket at the end of the auger (last 6-8 inches) is full of soil or refusal occurs. Several runs with the auger is anticipated in order to obtain the appropriate volume. A hand shovel may also be used to bypass large rocks in order to continue with the auger. The auger is then extruded counter-clockwise from the ground and the soil is removed from the auger and placed in a stainless steel bowl. After 1,125[2] ml of soil has been collected, the soil will be mixed in the bowl and transferred to two or three 500-ml sample bottles and one 125-ml sample bottle with a stainless steel scoopula. Sample bottles will be labeled accordingly and the appropriate sample information will be documented on the COC after each sample is collected. Samples will then be packaged and cooled to 4 degrees Celsius.

Waste Generation and Equipment Decontamination

Decontamination of sampling equipment will be done between each sample. Decontamination will include thoroughly washing the inside and outside of the sampling equipment with a spray of ALCONOX™ or LIQUINOX™ and water; rinsing with distilled,

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[1]The sample volume varies between 1,000 and 1,500 ml depending on the analyses for the sample.

[2]The sample volume varies between 1,125 and 1,625 ml depending on the analyses for the sample.

deionized water; and drying before reusing. No soil waste will be generated. The soil removed from the hand-auger holes, while collecting samples at a depth of 18 to 36 inches, will be return to the hole. The sampling tools, which are scoopulas/trowels, hand-augers, and shovels, will be decontaminated with water and ALCONOX™ after each use. The decon leachate will be stored in capped 1-gallon containers. One or two containers will be used for each site and two to four containers will be used for the background samples. The containers will be labeled as "IDW" and the site number identified on each container. All the containers will be stored at Site 232, a central location. The leachate waste will be disposed according to the analytical results of the soil samples collected at the site.

Site Descriptions

The sites that will be sampled are

- Site 46, Old Acid Waste Line Outfall;
- Site 50, Old Centrifuge Site;
- Site 77, Oil Surface Impoundment;
- Site 227, Bldg. 904 outfall;
- Site 229, Storm Drain System Outfall;
- Site 230, Storm Drain System Outfall;
- Site 231, Storm Drain System Outfall;
- Site 232, Storm Drain System Outfall;
- Site 233, Storm Drain System Outfall;
- Site 234, Storm Drain System Outfall; and
- Site 235, Storm Drain System Outfall.

The site locations are shown in Figure 1. A description of the site history, conditions, previous investigations, and sampling plans are described in the following sections.

Site 46: Acid Waste Line Outfall

The Old Acid Waste Line carried wastes from several buildings in TA I. The waste line begins as a north-south trending, 750-feet long open trench in a grassy field northwest of Building 981-1 in TA IV. No pipe opening is visible at the "head" of the trench. As the trench crosses the field, it turns to the southeast and continues to a non-engineered spillway at the edge of Tijeras Arroyo. The spillway lies on a bank (40 to 50 feet of relief) composed of compacted alluvial sediment. Historical aerial photographs show vegetation, presumably supported by the discharge, growing southeast of the spillway to the active arroyo channel (about 200 feet distance from the spillway). The site is not restricted and is easily accessible.

During use, discharged effluent averaged an estimated 130,000 gallons per day. Use of the line has been discontinued. The line received wastes from plating, etching, and photo processing operations, and cooling tower "blow down". Acids and metals are target contaminants. Chromic acid and ferric chloride are mentioned specifically in the site history, and ferric chloride was found in the soils during a limited sampling event. Various radionuclides, possibly including tritium, uranium, and plutonium were used in TA I.

Building 863 was a source of discharge to the Acid Line. The information sheet for ER Site 98 (Building 863, TCA Photochemical Release: Silver Catch Boxes) indicates the presence of trichloromethane, silver, and photo-processing chemicals with an ammonia-like odor. The waste solution from the silver recovery unit reportedly was discharged to the Old Acid Waste Line, which is the only specific information about chemical discharges.

The site has been visually surveyed for surface indications of unexploded ordnance and high explosives (UXO/HE). No UXO/HE were found. Also, a surface radiation survey was

conducted on the entire site. No surface radiation anomalies were detected.

The sampling program includes four samples collected at the "head" of the site outfall (by the fire extinguisher training area west of TA IV) and four samples collected by the spillway into the Tijeras Arroyo drainage (Figure 1). Every sample will be analyzed for tritium, metals, chromium^{+6} (if chromium is detected), TKN, and nitrate/nitrite. Half the samples will also be analyzed for semi-volatiles and cyanide. Additionally, all the subsurface samples will be analyzed for volatiles. The analytes are listed in Table 1. A "4" on the table indicates that ALL the samples will be analyzed
for that specific analyte whereas a "2" on the table indicates half the samples will have additional analyses for the analyte listed.

Site 50: Old Centrifuge
Site 50, Old Centrifuge, was an outdoor, rocket propelled centrifuge that was used in the early 1950s to test units under G forces. The facility is located east of the TA II fence in a slight depression on top the escarpment northwest of Tijeras Arroyo. The concrete centrifuge pad has a diameter of 80 to 90 feet. The site has a 7-foot high wooden retaining wall on the north, east, and south sides. The west side is open. The centrifuge arm assembly, which has a 20-foot radius, is sitting outside the wall to the north and appears to be intact. Control wiring to the center axis of the centrifuge was suspended from a cable between two telephone poles on the north and south side of the pad. The control wiring went to a bunker located to the southwest over the escarpment. The bunker had a electrical transformer containing PCB. The electrical transformer has been removed. The pad was not stained and no spills or leaks were reported.

The centrifuge was rocket driven by two T40 6-KS-3000 or two Deacon 3.5DS-5700 solid rocket motors. The combustion byproducts produced by these rocket motors were carbon dioxide, carbon monoxide, water, hydrochloric acid, aluminum oxide, and possibly barium oxide. No other HE is known or suspected at the site. The rocket orientation would expel combustion byproducts towards the retaining wall and the opening to the west. The rocket propellant would be consumed in the rocket motor case. Under normal operating conditions, no unburned propellant would be released.

In 1987, a reconnaissance investigation at five potential contaminated sites, including the Old Centrifuge Site, was conducted by the ER Project. Samples were analyzed for uranium, TNT, HSL inorganics, TCLP constituents, and EP Toxicity constituents. Metals, including barium, were detected at concentrations well below regulatory action levels. Total uranium concentrations were typical of area background levels. TNT, pesticides, PCBs, herbicides, and semi-volatiles TCLP compounds were not detected.

Prior to sampling, the surface will be surveyed for radiation. If contamination exists, it is expected to be around the edge of the centrifuge pad at the surface, probably along the open west side. The constituents of concern are metals (specifically lead, beryllium, and barium), depleted uranium, and high explosives. Four surface samples and four subsurface samples will be collected. The sampling locations will be biased toward the west side of the site because that is the open side (Figure 1). All surface samples will be analyzed for all the COCs. One-half of the subsurface samples will be analyzed for uranium and high explosives. All four subsurface samples will be analyzed for metals.

Site 77: Oil Surface Impoundment
The Oil Surface Impoundment Site is outside the TA IV fence, southeast of Building 981-1. The surface impoundment, which was constructed in the 1970's, is used to catch waste water from accelerators. At the time of the RCRA facilities environmental survey, the impoundment was unlined. Since then the impoundment was drained. Soil samples were analyzed for PCBs and

solvents. Based on the analytical results, the impoundment was determined to be clean. Subsequently, the impoundment was lined with geotextile and is now regulated under Sandia's Surface Water Discharge Program.

This site will not require UXO/HE or radiation surface surveys. Minimal confirmation sampling and analysis is proposed to verify that the site is clean. Three surface and three shallow subsurface samples are proposed. The samples will be collected along the perimeter of the existing lined pond (Figure 1). All the samples will be analyzed for PCBs. The subsurface soil samples also will be analyzed for volatile organic compounds (Table 1).

Site 227: Bunker 904 Outfall

Site 227 is an inactive outfall from the septic system for Building 904 (ER Site 48) in TA II. The site starts where the discharge exits the septic tank piping system, approximately 100 feet northeast of the southernmost point of TA II. The extent of the area influenced by the discharge may include the bank of Tijeras Arroyo below the outfall and some area between the outfall and the main channel of Tijeras Arroyo. The site is along the eastern edge of ER Site 45.

Building 904, built in 1948, was used for weapons assembly, HE testing, photo processing, and various other testing. Sanitary wastes were discharged to a septic tank, and other wastes were discharged to the outfall.

Mineral oil is also being considered a potential soil contaminant at all outfalls along the Tijeras Arroyo due to a recent release (June 1994) of mineral oil at Outfall 232 and vague historical records.

Possible soil contaminants are explosives, radioactive materials from weapons processing, including tritium, uranium, and plutonium, solvents (acetone, methylene chloride, methyl ethyl ketone, carbon tetrachloride, toluene, xylene, hexane, alcohols), and inorganics (ammonium hydroxide, barium, cadmium, silver, chromium, titanium, cyanide).

Access to this site is along the TA II perimeter road. This site is within the TA II testing exclusion zone. The best days to sample are generally Friday, Saturday, and Sunday, when testing ceases. Bruce Berry (telephone 845-8018) must be contacted to gain permission and access to this site. Prior to sampling

1. tumbleweeds will be cleared from locations to be sampled and placed adjacent to the drainage;
2. these locations will be visually scanned for UXO/HE; and
3. these locations will be screened for surface radiation anomalies.

The proposed sampling program is to collect four surface soil samples and four shallow subsurface samples. Two surface and two subsurface samples will be collected at the outfall. The other two surface and two subsurface samples will be collected at the furthest visible channel erosion and scour (Figure 1). The analytes are listed in Table 1.

Sites 229 - 235: Storm Drain Systems Outfalls

These sites consist of the discharge areas at seven outfalls along the northern embankment of Tijeras Arroyo. The outfalls discharged industrial effluent and storm water from TAs I, II, and IV. Presently they only discharge storm water. The outfalls receive runoff from Site 96 (Storm Drain System) and other engineered drain systems within the three TAs. The sites are along approximately ¾ miles of the embankment.

The specific constituents in the industrial effluent at these sites are not known. The possible discharged contaminants include chromates, antifoulants, chromium, sodium hydroxide, hydrochloric acid, chromosulfuric acid, diesel, and other petroleum products. To cover this array of possible contaminants, soil samples will be analyzed for volatiles (subsurface samples only), semi-volatiles, metals and chromium^{+6}, if chromium is found in the metals analysis.

Mineral oil is also being considered a potential soil contaminant at all outfalls along the Tijeras Arroyo due to a recent release (June '94) of mineral oil at Outfall 232 and vague historical records. Therefore, soil samples will also be analyzed for TPH.

At Sites 229 through 234, prior to sampling

1. tumbleweeds will be cleared from locations to be sampled and placed adjacent to the drainage;
2. these locations will be visually scanned for UXO/HE; and
3. these locations will be screened for surface radiation anomalies.

Site 229 is due east of the footings of the old guard tower and the south "corner" of the TA II fence. It discharges near the top of the embankment through the center of ER Site 45. Access to this site is along the TA II perimeter road. This site is within the TA II testing exclusion zone. The best days to sample are generally Friday, Saturday, and Sunday, when testing ceases. Bruce Berry (telephone 845-8018) must be contacted to gain permission and access to this site. Because this site discharges from TA II, various radionuclides, possibly including tritium, uranium, and plutonium are of concern. Four surface soil and four subsurface soil samples will be collected at this site (Figure 1). The analytes are listed in Table 1.

Site 230 is west of Building 970 in TA IV. A drain pipe discharges into a bowl-shaped concrete structure adjacent to Building 970A. Flow from this structure is directed to a drain and flume located approximately 120 feet further west. The flume carries the flow to a discharge point slightly above the base of the arroyo embankment. Doug Bloomquist (845-7455) must be contacted to ensure that no laser testing is being performed in the area. Four surface soil and four subsurface soil samples will be collected at this site (Figure 1). The analytes are listed in Table 1.

Site 231 is west of Building 970 in TA IV. A drain pipe discharges to a concrete flume near the top of the embankment. The flume carries the flow to a discharge point near the base of the slope. Doug Bloomquist (845-7455) must be contacted to ensure that no laser testing is being performed in the area..Four surface soil and four subsurface soil samples will be collected at this site (Figure 1). The analytes are listed in Table 1.

Site 232 consists of two outfalls. One outfall is south of Building 970A, east of the lined lagoon. A drain pipe discharges to a concrete flume near the top of the embankment. The flume carries the flow to at discharge point near the bottom of hillside. On June 1, 1994, about 150 to 350 gallons of mineral oil was spilled into this outfall through the storm water drain by building 986. The day after the spill the site was screened for radiation and UXO/HE. No surface radiation anomalies or UXO/HE were found. Also, four surface soil and four subsurface soil samples were collected. The samples were sent to Quintera Laboratory in Denver for analysis for organics, metals, chromium^{+6}, and gamma spec. Other than TPH from the mineral, no contaminants were detected. A Voluntary Corrective Measure was conducted in July and August to remove soil contaminated with mineral oil above 100 mg/kg of TPH.

The second outfall in Site 232 also is south of Building 970A, west of lined lagoon, and approximately 120 feet east of the other Site 232 outfall. Discharge occurs from a concrete structure opening near base of embankment. Access to the site is along the road outside the south side of TA IV. Four surface soil and four subsurface soil samples will be collected at this drainage Figure 1). The analytes are listed in Table 1.

Site 233 is south-southwest of Building 986. Near the top of an escarpment, a small metal drain pipe discharges to an open drain which directs flow within another pipe before discharging near the base of the hillslope. Access to the site is along the road outside the south side of TA IV. Four surface soil and four subsurface soil samples will be collected at this site (Figure 1). The analytes are listed in Table 1.

Site 234 is southeast of Building 9811 (Inflatable Building) and a lagoon impoundment (Site 77).

The site discharges into a steep-sided, deeply incised channel cut into the hillside. The drainage channel splits directly uphill of a tree. Access to the site is along the road outside the south side of TA IV. Both channels will be sampled. Six surface soil and six subsurface soil samples will be collected at this site (Figure 1). The analytes are listed in Table 1.

Site 235 is immediately downstream of a large concrete spillway on the northeast side of Pennsylvania and south of the Skeet Range, at the point where the road comes off the north bank of the arroyo and descends into the channel. The flow moves in a confined channel after dropping down the spillway. The site has been cleared for visible surface UXO/HE and screened for surface radiation with no anomalies detected. This channel is considerably larger than the other outfall sites. Six surface soil and six subsurface soil samples will be collected at this site (Figure 1). The analytes are listed in Table 1.

Background

Background soil concentrations for organic contaminants should be negligible. Background concentrations for total metals and radionuclides must be determined for comparison to concentrations found at the sites. Twelve locations have been identified to collect samples for background determination (Figure 1). At each of these sites, one sample will be collected at a depth of 0-6 inches and a second sample collected at 18-36 inches (Table 1).. In addition, the background study report prepared by International Technology Corporation (May 1994) will also be used to evaluate the data.

Quality Assurance

As shown in Table 1, quality assurance samples will include the following:

- Field "duplicates" on more than 10 percent of the samples. These samples will be collected adjacent to the original surface soil sample and in the same hole as the original subsurface soil sample;
- Field soil blanks for more than 10 percent of the VOC analyses. These sample will be obtained from Sample Management Office (SMO) and will contain no VOCs; and
- One rinsate blank. All rinsate will be composited in one container. A sample of the rinsate will be analyzed for all constituents. The disposal method for the rinsate will be determined by the analytical results on this sample.

Table 1. List of Analytes - Tijeras A[redacted] Outfall Sampling and Analysis Plan

			Surface Soils															Subsurface Soils													
Site	Site Name	Potential Contaminants	Number of Samples	BNAs (8270)	TAL Metals (6010/7000)	Cr^{+6}* (aqueous leaching)	Cyanide (acid digestion)	TPH (8015)	Explosives Res (8330)	TKN (acid digestion)	NO_3/NO_2 (353.2)	Gamma Spec (In-House) 600 901.1	Gamma Spec (Off-site) 600 901.1	PCBs (8080)	Tritium (600 906.0)	Isotopic Plutonium (600 7-79-081)	Isotopic Uranium (HASL-300 4.5)	Number of Samples	VOCs (8240)	BNAs (8270)	TAL Metals (6010/7000)	Cr^{+6}* (aqueous leaching)	Cyanide (acid digestion)	TPH (8015)	Explosives Res (8330)	TKN (acid digestion)	NO_3/NO_2 (353.2)	Gamma Spec (In-House) 600 901.1	Gamma Spec (Off-site) 600 901.1	PCBs (8080)	Tritium (600 906.0)	Isotopic Plutonium (600 7-79-081)	Isotopic Uranium (HASL-300 4.5)
46	Old Acid Waste Line Outfall (Tijeras Arroyo)	Ferric chloride, chromic acid and other acids, ammonia, photo processing chemicals and other unknown chemicals	4	2	4	4	2			4	4	4	2		4	2	2	4	4	2	4	4	2			4	4	4			4	2	2
50	Old Centrifuge Site (TA-2)	Rocket propellant and residues	4		4				4			2			2	1	2	4			4				2						1		1
77	Oil Surface Impoundment	Solvents and PCBs	4											4				4	4											4			
227	Bldg. 904 outfall (TA-2)	High explosives, radioactive materials, nitrate, toluene, methanol, other solvents, carbon tetrachloride, ammonium hydroxide, barium, cadmium, silver, chromium, titanium, cyanide	4	2	4	4	2	2	2	4	4	4	2		4	2	2	4	4	2	4	4	2	4	2	4	4	4			4	2	2
229	Storm Drain System Outfall	Chromates, antifoulants, chromium, sodium hydroxide, hydrochloric acid, chromosulfuric acid, diesel, other petroleum products	4	2	4	4		4				4	2		4	2	2	4	4	2	4	4		4				4			4	2	2
230	Storm Drain System Outfall	Chromates, antifoulants, chromium, sodium hydroxide, hydrochloric acid, chromosulfuric acid, diesel, other petroleum products	4	2	4	4		4				2			2	1	1	4	4	2	4	4		4				2					
231	Storm Drain System Outfall	Chromates, antifoulants, chromium, sodium hydroxide, hydrochloric acid, chromosulfuric acid, diesel, other petroleum products	4	2	4	4		4				2			2	1	1	4	4	2	4	4		4				2					
232	Storm Drain System Outfall	Chromates, antifoulants, chromium, sodium hydroxide, hydrochloric acid, chromosulfuric acid, diesel, other petroleum products	4	2	4	4		4				2			2	1	1	4	4	2	4	4		4				2					
233	Storm Drain System Outfall	Chromates, antifoulants, chromium, sodium hydroxide, hydrochloric acid, chromosulfuric acid, diesel, other petroleum products	4	2	4	4		4				2			2	1	1	4	4	2	4	4		4				2					
234	Storm Drain System Outfall	Chromates, antifoulants, chromium, sodium hydroxide, hydrochloric acid, chromosulfuric acid, diesel, other petroleum products	6	3	6	6		6				2			2	1	1	6	6	3	6	6		6				2					
235	Storm Drain System Outfall	Chromates, antifoulants, chromium, sodium hydroxide, hydrochloric acid, chromosulfuric acid, diesel, other petroleum products	4	2	4	4		4				2			2	1	1	4	4	2	4	4		4				2					
Na	Background		12		12							12			3	3	3	12			12							12			3	3	3
QA	Duplicates	Na		2	5	4	1	4	1	1	1		1	1			2		5	2	5	4	1	4	1	1	1			1			1
QA	Field Soil Blank	Na																	5														
QA	Rinsate	Na		1	1	1	1	1	1	1	1	1	1	1	1	1	1		1		1												
	Totals		**58**	**22**	**60**	**43**	**6**	**37**	**8**	**10**	**10**	**39**	**8**	**6**	**30**	**17**	**20**	**58**	**53**	**21**	**60**	**42**	**5**	**38**	**5**	**9**	**9**	**36**		**5**	**16**	**9**	**11**
	Totals - Surface Plus Subsurface		**116**	**43**	**120**	**85**	**11**	**75**	**13**	**19**	**19**	**75**	**8**	**11**	**46**	**26**	**31**		**53**														

*** Analyze for Cr^{+6} only if Cr is detected in metals analysis**

Appendix B
Analytical Results

ACRONYMS FOR ANALYTICAL DATA

Organic/metals data for soil = mg/kg
Radionuclides data for soil = pCi/g

ND = Not detected

NS = Not significant

MDA = Maximum Detectable Activity

J = Detected at a concentration below the laboratory reporting limit

B = Detected in the associated blank sample

Site 46 Soil Results

Sample Identifier	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Sodium
46-01-A	7000	11	6.7	180	0.4	3.1	45000	8.3	5.2	10	12000	12	3700	180	ND	8.2	1800	ND	ND	260
46-01-B	7900	13	6.3	180	0.4	4	42000	15	4.3	11	13000	13	3500	180	ND	13	1900	ND	0.6	290
46-02-A	11000	17	7.5	200	0.5	3.5	32000	13	5.2	12	17000	12	3900	210	ND	11	2500	ND	ND	320
46-02-B	9500	16	6.7	220	0.4	2.2	74000	7.7	4.3	10	12000	9.3	3600	140	ND	7.3	1500	ND	ND	290
46-03-A	3700	6	4.3	140	0.2	1.5	26000	3.8	3.3	8	8800	7.5	2500	170	ND	4.3	950	ND	ND	ND
46-03-B	4200	8	1	160	ND	1.9	23000	5.2	2.9	6	11000	7.7	2300	160	ND	4.4	1000	ND	ND	290
46-04-A	4400	7	ND	140	0.2	1.6	27000	4.4	3.4	11	8900	7.8	2600	170	ND	4.9	1100	ND	ND	270
46-04-B	4500	8	0.8	150	0.2	2.7	35000	9.5	4	13	11000	27	3000	190	ND	7.5	1200	ND	0.6	270

Sample Identifier	Thallium	Vanadium	Zinc	Cr+6*	Cyanide	TKN	NO3/NO2	Radium-226	Radium-226	Radium-228	Potassium-40	Lead-212	Lead-214	Tritium	Plutonium-239/240	Plutonium-238	Uranium-238	Uranium-235/236	Uranium-234
46-01-A	ND	25	55	ND	ND	310	1000	NS	0.9	ND	16.4			0.04	<0.008	0.00	0.51	0.02	0.6
46-01-B	ND	26	65	ND	0.2	380	1230	NS	0.8	ND				0.04	<0.006	0.00	0.54	0.02	0.5
46-02-A	ND	34	70	ND	ND	360	1300	NS						0.04					
46-02-B	ND	27	59	ND	ND	470	1200	2.7	0.7	ND				0.04					
46-03-A	ND	18	54	ND	ND	120	1400	NS			22.3	0.9	0.93	0.02	<0.004	0.00	0.68	0.03	0.8
46-03-B	ND	20	51	ND	ND	130	150	2.1	0.7	ND				0.04	<0.008	0.00	0.65	0.03	0.7
46-04-A	ND	18	64	ND	ND	160	410	NS						0.03					
46-04-B	ND	22	61	ND	0.2	190	ND	2.1	0.7	ND				0.17					

Concentrations in mg/kg
Activities in pCi/g
Sample Identifier XX-XX-A - surface soil samples
Sample Identifier XX-XX-B - subsurface soil samples

Quality Assurance Results for Organic Constituents

Sample Identifier	Sample Type	2-Butanone	2-Hexanone	4-Methyl-2-pentanone	Acetone	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Chrysene	Di-n-octyl phthalate	Fluoranthene	Methylene Chloride	Phenanthrene	Pyrene	Styrene	total-Xylenes	TPH
227-01-A	original										0.066 J		0.055 J	0.040 J			
227-01-A	duplicate										0.038 J		0.051 J				
227-01-B	original	0.007 J		0.001 J													
227-01-B	duplicate	0.006 J			0.006 J												
227-04-B	original	0.004 J															
227-04-B	duplicate	0.005 J															
229-01-A	original					0.071 J	0.050 J	0.16 J	0.11 J		0.23 J		0.17 J	0.19 J			ND
229-01-A	duplicate					0.006 J	0.092 J	0.16 J	0.12 J		0.20 J		0.18 J	0.28 J			81
229-02-B	original	0.006 J															
229-02-B	duplicate	0.006 J															
229-03-B	original	0.006 J															
229-03-B	duplicate	0.006 J															
230-04-B	original	0.003 JB								0.16 J							
230-04-B	duplicate																
235-02-B	original	0.006 JB															
235-02-B	duplicate	0.004 JB															
Site 227	trip blank	0.010 B	0.003 J	0.002 J	0.019												
Site 229	trip blank	0.009 JB			0.015												
Site 230	trip blank	0.004 JB										0.003 J					
Site 232	trip blank	0.007 JB															
Site 234	trip blank	0.007 JB			0.015										0.001 J		
Site 235	rinsate	0.005 JB			0.010											0.001 J	ND

Quality Assurance Results for Inorganic and Radiological Constituents

Sample Identifier	Sample Type	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Nickel	Vanadium	Zinc
227-02-A	original	5800	9.3	5.9	180	ND	2.1	6.6	4.1	7.8	13000	7.5	160	ND	5.4	27	51
227-02-A	duplicate	6500	11	1.4	150	0.25	2.5	6.4	4.1	13	14000	9.1	170	ND	5.9	28	51
227-03-B	original	5100	8.8	0.92	140	ND	2.1	5.9	4.5	11	13000	7.5	200	ND	5.4	25	48
227-03-B	duplicate	6400	9.9	5.6	140	0.25	2.9	7.4	4.6	10	16000	8.9	230	ND	5.9	33	50
229-04-A	original	8100	13	5.7	150	0.32	2.3	8.0	4.2	7.9	13000	12	210	ND	6.3	24	55
229-04-A	duplicate	7700	12	1.5	140	0.30	2.2	8.0	4.2	7.7	12000	11	190	ND	6.2	24	52
230-04-B	original	1500	3.3	1.6	130	ND	0.61	2.3	ND	18	3500	4.2	110	ND	3.0	9.1	82
230-04-B	duplicate	2400	4.9	1.7	140	ND	0.68	3.1	2.5	15	4500	4.1	120	ND	3.4	9.7	71
235-01-A	original	3600	6.2	5.1	150	ND	2.7	6.0	8.4	6.6	20000	7.6	210	ND	4.5	36	66
235-01-A	duplicate	3000	5.3	1.3	160	ND	1.6	4.2	5.7	6.5	12000	9.4	180	ND	4.4	22	66
50-01-B	original	3100	6.5	2.1	110	0.25	1.3	4.1	3.9	6.2	7600	6.6	130	ND	4.5	17	18
50-01-B	duplicate	3900	7.5	2.0	110	0.26	1.3	4.3	4.0	5.7	8800	5.9	150	ND	4.2	18	21
50-02-A	original	5800	12	4.2	220	0.38	1.6	5.2	4.3	12	6700	25	210	ND	7.1	11	69
50-02-A	duplicate	7000	14	6.4	280	0.55	2.2	8.3	6.1	17	9000	35	290	0.04	9.4	18	61
Bkg-05-A	original	6400	13	5.7	210	0.53	1.8	6.1	6.6	14	10000	16	330	ND	8.9	22	37
Bkg-05-A	duplicate	5900	12	7.6	190	0.50	1.7	6.0	6.3	14	10000	16	320	ND	8.7	24	36
Site 235	rinsate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Sample Identifier	Sample Type	TKN	NO_3/NO_2	Potassium 40	Lead 212	Lead 214	Plutonium 239/240	Uranium 238	Uranium 235/236	Uranium 234
227-02-A	original	400	2.7							
227-02-A	duplicate	320	9.3							
227-03-A	original						0.004	0.4	0.15	0.61
227-03-A	duplicate							0.67	0.023	0.67
227-03-B	original							0.72	0.11	0.72
227-03-B	original	220	ND							
227-03-B	duplicate			27.8	0.71	0.7				
227-03-B	duplicate	190	1.4							
229-01-A	original						0.007	0.45	0.17	0.67
229-01-A	duplicate							0.73	0.034	0.6
229-03-B	original							0.45	0.058	0.45
229-03-B	duplicate							0.99	0.06	1

Notes on Quality Assurance Data

Explosive residues were not detected in Site 50 duplicate sample

Hexavalent chromium was not detected in five duplicates and one decon rinsate

Cyanide was not detected in two duplicates and one decon rinsate

PCBs were not detected in one Site 77 duplicate sample

Tritium and Plutonium-238 were not detected in four duplicate samples

Selenium, silver, and thallium were not detected in any quality assurance samples

Appendix C
Background Calculations for Metals and Radionuclides

Appendix C. Background Calculations for Metals and Radionuclides

To evaluate metals data, 24 background samples were collected for metals analyses.[4] Distribution analyses was performed first by constructing histograms. The histograms indicated a parametric distribution. Outliers were screened in a two-step process as described in the base wide background report (IT .1994). The first step is to perform an "a priori" screening for very high values relative to the rest of the data set. This is qualitatively performed by visually examining a column of sorted values. Maximum values that are a factor of 3 or 4 times higher than their nearest neighbor are removed from the data set during this step. None of the anomalous values were deleted by the "a priori" process.

The second step, from EPA, 1989, determines whether an observation that appears extreme fits the data distribution. A statistical parameter, T_n is calculated:

$$T_n = (X_n - X_a)/S$$

where:

X_n = questionable observation;

X_a = sample arithmetic mean; and

S = sample standard deviation

T_n is compared to a table of one-sided critical values for the appropriate significance level (upper 5 percent) and sample size from a table provided in EPA 1989. Extreme concentrations for barium, calcium, chromium, copper and nickel were identified as outliers and were excluded from the data set. These anomalous values may have resulted from laboratory or sampling error.

Probability plots were then replotted to determine whether the data fit normal or lognormal populations. These plots are shown in Appendix D. The UTL[5] was calculated for data sets that fit a normal or lognormal distribution. Data sets are provided in Appendix D. As recommended by EPA, a tolerance coefficient value of 95 percent was used (EPA 1989). Most metals background data fit lognormal distributions. Iron and zinc data fit normal distributions. UTLs were not calculated for mercury, selenium, and silver because mercury and selenium were not detected and silver was detected only once in the 24 background samples. The beryllium background data did not fit a normal or lognormal distribution. The maximum value in a data set is commonly taken as the UTL in a non-parametric setting (Guttman, 1970). The maximum background beryllium concentration was 0.53 mg/kg.

Base-wide background UTLs for radionuclides were established by International Technology (IT) Corporation to compare and evaluate radionuclide data (IT, 1994). A table is provided in Appendix

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[2]These data are referred to as local background data. The data collected throughout Kirtland Air Force Base (KAFB), with most of the data collected within SNL/NM technical areas, are called base-wide background data (IT 1994).

[3]UTL = x + K•S, where:
UTL = Upper tolerance limit;
x = Sample arithmetic mean (for normal distribution), sample geometric mean (for lognormal distribution);
S = Sample standard deviation; and
K = One-sided normal tolerance factor (95 percent for these evaluations).

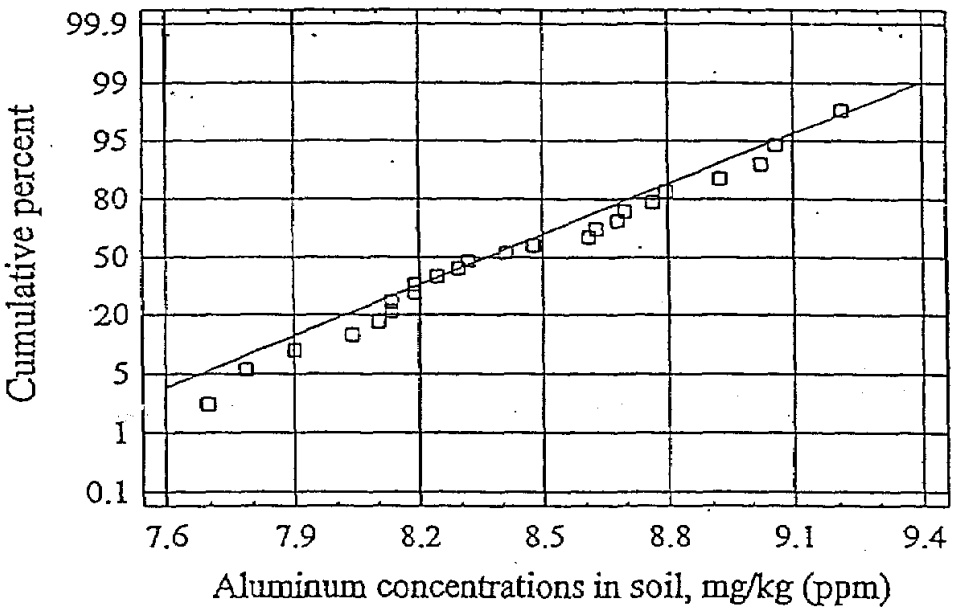
D with radionuclide background data and the corresponding UTLs. The maximum activity from the six local background samples for isotopic plutonium and isotopic uranium was used as an additional method to evaluate the data. Also, in-house gamma spectroscopy was performed on all 24 background samples and indicated low levels of radioactivity but no significant contamination.

Appendix D
Probability Plots, Local Background UTL Calculations, and Base-Wide Background UTLs for Radionuclides

Summary Statistics for log(Aluminum)

Count = 24
Average = 8.42942
Median = 8.36529
Mode =
Geometric mean = 8.41976
Variance = 0.170246
Standard deviation = 0.412609
Standard error = 0.0842235
Minimum = 7.69621
Maximum = 9.21034
Range = 1.51413
Lower quartile = 8.13153
Upper quartile = 8.73178
Interquartile range = 0.600253
Skewness = 0.132255
Stnd. skewness = 0.26451
Kurtosis = -0.792361
Stnd. kurtosis = -0.792361
Coeff. of variation = 4.89487
Sum = 202.306

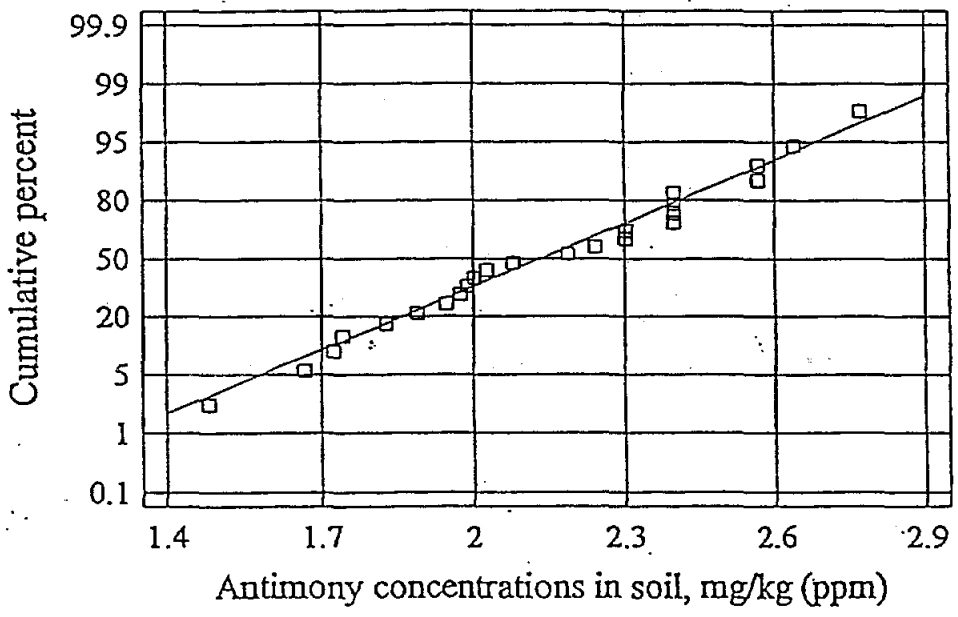
Lognormal Probability Plot for Aluminum



ry Statistics for log(Antimony)

24
ge = 2.14609
dian = 2.13275
de = 2.3979
ometric mean = 2.12004
riance = 0.113831
tandard deviation = 0.337309
tandard error = 0.0688692
nimum = 1.4816
ximum = 2.77259
nge = 1.29098
wer quartile = 1.91649
per quartile = 2.3979
terquartile range = 0.481405
ewness = -0.040772
nd. skewness = -0.0815441
rtosis = -0.744171
nd. kurtosis = -0.744171
eff. of variation = 15.7211
n = 51.5062

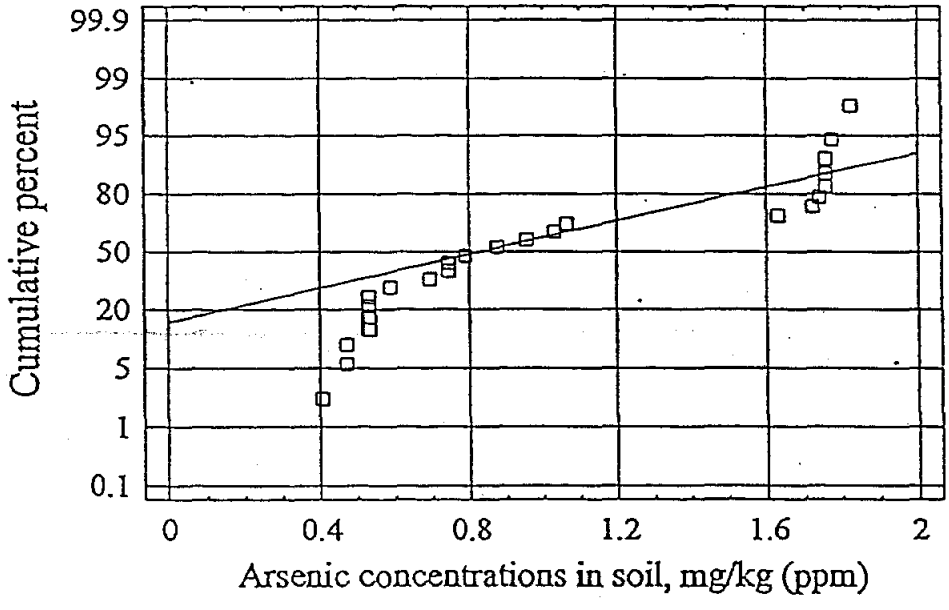
Lognormal Probability Plot for Antimony



ummary Statistics for log(Arsenic)

ount = 24
verage = 1.038
edian = 0.031963
ode =
eometric mean = 0.908119
ariance = 0.291153
tandard deviation = 0.539586
tandard error = 0.110143
inimum = 0.405465
aximum = 1.82455
nge = 1.41908
wer quartile = 0.530628
per quartile = 1.73162
terquartile range = 1.20099
ewness = 0.463036
nd. skewness = 0.926071
rtosis = -1.58507
nd. kurtosis = -1.58507
eff. of variation = 51.983
n = 24.9121

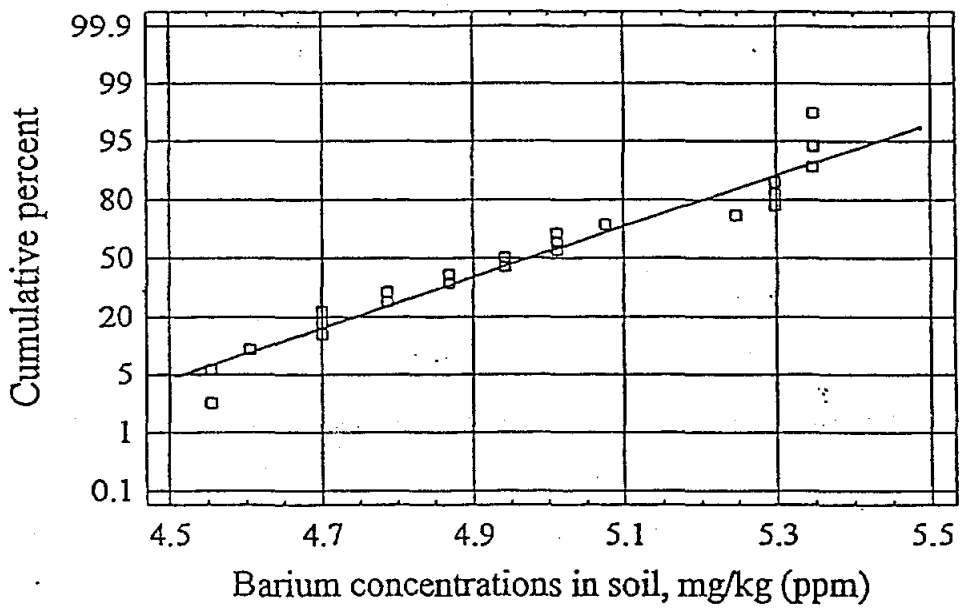
Lognormal Probability Plot for Arsenic



mary Statistics for log(Barium)

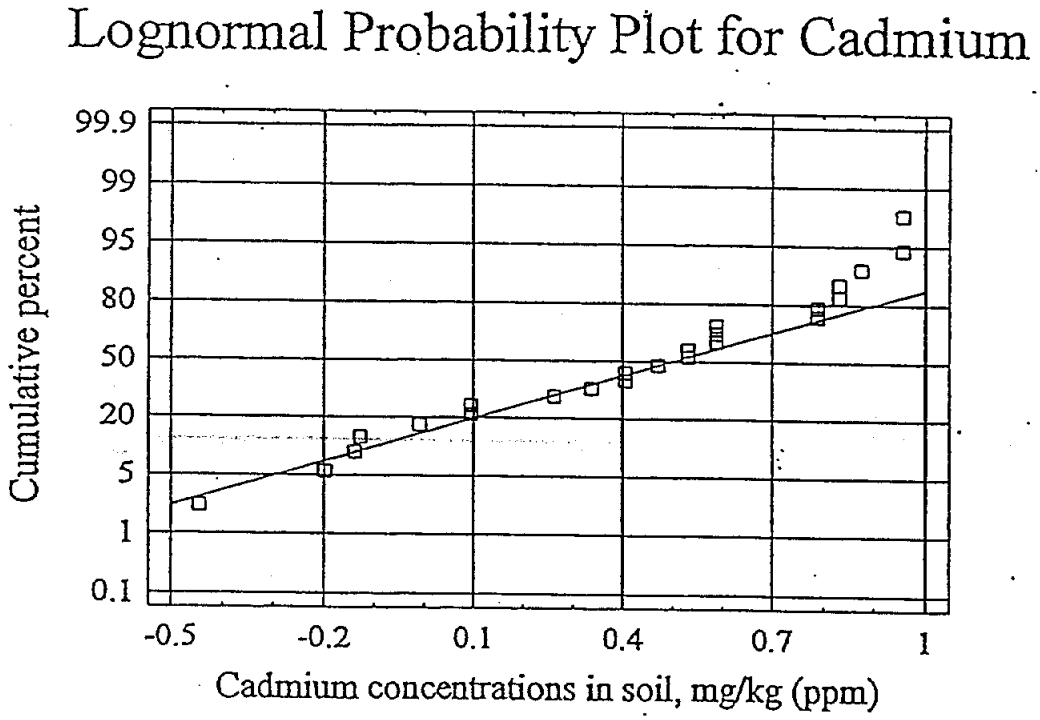
[redacted]23
[redacted] 4.96940
[redacted] 4.94164
[redacted] = 5.34711
metric mean = 4.96236
iance = 0.0740602
ndard deviation = 0.27214
ndard error = 0.0567451
imum = 4.55388
imum = 5.34711
ge = 0.793231
er quartile = 4.70048
er quartile = 5.29832
erquartile range = 0.597837
wness = 0.0653415
d. skewness = 0.127931
tosis = -1.30542
d. kurtosis = -1.27794
ff. of variation = 5.47622
= 114.298

Lognormal Probability Plot for Barium



Summary Statistics for log(Cadmium)

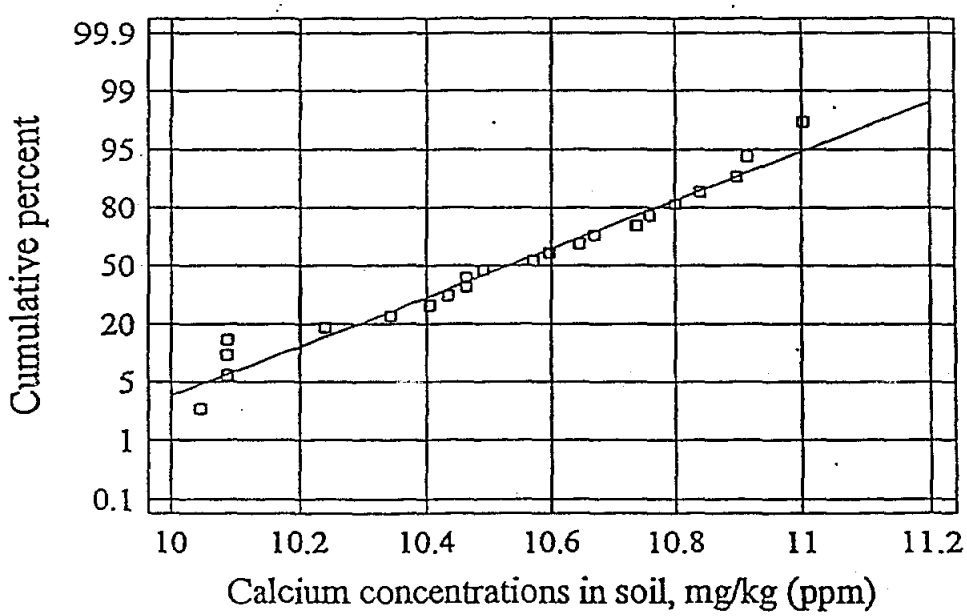
Count = 24
Average = 0.416764
Median = 0.500316
Mode =
Geometric mean =
Variance = 0.159937
Standard deviation = 0.399922
Standard error = 0.0816337
Minimum = -0.446287
Maximum = 0.955511
Range = 1.4018
Lower quartile = 0.0953102
Upper quartile = 0.788457
Interquartile range = 0.693147
Skewness = -0.506707
Stnd. skewness = -1.01341
Kurtosis = -0.674504
Stnd. kurtosis = -0.674504
Coeff. of variation = 95.9587
Sum = 10.0023



ummary Statistics for log(Calcium)

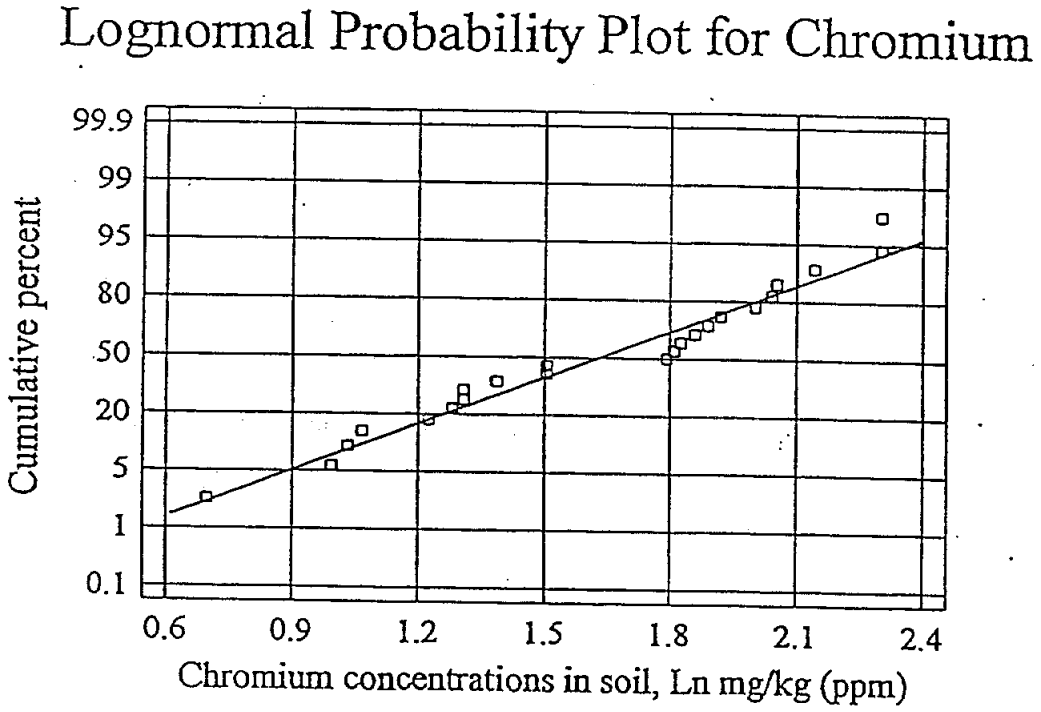
```
    23
  = 10.5579
an = 10.5713
de = 10.0858
ometric mean = 10.5532
riance = 0.10513
andard deviation = 0.324237
andard error = 0.0676081
nimum = 10.0432
ximum = 11.2645
nge = 1.22121
wer quartile = 10.3417
per quartile = 10.7996
terquartile range = 0.457833
ewness = 0.109797
nd. skewness = 0.214971
rtosis = -0.415646
nd. kurtosis = -0.406895
eff. of variation = 3.07103
n = 242.832
```

Lognormal Probability Plot for Calcium



Summary Statistics for log(Chromium)

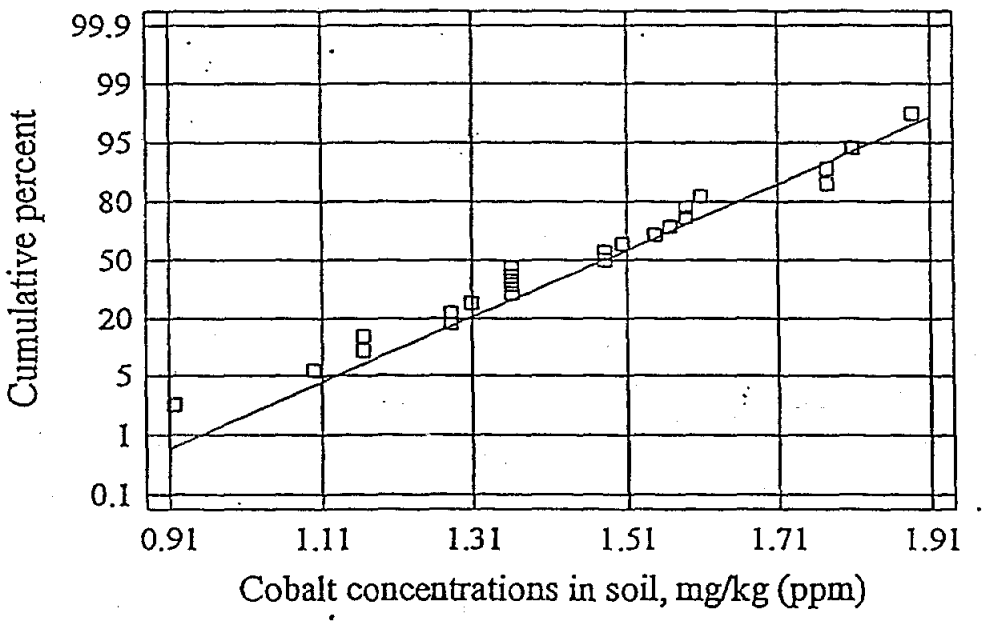
Count = 23
Average = 1.61841
Median = 1.79176
Mode =
Geometric mean = 1.55042
Variance = 0.204195
Standard deviation = 0.451879
Standard error = 0.0942233
Minimum = 0.693147
Maximum = 2.30259
Range = 1.60944
Lower quartile = 1.28093
Upper quartile = 2.00148
Interquartile range = 0.720546
Skewness = -0.274151
Stnd. skewness = -0.536757
Kurtosis = -0.905395
Stnd. kurtosis = -0.886332
Coeff. of variation = 27.9211
Sum = 37.2235



ummary Statistics for log(Cobalt)

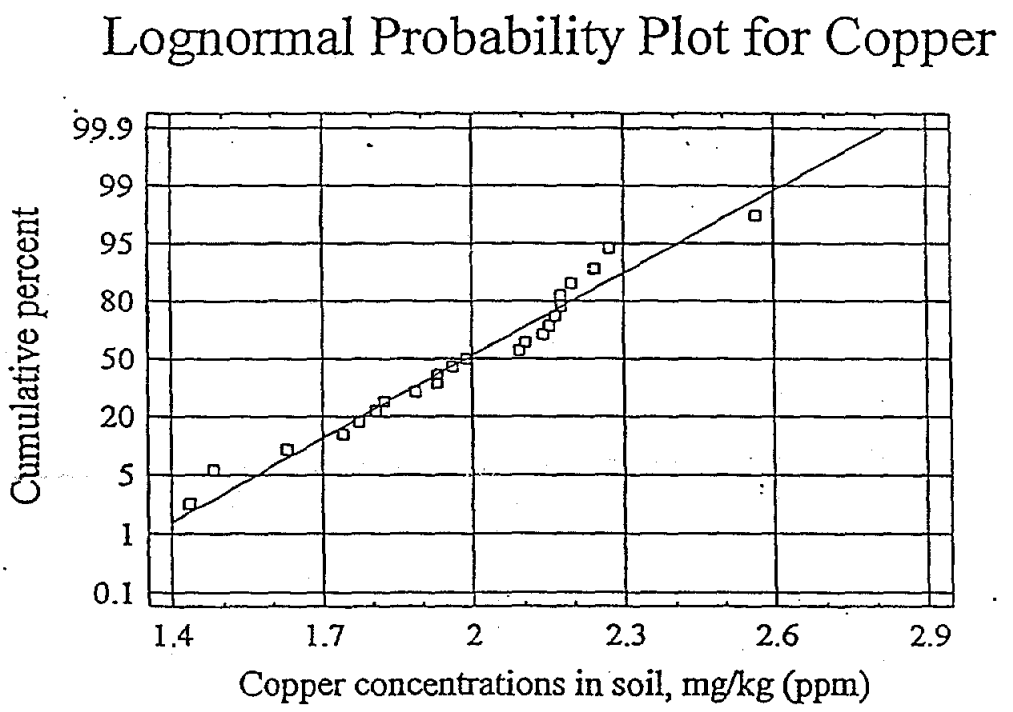
[redacted] 24
[redacted] = 1.29969
[redacted]an = 1.42129
ode =
eometric mean =
ariance = 0.574775
tandard deviation = 0.758139
tandard error = 0.154754
inimum = -2.07944
aximum = 1.88707
ange = 3.96651
ower quartile = 1.28093
pper quartile = 1.58924
nterquartile range = 0.308301
kewness = -4.13299
nd. skewness = -8.26598
urtosis = 18.9091
nd. kurtosis = 18.9091
oeff. of variation = 58.3324
m = 31.1925

Lognormal Probability Plot for Cobalt



Summary Statistics for log(Copper)

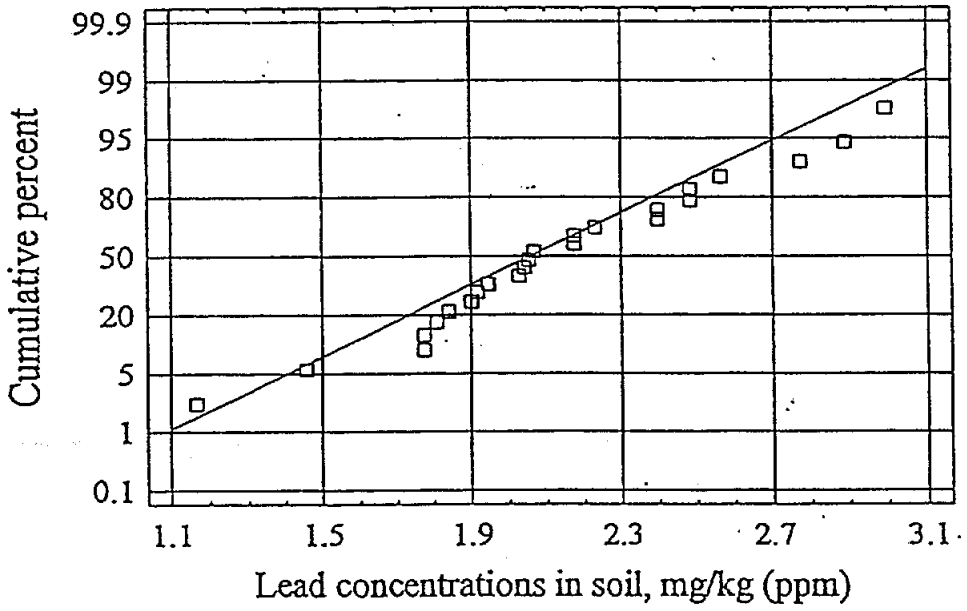
Count = 23
Average = 1.98556
Median = 1.98787
Mode =
Geometric mean = 1.96762
Variance = 0.0713494
Standard deviation = 0.267113
Standard error = 0.0556969
Minimum = 1.43508
Maximum = 2.56495
Range = 1.12986
Lower quartile = 1.80829
Upper quartile = 2.17475
Interquartile range = 0.366463
Skewness = -0.263077
Stnd. skewness = -0.515077
Kurtosis = 0.18883
Stnd. kurtosis = 0.184854
Coeff. of variation = 13.4528
Sum = 45.6679



Summary Statistics for log(Lead)

[redacted] = 24
[redacted]ge = 2.13936
[redacted]n = 2.06049
[redacted]ode =
Geometric mean = 2.09509
Variance = 0.187882
Standard deviation = 0.433454
Standard error = 0.0884784
Minimum = 1.16315
Maximum = 2.99573
Range = 1.83258
Lower quartile = 1.87133
Upper quartile = 2.4414
Interquartile range = 0.570072
Skewness = 0.0350174
Stnd. skewness = 0.0700348
Kurtosis = 0.200156
Stnd. kurtosis = 0.200156
Coeff. of variation = 20.261
Sum = 51.3446

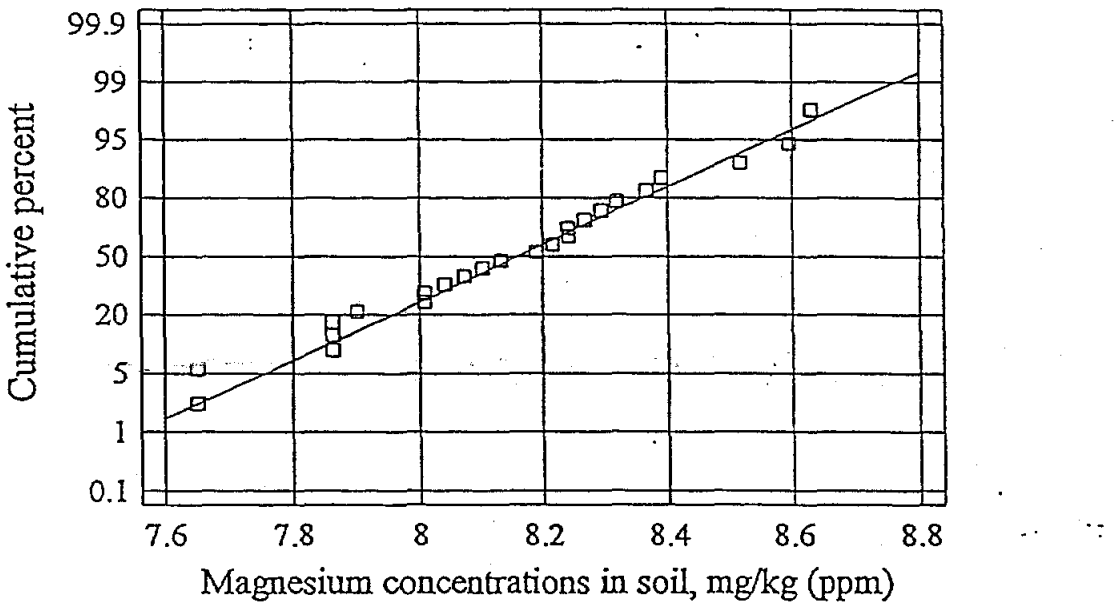
Lognormal Probability Plot for Lead



Summary Statistics for log(Magnesium)

Count = 24
Average = 8.14232
Median = 8.16011
Mode =
Geometric mean = 8.13815
Variance = 0.0706013
Standard deviation = 0.265709
Standard error = 0.0542376
Minimum = 7.64969
Maximum = 8.63052
Range = 0.980829
Lower quartile = 7.95369
Upper quartile = 8.3064
Interquartile range = 0.352709
Skewness = -0.0600481
Stnd. skewness = -0.120096
Kurtosis = -0.414246
Stnd. kurtosis = -0.414246
Coeff. of variation = 3.26331
Sum = 195.416

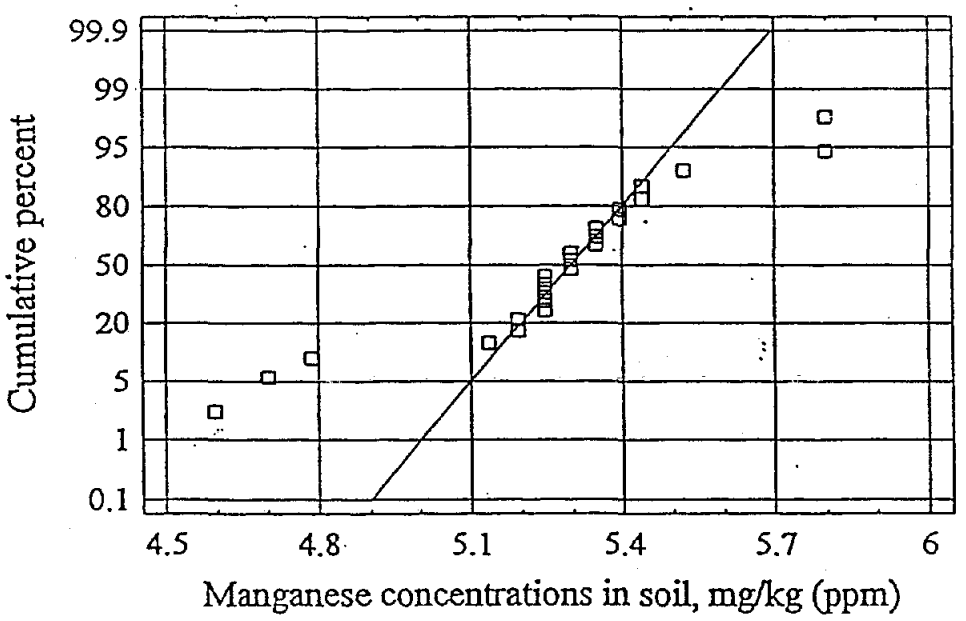
Lognormal Probability Plot for Magnesium



Summary Statistics for log(Manganese)

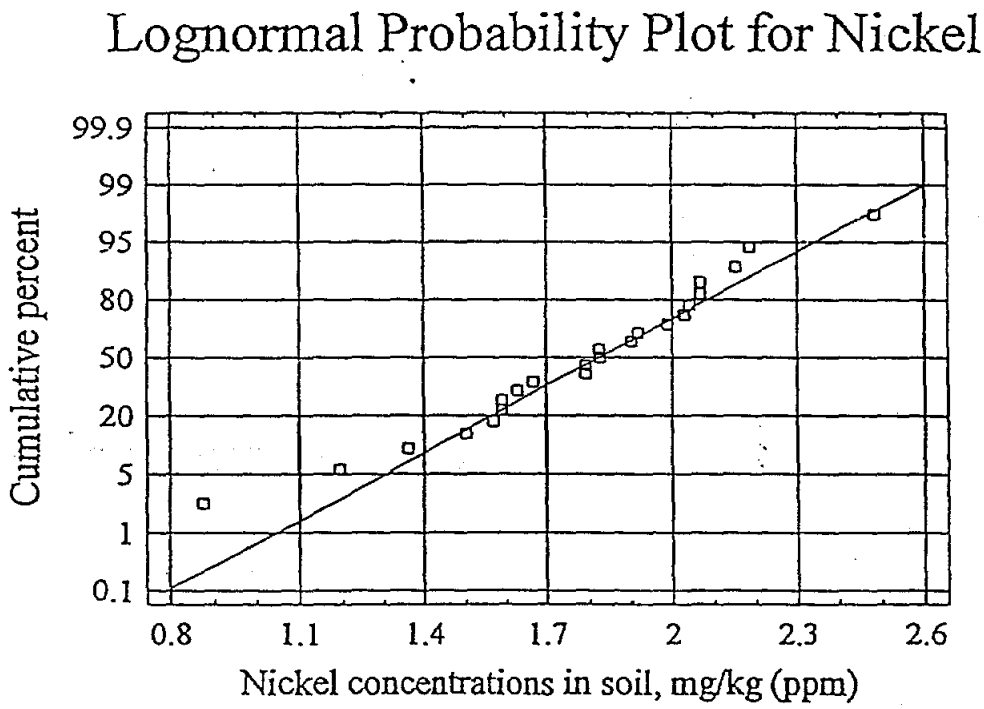
[redacted] = 24
[redacted]e = 5.2733
[redacted]n = 5.29832
Mode =
Geometric mean = 5.2661
Variance = 0.0771874
Standard deviation = 0.277826
Standard error = 0.056711
Minimum = 4.59512
Maximum = 5.79909
Range = 1.20397
Lower quartile = 5.21999
Upper quartile = 5.39363
Interquartile range = 0.173637
Skewness = -0.660387
Std. skewness = -1.32077
Kurtosis = 1.62566
Std. kurtosis = 1.62566
Coeff. of variation = 5.26854
Sum = 126.559

Lognormal Probability Plot for Manganese



Summary Statistics for log(Nickel)

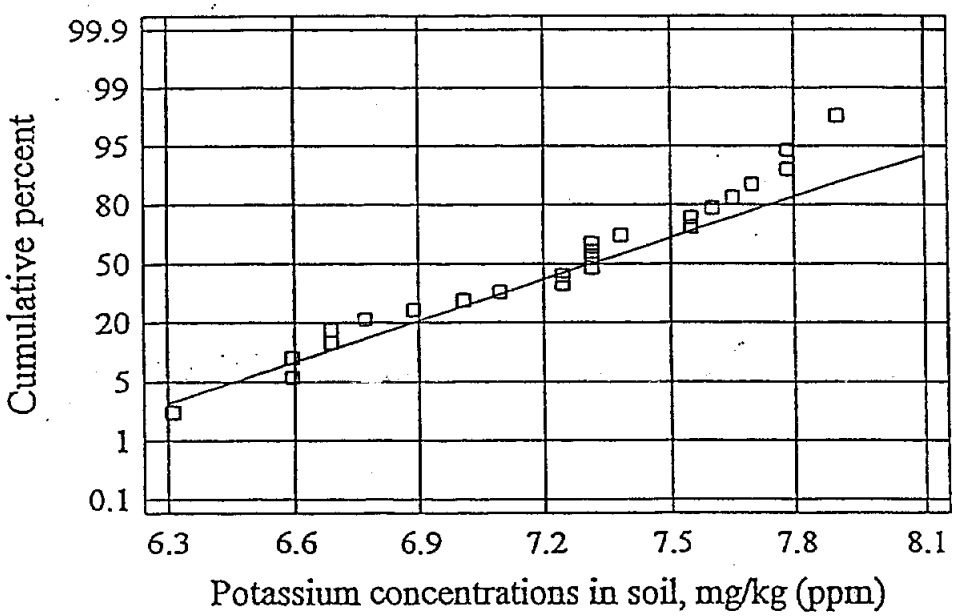
Count = 23
Average = 1.70451
Median = 1.02455
Mode =
Geometric mean = 1.74596
Variance = 0.1246
Standard deviation = 0.352987
Standard error = 0.0736029
Minimum = 0.875469
Maximum = 2.48491
Range = 1.60944
Lower quartile = 1.58924
Upper quartile = 2.04122
Interquartile range = 0.451985
Skewness = -0.609856
Stnd. skewness = -1.19403
Kurtosis = 0.992502
Stnd. kurtosis = 0.971605
Coeff. of variation = 19.7806
Sum = 41.0438



ummary Statistics for log(Potassium)

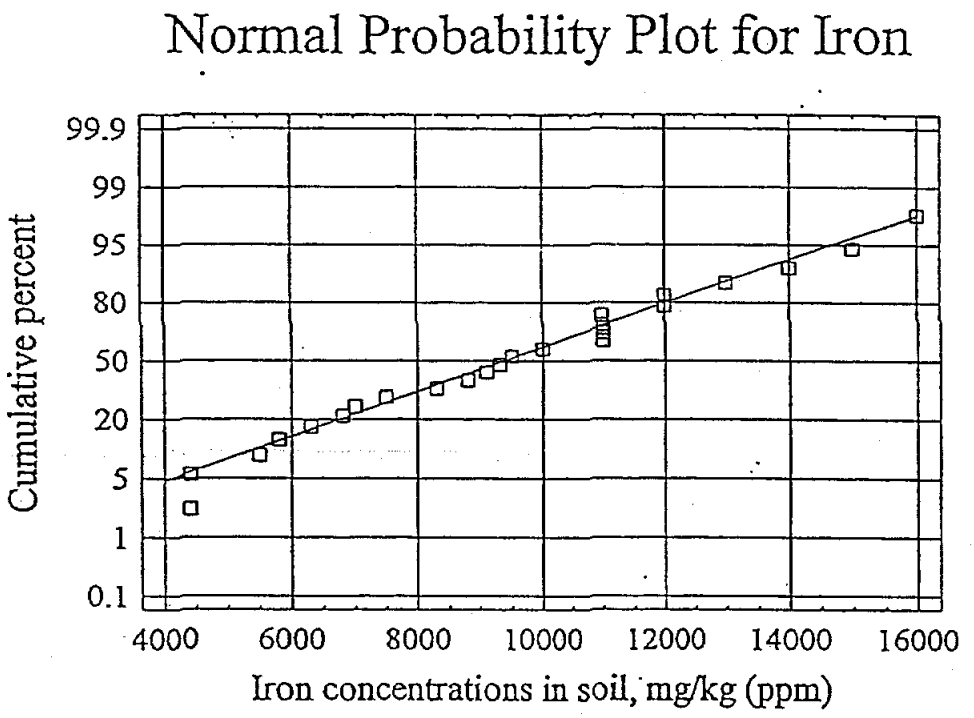
```
 = 24
 = 7.21062
 = 7.31322
 = 7.31322
ometric mean = 7.20542
riance = 0.195599
andard deviation = 0.442265
andard error = 0.0902771
nimum = 6.30992
ximum = 7.90101
nge = 1.59109
wer quartile = 6.82802
per quartile = 7.57526
terquartile range = 0.747233
ewness = -0.373735
nd. skewness = -0.74747
rtosis = -0.83864
nd. kurtosis = -0.83864
eff. of variation = 6.12673
m = 173.247
```

Lognormal Probability Plot for Potassium



Summary Statistics for Iron

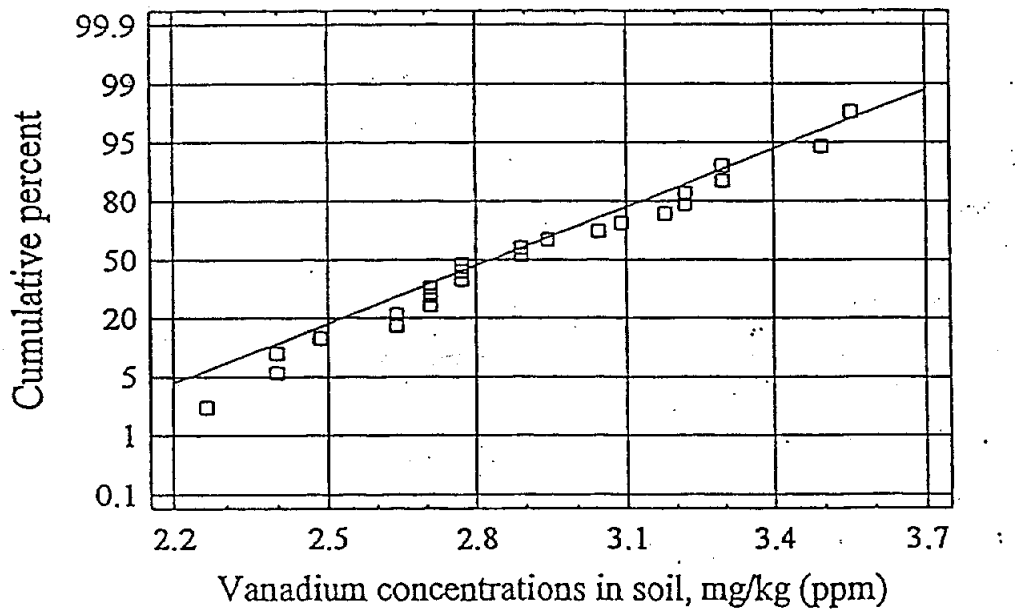
Count = 24
Average = 9529.17
Median = 9400.0
Mode = 11000.0
Geometric mean = 8977.5
Variance = 1.0363E7
Standard deviation = 3219.17
Standard error = 657.109
Minimum = 4400.0
Maximum = 16000.0
Range = 11600.0
Lower quartile = 6900.0
Upper quartile = 11500.0
Interquartile range = 4600.0
Skewness = 0.20025
Stnd. skewness = 0.400499
Kurtosis = -0.620589
Stnd. kurtosis = -0.620589
Coeff. of variation = 33.7822
Sum = 228700.0



ummary Statistics for log(Vanadium)

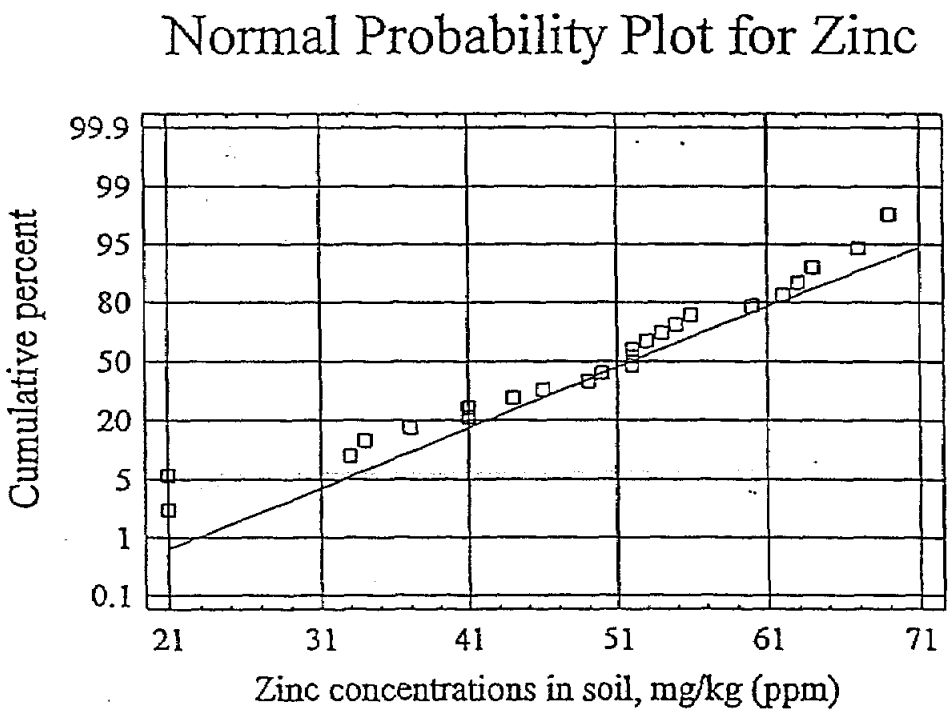
[redacted] 24
= 2.09094
an = 2.03148
ode =
eometric mean = 2.07064
ariance = 0.122444
tandard deviation = 0.34992
tandard error = 0.0714271
inimum = 2.26176
aximum = 3.55535
ange = 1.29358
ower quartile = 2.67355
pper quartile = 3.19846
nterquartile range = 0.524911
kewness = 0.158415
tnd. skewness = 0.316831
urtosis = -0.688491
tnd. kurtosis = -0.688491
oeff. of variation = 12.104
um = 69.3826

Lognormal Probability Plot for Vanadium



Summary Statistics for Zinc

Count = 24
Average = 49.0
Median = 52.0
Mode = 52.0
Geometric mean = 46.9434
Variance = 171.478
Standard deviation = 13.095
Standard error = 2.673
Minimum = 21.0
Maximum = 69.0
Range = 48.0
Lower quartile = 41.0
Upper quartile = 58.0
Interquartile range = 17.0
Skewness = -0.633044
Stnd. skewness = -1.26609
Kurtosis = -0.0224531
Stnd. kurtosis = -0.0224531
Coeff. of variation = 26.7244
Sum = 1176.0



Local Background Soil Results

Sample Identifier	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury
Bkg-01-A	2700	6	2	110	ND	0.9	23000	3	3	6	5800	6	2100	190	ND
Bkg-01-B	4100	8	2	130	0.3	1.5	24000	5	4	7	8800	7	3100	230	ND
Bkg-02-A	2400	4	2	110	ND	0.8	35000	2	3	4	4400	3	2100	99	ND
Bkg-02-B	3400	7	2	130	ND	1	31000	3	3	6	6300	8	2700	210	ND
Bkg-03-A	4800	9	5	110	0.4	1.8	36000	6	5	9	11000	9	3700	210	ND
Bkg-03-B	6000	10	2	95	0.4	1.8	28000	7	5	9	11000	9	4400	250	ND
Bkg-04-A	4000	7	2	120	0.3	2.3	24000	9	4	13	9300	8	3000	190	ND
Bkg-04-B	3300	6	2	120	ND	1.4	24000	4	4	7	8300	6	2600	210	ND
Bkg-05-A	6400	13	6	210	0.5	1.8	78000	6	7	14	10000	16	5600	330	ND
Bkg-05-B	5500	10	6	140	0.5	1.7	33000	6	6	9	11000	11	3900	330	ND
Bkg-06-A	4500	9	6	150	0.3	1.5	46000	19	4	8	9100	8	3800	190	ND
Bkg-06-B	3800	8	2	150	0.3	1.1	51000	4	4	7	6800	7	3400	200	ND
Bkg-07-A	3100	6	2	95	0.3	1.1	34000.	4	4	6	7000	12	2600	170	ND
Bkg-07-B	3600	7	3	100	0.3	1.3	39000	4	4	6	7500	7	3000	180	ND
Bkg-08-A	2200	5	6	160	ND	0.6	54000	3	ND	4	4400	4	2600	110	ND
Bkg-08-B	3600	7	3	190	ND	1.6	60000	5	4	7	9500	6	4100	180	ND
Bkg-09-A	5900	11	6	210	0.4	1.7	49000	6	5	7	11000	8	5400	230	ND
Bkg-09-B	3400	7	3	210	0.3	0.9	82000	3	3	5	5500	6	3800	120	ND
Bkg-10-A	7500	11	2	140	0.3	2.3	42000	8	5	8	13000	12	3200	190	ND
Bkg-10-B	6600	11	6	150	0.3	2.6	35000	7	4	10	14000	11	3300	200	ND
Bkg-11-A	8300	13	2	200	0.4	2.2	43000	8	5	9	12000	18	3600	190	ND
Bkg-11-B	10000	16	2	200	0.5	2.4	40000	10	6	9	16000	20	4000	220	ND
Bkg-12-A	5600	11	2	200	0.3	2.2	55000	7	5	9	12000	9	4300	200	ND
Bkg-12-B	8600	14	6	290	0.4	2.6	47000	10	6	9	15000	13	5000	220	ND

Concentrations in mg/kg
Activities in pCi/g
Sample Identifier XX-XX-A - surface soil samples
Sample Identifier XX-XX-B - subsurface soil samples

Local Background Soil Results

Sample Identifier	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc	Tritium	Plutonium 239/24	Plutonium 238	Uranium-238	Uranium-235/236	Uranium-234
Bkg-01-A	4	1500	ND	ND	ND	ND	11	50						
Bkg-01-B	6	2000	ND	ND	ND	ND	16	63						
Bkg-02-A	2	730	ND	ND	ND	ND	9.6	41						
Bkg-02-B	5	1600	ND	ND	ND	ND	11	53						
Bkg-03-A	7	1500	ND	ND	ND	ND	19	56						
Bkg-03-B	9	1200	ND	ND	480	ND	15	62						
Bkg-04-A	12	1900	ND	1	ND	ND	18	55	<0.010	<0.009	<0.011	0.8	0.28	1
Bkg-04-B	5	1400	ND	ND	ND	ND	16	52	<0.022	<0.008	<0.009	0.3	0.02	0.3
Bkg-05-A	9	2700	ND	ND	ND	ND	22	37						
Bkg-05-B	8	1400	ND	ND	ND	ND	18	34						
Bkg-06-A	13	1500	ND	ND	ND	ND	16	52						
Bkg-06-B	6	800	ND	ND	420	ND	14	54						
Bkg-07-A	5	870	ND	ND	ND	ND	15	21						
Bkg-07-B	5	800	ND	ND	380	ND	15	21						
Bkg-08-A	3	730	ND	ND	ND	ND	12	33						
Bkg-08-B	5	980	ND	ND	430	ND	21	67						
Bkg-09-A	8	1100	ND	ND	280	ND	24	41						
Bkg-09-B	5	550	ND	ND	640	ND	14	44						
Bkg-10-A	6	2400	ND	ND	ND	ND	27	52						
Bkg-10-B	7	2200	ND	ND	ND	ND	27	49						
Bkg-11-A	7	2100	ND	ND	280	ND	25	60	<0.023	<0.007	<0.017		0.03	0.5
Bkg-11-B	8	2400	ND	ND	290	ND	35	64	<0.024	<0.012	<0.018		0.03	0.6
Bkg-12-A	6	1500	ND	ND	ND	ND	25	46	<0.084	<0.030	<0.017		0.17	0.8
Bkg-12-B	8	1900	ND	ND	620	ND	33	69	<0.023	0.035	0.038	0.6	0.33	0.9

Concentrations in mg/kg
Activities in pCi/g
Sample Identifier XX-XX-A - surface soil samples
Sample Identifier XX-XX-B - subsurface soil samples

Normal Parameters for Tijeras Arroyo Local Metal Background Data

Statistical Parameter	Aluminum	Antimony	Arsenic	Barium	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Nickel	Vanadium	Zinc
median	4300	8.5	2	140	2	6	4.2	7.3	9400	7.9	200	6.2	17	52
geometric mean	4579.9	8.6	3	144	2	5	3.7	7.3	8977.5	8.5	195	6	18	47
maximum	10000	16	6	210	3	10	6.6	13	16000	20	330	12	35	69
minimum	2200	4.4	2	95	1	2	0.1	4.2	4400	3.2	99	2.4	9.6	21
arithmetic average	4970.8	9	3	149	2	5.5	4.2	7.5	9529.2	9.3	202	6.3	19	49
standard deviation	2095.4	3	2	40.5	1	2.3	1.3	2	3219.2	4.2	53.6	2.1	6.9	13
normal tolerance	2.309	2.3	2	2.33	2	2.3	2.3	2.3	2.309	2.3	2.31	2.3	2.3	2.3
UTL	4927.4	16	7	244	3	11	7.3	12	16962	19	326	11	35	79

Lognormal Parameters for Tijeras Arroyo Local Metal Background Data

Statistical Parameter	Aluminum	Antimony	Arsenic	Barium	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Nickel	Vanadium	Zinc
arithmetic average	8.4294	2.2	1	4.97	0	1.6	1.3	2	9.1025	2.1	5.27	1.8	2.9	3.8
standard deviation	0.4126	0.3	1	0.27	0	0.5	0.8	0.3	0.3631	0.4	0.28	0.4	0.3	0.3
normal tolerance	2.309	2.3	2	2.33	2	2.3	2.3	2.3	2.309	2.3	2.31	2.3	2.3	2.3
UTL	9.3821	2.9	2	5.6	1	2.7	3.1	2.6	9.941	3.1	5.91	2.6	3.7	4.6
e^{UTL}	11874	19	10	271	4	14	21	14	20764	23	370	14	40	98

sufficient data for mercury, selenium, silver, and thallium to calculate statistics
All concentrations in mg/kg

Summary of Background Concentrations for Radionuclides in Soil

Analyte	Original Number of Samples	Number of Detects	Number of Rejected Samples	Distribution Type	Range (pCi/g)	n[a]	Geometric Mean (pCi/g)	Median (pCi/g)	95th Upper Tolerance Limit (pCi/g)	95th Percentile (pCi/g)
Bismuth-212	324	17	307	Nonparametric	0.414–2.7	17	1.1055	1.0	–	2.7
Bismuth-214	340	321	19	Nonparametric	0.27–1.4	321	0.848	0.6	–	0.8
Cesium-137 (Surface) (Subsurface)	802 – –	561 – –	26 – –	– Nonparametric Unknown[c]	– 0.004–10.1 <detection limit (<0.0686)	– 604 172	– 0.200 <detection limit (<0.0686)	– 0.2495 <detection limit (<0.0686)	– – –	– 0.92 <detection limit (<0.0686)
Cobalt-60	321	11	74	Unknown	<detection limit (<0.0418)	247	<detection limit (<0.0418)	<detection limit (<0.0418)		<detection limit (<0.0418)
Lead-210[b]	338	40	292	Nonparametric	0.3–12.0	46	2.26838	2.835	–	6.8
Lead-212[b]	323	233	90	Lognormal	0.1–1.4	233	0.49689	0.5	1.0795	–
Lead-214[b]	249	241	9	Lognormal	0.29–1.13	240	0.549	0.56	0.90	–
Potassium-40	722	720	4	Normal	0.192–31.0	718	15.889	16.4	25.34	–
Radium-224	24	24	0	Nonparametric	0.43–0.97	24	0.6747	0.655	–	0.968
Radium-226	368	53	314	Lognormal	0.5–2.09	54	0.713	0.590	1.94	–
Radium-228	24	24	0	Nonparametric	0.45–1.05	24	0.695	0.630	–	1.05
Radon	0	0	0	Unknown	–	0	–	–	–	–
Strontium-90	54	45	9	Nonparametric	0.032–1.85	45	0.2528	0.2883	–	0.766
Thorium-232	136	136	0	Lognormal	0.23–1.20	136	0.7971	0.810	1.258	–
Thorium-234	365	52	330	Lognormal	0.324–3.0	35	0.7796	0.71	2.89	–
Tritium	0	0	0	Unknown	–	0	–	–		–
Uranium-234	4	4	0	Nonparametric	0.8–1.0	4	0.897	0.9	–	1.0
Uranium-235	95	21	75	Nonparametric	0.05–0.18	20	0.1198	0.1235	–	0.168
Uranium-238	223	206	17	Nonparametric	0.0033–2.065	206	0.506	0.763	–	1.1

[a]Sample size.
[b]These constituents are not listed as COC in Table 2-2 for this media.
[c]Constituents of concern are of unknown distribution type because data are either below the limit of detection, unusable, or nonexistent.

(IT, 1994)

Department of Energy
Field Office, Albuquerque
Kirtland Area Office
P.O. Box 5400
Albuquerque, New Mexico 87115

OCT 17 1996

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

Mr. Benito Garcia, Bureau Chief
New Mexico Environment Department
Hazardous and Radioactive Materials Bureau
2044 Galisteo Street
P.O. Box 26110
Santa Fe, NM 87505-2100

Dear Mr. Garcia:

Enclosed are two copies of the Sandia National Laboratories, New Mexico/Department of Energy (SNL/NM/DOE) response to the New Mexico Environment Department (NMED) technical comments on the 23 No Further Action (NFA) proposals submitted to NMED in June of 1995.

If you have any questions, please contact John Gould at (505) 845-6089, or Mark Jackson at (505) 845-6288.

Sincerely,

Michael J. Zamorski
Acting Area Manager

Enclosure

cc w/enclosure:
T. Trujillo, AL, ERD
W. Cox, SNL, MS 1147
N. Weber, NMED-AIP
R. Kern, NMED-AIP
D. Neleigh, EPA, Region 6 (2 copies)

cc w/o enclosure:
B. Oms, KAO-AIP
E. Krauss, SNL, MS 0141
B. Hoditschek, NMED
S. Dinwiddie, NMED

OCT 21 1996

Sandia National Laboratories
Albuquerque, New Mexico
October 1996

Environmental Restoration Project
Responses to NMED Technical Comments
on No Further Action Proposals
Dated June 1995

INTRODUCTION

This document responds to comments received in a letter from the State of New Mexico Environment Department to the U.S. Department of Energy (Zamorski, July 29, 1996) documenting the review of 23 No Further Action (NFA) Proposals submitted in June 1995.

This response document is organized in numerical order by operable unit (OU) and subdivided in numerical order by site number, Each OU section provides NMED comments repeated in **bold** by comment number and by site number in the same order as provided in the call for response to comments. The DOE/SNL response is written in normal font style on a separate line under "Response". Responses to general technical comments begin on page 3 and responses to site-specific technical comments begin on page 4. Responses to general risk assessment comments begin on page 143 and responses to specific risk assessment comments begin on page 144. Additional supporting information for the site-specific comments is included as figures and tables within each comment response and as attachments to each section of this document.

TABLE OF CONTENTS

9. Site 46, OU 1309, Old Acid Waste Line Outfall Site

a. NMED understands that Site 46 had an operational life of approximately 15 to 20 years and discharged an estimated 130,000 gallons per day of industrial effluents from TA-I (plating, etching, and photo processing operations, plus cooling tower blowdown). Potential contaminants include metals (especially Cr, Ni, Cd, and Ag), radionuclides, VOCs, SVOCs, and nitrate.

Response: No response is required.

b. There is inadequate technical information on the location, including the depth, of the outfall pipe. This location must be determined to ensure the adequacy of sampling and detection of possible releases to the environment. Historical photographs and/or trenching may help to locate the outfall pipe and the outfall trench associated with the old acid waste line.

Response: SNL/NM performed additional research and presents the following additional technical information. In addition to the suggested historical photographs and trenching, SNL/NM researched engineering drawings, conducted a sewer-line camera survey, performed several field checks, and gathered additional analytical data.

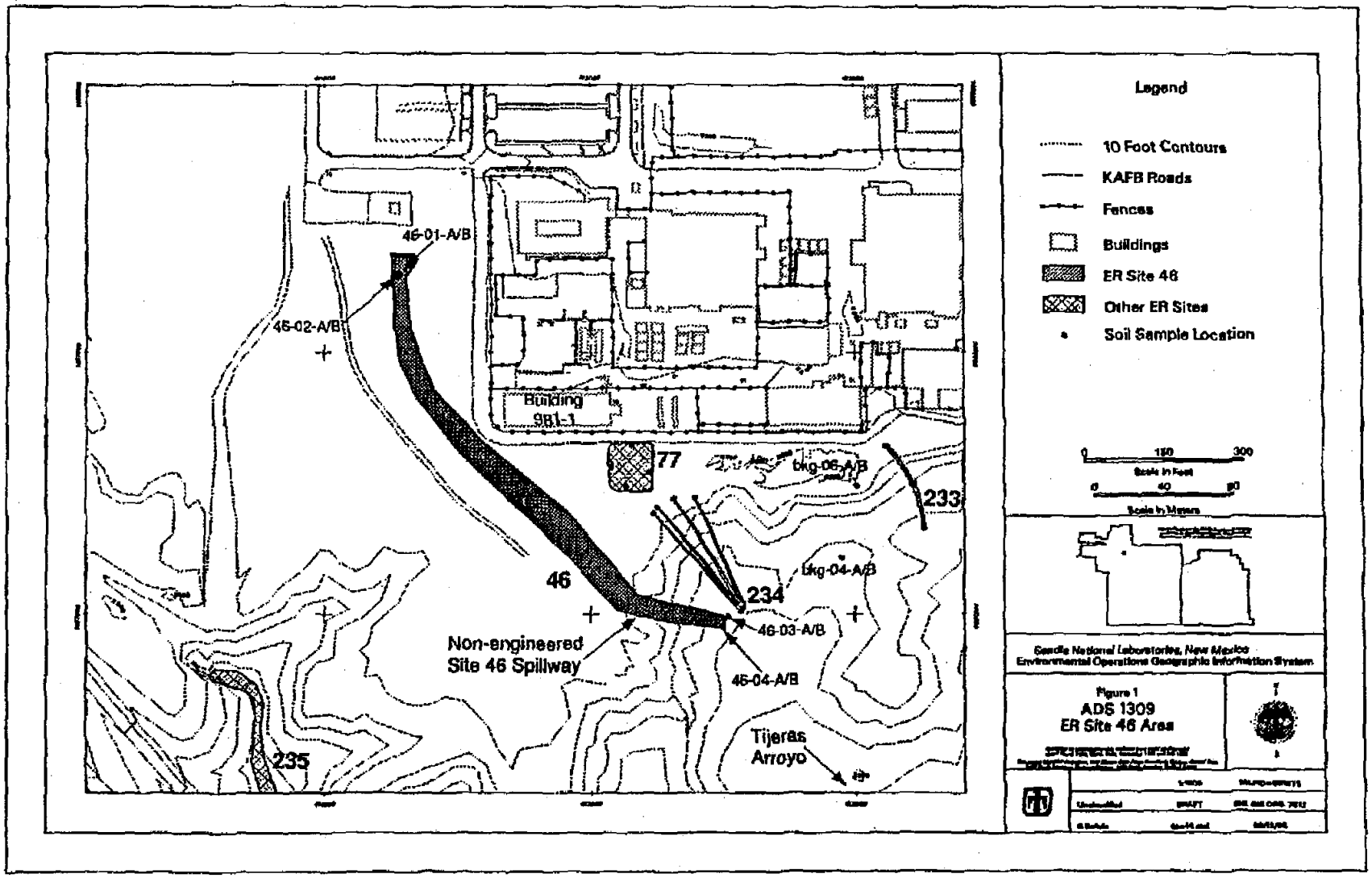
The waste line is composed of 8-inch diameter, vitreous clay pipe. Use of the line was discontinued in the late 1960s and the line disconnected from the TA-I buildings. The waste line runs along the ground surface in the northern part of ER Site 46. The recent research has revealed that the original, 1993 ER site boundary did not encompass the exposed segment of the acid waste line. The line does not end at the northern end of the drainage ditch as previously thought.

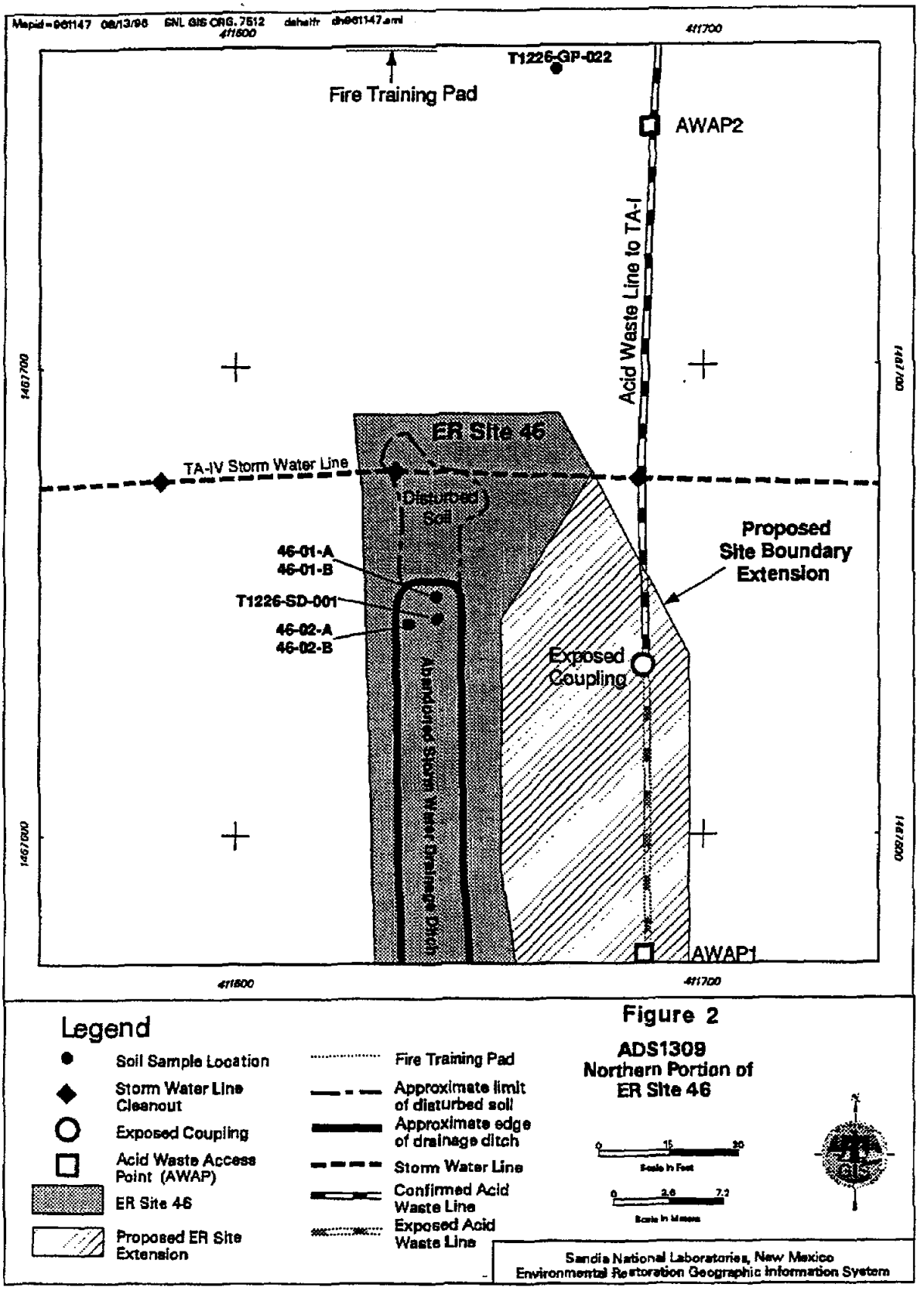
Figures 1, 2, and 3 show that the original ER site boundary has been adjusted eastward about 40 ft to enclose the exposed segment of the line.

A video-camera survey conducted by SNL/NM Facilities Engineering has confirmed that the line actually ends about 200 ft to the southeast of the previously assumed outfall location (SNL/NM, 1995a). From TA-I southward to the outfall, the camera survey was conducted at a series of trenches known as acid waste access points (AWAPs). Near ER Site 46, access points AWAP1 and AWAP2 were trenched for camera entry points because the line was not constructed with cleanouts (Romero, 1996). From the exposed line coupling (joint) southward to the drainage ditch, the acid waste line is intermittently visible for about 100 ft along the ground surface as a cracked, 8-inch diameter, clay line. Grading activities associated with TA-IV have either covered the southernmost 70 ft of the line with soil or have destroyed that portion of the line.

The northern end of the drainage ditch, which was assumed in 1993 to be the discharge point for the acid waste line, is actually the location where TA-IV storm-water once discharged. Storm water from TA-IV now flows through a buried line that has been recently extended further westward to the Ninth Street Channel. The storm-water line is buried at a depth of approximately 2 feet and is evident as three cleanouts on the south side of the fire-training pad. Diversion of TA-IV storm water from the ditch to the channel occurred after the acid waste line was taken out of service. Construction activities associated with the storm-water line apparently resulted in heavy vehicles driving over the acid waste line and cracking it in several places many years after the line was taken out of service.

Additional sampling results from the TA-I OU field investigation has recently become available. The 1.3 mile sewer line that once discharged water to the ER Site 46 outfall is known as ER Site 226 and was recently investigated under TA-I OU Workplan activities. In July 1995, the TA-I field investigation collected soil and sediment samples at 27 locations along the waste line. A Geoprobe rig was used to collect the soil samples; the maximum sampling depth was 14 ft. A pair of sediment samples was also collected beneath two manholes. Another sediment sample (T1226-SD-001) consisting of soil was collected at one ft below the floor of the drainage ditch. Geoprobe T1226-GP-022 was located about 70 ft north of ER Site 46 (Figure 2). The soil and sediment samples were analyzed by both on-site and off-site analytical laboratories for VOCs, SVOCs, PCBs, metals, and radionuclides. No VOCs, SVOCs, or PCBs were detected. Metals and radionuclides were within the range of background concentrations. The ER Site 226 analytical data will be submitted in its entirety in upcoming TA-I OU site-specific NFA and VCM reports. SNL/NM will propose that ER Site 226 be granted NFA status.


46-01-A/B
46-02-A/B
Building
981-1
77
bkg-06-A/B
233
46
bkg-04-A/B
234
46-03-A/B
Non-engineered
Site 46 Spillway
46-04-A/B
Tijeras
Arroyo
235
Legend
10 Foot Contours
KAFB Roads
Fences
Buildings
ER Site 46
Other ER Sites
Soil Sample Location
0 150 300
Scale in Feet
0 40 80
Scale in Meters
Sandia National Laboratories, New Mexico
Environmental Operations Geographic Information System
Figure 1
ADS 1309
ER Site 46 Area
DRAFT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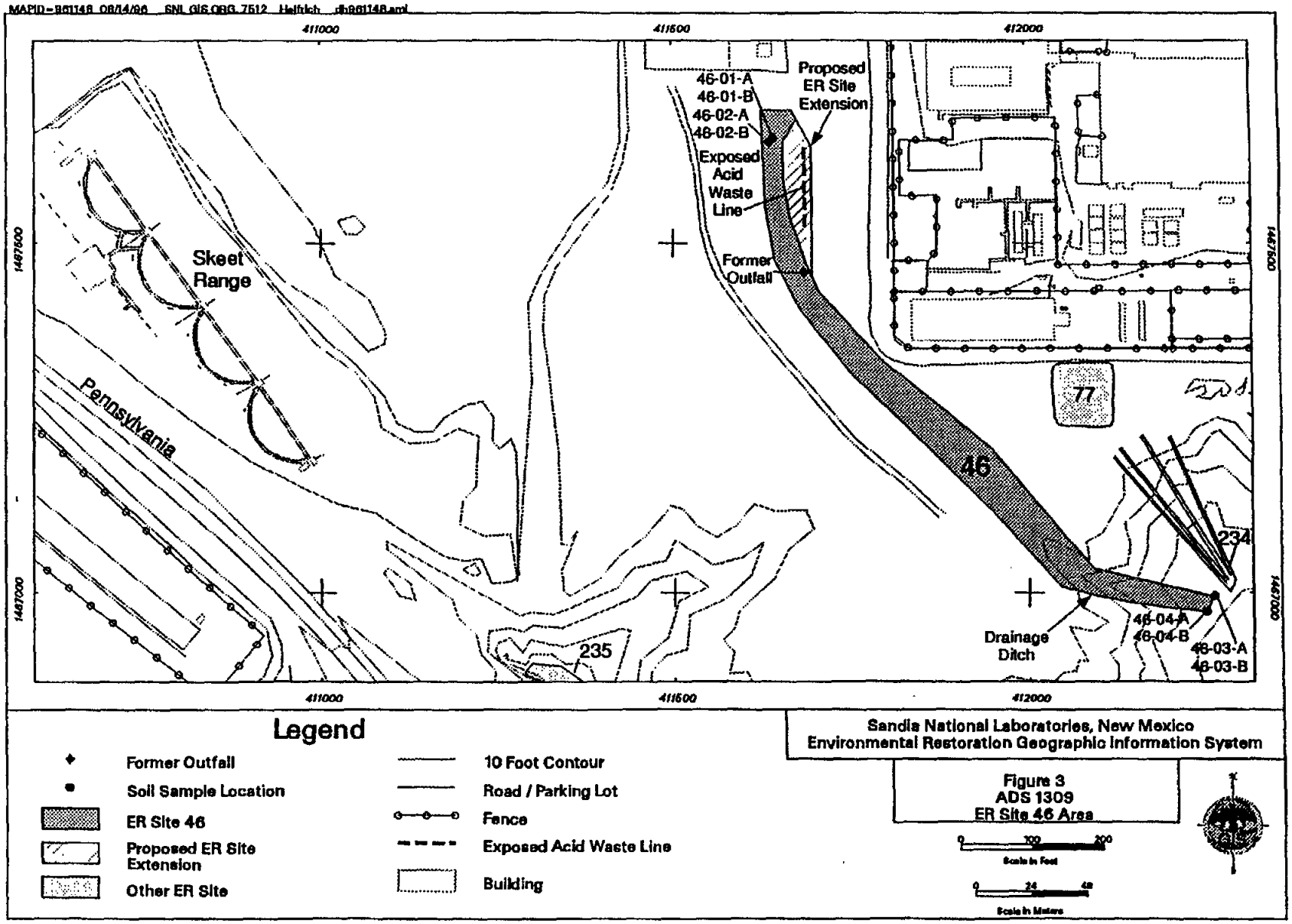
411600
411700
T1226-GP-022
Fire Training Pad
AWAP2
Acid Waste Line to TA-I
1467700
1467600
1467500
ER Site 46
TA-IV Storm Water Line
Disturbed Soil
46-01-A
46-01-B
T1226-SD-001
46-02-A
46-02-B
Proposed Site Boundary Extension
Exposed Coupling
Abandoned Storm Water Drainage Ditch
AWAP1
411600
411700
Legend
Soil Sample Location
Storm Water Line Cleanout
Exposed Coupling
Acid Waste Access Point (AWAP)
ER Site 46
Proposed ER Site Extension
Fire Training Pad
Approximate limit of disturbed soil
Approximate edge of drainage ditch
Storm Water Line
Confirmed Acid Waste Line
Exposed Acid Waste Line
Figure 2
ADS1309
Northern Portion of ER Site 46
0 15 30
Scale in Feet
0 2.5 7.5
Scale in Meters
N
Sandia National Laboratories, New Mexico
Environmental Restoration Geographic Information System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411000
411500
412000
1487500
1487000
46-01-A
46-01-B
46-02-A
46-02-B
Proposed ER Site Extension
Exposed Acid Waste Line
Former Outfall
Skeet Range
Pennsylvania
77
46
234
235
Drainage Ditch
46-04-A
46-04-B
46-03-A
46-03-B
Legend
Former Outfall
Soil Sample Location
ER Site 46
Proposed ER Site Extension
Other ER Site
10 Foot Contour
Road / Parking Lot
Fence
Exposed Acid Waste Line
Building
Sandia National Laboratories, New Mexico
Environmental Restoration Geographic Information System
Figure 3
ADS 1309
ER Site 46 Area
0 100 200
Scale in Feet
0 24 48
Scale in Meters

The recently obtained technical information indicates that the northernmost ER Site 46 soil samples (46-01-A, 46-01-B, 46-02-A, 46-02-B, T1226-SD-001) do not adequately characterize the vicinity of the outfall. The 1994 soil samples were not properly located at the former outfall location. However, the soil samples near the southern end of the drainage ditch are useful for understanding the potential impact of the waste-water discharge. Four soil samples (46-03-A, 46-03-B, 46-04-A, and 46-04-B) were collected at the lower end of the drainage ditch. The results of the soil sampling are presented below in the section SNL/NM Analytical Data Summary for ER Site 46 which follows SNL/NM Response to NMED Comment 9.

c. Considering the volumes of effluent discharged from the old acid waste line, NMED is concerned about whether any contaminants are potentially detectable in near surface soils. Additionally, NMED is concerned about whether contaminants may have been "flushed" to groundwater beneath the site. Therefore, NMED considers that deeper borehole soil sampling, including hydrogeological characterization, is appropriate for Site 46, and that groundwater monitoring should be implemented to determine if there have been any releases to groundwater in the vicinity of Site 46.

Response: SNL/NM believes that some trace of contamination would be found in the ER Site 46 or ER Site 226 soil and sediment samples if a significant deeper problem existed. The analytical methodology incorporated part-per-billion detection limits (Attachment A). The issue of groundwater characterization is discussed in the risk assessment section at the end of the ER Site 46 response.

d. Page 3, Section 3.1, in reference to SNL/NM's statement "Most of the potential contamination resulting from discharge effluent would have most likely settled at or before the furthest extent of visible erosion/scour." What is the rationale supporting this statement?

Response: SNL/NM assumed that decreasing water velocity along the floor of the unlined drainage ditch would have allowed most of the water and associated contaminants to have percolated into the soil before reaching the furthest extent of visible erosion and scour. However, SNL/NM used a conservative approach and sampled at the far end of drainage ditch (Figure 3).

e. Page 4, Section 3.5 in reference to SNL/NM's statement "... metals and radioactive constituents generally adsorb on soil and precipitate rather than remaining soluble." What is the rationale for this statement, considering

that large volumes of presumably acidic waste were discharged from the line which might have driven contaminants deep at this site?

Response: The soil in the area are characterized as having a high content of calcium carbonate (caliche) and would have provided some measure of neutralization (buffering) for the acidic waste water. A calculation of effective buffering is not practical because the actual pH of waste water is not known. However, the waste water does not appear to have been very acidic because the fragments of the vitreous clay line at ER Site 46 is not eroded or etched.

f. Method detection limits are not provided in Table 1 or Appendix B.

Response: Method detection limits are listed in Attachment A of this response.

g. Page 3; Historical Operations: SNL/NM should provide NMED with data or records that include what specific wastes were sent through the line?

Response: The *Final RCRA Facility Assessment Report* (EPA, 1987) stated that "the waste line outfall discharged 130,000 gallons per day of acidic waste water for Area I into Tijeras Arroyo. Approximately 200 gallons per day of the discharge consisted of chromic acid. Ferric chloride was also discharged. Discharges included cooling tower blowdown and waste liquid from etching processes." Research, consisting mostly of personnel interviews, has been conducted by the TA-I OU for ER Site 226. They determined that the waste steam also included plating solutions and photo-processing water. The other potential COCs are trichloromethane, silver, and possibly various radionuclides (tritium, uranium, and plutonium). More detailed data and records are not available for the acid waste line. No organic waste in the form of sewage was discharged through the waste line.

h. Page 3; Unit Characteristics: Please describe what the waste line was composed of and how deep the line was placed in the ground. Is the pipe still in the ground?

Response: The waste line is composed of 8-inch diameter, vitreous clay pipe. The line is no longer in use and has been disconnected from the TA-I buildings. The waste line runs along the ground surface in the northern part of ER Site 46 (Figures 2 and 3).

Additional research for ER Site 46 has revealed that the original site boundary was insufficient. The original boundary was set in 1993 and has recently been adjusted eastward about 40 ft to encompass the exposed trend of the acid waste

line. The acid waste line does not end at the northern end of the drainage ditch as previously thought (Figure 2). A video camera survey conducted by SNL/NM Facilities Engineering in 1994 has revealed that the line actually ends about 200 ft to the southeast of the previously assumed outfall location. The points AWAP1 and AWAP2 are 'acid waste access points' that were dug to verify the line location. From an exposed line coupling southward to the drainage ditch, the acid waste line is intermittently visible for about 100 ft along the ground surface as a cracked, 8-inch diameter, clay line (Romero, 1996). The acid waste line apparently discharged into the ditch at a point approximately 200 ft south of the 1993 interpretation. The area has been partially regraded and obscures the line south of point AWAP1.

The northern end of the drainage ditch that was presumed to be the discharge point for the acid waste line is actually the location where TA-IV storm-water once discharged. Storm water from TA-IV now flows through a buried, east-west trending line to the Ninth Street Channel and down to Tijeras Arroyo. The storm-water line is buried at a depth of approximately 2 feet and is evident as three cleanouts on the south side of the fire-training pad (Figure 2). Diversion of TA-IV storm water from the ditch to the buried line occurred after the acid waste line was taken out of service. Construction activities associated with the storm-water line apparently resulted in heavy vehicles driving over the acid waste line and cracking it in several places.

i. Did SNL/NM find the actual outfall pipe? In addition, why did SNL/NM not take any samples along the 750 ft. length of the pipeline? Why was a soil gas survey not performed?

Response: SNL/NM has recently located the exposed portion of the acid waste line. Unfortunately, the exposed portion was not identified before the soil sampling was conducted in 1994. The original boundary of ER Site 46 was set in 1993 and has now been adjusted eastward about 40 ft to encompass the exposed trend of the acid waste line. The acid waste line does not end at the northern end of the drainage ditch as previously thought. The former discharge location for the outfall was in the drainage ditch about 200 feet farther south than originally thought (Figure 3).

The length of the waste line from its beginning in the north-central part of TA-I to the outfall is not 750 ft. Rather, the length of the waste line is about 1.3 miles. The entire length of the waste line is designated as ER Site 226 and has been investigated under TA-I OU Workplan activities. The Tijeras Arroyo OU has separately investigated ER Site 46 which includes the waste line outfall and the drainage ditch. The length of the drainage ditch is about 1,000 ft.

In July 1995, the TA-I OU field investigation for ER Site 226 collected soil and sediment samples at 27 locations along the waste line. A Geoprobe rig was used to collect the soil samples; the maximum sampling depth was 14 ft. Sediment samples were collected beneath two manholes that are located north of ER Site 46. Another sediment sample (T1226-SD-001) consisting of soil was collected at the north end of the ditch at a depth one ft below the floor of the drainage ditch (Figure 2). The soil and sediment samples were analyzed by both on-site and off-site analytical laboratories for VOCs, SVOCs, PCBs, metals, and radionuclides. No VOCs, SVOCs, or PCBs were detected. Metals and radionuclides were within the range of background concentrations. The ER Site 226 analytical data will be submitted in its entirety in upcoming TA-I OU site-specific NFA and VCM reports.

Soil-vapor (soil-gas) samples were not collected because the waste stream predominantly consisted of waste water with few volatile compounds.

The analytical results that were previously presented in the June 1995 *Proposal for NFA - Site 46* as Table 1 and Appendix B have been reorganized in this Notice of Deficiency (NOD) response. The section SNL/NM Analytical Data Summary for ER Site 46 at the end of this response section discusses the concentrations and potential risks of contaminants in soil.

j. Page 4; Assessment of Gaps Information: Why did SNL/NM use such a large sampling interval (6-36")?

Response: The 30-inch sampling interval was used because 1,000 to 1,625 milliliters (mL) of soil was needed to fill the sample containers. The 2-inch-diameter hand auger yielded about 50 mL of soil per vertical inch of borehole. As a result, about 20 to 33 inches of soil core were needed. The large volume of soil was required because three analytical laboratories (two offsite and one onsite) were needed to analyze the soil for a wide range of COCs. Appendix A in the June 1995 *Proposal for NFA - Site 46* contained the sampling and analysis plan (SAP) that was used for the Tijeras Arroyo ER Sites.

k. Page 12; Figure 1: Please provide a more detailed map of Figure 1 showing the sampling location(s) where the liquid would hit the ground from the pipe.

Response: A more detailed map is presented as Figures 2 and 3.

l. Page 13; Table 1: Please include the sampling depths in the revised table.

Response: The sampling depths have been footnoted on Table 4.

m. General Comment: NMED has some concerns regarding the sampling performed at this SWMU. Since this SWMU allegedly released waste water, 130,000 gallons per day, for at least 15 years, NMED is concerned that there is no evidence of contamination found in the soil and possibly other media. NMED believes that the following additional work should be implemented:

m-1. An active soil gas survey should be performed near the buried pipe and the outfall areas/drainage channel.

Response: For four reasons, SNL/NM believes that field-screening soil-vapor samples will not be beneficial. (1) As a cost-effective field-screening tool, SNL/NM has used soil-vapor sampling at other ER sites where the locations of release sites are not well known or the sampling area is large. Now the former outfall location has been well documented by trenching, a camera survey, and the review of aerial photography and engineering drawings. (2) Significant amounts of VOCs are not known to have been present in the waste water. (3) Furthermore, no VOCs have been detected in the soil and sediment samples that were collected by the TA-I OU field investigation. (4) The quantitative analytical data for the soil samples is more useful than qualitative soil-vapor data.

m-2. Deeper soil samples (minimum 20 ft.) should be taken in the outfall areas/drainage channel, and at various locations underneath the pipe. Locations should be chosen based upon the soil gas survey results.

Response: SNL/NM asserts that the previous soil sampling is adequate. Supplemental sampling has already been conducted along the waste line as part of the TA-I OU field investigation of ER Site 226. These results are discussed in Responses B and I, and in the SNL/NM Analytical Data Summary for ER Site 46 section.

m-3. Additional sampling of the outfall areas/drainage areas that received the waste. NMED questions whether the soil sampling locations originally chosen actually received wastes.

Response: The northernmost sample at the head of the drainage ditch are not useful for characterizing the potential impact of the waste water. However, the

southernmost samples are definitely located in the drainage ditch that received the waste water (Figure 3).

n. RECOMMENDATION: Based upon site concerns, including the inadequacy of previous soil sampling, lack of site-specific hydrogeological information, and need for groundwater monitoring, NMED considers that NFA is not appropriate for Site 46. NMED recommends that SNL/NM submit a RFI Workplan for Site 46, which should address a proposal for comprehensive investigation of the site.

Response: The TA-I OU field investigation has already sampled soil and sediment along the entire length of the acid waste line. The soil and sediment samples were analyzed by both on-site and off-site analytical laboratories for VOCs, SVOCs, PCBs, metals, and radionuclides. No VOCs, SVOCs, or PCBs were detected. Metals and radionuclides were within the range of background concentrations. The ER Site 226 analytical data will be submitted in its entirety in upcoming TA-I OU site-specific NFA and VCM reports. SNL/NM will propose that ER Site 226 be granted NFA status.

The soil-sampling results are discussed in the SNL/NM Analytical Data Summary for ER Site 46 section. The risk assessment shows that ER Site 46 does not have significant potential from either non-radioactive or radioactive contaminants to affect human health under either an industrial or a residential land-use scenario (Attachment D). NMED's concerns about groundwater characterization will be addressed by the additional sampling that has been proposed in the *Sandia North Groundwater Investigation Plan* (GIP). As a separate initiative from the Tijeras Arroyo OU, SNL/NM has prepared the GIP (dated March 29, 1996) to discuss the sampling program for characterizing the distribution of chlorinated solvents in groundwater near TA-II (SNL/NM, 1996b). Soil, soil-vapor, and groundwater samples will be collected at various locations around TA-I, TA-II, and TA-IV. One of the GIP sampling locations will be near ER Site 46.

SNL/NM Analytical Data Summary for ER Site 46

Introduction

Since the submission of the June 1995 *Proposal for NFA - Site 46*, three significant approaches have been employed by the SNL/NM ER Project for evaluating the potential impact of contaminants upon human health. First, a site-wide (the KAFB and SNL/NM area) statistical study has been recently completed for determining the background concentrations of metals and radionuclides in soil and water (IT, 1996). These new background values are listed in Attachment D

and have been through a more rigorous statistical analysis and therefore replace the values that were used in the June 1995 NFA proposals. Second, the Tijeras Arroyo background values in Attachment D have been recalculated using U.S. EPA guidance (EPA, 1989; EPA, 1992a; EPA, 1992b). Third, a standardized risk-assessment approach has been implemented by SNL/NM with U.S. EPA Region VI acceptance. These three approaches and the screening of regulatory standards have been incorporated in the ER Site 46 risk assessment that is presented in Attachment D. Elevated metals and other non-radioactive constituents were evaluated using U.S. EPA guidance (EPA, 1989; EPA, 1991). Radionuclides that exceeded background were evaluated using DOE guidance and the RESRAD computer code for residual radioactive material (ORNL, 1994).

Background Concentrations

As part of the site-wide study, background concentrations were calculated for both the surface and subsurface soils of the North Super Group, which is defined as soils present in TA-I, TA-II, TA-IV, the northern rim of Tijeras Arroyo, and the northeastern portion of KAFB (IT, 1996). The depth of six inches was used for defining surface soil from subsurface soil. Two background concentrations are therefore listed for most of the metals and radionuclides in Tables 5 and 6. The background concentrations consist of either Upper Tolerance Limits (UTLs) or 95th Percentiles. An UTL was calculated for those COCs with normal or lognormal distributions; the 95th percentile was calculated for those COCs with nonparametric distributions.

Quality Assurance / Quality Control

The analytical results that were previously presented in the June 1995 *Proposal for NFA - Site 46* as Table 1 and Appendix B have been reorganized in this NOD response to incorporate the three new approaches. To prevent confusion, the reorganized analytical data are presented herein as Tables 4, 5, and 6. The tables present the maximum concentrations for each detected analyte as reported by the two offsite, U.S. EPA Contract Laboratory Program (CLP) - certified, analytical laboratories (the Quanterra Environmental Services - St. Louis Laboratory and the Environmental Control Technology Corporation [ENCOTEC] - Ann Arbor laboratory). The actual laboratory reports are available for review at the ER Project Records Center in Building 6584.

Attachment A lists the analytical methods and detection limits that were used in the Tijeras Arroyo OU sampling program. Quality Assurance (QA) samples, including field duplicates, trip blanks and rinsate samples also were collected as part of the Tijeras Arroyo OU site-sampling program. The QA results

Table 4. All reported concentrations of VOCs and SVOCs in ER Site 46 soil samples.

Sample Identifier[1]	Analyte	Type	Detection Limit (mg/kg, ppm)	Reported Concentration (mg/kg, ppm)	Qualifier
46-01-B	2-butanone	VOC[2]	0.010	0.003	B[3]J[4]
46-02-B	2-butanone	VOC	0.010	0.005	BJ
46-03-B	2-butanone	VOC	0.010	0.005	BJ
46-04-B	2-butanone	VOC	0.010	0.004	BJ
46-01-B	Di-n-butyl-phthalate	SVOC[5]	0.330	0.066	J

[1]Sample identifier: First set of numbers denotes ER Site, second set of numbers denotes sample location, letter designator denotes sample depth (A denotes sample depth of 0 - 6 inches; B denotes sample depth of 6 - 30 or 6 - 36 inches).
[2]VOC = Volatile organic compound (EPA Method 8240).
[3]B = Qualifier denotes that the analyte was measured in the associated blank sample.
[4]J = Qualifier denotes that the analyte was reported at below the laboratory detection limit.
[5]SVOC = Semi-volatile organic compound (EPA Method 8270).

Table 5. Comparison of maximum concentrations in ER Site 46 soil versus Proposed Subpart S action levels and background UTLs and 95th Percentiles for North Super Group surface and subsurface soils.

Analyte	Maximum concentration in ER Site 46 soil (mg/kg, ppm)	Proposed Subpart S and lead action levels (mg/kg, ppm) (EPA, 1990;EPA, 1994)	Surface soil UTL (mg/kg, ppm) (IT, 1996)	Surface soil 95th Percentile (mg/kg, ppm) (IT, 1996)	Subsurface soil UTL (mg/kg, ppm) (IT, 1996)	Subsurface soil 95th Percentile (mg/kg, ppm) (IT, 1996)
Metals						
Aluminum (Al)	11,000.0	n.s.[1]	n.c.[2]	n.c.	n.c.	n.c.
Antimony (Sb)	17.0	30.0	n.a.[3]	3.9	n.a.	3.9
Arsenic (As)	7.5	80.0	n.a.	5.6	n.a.	4.4
Barium (Ba)	220.0	4,000.0	n.a.	200.0	n.a.	336.0
Beryllium (Be)	0.5	0.2	n.a.	0.8	n.a.	0.8
Cadmium (Cd)	3.5	40.0	n.a.	1.6	n.a.	0.9
Calcium (Ca)	74,000.0	n.s.	n.c.	n.c.	n.c.	n.c.
Chromium (Cr)-total	15.0	n.s.	n.a.	17.3	n.a.	12.8
Chromium-VI (Cr+6)	<0.1	400.0	n.c.	n.c.	n.c.	n.c.
Cobalt (Co)	5.2	n.s.	n.a.	7.1	n.a.	8.8
Copper (Cu)	13.0	n.s.	n.a.	25.5	n.a.	88.2
Iron (Fe)	17,000.0	n.s.	n.c.	n.c.	n.c.	n.c.
Lead (Pb)	27.0	400.0.	68.0	n.a.	n.a.	11.2
Magnesium (Mg)	3,900.0	n.s.	n.c.	n.c.	n.c.	n.c.
Manganese (Mn)	210.0	n.s.	n.c.	n.c.	n.c.	n.c.
Mercury (Hg)	<0.04	20.0	n.a.	0.31	n.a.	<0.1
Nickel (Ni)	13.0	2,000.0	n.a.	25.4	n.a.	25.4
Potassium (K)	2,500.0	n.s.	n.c.	n.c.	n.c.	n.c.
Selenium (Se)	<0.25	n.s.	n.a.	<1.0	n.a.	<1.0
Silver (Ag)	0.6	200.0	n.a.	2.0	n.a.	<1.0
Sodium (Na)	320.0	n.s.	n.c.	n.c.	n.c.	n.c.
Thallium (Tl)	<0.5	n.s.	n.a.	<1.1	n.a.	<1.1
Vanadium (V)	34.0	n.s.	47.2	n.a.	n.a.	42.8
Zinc (Zn)	70.0	n.s.	n.a.	82.4	n.a.	82.4
Miscellaneous						
Cyanide	0.16	2,000.0	n.c.	n.c.	n.c.	n.c.
Nitrate + Nitrite	1,400.0	8,000.0[4]	n.c.	n.c.	n.c.	n.c.

[1] *n.s. = not specified.*
[2] *n.c. = not calculated.* The analyte is not a COC for SNL or KAFB (IT, 1996).
[3] *n.a. = not applicable.* The UTL is provided for those COCs with normal or lognormal distributions; the 95th percentile is provided for those COCs with *nonparametric distributions.*
[4] The RCRA Subpart S value for nitrite (8,000 ppm) is lower than the nitrate value of 100,000 ppm (EPA, 1990).

Table 6. Comparison of all reported maximum radionuclide activities in ER Site 46 soil versus background UTLs and 95th Percentiles for SNL North Area Group surface and subsurface soils.

Radionuclide	Maximum activity in ER Site 46 soil (pCi/g)	Surface soil UTL (pCi/g) (IT, 1996)	Surface soil 95th Percentile (pCi/g) (IT, 1996)	Subsurface soil UTL (pCi/g) (IT, 1996)	Subsurface soil 95th Percentile (pCi/g) (IT, 1996)
Plutonium-238	<0.005	n.c.[1]	n.c.	n.c.	n.c.
Plutonium-239/240	<0.004	n.c.	n.c.	n.c.	n.c.
Tritium	0.044	n.c.	n.c.	n.c.	n.c.
Uranium-234	0.79	1.6	n.a.[2]	1.6	n.a.
Uranium-235/236	0.034	n.a.	0.18	n.a.	0.18
Uranium-238	0.68	n.a.	1.3	n.a.	1.3

[1]n.c. = not calculated. The analyte is not a COC at SNL or KAFB (IT, 1996).
[2]n.a. = not applicable. The UTL is provided for those COCs with normal or lognormal distributions; the 95th percentile is provided for those COCs with nonparametric distributions.

demonstrated the effectiveness of the decontamination procedures (Appendix B - June 1995 *Proposal for NFA - Site 46*). As shown in Appendix B of the June 1995 *Proposal for NFA - Site 46* and Attachment B, Eleven QA-field duplicates were collected for the soil samples. Relative percent difference (RPD) values were calculated for the metals, nitrate/nitrite, and radionuclides. The lack of detectable VOCs, SVOCs, and HE compounds did not allow RPDs to be calculated for those compounds. Of the 111 detectable metal and nitrate/nitrite concentrations, 85% of the RPDs were below the EPA-recommended target of 35%. Fifteen percent of the remaining RPDs were above the 35% target and probably are a function of the soil heterogeneity rather than a systematic error in sampling or analytical procedures. Of the nine detectable radionuclide activities, six were above the EPA-recommended target of 35%. However, the use of RPDs to evaluate the radionuclides values does not appear to be realistic because the activities were less than one pCi/g. Such low activities are well below background and are reported with relatively large 2-sigma errors. For example, U-235/236 was reported at 0.023 pCi/g with a 2-sigma error of 0.018 pCi/g. With a 95% confidence interval, the U-235/236 activity is in the range of 0.005 to 0.041 pCi/g and could therefore actually be below the minimum detectable activity (MDA) of 0.009 pCi/g. Soil heterogeneity could also account for the range of RPD values for the radionuclides. To conclude, the RPD values indicate that both the metal, nitrate/nitrite, and radionuclide analyses are of sufficient quality for preparing this NOD response.

Table 4 is the most detailed table and contains the maximum concentrations as well as all reported concentrations, including 'J' and 'B' values, for VOCs and SVOCs. Table 5 compares the maximum concentrations of metals, cyanide, and nitrate/nitrite (NO2+NO3) in ER Site 46 soil versus the Proposed Subpart S action levels (EPA, 1990) and the newly available background values (IT, 1996). Table 6 compares the maximum radionuclide activities in ER Site 46 soil versus the background UTLs and 95th Percentiles.

No VOC or SVOC contamination was detected in the ER Site 46 soil samples. Two organic compounds were reported with qualification. The 2-butanone concentrations ranged from 0.003 to 0.005 mg/kg (ppm) and all had both 'J' and 'B' qualifiers as being below the laboratory reporting limit, and being detected in the associated blank sample, respectively. The reported di-n-butyl phthalate concentration of 0.066 mg/kg (ppm) was also a 'J' value. Both 2-butanone and phthalates are common laboratory contaminants (Bleyler, 1988).

Three radionuclides that were discussed in the June 1995 *Proposal for NFA - Site 46* were discounted from this NOD response. Lead-212 and lead-214 were discounted on the basis of their respective short half-lives of 10.64 hours and

27 minutes. Potassium-40 was discounted because it is a naturally occurring radionuclide (Turner, 1992) that is not produced by SNL/NM reactors or accelerators.

Sampling Locations

During the Tijeras Arroyo OU sampling program, five soil samples (46-01-A, 46-01-B, 46-02-A, 46-02-B, and T1226-SD-001) were collected at the northern end of the drainage ditch (Figures 2 and 3). Four soil samples (46-03-A, 46-03-B, 46-04-A, and 46-04-B) were collected approximately 750 ft to the southeast of the former outfall at the lower end of the drainage ditch on the northern rim of Tijeras Arroyo.

Risk Assessment Conclusion

Using conservative assumptions and employing a Reasonable Maximum Exposure (RME) approach from RAGS (EPA, 1989), the risk assessment calculations show that for the industrial land-use scenario the Hazard Index (0.03) is significantly less than the U.S. EPA standard of 1. The estimated cancer risk (5×10^{-6}) is in the low-end of the suggested acceptable risk range (10^{-4} to 10^{-6}). The calculations show that for the residential land-use scenario the Hazard Index (0.15) is also significantly less than the U.S. EPA standard of 1. The estimated cancer risk (2×10^{-5}) is in the middle of the suggested acceptable risk range (10^{-4} to 10^{-6}). The dose and corresponding cancer risk from the radioactive components are much less than EPA guidance values; the estimated doses are 6×10^{-6} and 2×10^{-7} mrem/yr for the industrial and residential land-use scenarios, respectively. These values are much less than the Total Effective Dose Equivalent (TEDE) goal of 15 mrem/yr (40 CFR Part 196, 1994). The corresponding estimated cancer risk values are 1×10^{-10} and 4×10^{-12} for the industrial and residential land-use scenarios, respectively. These values are also much less than risk values calculated due to naturally occurring radiation. In conclusion, ER Site 46 does not have significant potential from either non-radioactive or radioactive contaminants to affect human health under either an industrial or a residential land-use scenario (Attachment D).

Based on the results of the field investigations and risk assessments for both ER Sites 46 and 226, SNL/NM reiterates the request that ER Site 46 be approved for NFA status. However, as a separate initiative from the Tijeras Arroyo OU, additional sampling has been proposed in the *Sandia North Groundwater Investigation Plan* (GIP). The GIP discusses the proposed sampling program that will be used for characterizing the distribution of chlorinated solvents in groundwater near TA-II (SNL/NM, 1996b). Soil, soil-vapor, and groundwater

samples will be collected at various locations around TA-I, TA-II, TA-IV, and Tijeras Arroyo. One of the GIP sampling locations will be near ER Site 46.

ATTACHMENT A

ANALYTICAL METHODS FOR SOIL SAMPLES

Attachment A -
Analytical Methods for Soil Samples

Table A-1. Analytical Methods and Detection Limits for Cyanide, Nitrate/Nitrite, SVOCs, TKN, TPH, and VOCs in soil.

Analyte	Method	Detection Limit, mg/kg (ppm)	Analytical Lab
Cyanide	U.S. EPA Method 9010	0.10	ENCOTEC
Nitrate/Nitrite	U.S. EPA Method 353.2	100.0	ENCOTEC
SVOCs	U.S. EPA Method 8270	0.30 - 2.6	ENCOTEC
TPH	U.S. EPA Method 418.1	40.0	ENCOTEC
VOCs	U.S. EPA Method 8240	0.005 - 0.010	ENCOTEC

ENCOTEC = Environmental Control Technology Corporation, Ann Arbor, Michigan
SVOCs = Semi-volatile organic compounds
TKN = Total Kjedahl Nitrogen
TPH = Total Petroleum Hydrocarbons
VOCs = Volatile Organic Compounds

Table A-2. Analytical Methods and Detection Limits for Metals in soil.

Metal	U.S. EPA Method	Detection Limit (mg/kg, ppm)	Analytical Lab
Aluminum(Al)	6010	10	ENCOTEC
Antimony (Sb)	6010	3.0	ENCOTEC
Arsenic (As)	6010	0.50	ENCOTEC
Barium (Ba)	6010	10	ENCOTEC
Beryllium (Be)	6010	0.25	ENCOTEC
Cadmium (Cd)	6010	0.27	ENCOTEC
Calcium (Ca)	6010	250	ENCOTEC
Chromium (Cr)-total	6010	1.0	ENCOTEC
Chromium-VI (Cr+6)	7196	0.1	ENCOTEC
Cobalt (Co)	6010	2.5	ENCOTEC
Copper (Cu)	6010	1.2	ENCOTEC
Iron (Fe)	6010	5.0	ENCOTEC
Lead (Pb)	6010	2.0	ENCOTEC
Magnesium (Mg)	6010	256	ENCOTEC
Manganese (Mn)	6010	0.75	ENCOTEC
Mercury (Hg)	7471	0.04	ENCOTEC
Nickel (Ni)	6010	2.0	ENCOTEC
Potassium (K)	6010	250	ENCOTEC
Selenium (Se)	7741	0.25	ENCOTEC
Silver (Ag)	6010	0.5	ENCOTEC
Sodium (Na)	6010	250	ENCOTEC
Thallium (Tl)	6020	0.5	ENCOTEC
Vanadium (V)	6010	2.5	ENCOTEC
Zinc (Zn)	6010	1.0	ENCOTEC

Table A-3. Analytical Methods and Detection Limits for High Explosive Compounds in soil.

High Explosive Compound	U.S. EPA Method	Detection Limit (mg/kg, ppm)	Analytical Lab
1,3-Dinitrobenzene	8330	1.25	ENCOTEC
2,4-Dinitrotoluene	8330	1.25	ENCOTEC
2,6-Dinitrotoluene	8330	1.25	ENCOTEC
HMX	8330	1.25	ENCOTEC
Nitrobenzene	8330	1.25	ENCOTEC
o-nitrotoluene	8330	1.25	ENCOTEC
m-nitrotoluene	8330	1.25	ENCOTEC
p-nitrotoluene	8330	1.25	ENCOTEC
RDX	8330	1.25	ENCOTEC
Tetryl	8330	1.25	ENCOTEC
1,3,5-Trinitrobenzene	8330	1.25	ENCOTEC
2,4,6-Trinitrotoluene	8330	1.25	ENCOTEC

Table A-4. Analytical Methods for Radionuclides in soil.

Radionuclide	Method	Analytical Lab
Americium-241	HASL 300 - Gamma Spectroscopy	Quanterra
Cadmium-109	HASL 300 - Gamma Spectroscopy	Quanterra
Cerium-139	HASL 300 - Gamma Spectroscopy	Quanterra
Cesium-137	HASL 300 - Gamma Spectroscopy	Quanterra
Cobalt-57	HASL 300 - Gamma Spectroscopy	Quanterra
Cobalt-60	HASL 300 - Gamma Spectroscopy	Quanterra
Iodine-129	HASL 300 - Gamma Spectroscopy	Quanterra
Lead-212/214	HASL 300 - Gamma Spectroscopy	Quanterra
Mercury-203	HASL 300 - Gamma Spectroscopy	Quanterra
Plutonium-238	NAS-NS-3058 /SL13028/SL13033	Quanterra
Plutonium-239/240	NAS-NS-3058 /SL13028/SL13033	Quanterra
Potassium-40	HASL 300 - Gamma Spectroscopy	Quanterra
Strontium-85	HASL 300 - Gamma Spectroscopy	Quanterra
Thorium-232	HASL 300 - Gamma Spectroscopy	Quanterra
Thorium-234	HASL 300 - Gamma Spectroscopy	Quanterra
Tin-113	HASL 300 - Gamma Spectroscopy	Quanterra
Tritium	EERF-H.01	Quanterra
Uranium-234	NAS-NS-3050	Quanterra
Uranium-235/236	NAS-NS-3050	Quanterra
Uranium-238	NAS-NS-3050	Quanterra
Yttrium-88	HASL 300 - Gamma Spectroscopy	Quanterra

Quanterra = Quanterra Environmental Services - St. Louis Laboratory

ATTACHMENT B

RPD VALUES FOR SOIL SAMPLES

Attachment B -
RPD Values for Soil Samples

Table B-1. RPD values for soil sample 227-03-B.

Analyte	Sample 227-03-B, concentration (mg/kg) or activity (pCi/g)	Sample 227-03-B-duplicate, concentration (mg/kg) or activity (pCi/g)	RPD (%)
Al	6400	5100	23
Sb	9.9	8.8	12
As	5.6	0.92	144
Ba	140	140	0
Be	0.25	<0.25	N/A
Cd	2.9	2.1	32
Cr	7.4	5.9	23
Co	4.6	4.5	2
Cu	11	10	10
Fe	16000	13000	21
Pb	8.9	7.5	17
Mn	230	200	14
Hg	<0.04	<0.04	N/A
Ni	5.9	5.4	9
V	33	25	28
Zn	50	48	4
Nitrate/Nitrite	1.4	<100	N/A
Pu-239/240	n.d.a.	n.d.a.	N/A
U-238	n.d.a.	n.d.a.	N/A
U-235/236	n.d.a.	n.d.a.	N/A
U-234	n.d.a.	n.d.a.	N/A
Tritium	n.d.a.	n.d.a.	N/A

RPD = Relative percent difference = $[\{D_1-D_2\}/\{(D_1+D_2)/2\}] \times 100$
n.d.a. = no duplicate analysis
N/A = not applicable

Table B-2. RPD values for soil sample 229-04-A.

Analyte	Sample 229-04-A, concentration (mg/kg) or activity (pCi/g)	Sample 229-04-A-duplicate, concentration (mg/kg) or activity (pCi/g)	RPD (%)
Al	8100	7700	5
Sb	13	12	8
As	5.7	1.5	117
Ba	150	140	7
Be	0.32	0.30	6
Cd	2.3	2.2	4
Cr	8.0	8.0	0
Co	4.2	4.2	0
Cu	7.9	7.7	3
Fe	13000	12000	8
Pb	12	11	9
Mn	210	190	10
Hg	<0.04	<0.04	N/A
Ni	6.3	6.2	2
V	24	24	0
Zn	55	52	6
Nitrate/Nitrite	n.d.a.	n.d.a.	N/A
Pu-239/240	n.d.a.	n.d.a.	N/A
U-238	n.d.a.	n.d.a.	N/A
U-235/236	n.d.a.	n.d.a.	N/A
U-234	n.d.a.	n.d.a.	N/A
Tritium	n.d.a.	n.d.a.	N/A

Table B-3. RPD values for soil sample 230-04-B.

Analyte	Sample 230-04-B, concentration (mg/kg) or activity (pCi/g)	Sample 230-04-B-duplicate, concentration (mg/kg) or activity (pCi/g)	RPD (%)
Al	2400	1500	46
Sb	4.9	3.3	39
As	1.7	1.6	6
Ba	140	130	7
Be	<0.25	<0.25	N/A
Cd	0.68	0.61	11
Cr	3.1	2.3	30
Co	2.5	ND	N/A
Cu	18	15	18
Fe	4500	3500	25
Pb	4.2	4.1	2
Mn	120	110	9
Hg	<0.04	<0.04	N/A
Ni	3.4	3.0	13
V	9.7	9.1	6
Zn	82	71	14
Nitrate/Nitrite	n.d.a.	n.d.a.	N/A
Pu-239/240	n.d.a.	n.d.a.	N/A
U-238	n.d.a.	n.d.a.	N/A
U-235/236	n.d.a.	n.d.a.	N/A
U-234	n.d.a.	n.d.a.	N/A
Tritium	n.d.a.	n.d.a.	N/A

Table B-4. RPD values for soil sample 235-01-A.

Analyte	Sample 235-01-A, concentration (mg/kg) or activity (pCi/g)	Sample 235-01-A-duplicate, concentration (mg/kg) or activity (pCi/g)	RPD (%)
Al	3600	3000	18
Sb	6.2	5.3	16
As	5.1	1.3	119
Ba	160	150	6
Be	<0.25	<0.25	N/A
Cd	2.7	1.6	51
Cr	6.0	4.2	35
Co	8.4	5.7	38
Cu	6.6	6.5	2
Fe	20000	12000	50
Pb	9.4	7.6	21
Mn	210	180	15
Hg	<0.04	<0.04	N/A
Ni	4.5	4.4	2
V	36	22	48
Zn	66	66	0
Nitrate/Nitrite	n.d.a.	n.d.a.	N/A
Pu-239/240	n.d.a.	n.d.a.	N/A
U-238	n.d.a.	n.d.a.	N/A
U-235/236	n.d.a.	n.d.a.	N/A
U-234	n.d.a.	n.d.a.	N/A
Tritium	n.d.a.	n.d.a.	N/A

Table B-5. RPD values for soil sample 50-01-B.

Analyte	Sample 50-01-B, concentration (mg/kg) or activity (pCi/g)	Sample 50-01-B-duplicate, concentration (mg/kg) or activity (pCi/g	RPD (%)
Al	3900	3100	23
Sb	7.5	6.5	14
As	2.1	2.0	5
Ba	110	110	0
Be	0.26	0.25	4
Cd	1.3	1.3	0
Cr	4.3	4.1	5
Co	4	3.9	3
Cu	6.2	5.7	8
Fe	8800	7600	15
Pb	6.6	5.9	11
Mn	150	130	14
Hg	<0.04	<0.04	N/A
Ni	4.5	4.2	7
V	18	17	6
Zn	21	18	15
Nitrate/Nitrite	n.d.a.	n.d.a.	N/A
Pu-239/240	n.d.a.	n.d.a.	N/A
U-238	n.d.a.	n.d.a.	N/A
U-235/236	n.d.a.	n.d.a.	N/A
U-234	n.d.a.	n.d.a.	N/A
Tritium	n.d.a.	n.d.a.	N/A

Table B-6. RPD values for soil sample 50-02-A.

Analyte	Sample 50-02-A, concentration (mg/kg) or activity (pCi/g)	Sample 50-02-A-duplicate, concentration (mg/kg) or activity (pCi/g)	RPD (%)
Al	7000	5800	19
Sb	14	12	15
As	6.4	4.2	42
Ba	280	220	24
Be	0.55	0.38	37
Cd	2.2	1.6	32
Cr	8.3	5.2	46
Co	6.1	4.3	35
Cu	17	12	34
Fe	9000	6700	29
Pb	35	25	33
Mn	290	210	32
Hg	<0.04	0.04	N/A
Ni	9.4	7.1	28
V	18	11	48
Zn	69	61	12
Nitrate/Nitrite	n.d.a.	n.d.a.	N/A
Pu-239/240	n.d.a.	n.d.a.	N/A
U-238	n.d.a.	n.d.a.	N/A
U-235/236	n.d.a.	n.d.a.	N/A
U-234	n.d.a.	n.d.a.	N/A
Tritium	n.d.a.	n.d.a.	N/A

Table B-7. RPD for soil sample BKG-05-A.

Analyte	Sample BKG-05-A, concentration (mg/kg) or activity (pCi/g)	Sample BKG-05-A-duplicate, concentration (mg/kg) or activity (pCi/g)	RPD (%)
Al	6400	5900	8
Sb	13	12	8
As	7.6	5.7	29
Ba	210	190	10
Be	0.53	0.50	6
Cd	1.8	1.7	6
Cr	6.1	6.0	2
Co	6.6	6.3	5
Cu	14	14	0
Fe	10000	10000	0
Pb	16	16	0
Mn	330	320	3
Hg	<0.04	<0.04	N/A
Ni	8.9	8.7	2
V	24	22	9
Zn	37	36	3
Nitrate/Nitrite	n.d.a.	n.d.a.	N/A
Pu-239/240	n.d.a.	n.d.a.	N/A
U-238	n.d.a.	n.d.a.	N/A
U-235/236	n.d.a.	n.d.a.	N/A
U-234	n.d.a.	n.d.a.	N/A
Tritium	n.d.a.	n.d.a.	N/A

Table B-8. RPD values for soil sample 227-02-A.

Analyte	Sample 227-02-A, concentration (mg/kg) or activity (pCi/g)	Sample 227-02-A-duplicate, concentration (mg/kg) or activity (pCi/g)	RPD (%)
Al	6500	5800	11
Sb	11	9.3	17
As	5.9	1.4	123
Ba	180	150	18
Be	<0.25	<0.25	N/A
Cd	2.5	2.1	17
Cr	6.6	6.4	3
Co	4.1	4.1	0
Cu	13	7.8	50
Fe	14000	13000	7
Pb	9.1	7.5	19
Mn	170	160	6
Hg	<0.04	<0.04	N/A
Ni	5.9	5.4	9
V	28	27	4
Zn	51	51	0
Nitrate/Nitrite	9.3	2.7	N/A
Pu-239/240	n.d.a.	n.d.a.	N/A
U-238	n.d.a.	n.d.a.	N/A
U-235/236	n.d.a.	n.d.a.	N/A
U-234	n.d.a.	n.d.a.	N/A
Tritium	n.d.a.	n.d.a.	N/A

Table B-9. RPD values for soil sample 229-03-B.

Analyte	Sample 229-03-B, concentration (mg/kg) or activity (pCi/g)	Sample 229-03-B-duplicate, concentration (mg/kg) or activity (pCi/g)	RPD (%)
Al	n.d.a.	n.d.a.	N/A
Sb	n.d.a.	n.d.a.	N/A
As	n.d.a.	n.d.a.	N/A
Ba	n.d.a.	n.d.a.	N/A
Be	n.d.a.	n.d.a.	N/A
Cd	n.d.a.	n.d.a.	N/A
Cr	n.d.a.	n.d.a.	N/A
Co	n.d.a.	n.d.a.	N/A
Cu	n.d.a.	n.d.a.	N/A
Fe	n.d.a.	n.d.a.	N/A
Pb	n.d.a.	n.d.a.	N/A
Mn	n.d.a.	n.d.a.	N/A
Hg	n.d.a.	n.d.a.	N/A
Ni	n.d.a.	n.d.a.	N/A
V	n.d.a.	n.d.a.	N/A
Zn	n.d.a.	n.d.a.	N/A
Nitrate/Nitrite	n.d.a.	n.d.a.	N/A
Pu-239/240	n.d.a.	n.d.a.	N/A
U-238	0.99	0.45	75
U-235/236	0.060	0.058	3
U-234	1.00	0.45	76
Tritium	n.d.a.	n.d.a.	N/A

Table B-10. RPD values for soil sample 229-01-A.

Analyte	Sample 229-01-A, concentration (mg/kg) or activity (pCi/g)	Sample 229-01-A-duplicate, concentration (mg/kg) or activity (pCi/g)	RPD (%)
Al	n.d.a.	n.d.a.	N/A
Sb	n.d.a.	n.d.a.	N/A
As	n.d.a.	n.d.a.	N/A
Ba	n.d.a.	n.d.a.	N/A
Be	n.d.a.	n.d.a.	N/A
Cd	n.d.a.	n.d.a.	N/A
Cr	n.d.a.	n.d.a.	N/A
Co	n.d.a.	n.d.a.	N/A
Cu	n.d.a.	n.d.a.	N/A
Fe	n.d.a.	n.d.a.	N/A
Pb	n.d.a.	n.d.a.	N/A
Mn	n.d.a.	n.d.a.	N/A
Hg	n.d.a.	n.d.a.	N/A
Ni	n.d.a.	n.d.a.	N/A
V	n.d.a.	n.d.a.	N/A
Zn	n.d.a.	n.d.a.	N/A
Nitrate/Nitrite	n.d.a.	n.d.a.	N/A
Pu-239/240	n.d.a.	n.d.a.	N/A
U-238	0.73	0.45	47
U-235/236	0.17	0.034	133
U-234	0.67	0.6	11
Tritium	n.d.a.	n.d.a.	N/A

Table B-11. RPD values for soil sample 227-03-A.

Analyte	Sample 227-03-A, concentration (mg/kg) or activity (pCi/g)	Sample 227-03-A-duplicate, concentration (mg/kg) or activity (pCi/g)	RPD (%)
Al	n.d.a.	n.d.a.	N/A
Sb	n.d.a.	n.d.a.	N/A
As	n.d.a.	n.d.a.	N/A
Ba	n.d.a.	n.d.a.	N/A
Be	n.d.a.	n.d.a.	N/A
Cd	n.d.a.	n.d.a.	N/A
Cr	n.d.a.	n.d.a.	N/A
Co	n.d.a.	n.d.a.	N/A
Cu	n.d.a.	n.d.a.	N/A
Fe	n.d.a.	n.d.a.	N/A
Pb	n.d.a.	n.d.a.	N/A
Mn	n.d.a.	n.d.a.	N/A
Hg	n.d.a.	n.d.a.	N/A
Ni	n.d.a.	n.d.a.	N/A
V	n.d.a.	n.d.a.	N/A
Zn	n.d.a.	n.d.a.	N/A
Nitrate/Nitrite	n.d.a.	n.d.a.	N/A
Pu-239/240	n.d.a.	n.d.a.	N/A
U-238	0.67	0.4	50
U-235/236	0.15	0.023	147
U-234	0.67	0.61	9
Tritium	<0.012	<0.014	N/A

ATTACHMENT C

RELEVANT ENVIRONMENTAL ASPECTS OF TA-IV

Attachment C -
Relevant Environmental Aspects of TA-IV

Since submittal of the Tijeras Arroyo Operable Unit NFA Proposals in June 1995, SNL has collected additional historical, regulatory compliance, and process information for Technical Area IV (TA-IV). In April 1996, the *Environmental Assessment for Operation, Upgrades, and Modifications in SNL/NM Technical Area IV* was submitted to various agencies (SNL/NM, 1996). SNL Organization 9300, the Applied Physics, Engineering, and Testing Center, operates TA-IV. With research operation beginning in 1980, TA-IV is the newest SNL technical area and has always operated using modern environmental, safety, and health procedures and considerations. Approximately 750 people work at the 83 acre facility. The principal mission for TA-IV is the research, development, and testing of pulsed power technology. Other activities include computer science, flight dynamics, satellite processing, and robotics. Major facilities include the SATURN x-ray facility, the High Energy Radiation Megavolt Electron Source-III (HERMES-III) gamma-ray facility, and the Particle Beam Fusion Accelerator-II (PBFA-II). Other smaller facilities include the Rocket Systems and Flight Dynamic Laboratory, the Payload and Satellite Processing Facility, the parallel Computing Science Laboratory, the Robotics Laboratory, and seven small accelerators.

Biological resources were evaluated before the construction of various TA-IV buildings was begun. An *Environmental Assessment for Operation, Upgrades, and Modifications in SNL/NM Technical Area IV* be was submitted to various agencies in 1996 (SNL/NM, 1996). This evaluation of biological resources at TA-IV is relevant for ten of the ER Sites (sites 46, 50, 77, 227, 229, 230, 231, 233, 234, and 235). These ten sites are located along the northern rim of Tijeras Arroyo in the vicinity of TA-I, TA-II, TA-IV, Pennsylvania Avenue, a Skeet Range, KAFB Landfill 8, and the Albuquerque International Airport. No undisturbed natural habitat remains in the vicinity of TA-IV. Vegetation is limited to scattered ruderal plants and a row of ornamental ash trees. Sufficient food, water, and cover are not available to support wildlife. No federally-listed endangered or threatened species (plants or animals) or state-listed endangered wildlife species (Group 1 or Group 2) are known to occur within the vicinity of TA-IV, based on two biological surveys performed by IT Corporation in 1995 for the SNL/NM Environmental Restoration Project (IT, 1995). No natural lakes or wetlands are present and all drainage flows are intermittent, occurring during periods of precipitation. The Environmental Assessment report concluded that additional building construction would have no impact on biological resources.

Air monitoring is routinely conducted at TA-IV when the various accelerators are operating. The HERMES-III, PBFA-II, and SABRE accelerators generate short-lived nitrogen-13 and oxygen-15 radioactive air emissions but are in amounts million of times smaller than Clear Air Act standards (SNL/NM, 1995c). The half-lives for nitrogen-13 and oxygen-15 are 10 minutes and 2 minutes, respectively. The SATURN accelerator has historically released tritium, but the dose was at such a low level that the source was exempted from the National Emission Standards for Hazardous Air Pollutants (NESHAP) permit requirement.

No ER sites are located within TA-IV. Likewise, no septic tanks have been used at TA-IV. However, 21 aboveground and underground storage tanks (USTs) have been used, primarily for storing dielectric oil. Only above storage tanks (ASTs) are still in use at TA-IV. These 20 tanks store dielectric oil, acid, caustic, and deionized water. No USTs are currently registered with the NMED. A fuel-oil UST (970-1) was removed in 1994; no soil contamination was present.

The Storm Water Program in the SNL/NM Compliance and Generator Interface Department is responsible for measuring and reporting storm-water quality associated with storm-water outfalls located across SNL/NM. The storm-water results are reported annually in the Site Environmental Report (SNL/NM, 1995c). In accordance with National Pollutant Discharge Elimination System (NPDES) requirements, SNL/NM submitted an *Application For Permit to Discharge Stormwater - Discharges Associated with Industrial Activity* to U.S. EPA Region VI in 1992 (SNL/NM, 1992). Due to workload constraints, the U.S. EPA has not acted on the permit. In 1996, SNL/NM will submit a multi-sector permit to the U.S. EPA for their approval with State of New Mexico review and concurrence.

The Storm Drain System Outfall known as ER Site 235 is located about 500 ft southwest of TA-IV on the northern rim of Tijeras Arroyo near the Pennsylvania Avenue bridge. The site consists of a flood-control channel that extends for about 1,500 ft below a concrete baffle chute (energy dissipator). A storm-water monitoring station is located at the upper end of the baffle chute and is designated as Outfall 5 in the NPDES application (SNL, 1992). Sporadic storm water from the northeastern part of Kirtland Air Force Base (KAFB), including SNL Technical Areas I and IV, flows through the baffle chute and the channel before reaching Tijeras Arroyo. The outfall drains approximately 475 acres of which 65% is an impervious surface (SNL, 1996). Figures in the NOD response for ER Site 235 show the watershed. The SNL/NM Storm Water Program collected water samples from Outfall 5 on July 23, 1992, August 6, 1992, and May 25, 1994. Composite and grab samples were analyzed for total metals, general inorganics, and various other parameters. Since the NPDES application has not been reviewed by the U.S. EPA, the water samples have been compared to the most stringent standards available (Federal drinking water standards). Except for manganese and coliform, the quality of the storm water was better than the Federal standards (Tables C-1 and C-2). Manganese was reported at 0.13 mg/L (ppm) which is slightly above the Secondary Maximum Contaminant Level (SMCL) of 0.05 mg/L (ppm). However, the metal analyses were total values, not the dissolved values which are typically compared to drinking water standards. The presence of coliform at 2,000 colonies per 100 mL of water most likely reflects transient wildlife. Water samples were not collected in 1993 or 1995 because of insufficient precipitation.

In the June 1995 NFA Proposal, the SNL/NM ER project considered the potential COCs in soil at ER Site 235 to be: chromates, antifoulants, chromium, sodium hydroxide, hydrochloric acid, diesel fuel, and mineral oil. Both radiation and unexploded ordnance (UXO) field surveys have been conducted at ER Site 235; no anomalies were detected.

No stained soil or stressed vegetation has been documented at the site. The SNL/NM ER project collected soil samples along the drainage ditch in the Fall of 1994; the results are discussed in the NOD Response.

Five other outfalls (ER Sites 230, 231, 232, 233, and 234) are located along the steep, Tijeras Arroyo northern rim at the eastern and southern edges of TA-IV. The purpose of the TA-IV outfalls is to reduce the amount of soil erosion caused by storm water. Discharge of storm water only occurs several days per year. During the period of April 7 to December 31, 1995, an automatic flow meter recorded storm-water flows on ten different days. Engineering drawings for the TA-IV storm-water and sanitary-sewer systems are presented in the NOD responses for ER Sites 230, 231, 233, and 234. No process or waste waters flow into the outfalls. Such fluids are directed to the sanitary sewer system or two evaporative lagoons.

The five TA-IV outfalls were added to the ER site list in 1993. However, only one of the sites has been involved in the spill or release of a Reportable Quantity (SNL, 1995b). The sole incident occurred in 1994 when mineral oil was spilled at ER Site 232. The contaminated soil was subsequently removed for off-site disposal. A NFA proposal for ER Site 232 will be submitted to NMED in late 1996.

In the June 1995 NFA Proposals, the SNL/NM ER project considered the potential COCs in soil at ER Sites 230, 231, 233, and 234 to be: chromates, antifoulants, chromium, sodium hydroxide, hydrochloric acid, diesel fuel, petroleum products, and mineral oil. Both radiation and unexploded ordnance (UXO) field surveys have been conducted at each site; no anomalies were detected. No stained soil or stressed vegetation has been documented at any of the sites. The SNL/NM ER project collected soil samples at each site in the Fall of 1994; the results are discussed in the respective NOD Responses.

Outfall 6 is a catch basin that is located about 50 ft upslope of ER Site 233. According to NPDES guidance, only one of the TA-IV outfalls requires monitoring because all the TA-IV outfalls receive storm water from similar sources (Fink, 1996). Due to infrequent precipitation and the lack of an automatic sampler, only two water samples (July 31 and September 15, 1992) have been collected at Outfall 6. Except for manganese and coliform, the quality of storm water was better than the Federal standards for drinking water (Table C-3). Manganese was reported at 0.24 mg/L (ppm) which is slightly above the Secondary Maximum Contaminant Level (SMCL) of 0.05 mg/L (ppm). However, the metal analyses were total values, not the dissolved values which are typically compared to drinking water standards. The presence of coliform at 4,000 colonies per 100 mL of water most likely reflects transient wildlife.

Two evaporative lagoons (impoundments) are located at TA-IV and both serve similar functions. The primary purpose of the two lagoons is to store surface-water runoff from precipitation that collects in the sumps of the outdoor transformer-oil tank farm spill-containment areas (SNL/NM, 1995b). Both lagoons are lined with synthetic geotextile membranes. Surface-water runoff is pumped to the lagoons by manually operated sump

pumps. If visible oil is present in the sumps, a manually operated skimmer is used to transfer the skimmed oil to an oil storage tank. Lagoon #1 (ER Site 77) is located to the south of TA-IV and also receives non-routine water and transformer oil spills from floor trenches in Buildings 981 and 983. The capacity of Lagoon #1 is 137,000 gallons. Lagoon #2 is located in the eastern section of TA-IV and also receives non-routine water and transformer oil spills from floor trenches in Building 970. The capacity of Lagoon #2 is 127,000 gallons.

Operation of the two lagoons is the responsibility of SNL/NM Organization 9300 with oversight by the Water Quality Program in SNL/NM Organization 7500. The lagoons are regulated by NMED under 'Surface Water Discharge Plan 530' (DP-530). The Water Quality Program conducts semiannual inspections that include the measurement of the water levels and the collection of water samples. To date, water has not overflowed onto the ground surface. The water is analyzed for major ions, total dissolved solids (TDS), volatile organics, and extractable organics. Water quality results have not necessitated the pumping of the water for off-site disposal. NMED inspected the surface impoundments twice during 1995; no deficiencies were noted. The SNL/NM Water Quality Program submits a lagoon-monitoring report to NMED on a semiannual basis. The report includes water level measurements and analytical data.

References

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Table C-1. Comparison of Federal drinking water standards to maximum concentrations present in storm-water samples collected at NPDES Outfall 5 (ER Site 235) on July 23 and August 6, 1992 (SNL/NM, 1992).

Analyte	Maximum concentration of flow-weighted composite samples, mg/L (ppm)	Lowest MCL, MCLG, or SMCL, mg/L (ppm)	EPA method
Arsenic, total	0.0059	0.050	206.2
Barium, total	0.22	2.0	200.7
Cadmium, total	<0.0050	0.005	213.2
Chromium, total	<0.010	0.1	218.2
Copper, total	0.034	1.0	200.7
Lead, total	0.014	0.015	239.2
Manganese, total	0.13	0.05	200.7
Mercury, total	<0.00020	0.002	245.1
Nickel, total	<0.040	0.1	200.7
Selenium, total	<0.0050	0.05	270.2
Silver, total	<0.010	0.1	200.7
Zinc, total	0.18	5.0	200.7
BOD	11.0	n.s.	405.1
COD	87.9	n.s.	410.0
Cyanide	<0.010	n.s.	335.2
Fluoride	0.21	2.0	340.2
Gross Alpha	0±20 pCi/L	0 pCi/L	900.0/7110B
Gross Beta	10±20 pCi/L	0 mrem	900.0/7110B
HPLC Explosives	<0.032	0.0032	8330
Nitrate + Nitrite	0.76	10.0	353.2
Oil and Grease	<1.0	n.s.	413
Orthophosphate	0.18	n.s.	614
PCBs	<0.005	0.005	8080
Phenolics	0.016	n.s.	8040
Phosphorous as P	0.24	n.s.	365.3
Residual Chlorine	<0.20	n.s.	330
SVOCs	<0.085	0.085	8270
TDS	146.0	250.0	160.1
TKN	1.4	n.s.	351
Total Coliform	2,000 cl/100mL	0 cl/100mL	9230
TSS	221.0	n.s.	160.2
Volatile Organics	<0.005	n.s.	8240

Table C-2. Comparison of Federal drinking water standards to concentrations of total metals and general inorganics in storm-water samples collected at NPDES Outfall 5 (ER Site 235) on May 25, 1994.

Analyte	Composite sample concentration, mg/L (ppm)	Grab sample concentration, mg/L (ppm)	Lowest MCL, MCLG, or SMCL, mg/L (ppm)	EPA method
Antinomy, total	<0.060	<0.060	0.006	200.7
Arsenic, total	0.0033	<0.010	0.050	206.2
Beryllium, total	<0.0020	<0.0020	0.004	200.7
Cadmium, total	0.00076	0.0010	0.005	213.2
Chromium, total	0.0031	0.0044	0.1	218.2
Copper, total	0.0078	0.014	1.0	200.7
Lead, total	0.014	0.026	0.015	239.2
Mercury, total	<0.00020	<0.00020	0.002	245.1
Nickel, total	<0.040	<0.040	0.1	200.7
Selenium, total	<0.0050	<0.0050	0.05	270.2
Silver, total	<0.010	<0.010	0.1	200.7
Zinc, total	0.066	0.17	5.0	200.7
Alkalinity, total	57.2	46.2	n.s.	310.1
Ammonia as N	0.14	0.18	n.s.	350.1
Chloride	1.9	2.5	250.0	300.0
Fluoride	0.20	0.17	2.0	340.2
Nitrate + Nitrite	0.33	0.33	10.0	353.2
Phosphorous as P	0.25	0.36	n.s.	365.3
Sulfate	4.9	4.2	250.0	300.0
TDS	202.0	106.0	500.0	160.1
TSS	255.0	310.0	n.s.	160.2

All water analyses performed by the Quanterra Environmental Services, Inc. laboratory.
BOD = Biochemical Oxygen Demand
cl/mL = colonies per 100 milliliter of water
COD = Chemical Oxygen Demand
Drinking Water Standards: MCL = Maximum Contaminant Level; MCLG = Maximum Contaminant Level Goal; SMCL = Secondary Maximum Contaminant Level, (EPA, 1996). The lead value is an action level.
HPLC = High Performance Liquid Chromatography
mg/L = milligrams per liter = parts per million (ppm)
mrem = millirem
n.s. = not specified (U.S. EPA, 1996)
pCi/L = picocuries per liter
PCBs = Polychlorinated Biphenyls
TDS = Total Dissolved Solids
TKN = Total Kjedahl Nitrogen
TSS = Total Suspended Solids
VOCs = Volatile Organic Compounds. The reported concentrations of VOCs (2-hexanone at 0.011 mg/L (ppm), 2-butanone at 0.046 mg/L (ppm), and acetone at 0.0723 and 0.110 mg/L (ppm) are considered suspect because all three VOCs are common laboratory contaminants (Bleyler, 1988).

Table C-3. Comparison of Federal drinking water standards to maximum concentrations present in storm-water samples collected at NPDES Outfall 6 (catch basin above ER Site 233) on July 31 and September 15, 1992 (SNL/NM, 1992).

Analyte	Maximum concentration of flow-weighted composite samples, mg/L (ppm)	Lowest MCL, MCLG, or SMCL, mg/L (ppm)	EPA method
Arsenic, total	<0.0050	0.050	206.2
Barium, total	0.099	2.0	200.7
Cadmium, total	<0.0050	0.005	213.2
Chromium, total	<0.010	0.1	218.2
Copper, total	0.025	1.0	200.7
Lead, total	0.0067	0.015	239.2
Manganese, total	0.24	0.05	200.7
Mercury, total	<0.00080	0.002	245.1
Nickel, total	<0.040	0.1	200.7
Selenium, total	<0.010	0.05	270.2
Silver, total	<0.010	0.1	200.7
Zinc, total	0.20	5.0	200.7
BOD	62.8	n.s.	405.1
COD	422.0	n.s.	410.0
Cyanide	<0.010	n.s.	335.2
Fluoride	0.17	2.0	340.2
Gross Alpha	1±6 pCi/L	0 pCi/L	900.0/7110B
Gross Beta	10±3 pCi/L	0 mrem	900.0/7110B
HPLC Explosives	<0.0032	0.0032	8330
Nitrate + Nitrite	2.7	10.0	353.2
Oil and Grease	3.2	n.s.	413
Orthophosphate	<0.050	n.s.	614
PCBs	<0.005	0.005	8080
Phenolics	0.048	n.s.	8040
Phosphorous as P	0.060	n.s.	365.3
Residual Chlorine	1.9	n.s.	330
SVOCs	<0.085	0.085	8270
TDS	440.0	250.0	160.1
TKN	5.8	n.s.	351
Total Coliform	4,000 cl/100mL	0 cl/100mL	9230
TSS	56.0	n.s.	160.2
Volatile Organics	<0.005	n.s.	8240

ATTACHMENT D

ER SITE 46 RISK ASSESSMENT ANALYSIS

ATTACHMENT D - ER SITE 46: RISK ASSESSMENT ANALYSIS

I. Site Description and History

The Old Acid Waste Line Outfall, ER Site 46, is located at the southwest corner of TA-IV. The site consists of a shallow, 750-ft long, drainage ditch that received waste water from several TA-I buildings. During about 1950 to the late 1960s, the ditch received up to 130,000 gallons per day of waste water that contained plating and etching solutions, photographic processing water, and cooling tower blow-down water. The outfall did not receive sewage waste. Potential constituents of concern (COCs) in soil at the outfall include acids, metals, chromic acid, ferric chloride, tritium, uranium, plutonium, and trichloromethane (chloroform). The list of COCs was conservatively based upon chemicals used at TA-I. No stained soil or stressed vegetation has been documented at the site. The waste water flowed from TA-I through a 8-inch diameter, 1.3-mile long, sewer line that has been separately investigated and sampled by the TA-I Operable Unit as ER Site 226.

II. Risk Assessment Analysis

Risk assessment of a site includes a number of steps which culminate in a quantitative evaluation of the potential adverse human health effects caused by constituents located at the site. The steps to be discussed in this section include:

Step 1. Site data are described which provide information on the potential COCs, as well as the relevant physical characteristics and properties of the site.
Step 2. Potential pathways by which a representative population might be exposed to the COCs are identified.
Step 3. The potential intake of these COCs by the representative population is calculated using a tiered approach. The tiered approach includes screening steps, followed by potential intake calculations and a discussion or evaluation of the uncertainty in those calculations.
Step 4. Data are described on the potential toxicity and cancer effects from exposure to the COCs and subsequent intake.
Step 5. Potential toxicity effects (specified as a Hazard Index), cancer risks and radiation doses are calculated.
Step 6. These values are compared with standards established by the USEPA and USDOE to determine if further evaluation, and potential site clean-up, is required.
Step 7. Discussion of uncertainties in the previous steps.

II.1 Step 1. Site Data

Site history and site field characterization activities are used to identify potential COCs. The identification of COCs and the sampling to determine the concentration values of those COCs across the site are described in section SNL/NM Analytical Data Summary of the ER Site 46 NOD response. In order to provide conservatism in this risk assessment, the calculation uses only the maximum concentration value of each COC determined for the entire site. Chemicals that are essential nutrients such as iron, magnesium, calcium, potassium, and sodium were not included in this risk assessment per USEPA 1989a. Both radioactive and nonradioactive COCs are evaluated. The nonradioactive chemicals are both inorganics and organics.

II.2 Step 2. Pathway Identification

This site has been designated with a future land-use scenario of industrial (Attachment M). 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 for both chemicals and radionuclides is included because of the potential to inhale dust. Direct gamma exposure is also included in the radioactive contamination risk assessment. A groundwater pathway was not considered because no soil contamination was present in the sampling interval of 0 to 3 ft and the depth to groundwater is approximately 300 ft. Because of the lack of perennial surface water or other significant mechanisms for dermal contact, the dermal exposure pathway is considered to not be significant. No intake routes through plant, meat, or milk ingestion are considered appropriate.

PATHWAY IDENTIFICATION

Chemical Constituents	Radionuclide Constituents
Soil Ingestion	Soil Ingestion
Inhalation (Dust)	Inhalation (Dust and volatiles)
	Direct Gamma

II.3 Steps 3-5. Calculation of Hazard Indices and Cancer Risks

Steps 3 through 5 are discussed in this section. These steps include the discussion of the tiered approach in eliminating potential COCs from further consideration in the risk assessment process and the calculation of intakes from all identified exposure pathways, the discussion of the toxicity information, and the calculation of the hazard indices and cancer risks.

The risks from the COCs at ER Site 46 were evaluated using a tiered approach. First, the maximum concentrations of COCs for chemical constituents, were

compared to Tijeras Arroyo background screening levels using 95th UTLs or percentile values. If a maximum concentration of a particular COC exceeded the Tijeras Arroyo specific background screening level or if the COC was a radioactive constituent, then the COC was compared to the SNL/NM Site-Wide background screening level (IT, 1996). The Site-Wide UTL chosen for comparison was the minimum value when comparing surface and subsurface UTL values. This procedure was implemented to ensure use of the most conservative value during the comparison process and due to uncertainties associated with some sample depths. The maximum concentration of each COC was used in order to provide a conservative estimate of the associated risk. Those COCs that were below the background screening level were not considered in further risk assessment analyses.

Second, the remaining maximum concentrations were compared with action levels calculated using methods and equations promulgated in the proposed RCRA Subpart S (40 CFR Part 264, 1990) and Risk Assessment Guidance for Superfund (RAGS) (USEPA, 1989a) documentation. Accordingly, all calculations were based on the assumption that receptor doses from both toxic and potentially carcinogenic compounds result most significantly from ingestion of contaminated soil. Because the samples were all taken from the surface or near-surface, this assumption is considered valid. If there are 10 or fewer COCs and each has a maximum concentration less than one-tenth of the action level, then the site would be judged to pose no significant health hazard to humans. If there are more than 10 COCs, the proposed Subpart S screening procedure was skipped.

Third, hazard indices and risk due to carcinogenic effects were calculated using Reasonable Maximum Exposure (RME) methods and equations promulgated in RAGS (USEPA, 1989a). The combined effects of all COCs in the soils that were above background concentration values were calculated. For toxic compounds, this was accomplished by summing the individual hazard quotients for each metal into a total Hazard Index. This Hazard Index is compared to the recommended standard of 1. For potentially carcinogenic compounds, the individual risks were summed. The total risk was compared to the recommended risk range of 10^{-4} to 10^{-6}. For the radioactive COCs, the cumulative dose was calculated and the corresponding excess cancer risk estimated.

II.3.1 Comparison to Background and Action Levels

Nonradioactive ER Site 46 COCs are listed in Table 1; radioactive COCs are listed in Table 2. Both tables show the 95th percentile or UTL background levels (IT, 1996). Background levels for chromium VI, cyanide, and nitrate/nitrite are not available. Background levels for plutonium and tritium are not applicable because these radionuclides do not occur naturally, or due to fallout, at levels greater than typical detection limits of common laboratory instrumentation.

Background concentrations have been recalculated for the Tijeras Arroyo background locations that were used in the June 1995 NFA proposals. The recalculated Tijeras Arroyo values were prepared using a more rigorous statistical approach according to USEPA guidance (USEPA, 1989b, 1992a, and 1992b). The Tijeras Arroyo background locations were not differentiated on the basis of depth because of the homogenous nature of the soil and the limited sampling depth of 0 to 36 inches. As part of the IT (1996) site-wide study, background concentrations were calculated for both the surface (0-6 inch depth) and subsurface (>6 inch depth) soils of the North Super Group, which is defined as soils present in TA-I, TA-II, TA-IV, the northern rim of Tijeras Arroyo, and the northeastern portion of KAFB. The Site-Wide background levels have not yet been approved by the USEPA or the NMED but are the result of a comprehensive study of joint Sandia and U.S. Air Force data from the Kirtland Air Force Base (KAFB). The report was submitted for regulatory review in early 1996. The values shown in Table 1 and Table 2 supersede the background values described in an interim background study report (IT, 1994). Several compounds have maximum measured values greater than background screening levels. Those compounds are retained for further analysis. Because organic compounds do not have calculated background values, this screening step was skipped, and all organics are carried into the risk assessment analyses.

Table 1. Nonradioactive Analytes at ER Site 46 and Comparison to the Background Screening Values.

Analyte	Maximum concentration (mg/kg)	Recalculated 95th % or UTL Level (mg/kg) for Tijeras Arroyo OU Background Locations	Is maximum COC concentration less than or equal to the applicable Tijeras Arroyo OU background screening level?	Site-Wide 95th % or UTL Level (mg/kg) for North Super Group Soils (IT, 1996)	Is maximum COC concentration less than background screening value?
Aluminum	11,000	11,874	Yes		
Antimony	17.0	18.6	Yes		
Arsenic	7.5	5.9	No	4.4	No
Barium	220.0	298	Yes		
Beryllium	0.5	0.58	Yes		
Cadmium	3.5	3.0	No	0.9	No
Chromium-total	15.0	17.6	Yes		
Chromium (VI)	<0.1	NC	N/A	NC	No
Cobalt	5.2	7.3	Yes		
Copper	13.0	14.7	Yes		
Cyanide	0.16	NC	N/A	NC	No
Lead	27.0	23.1	No	11.2	No
Manganese	210.0	330	Yes		
Mercury	<0.04	NC	N/A	<0.1	No
Nickel	13.0	14.8	Yes		
Nitrate/Nitrite	1,400.0	NC	N/A	NC	No
Selenium	<0.25	NC	N/A	<1.0	No
Silver	0.6	NC	N/A	<1.0	No
Thallium	<0.5	NC	N/A	<1.1	No
Vanadium	34.0	40.4	Yes		
Zinc	70.0	79.2	Yes		

NC - not calculated
N/A - not applicable

Table 2. Radioactive Analytes at ER Site 46 and Comparison to the Background Screening Values.

Analyte	Maximum concentration (pCi/g)	Site-Wide 95th % or UTL Level (pCi/g)	Is maximum COC concentration non-detect or less than background screening value?
Pu-238	ND	NC	Yes
Pu-239/240	ND	NC	Yes
Tritium	0.044	NC	No
U-234	0.79	1.6	Yes
U-235/236	0.034	0.18	Yes
U-238	0.68	1.3	Yes

ND - radionuclide not detected above minimum detectable activity
NC - not calculated

The maximum concentration value for lead is 27.0 mg/kg. The EPA guidance for the screening value for lead for an industrial land-use scenario is 2000 mg/kg (EPA, 1996a); for a residential land-use scenario, the EPA screening guidance value is 400 mg/kg (EPA, 1994a). The maximum concentration value for lead at this site is less than both of those screening values and therefore lead is eliminated from further consideration in this risk assessment.

As part of the tiered approach to risk assessment, only those COCs that have values above the background screening level values are included in the next tier of risk assessment analyses. Also included in the next tier of analyses are COCs that do not have background screening values. If less than ten COCs are above the background screening level, those COCs are screened using the proposed Subpart S action level procedure. If more than 10 COCs are above the background screening level, the proposed Subpart S screening procedure is skipped. Table 3 shows the COCs that were greater than the background screening value and organic COCs that do not have background screening values. The table shows the proposed Subpart S action level for the contaminants. The table compares the maximum concentration values to 1/10 of the proposed Subpart S action level. This methodology was guidance given to SNL/NM from the USEPA (USEPA, 1996b). This is the second screening process in the tiered risk assessment approach. Two compounds had concentrations greater than 1/10 of the proposed Subpart S action level. Thallium does not have a proposed Subpart S action level. Because of these compounds, the site fails the proposed Subpart S screening criteria and a Hazard Index value and cancer risk value must be calculated for the ten COCs.

Radioactive contaminants do not have pre-determined action levels analogous to Subpart S and therefore this step in the screening process is not performed for radionuclides.

Table 3. Comparison of ER Site 46 COC Concentrations to Proposed Subpart S Action Levels.

COC name	Maximum concentration (mg/kg)	Proposed Subpart S Action Level (mg/kg)	Is individual contaminant less than 0.1 Action Level?
Arsenic	7.5	0.5	**No**
Cadmium	3.5	80	Yes
Chromium VI	<0.1	400	Yes
Cyanide	0.16	2,000	Yes
Mercury	<0.04	20	Yes
Nitrate/Nitrite	1,400	8,000*	**No**
Selenium	<0.25	400	Yes
Silver	0.6	400	Yes
Thallium	<0.5	NC	**No**
Di-n-butyl phthalate	0.066J	8,000	Yes

* Nitrate/Nitrite considered to be nitrite (most conservative)
NC - not calculated

II.3.2 Identification of Toxicological Parameters

Tables 4 and 5 show the COCs that have been retained in the risk assessment and the values for the toxicological information available for those COCs.

II.3.3 Exposure Assessment and Risk Characterization

Section II.3.3.1 describes the exposure assessment for this risk assessment. Section II.3.3.2 provides the risk characterization including the Hazard Index value and the excess cancer risk for both industrial and residential land-uses.

II.3.3.1 Exposure Assessment

Attachment M shows the equations and parameter values used in the calculation of intake values and the subsequent Hazard Index and Excess Cancer Risk values for the individual exposure pathways. The appendix shows the parameters for both industrial and residential land-use scenarios. The equations are based on RAGS (USEPA, 1989a). The parameters are based on information

from RAGS (USEPA, 1989a) as well as other EPA guidance documents and reflect the RME approach advocated by RAGS.

Table 4. Toxicological Parameter Values for Nonradioactive COCs

COC name	RfD_o (mg/kg-d)	RfD_{inh} (mg/kg-d)	Confidence	SF_o (kg-d/mg)	SF_{inh} (kg-d/mg)	Cancer Class^
Arsenic	0.0003	--	M	1.5	15	A
Cadmium	0.0005	0.000057	H	--	6.3	B1
Chromium (VI)	0.005	--	L	--	42	A
Cyanide	0.02	--	M	--	--	D
Mercury	0.0003	0.000086	--	--	--	D
Nitrate/ Nitrite*	0.1	--	--	--	--	D
Selenium	0.005	--	--	--	--	D
Silver	0.005	--	--	--	--	D
Thallium	--	--	--	--	--	D
Di-n-butyl phthalate	0.1	--	L	--	--	D

*Values are for nitrite (most conservative)
RfD_o - oral chronic reference dose in mg/kg-day
RfD_{inh} - inhalation chronic reference dose in mg/kg-day
SF_o - oral slope factor in $(mg/kg\text{-}day)^{-1}$
SF_{inh} - inhalation slope factor in $(mg/kg\text{-}day)^{-1}$
^ EPA weight-of-evidence classification system for carcinogenicity
A - human carcinogen
B1 - probable human carcinogen. Limited human data are available
B2 - probable human carcinogen. Indicates sufficient evidence in animals and inadequate or no evidence in humans.
C - possible human carcinogen
D - not classifiable as to human carcinogencity
E - evidence of noncarcinogenicity for humans
L - low
M - medium
H - High
-- information not available

Table 5. Toxicological Parameter Values for Radioactive COCs

COC name	SF_e (m^2/pCi-yr)	SF_o (1/pCi)	SF_{inh} (1/pCi)	Cancer Class ^
Tritium	0	7.2E-14	9.6E-14	A

SF_e - external exposure slope factor (risk/yr per pCi/m^2)
SF_o - oral (ingestion) slope factor (risk/pCi)
SF_{inh} - inhalation slope factor (risk/pCi)
^ EPA weight-of-evidence classification system for carcinogenicity
A - human carcinogen
B1 - probable human carcinogen. Limited human data are available
B2 - probable human carcinogen. Indicates sufficient evidence in animals and inadequate or no evidence in humans.
C - possible human carcinogen
D - not classifiable as to human carcinogencity
E - evidence of noncarcinogenicity for humans

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

II.3.3.2 Risk Characterization

Table 6 shows that for the ER Site 46 nonradioactive COCs, the Hazard Index value is 0.04 and the excess cancer risk is 5×10^{-6} for the assumed industrial land-use scenario. The numbers presented included exposure from soil ingestion and dust inhalation for the nonradioactive COCs.

For the residential land-use scenario, the Hazard Index value increases to 0.17 and the excess cancer risk is 2×10^{-5}. The numbers presented included exposure from soil ingestion and dust inhalation. Although USEPA (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, NM to be eroded and, subsequently, for dust to be present even in predominantly residential areas. Because of the nature of the local soil, other exposure pathways are not considered (see Attachment M).

For the radioactive COCs, contribution from the direct gamma exposure pathway is included. Table 7 shows the total effective dose equivalent (TEDE) for both an industrial (6×10^{-6} mrem/yr) and residential (8×10^{-6} mrem/yr) land-use. In

accordance with proposed EPA guidance, the standard being utilized is an excess TEDE of 15 mrem/yr (40 CFR Part 196, 1994), corresponding to an excess cancer risk of approximately 3×10^{-4}; the calculated dose values for ER Site 46 for both industrial and residential land-uses are well below that standard. The average radiation exposure due to natural sources (radon, internal radiation, cosmic radiation, and terrestrial radiation) in the U.S. is approximately 295 mrem/yr total effective dose (NCRP, 1987), with approximately 198 mrem/yr due to radon, 40 mrem/yr due to internal radiation (mainly K-40), 29 mrem/yr due to cosmic radiation and 28 mrem/yr due to terrestrial caused radiation. The value of 295 mrem/yr corresponds to an estimated cancer risk of 6×10^{-3}.

For a perspective on the estimated risk associated with background levels of radionuclides and to emphasize the conservativeness associated with RAGS RME risk and dose calculations, the excess cancer risk from background concentrations of radionuclides for relevant exposure pathways has also been estimated using RAGS methodologies. For an industrial or residential land-use scenario, using the 95th percentile or UTL values of radionuclides present in the background soil, the excess cancer risk from soil ingestion is calculated as 4×10^{-4}. The excess cancer risk for the inhalation pathway (i.e., inhalation of radon gas) is calculated as 0.1.

Table 7 shows not only the dose but also the estimated excess cancer risk as 1×10^{-10} for an industrial land-use and a value of 2×10^{-10} for a residential land-use. The excess cancer risk from the nonradioactive COCs and the radioactive COCs is not additive, as noted in RAGS (USEPA, 1989a).

Table 6. Risk Assessment Values for ER Site 46 Nonradioactive COCs.

COC Name	Maximum concentration (mg/kg)	Industrial Land-use Scenario		Residential Land-use Scenario	
		Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Arsenic	7.5	0.02	5E-6	0.09	2E-5
Cadmium	3.5	0.01	1E-9	0.03	2E-9
Chromium (VI)	<0.1	0.00	3E-10	0.00	4E-10
Cyanide	0.16	0.00	--	0.00	--
Mercury	<0.04	0.00	--	0.00	--
Nitrate/ Nitrite*	1,400.0	0.01	--	0.05	--
Selenium	<0.25	0.00	--	0.00	--
Silver	0.6	0.00	--	0.00	--
Thallium	<0.5	--	--	--	--
Di-n-butyl phthalate	0.066J	0.00	--	0.00	--
TOTAL		**0.04**	**5E-6**	**0.17**	**2E-5**

-- information not available

* Nitrate/Nitrite assumed to be nitrite (most conservative)

Table 7. Risk Assessment Values for ER Site 46 Radioactive COCs.

COC Name	Max. Conc. (pCi/g)	Total Effective Dose Equivalent for Industrial Land-use (mrem/yr)	Total Effective Dose Equivalent for Residential Land-use (mrem/yr)	Excess Cancer Risk for Industrial Land-use	Excess Cancer Risk for Residential Land-use
Tritium	0.044	6E-6	8E-6	1E-10	2E-10
TOTAL		**6E-6**	**8E-6**	**1E-10**	**2E-10**

II.4 Step 6. Comparison of Risk Values to Numerical Standards.

The risk assessment analyses considered the evaluation of the potential for adverse health effects for both an industrial land-use scenario, which is the designated land-use scenario for this site, and also a residential land-use scenario.

For the industrial land-use scenario, the Hazard Index calculated is 0.04; this is much less than the numerical standard of 1 suggested in RAGS (1989a). The excess cancer risk is estimated at 5×10^{-6}. In RAGS, the USEPA suggests that a range of values (10^{-6} to 10^{-4}) be used as the numerical standard; the value calculated for this site is in the low-end of the suggested acceptable risk range. Therefore, for an industrial land-use scenario, the Hazard Index risk assessment values are significantly less than the established numerical standard and the excess cancer risk is in the low-end of the suggested acceptable risk range.

For the radioactive components of the industrial land-use scenario, the calculated dose is 6×10^{-6} mrem/yr, which is significantly less than the numerical standard of 15 mrem/yr suggested in the draft EPA guidance. The excess cancer risk estimate is 1×10^{-10}, which is significantly less than the excess cancer risk from naturally occurring radioactive sources.

For the residential land-use scenario, the calculated Hazard Index is 0.17, which is again significantly less than the numerical guidance. The excess cancer risk is estimated at 2×10^{-5}; this value is in the middle of the suggested acceptable risk range. The dose from the radioactive components is 8×10^{-6} mrem/yr, which is significantly less than the numerical guidance. The associated cancer risk is 2×10^{-10}, significantly below background calculated risk values.

II.5 Uncertainty Discussion

The conclusion from the risk assessment analysis is that the potential effects on human health are small compared to established numerical standards. Although the maximum arsenic concentration (7.5 mg/kg) exceeds the calculated UTL, it is within the range of arsenic concentration values measured in the Site-Wide background study and may be part of background. Therefore, this risk assessment is conservative as arsenic is a significant contributor to both the Hazard Index and the excess cancer risk. The uncertainty in this conclusion is considered to be small. Because of the location and history of the site, there is low uncertainty in the land-use scenario and the potentially affected populations that were considered in making the risk assessment analysis. An RME approach was used to calculate the risk assessment values, which means that the parameter values used in the calculations were conservative and that the calculated intakes are likely overestimates. Maximum measured values of the

concentrations of the COCs were used to provide conservative results. Because the COCs are found in the 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. Table 4 shows the confidence in the toxicological parameter values. There is a mixture of estimated values and values from the Health Effects Assessment Summary Tables (HEAST) (EPA, 1996c) and Integrated Risk Information System (IRIS) (EPA, 1988, 1994b) data bases. Because of the conservative nature of the RME approach, the uncertainties in the toxicological values are not expected to be of high enough concern to change the conclusion from the risk assessment analysis. The overall uncertainty in all of the steps in the risk assessment process is considered to be not significant with respect to the conclusion reached.

III. Summary

The Old Acid Waste Line Outfall, ER Site 46, had relatively minor contamination consisting of some inorganic, organic and radioactive compounds. Although the maximum arsenic concentration (7.5 mg/kg) exceeds the calculated UTL, it is within the range of arsenic concentration values measured in the Site-Wide background study and may be part of background. In addition, based on historic records, arsenic is not considered to be a potential COC. Therefore, this risk assessment is conservative as arsenic is a significant contributor to both the Hazard Index and the excess cancer risk. Because of the location of the site on Kirtland AFB, the designated land-use scenario and the nature of the contamination, the potential exposure pathways identified for this site included soil ingestion and dust inhalation for chemical constituents and soil ingestion, dust inhalation, and direct gamma exposure for radionuclides. Using conservative assumptions and employing a RME approach to the risk assessment, the calculations show that for the industrial land-use scenario the Hazard Index (0.04) is significantly less than the USEPA standard of 1. The estimated cancer risk (5×10^{-6}) is in the low-end of the suggested acceptable risk range. The calculations show that for the residential land-use scenario the Hazard Index (0.17) is also significantly less than the USEPA standard of 1. The estimated cancer risk (2×10^{-5}) is in the middle of the suggested acceptable risk range. The dose and corresponding cancer risk from the radioactive components are much less than EPA guidance values; the estimated doses are 6×10^{-6} and 8×10^{-6} mrem/yr for the industrial and residential land-use scenarios, respectively. These values are much less than the numerical guidance of 15 mrem/yr in draft EPA guidance. The corresponding estimated cancer risk values are 1×10^{-10} and 2×10^{-10} for the industrial and residential land-use scenarios, respectively. These values are also much less than risk values calculated due to naturally occurring radiation.

The uncertainties associated with the calculations are considered small relative to the conservativeness of the risk assessment analysis. We therefore conclude

that this site does not have significant potential to affect human health under either an industrial or a residential land-use scenario.

The ecological risk for this site has not been estimated at this time. Site-Wide ecological risk analyses are being conducted and the relevant analyses for this site will be presented when available.

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ATTACHMENT M

SNL ER PROJECT EXPOSURE PATHWAY DISCUSSION FOR CHEMICAL AND RADIONUCLIDE CONTAMINATION

Sandia National Laboratories Environmental Restoration Program

EXPOSURE PATHWAY DISCUSSION FOR CHEMICAL AND RADIONUCLIDE CONTAMINATION

BACKGROUND

Sandia National Laboratories (SNL) 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 project site. 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 ER sites have similar types of contamination and physical settings, SNL believes that the risk assessment analyses at these sites will 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 views as resulting in a Reasonable Maximum Exposure (RME) value. Subject to comments and recommendations by the USEPA Region VI and NMED, SNL proposes that these default exposure routes and parameter values be used in future risk assessments.

At SNL/NM, all Environmental Restoration (ER) sites exist within the boundaries of the Kirtland AFB. 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/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 ER sites. At this time, all SNL/NM ER sites have been tentatively designated for either industrial or recreational future land use.

Based on this and other related information, 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 and risk values. 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), and;
- External exposure to penetrating radiation (immersion in contaminated air; immersion in contaminated water and exposure from ground surfaces with photon-emitting radionuclides).

Based on the location of the sites and the characteristics of the surface of the sites, we have evaluated these potential exposure routes to determine which should be considered in risk assessment analyses (the last exposure route is pertinent to radionuclides only). At SNL/NM ER sites, there does not presently 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 computer code RESRAD manual (ANL, 1993), risks resulting from immersion in contaminated air or water are not significant compared to risks from other radiation exposure routes; these are therefore not included. SNL/NM ER has therefore excluded the following four potential exposure routes from further risk assessment evaluations at any SNL/NM ER site:

- Ingestion of contaminated fish and shell fish;
- Ingestion of contaminated fruits and vegetables;
- Ingestion of contaminated meat, eggs, and dairy products; and
- 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 future risk assessments, the exposure routes that will be considered are:

- Ingestion of contaminated drinking water;
- Ingestion of contaminated soil;
- Inhalation of airborne compounds (vapor phase or particulate).
- Dermal contact with chemicals in water;
- Dermal contact with chemicals in soils; and
- External exposure to penetrating radiation from ground surfaces with photon-emitting radionuclides.

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 six of the above routes will, however, be considered. The general equations for calculating potential intakes via these routes are shown below. The equations are from the Risk Assessment Guidance for Superfund: Volume 1 (EPA, 1989a and 1991). Also shown are the default values SNL/NM ER

suggests for use in Reasonable Maximum Exposure (RME) risk assessment calculations for an industrial scenario, based on EPA and other governmental agency guidance. The pathways and values for chemical contaminants are discussed first, followed by those for radionuclide contaminants.

Chemicals

Ingestion of Chemicals in Drinking Water:

Scenario: A person ingests tap water and beverages made from tap water. All tap water consumed is assumed to come from an on-site drinking well. In accordance with EPA guidance, the default parameter values used reflect a residential exposure.

$$\text{Intake (mg/kg-day)} = \frac{CW \times IR \times EF \times ED}{BW \times AT}$$

CW = chemical concentration in water (mg/L)
IR = ingestion rate (L water/d);
EF = exposure frequency (d/yr);
ED = exposure duration (yr);
BW = body weight (kg);
AT = averaging time (d)

Parameter	Units	Point Value	Justification
CW	mg/L	site-specific	
IR	L/d	2	Exposure Factors Handbook (EPA, 1989b); reasonable worst-case value
EF	d/yr	350	Exposure Factors Handbook (EPA, 1989b) and RAGS, Vol 1, Part B (EPA, 1991), reasonable worst-case value
ED	yr	30	Exposure Factors Handbook (EPA, 1989b) and RAGS, Vol 1, Part B (EPA, 1991), reasonable worst-case value
BW	kg	70	Exposure Factors Handbook (EPA, 1989b); conservative estimate
AT	d	10950 25500	RAGS (EPA, 1989a); ED x 365 d/y for noncarcinogenic effects; 70 yr x 365 d/y for carcinogenic effects.

Ingestion of Chemicals in Soil:

Scenario: A worker engages in a combination of indoor and outdoor activities for 8 hours per day with inadvertent ingestion of soil from a layer of soil on the inside surfaces of the fingers and thumb from outdoor activities or inadvertent ingestion of soil from handling of food or cigarettes. An EPA suggested average value of 100 mg/d is used for the ingestion rate.

$$\text{Intake (mg/kg-day)} = \frac{CS \times IR \times (10^{-6}\ kg/mg) \times EF \times FI \times ED}{BW \times AT}$$

CS = chemical concentration in soil (mg/kg);
IR = ingestion rate (mg soil/d);
FI = fraction ingested (default to 1);
EF = exposure frequency (d/yr);
ED = exposure duration (yr);
BW = body weight (kg);
AT = averaging time (d).

Parameter	Units	Point Value	Justification
CS	mg/kg	site-specific	
IR	mg/d	100	Exposure Factors Handbook (EPA, 1989b), RAGS (EPA, 1989a); conservative estimate
EF	d/yr	250	Reasonable worst-case value for worker; RAGS (EPA, 1989a)
FI	--	1	Worst-case value
ED	yr	30	Reasonable worst-case value for worker
BW	kg	70	Exposure Factors Handbook (EPA, 1989b); conservative estimate
AT	d	10950 25500	RAGS (EPA, 1989a); ED x 365 d/y for noncarcinogenic effects; 70 yr x 365 d/y for carcinogenic effects.

Inhalation of Airborne (vapor phase or particulate) Chemicals:

Scenario: A worker is engaged in activities (indoors or outdoors) and inhales contaminant vapors present in the air or is exposed to contaminant particulates present in the air.

$$\text{Intake (mg/kg-day)} = \frac{CA \times IR \times ET \times EF \times ED}{BW \times AT}$$

CA = chemical concentration in air (mg/m^3);
IR = inhalation rate (m^3/h);
ET = exposure time (h/d);
EF = exposure frequency (d/yr);
ED = exposure duration (yr);
BW = body weight (kg);
AT = averaging time (d).

Parameter	Units	Point Value	Justification
CA	mg/m^3	site-specific	
IR	m^3/h	2.5	Exposure Factors Handbook (EPA, 1989b); reasonable worst-case value
EF	d/yr	250	Reasonable worst-case value for worker
ET	h/d	8	Reasonable worst-case value
ED	yr	30	Reasonable worst-case value for worker
BW	kg	70	Exposure Factors Handbook (EPA, 1989b); conservative estimate
AT	d	10950 25500	RAGS (EPA, 1989a); ED x 365 d/y for noncarcinogenic effects; 70 yr x 365 d/y for carcinogenic effects.

The chemical concentration in air can be either measured or calculated based on the concentration of contaminants in the soil. If field measurements are not available, vapor-phase concentrations can be determined using a volatilization factor (VF) to define the relationship between the concentration of contaminant in soil and the volatilized contaminants in air. Likewise, chemical concentrations based on particulates can be determined using a particulate emission factor (PEF) to define the relationship between the contaminant concentration in soil with the concentration of respirable particles in air due to fugitive dust emissions. The volatilization factor was established as part of the Hwang and Falco (1986) model developed by EPA's Exposure Assessment group. The particulate emission factor is derived by Cowherd (1985), applicable to a typical hazardous waste site where the surface contamination provides a relatively continuous and constant potential for emission over an extended period of time. The equations for calculating VFs and PEFs can be found in EPA (EPA, 1991). Alternative methods for calculating these factors are also available. These alternative methods can be discussed with EPA/NMED staff for use in risk assessments if they can be shown to be technically consistent or superior to current published guidance.

Dermal Contact with Chemicals in Water:

Scenario: A worker is in contact with contaminants in water, primarily through hygienic activities as hand washing or showering.

$$\text{Absorbed Dose (mg/kg-day)} = \frac{CW \times SA \times 10^4\ cm^2/m^2 \times PC \times ET \times EF \times ED \times 1\ L/10^3\ cm^3}{BW \times AT}$$

CW = chemical concentration in water (mg/L);
SA = skin surface area for contact (m^2);
PC = chemical specific dermal permeability constant (cm/h);
ET = exposure time (h/d);
EF = exposure frequency (d/yr);
ED = exposure duration (yr);
BW = body weight (kg);
AT = averaging time (d)

Parameter	Units	Point Value	Justification
CW	mg/L	site-specific	
SA	m^2	2	Exposure Factors Handbook (EPA, 1989b); {represents total body exposure); reasonable worst-case value
PC	cm/h	chemical specific	see e.g., Dermal Exposure Assessment (EPA, 1992)
EF	d/yr	250	Reasonable worst-case value for worker
ET	h/d	0.25	Dermal Exposure Assessment (EPA, 1992); reasonable worst case value
ED	yr	30	Reasonable worst-case value for worker
BW	kg	70	Exposure Factors Handbook (EPA, 1989b); conservative estimate
AT	d	10950 25500	RAGS (EPA, 1989a); ED x 365 d/y for noncarcinogenic effects; 70 yr x 365 d/y for carcinogenic effects.

Dermal Contact with Soil:

Scenario: A worker is in contact with contaminants in soil for an exposure duration determined through discussions with EPA/NMED staff. A worker gets exposure to the head, hands, forearms and lower legs.

$$\text{Absorbed Dose (mg/kg-day)} = \frac{CS \times (10^{-6}\ kg/mg) \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

CS = chemical concentration in soil (mg/kg);
SA = skin surface area for contact (m^2);
AF = soil to skin adherence factor (mg/cm^2);
ABS = absorption factor (unitless);
EF = exposure frequency (d/yr);
ED = exposure duration (yr);
BW = body weight (kg);
AT = averaging time (d).

Parameter	Units	Point Value	Justification
CS	mg/kg	site-specific	
SA	m^2	0.53	Dermal Exposure Assessment (EPA, 1992); {accounts for adult exposure to head, hands, forearms, and lower legs); reasonable worst-case value
AF	mg/cm^2	1.0	Dermal Exposure Assessment (EPA, 1992); reasonable worst-case value
ABS	--		
EF	d/yr	250	Reasonable worst-case value for worker
ET	h/d	TBD	To be determined based on discussions with NMED staff.
ED	yr	30	Reasonable worst-case value for worker
BW	kg	70	Exposure Factors Handbook (EPA, 1989b); conservative estimate
AT	d	10950 25500	RAGS (EPA, 1989a); ED x 365 d/y for noncarcinogenic effects; 70 yr x 365 d/y for carcinogenic effects.

EPA (EPA, 1992) recognizes that dermal contact exposure remains the least well understood of the major exposure routes. Chemical-specific data are often not available and dose-response relationships specific to dermal contact are not available. EPA (EPA, 1992) provides guidance on assessment of dermal exposure, including determination of permeability coefficients and other related parameters.

In addition to the equations presented above for absorbed dose via steady-state dermal exposure, EPA (EPA, 1992) presents methods for calculation of absorbed doses for unsteady-state exposure; these methods generally produce lower estimates of absorbed dose. The document also presents a screening process for determining if site-specific calculations of dermal exposure are necessary, assuming that dermal exposure is deemed a potentially valid route of contaminant exposure. In general, SNL/NM ER will use the latest guidance available from EPA on dermal exposure. This is an area where discussions with EPA/NMED staff on appropriate assumptions and parameter values is essential. Discussions with EPA/NMED staff are also necessary to determine when this exposure route should be invoked.

Radionuclides

Radionuclide Carcinogenic Effects from Water: Residential

Scenario: A worker drinks radioactively-contaminated water and inhales vapor from the water.

Total risk = $(C_{rw} \times SF_o \times IR_w \times EF \times ED) + (C_{rw} \times SF_i \times IR_{air} \times K \times EF \times ED)$

C_{rw} = radionuclide concentration in water (pCi/L)
SF_i = inhalation slope factor (risk/pCi)
SF_o = oral (ingestion) slope factor (risk/pCi)
EF = exposure frequency (d/y)
ED = exposure duration (y)
IR_{air} = indoor inhalation rate (m^3/d)
IR_w = water ingestion rate (L/d)
K = volatilization factor (unitless)

Parameter	Units	Point Value	Justification
C_{rw}	pCi/L	site-specific	
SF_i	risk/pCi	radionuclide-specific	
SF_o	risk/pCi	radionuclide-specific	
EF	d/y	350	RAGS (EPA, 1989a)
ED	y	30	Reasonable worst-case estimate.
IR_{air}	m^3/d	15	RAGS (EPA, 1989a)
IR_w	L/d	2	Reasonable worst-case estimate.
K	unitless	0.5	RAGS (EPA, 1989a)

Radionuclide Carcinogenic Effects from Soil: Industrial

Scenario: A worker inadvertently ingests soil, inhales vapor and particulates from soil and is externally exposed to penetrating radiation ground surfaces contaminated with photon-emitting radionuclides.

Total risk = $C_{rs} \times ED \times [(SF_o \times 10^{-3}g/mg \times EF \times IR_{soil}) + (SF_i \times 10^3 g/kg \times EF \times IR_{air}/VF) + (SF_i \times 10^3 g/kg \times EF \times IR_{air}/PEF) + (SF_e \times 10^3 g/kg \times D \times SD \times (1-S_e) \times T_e)]$

C_{rs} = radionuclide concentration (pCi/g)
SF_i = inhalation slope factor (risk/pCi)
SF_o = oral (ingestion) slope factor (risk/pCi)
SF_e = external exposure slope factor (risk/y per pCi/m^2)
EF = exposure frequency (d/y)
ED = exposure duration (y)
IR_{air} = inhalation rate (m^3/d)

IR_{soil} = soil ingestion rate (mg/d)
VF = soil-to-air volatilization factor (m^3/kg)
PEF = particulate emission factor (m^3/kg)
D = depth of radionuclides in soil (m)
SD = soil density (kg/m^3)
S_e = gamma shielding factor (unitless)
T_e = gamma exposure factor (unitless)

Parameter	Units	Point Value	Justification
C_r	pCi/g	site-specific	
SF_i	risk/pCi	radionuclide-specific	
SF_o	risk/pCi	radionuclide-specific	
SF_e	risk/y per pCi/m^2	radionuclide-specific	
EF	d/y	250	RAGS (EPA, 1989a)
ED	y	30	Reasonable worst-case estimate.
IR_{air}	m^3/d	20	RAGS (EPA, 1989a)
IR_{soil}	mg/d	100	Reasonable worst-case estimate.
VF	m^3/kg	nuclide-specific	
PEF	m^3/kg	1.32×10^9	Region VI guidance.
D	m	0.1	RAGS (EPA, 1989a)
SD	kg/m^3	1430	RAGS (EPA, 1989a)
S_e	unitless	0.2	RAGS (EPA, 1989a)
T_e	unitless	1	RAGS (EPA, 1989a)

Summary for an Industrial Land-Use Scenario

SNL proposes the described default exposure routes and parameter values for use in risk assessments at sites that have an industrial future land-use scenario. The parameter values are based on 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 will use them in risk assessments for all sites where the assumptions are consistent with site-specific conditions. All deviations will be documented.

Summary for an Residential Land-Use Scenario

Sandia may choose to evaluate some sites using a residential land-use scenario in order to provide an indication of the effects of data uncertainty on risk value calculations or in order to potentially mitigate the need for institutional controls or restrictions on Sandia ER sites. For a risk assessment evaluating a residential land-use scenario, Sandia will use parameter values as documented in the Risk Assessment Guidance for Superfund (RAGS, 1989a). That EPA guidance document provides detailed discussion on the appropriate values to use for all of the potential exposure pathways.

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ATTACHMENT N

REFERENCES FOR TIJERAS ARROYO OU NOD RESPONSES

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GENERAL RISK ASSESSMENT COMMENTS

1. **Conclusions throughout the report are based largely on comparisons with previously established upper tolerance limits (UTLs). These UTLs have not been approved by NMED or limits (UTLs). These UTLs have not been approved by NMED or EPA and are therefore considered draft. The presented values have been compared with protective screening values for human health. Both residential and industrial scenario screening values have been considered since Sandia does not have a final future land use plan at this time.**

   Response: DOE/SNL understands that UTLs are considered draft until approved by NMED and EPA. As of April 1996, DOE/SNL has a final future land use plan and risk assessments will use future land use scenarios based upon that plan.

2. **The sites with reported radionuclides above background levels were evaluated based on a DOE established acceptable dose. EPA Region 6 policy requires that the evaluation of risk to radionuclides include an estimation of potential carcinogenic risk. A revision to the risk evaluation is requested.**

   Response: DOE/SNL will provide potential carcinogenic risk and dose due to radionuclide contamination in future NFA proposal submissions and resubmissions.

3. **For all sites, the following issues must be addressed: 1) potential ecological risk posed at the site, 2) the site as a potential source for ecological risk in transport of constituents through the septic system into Tijeras Arroyo, and 3) detection limits relative to human health-based screening levels.**

   Response: DOE/SNL is currently working on ecological risk assessments for all ER Sites which will be submitted as a supplemental document to NMED upon completion. DOE/SNL considers detection limits in preparing human health-based risk assessments.

9. Site 46, OU 1309, Old Acid Waste Line Outfall Site

See general comment on risk analysis of radionuclides. [The sites with reported radionuclides above background levels were evaluated based on a DOE established acceptable dose. EPA Region 6 policy requires that the evaluation of risk to radionuclides include an estimation of potential carcinogenic risk. A revision to the risk evaluation is requested.]

Response: SNL/NM has recently completed, with EPA Region VI concurrence, a quantitative risk assessment for all contaminants, including cancer-causing radionuclides, in soil. The section Site 46, OU 1309, Old Acid Waste Line Site in NMED Site-Specific Technical Comments discusses the risk assessment.

NOD

U.S. Department of Energy
Albuquerque Operations Office
Kirtland Area Office
P.O. Box 5400
Albuquerque, NM 87185-5400

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JAN 26 2000

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

Mr. James Bearzi, Chief
Hazardous and Radioactive Materials Bureau
New Mexico Environment Department
2044 Galisteo Street
P.O. Box 26110
Santa Fe, NM 87502-2100

Dear Mr. Bearzi:

Enclosed is one of two NMED copies of the Department of Energy and Sandia National Laboratories/New Mexico response to the NMED Notice of Deficiency (NOD), dated October 13, 1999, for Environmental Restoration sites 7, 46, 48, 50, 136, 159, 166, 227, 229, 230, 231, 233, 234, and 235. These sites were all included in the 2nd batch of No Further Action (NFA) proposals.

If you have any questions, please contact John Gould at (505) 845-6089.

Sincerely,

George K. Lasker

Michael J. Zamorski
Area Manager

Enclosure

Sandia National Laboratories
Albuquerque, New Mexico
December 1999

Environmental Restoration Project
Responses to NMED Notice of Deficiency
No Further Action Proposals (2nd Round)
Dated June 1995

INTRODUCTION

Sandia National Laboratories/New Mexico (SNL/NM) is submitting this Notice of Deficiency (NOD) response for sites managed by the Tijeras Arroyo Operable Unit (OU) 1309 and the Technical Area (TA) II OU 1303. This response addresses Enclosures A and B comments in the October 13, 1999 NOD (NMED, 1999).

This is the second NOD response for Environmental Restoration (ER) Sites 50 and 235. Most of the following information addresses omissions in the ER Sites 50 and 235 No Further Action (NFA) Proposals (SNL/NM, 1995) and the first ER Sites 50 and 235 NOD responses (SNL/NM, 1996). This response addresses the need for reorganizing the confirmatory sampling analytical data and conducting human health and ecological risk assessments. For ER Site 50, this response also contains additional analytical data obtained during the Voluntary Corrective Measure activities recently conducted at nearby ER Site 228A (the Centrifuge Dump Site) in 1999 (SNL/NM, 1999). For ER Site 235, this response addresses the need for reorganizing the confirmatory sampling analytical data and conducting human and ecological risk assessments.

TABLE OF CONTENTS

RESPONSES TO NMED NOTICE OF DEFICIENCY COMMENTS ON NO FURTHER ACTION PROPOSALS ER SITES 7, 46, 48, 135, 136, 159, 165, 166, 167, 227, 229, 230, 231, 232, 233, AND 234 JUNE 1995 (2ND ROUND)

ENCLOSURE B

The following discussion documents the negotiations between SNL/NM ER staff and NMED HRMB staff as requested in NMED (1999). These negotiations were finalized in a November 17, 1999 meeting.

The outfalls at ER Sites 46 and 227 are of the most concern to the HRMB; the others, which are storm drain outfalls, are clustered near ER sites 46 and 227. More specifically, ER Sites 229, 230, and 231 are grouped near ER Site 227; whereas, ER Sites 232, 233, and 234 are located near ER Site 46. Additional site characterization work proposed includes:

1. **Locate each outfall accurately.**

   Response: SNL/NM will locate each outfall accurately for ER Sites 46, 227, 229, 230, 231, 232, 233, and 234. The recent discussions have revealed that the type of water released to each site needs to be clarified. ER Site 46 received rinse waters from TA-I buildings. ER Sites 227 and 229 received rinse waters from TA-II buildings. ER Sites 230, 231, 232, and 233 currently receive storm water from TA-IV. ER Site 234 previously received storm water from TA-IV, but is now inactive. Except for ER Site 232, all of these OU 1309 sites were documented in the 2nd Round of the NFA proposals.

The NFA proposal for ER Site 232 was submitted in the 8th Round in July 1997; additional work for ER Site 232 is addressed in SNL/NM (1999).

2. **Collect and analyze soil samples at the points of surface discharge and along the drainage channels. Analytical results of previous sampling will be used, to the extent possible, to meet this requirement.**

Response: SNL/NM will collect and analyze soil samples at the points of surface discharge and along the drainage channels that are unlined. More details are presented in item #4 below. Analytical results of previous sampling will be used, to the extent possible, to meet the NMED requirement. The soil samples will be collected according to the following Fiscal Year (FY) schedule: ER Site 46 (FY01), ER Site 227 (FY01), ER Site 229 (FY01), ER Site 230 (FY02), ER Site 231 (FY02), ER Site 232 (FY01), ER Site 233 (FY02), and ER Site 234 (FY02).

3. **Collect deep soil samples and vapor samples at ER Sites 46 and 227. Two 150-ft deep boreholes should be drilled at ER Site 46; one similar borehole should be drilled at ER Site 227. The soil-vapor monitor wells will be permanent installations. Soil samples will be analyzed for radiological constituents, metals, volatile organic compounds, semi-volatile organic compounds, high explosives, hexavalent chromium, iron, and chloride.**

Response: SNL/NM will install two permanent 150-foot deep soil-vapor monitor wells at ER Site 46 and one similar monitor well at ER Site 227. At ER Site 46, the first well will be located at the end of the acid waste line, while the second well will be located at the southern end of the site. [The end (former outfall) of the acid waste line is estimated to be about 50 ft south-southwest of monitor well TJA-3.] The ER Site 227 well will be located at the eastern end of the site near the slope break. Soil samples will be analyzed for radiological constituents (gamma spectroscopy and gross alpha/beta), RCRA metals, volatile organic compounds, semi-volatile organic compounds, high explosives, hexavalent chromium, iron, and chloride. According to the FY00 baseline, performance of this fieldwork is scheduled for FY01.

4. **Collect shallow subsurface soil samples at each storm drain outfall (two boreholes at each location at maximum depths of 5 ft). The soil samples will be analyzed for radiological constituents, metals, volatile organic compounds, semi-volatile organic compounds, and high explosives.**

Response: SNL/NM will collect shallow subsurface samples at two locations each at the storm-drain outfalls (ER Sites 230, 231, 232, 233, and 234). The samples will be collected at a depth of five ft, bgs from hand-augered boreholes. Except for ER Site 234, the boreholes for the TA-IV storm-drain outfalls will be located 5 ft and 30 ft downslope from the lowermost concrete structures at ER Sites 230, 231, 232, and 233. Not to be forgotten, ER Site 232 is unique because two storm drains are located there. At the remaining TA-IV storm-drain outfall (ER Site 234), the boreholes will be located at a similar lateral spacing with the northernmost borehole being located at the lowermost tip

of the site. The soil samples from each site will be analyzed for radiological constituents (gamma spectroscopy and gross alpha/beta), RCRA metals, volatile organic compounds, semi-volatile organic compounds, and high explosives.

5. **Collect a surface soil sample upstream of the drop inlet at ER Site 230. The soil sample will be analyzed for radiological constituents, metals, volatile organic compounds, semi-volatile organic compounds, and high explosives.**

   Response: SNL/NM also will collect a surface (0 – 0.5 ft, bgs) soil sample for ER Site 230. The sample will be collected upstream of the drop inlet and next to the chain-link fence. The soil sample will be analyzed for radiological constituents (gamma spectroscopy and gross alpha/beta), RCRA metals, volatile organic compounds, semi-volatile organic compounds, and high explosives.

6. **A new ground-water monitor well will be installed at the bottom of the slope at ER Site 46. The well will be completed in the regional aquifer, if perched water is not encountered.**

   Response: SNL/NM will install a groundwater monitor well at the bottom of the slope at ER Site 46. The well will be completed in the regional aquifer, if perched water is not encountered.

7. **Summarize in written form, as applicable, all geologic, hydrologic, and ground-water quality data for all boreholes and ground-water monitor wells in the vicinity of ER Sites 46 and 227. The information requested above for the TA-2 septic systems will meet this requirement for ER Site 227, which is located adjacent to TA-2.**

   Response: SNL/NM will summarize in written form, as applicable, all geologic, hydrologic, and groundwater quality data for all boreholes and groundwater monitor wells in the vicinity of ER Sites 46 and 227. This information will be presented in the Sandia North Groundwater Investigation Annual Report for FY01 or FY02.

8. **Revise and resubmit the data tables in the NFA proposals for each site, meeting the standards achieved in the 12th Round NFA proposals.**

   Response: After all the requested soil samples have been collected and the analytical results received, SNL/NM will revise and resubmit the soil-sample data tables for ER Sites 46, 227, 229, 230, 231, 232, 233, and 234 in a format meeting the standards set in the 12th Round NFA proposals. Risk assessments (human-health and ecological) will be prepared. The data tables and risk assessments will be incorporated into the 'statement of basis' format.

NOD

National Nuclear Security Administration
Sandia Site Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

NOV 1 2 2004

CERTIFIED MAIL--RETURN RECEIPT REQUESTED

Mr. James Bearzi, Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Road East, Building 1
Santa Fe, NM 87505

Dear Mr. Bearzi:

On behalf of the Department of Energy (DOE) and Sandia Corporation, DOE is submitting additional information to complete responses to the New Mexico Environment Department (NMED) for the Solid Waste Management Units (SWMUs) identified below:

OU 1303, SWMUs 1 and 3: This submittal documents the final backfilling of the Voluntary Corrective Measure excavation and provides a risk assessment. It is an addendum to the No Further Action (NFA) proposal of September 1997 and provides additional information in response to the three NMED Requests for Supplemental Information (RSIs) of January, June, and December 1999.

OU 1306, SWMU 78: This submittal completes the response to the NMED RSI of May 2000. It includes results of additional sampling, a geophysical survey, an NFA proposal, and a risk assessment.

OU 1306, SWMU 196: This submittal completes the response to the NMED RSI of May 2000. It includes the results of additional sampling, an NFA proposal, and a risk assessment.

OU 1309, SWMU 45: This submittal completes the response to the three NMED RSIs of January, June, and December 1999. It provides results of the additional requested fieldwork and evaluates newly identified information that was not available at the time of the initial response in September1999. It also includes a risk assessment.

OU 1309, SWMU 46: This submittal completes the response to the NMED Notice of Deficiency of October 1999 and provides the final results for the Voluntary Corrective Action (VCA) conducted at the site in 2003. In addition to the results of the VCA, it includes a risk assessment.

Review and analyses of all relevant data for these SWMUs indicate that concentrations of constituents of concern are lower than applicable risk assessment action levels. Based upon confirmatory sampling data, constituents of concern that

could have been released from each site to the environment pose an acceptable level of risk under current and projected land use. Therefore, a determination of Corrective Action Complete without controls is recommended for all these SWMUs.

If you have any questions regarding this submittal, please contact John Gould of my staff at (505) 845-6089.

Sincerely,

Patty Wagner
Manager

Enclosures

cc w/enclosures:
W. Moats, NMED (Via Certified Mail)
M. Gardipe, DOE/SC/ERD
C. Voorhees, NMED-OB, Santa Fe
D. Bierley, NMED-OB

cc w/o enclosures:
L. King, EPA Region 6 (Via Certified Mail)
F. Nimick, SNL, MS 1089
D. Stockham, SNL, MS 1087
B. Langkopf, SNL, MS 1087
C. Chocas, SNL, MS 1120
J. Copland, SNL, MS 1087
D. Miller, SNL, MS 1088
R. E. Fate, SNL, MS 1089
M. J. Davis, SNL, MS 1089
A. Blumberg, SNL, MS 0141

Sandia National Laboratories
Albuquerque, New Mexico
October 2004

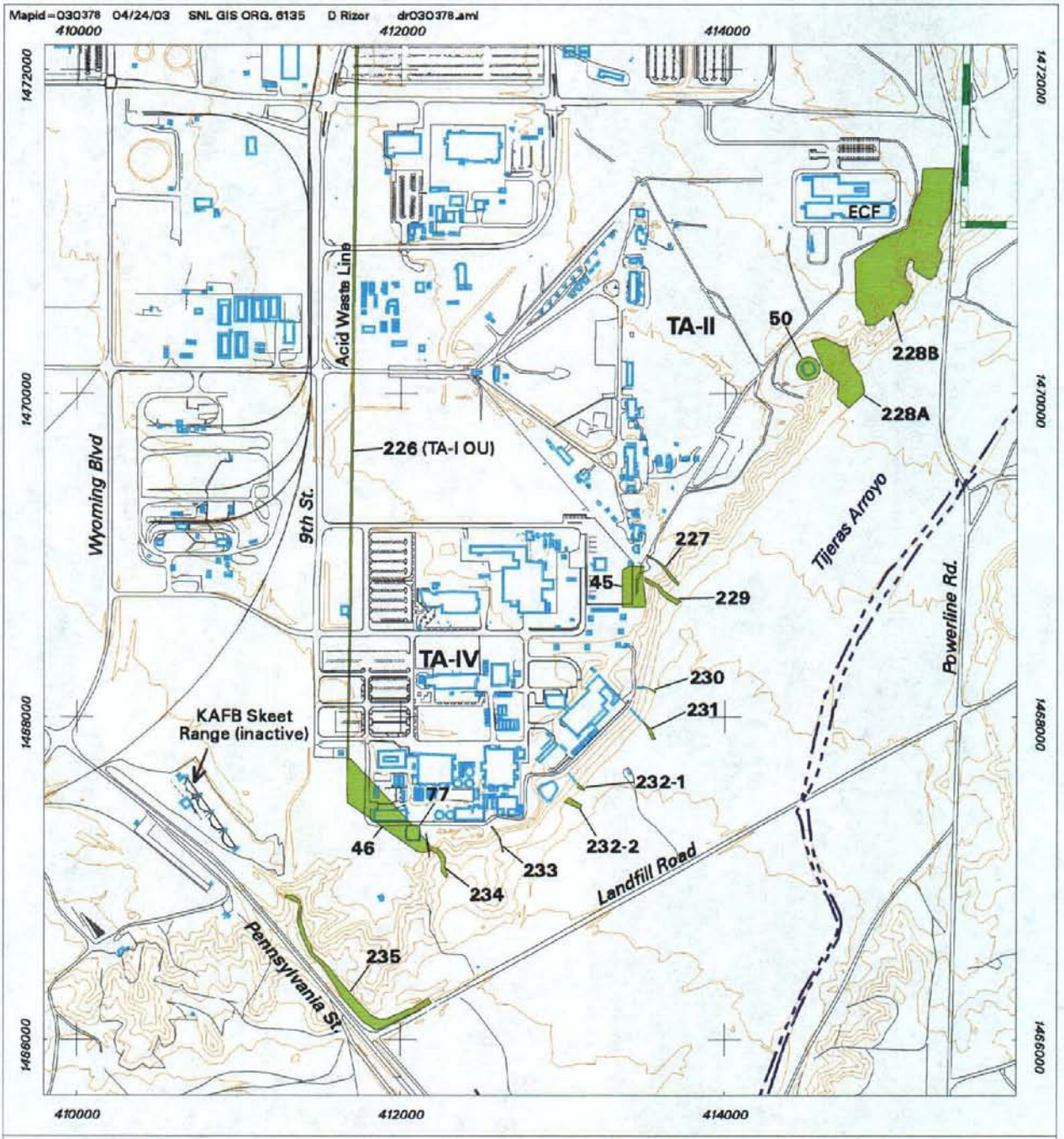
Environmental Restoration Project
Response to the NMED Notice of Deficiency
for Solid Waste Management Unit 46
No Further Action Proposal (2nd Round)
Dated June 1995

INTRODUCTION

Sandia National Laboratories/New Mexico (SNL/NM) is submitting this Notice of Deficiency (NOD) response for Solid Waste Management Unit (SWMU) 46 (the Old Acid Waste Line Outfall), which is managed by the Tijeras Arroyo Operable Unit (TJAOU).

Several site-specific compliance documents are applicable to SWMU 46. In 1995, SNL/NM submitted a proposal for no further action (NFA) to the New Mexico Environment Department (NMED) (SNL/NM June 1995). After receiving NOD comments (NMED July 1996), SNL/NM submitted an NOD response in 1996 (SNL/NM October 1996). In 1999, NMED issued a second set of NOD comments that requested several types of additional sampling (NMED October 1999). SNL/NM submitted a second NOD Response in 1999 that merely acknowledged the need for the additional sampling (SNL/NM December 1999a). This third response follows the NMED October 1999 format and presents analytical results for the requested sampling. This response also discusses the Voluntary Corrective Action (VCA) that was conducted at SWMU 46 in 2003.

SWMU 46 is the inactive outfall (discharge point) for the Old Acid Waste Line (SWMU 226) that was connected to research buildings in Technical Area (TA)-I (Figure 1). Prior to the SWMU 46 VCA excavation work, the acid waste line was exposed at the north end of SWMU 46. The line consisted of 8-inch-diameter, vitrified clay pipe (VCP). From about 1948 through late 1974, SWMU 46 discharged acid waste water that contained a variety of chemicals. Process knowledge indicates that the constituents of concern (COCs) for SWMU 46 consist of metals, polychlorinated biphenyls (PCBs), volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), cyanide, nitrate, and radionuclides (gamma emitters and tritium).



Legend

- Road
- 10 Foot Contour
- Tijeras Arroyo Active Channel
- KAFB Boundary
- Building / Structure
- SWMU

Figure 1
Tijeras Arroyo Operable Unit 1309
Solid Waste Management Units (SWMUs) along Tijeras Arroyo

0 500 1000
Scale in Feet

0 120 240
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

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The Comprehensive Environmental Assessment and Response Program report (DOE 1987) states that the discharge rate for SWMU 46 was 130,000 gallons per day (gpd). However, no other documents substantiate this rate. Assuming that 130,000 gpd were discharged for 27 years at a constant rate, the resulting total would be approximately 1.3 billion gallons of waste water.

A considerable amount of process knowledge has been obtained since submittal of the SWMU 46 NFA proposal (SNL/NM June 1995) and the two SWMU 46 NOD responses (SNL/NM October 1996; SNL/NM December 1999a). In 2000, a review of historic aerial photographs was conducted. Most important was the identification of three outfall ditches at SWMU 46 (Figure 2). During 1948 through 1974, waste water discharged into three nearly parallel, earthen outfall ditches (OD-1, OD-2, and OD-3) that extended southeastward from the acid waste line and merged into a confluence on the northern rim of Tijeras Arroyo (Attachment A). Each of the outfall ditches was approximately 3 feet deep, 5 feet wide, and 700 feet long. The ditches were not lined with concrete or other material. More details concerning the process knowledge for SWMU 46 are discussed in the SWMU 46 VCA Plan (Attachment A).

The historic aerial photographs also showed that TA-IV construction activities have disturbed much of the SWMU 46 area. In 1977, a 1,150-foot long storm-water ditch was constructed at the southwest corner of TA-IV (Figure 3). The ditch was used for about one year to drain storm water from unpaved TA-IV parking lots. In late 1978, the northern end of the storm-water ditch and nearly the entire length of each outfall ditch were backfilled with soil. The near total disappearance of the three outfall ditches contributed to the remaining segment of the storm-water ditch being mistakenly identified in 1994 as the SWMU 226 discharge point (the SWMU 46 outfall). Soil samples were collected from the storm-water ditch in 1994.

In July 2000, the confluence of the SWMU 46 outfall ditches was identified in the field for the first time. The remaining easternmost segments of OD-1 and OD-2 were found to be about 60 feet long. No evidence was found for Outfall Ditch (OD)-3 because the southeastern end of OD-3 had been disturbed by the installation of a TA-IV storm-water outfall pipe. The pipe and associated storm-water discharge has been identified as SWMU 234 (SNL/NM December 2002). TA-IV storm water discharged at SWMU 234 from 1979 until the early 1990s.

This NOD response restates each of the NMED comments (in bold font) in the same order in which the comments were provided. Following each comment, the word "Response" introduces the SNL/NM reply. Additional supporting information is included in the attachments.

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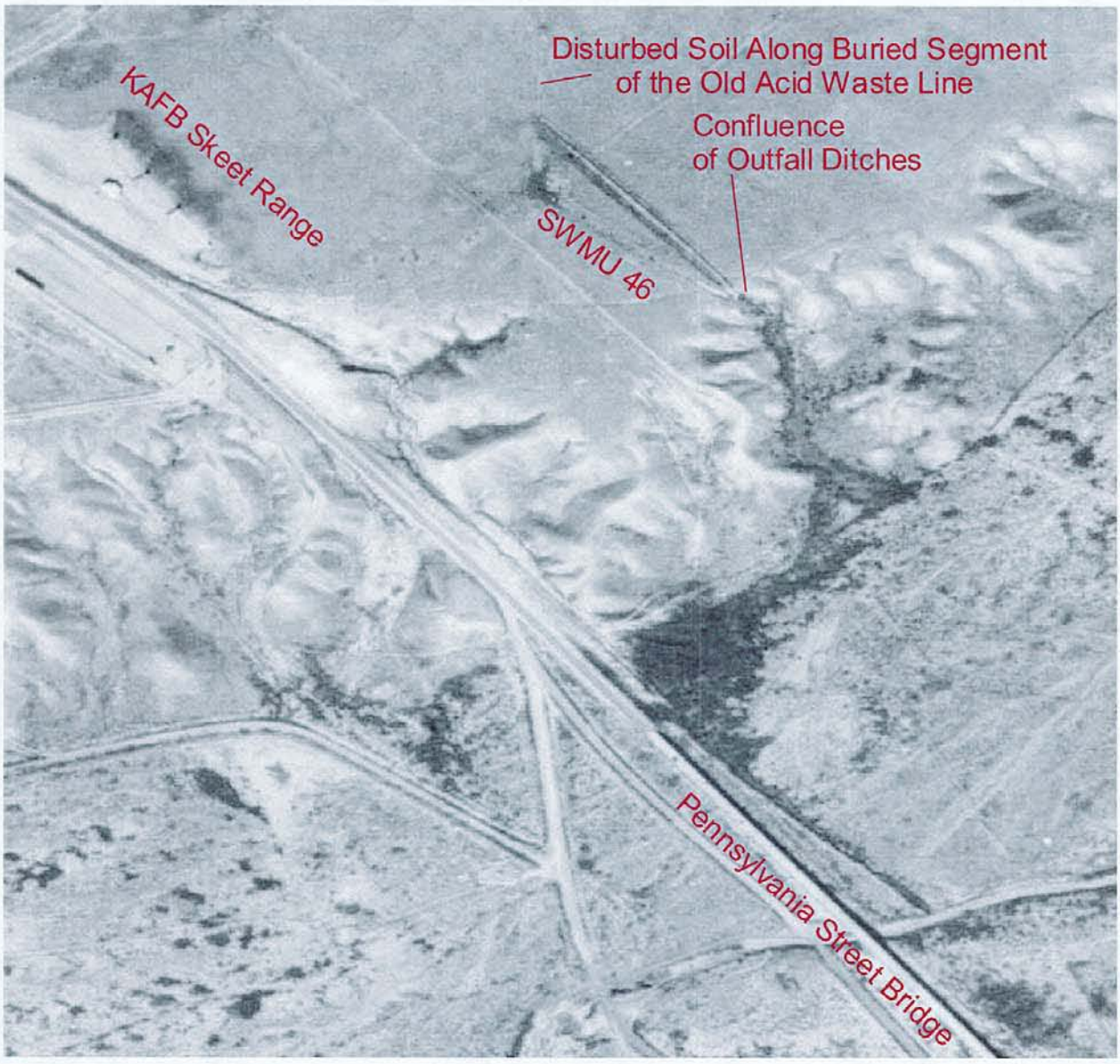

Photo Date: November 10, 1972 Project: KP Frame: 5-2

Figure 2
Enlargement of High Altitude
Aerial Photograph showing
SWMU 46, (Old Acid Waste Line Outfall),
November, 1972

0 200 400
Approximate Scale in Feet

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

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Figure 3
Low-altitude oblique aerial photograph showing construction of TA-IV in 1978.
Storm-water ditch is visible at lower left corner of photograph.
The three SWMU 46 outfall ditches are faintly visible and are located between the storm-water ditch and Buildings 980 and 981. View to the north, 1978.

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LIST OF ATTACHMENTS

Attachment	Title
A	Voluntary Corrective Action Plan, Solid Waste Management Unit 46 – Old Acid Waste Line Outfall
B	Summary of Analytical Results for Characterization Soil Samples from SWMU 46 Geoprobe® Boreholes
C	Summary of Analytical Results for Confirmatory Soil Samples from SWMU 46 VCA
D	Summary of Analytical Results for Characterization Soil Samples from SWMU 46 Deep Boreholes
E	Summary of Analytical Results for Characterization Soil Samples from SWMU 234 Applicable to SWMU 46
F	Summary of Analytical Results for SWMU 46 and SWMU 234 Characterization and Confirmatory Soil Samples
G	Risk Assessment Summary for SWMU 46
H	Site Conceptual Model for SWMU 46

Site Specific Comments
October 1999 Notice of Deficiency
Proposed Additional Site Characterization Work
Sandia National Laboratories / U.S. Department of Energy
Responses to the Notice of Deficiency
Issued November 15, 1995, for
No Further Action Proposals (June 1995, Round 2 NFAs)

ER Sites 46, 232, 233, 234, 227, 229, 230, and 231 (OU 1309 Outfalls)

The outfalls at ER Sites 46 and 227 are of the most concern to the HRMB; the others, which are storm drain outfalls, are clustered near ER sites 46 and 227. More specifically, ER Sites 229, 230, and 231 are grouped near ER Site 227; whereas, ER Sites 232, 233, and 234 are located near ER Site 46. Additional site characterization work proposed includes:

1. **Locate each outfall accurately.**

   Response: Accurate locations for each outfall are shown in Figure 1. SWMU 46 (the Old Acid Waste Line Outfall) encompasses approximately 2.25 acres at the southwest corner of TA-IV. In 2000, the boundary for SWMU 46 was revised to encompass the three outfall ditches where waste water had discharged. As mentioned in the Introduction, the storm-water ditch was not a waste-water discharge location. Figure 4 shows the former and revised boundaries for SWMU 46.

   This NOD Response solely addresses SWMU 46. The NOD Response for SWMUs 230 through 234 was submitted to NMED in 2002 (SNL/NM December 2002). The NOD Response for SWMUs 227 and 229 was submitted to NMED in 2003 (SNL/NM July 2003).

2. **Collect and analyze soil samples at the points of surface discharge and along the drainage channels. Analytical results of previous sampling will be used, to the extent possible, to meet this requirement.**

   Response: As shown in Table 1, four sampling events provide the analytical data for this NOD Response. The data are discussed according to the relevant NMED comment. The corresponding analytical results in Attachments B through E were compiled using the format of the 12th Round NFA proposals.

   Analytical results previously presented in the SWMU 46 NFA proposal (SNL/NM June 1995) are not discussed because the corresponding eight soil samples (46-01-A through 46-04-B) are not useful for characterizing the waste-water discharge. As mentioned in the Introduction, a recent interpretation of historic aerial photographs has revealed that the storm-water ditch was not the location where waste water had discharged. As

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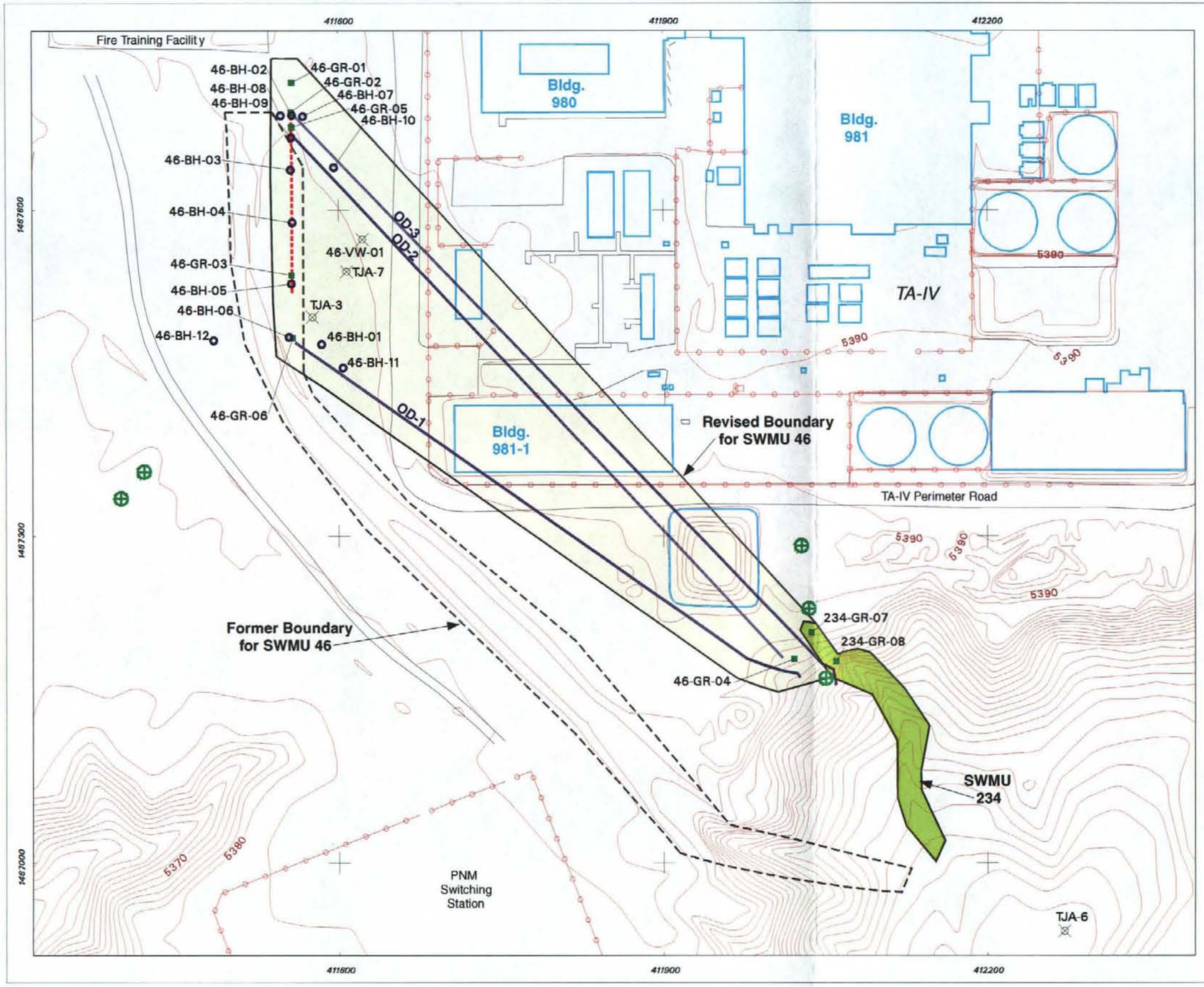
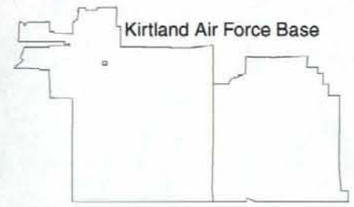


Legend

- Soil Sample
- Borehole
- Monitor Well
- Large Tree
- Fence
- Road
- Former SWMU 46 Boundary
- 2 Foot Contour
- Acid Waste Line (visible segment prior to Voluntary Corrective Action)
- Outfall Ditch (OD) from 1966 Aerial Photograph
- Building / Structure
- SWMU 46
- SWMU 234

0 100 200
Scale in Feet
0 24 48
Scale in Meters



Sandia National Laboratories, New Mexico
Environmental Geographic Information System

Figure 4
SWMU 46
Characterization
Sample Locations

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

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NFA

Table 1
Location of Analytical Results for SWMU 46 and SWMU 234 Soil Sampling Events

Sampling Event	Response to NMED Comment Number	Attachment
SWMU 46 Geoprobe® Characterization	2	B
SWMU 46 VCA Confirmatory	2	C
SWMU 46 Deep Borehole Characterization	3	D
SWMU 234 Characterization	4	E

NMED = New Mexico Environment Department.
SWMU = Solid Waste Management Unit.
VCA = Voluntary Corrective Action.

recommended by the NMED (Copland November 2003), analytical results for the soil samples from the storm-water ditch are not included in this NOD Response.

However, the soil samples collected at SWMU 46 in 2001 and 2003 are applicable. Geoprobe® characterization samples were collected in August 2001. VCA confirmatory samples were collected in August 2003. Analytical results from both sampling events are discussed as follows.

Geoprobe® Samples

In August 2001, twelve Geoprobe® boreholes were sampled at depths ranging from 3 to 18 feet below ground surface (bgs) (Table 2). The Geoprobe® samples were collected along the outfall ditches near the exposed portion of the acid waste line (Figure 4). Soil samples were collected using transparent butyl-acetate sleeves installed in a split-spoon sampler. Green-stained soil was evident to a depth of 10 feet at 46-BH-02; none of the other boreholes contained stained soil. The analytes consisted of metals, PCBs, VOCs, SVOCs, high-explosive (HE) compounds, and gamma-emitting radionuclides.

Maximum concentrations for the Geoprobe® boreholes are summarized in Tables 3 and 4. Complete results and corresponding method detection limits (MDLs) are presented in Attachment B (Tables B-1 through B-11) using the 12th Round NFA format. For the 12 boreholes, 10 metals exceeded background concentration levels. For example, total chromium was detected at a maximum concentration of 120 milligrams (mg)/kilogram (kg) (Table B-1). MDLs for the metals are listed in Table B-2. The maximum cyanide concentration was 12.7 mg/kg (Table B-1). The maximum total PCB concentration was 841 micrograms (µg)/kg (Table B-3). PCB detection limits are listed in Table B-4. Four VOCs were detected; 2-butanone had the highest concentration at 107 µg/kg (Table B-5). VOC detection limits are listed in Table B-6. Of the 26 detected SVOCs (Table B-7), 13 had low concentration levels that were J qualified (estimated value less than laboratory reporting limit). All but 2 of the 13 remaining SVOCs were less than 1,000 µg/kg. Phenol and bis(2-ethylhexyl) phthalate were detected at 1,590 and 2,040 µg/kg,

Table 2
Geoprobe® Boreholes and Corresponding
Characterization Soil Samples Collected at SWMU 46

Geoprobe® Borehole	Soil Sample Depths (ft bgs)
46-BH-02	4.0, 5.0, 6.0, 7.5, 8.5, 9.5, 12.5, 13.5, 14.0, 16.5, 17.5, 18.0
46-BH-03	4.5, 5.0, 7.0, 8.0, 9.0, 13.0
46-BH-04	3.0, 4.0, 5.0, 8.5, 9.0, 10.5, 11.5, 12.0, 13.0
46-BH-05	4.5, 5.5, 6.0, 7.0, 8.0
46-BH-06	4.5, 5.5, 6.0, 8.5, 9.5, 10.0
46-BH-07	4.5, 5.5, 6.0, 8.5, 9.5, 10.0, 11.5, 12.5, 13.0
46-BH-08	4.5, 5.5, 6.0, 8.5, 9.5, 10.0, 12.0, 13.5, 14.0
46-BH-09	4.5, 5.5, 6.0, 7.5, 8.5, 9.0
46-BH-10	4.5, 5.5, 6.0, 7.0, 8.0, 8.5
46-BH-11	4.5, 5.5, 6.0, 7.0, 8.0, 8.5
46-BH-12	4.5, 5.5, 6.0, 8.0, 8.5, 9.0, 9.5

bgs = Below ground surface.
BH = Borehole.
ft = Foot (feet).
SWMU = Solid Waste Management Unit.

Table 3
Summary of Inorganic Analyses for SWMU 46 Acid Waste Line Characterization Samples and Confirmatory Soil Samples

COC	Maximum Concentration for VCA Trench Confirmatory Soil Samples[a]	Maximum Concentration for VCA Confluence Confirmatory Soil Samples[b]	Maximum Concentration for Geoprobe® Characterization Soil Samples[c]	Maximum Concentration for Deep Borehole Characterization Soil Samples[d]	Maximum Concentration for all SWMU 46 Confirmatory and Characterization Soil Samples	NMED Maximum Background for North Area Supergroup[e]
Metals (mg/kg)						
Antimony	0.724 J	0.583 J	0.602 J	ND	0.724 J	3.9
Arsenic	4.13	**5.23**	3.94	2.8	**5.23**	4.4
Barium	**311**	**330 J**	**572**	139	**572**	200
Beryllium	0.557	0.611	0.54	**0.891**	**0.891**	0.80
Cadmium	**213**	**2.48**	**3.12**	**0.976**	**213**	0.9
Chromium VI	1.61	2.08	NA	0.262	2.08	NS
Chromium-total	**78.7 J**	**26.4**	**120**	**18.5**	**120**	12.8
Cobalt	5.73	5.64	7.93[f]	6.23	7.93[f]	7.1
Copper	**133 J**	**28.3**	**72**	12.9	**133 J**	17
Iron	15,800	13,500	20,900	16,100	20,900	NC
Lead	**66.8 J**	**12.2**	**46**	10.2	**66.8 J**	11.2
Mercury	0.0766	0.0603	0.0175	0.0221 B3, J	0.0766	<0.1
Nickel	**379**	**30.3**	**63.4**	11.7	**379**	25.4
Selenium	0.394 J	ND	0.475 J	**1.28**	**1.28**	<1
Silver	**12.4**	**1**	**16.2**	ND	**16.2**	<1
Thallium	ND	ND	**1.88**	**2.19**	**2.19**	<1.1
Vanadium	**34.7**	**33.5**	**46.5**	27.4	**46.5**	33
Zinc	**149 J**	33.6	64	63.9	**149 J**	76
Cyanide-total	NS	NS	12.7	NA	12.7	NS
Radionuclides (pCi/g)						
Cesium-137	NS	NS	0.0336 U	0.0685 U	0.0685 U	0.084
Thorium-232	NS	NS	NA	**1.91**	**1.91**	1.54

Refer to footnotes at end of table.

Table 3 (Concluded)
Summary of Inorganic Analyses for SWMU 46 Acid Waste Line Characterization Samples and Confirmatory Soil Samples

COC	Maximum Concentration for VCA Trench Confirmatory Soil Samples[a]	Maximum Concentration for VCA Confluence Confirmatory Soil Samples[b]	Maximum Concentration for Geoprobe® Characterization Soil Samples[c]	Maximum Concentration for Deep Borehole Characterization Soil Samples[d]	Maximum Concentration for all SWMU 46 Confirmatory and Characterization Soil Samples	NMED Maximum Background for North Area Supergroup[e]
Tritium (pCi/L)	NS	NS	NA	140	140	420
Uranium-235	NS	NS	**0.209 U**	0.316 U	0.316 U	0.18
Uranium-238	NS	NS	**2.07**	0.946 U	**2.07**	1.3

Note: Values in **bold** exceed background levels.
[a]VCA Trench - Confirmatory Soil Sample Locations: 46-GR-06 through 46-GR-23, and 46-GR-26. Sampling depth range was 0 to 7 ft bgs.
[b]VCA Confluence – SWMU 46 Confirmatory Soil Sample Locations: 46-GR-24 and 46-GR-25; SWMU 234 Characterization Soil Sample Locations: 234-GR-07 and 234-GR-08. Sampling depth range was 0 to 12 ft bgs.
[c]Geoprobe® Confirmatory Soil Sample Locations: Boreholes 46-BH-02 through 46-BH-12. Sampling depth range was 3 to 18 ft bgs.
[d]Deep boreholes: TJA-6 and 46-VW-01. Sampling depth range was 45 to 295 ft bgs.
[e]Dinwiddie September 1997; lowest maximum background concentration for subsurface and/or surface soil.
[f]Does not exceed subsurface maximum background of 8.8 mg/kg.

B3 = Analyte detected in the associated initial calibration blank or continuing calibration blank.
bgs = Below ground surface.
BH = Borehole.
COC = Constituent of concern.
ft = Foot (feet).
GR = Grab sample.
J = Estimated concentration.
mg/kg = Milligram(s) per kilogram.
NA = Not analyzed.
NC = Not calculated.
ND = Not detected.
NMED = New Mexico Environment Department.
NS = Not sampled (analyte was screened out for consideration by previous sampling results).
pCi/g = Picocurie(s) per gram.
pCi/L = Picocurie(s) per liter.
SWMU = Solid Waste Management Unit.
TJA = Tijeras Arroyo.
U = The analyte was analyzed for but was not detected.
VCA = Voluntary Corrective Action.
VW = Vapor Well.

Table 4
Summary of Organic Analyses for SWMU 46 Acid Waste Line Characterization Samples and Confirmatory Soil Samples

COC	Maximum Concentration for VCA Trench Confirmatory Soil Samples[a]	Maximum Concentration for VCA Confluence Confirmatory Soil Samples[b]	Maximum Concentration in Geoprobe® Confirmatory Soil Samples[c]	Maximum Concentration in Deep Borehole Confirmatory Soil Samples[d]	Maximum Concentration for all SWMU 46 Confirmatory and Characterization Soil Samples
VOCs (µg/kg)					
Acetone	ND	ND	2.35 J	13.2	13.2
2-Butanone	ND	ND	107	56.9 J	107
Methylene chloride	ND	ND	7.04	3.85 J	7.04
Toluene	ND	ND	17	0.998 J	17
SVOCs (µg/kg)					
Acenaphthene	ND	6.26 J	5.69 J	ND	6.26 J
Acenaphthylene	ND	ND	4.06 J	ND	4.06 J
Anthracene	ND	21.2 J	18.5 J	ND	21.2 J
Benzo(a)anthracene	121	258	49.5	ND	258
Benzo(a)pyrene	197	435	82.4	ND	435
Benzo(b)fluoranthene	300	506	149	ND	506
Benzo(g,h,i)perylene	99.7	309	47.1	ND	309
Benzo(k)fluoranthene	139	471	64.1	ND	471
Butylbenzylphthalate	ND	ND	56.5 J	ND	56.5 J
Carbazole	ND	18.2 J	10.9 J	ND	18.2 J
2-Chlorophenol	ND	ND	8.35 J	ND	8.35 J
Chrysene	220	435	68.8	ND	435
Di-n-butylphthalate	26.2 J	20.7 J	49.5 J	ND	49.5 J
Di-n-octylphthalate	ND	10.2 J	ND	ND	10.2 J
Diethylpthalate	87.7 J	ND	ND	ND	87.7 J
Dibenzofuran	ND	ND	9.4 J	ND	9.4 J
1,2-Dichlorobenzene	ND	ND	4.51 J	ND	4.51 J
1,3-Dichlorobenzene	ND	ND	4.86 J	ND	4.86 J
Diphenylamine	ND	ND	7.3 J	ND	7.3 J
bis(2-Ethylhexyl) phthalate	825	141 J	2,040	1,070 J	2,040
Fluoranthene	267 J	450	106	ND	450
Fluorene	4.79 J	6.66 J	14 J	ND	14 J
Hexachlorobenzene	ND	ND	5.7 J	ND	5.7 J

Refer to footnotes at end of table.

Table 4 (Concluded)
Summary of Organic Analyses for SWMU 46 Acid Waste Line Characterization Samples and Confirmatory Soil Samples

COC	Maximum Concentration for VCA Trench Confirmatory Soil Samples[a]	Maximum Concentration for VCA Confluence Confirmatory Soil Samples[b]	Maximum Concentration in Geoprobe® Confirmatory Soil Samples[c]	Maximum Concentration in Deep Borehole Confirmatory Soil Samples[d]	Maximum Concentration for all SWMU 46 Confirmatory and Characterization Soil Samples
Indeno(1,2,3-cd)pyrene	90.9	345 J	39	ND	345 J
Naphthalene	ND	ND	3.45 J	ND	3.45 J
Phenanthrene	81.8	139	68.2	ND	139
Phenol	ND	ND	1,590	6.69 J	1,590
Pyrene	213	603	98	ND	603
HE Compound (µg/kg)					
2-Nitrotoluene	NS	NS	15.2	ND	15.2
Total PCBs[e] (µg/kg)	129.8	ND	841	ND	841

[a]VCA Trench—Confirmatory Soil Sample Locations: 46-GR-06 through 46-GR-23, and 46-GR-26. Sampling depth range was 0 to 7 ft bgs.
[b]VCA Confluence—SWMU 46 Confirmatory Soil Sample Locations: 46-GR-24 and 46-GR-25; SWMU 234 Characterization Soil Sample Locations: 234-GR-07 and 234-GR-08. Sampling depth range was 0 to 12 ft bgs.
[c]Geoprobe® Confirmatory Soil Sample Locations : boreholes 46-BH-02 through 46-BH-12. Sampling depth range was 3 to 18 ft bgs.
[d]Deep boreholes: TJA-6 and 46-VW-01. Sampling depth range was 45 to 295 ft bgs.
[e]Total PCBs is the summed value of Aroclor-1016, Aroclor-1221, Aroclor-1232, Aroclor-1242, Aroclor-1248, Aroclor-1254, and Aroclor-1260.

bgs = Below ground surface.
BH = Borehole.
COC = Constituent of concern.
ft = Foot (feet).
GR = Grab sample.
HE = High explosive(s).
J = Estimated concentration.
µg/kg = Microgram(s) per kilogram, equivalent to parts per billion.
ND = The analyte was analyzed for but was not detected.
NS = Not sampled (analyte was screened out for consideration by previous sampling results).
PCB = Polychlorinated biphenyl.
SVOC = Semivolatile organic compound.
SWMU = Solid Waste Management Unit.
TJA = Tijeras Arroyo.
VCA = Voluntary Corrective Action.
VOC = Volatile organic compound.
VW = Vapor Well.

respectively. SVOC detection limits are listed in Table B-8. The HE compound 2-nitrotoluene was detected at 15.2 µg/kg (Table B-9); no other HE compounds were detected using the MDLs listed in Table B-10. Radionuclides (gamma emitters) were within, or similar to, background activities (Table B-11).

VCA Remediation and Confirmatory Sampling

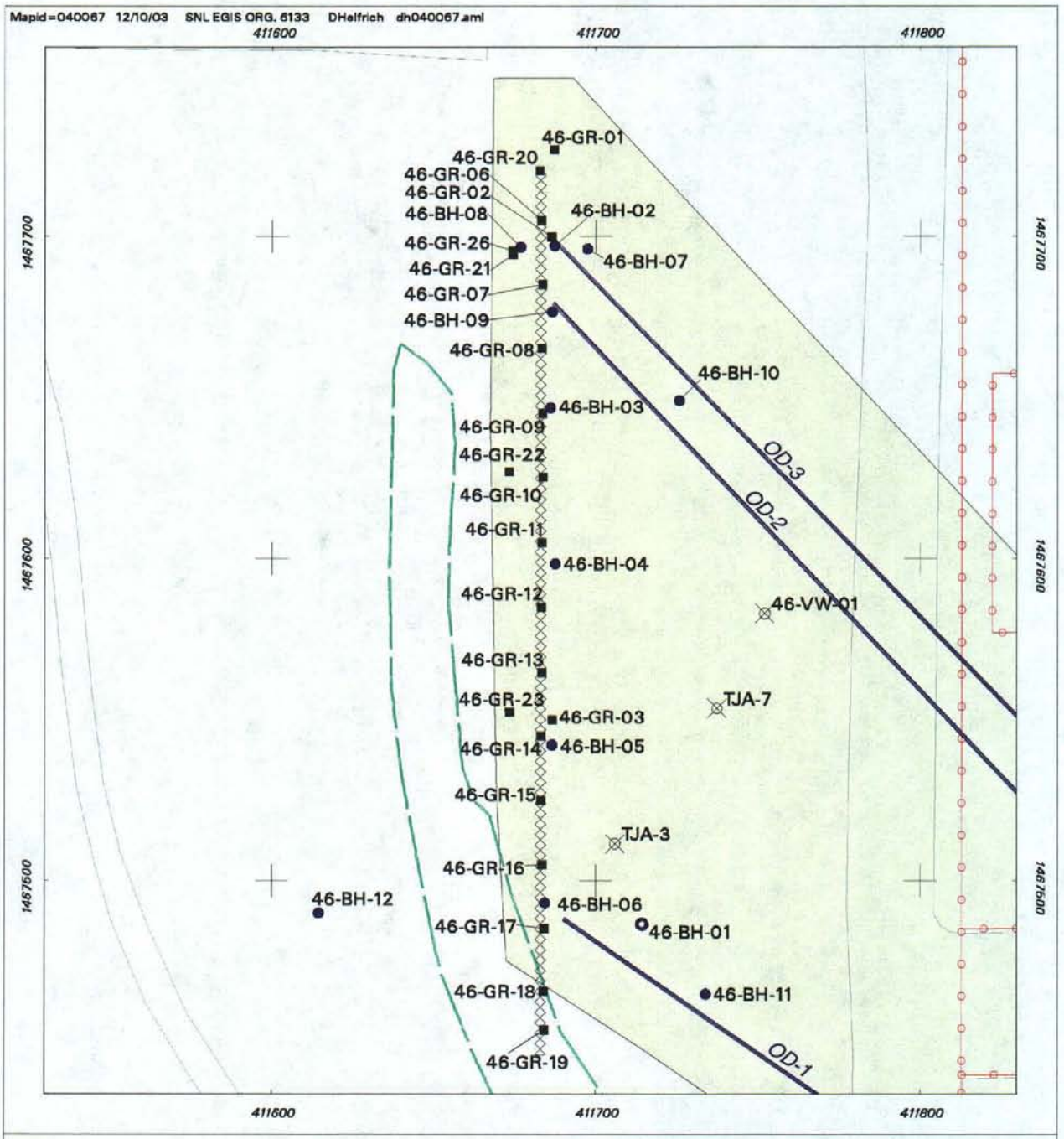
In August 2003, a VCA was conducted at SWMU 46 for the purpose of removing contaminated soil and collecting additional confirmatory soil samples suitable for risk assessment purposes (SNL/NM August 2003). Attachment A contains the SWMU 46 VCA Plan, which was used to guide the field activities. Preliminary remediation goals were calculated in accordance with NMED guidance (NMED December 2000) for an industrial land-use scenario, which is the designated land use for SWMU 46. The VCA was primarily designed to remove soil containing elevated concentrations of metals. The VCA also addressed the need to remove soil that contained PCBs exceeding the SNL/NM Environmental Restoration (ER) Project voluntary cleanup level for total PCBs of 1 mg/kg. Previous analytical results had demonstrated that two sampling locations from the interior of the acid waste line (sloughed soil samples 46-GR-02 and 46-GR-03) contained significant contamination (Attachment A). For example, soil samples from Locations 46-GR-02 and 46-GR-03 contained total PCBs at 49.9 and 6.17 mg/kg, respectively.

The principal VCA activity consisted of using an excavator to remove the exposed portion of the acid waste line along with the sloughed soil contained within the line. The resulting VCA remediation trench extended north to south and had a width of approximately 2.5 feet (the width of the excavator bucket) (Figure 5). An underlying 0.5-foot layer of soil was removed from the beneath the line. As a result, the trench depth varied from 2 to 0.8 feet, becoming more shallow toward the southern end of the acid waste line where the waste water had previously discharged.

As shown in Figure 6, the VCA remediation trench cut across the starting point of all three outfall ditches (OD-1, OD-2, and OD-3) and had a length of approximately 275 feet. The northern limit of the trench was selected to be the approximate midpoint between Sample Location 46-GR-01 (where the waste line was known to be intact with no sloughed soil being present in the waste line) and Sample Location 46-GR-02 (where elevated concentrations of COCs were present in sloughed soil). The southern limit of the trench was the farthest end of the acid waste line as determined by historic aerial photographs (SNL/NM August 2003, Attachment A).

As noted in Table 5, a hand trowel was used to sample the VCA confirmatory sampling locations (46-GR-06 through 46-GR-20) from the trench floor at a lateral spacing of approximately 20 feet. Samples from the trench floor consisted of undisturbed, stiff, brownish, clayey sand. A backhoe was used to collect soil samples from 5 feet below the trench floor at three locations (46-GR-07, 46-GR-12, and 46-GR-17). As shown in

Figure 5
Handheld photograph showing the VCA remediation trench at SWMU 46. Roll-off bins for waste (contaminated soil and pipe pieces) are located along east side of trench.
View to the south, August 2003.



Legend

- Grab Sample
- Test Borehole
- Geoprobe Borehole
- Monitor Well
- VCA Remediation Trench
- Fence
- Unpaved Road
- Outfall Ditch (OD)
- Storm Water Ditch (Abandoned)
- SWMU 46

Figure 6
VCA Remediaton Trench and Confirmatory Sampling Locations at SWMU 46

0 25 50
Scale in Feet

0 6 12
Scale in Meters

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Table 5
Confirmatory Soil Samples Collected During the SWMU 46 VCA

VCA Confirmatory Sample Location	Depth (ft) measured from surrounding ground surface	Sample Device	Depth (ft) measured from floor of VCA remediation trench
Remediation Trench			
46-GR-06-2'-S	2	HT	0
46-GR-07-2'-S	2	HT	0
46-GR-07-5'-S	7	B	5
46-GR-08-1.5'-S	1.5	HT	0
46-GR-09-2'-S	2	HT	0
46-GR-10-1.3'-S	1.3	HT	0
46-GR-11-1.5'-S	1.5	HT	0
46-GR-12-1.3'-S	1.3	HT	0
46-GR-12-5'-S	6.3	B	5
46-GR-13-1.5'-S	1.5	HT	0
46-GR-14-1'-S	1	HT	0
46-GR-15-1'-S	1	HT	0
46-GR-16-0.8'-S	0.8	HT	0
46-GR-17-0.7'-S	0.7	HT	0
46-GR-17-0.7'-duplicate	0.7	HT	0
46-GR-17-5'-S	5.7	B	5
46-GR-18-0.5'-S	0.5	HT	0
46-GR-19-0.5'-S	0.5	HT	0
46-GR-20-2.5'-S	2.5	HT	0
46-GR-21-0'-S	0	HT	NA
46-GR-21-0.1'-S	0.1	HT	NA
46-GR-21-0.1'-duplicate	0.1	HT	NA
46-GR-22-0'-S	0	HT	NA
46-GR-23-0'-S	0	HT	NA
46-GR-26-0'-S	0	HT	NA
Surviving segments of Outfall Ditches OD-1 and OD-2	Depth (ft) measured from surrounding ground surface	Sample Device	Depth (ft) measured from floor of outfall ditch
46-GR-24-0'-S	2	HT	0
46-GR-24-2'-S	4	B	2
46-GR-24-5'-S	7	B	5
46-GR-24-5'-duplicate	7	B	5
46-GR-25-0'-S	2	HT	0
46-GR-25-2'-S	4	E	2
46-GR-25-5'-S	7	E	5
46-GR-25-10'-S	12	E	10

B = Backhoe bucket.
E = Excavator bucket.
ft = Foot (feet).
GR = Grab sample.
HT = Hand trowel.
NA = Not applicable (background sample is located outside of the VCA remediation trench).
OD = Outfall Ditch.
S = Soil sample.
SWMU = Solid Waste Management Unit.
VCA = Voluntary Corrective Action.

Figure 6, soil samples also were collected outside the trench at four undisturbed background locations (46-GR-21, 46-GR-22, 46-GR-23, and 46-GR-26). Samples from the background locations consisted of yellowish, aeolian sand.

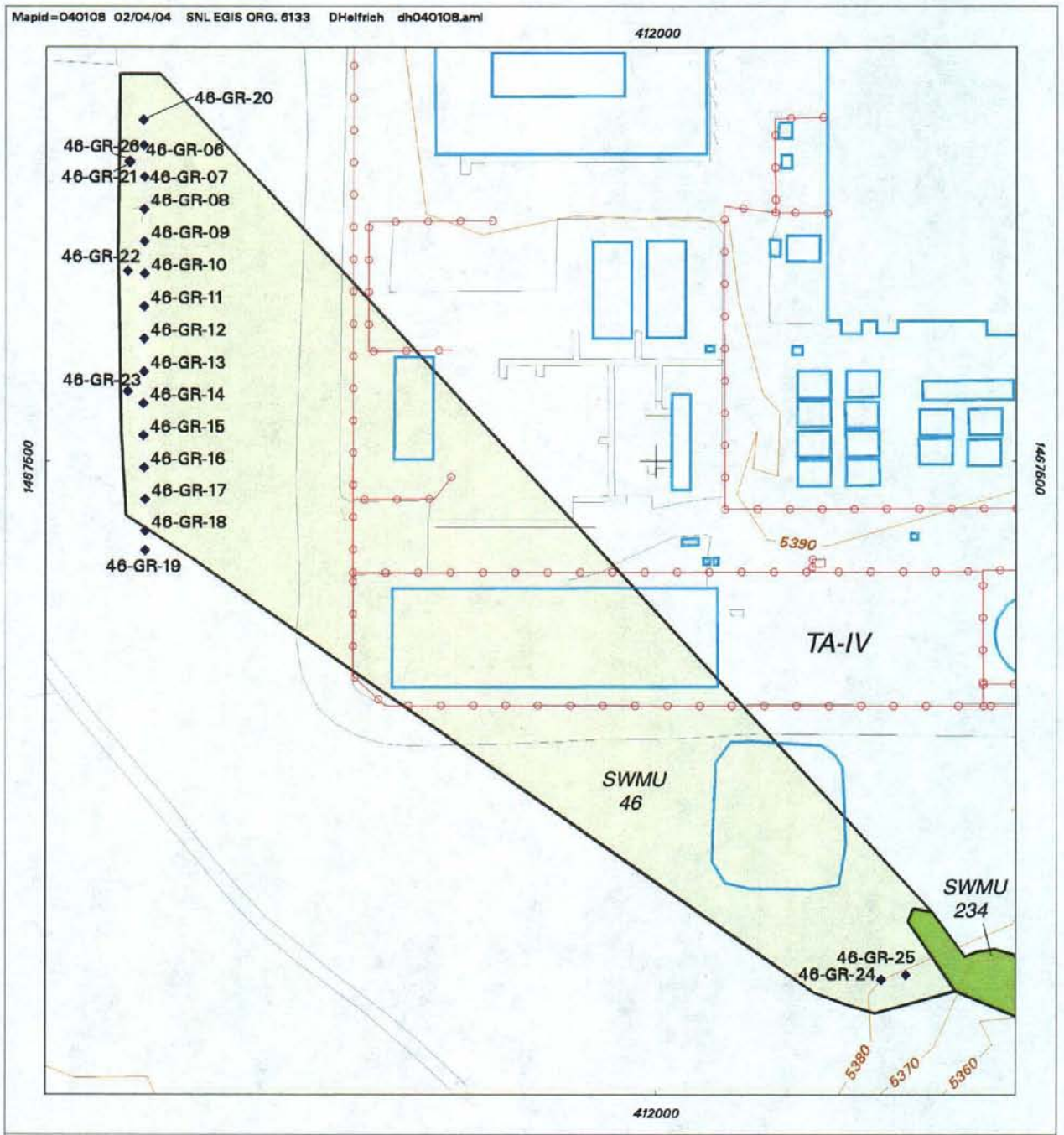
Approximately 50 cubic yards of excavated soil and pieces of VCP were placed into a series of roll-off bins. After waste-characterization samples were evaluated, the roll-off bins were shipped to an off-site waste disposal facility. The waste was categorized as nonregulated. None of the excavated soil or VCP pieces were returned to the ground surface. In February 2004, the VCA remediation trench was backfilled with clean, off-site soil.

Confirmatory soil samples also were collected from the two surviving segments of outfall ditches at the southeast (confluence) end of the site (Figure 7). Locations 46-GR-24 and 46-GR-25 were sampled at Outfall Ditches OD-1 and OD-2, respectively (Table 5). Samples of loose sand were collected from the floor of each ditch with a hand trowel. A hard layer of stratified (undisturbed) gravel was present at a depth of 0.5 feet bgs, necessitating the use of heavy equipment for collecting deeper samples. A backhoe was used to sample Location 46-GR-24 at depths of 2 and 5 feet bgs. The samples consisted of undisturbed, stiff, brownish clay with caliche streaks. Subsurface samples at Outfall Ditch OD-2 were collected with an excavator because of the steep terrain (Figure 8). Location 46-GR-25 was sampled at depths of 2, 5, and 10 feet bgs; the three samples consisted of brownish-white, clayey sand.

Samples were not collected from Outfall Ditch OD-3 as part of the VCA activities because the ditch had been destroyed by TA-IV construction activities in the 1990s. However, certain soil samples from the SWMU 234 characterization sampling are applicable to OD-3 (See SNL/NM Response to Comment 4).

During excavation and sampling activities, a photoionization detector was used for the field screening of confirmatory soil samples; no VOCs were detected. Fourteen field-screening soil samples collected from the trench floor were sent to a local off-site laboratory (Hall Laboratories in Albuquerque, New Mexico) for 48-hour turnaround. The maximum total PCB concentration was 0.25 mg/kg, which is below the voluntary SNL/NM cleanup level of 1 mg/kg.

Soil samples from the VCA remediation trench revealed nine metals above background levels. Maximum concentrations are listed in Tables 3 and 4. Complete results and corresponding MDLs for all analytes are presented in Attachment C (Table C-1 through C-8). Of the nine metals, cadmium was the most significant having a maximum concentration of 213 mg/kg, which exceeds the background level of 0.9 mg/kg (Table C-1). The sample locations for all metal detections are listed in Table F-1 (Attachment F). MDLs for the Target Analyte List (TAL) metals are listed in Table C-2. The maximum total PCB concentration was 129.8 µg/kg (Table C-3). PCB detection limits are listed in Table C-4. No unqualified VOCs were detected (Table C-5). VOC detection limits are listed in Table C-6. Low levels of 13 SVOCs were detected;



Legend

- Soil Sample Location
- Fence
- Pavement / Unpaved Road
- Building / Structure
- SWMU 46
- SWMU 234

Figure 7
Confirmatory Soil Sample Locations for SWMU 46 Voluntary Corrective Action

0 50 100
Scale in Feet

0 12 24
Scale in Meters

N

GIS

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

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Figure 8
Handheld photograph showing confirmatory soil sampling at the SWMU 46 confluence.
Technician is measuring depth of soil sample at Outfall Ditch OD-2.
Outfall Ditch OD-1 is visible in left corner of photograph.
View to the northwest, August 2003.

bis(2-ethylhexyl) phthalate had the maximum concentration at 825 µg/kg (Table C-7). SVOC detection limits are listed in Table C-8.

Lower concentrations of COCs were detected at the VCA confluence sampling locations (46-GR-24 and 46-GR-25). Soil samples collected at the confluence included nine metals above background levels. Maximum concentrations are summarized in Tables 3 and 4. Complete results and corresponding MDLs are presented in Attachment C. The maximum cadmium concentration was 2.48 mg/kg, which is above the background level of 0.9 mg/kg. Of the nine metals, total chromium was most significant having a maximum concentration of 26.4 mg/kg, which exceeds the background concentration of 12.8 mg/kg (Table C-1). The MDLs for metals are listed in Table C-2. No PCBs were detected (Table C-3) using the MDLs listed in Table C-4. No VOCs were detected (Table C-5) using the MDLs listed in Table C-6. Low levels of 17 SVOCs were detected; pyrene had the maximum concentration at 603 µg/kg (Table C-7). SVOC detection limits are listed in Table C-8.

No significant quality assurance (QA)/quality control (QC) issues were identified in the confirmatory results. However, the PCB detections for TJAOU-46-GR-21-0.0-S are considered to be suspect because this sample was collected at a background location (46-GR-21) outside the VCA remediation trench (Figure 7). This soil sample was collected from a depth of 0 to 0.1 feet bgs in August 2003. The PCB detections for Aroclor-1242, Aroclor-1254, and Aroclor-1260 were 916, 1,760, and 532 µg/kg, respectively (Table C-3). All three values were flagged with the qualifiers A1 and J (laboratory accuracy and/or bias measurements for the associated surrogate spike do not meet acceptance criteria and the associated value is an estimated quantity, respectively). To further evaluate the suspect PCB detections, Location 46-GR-21 was resampled in November 2003. The divot where the August 2003 sample was collected was still present in November 2003, and Sample TJAOU-46-GR-21-0.1-S was collected from 0.1 to 0.2 feet bgs. A duplicate (TJAOU-46-GR-21-0.1-D) also was collected. A surface soil sample (TJAOU-46-GR-26-0.0-S) was collected at approximately 1 foot north of the divot. For the three November 2003 samples (TJAOU-46-GR-21-0.1-S, TJAOU-46-GR-21-0.1-D, and TJAOU-46-GR-26-0.0-S), the maximum PCB concentration was Aroclor-1254 at 2.05 J µg/kg (Attachment C). Therefore, the analytical results for the August 2003 soil sample, TJAOU-46-GR-21-0.0-S, are not considered representative of site conditions, and are therefore not used in the risk assessments in response to NMED Comment 8.

3. **Collect deep soil samples and vapor samples at ER Sites 46 and 227. Two 150-ft deep boreholes should be drilled at ER Site 46; one similar borehole should be drilled at ER Site 227. The soil-vapor monitor wells will be permanent installations. Soil samples will be analyzed for radiological constituents, metals, volatile organic compounds, semi-volatile organic compounds, high explosives, hexavalent chromium, iron, and chloride.**

Response: Sampling results for SWMU 227 were submitted in a separate NOD response (SNL/NM July 2003). This response addresses the analytical results for deep soil samples collected at SWMU 46.

In January and March 2001, characterization soil samples were collected from deep boreholes located at both ends of SWMU 46 (Figure 4). Soil samples were collected at the northern end of the site from the 46-VW-01 borehole at 50-foot intervals ranging from 45 to 295 feet bgs (Table 6). Soil samples were collected at the southern end of the site from the TJA-6 borehole at 50-foot intervals ranging from 45 to 245 feet bgs. The analytes consisted of metals, PCBs, VOCs, SVOCs, HE, and gamma-emitting radionuclides.

Table 6
Characterization Soil Samples Collected From Deep Boreholes at SWMU 46

Sample Location	Sample Depths (ft bgs)
46-VW-01	45
	95
	145
	195
	245
	295
TJA-6	45
	95
	145
	245

bgs = Below ground surface.
ft = Foot (feet).
SWMU = Solid Waste Management Unit.
TJA = Tijeras Arroyo.
VW = Vapor Well.

The analytical results for the 46-VW-01 and the TJA-6 soil samples show no significant contamination. The maximum concentrations are summarized in Tables 3 and 4. Complete results and corresponding MDLs are presented in Attachment D (Tables D-1 through D-9). Metals concentrations are within, or similar to, background levels (Table D-1). For example, cadmium was detected at a maximum concentration of 0.976 mg/kg, which slightly exceeds the background cadmium value of 0.9 mg/kg. MDLs for the TAL metals are listed in Table D-2. No PCBs were detected using the MDLs listed in Table D-3. Low concentration levels of four VOCs (acetone, 2-butanone, methylene chloride, and toluene) were detected (Table D-4). The highest VOC concentration was 2-butanone at 56.9 J µg/kg. Trichloroethylene (TCE) was not detected. VOC detection limits are listed in Table D-5. Two SVOCs (bis[2-ethylhexyl] phthalate and phenol) were detected; bis(2-ethylhexyl) phthalate had the maximum SVOC concentration at 1,070 µg/kg (Table D-6). SVOC detection limits are listed in Table D-7. HE compounds were not detected using the MDLs listed in Table D-8. Gamma-emitting

radionuclides and tritium were within background activities (Tables D-9 and D-10, respectively).

Two soil-vapor sampling investigations involving deep (greater than 150 feet bgs) boreholes have been conducted at SWMU 46. The first involved collecting soil-vapor samples from the pilot borehole for TJA-3, which is the groundwater monitoring well that was installed at the north end of SWMU 46 in August 1998 (Skelly August 2002). Soil-vapor samples were collected from six depths (37, 97, 137, 197, 237, and 312 feet bgs) with a Simulprobe™ sampler driven ahead of the drill string. Low to high concentration levels of 16 VOCs were detected in the soil-vapor samples. TCE had the maximum concentration in soil vapor at 10,000 parts per billion by volume (ppbv) in the sample from 137 feet bgs. However, the TCE concentration at 197 feet bgs was 320 ppbv. Methylene chloride had the second highest VOC concentration at 620 ppbv in the sample from 137 feet bgs.

To better quantify the VOC concentrations in soil vapor, a second soil-vapor investigation installed two soil-vapor monitoring wells, 46-VW-01 and 46-VW-02, at the northern and southern ends of SWMU 46, respectively (Figure 4). The boreholes were advanced using air-rotary casing hammer techniques. The monitoring wells were equipped with Flexible Liner Underground Technology™ systems with sampling ports set at 50-foot-intervals. The sampling ports for Monitoring Well 46-VW-01 were set at 15, 65, 115, 165, 215, and 265 feet bgs. The sampling ports for Monitoring Well 46-VW-02 were set at 46, 96, 146, 196, 246, and 296 feet bgs. Soil vapor samples were collected for five quarters (April 2001 through March 2002) using Summa™ canisters (Tables 7 and 8). The samples were analyzed by an off-site laboratory (Quanterra/Severn Trent, California) using U.S. Environmental Protection Agency (EPA) Method TO-14.

Soil-Vapor Monitoring Well 46-VW-01 is located at the northern end of SWMU 46 approximately 110 feet from the starting point for Outfall Ditch OD-1 (Figure 4). For the five quarters, the maximum TCE concentration from Monitoring Well 46-VW-01 was 46,000 ppbv, collected from a depth of 115 feet bgs (Table 7). As shown in Figure 9, soil-vapor samples from the 115-foot-bgs sampling port consistently yielded the greatest concentration each quarter (Skelly August 2003). The deepest sampling port at 265 feet bgs in Monitoring Well 46-VW-01 yielded a maximum TCE concentration of 350 ppbv. TCE comprised the bulk of total VOCs detected in the soil-vapor samples for all six sample ports. The percentage of total VOC concentrations attributable to TCE ranged from 56.7 to 98.3 percent. For total VOC concentrations exceeding 1,000 ppbv, TCE accounted for 89.9 to 98.3 percent of total VOCs.

Monitoring Well 46-VW-02 is located approximately 190 feet east of the ravine where waste water flowed down the northern rim of Tijeras Arroyo. The ground elevation at Monitoring Well 46-VW-02 is approximately 44 feet lower than Monitoring Well 46-VW-01. For the five quarters, much lower VOC concentrations were present in soil-vapor samples collected from Monitoring Well 46-VW-02 (Table 8). TCE comprised the majority of total VOCs detected in the soil-vapor samples. The maximum TCE concentration from Monitoring Well 46-VW-02 was 650 ppbv, which was collected from a depth of 96 feet bgs (Figure 10). For four of the five quarters, the highest TCE

Table 7
TCE and Total VOC Concentrations in Soil-Vapor Samples
Collected from Monitoring Well 46-VW-01

Quarterly Event	Sample ID	Sample Depth (ft bgs)	TCE Concentration (ppbv)	Total VOCs (ppbv)	Percentage of Total VOCs comprised of TCE
April 2001 AR/COC 604434	46-VW-01-SV-015	15	610	642.5	94.9
	46-VW-01-SV-065	65	11,000	11,593	94.9
	46-VW-01-SV-115	115	46,000	48,380	95.1
	46-VW-01-SV-115-SD	115	45,000	47,630	94.5
	46-VW-01-SV-165	165	17,000	18,080	94.0
	46-VW-01-SV-215	215	540	647	83.5
	46-VW-01-SV-265	265	140	243.9	56.7
June 2001 AR/COC 604643	46-VW-01-SV-015	15	800	834.7	95.8
	46-VW-01-SV-065	65	11,000	11,500.5	95.6
	46-VW-01-SV-115	115	34,000	35,900	94.7
	46-VW-01-SV-115-SD	115	34,000	35,310	96.3
	46-VW-01-SV-165	165	18,000	19,290	93.3
	46-VW-01-SV-215	215	650	681.3	95.4
	46-VW-01-SV-265	265	66	86.3	76.5
September 2001 AR/COC 604921	46-VW-01-SV-015	15	1,100	1,118.9	98.3
	46-VW-01-SV-065	65	11,000	11,504	95.6
	46-VW-01-SV-115	115	45,000	46,770	96.2
	46-VW-01-SV-115-SD	115	45,000	46,790	96.2
	46-VW-01-SV-165	165	21,000	22,060	95.2
	46-VW-01-SV-215	215	820	870.3	94.2
	46-VW-01-SV-265	265	280	298.4	93.8
December 2001 AR/COC 605162	46-VW-01-SV-015	15	2,200	2,258.9	97.4
	46-VW-01-SV-065	65	12,000	12,523	95.8
	46-VW-01-SV-115	115	37,000	38,460	96.2
	46-VW-01-SV-165	165	16,000	16,850	95.0
	46-VW-01-SV-215	215	870	912.4	83.0
	46-VW-01-SV-265	265	350	387.3	90.4
March 2002 AR/COC 605407	46-VW-01-SV-015	15	1,500	1,532.9	97.9
	46-VW-01-SV-065	65	11,000	12,235	89.9
	46-VW-01-SV-115	115	46,000	47,530	96.8
	46-VW-01-SV-165	165	21,000	21,938	95.7
	46-VW-01-SV-215	215	1,100	1,141.6	96.4
	46-VW-01-SV-265	265	170	185.7	91.5

AR/COC = Analysis request/chain-of-custody record.
bgs = Below ground surface.
ft = Foot (feet).
ID = Identification number.
ppbv = Parts per billion on a volume-per-volume basis.
SD = Duplicate sample of soil vapor.
SV = Soil Vapor.
TCE = Trichloroethylene.
VOC = Volatile organic compound.
VW = Vapor Well (monitoring).

Table 8
TCE and Total VOC Concentrations in Soil-Vapor Samples
Collected from Monitoring Well 46-VW-02

Quarterly Event	Sample ID	Sample Depth (ft bgs)	TCE Concentration (ppbv)	Total VOCs (ppbv)	Percentage of Total VOCs comprised of TCE
April 2001 AR/COC 604434	46-VW-02-SV-046	46	120	143.4	83.7
	46-VW-02-SV-096	96	250	279	89.6
	46-VW-02-SV-146	146	4.6	14.7	31.3
	46-VW-02-SV-146-SD	146	4.5	19.7	22.8
	46-VW-02-SV-196	196	9.5	26.9	35.3
	46-VW-02-SV-246	246	59	79.8	73.9
June 2001 AR/COC 604643	46-VW-02-SV-046	46	170	189.5	89.7
	46-VW-02-SV-096	96	380	391.9	97.0
	46-VW-02-SV-146	146	22	24.6	89.4
	46-VW-02-SV-196	196	440	462.3	95.2
	46-VW-02-SV-246	246	420	450.9	93.1
September 2001 AR/COC 604921	46-VW-02-SV-046	46	370	378.2	97.8
	46-VW-02-SV-096	96	560	598.3	93.6
	46-VW-02-SV-146	146	170	194.8	87.3
	46-VW-02-SV-196	196	210	239.4	87.7
	46-VW-02-SV-246	246	480	503.0	95.4
December 2001 AR/COC 605162	46-VW-02-SV-046	46	350	366.4	95.5
	46-VW-02-SV-096	96	650	702.6	92.5
	46-VW-02-SV-096-SD	96	570	599.6	95.1
	46-VW-02-SV-146	146	520	560.9	92.7
	46-VW-02-SV-196	196	130	150.3	86.5
	46-VW-02-SV-246	246	300	328	91.5
March 2002 AR/COC 605407	46-VW-02-SV-046	46	220	232.7	94.5
	46-VW-02-SV-046-SD	46	210	234.4	89.6
	46-VW-02-SV-096	96	400	417.5	95.8
	46-VW-02-SV-146	146	200	239.6	83.5
	46-VW-02-SV-196	196	100	126	79.4
	46-VW-02-SV-246	246	160	173.8	92.1

AR/COC = Analysis request/chain-of-custody record.
bgs = Below ground surface.
ft = Foot (feet).
ID = Identification number.
ppbv = Parts per billion on a volume-per-volume basis.
SD = Duplicate sample of soil vapor.
SV = Soil Vapor.
TCE = Trichloroethylene.
VOC = Volatile organic compound.
VW = Vapor Well (monitoring).

Site-Specific Comments

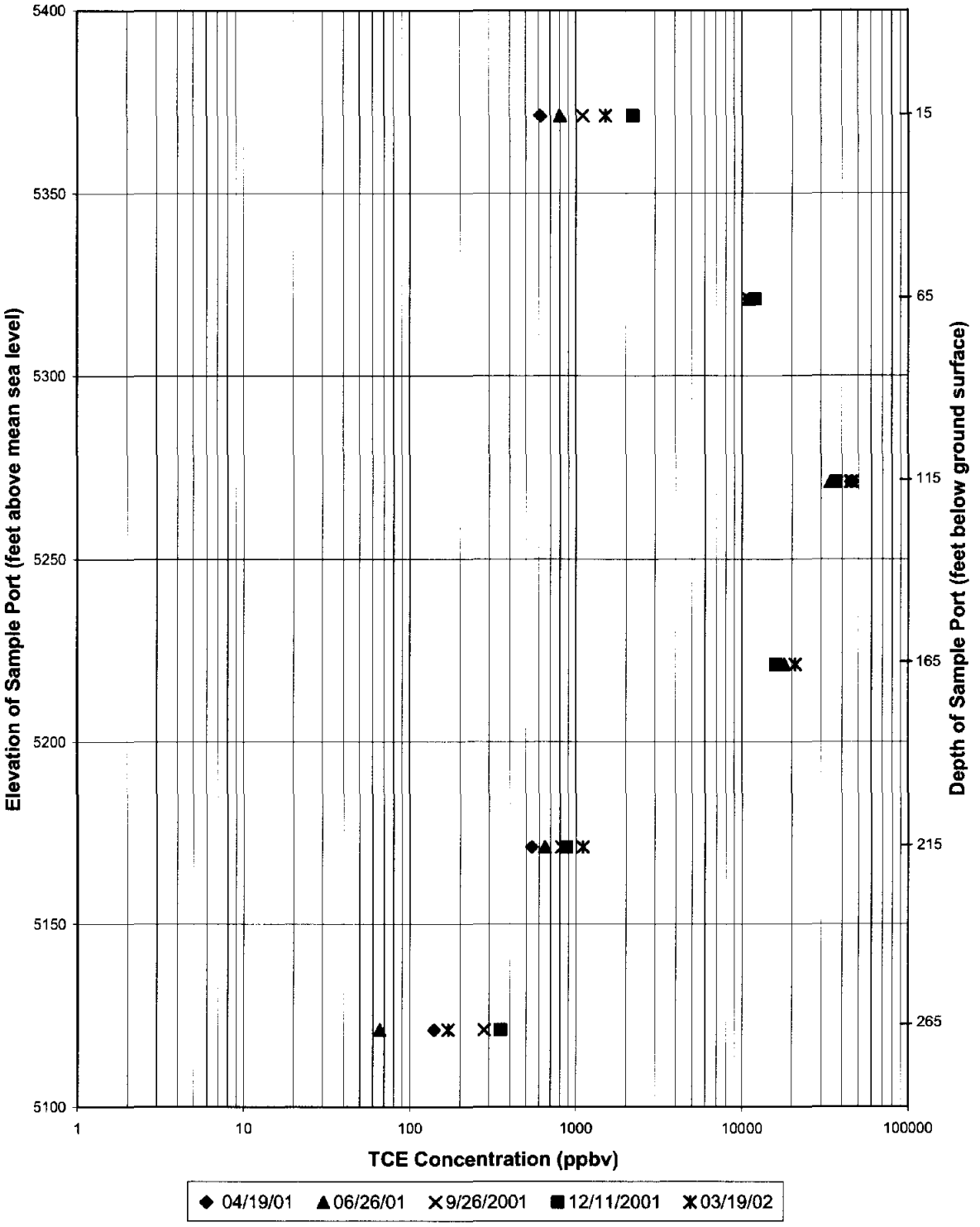

Figure 9
TCE Concentrations in Soil Vapor Samples Collected from
Monitoring Well 46 VW-01 from April 2001 through March 2002

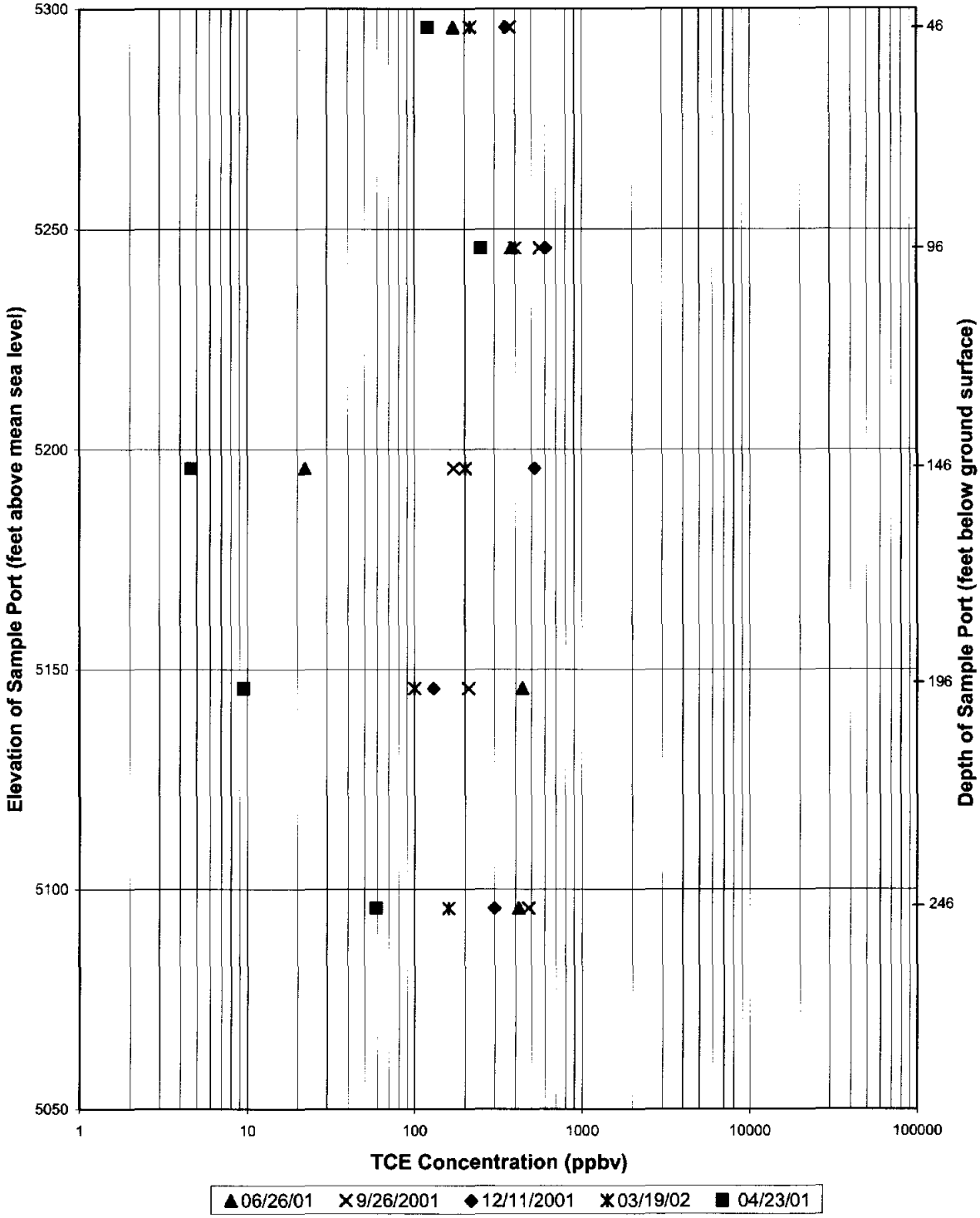

Figure 10
TCE Concentrations in Soil Vapor Samples Collected from
Monitoring Well 46-VW-02 from April 2001 through March 2002

concentrations were reported for the 96-foot-bgs sample port. The percentage of total VOC concentrations attributable to TCE ranged from 22.8 to 97.8 percent. For total VOC concentrations exceeding 100 ppbv, TCE accounted for 79.4 to 97.8 percent. The deepest sampling port at 246 feet bgs in Monitoring Well 46-VW-02 yielded a maximum TCE concentration of 480 ppbv for the five quarters.

To summarize the results for all five quarters, 22 VOCs were detected in soil-vapor samples collected from the two soil-vapor monitoring wells at SWMU 46, but most of the VOC concentrations were J-qualified values. The maximum total VOC concentrations at Monitoring Wells 46-VW-01 and 46-VW-02 were 48,380 and 703 ppbv, respectively (Tables 7 and 8). For perspective, the soil-vapor investigation at the SNL/NM Chemical Waste Landfill (CWL) used an NMED-approved, 100,000 ppbv threshold for defining the total VOC plume edge (Sisneros February 1993). The NMED has not specified a threshold value for SWMU 46. Because the SWMU 46 maximum total VOC concentration is less than the CWL threshold, additional soil-vapor characterization at SWMU 46 does not appear to be necessary.

4. **Collect shallow subsurface soil samples at each storm drain outfall (two boreholes at each location at maximum depths of 5 ft). The soil samples will be analyzed for radiological constituents, metals, volatile organic compounds, semi-volatile organic compounds, and high explosives.**

Response: SWMU 46 is not a storm-drain outfall. However, shallow soil samples were collected for the SWMU 46 waste-water outfall ditches as part of two sampling events, the SWMU 46 VCA and the SWMU 234 characterization sampling. The analytical results of the SWMU 46 VCA confirmatory sampling are discussed in the SNL/NM response to NMED Comment 2.

The northernmost SWMU 234 soil sample locations (234-GR–07 and 234-GR–08) are useful for evaluating SWMU 46 because these soil samples were collected from undisturbed soil where Outfall Ditch OD-3 was previously located (Figure 4). The SWMU 234 samples were collected in June 2001 for inclusion in the NOD Response for SWMUs 230 through 234 (SNL/NM December 2002).

Soil samples from Locations 234-GR-07 and 234-GR-08 were collected from a depth of 5 feet bgs and consisted of undisturbed, clayey sand (Table 9). Because of the steep terrain and a gravel/cobble horizon, a backhoe was used to collect the samples (SNL/NM December 2002). As mentioned previously in the Introduction, the entire length of Outfall Ditch OD-3 was disturbed in the 1990s by TA-IV construction activities. However, the overall topography has not changed significantly. The 5-foot-bgs soil sample for Location 234-GR-07 is estimated to have been collected from approximately 2 feet below the previous floor of Outfall Ditch OD-3. Location 234-GR-08 is situated farther down the arroyo rim. The 5-feet-bgs soil sample at Location 234-GR-08 is estimated to have been collected from approximately 14 feet below the previous floor of Outfall Ditch OD-3.

Table 9
Soil Samples Collected at SWMU 234 Applicable to SWMU 46 Outfall Ditch OD-3

Sample Location	Depth (ft bgs) Measured from Surrounding Ground Surface	Estimated Depth (ft bgs) Relative to Previous Floor of OD-3
234-GR-07	5	2
234-GR-08	5	14

bgs = Below ground surface.
ft = Foot (feet).
GR = Grab sample.
OD = Outfall Ditch.
SWMU = Solid Waste Management Unit.

The SWMU 234 analytes consisted of metals, VOCs, SVOCs, and radionuclides (gamma emitters, tritium, gross alpha/beta activity). The analytical results for Locations 234-GR-07 and 234-GR-08 are included in the VCA confluence results in Tables 3 and 4. Complete results and corresponding MDLs are presented in Attachment E (Tables E-1 through E-8) in the format of 12th Round NFA proposals.

Only one metal for Locations 234-GR-07 and 234-GR-08 exceeds background levels; silver was detected at 1 mg/kg, which slightly exceeds the background concentration of less than 1 mg/kg (Table E-1). MDLs for metals are listed in Table E-2. No VOCs were detected at the MDLs listed in Table E-3. Seventeen SVOCs were detected; pyrene had the maximum concentration at 603 µg/kg (Table E-4). SVOC detection limits are listed in Table E-5. Radionuclides (gamma emitters, tritium, and gross alpha/beta activity) were within background activities (Tables E-6, E-7, and E-8, respectively).

5. **Collect a surface soil sample upstream of the drop inlet at ER Site 230. The soil sample will be analyzed for radiological constituents, metals, volatile organic compounds, semi-volatile organic compounds, and high explosives.**

Response: This comment is not applicable to SWMU 46.

6. **A new ground-water monitor well will be installed at the bottom of the slope at ER Site 46. The well will be completed in the regional aquifer, if perched water is not encountered.**

Response: In 2001, Monitoring Well TJA-6 was completed in the regional aquifer at the lower (southeastern) end of SWMU 46. Perched groundwater was not observed during the drilling for TJA-6.

Groundwater studies for the vicinity of SWMU 46 are coordinated by the Tijeras Arroyo Groundwater (TAG) Investigation. The COCs for the TAG Investigation are TCE and nitrate. Three groundwater monitoring wells are located at SWMU 46. Monitoring Well TJA-3 was installed at the northern end of SWMU 46 in August 1998. The well was completed in the regional aquifer at a depth of 496 to 516 feet bgs. From January

through March 2001, Monitoring Wells TJA-6 and TJA-7 were installed at SWMU 46. Monitoring Well TJA-7 was completed in the perched system at 291 to 311 feet bgs and is a companion well for Regional Well TJA-3. Near the southern end of the site, Monitoring Well TJA-6 was installed about 300 feet south of the outfall ditch confluence. Monitoring Well TJA-6 was completed in the regional aquifer at a depth of 455 to 475 feet bgs.

The analytical results from the fourth quarter of 2003 are the most recent for the three monitoring wells. To date, the maximum TCE concentration in groundwater samples from the perched system has been 1.46 µg/liter (L), which is below the EPA Maximum Contaminant Limit (MCL) of 5 µg/L. Groundwater samples from the perched system have contained a maximum nitrate concentration of 41 mg/L, which exceeds the MCL of 10 mg/L.

Samples from the regional aquifer have contained a maximum TCE concentration of 1.39 µg/L, which is below the MCL of 5 µg/L. Groundwater samples from the regional aquifer have revealed a maximum nitrate concentration of 3.7 mg/L.

Several sites, including SWMU 46, may be responsible for the groundwater contamination beneath the site (SNL/NM November 2002, SNL/NM June 2003). Groundwater sampling results are discussed further in the "TAG Continuing Investigation Report" (CIR) (SNL/NM November 2002). A comprehensive summary of groundwater data will be presented in the "TAG Final Report," which is scheduled for submittal to the NMED in 2006 (SNL/NM *in preparation*).

7. **Summarize in written form, as applicable, all geologic, hydrologic, and ground-water quality data for all boreholes and ground-water monitor wells in the vicinity of ER Sites 46 and 227. The information requested above for the TA-2 septic systems will meet this requirement for ER Site 227, which is located adjacent to TA-2.**

Response: In the TAG CIR (SNL/NM November 2002), SNL/NM summarized in written form, as applicable, all geologic, hydrologic, and groundwater quality data for all boreholes and groundwater monitoring wells in the vicinity of SWMU 46. Additional information will be presented in the "TAG Final Report," which is scheduled for submittal to the NMED in 2006 (SNL/NM *in preparation*).

8. **Revise and resubmit the data tables in the NFA proposals for each site, meeting the standards achieved in the 12th Round NFA proposals.**

Response: As mentioned above in the response to NMED Comment 2, analytical results previously presented in the SWMU 46 NFA proposal (SNL/NM June 1995) are not useful for characterizing the waste-water discharge. Instead, more recent sampling results for applicable SWMU 46 locations are presented in Attachments B, C, D, and E using the format of the 12th Round NFA proposals. The results were discussed in the SNL/NM response to NMED Comments 2, 3, and 4 (see Table 1).

Summary of Analytical Results for Risk Assessment

As shown in Table 10, four sampling events provide the analytical data relevant to the SWMU 46 risk assessments.

Table 10
Soil Sampling Locations for SWMU 46 Risk Assessments

Sampling Event	Sample Locations	Sample Depth Range (ft bgs)
SWMU 46 Geoprobe® Characterization	46-BH-02 through 46-BH-12	3–18
SWMU 46 VCA Confirmatory	Remediation trench: 46-GR-05 through 46-GR-23, and 46-GR-26. Confluence: 46-GR-24 and 46-GR-25	0–7 0–12
SWMU 46 Deep Borehole Characterization	TJA-6 46-VW-01	45–245 45–295
SWMU 234 Characterization	234-GR-07 234-GR-08	5 5

bgs = Below ground surface.
BH = Borehole.
ft = Foot (feet).
GR = Grab sample.
SWMU = Solid Waste Management Unit.
TJA = Tijeras Arroyo.
VCA = Voluntary Corrective Action.
VW = Vapor Well.

Summary of Analytes and Analytical Laboratories

The soil samples collected for SWMU 46 were analyzed for metals, cyanide, VOCs, SVOCs, HE compounds, tritium, and gamma-emitting radionuclides. Approximately 98 percent of the soil samples were analyzed by the off-site General Engineering Laboratories Inc. The remainder of the soil samples were analyzed for gamma-emitting radionuclides by the on-site SNL/NM Radiation Protection Sample Diagnostics (RPSD) Laboratory.

The characterization and confirmatory analytical data were reviewed and verified/validated according to "Data Validation Procedure for Chemical and Radiochemical Data," in SNL/NM ER Project Administrative Operating Procedure (AOP) 00-03, Revision 0 (SNL/NM December 1999b). In addition, the RPSD Laboratory reviewed all gamma spectroscopy results according to "Laboratory Data Review Guidelines," Procedure No. RPSD-02-11, Issue No. 2 (SNL/NM July 1996). Data qualifiers from the verification/validation process are incorporated into the analytical tables that are presented in Attachments B, C, D, and E using the 12th Round NFA format. Except for the PCB results concerning Soil Sample

Site-Specific Comments

TJAOU-46-GR-21-0.0-S, no significant QA/QC issues were identified. Sample TJAOU-46-GR-21-0.0-S was discussed in the SNL/NM response to NMED Comment 2.

As shown in Table 11, a total of 327 analyses (environmental samples plus duplicates) were utilized for the SWMU 46 risk assessments. The analytical results for the characterization and confirmatory soil sampling at SWMU 46 are summarized in Table F-1 (Attachment F), which lists the maximum concentrations, sample locations for detections, and background values for each of the analytes. All detections, qualified results, and MDLs are listed in Attachments B, C, D, and E using the 12th Round NFA format. Data quality objectives are discussed in Section II of Attachment G.

Table 11
Number of Samples per Analyte for the
Four Sampling Events Applicable to the SWMU 46 Risk Assessments

Analyte	Environmental Samples	Analytical Laboratory	Duplicates	Total Soil Samples	Equipment Blanks	Trip Blanks
Metals and Cyanide	61	GEL	3	64	7	NA
PCBs	57	GEL	3	60	5	NA
VOCs	69	GEL	3	72	9	12
SVOCs	61	GEL	3	64	8	NA
HE Compounds	27	GEL	1	28	1	NA
Radionuclides	33	GEL	2	35	6	NA
Radionuclides	4	RPSD	0	4	2	NA
Total	312	NA	15	327	38	12

GEL = General Engineering Laboratories, Inc.
HE = High explosive(s).
NA = Not applicable.
PCB = Polychlorinated biphenyl.
RPSD = Radiation Protection Sample Diagnostics.
SVOC = Semivolatile organic compound.
SWMU = Solid Waste Management Unit.
VOC = Volatile organic compound.

Highlights of the analytical results include:

- Thirteen metals (arsenic, barium, beryllium, cadmium, total chromium, copper, lead, nickel, selenium, silver, thallium, vanadium, zinc) were detected at levels above background concentrations.
- The maximum total PCB concentration was 0.1298 mg/kg.
- Three radionuclides (thorium-232, uranium-235, and uranium-238) were detected at levels slightly above background activities.

Site-Specific Comments

- Low concentrations of four VOCs (acetone, 2-butanone, methylene chloride, and toluene) were detected.
- Low concentrations of 28 SVOCs were detected.
- One HE compound, 2-nitrotoluence at a concentration of 15.2 µg/kg, was detected.
- The maximum cyanide concentration was 12.7 mg/kg.

Risk Summary

The analytical results of the soil sampling have identified only minor amounts of soil contamination remaining at SWMU 46. The maximum analyte values were used in the risk assessments. The Risk Assessment Summary and the Site Conceptual Model for SWMU 46 are presented in Attachments G and H, respectively.

The risk assessment performed for this site initially used maximum COC concentrations to evaluate the potential for adverse health effects under industrial and residential land-use scenarios. For the industrial land-use scenario, the total and incremental human health hazard index (HI) and estimated excess cancer risk are below NMED guidelines.

Although both the HI and estimated excess cancer risk are above the NMED guideline for the residential land-use scenario, maximum concentrations were used in the risk calculation. Because the site has been adequately characterized, average concentrations are more representative of actual site conditions. Using the 95% upper confidence limit (UCL) of the mean concentrations for the main contributors to excess cancer risk and total and incremental HI values reduces the total HI and estimated excess cancer risk to 1.61 and 3.86E-6, respectively. The incremental HI and excess cancer risk are reduced to 1.45 and 3.86E-6, respectively. The 95% UCL concentrations (summarized in Appendix 2 of the Risk Assessment for SWMU 46) include 2.8 mg/kg for arsenic (which is below background and therefore eliminates arsenic from further evaluation), 40.6 mg/kg for cadmium, 87.5 mg/kg for nickel, 1.1 mg/kg for thallium, 0.06 mg/kg for benzo(a)anthracene, and 0.05 mg/kg for benzo(a)perylene. Thus, by using realistic concentrations in the risk calculations that more accurately depict actual site conditions, both the total and incremental estimated excess cancer risk values are below NMED guidelines. In addition, only cadmium resulted in an individual hazard quotient (HQ) for noncarcinogens that exceeds 1.0 under these conditions. The HQ for cadmium (1.03) was only slightly greater than 1.0. These incremental risk calculations indicate insignificant risk to human health from nonradiological COCs under a residential land-use scenario.

The human health industrial and residential land-use scenario incremental dose calculations for radiological COCs are below the EPA numerical guidelines.

Site-Specific Comments

Ecological risks associated with SWMU 46 were estimated through a screening assessment that incorporates site-specific information when available. Initial calculations of HQs indicated a potential risk for 12 inorganic and 9 organic constituents of potential ecological concern (COPECs). However, based upon the analysis of uncertainties associated with these HQs, the actual potential for risk to ecological receptors from these COPECs is expected to be low. The overestimation of risk is primarily due to the use of maximum detected values as the exposure point concentrations for these HQs. Predicted risks from exposures based upon the 95% UCL concentrations are significantly lower. All HQs based upon the 95% UCLs are less than 5 and/or are attributable to conservative toxicity benchmarks or conservative assumptions of bioavailability. Based upon this final analysis, ecological risks associated with SWMU 46 are expected to be low.

In conclusion, human health and ecological risks are within the acceptable range according to NMED guidance.

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ATTACHMENT A
Voluntary Corrective Action Plan
Solid Waste Management Unit 46–Old Acid Waste Line Outfall

Sandia National Laboratories/New Mexico Environmental Restoration Project

Voluntary Corrective Action Plan Solid Waste Management Unit 46— Old Acid Waste Line Outfall

August 2003

United States Department of Energy
Sandia Site Office

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ACRONYMS AND ABBREVIATIONS

amsl	above mean sea level
AWAP	acid waste access point
bgs	below ground surface
CEARP	Comprehensive Environmental Assessment and Response Program
COA	City of Albuquerque
COC	constituent of concern
DOE	U.S. Department of Energy
DOU	Document of Understanding
DRO	diesel range organics
EB	equipment blank
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration
FIP	Field Implementation Plan
gpd	gallon(s) per day
GRO	gasoline range organics
HASP	Health and Safety Plan
HE	high explosive(s)
KAFB	Kirtland Air Force Base
kg	kilogram(s)
L	liter(s)
MCL	Maximum Contaminant Limit
µg	microgram(s)
mg	milligram(s)
NFA	No Further Action
ng	nanogram(s)
NMED	New Mexico Environment Department
NOD	Notice of Deficiency
OU	Operable Unit
PCB	polychlorinated biphenyl
ppbv	parts per billion by volume
ppm	part per million
PRG	Preliminary Remediation Goals
QA	quality assurance
QC	quality control
RCRA	Resource Conservation and Recovery Act
SNL/NM	Sandia National Laboratories/New Mexico
SVOC	semivolatile organic compound
SWMU	Solid Waste Management Unit
TAG	Tijeras Arroyo Groundwater
TA	Technical Area
TB	trip blank
TCE	trichloroethylene
TJAOU	Tijeras Arroyo Operable Unit
TPH	total petroleum hydrocarbons
UXO	unexploded ordnance
VCA	Voluntary Corrective Action
VOC	volatile organic compound
WMP	Waste Management Plan

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1.0 INTRODUCTION

This document describes the proposed plan for conducting a Voluntary Corrective Action (VCA) at Environmental Restoration (ER) Solid Waste Management Unit (SWMU) 46, the Old Acid Waste Line Outfall. SWMU 46 is located at Sandia National Laboratories/New Mexico (SNL/NM) on Kirtland Air Force Base (KAFB) (Figure 1-1). This document was prepared in accordance with the "Environmental Restoration Document of Understanding [DOU]," negotiated and agreed upon in November 1995 by SNL/NM, the U.S. Department of Energy (DOE), the New Mexico Environment Department (NMED), and the U.S. Environmental Protection Agency (EPA). This document is based upon the Expedited Clean-up/Voluntary Corrective Measure Plan Annotated Outline from Annex N of the DOU (SNL/NM April 1996a) and the NMED Hazardous and Radioactive Materials Bureau *Standard Operating Procedures Manual, Volume 1—External* (NMED March 1998).

Several site-specific compliance documents are applicable to SWMU 46. In 1995, SNL/NM submitted a proposal for no further action (NFA) to NMED for SWMU 46 (SNL/NM June 1995a). After receiving Notice of Deficiency (NOD) comments (NMED July 1996), SNL/NM submitted an NOD response in 1996 (SNL/NM October 1996). In 1999, NMED issued a second set of NOD comments in which they requested several types of additional sampling (NMED October 1999). SNL/NM submitted a second NOD Response in 1999 that acknowledged the need for additional work (SNL/NM December 1999).

The VCA for SWMU 46 is scheduled for the summer of 2003. SWMU 46 is located at the southwest corner of Technical Area (TA)-IV (Figure 1-2). Most of the acid waste line at SWMU 46 is presently visible along the ground surface. From 1948 through 1974, SWMU 46 was the discharge point for approximately 1.3 billion gallons of TA-I waste water. In 2001, samples of stained soil were collected from the interior of the acid waste line that contained 13 metals exceeding background levels as well as polychlorinated biphenyls (PCBs) exceeding the ER Project voluntary cleanup level of 1 part per million (ppm) total PCBs. The stained soil may have been caused by organic dyes in the waste water produced by TA-I photographic-processing laboratories. Soil-vapor samples suggest that SWMU 46 also may be a source of trichloroethylene (TCE), which has impacted groundwater.

The objective of the VCA at SWMU 46 is to reduce the potential hazard to human health and the environment by excavating contaminated soil, collecting confirmatory soil samples for all constituents of concern (COCs), and disposing of the waste. This VCA project will be implemented as a Resource Conservation and Recovery Act (RCRA) corrective action and is designed to make the site available for future industrial use. The ultimate goal of the VCA is to remediate SWMU 46 to meet NMED's requirements for NFA status.

The SNL/NM ER Project considered the following factors in determining the need for a VCA at SWMU 46:

- The site contains residual contamination resulting from the past disposal of waste water.
- Future intrusive activities pose the potential for workers to be exposed to COCs.
- Previous sampling has adequately identified the COCs.

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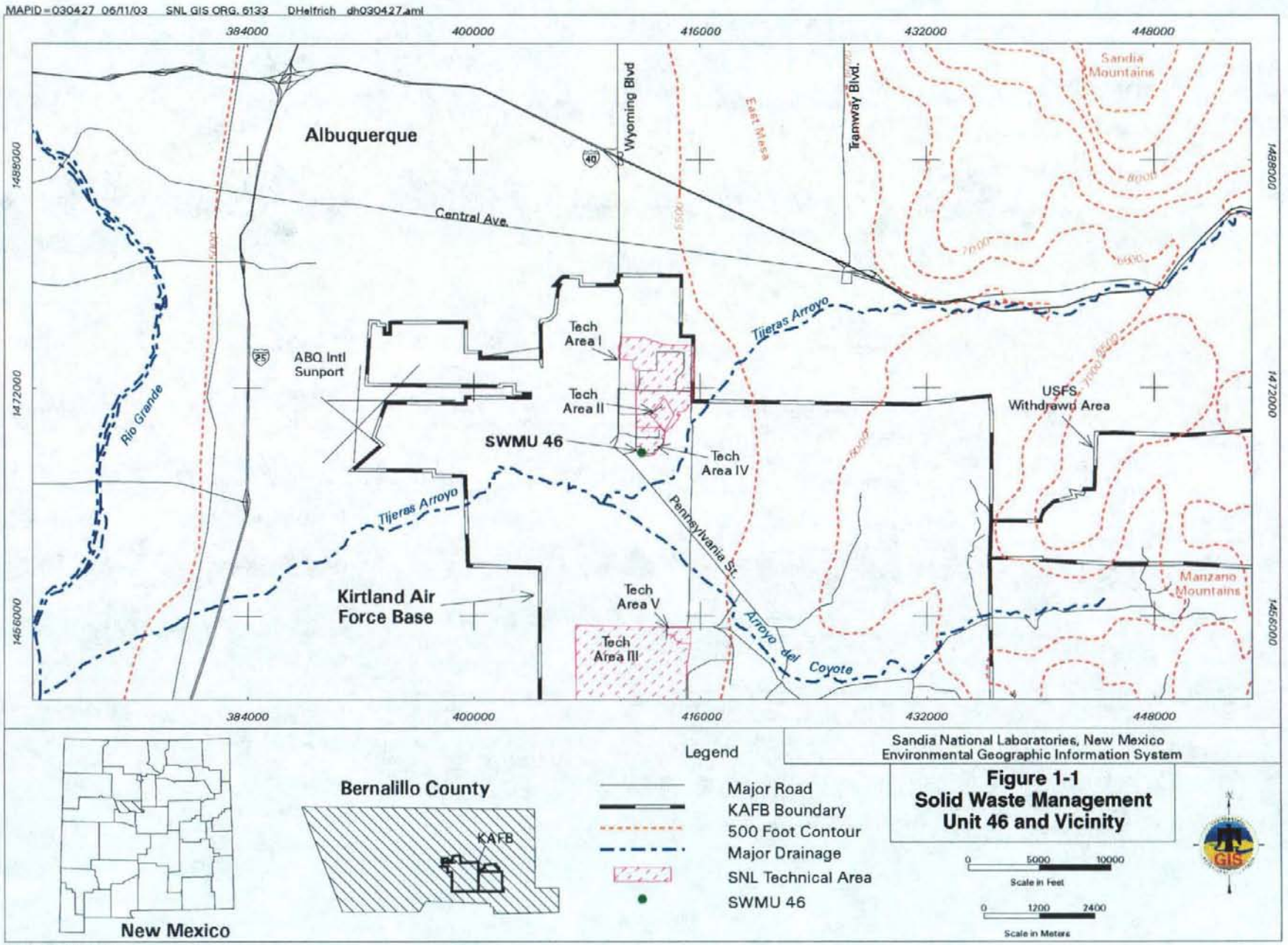

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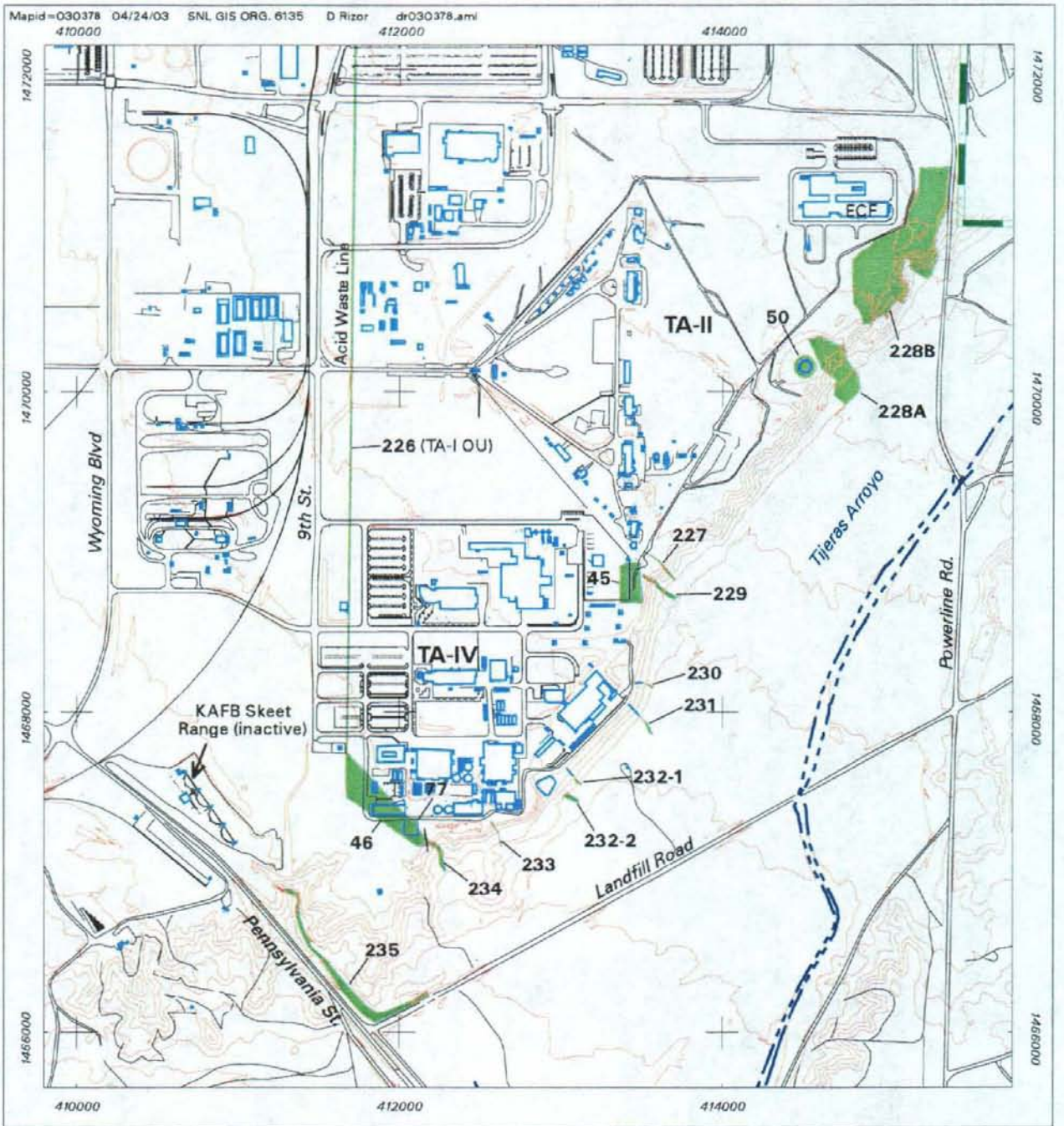

Legend

- Road
- 10 Foot Contour
- Tijeras Arroyo Active Channel
- KAFB Boundary
- Building / Structure
- SWMU

Figure 1-2
Tijeras Arroyo Operable Unit 1309
Solid Waste Management Units (SWMUs) along Tijeras Arroyo

0 500 1000
Scale in Feet

0 120 240
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

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- Remediating the significantly contaminated soil requires partial excavation of the site.
- Remediation efforts will reduce environmental, safety, and health risks.

1.1 Description of SWMU 46

SWMU 46 encompasses approximately 2.11 acres at the southwest corner of TA-IV. The site consists of the inactive outfall (discharge point) for the Old Acid Waste Line (SWMU 226) that was connected to six research buildings in TA-I. The acid waste line is constructed of 8-inch-diameter vitrified clay pipe. SWMU 46 was identified during the 1987 Comprehensive Environmental Assessment and Response Program (CEARP) as the Old Acid Waste Line Outfall (DOE 1987). From about 1948 through late 1974, SWMU 46 discharged acid waste water that contained a variety of chemicals and possibly some radionuclides. The waste water discharged into three shallow, nearly parallel, earthen outfall ditches (OD-1, OD-2, and OD-3) that extended across the East Mesa. Each outfall ditch measured approximately 700 feet long. The confluence of these three outfall ditches is still present on the northern rim of Tijeras Arroyo (Figure 1.1-1).

The specific types and volumes of waste water discharged from the acid waste line are not clearly documented. According to the CEARP (DOE 1987), the "old acid waste line was used to discharge about 130,000 gallons per day (gpd) of acidic waste water from Area I to an open ditch that emptied into Tijeras Arroyo. Most of the water was from cooling tower blowdown; however, this line also carried some waste liquid from etching and photographic processing. The contaminants discharged were primarily chromic acid (approximately 200 gallons per day) and ferric chloride."

The CEARP is the only historical document that cites a waste-water discharge rate for the acid waste line (DOE 1987). Assuming that 130,000 gpd were discharged for 27 years, the resulting total would be approximately 1.3 billion gallons of waste water. However, the CEARP-cited discharge rate of 130,000 gpd, which is equivalent to approximately 90 gallons per minute, may be too high. Neither historic aerial photographs nor field inspections of the remaining OD-1 and OD-2 segments have identified an amount of soil erosion large enough to correspond to this much waste water. However, the volume of waste water was sufficient to create brushy vegetation along the approximately 700-foot-long outfall ditches that continued an additional 1,400 feet past the confluence of the outfall ditches.

PCBs and elevated concentrations of metals, such as arsenic, cadmium, and chromium, have been identified in SWMU 46 soil samples. Soil-vapor samples suggest SWMU 46 may be a release site for TCE that has impacted groundwater.

1.1.1 Operational History

The Tijeras Arroyo Operable Unit (TJAOU) manages SWMU 46. Other Operable Units (OUs) also have provided relevant information for the site. In the 1990s, TA-I OU personnel interviewed laboratory personnel, and various lateral extensions were excavated showing that the acid waste line was connected to Buildings 839, 840, 841, 860, 863, and 892. These buildings contained various shops (instrument repair, machining, ceramics, sheet metal,

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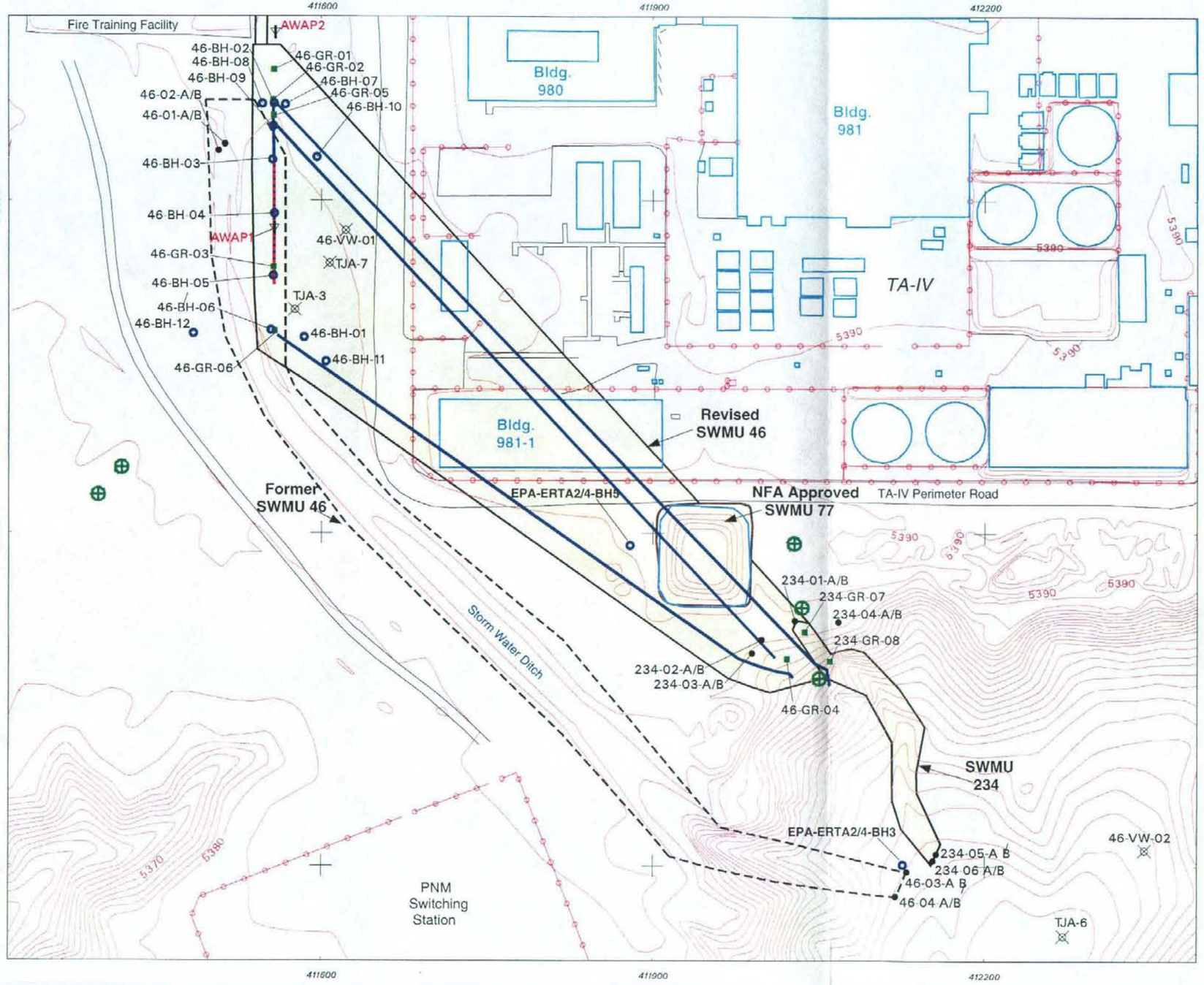

Legend

- Acid Waste Line Components
- Soil Sample (2001)
- Soil Sample (1994)
- Borehole
- Monitor Well
- Current Large Tree
- Fence
- Road
- Former SWMU 46 Boundary
- Acid Waste Line (visible segment)
- 2 Foot Contour
- Outfall Ditch from 1966 Air Photo
- SWMUs 46 & 234
- Building / Structure

0 100 200
Scale in Feet

0 24 48
Scale in Meters

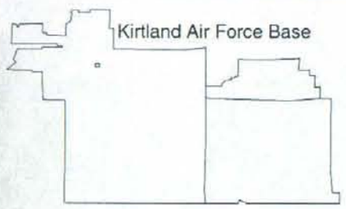

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Figure 1.1-1
Sample Locations at SWMU 46

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

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Unclassified		SNL GIS ORG. 6133
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welding, paint, plating), a foundry, microelectronic clean rooms, office space, general research laboratories, environmental-conditions test chambers, storage rooms, and facilities for the assembly of weapon components (SNL/NM May 1997; DOE December 2001).

In addition to the various chemicals (cooling tower blowdown, chromic acid, ferric chloride, etching liquids, and photographic processing waste water) mentioned in the CEARP (DOE 1987), the acid waste line also received electroplating solutions and chromates (SNL/NM May 1997). Most of the chemicals used in the six buildings were typically containerized for off-site disposal. However, some waste waters discharged to the acid waste line may have contained various organic compounds (acetone, TCE, and toluene); isopropyl alcohol; methyl alcohol; electroplating solutions containing nickel acetate, cadmium cyanide, copper cyanide, hydrogen sulfide, nickel sulfate, copper sulfate, and sodium dichromate; polyvinyl alcohol binder; various acids (acetic, chromic, sulfuric, nitric); sodium hydroxide; paints; paint strippers; machining coolant oils; metals (aluminum, depleted uranium, lead, and silver); and PCBs. Photographic laboratory waste water typically contains a variety of solutions, such as developers, washes, bleaches, fixers, conditioners, and stabilizers.

The acid waste line may have received a relatively minor amount of sanitary waste (sewage) from inadvertent cross-connections between various TA-I piping systems. However, the disposal of sewage in the outfall ditches was probably limited because of health concerns and odor problems. Storm-water systems were not connected to the acid waste line.

OD-1 was constructed in 1948. Soon after, the flow of waste water was apparently limited by the buildup of either vegetation and/or sloughed soil from the unlined ditch banks. The low slope (grade) of the acid waste line and outfall ditch aggravated the drainage problem. OD-2 was constructed about 1950. OD-3 was constructed in the mid-1960s. All three outfall ditches carried waste water until late 1974. Ponding visible in historic aerial photographs shows that all three outfall ditches were essentially linked together at the northern end of the site. As a result, the three outfall ditches carried the same types of waste water and COCs.

1.1.2 Constituents of Concern

Process knowledge indicates that the potential COCs for SWMU 46 consist of:

- Metals, including chromium-VI
- PCBs
- Volatile organic compounds (VOCs)
- Semivolatile organic compounds (SVOCs)
- Cyanide
- Nitrate
- Radionuclides (gamma-emitters and tritium)

1.1.3 Physical Setting

SWMU 46 is located on land that the DOE leases from KAFB. Ground elevations at SWMU 46 range from approximately 5,390 feet above mean sea level (amsl) at the northern site boundary to about 5,370 feet amsl at the southern site boundary on the northern rim of Tijeras Arroyo (Figure 1.1-1). The site, approximately 2.11 acres, is not fenced. SWMU 46 is located in a relatively remote setting where the only foot traffic consists of the occasional jogger and walker.

The fire-extinguisher training facility and the unpaved TA-IV perimeter road are nearby. Outdoor classes involving about a dozen trainees are held at the fire-extinguisher training facility about once per month. A few vehicles per day use the perimeter road. The southeastern end of SWMU 46 is situated on the steeply sloping rim of Tijeras Arroyo; however; the majority of the site is located on a flat portion of the East Mesa. SWMU 46 is on the east side of the inactive KAFB skeet range (Figure 1-2).

The annual precipitation at KAFB is 8.2 inches (SNL/NM February 2001). No springs or perennial surface-water bodies are located within two miles of SWMU 46. The site is situated approximately 2,000 feet north of the active channel of Tijeras Arroyo and outside of the 100-year floodplain. Surface water flows in the active channel at the nearby Pennsylvania Street Bridge approximately a dozen days per year and only as a result of significant precipitation events. Tijeras Arroyo is the most significant surface-water drainage feature on KAFB and originates in Tijeras Canyon, which is bounded by the Sandia Mountains to the north and the Manzano Mountains to the south. The arroyo contains a drainage basin that captures runoff from Tijeras Canyon and various storm-water channels at KAFB, SNL/NM, and southeast Albuquerque. The arroyo eventually drains into the Rio Grande, approximately 8 miles west of SWMU 46.

The soil at SWMU 46 is poorly developed with high alkalinity. The subsurface geology consists of unconsolidated alluvial and colluvial deposits derived from the Sandia and Manzanita Mountains. These upper Santa Fe Group deposits consist of sediment ranging from clay to gravel derived from 1) the granitic rocks of the Sandia Mountains, and 2) greenstone, limestone, and quartzite derived from the Manzanita Mountains. The depth to Pennsylvanian strata and/or Precambrian basement beneath TA-IV is approximately 3,000 feet below ground surface (bgs).

Groundwater data for SWMU 46 was obtained from the Tijeras Arroyo Groundwater (TAG) investigation. The hydrogeologic setting of the TAG study area is dominated by two water-bearing zones, the perched system and the regional aquifer, both of which are present within the upper Santa Fe Group. The perched system is not used as a water supply source. However, the City of Albuquerque (COA), KAFB, and the Veterans Administration use the regional aquifer for water supply purposes.

At the northern end of SWMU 46, the depth to the perched system is approximately 303 feet bgs. However, the site extends across the southwestern boundary of the perched system, which covers approximately 3.5 square miles in the central part of the TAG study area. The direction of groundwater flow in the perched system is to the southeast. Discontinuous, yet overlapping multiple lenses of unsaturated alluvial-fan sediment serve as a perching horizon beneath the perched system and above the regional aquifer. The depth to the regional aquifer is approximately 499 feet bgs at the northern edge of the site. The direction of groundwater flow in the regional aquifer is principally to the northwest towards several water-supply wells. The nearest water-supply well (KAFB-1) is located approximately 1.3 miles northwest of the site. Groundwater from the perched system merges with the regional aquifer southeast of Tijeras Arroyo. The regional aquifer extends across the entire TAG study area and the Albuquerque Basin.

The vicinity of SWMU 46 is unpaved. During most rainfall events, rain quickly infiltrates the soil at SWMU 46. However, virtually all of the moisture undergoes evapotranspiration. Estimates of evapotranspiration for the KAFB area range from 95 to 99 percent of the annual rainfall (SNL/NM February 1998).

The area around SWMU 46 originally consisted of desert grassland habitat, but this has been highly disturbed by various construction activities (IT 1995). The site is mostly barren but has some limited vegetation consisting of ruderal species, such as Russian thistle (tumbleweed). Grasslands are the dominant plant community west of SWMU 46 and include species such as blue and black grama and western cheatgrass (IT 1995). The indigenous wildlife includes reptiles, birds, and small mammals. However, wildlife use is limited by the degree of disturbance and proximity to operational facilities. The site was surveyed for sensitive species in 1994 (IT 1995); no threatened or endangered species, nor any other species of concern, were identified in the vicinity of SWMU 46. No riparian or wetland habitats are present within four miles of the site. No significant archaeological artifacts or cultural resources have been identified in the vicinity of SWMU 46 (Hoagland September 1994).

1.2 Assumptions

The proposed SWMU 46 VCA activities are based upon the following assumptions and conclusions.

- Sufficient process knowledge has identified all the potential COCs.
- No radioactive or unexploded ordnance (UXO)/high explosive (HE) hazards are present.
- The relevant background levels for metals and radionuclides in soil have been defined by the NMED (Dinwiddie September 1997).
- The risk-based Preliminary Remediation Goals (PRGs) calculated by SNL/NM (Tharp April 2003) are defensible.
- The background levels and PRGs are adequate for determining the SWMU 46 Remediation Targets.
- The area requiring excavation has been adequately defined by soil sampling.
- The VCA is designed to remove all of the contaminated soil with COC concentrations that exceed the SWMU 46 Remediation Targets.
- Adequate disposal capacity is available for all expected waste types.

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2.0 RESULTS OF INVESTIGATIONS

This section discusses the SWMU 46 environmental investigations, summarizes the analytical results, presents background levels, discusses quality assurance (QA)/quality control (QC) protocols, and establishes PRGs for the remediation work.

2.1 Environmental Investigations

Several types of environmental investigations have been conducted at SWMU 46.

2.1.1 Unexploded Ordnance/High Explosive and Radiation Surveys

In 1994 and 2001, SWMU 46 was surveyed for UXO/HE and radiological material; none were found.

2.1.2 Video Camera Survey

In 1993, SNL/NM Facilities Engineering conducted a video-camera survey of the acid waste line (SNL/NM February 1995). Because the acid waste line was not constructed with cleanouts, openings for the video camera were cut into the clay pipe at a series of locations that were identified as acid waste access points (AWAPs). Two AWAPs are located at SWMU 46. Much of the acid waste line at SWMU 46 was found to be partially collapsed and filled with sloughed soil, apparently caused by heavy equipment used for constructing the nearby surface-water ditch in 1977.

2.1.3 Historic Aerial Photographs

In the summer of 2000, the ER Project conducted a comprehensive review of historic aerial photographs for the period of 1951 to the present. Three previously overlooked outfall ditches were identified and are now known as OD-1, OD-2, and OD-3. The outfall ditches extended southeastward from various outlets on the acid waste line and merged into a confluence that is currently visible among some elm trees about 150 feet south of the TA-IV fence. Each of the outfall ditches measured about 3 feet deep, 5 feet wide, and 700 feet long. In 1948, the discharge of waste water began at the first outfall ditch (OD-1). Soon after, the flow of waste water was apparently limited by the buildup of either vegetation and/or sloughed soil from the unlined ditch banks. The low slope (grade) of the acid waste line and outfall ditch aggravated the drainage problem. Thus, a second outfall ditch was required. About 1950, an intermediate outlet was constructed on the acid waste line about 240 feet north of the OD-1 outlet; this second outlet became the starting point for outfall ditch OD-2. In the mid-1960s, another intermediate outlet was constructed in the acid waste line about 20 feet north of the OD-2 outlet; this third outlet became the starting point for OD-3. A slight topographic dip near the three outlets allowed waste water to eventually flow into all three ditches simultaneously. The flow continued through the three outfall ditches until late 1974. Since then, no waste water has discharged to SWMU 46.

The aerial photographs also show that construction of TA-IV disturbed much of the SWMU 46 area. In 1977, a 1,150-foot-long surface-water ditch was constructed from the northwest corner of TA-IV to an undisturbed ravine on the arroyo rim. The ditch was used for about one year to drain storm water from some of the unpaved TA-IV parking lots. Use of the surface-water ditch was discontinued in 1978 after buried piping was extended from TA-IV to the Ninth Street Channel. In late 1978, the northernmost 150 feet of the surface-water ditch was backfilled with soil. In the early 1980s, virtually the entire length of each outfall ditch was similarly backfilled with soil when two TA-IV structures (Building 981-I and the SWMU 77 surface-water impoundment) were built. The southernmost 25 feet of the acid waste line and the original 1948 outlet were destroyed by the construction activities. The near total disappearance of the three outfall ditches and the coincidental construction of the surface-water ditch led to the surface-water ditch being mistakenly identified in 1994 as an outfall ditch for SWMU 46. Soil samples were collected from the surface-water ditch in 1994.

In July 2000, the confluence of the SWMU 46 outfall ditches was identified in the field for the first time. The remaining easternmost segments of OD-1 and OD-2 were found to be about 60 feet long. No evidence was found nearby for OD-3. The easternmost segment of OD-3 had been disturbed by the construction of a TA-IV storm-water outfall pipe, which is now known as SWMU 234. TA-IV storm water discharged at SWMU 234 from 1979 until the early 1990s. SWMU 234 has been proposed for NFA status (SNL/NM June 1995b), and recent soil sampling has confirmed that no significant contamination is associated with the TA-IV storm-water discharge (SNL/NM December 2002).

In March 2001, a series of shallow trenches were dug by hand along the southern end of the acid waste line. The top of the line was covered by only 2 inches of soil. The trenches better defined the surviving end of the line. The present end of the line is now known to be about 20 feet west of Monitoring Well TJA-3. When compared to the digitized locations of the outfall ditches based upon the historic aerial photographs, it is apparent that about 26 feet of the southernmost part of the line was destroyed when the nearby surface-water ditch was constructed in 1977.

2.1.4 Soil-Vapor Sampling

Four soil-vapor sampling investigations have been conducted at SWMU 46. The first involved collecting soil-vapor samples from the pilot borehole for TJA-3, the groundwater monitoring well that was installed at the northern end of SWMU 46 in August 1998. Soil-vapor samples were collected from six depths (37, 97, 137, 197, 237, and 312 feet bgs) with a Simulprobe™ sampler driven ahead of the drill string. Low to high concentration levels of 16 VOCs were detected in soil-vapor samples. TCE had the maximum concentration in soil vapor at 10,000 parts per billion by volume (ppbv) in the sample from 137 feet bgs. However, the TCE concentration of 320 ppbv at 197 feet bgs was much lower. Methylene chloride had the second highest VOC concentration at 620 ppbv in the sample from 137 feet bgs. Vinyl chloride was not detected in any of the soil-vapor samples. Soil samples were not collected from the pilot borehole.

In August 1998, soil-vapor samples were collected from four Geoprobe® boreholes (EPA-ERTA2/4-BH-1, EPA-ERTA2/4-BH-2, EPA-ERTA2/4-BH-3, and EPA-ERTA2/4-BH-5). Samples were collected at depths of 10, 20, and 30 feet bgs using a Tedlar™ bag system. Low concentration levels of 16 VOCs were detected in soil-vapor samples collected near the confluence of the outfall ditches at Boreholes EPA-ERTA2/4-BH-3 and EPA-ERTA2/4-BH-5. TCE had the maximum concentration at 55 ppbv. VOCs were not detected at Boreholes

EPA-ERTA2/4-BH-1 and EPA-ERTA2/4-BH-2, which were located approximately 700 and 300 feet south of the confluence, respectively.

In October 1999, passive soil-vapor samples were collected using 36 VaporTec™ collectors (TJAOU-46-SVX-01 through TJAOU-46-SVX-36). The sampling area covered approximately 7 acres and focused on the surface-water ditch, which at the time was the suspected waste-water discharge location. After being buried for 30 days at shallow depths ranging from approximately 0.5 to 1 foot bgs, the collectors were retrieved and subsequently analyzed for VOCs and total petroleum hydrocarbons (TPH) gasoline range organics (GRO) and diesel range organics (DRO) using EPA Methods 8021M and 8015M, respectively (TEG-Rocky Mountain January 2000). VOC values were reported in nanograms (ng) of contaminant sorbed onto the activated carbon sampling media. Low concentration levels of 17 VOCs were detected. The highest values for TCE and vinyl chloride were 257 and 103 ng, respectively.

TCE was detected at 14 of the 36 VaporTec™ locations, but the distribution of TCE did not coincide with the surface-water ditch. This prompted the review of the aerial photographs that is discussed in Section 2.1.3. The highest TCE value of 257 ng corresponded to Collector TJAOU-46-SVX-01, which was located near the previously overlooked acid waste line. Most of the TCE in the soil vapor was present near the estimated locations of the northern ends of the outfall ditches. However, TCE was not detected in Collector TJAOU-46-SVX-24, which was located adjacent to Monitoring Well TJA-3. This discrepancy between the TCE in soil vapor and the location of the outfall ditches was suspected to be the result of past TA-IV construction activities and the migration and/or degradation of contaminants.

Vinyl chloride had the maximum VOC concentration in soil vapor at 103 ng from VaporTec™ Collector TJAOU-46-SVX-24, which was located adjacent to Monitoring Well TJA-3. Vinyl chloride was detected at each of the 36 soil-vapor sampling locations although no available information suggests that SNL/NM has used vinyl chloride. Because vinyl chloride was not detected in the trip blank or in any of the analytical laboratory QA/QC samples, the presence of vinyl chloride at each sampling location suggests that it may be a degradation product of TCE in soil. The lack of vinyl chloride in the deeper soil-vapor samples from the TJA-3 borehole also suggests that TCE degradation is more prevalent near the ground surface. An interpretation that other contaminants present in soil vapor are the result of degradation is not defensible because a variety of VOCs were present in the waste water.

Minor amounts of TPH were detected in the soil-vapor samples. Twenty-six VaporTec™ collectors yielded DRO, with a maximum concentration of 49.6 ng. Only two collectors yielded detectable concentrations of GRO with a maximum concentration of 2.31 ng. These TPH concentrations may be the result of activities associated with TA-IV construction or the nearby fire-training facility.

From April 2001 through March 2002, soil-vapor samples were collected from Monitoring Wells 46-VW-01 and 46-VW-02 for five quarterly events. These two monitoring wells are equipped with Flexible Liner Underground Technology™ (FLUTe) systems. The sampling ports for Monitoring Well 46-VW-01 are set at 15, 65, 115, 165, 215, and 265 feet bgs. The sampling ports for Monitoring Well 46-VW-02 are set at 46, 96, 146, 196, 246, and 296 feet bgs. Summa™ canisters were used to collect soil-vapor samples, which were analyzed for VOCs. For the five quarters, the maximum TCE concentration from Monitoring Well 46-VW-01 was 46,000 ppbv, which was collected from a depth of 115 feet bgs. Monitoring Well 46-VW-01 yielded a maximum TCE concentration of 350 ppbv from the sampling port at 265 feet bgs. For

the five quarters, the maximum TCE concentration from Monitoring Well 46-VW-02 was 650 ppbv, which was collected from a depth of 96 feet bgs. Monitoring Well 46-VW-02 yielded a maximum TCE concentration of 480 ppbv from the sampling port at 246 feet bgs.

Twenty-two VOCs were detected in soil-vapor samples collected from the two monitoring wells, but most are single-digit "J" (laboratory estimated) values. The maximum total VOCs concentrations at Monitoring Wells 46-VW-01 and 46-VW-02 were 48,380 and 703 ppbv, respectively. For perspective, the soil-vapor investigation at the SNL/NM Chemical Waste Landfill used an NMED-approved, 100,000-ppbv threshold for defining the total VOCs plume edge. NMED has not specified a threshold value for SWMU 46. Therefore, additional soil-vapor characterization at SWMU 46 does not appear to be necessary.

2.1.5 Soil Sampling

In September 1994, soil samples were collected from what was then suspected to be the location of waste-water discharge. Eight soil samples (46-01-A through 46-04-B) were collected from a nearby surface-water ditch that had been used from 1977 to 1978. The maximum sampling depth was approximately 3 feet bgs. However, recent interpretation of historic aerial photographs has revealed that the surface-water ditch was not the location where waste water had discharged. Unfortunately, analytical data from the 1994 sampling event was used in the SWMU 46 NFA Proposal (SNL/NM June 1995a). The samples were analyzed for VOCs, SVOCs, Target Analyte List (TAL) metals, chromium-VI, total cyanide, total Kjeldahl nitrogen, nitrate/nitrite, tritium, and gamma-emitting radionuclides. No contamination was detected in the soil samples. Because the eight soil samples are not useful for characterizing the waste-water discharge location, the associated analytical results are excluded from the following discussion.

In 2001, the first "properly located" soil samples were collected at SWMU 46. Table 2.1.5-1 lists the sampling locations that are applicable for characterizing the waste-water discharge at SWMU 46. The sample locations for the entire site are shown on Figure 1.1-1. Figure 2.1.5-1 shows the sample locations at the northern end of SWMU 46 in greater detail. Soil samples were collected from deep boreholes located at both ends of SWMU 46. Soil samples were collected from Borehole 46-VW-01 (at the north end of the site) at depths of 45, 95, 145, 195, 245, and 295 feet bgs. Soil samples were collected from Borehole TJA-6 (at the south end of the site) at depths of 45, 95, 145, and 245 feet bgs.

The analytical results for the 46-VW-01 and the TJA-6 soil samples showed no contamination. No PCBs were detected. Metals concentrations were within, or similar to, background levels. Radionuclides (gamma-emitters and tritium) were within background levels. Low concentration levels of four VOCs (acetone, 2-butanone, methylene chloride, and toluene) and two SVOCs (bis[2-ethylhexyl] phthalate and phenol) were reported. TCE was not detected.

In April 2001, soil samples were collected from four locations at the northern end of the site. Beginning at the southeast corner of the fire-training facility, a backhoe was used to excavate a gravel parking lot. The top of the acid waste line was identified at a depth of approximately 1.5 feet bgs. A hand auger was used to collect a soil sample (TJAOU-46-GR-01) from beneath the acid waste line at a depth of 2.5 to 3.5 feet bgs. The backhoe was then used to excavate to 4 feet bgs; no stained soil was evident in the vicinity of Sample TJAOU-46-GR-01. A trench dug southward along the acid waste line for a distance of about 30 feet revealed the third outlet (for OD-3) of the acid waste line. Between the first sample location and the third outlet, the

Table 2.1.5-1
Soil Sampling Locations for SWMU 46

Sample Location	Depth (ft bgs)	Date	Sampling Method and Setting
TJA-6	45, 95, 145, 245	January 2001	Drill rig–southeast end of site
46-VW-01	45, 95, 145, 195, 245, 295	March 2001	Drill rig–north end of site
TJAOU-46-GR-01	2.5–3.5	April 2001	Hand trowel–under acid waste line
TJAOU-46-GR-02	1.0	April 2001	Hand trowel–from acid waste line
TJAOU-46-GR-03	1.0	April 2001	Hand trowel–from acid waste line
TJAOU-46-GR-04	0.5–1.5	April 2001	Hand trowel–southeast end of site
TJAOU-46-BH-01	none	Not applicable	Not applicable–groundwater test hole
TJAOU-46-BH-02	4.0–18.0	August 2001	Geoprobe™–north end of site
TJAOU-46-BH-03	4.5–13.0	August 2001	Geoprobe™–north end of site
TJAOU-46-BH-04	3.0–13.0	August 2001	Geoprobe™–north end of site
TJAOU-46-BH-05	4.5–8.5	August 2001	Geoprobe™–north end of site
TJAOU-46-BH-06	4.5–10.0	August 2001	Geoprobe™–north end of site
TJAOU-46-BH-07	4.5–13.0	August 2001	Geoprobe™–north end of site
TJAOU-46-BH-08	4.5–14.0	August 2001	Geoprobe™–north end of site
TJAOU-46-BH-09	4.5–9.0	August 2001	Geoprobe™–north end of site
TJAOU-46-BH-10	4.5–8.5	August 2001	Geoprobe™–north end of site
TJAOU-46-BH-11	4.5–8.5	August 2001	Geoprobe™–north end of site
TJAOU-46-BH-12	4.5–9.5	August 2001	Geoprobe™–north end of site

bgs = Below ground surface.
BH = Borehole.
ft = Foot (feet).
GR = Grab sample.
SWMU = Solid Waste Management Unit.
TJA = Tijeras Arroyo.
TJAOU = Tijeras Arroyo Operable Unit.

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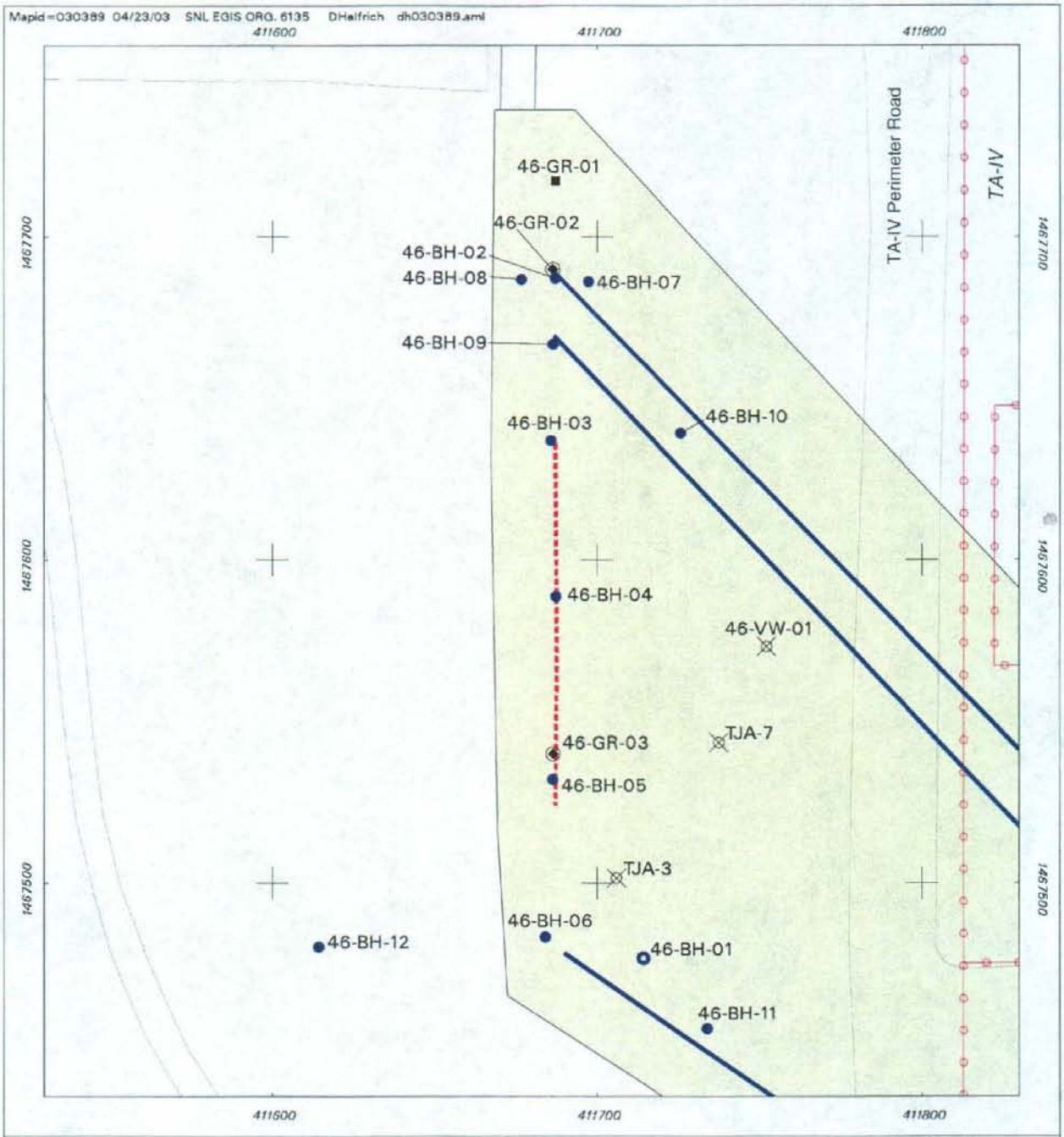

Legend

- Soil Sample
- Test Borehole
- Geoprobe Borehole
- Monitor Well
- Soil Sample with Analytical Results Exceeding Remediation Target
- Fence
- Unpaved Road
- Acid Waste Line (visible segment)
- Outfall Ditch from 1966 Air Photo
- SWMU 46

Figure 2.1.5-1
Sampling Locations at the Northern End of SWMU 46

0 25 50
Scale in Feet

0 6 12
Scale in Meters

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acid waste line was intact, and no discolored soil was evident. However, stained soil was found at the third outlet, which was buried at a depth of only about 6 inches bgs. The soil staining varied from gray to green to blue. The stained soil appeared to be confined laterally to about 3 feet of the line. However, the limit of stained soil was not fully determined. Sample TJAOU-46-GR-02 was collected from the sloughed soil present inside the third outlet. Farther south along the acid waste line, another sample of sloughed soil (TJAOU-46-GR-03) was collected from a broken section of the acid waste line. Here, the top of the acid waste line was only a few inches bgs and the degree of staining was less intense.

The soil staining at SWMU 46 was similar in appearance to the stained soil excavated during the demolition of the Building 863 Motion Picture Lab (Durand April 2003). According to Kodak™ personnel, the blue staining is most likely caused by organic dyes. Chromium is known to have been a chemical associated with the photo-processing operation and was used for yellow pigment formulations, but discontinued in the late 1960s to early 1970s (Durand April 2003). Liquid waste drained from the Building 863 piping system contained both silver and chromium at levels above RCRA toxicity characteristic release criteria (IT April 1998). The chromic acid vat area in Building 863 contained dry chemical waste, a vat base, and an underlying concrete floor that displayed a "unique purple stain" attributed to the use and storage of chromic acid (IT April 1998).

Except for cadmium at 55.3 milligrams (mg)/kilogram (kg), Soil Sample TJAOU-46-GR-01 (located at the northern end of the site and under one of the acid waste line couplings) contained no contamination. Soil Samples TJAOU-46-GR-02 and TJAOU-46-GR-03, collected from sloughed soil present inside the acid waste line, were significantly contaminated, primarily with metals and PCBs. For example, Soil Samples TJAOU-46-GR-02 and TJAOU-46-GR-03 contained total PCBs at 49.9 mg/kg and 6.17 mg/kg, respectively. The two samples contained 13 metals at concentrations above background levels. The maximum metals concentrations for the two soil samples were antimony at 19.4 mg/kg, arsenic at 8.35 mg/kg, barium at 589 mg/kg, cadmium at 105 mg/kg, total chromium at 4,820 mg/kg, chromium-VI at 7.41 mg/kg, copper at 1,150 mg/kg, lead at 1,100 mg/kg, mercury at 0.9 mg/kg, nickel at 693 mg/kg, selenium at 1.67 mg/kg, silver at 278 mg/kg, and zinc at 427 mg/kg. The maximum cyanide concentration was 311 mg/kg. Two VOCs were detected; the TCE concentration was 2 micrograms (µg)/kg and the methylene chloride concentration was 2.21 J µg/kg. Seven SVOCs were detected; benzo(a)fluoranthene had the highest concentration at 843 µg/kg. No HE compounds were detected. Radionuclides (gamma-emitters and tritium) were within, or similar to, background levels. Soil Sample TJAOU-46-GR-02 contained nitrate plus nitrite at 123 mg/kg.

Also in April 2001, soil sampling was conducted at the southeastern end of OD-2 near the confluence. Two soil samples were collected at Location TJAOU-46-GR-04 from 0.5 and 1.5 feet bgs. The samples consisted of native soil from beneath the floor of the outfall ditch where the ditch was only about 3 feet wide and 2 feet deep. No stained soil was evident at OD-2. Soil Sample TJAOU-46-GR-04 (from OD-2 at the southeast end of the site) contained no contamination except possibly cadmium at 2.69 mg/kg (background is 0.9 mg/kg).

In August 2001, 12 Geoprobe® boreholes were sampled along the visible portion of the acid waste line at the northern end of the site. The sampling depths ranged from 3 to 18 feet bgs. Green staining was evident to a depth of 10 feet at 46-BH-02; none of the other boreholes contained stained soil. The detected COCs were the same as the stained-soil samples, but the borehole samples contained significantly lower concentrations. Located near Soil Samples GR-02 and GR-03, three boreholes (46-BH-02, 46-BH-08, and 46-BH-09) contained the highest concentrations. For the 12 boreholes, 8 metals exceeded background levels. For

example, chromium was reported at 120 mg/kg. The maximum total PCBs concentration was 0.841 mg/kg. Cyanide was reported at 12.7 mg/kg. Radionuclides (gamma-emitters) were within, or similar to, background levels. Four VOCs were reported; toluene had the highest concentration at 107 µg/kg. Of 25 SVOCs reported, 13 had low concentration levels that were J qualified. All but 2 of the 12 remaining SVOCs were less than 1 mg/kg. Phenol and bis(2-ethylhexyl) phthalate were reported at 1.59 and 2.04 mg/kg, respectively.

2.1.6 Groundwater Investigations

As part of the Sandia North (now known as the TAG) groundwater investigation, Monitoring Well TJA-3 was installed at the northern end of SWMU 46 in August 1998. The well was completed in the regional aquifer at a depth of 496 to 516 feet bgs. The perched system was not encountered during the drilling of Test Borehole 46-BH-01, which was located 25 feet southeast of Monitoring Well TJA-3.

From January through March 2001, four monitoring wells (TJA-6, TJA-7, 46-VW-01, and 46-VW-02) were installed at SWMU 46. At the northern end of the site, Monitoring Wells TJA-7 and 46-VW-01 were installed near TJA-3. Monitoring Well TJA-7 was completed in the shallow water-bearing zone at 291 to 311 feet bgs and is a companion well for Regional Well TJA-3. Near the southern end of the site, Monitoring Wells 46-VW-02 and TJA-6 were installed about 300 feet south of the outfall ditch confluence. Monitoring Well TJA-6 was completed in the regional aquifer at a depth of 455 to 475 feet bgs. Shallow groundwater was not detected during the drilling for TJA-6.

Three groundwater monitoring wells (TJA-3, TJA-6, and TJA-7) are located at the site. Monitoring Wells TJA-3 and TJA-6 are completed in the regional aquifer. Monitoring Well TJA-7 is completed in the perched system, which does not extend as far as the southeastern end of SWMU 46. The last available groundwater analyses are from March 2002. In April 2002, sampling of TAG monitoring wells was temporarily suspended with NMED approval. The COCs for the TAG study area are TCE and nitrate. At SWMU 46, groundwater samples from the perched system have not contained detectable concentrations of TCE. However, groundwater samples from the perched system have contained a maximum nitrate concentration of 41 mg/liter (L), which exceeds the federal Maximum Contaminant Limit (MCL) of 10 mg/L. Samples from the regional aquifer have contained a maximum TCE concentration of 1.39 µg/L, which is below the MCL of 5 µg/L. Groundwater samples from the regional aquifer have contained a maximum nitrate concentration of 3.7 mg/L. Several sites, including SWMU 46, may be responsible for the groundwater contamination beneath the site (SNL/NM August 2002; SNL/NM December 2002).

In February 2003, an AquaTrack geophysical survey was conducted over approximately 64 acres centered on the northern end of SWMU 46 (Sunrise Engineering, Inc. April 2003). AquaTrack is a patented geophysical technology used to map groundwater bodies using controlled source–frequency domain magnetics. Electrodes were placed in the standing groundwater present in Monitoring Wells TJA-3 and TJA-7. The electrodes were energized with low frequency (400-hertz) alternating current. Magnetic sensor data were collected along eight transects ranging in length from 1,000 to 2,000 feet. The magnetic sensor data were subsequently computer-processed and contoured into a magnetic field strength map. The perched system was interpreted to have a meandering edge that trends northwest to southeast across SWMU 46.

2.2 Summary of Analytical Results for Soil Samples

Analytical results for soil samples collected in 2001 at SWMU 46 are summarized in Tables 2.2-1 and 2.2-2. Analyses were conducted by General Engineering Laboratories, Inc. As noted, the list of potential COCs (metals, cyanide, PCBs, nitrate, VOCs, SVOCs, HE compounds, and radionuclides) is extensive for SWMU 46 because six TA-I buildings were connected to the acid waste line. Planning for the VCA has been aided by the fact that all the COCs have been identified. Several COCs (HE compounds, cyanide, radionuclides, nitrate, VOCs, and SVOCs) are therefore not a serious concern for the VCA cleanup because each COC was either not detected or was detected at a concentration below the respective VCA Remediation Target. Highlights of the analytical results include:

- Fifteen metals (antimony, arsenic, barium, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, vanadium, and zinc) were reported at concentrations above background levels (Table 2.2-1).
- The maximum total PCBs concentration (composed of Aroclor-1016, Aroclor-1221, Aroclor-1232, Aroclor-1242, Aroclor-1248, Aroclor-1254, and Aroclor-1260) was 49.9 mg/kg (Table 2.2-2).
- Three radionuclides (cesium-137, uranium-235, and uranium-238) were within, or very similar to, background levels (Table 2.2-1).
- The maximum total cyanide concentration in soil was 311 mg/kg (Table 2.2-1).
- The maximum nitrate plus nitrite concentration was 123 mg/kg (Table 2.2-1).
- Low concentration levels of five VOCs (acetone, 2-butanone, methylene chloride, toluene, and TCE) were detected (Table 2.2-2).
- Low concentration levels of 26 SVOCs, such as acenaphthene, were detected (Table 2.2-2).
- No HE compounds were detected.

Several findings are applicable to the soil samples that were collected from the acid waste line in April 2001:

- The presence of sloughed soil in the acid waste line at SWMU 46 probably resulted from construction activities, mostly likely occurring in 1977. Heavy equipment crushed the shallowly buried acid waste line.
- The soil did not exhibit depositional features, such as layering, that would suggest the soil was sediment transported down the acid waste line.
- The blue-stained soil at Location 46-GR-02 probably reflects the sloughed soil being protected from rainfall for about 25 years (1977 to 2001). Soil along the outside of the acid waste line was not similarly stained. Apparently, rainfall had leached away the soil-staining chemicals.

Table 2.2-1
Comparison of Inorganic Analyses of SWMU 46 Soil Samples to
Background Levels, Preliminary Remediation Goals, and Remediation Targets

COC	Maximum Concentration in Discrete Samples[a] (mg/kg)	Maximum Concentration in Geoprobe Samples[b] (mg/kg)	Maximum Concentration in Deep Borehole Samples[c] (mg/kg)	NMED Maximum Background for North Supergroup[d] (mg/kg)	Preliminary Remediation Goal (mg/kg)	Synergistic Preliminary Remediation Goal (mg/kg)	Remediation Target (mg/kg)
Metals							
Antimony (Sb)	**19.4**	0.602 J	0.237 U	3.9	384	30	30
Arsenic (As)	**8.35**	3.94	2.8	4.4	16	1	4.4
Barium (Ba)	**589**	**572 B**	139	200	62,859	4,835	4,835
Beryllium (Be)	0.492	0.54	**0.891**	0.80	1,829	141	141
Cadmium (Cd)	**105**	**3.12**	**0.976**	0.9	507	39	39
Chromium (Cr) +6	7.41	NA	0.262	NS	2,435	187	187
Chromium (Cr)-total	**4,820**	**120**	**18.5**	12.8	1,438,086	110,622	110,622
Cobalt	8.33	7.93	6.23	8.8	12,918	994	994
Copper	**1,150**	7.67	12.9	17	35,473	2,729	2,729
Lead (Pb)	**1,100**	**46**	10.2	11.2	NS	NA	400[e]
Mercury (Hg)	**0.906**	0.0175	0.00642 J	<0.1	287	22	22
Nickel (Ni)	**693**	**63.4**	11.7	25.4	19,174	1,475	1,475
Selenium (Se)	**1.67**	0.475 J	**1.28**	<1	4,794	369	369
Silver (Ag)	**278**	**16.2**	0.578 U	<1	4,794	369	369
Thallium (Tl)	**1.45**	**1.88**	**2.19**	<1.1	63	5	5
Vanadium (V)	25.7	**46.5**	27.4	33	6,791	522	522
Zinc (Zn)	**427**	33.2	63.9	76	287,617	22,124	22,124
Cyanide (CN)-total	311	12.7	NA	NS	12,313	947	947
Nitrate plus nitrite	123	NA	NA	NS	985,060	75,774	75,774

Refer to footnotes at end of table.

Table 2.2-1 (Concluded)
Comparison of Inorganic Analyses of SWMU 46 Soil Samples to
Background Levels, Preliminary Remediation Goals, and Remediation Targets

COC	Maximum Concentration in Discrete Samples[a] (mg/kg)	Maximum Concentration in Geoprobe Samples[b] (mg/kg)	Maximum Concentration in Deep Borehole Samples[c] (mg/kg)	NMED Maximum Background for North Supergroup[d] (mg/kg)	Preliminary Remediation Goal (mg/kg)	Synergistic Preliminary Remediation Goal (mg/kg)	Remediation Target (mg/kg)
Radionuclides							
Cesium-137	**0.228 pCi/g**	0.0336 U pCi/g	0.0685 U pCi/g	0.084 pCi/g	22.1 pCi/g	22.1 pCi/g	22.1 pCi/g
Thorium-232	1.19 pCi/g	NA	**1.91** pCi/g	1.54 pCi/g	4.45 pCi/g	4.45 pCi/g	4.45 pCi/g
Tritium	87.7 pCi/L	NA	140 pCi/L	420 pCi/L	2,980 pCi/L	2,980 pCi/L	2,980 pCi/L
Uranium-235	**0.312 U pCi/g**	**0.209 U pCi/g**	**0.316 U** pCi/g	0.18 pCi/g	88.1 pCi/g	88.1 pCi/g	88.1 pCi/g
Uranium-238	**2.18 pCi/g**	**2.07 pCi/g**	0.946 U pCi/g	1.3 pCi/g	491 pCi/g	491 pCi/g	491 pCi/g

Note: Values in **bold** exceed background levels.
[a]Discrete samples: TJAOU-46-GR-01 through TJAOU-46-GR-04. Sampling depth range = 0.5 to 4.5 ft bgs.
[b]Geoprobe boreholes: TJAOU-46-BH-02 through TJAOU-46-BH-12. Sampling depth range = 3 to 18 ft bgs.
[c]Deep boreholes: TJA-6 and 46-VW-01. Sampling depth range = 45 to 295 ft bgs.
[d]Dinwiddie September 1997.
[e]Lead cleanup level for residential exposure (Laws July 1994).
B = Analyte detected in an associated blank
bgs = Below ground surface.
COC = Constituent of concern.
ft = Foot (feet).
J = Estimated concentration.
mg/kg = Milligram(s) per kilogram.
NA = Not applicable.
NMED = New Mexico Environment Department.
NS = Not specified.
pCi/g = Picocurie(s) per gram.
pCi/L = Picocurie(s) per liter.
SWMU = Solid Waste Management Unit
U = Nondetect.

Table 2.2-2
Comparison of Organic Analyses of SWMU 46 Soil Samples to Preliminary Remediation Goals and Remediation Targets

COC	Maximum Concentration in Discrete Samples[a] (µg/kg)	Maximum Concentration in Geoprobe Samples[b] (µg/kg)	Maximum Concentration in Deep Borehole Samples[c] (µg/kg)	Preliminary Remediation Goal (µg/kg)	Synergistic Preliminary Remediation Goal (µg/kg)	Remediation Target (µg/kg)
VOCs						
Acetone	ND	2.35 J	13.2	60,958,000	1,966,387	1,966,387
2-Butanone	ND	107	56.9 J	2,054,000	66,258	66,258
Methylene chloride	2.21 J	3.28 J	3.85 J	15,000	484	484
Toluene	ND	17	0.998 J	17,886,000	576,968	576,968
Trichloroethene	2.03	ND	ND	8,000	258	258
SVOCs						
Acenaphthene	ND	5.69 J	ND	31,151,000	1,004,871	1,004,871
Acenaphthylene	ND	4.06 J	ND	3,441,000	111,000	111,000
Anthracene	57.5	18.5 J	ND	162,495,000	5,241,774	5,241,774
Benzo(a)anthracene	ND	49.5	ND	21,000	677	677
Benzo(a)pyrene	ND	82.4	ND	2,000	65	65
Benzo(b)fluoranthene	843	149	ND	21,000	677	677
Benzo(ghi)perylene	ND	47.1	ND	2,000	65	65
Benzo(k)fluoranthene	ND	64.1	ND	211,000	6,806	6,806
Butylbenzylphthalate	ND	56.5	ND	191,718,000	6,184,452	6,184,452
Carbazole	ND	10.9 J	ND	1,342,000	43,290	43,290
2-Chlorophenol	ND	8.35 J	ND	3,169,000	102,226	102,226
Chrysene	428	68.8	ND	2,110,000	68,065	68,065
Di-n-butylphthalate	374 J	49.5 J	ND	61,561,000	1,985,839	1,985,839
Dibenzofuran	ND	9.4 J	ND	3,766,000	121,484	121,484
1,2-Dichlorobenzene	ND	4.51 J	ND	20,716,000	668,258	668,258
1,3-Dichlorobenzene	ND	4.86 J	ND	1,342,000	43,290	43,290
Diphenylamine	ND	7.3 J	ND	23,965,000	773,065	773,065
bis(2-Ethylhexyl) phthalate	ND	2,040	1,070 J	1,917,000	61,839	61,839
Fluoranthene	435	106	ND	22,000,000	709,677	709,677
Fluorene	ND	14 J	ND	23,578,000	760,581	760,581
Hexachlorobenzene	1,060 J	5.7 J	ND	11,000	355	355
Indeno(1,2,3-c,d)pyrene	ND	39	ND	21,000	677	677
Naphthalene	ND	3.45 J	ND	1,628,000	52,516	52,516
Phenanthrene	252 J	68.2	ND	27,000	871	871

Refer to footnotes at end of table.

Table 2.2-2 (Concluded)
Comparison of Organic Analyses of SWMU 46 Soil Samples to Preliminary Remediation Goals and Remediation Targets

COC	Maximum Concentration in Discrete Samples[a] (µg/kg)	Maximum Concentration in Geoprobe Samples[b] (µg/kg)	Maximum Concentration in Deep Borehole Samples[c] (µg/kg)	Preliminary Remediation Goal (µg/kg)	Synergistic Preliminary Remediation Goal (µg/kg)	Remediation Target (µg/kg)
Phenol	ND	1,590	6.69 J	184,691,000	5,957,774	5,957,774
Pyrene	349	98	ND	18,468,000	595,742	595,742
HE Compounds	ND	ND	NA	NC	NC	NC
Total PCBs	49.9 ppm	0.841 ppm	ND	NC	NC	1,000[d]

[a]Discrete samples: TJAOU-46-GR-01 through TJAOU-46-GR-04. Sampling depth range = 0.5 to 4.5 ft bgs.
[b]Geoprobe boreholes: TJAOU-46-BH-02 through TJAOU-46-BH-12. Sampling depth range = 3 to 18 ft bgs.
[c]Deep boreholes: TJA-6 and 46-VW-01. Sampling depth range = 45 to 295 ft bgs.
[d]ER Project voluntary cleanup level for total PCBs.

bgs = Below ground surface.
COC = Constituent of concern.
ER = Environmental Restoration.
ft = Foot (feet).
HE = High explosive(s).
J = Estimated concentration.
µg/kg = Microgram(s) per kilogram.
NA = Not analyzed.
NC = Not calculated.
ND = Not detected.
PCB = Polychlorinated biphenyl.
ppm = Part(s) per million.
SVOC = Semivolatile organic compound.
SWMU = Solid Waste Management Unit.
VOC = Volatile organic compound.

- Only one of the 12 Geoprobe boreholes yielded stained soil. Borehole 46-BH-02 (near Location 46-GR-02) contained occasional streaks of green soil to a depth of 10 feet bgs. No green-stained soil was evident from 10 feet bgs to the total depth of 18 feet bgs.

- Demolition work at Building 863 (the Motion Picture Laboratory) also uncovered blue-stained soil, which was attributed to chromic acid and/or organic dyes (see Section 2.1.5).

2.3 Background Comparison

Concentrations of metals and radionuclides in SWMU 46 soil samples were compared to background levels established for the North Supergroup soil by NMED (Dinwiddie September 1997).

2.4 Quality Assurance/Quality Control

This section discusses the QA/QC protocols that were used during the collection of soil samples at SWMU 46. Site-specific Data Quality Objectives were presented in two sampling and analysis plans (Copland April 2001a; Copland August 2001). Except for occasional QA/QC qualifiers, such as analytes reported for equipment rinsate or method blanks, no significant data validation problems were identified in the SWMU 46 data set. Therefore, the analytical data set is of sufficient quality for defining the remediation area.

2.5 Preliminary Remediation Goals

The calculation of PRGs provides a basis for evaluating the appropriate remediation levels for each COC in the soil. The PRGs are applicable to SNL/NM SWMUs requiring remediation and were calculated according to the Citizen's Advisory Board recommendations (DOE et al. September 1995). The exposure pathways of concern for the nonradiological and radiological COCs are the ingestion and inhalation of soil containing COCs. For radiological compounds, an additional exposure pathway is external exposure to penetrating radiation.

Neither a human health nor an ecological risk assessment was prepared for this VCA Plan because the site has not yet been remediated. The risk assessments will be prepared after the confirmatory soil sampling results are received following site remediation. Because SWMU 46 is proposed for continued industrial use, is small in size, and contains no endangered or sensitive species, the ecological risk assessment will use the deer mouse as the sole wildlife receptor.

2.6 Remediation Targets

Although additional sampling data are required to adequately characterize the nature and extent of contamination at SWMU 46, a sufficient amount of technical information and sampling results have been acquired for designing the VCA. The PRGs listed in Tables 2.2-1 and 2.2-2 were calculated (Tharp April 2003) in accordance with NMED guidance (NMED December 2000) for

an industrial land use scenario, which is the designated land use for SWMU 46. Tables 2.2-1 and 2.2-2 also list the SWMU 46 Remediation Targets that are derived from the PRG calculations.

For planning purposes, the possible synergistic effects caused by multiple COCs in the soil were conservatively evaluated by dividing the PRG by the number of chemicals relevant to a particular analytical suite. For example, each metals PRG was divided by 13, which is the number of metals that exceed background levels in SWMU 46 soil samples. Except for arsenic, the SWMU 46 Remediation Target for each metal is one-thirteenth of the respective PRG. The synergistic PRG for arsenic was less than the background level and thus not realistic. The Remediation Target for arsenic is the background level specified by NMED (Dinwiddie September 1997). The PRG for each VOC and SVOC was divided by 31, which is the number of VOCs and SVOCs detected in SWMU 46 soil samples. Background levels are not applicable to VOCs or SVOCs.

The implied "action" to be taken if analytical results from the confirmatory soil samples exceed the SWMU 46 Remediation Targets is to either: (1) conduct additional excavation work until the contamination is below the SWMU 46 Remediation Target, or (2) further evaluate the analytical results with respect to risk factors specific to SWMU 46. If the contaminant levels do not exceed the cumulative risk assessment values prepared using site-specific risk factors, the site will require no further remediation, and an NOD Response requesting NFA status will be submitted. The cumulative (inherently synergistic) risk assessments will take into account the effect of multiple COCs.

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3.0 VCA REMEDIATION

The VCA will be conducted in 2003 and will remove the visible portions of the acid waste line and associated soil near the northern end of SWMU 46 (Figure 3-1). Confirmatory soil samples will be collected from the VCA trench and also from the confluence of the outfall ditches at the southeast end of the site. Section 3.1 presents an overview of the proposed remediation of SWMU 46. All VCA activities will be conducted in accordance with this VCA Plan, the Health and Safety Plan (HASP), the Waste Management Plan (WMP), and the Field Implementation Plan (FIP).

3.1 Overview and Rationale

This VCA for SWMU 46 is intended to remove contaminated soil that exceeds the SWMU 46 Remediation Targets, rendering the site suitable for continued industrial use.

3.2 Permitting, Approval, and Notification Requirements

The remediation of SWMU 46 will be conducted as a VCA, the completion of which will be considered the final remedy. A public briefing concerning the SWMU 46 VCA Plan will be presented at a DOE quarterly public meeting. A copy of this VCA Plan will be submitted to NMED.

In accordance with the National Environmental Policy Act, a review of the potential impacts of this project has already been undertaken, and clearance to proceed has been granted (SNL/NM March 2003). All necessary permits will be obtained before the VCA fieldwork begins. For example, a Dig/Penetration (digging) Permit will be obtained from SNL/NM Facilities Engineering. Because the site is located outside of the Tijeras Arroyo floodplain, a U.S. Army Corps of Engineers permit is not required. A COA Topsoil Disturbance Permit is not necessary because less than 0.75 acres will be excavated.

3.3 Remediation Activities

The remediation activities for the SWMU 46 VCA will involve the following:

- Remove the broken sections of the acid waste line using an excavator. The remediation trench will be approximately 200 feet long and 2 feet wide, with an average depth of approximately 1.5 feet. The trench will extend across the starting locations for all three outfall ditches.
- Remove sloughed (stained) soil associated with the acid waste line.
- Excavate contaminated soil where metals concentrations exceed the risk-based SWMU 46 Remediation Targets. Table 2.2-1 shows that only two metals (arsenic and cadmium) exceed the SWMU 46 Remediation Targets.

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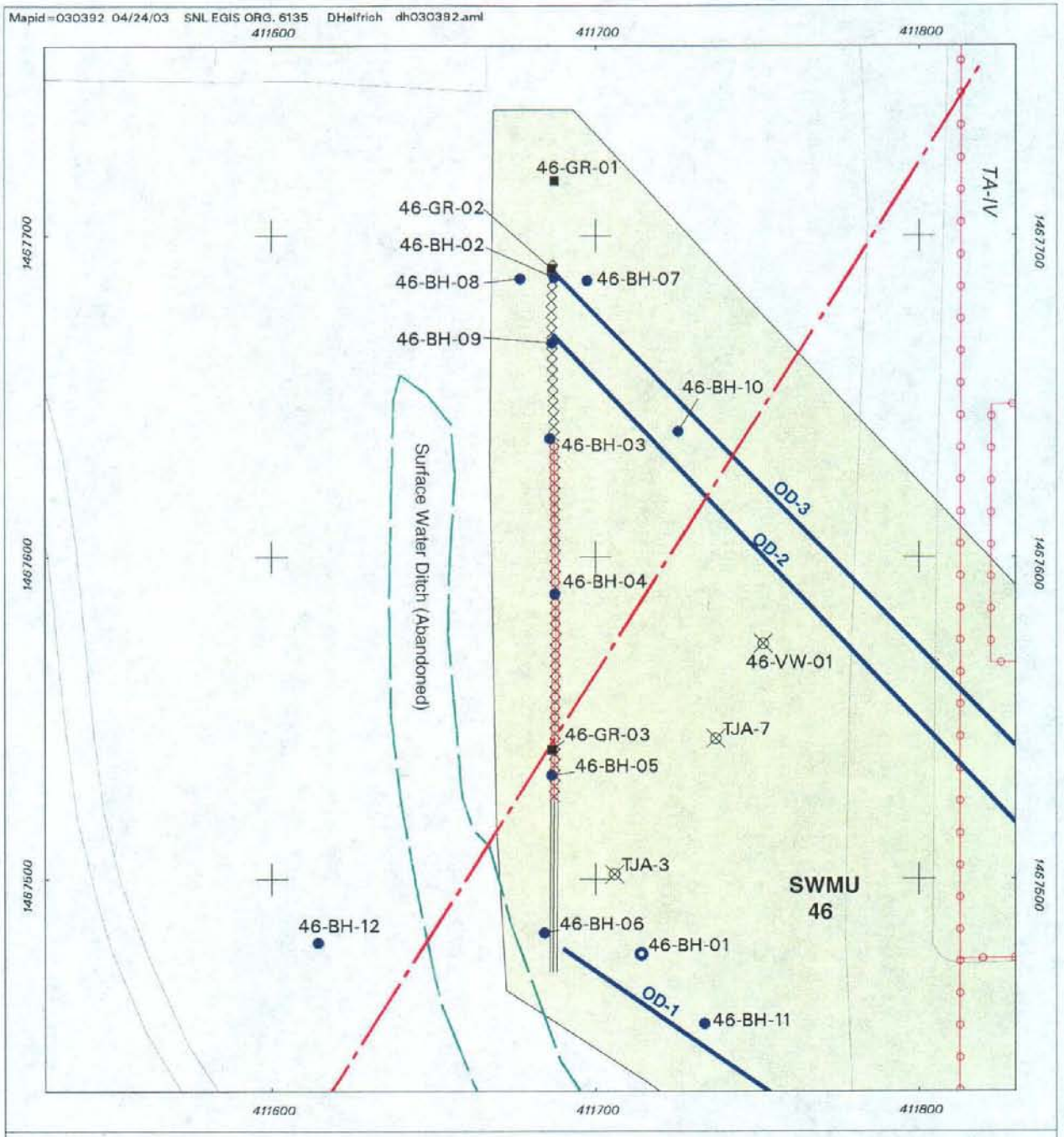

Legend

- Grab Sample
- Test Borehole
- Fence
- Unpaved Road
- VCA Remediation Trench
- Buried Electrical Line
- Acid Waste Line (visible segment)
- Outfall Ditch from 1966 Air Photo
- Surface Water Ditch (Abandoned)
- SWMU 46
- Geoprobe Borehole
- Monitor Well

Figure 3-1
VCA Remediation Area at SWMU 46

0 25 50
Scale in Feet

0 6 12
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

840857.04070000 A4

- Excavate contaminated soil where total PCBs exceed the VCA Remediation Target of 1 ppm (mg/kg).
- Load the contaminated soil and waste-line pieces directly into approved waste containers.
- Ship the waste containers to a waste-disposal facility after waste characterization analyses are evaluated.
- Collect confirmatory samples from the remediation trench and from the confluence of the outfall ditches.
- Prepare cumulative risk assessments using the confirmatory soil sampling results.
- Prepare a Final Report in the form of an NOD Response for SWMU 46.
- If the risk assessments demonstrate that the site has been adequately remediated, the remediation trench will be backfilled with clean soil.

Additional details of the VCA activities are discussed in the following sections.

3.3.1 Site Preparation

Prior to the start of excavation work, the site will be prepared to minimize potential adverse impacts to human health and the environment. An exclusion zone will be established to minimize worker and visitor exposure to hazards and to facilitate implementation of the HASP. The areas of excavation, as well as the waste-staging areas, will be roped off and/or fenced to prevent inadvertent entry of workers/visitors. Because the topography of the SWMU 46 VCA area is relatively flat and more than 300 feet from the arroyo rim, no surface-water controls are required.

3.3.2 Excavation Procedures

The excavation work will be conducted at the northern end of the site (the VCA area) as shown on Figure 3-1. Remediation will involve excavating approximately 50 cubic yards of soil and vitrified clay pipe using heavy equipment such as a backhoe and trackhoe (excavator). The material will be placed into approved waste containers for shipment to a waste disposal facility (see Section 3.4).

If the remediation trench is excavated to a depth exceeding 4 feet bgs, sloping and shoring requirements that meet or exceed Occupational Safety and Health Administration guidance will be used. Airborne dust will be mitigated by watering the work area as necessary. Additional safety requirements are discussed in the SWMU 46 HASP.

3.3.3 Field-Screening Activities

To comply with WMP and HASP requirements, field-screening procedures will be performed on soil and pieces of the acid waste line using a photoionization detector to measure VOC concentrations.

3.4 Waste Management Issues

The waste generated at the site during the VCA activities will include solid and possibly hazardous waste. No radioactive waste is anticipated based upon previous soil sampling results; SWMU 46 is not a Radioactive Materials Management Area.

The waste will consist of soil and broken pieces of the acid waste line, which is composed of vitrified clay pipe. Each section is approximately 5 feet long and 8 inches in diameter. The acid waste line couplings are sealed with black tar and oakum (jute fiber). Much of the acid waste line at SWMU 46 was broken into small pieces (fist- to football-size) when heavy equipment drove over the area in 1977 during the construction of a nearby surface-water ditch.

Waste generation will follow SNL/NM waste minimization, recycling, segregation, and reduction practices. A Pollution Prevention Opportunity Assessment will be prepared and followed as closely as reasonably practicable during the remediation activities. Waste minimization will involve reuse and recycling of equipment, material, and personal protective equipment to minimize unnecessary hazardous waste. Reasonable attempts will be made to minimize waste by segregating solid from potentially hazardous waste. The waste will be transported to permitted facilities for disposal as solid or hazardous waste following applicable state and federal regulations and SNL/NM and DOE protocols. The SWMU 46 WMP provides details regarding the sampling, characterization, tracking/labeling, staging, and management requirements for all waste types.

Table 3.4-1 lists the estimated volumes of contaminated soil and debris that will be generated during the VCA. Waste characterization sampling will be conducted for the excavated soil according to the WMP.

Table 3.4-1
Estimated Volumes of Contaminated Soil and Debris for SWMU 46 VCA

Waste Item	Surface Area (ft^2)	Assumed Average Thickness (ft)	Estimated Volume[a]	Anticipated Waste Category
Contaminated soil	660	1.5	1,000 ft^3 = 37 yd^3 (fluffed: 48 yd^3)	Hazardous Waste
Fragments of vitrified clay pipe	NA[b]	NA	2 yd^3	Hazardous Waste

[a]Fluffed soil volume assumes 30% expansion (noncompacted soil).
[b]The fragments are relatively small in size.
ft = Foot (feet).
NA = Not applicable.
SWMU = Solid Waste Management Unit.
VCA = Voluntary Corrective Action.
yd = Yard(s).

3.5 Confirmatory Sampling

Confirmatory sampling will be conducted at the conclusion of the excavation work. The analytical results will be compared to the SWMU 46 Remediation Targets in Tables 2.2-1 and 2.2-2. A more detailed discussion of the confirmatory sampling is presented in the FIP.

In accordance with the FIP, confirmatory soil sampling will be conducted at the remediation trench to determine whether contaminated soil that exceeds the SWMU 46 Remediation Targets has been removed. Soil samples will be collected using either discrete (grab), hand-auger, and/or backhoe techniques.

Soil samples will be collected at 20-foot intervals along the lateral extent of the remediation trench. The samples will be collected from the floor of the trench, which will average approximately 1.5 feet bgs (the pre-existing grade). These shallow samples will be collected with a hand trowel.

Soil samples also will be collected at two locations at the outfall ditch confluence. A backhoe will be used to collect the samples from 5 feet bgs. During previous sampling activities along the arroyo rim, hard caliche layers and cobbles have been encountered. The proposed sampling depth and method are consistent with other TJAOU outfall sampling projects, which NMED has endorsed (Copland April 2001b; Copland April 2001c).

An approximate number of VCA confirmatory soil samples is provided in Table 3.5-1; more details are included in the FIP. Additional samples may be collected depending upon field conditions.

Table 3.5-1
Estimated Number of Confirmatory Soil Sampling Locations for SWMU 46 VCA

Analyte	Soil Sample Locations at Remediation Trench	Soil Sample Locations at Outfall Ditch Confluence	EPA Analytical Method[a]
TAL Metals	15	2	6010/7471
Chromium-VI	15	2	7196
PCBs	15	2	8082
VOCs	5	1	8260
SVOCs	5	1	8270

[a]EPA November 1986.
EPA = U.S. Environmental Protection Agency.
PCB = Polychlorinated biphenyl.
SVOC = Semivolatile organic compound.
SWMU = Solid Waste Management Unit.
TAL = Target Analyte List.
VCA = Voluntary Corrective Action.
VOC = Volatile organic compound.

Table 3.5-2 lists the proposed sampling depths for the confirmatory soil samples.

Table 3.5-2
Proposed Depths of Confirmatory Soil Samples for SWMU 46 VCA

	Sampling Depth (ft bgs)
Remediation Trench	Trench Floor (expected to average about 1.5 ft bgs) 3.5 ft Beneath Trench Floor (5 ft bgs)
Outfall Ditch Confluence	Floor of Outfall Ditches (OD-1 and OD-2) 5 ft bgs Beneath the Floor of the Outfall Ditch

bgs = Below ground surface.
ft = Foot (feet).
SWMU = Solid Waste Management Unit.
VCA = Voluntary Corrective Action.

Additional samples for QA/QC evaluation will be collected according to the ER Project Quality Assurance Project Plan (SNL/NM April 1996b). The QA/QC samples will include equipment blank (EB), trip blank (TB), and soil duplicate samples. EB and VOC TB samples will be submitted with each analytical batch. The duplicate samples will be collected at a rate exceeding either 1 duplicate per analytical batch or 1 duplicate per 20 soil samples. Field activities will be documented in logbooks, and all soil sample locations will be surveyed using Global Positioning System equipment.

3.6 Site Restoration

If analytical results from the VCA confirmatory soil samples verify that no contamination in excess of the SWMU 46 Remediation Targets remains on site at SWMU 46, the trench will be backfilled with clean soil and returned to the original grade.

3.7 Final Inspection

At the completion of the VCA activities, a final site inspection will be held for NMED and DOE representatives.

3.8 Final Report

After completing the VCA fieldwork and evaluating the analytical data, a final report in the form of an NOD Response will be submitted for regulatory review. The NOD Response will include the VCA confirmatory data, a cumulative risk assessment, and the justifications for any significant deviations to the VCA Plan.

4.0 PROJECT MANAGEMENT

The SWMU 46 VCA will be managed by the TJAOU of the SNL/NM ER Project.

4.1 Schedule and Cost

The excavation work is anticipated to take approximately two weeks and is scheduled to begin in the summer of 2003. The projected Fiscal Year 2003 budget for the VCA is $300,000.

4.2 Stakeholder Notifications

A public presentation for this VCA Plan will be made at a DOE quarterly public meeting. Informal discussions will continue to be held among SNL/NM, DOE, and NMED staff.

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5.0 IMPLEMENTATION PLANS

Three SWMU 46 plans (FIP, HASP, and WMP) complement this VCA Plan.

5.1 Field Implementation Plan

The SWMU 46 VCA FIP discusses in greater detail the confirmatory soil sampling requirements. A copy of the FIP will be kept on site during the sampling activities.

5.2 Health and Safety Plan

Fieldwork hazards will be mitigated according the SWMU 46 VCA HASP. A copy of the HASP will be available at the site during all fieldwork activities.

5.3 Waste Management Plan

Waste will be managed according to the SWMU 46 VCA WMP. A copy of the WMP will be kept on site during the excavation and waste handling activities.

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ATTACHMENT B
Summary of Analytical Results for Characterization Soil Samples from SWMU 46 Geoprobe® Boreholes

LIST OF TABLES

Table B-1
Summary of SWMU 46 Characterization Soil Sampling
Metals Analytical Results for Geoprobe Investigation
August 2001
(Off-Site Laboratory[a])

Sample Attributes			Metals (EPA Methods SW846 3005/SW846 3050/SW846 7470/SW846 7471/SW846 9012[b]) (mg/kg)				
Record Number[c]	ER Sample ID	Sample Depth (ft)	Antimony	Arsenic	Barium	Beryllium	Cadmium
604764	TJAOU-46-BH-010-5.5-S	5.5	ND (0.465) [A2,UJ]	1.85 [J,P1]	72.5 [J,P1]	0.344 J (0.49)	0.103 J (0.49) [B3,J]
604764	TJAOU-46-BH-010-8.0-S	8.0	ND (0.443) [A2,UJ]	1.69 [J,P1]	79 [J,P1]	0.299 J (0.467)	0.139 J (0.467) [B3,J]
604764	TJAOU-46-BH-011-5.5-S	5.5	ND (0.431) [A2,UJ]	1.28 [J,P1]	34.2 [J,P1]	0.321 J (0.455)	0.076 J (0.455) [B3,J]
604764	TJAOU-46-BH-011-8.0-S	8.0	ND (0.456) [A2,UJ]	1.8 [J,P1]	99.4 [J,P1]	0.343 J (0.481)	0.0913 J (0.481) [B3,J]
604764	TJAOU-46-BH-012-5.5-S	5.5	ND (0.465) [A2,UJ]	1.38 [J,P1]	77 [J,P1]	0.396 J (0.49)	0.122 J (0.49) [B3,J]
604764	TJAOU-46-BH-012-9.0-S	9.0	ND (0.46) [A2,UJ]	1.83 [J,P1]	53.4 [J,P1]	0.318 J (0.485)	0.128 J (0.485) [B3,J]
604760	TJAOU-46-BH-02-5.0-S	5.0	ND (0.435)	3.36	96.2	0.401 J (0.459)	0.329 J (0.459)
604760	TJAOU-46-BH-02-8.5-S	8.5	ND (0.46)	1.45	133	0.352 J (0.485)	0.181 J (0.485)
604760	TJAOU-46-BH-02-13.5-S	13.5	ND (0.474)	1.89	**216**	0.245 J (0.5)	0.0886 J (0.5)
604760	TJAOU-46-BH-02-17.5-S	17.5	ND (0.451)	3.91	**372**	0.496	0.216 J (0.476)
604760	TJAOU-46-BH-03-4.5-S	4.5	ND (0.474)	1.74	80.1	0.299 J (0.5)	0.213 J (0.5)
604760	TJAOU-46-BH-03-7.0-S	7.0	ND (0.447)	2.28	156	0.335 J (0.472)	**1.24**
604760	TJAOU-46-BH-04-4.0-S	4.0	ND (0.443)	2.06	111	0.319 J (0.467)	0.318 J (0.467)
604760	TJAOU-46-BH-04-8.5-S	8.5	ND (0.474)	1.84	89	0.336 J (0.5)	0.267 J (0.5)
604760	TJAOU-46-BH-04-11.5-S	11.5	ND (0.456)	1.76	112	0.346 J (0.481)	0.235 J (0.481)
604762	TJAOU-46-BH-05-5.5-S	5.5	ND (0.456) [A2,UJ]	1.84	71.3	0.328 J (0.481)	0.335 J (0.481)
604762	TJAOU-46-BH-05-8.0-S	8.0	ND (0.469) [A2,UJ]	1.6	69.2	0.313 J (0.495)	0.228 J (0.495)
604762	TJAOU-46-BH-06-5.5-S	5.5	ND (0.465) [A2,UJ]	1.67	112	0.373 J (0.49)	0.281 J (0.49)
604762	TJAOU-46-BH-06-9.5-S	9.5	ND (0.474) [A2,UJ]	2.43	**339**	0.288 J (0.5)	0.192 J (0.5)
604762	TJAOU-46-BH-07-5.5-S	5.5	ND (0.447) [A2,UJ]	2	199	0.325 J (0.472)	0.264 J (0.472)
604762	TJAOU-46-BH-07-9.5-S	9.5	ND (0.469) [A2,UJ]	1.36	100	0.253 J (0.495)	0.328 J (0.495)
604762	TJAOU-46-BH-07-12.5-S	12.5	ND (0.46) [A2,UJ]	1.67	79.4	0.309 J (0.485)	0.199 J (0.485)
604762	TJAOU-46-BH-08-5.5-S	5.5	0.602 J (0.909) [A2,UJ]	3.94	147	0.54	**3.12**
604762	TJAOU-46-BH-08-9.5-S	9.5	ND (0.46) [A2,UJ]	1.91	84	0.304 J (0.485)	0.199 J (0.485)
604762	TJAOU-46-BH-08-13.5-S	13.5	ND (0.435) [A2,UJ]	2.1	**572**	0.232 J (0.459)	0.042 J (0.459)
604764	TJAOU-46-BH-09-5.5-S	5.5	ND (0.46) [A2,UJ]	2.13 [J,P1]	100 [J,P1]	0.317 J (0.485)	0.0995 J (0.485) [B3,J]
604764	TJAOU-46-BH-09-8.5-S	8.5	ND (0.451) [A2,UJ]	1.92 [J,P1]	63.4 [J,P1]	0.315 J (0.476)	0.11 J (0.476) [B3,J]
Background Concentration[d] (surface/subsurface)[e]			3.9/3.9	5.6/4.4	200/200	0.8/0.8	<1/0.9
Quality Assurance/Quality Control Samples (mg/L)							
604761	TJAOU-46-BH-02-EB1	NA	ND (0.0038)	ND (0.00457) [B3,UJ]	0.00074 J (0.005) [B,J]	ND (0.0002)	ND (0.00025)

Refer to footnotes at end of table.

Table B-1 (Continued)
Summary of SWMU 46 Characterization Soil Sampling
Metals Analytical Results for Geoprobe Investigation
August 2001
(Off-Site Laboratory[a])

Sample Attributes			Metals (EPA Methods SW846 3005/SW846 3050/SW846 7470/SW846 7471/SW846 9012[b]) (mg/kg)				
Record Number[c]	ER Sample ID	Sample Depth (ft)	Chromium	Cobalt	Copper	Iron	Lead
604764	TJAOU-46-BH-010-5.5-S	5.5	5.27 [J,P1]	4.41	6.76	11,400	4.04
604764	TJAOU-46-BH-010-8.0-S	8.0	8.17 [J,P1]	3.72	5.79	11,500	3.58
604764	TJAOU-46-BH-011-5.5-S	5.5	3.92 [J,P1]	4.37	5.09	8,620	3.1
604764	TJAOU-46-BH-011-8.0-S	8.0	5.86 [J,P1]	3.85	6.08	11,700	4.24
604764	TJAOU-46-BH-012-5.5-S	5.5	7.18 [J,P1]	5.53	6.16	13,200	3.39
604764	TJAOU-46-BH-012-9.0-S	9.0	8.93 [J,P1]	4.8	7.08	16,200	4.58
604760	TJAOU-46-BH-02-13.5-S	13.5	5.75	2.39	2.76	5,540	3.06
604760	TJAOU-46-BH-02-17.5-S	17.5	11.3	5.88	7.21	12,800	6.47
604760	TJAOU-46-BH-02-5.0-S	5.0	9.98	4.56	11.5	14,200	5.04
604760	TJAOU-46-BH-02-8.5-S	8.5	7.53	5	5.18	11,700	3.52
604760	TJAOU-46-BH-03-4.5-S	4.5	8.92	4.15	10.8	12,500	4.78
604760	TJAOU-46-BH-03-7.0-S	7.0	**13.2**	7.93	14.3	17,000	5.55
604760	TJAOU-46-BH-04-11.5-S	11.5	**13.4**	5.64	13.9	12,500	4.52
604760	TJAOU-46-BH-04-4.0-S	4.0	9.6	6.24	12.9	20,900	4.38
604760	TJAOU-46-BH-04-8.5-S	8.5	12.3	5.98	14.2	15,500	4.9
604762	TJAOU-46-BH-05-5.5-S	5.5	9.29	5.6	6.58	16,500 [J]	4.62
604762	TJAOU-46-BH-05-8.0-S	8.0	6.72	5.78	9.25	11,700 [J]	6.33
604762	TJAOU-46-BH-06-5.5-S	5.5	9.02	4.94	7.25	15,500 [J]	4.46
604762	TJAOU-46-BH-06-9.5-S	9.5	8.48	5.11	5.96	14,700 [J]	5.39
604762	TJAOU-46-BH-07-12.5-S	12.5	7.97	4.62	6.83	12,500 [J]	4.16
604762	TJAOU-46-BH-07-5.5-S	5.5	10	7	6.76	17,900 [J]	5.25
604762	TJAOU-46-BH-07-9.5-S	9.5	11	6.52	7.04	13,700 [J]	3.93
604762	TJAOU-46-BH-08-13.5-S	13.5	4.7	2.27	1.92	4,790 [J]	2.76
604762	TJAOU-46-BH-08-5.5-S	5.5	**120**	4.76	**72**	14,600 [J]	**46**
604762	TJAOU-46-BH-08-9.5-S	9.5	8.56	4.77	6.87	17,100 [J]	4.39
604764	TJAOU-46-BH-09-5.5-S	5.5	7.43 [J,P1]	4.45	7.27	14,300	3.91
604764	TJAOU-46-BH-09-8.5-S	8.5	**18.6 [J,P1]**	4.35	7.67	13,000	3.86
Background Concentration[d] (surface/subsurface)[e]			17.3/12.8	7.1/8.8	17/17	NC	39/11.2
Quality Assurance/Quality Control Samples (mg/L)							
604761	TJAOU-46-BH-02-EB1	NA	ND (0.00078)	ND (0.0003)	ND (0.00267)	0.0498 J (0.05) [B,J]	ND (0.00344)

Refer to footnotes at end of table.

Table B-1 (Continued)
Summary of SWMU 46 Characterization Soil Sampling
Metals Analytical Results for Geoprobe Investigation
August 2001
(Off-Site Laboratory[a])

Sample Attributes			Metals (EPA Methods SW846 3005/SW846 3050/SW846 7470/SW846 7471/SW846 9012[b]) (mg/kg)			
Record Number[c]	ER Sample ID	Sample Depth (ft)	Mercury	Nickel	Selenium	Silver
604764	TJAOU-46-BH-010-5.5-S	5.5	ND (0.00414) [B3,UJ]	5.78 [J,P1]	0.421 J (0.49)	ND (0.113)
604764	TJAOU-46-BH-010-8.0-S	8.0	ND (0.00447) [B3,UJ]	6.11 [J,P1]	ND (0.253)	ND (0.108)
604764	TJAOU-46-BH-011-5.5-S	5.5	ND (0.00428) [B3,UJ]	4.01 [J,P1]	ND (0.246)	ND (0.105)
604764	TJAOU-46-BH-011-8.0-S	8.0	ND (0.00431) [B3,UJ]	5.57 [J,P1]	ND (0.26)	ND (0.111)
604764	TJAOU-46-BH-012-5.5-S	5.5	0.00629 J (0.00939) [B3,J]	5.87 [J,P1]	0.285 J (0.49)	ND (0.113)
604764	TJAOU-46-BH-012-9.0-S	9.0	ND (0.00363) [B3,UJ]	6.39 [J,P1]	0.475 J (0.485)	ND (0.112)
604760	TJAOU-46-BH-02-13.5-S	13.5	0.00739 J (0.00905)	4.3	ND (0.27)	0.121 J (0.5)
604760	TJAOU-46-BH-02-17.5-S	17.5	0.00689 J (0.00858)	9.46	ND (0.257)	ND (0.11)
604760	TJAOU-46-BH-02-5.0-S	5.0	0.0175	7.58	ND (0.248)	**3.12**
604760	TJAOU-46-BH-02-8.5-S	8.5	0.00483 J (0.00905)	6.86	ND (0.262)	0.149 J (0.485)
604760	TJAOU-46-BH-03-4.5-S	4.5	0.00497 J (0.00853)	5.84	ND (0.27)	ND (0.116)
604760	TJAOU-46-BH-03-7.0-S	7.0	0.0089 J (0.00987)	9.5	ND (0.255)	0.16 J (0.472)
604760	TJAOU-46-BH-04-11.5-S	11.5	0.00437 J (0.00892)	**63.4**	ND (0.26)	ND (0.111)
604760	TJAOU-46-BH-04-4.0-S	4.0	0.00449 J (0.0096)	7.74	ND (0.253)	ND (0.108)
604760	TJAOU-46-BH-04-8.5-S	8.5	ND (0.00397)	7.55	ND (0.27)	ND (0.116)
604762	TJAOU-46-BH-05-5.5-S	5.5	0.00865 [B,J]	12.7	ND (0.26)	ND (0.111)
604762	TJAOU-46-BH-05-8.0-S	8.0	0.00899 J (0.00951) [B,J]	7.16	ND (0.268)	ND (0.114)
604762	TJAOU-46-BH-06-5.5-S	5.5	0.00796 J (0.00972) [B,J]	7.03	ND (0.265)	ND (0.113)
604762	TJAOU-46-BH-06-9.5-S	9.5	0.00702 J (0.00888) [B,J]	6.28	ND (0.27)	ND (0.116)
604762	TJAOU-46-BH-07-12.5-S	12.5	0.0119 [B,J]	6.36	ND (0.262)	ND (0.112)
604762	TJAOU-46-BH-07-5.5-S	5.5	0.00941 [B,J]	6.81	ND (0.255)	0.149 J (0.472)
604762	TJAOU-46-BH-07-9.5-S	9.5	0.00782 [B,J]	7.64	ND (0.268)	ND (0.114)
604762	TJAOU-46-BH-08-13.5-S	13.5	0.01 [B,J]	3.64	ND (0.248)	ND (0.106)
604762	TJAOU-46-BH-08-5.5-S	5.5	0.0464	**38.3**	0.317 J (0.455)	**16.2**
604762	TJAOU-46-BH-08-9.5-S	9.5	0.0072 J (0.00884) [B,J]	6.51	0.317 J (0.485)	ND (0.112)
604764	TJAOU-46-BH-09-5.5-S	5.5	0.00481 J (0.00992) [B3,J]	6.55 [J,P1]	0.444 J (0.485)	ND (0.112)
604764	TJAOU-46-BH-09-8.5-S	8.5	ND (0.00439) [B3,UJ]	**33.4 [J,P1]**	0.37 J (0.476)	ND (0.11)
Background Concentration[d] (surface/subsurface)[e]			<0.25/<0.1	25.4/25.4	<1/<1	<1/<1
Quality Assurance/Quality Control Samples (mg/L)						
604761	TJAOU-46-BH-02-EB1	NA	ND (0.00007)	0.00099 J (0.005) [B,J]	ND (0.00309)	ND (0.0002)

Refer to footnotes at end of table.

Table B-1 (Continued)
Summary of SWMU 46 Characterization Soil Sampling
Metals Analytical Results for Geoprobe Investigation
August 2001
(Off-Site Laboratory[a])

Sample Attributes			Metals (EPA Methods SW846 3005/SW846 3050/SW846 7470/SW846 7471/SW846 9012[b]) (mg/kg)			
Record Number[c]	ER Sample ID	Sample Depth (ft)	Thallium	Vanadium	Zinc	Total Cyanide
604764	TJAOU-46-BH-010-5.5-S	5.5	ND (0.926)	22.3 [J,P1]	26.8 [J,P1]	0.107 J (0.25)
604764	TJAOU-46-BH-010-8.0-S	8.0	ND (0.883)	22.3 [J,P1]	24.6 [J,P1]	0.08 J (0.25)
604764	TJAOU-46-BH-011-5.5-S	5.5	ND (0.858)	16.4 [J,P1]	17 [J,P1]	ND (0.0691)
604764	TJAOU-46-BH-011-8.0-S	8.0	ND (0.908)	21.8 [J,P1]	24 [J,P1]	ND (0.0691)
604764	TJAOU-46-BH-012-5.5-S	5.5	ND (0.926)	27.9 [J,P1]	21.8 [J,P1]	0.0875 J (0.25)
604764	TJAOU-46-BH-012-9.0-S	9.0	ND (0.917)	30.8 [J,P1]	28.3 [J,P1]	0.0951 J (0.25)
604760	TJAOU-46-BH-02-13.5-S	13.5	ND (0.944)	15.6	12.6	0.113 J (0.25)
604760	TJAOU-46-BH-02-17.5-S	17.5	ND (0.899)	**33.4**	33.2	0.098 J (0.25)
604760	TJAOU-46-BH-02-5.0-S	5.0	**ND (2.17)**	**34.1**	26.3	0.185 J (0.25)
604760	TJAOU-46-BH-02-8.5-S	8.5	ND (0.917)	22.9	19.4	0.113 J (0.25)
604760	TJAOU-46-BH-03-4.5-S	4.5	**ND (2.36)**	27	25.5	0.128 J (0.25)
604760	TJAOU-46-BH-03-7.0-S	7.0	**ND (2.23)**	**37.7**	30.5	ND (0.0691)
604760	TJAOU-46-BH-04-11.5-S	11.5	**ND (2.27)**	26.5	28	ND (0.0691)
604760	TJAOU-46-BH-04-4.0-S	4.0	**ND (2.21)**	**46.5**	29.3	0.107 J (0.25)
604760	TJAOU-46-BH-04-8.5-S	8.5	**ND (2.36)**	**35.6**	28.3	ND (0.0691)
604762	TJAOU-46-BH-05-5.5-S	5.5	**ND (2.27)**	**36.6**	27.2	0.0955 J (0.25)
604762	TJAOU-46-BH-05-8.0-S	8.0	ND (0.935)	24	30.4	0.0895 J (0.25)
604762	TJAOU-46-BH-06-5.5-S	5.5	**ND (2.31)**	**34**	30.5	ND (0.0691)
604762	TJAOU-46-BH-06-9.5-S	9.5	**ND (2.36)**	30.6	24.6	0.157 J (0.25)
604762	TJAOU-46-BH-07-12.5-S	12.5	ND (0.917)	25.9	24.4	0.071 J (0.25)
604762	TJAOU-46-BH-07-5.5-S	5.5	**ND (2.23)**	**40**	27.7	0.203 J (0.25)
604762	TJAOU-46-BH-07-9.5-S	9.5	ND (0.935)	29.2	31.2	0.0805 J (0.25)
604762	TJAOU-46-BH-08-13.5-S	13.5	**1.88**	13.7	10.4	0.154 J (0.25)
604762	TJAOU-46-BH-08-5.5-S	5.5	ND (0.858)	**33.3**	64	12.7
604762	TJAOU-46-BH-08-9.5-S	9.5	**ND (2.29)**	**34.6**	28.5	0.0745 J (0.25)
604764	TJAOU-46-BH-09-5.5-S	5.5	ND (0.917)	31.6 [J,P1]	23.7 [J,P1]	0.234 J (0.25)
604764	TJAOU-46-BH-09-8.5-S	8.5	ND (0.899)	27.8 [J,P1]	26 [J,P1]	0.119 J (0.25)
Background Concentration[d] (surface/subsurface)[e]			<1.1/<1.1	33/33	76/76	NC

Refer to footnotes at end of table.

Table B-1 (Concluded)
Summary of SWMU 46 Characterization Soil Sampling
Metals Analytical Results for Geoprobe Investigation
August 2001
(Off-Site Laboratory[a])

Sample Attributes			Metals (EPA Methods SW846 3005/SW846 3050/SW846 7470/SW846 7471/SW846 9012[b]) (mg/kg)			
Record Number[c]	ER Sample ID	Sample Depth (ft)	Thallium	Vanadium	Zinc	Total Cyanide
Quality Assurance/Quality Control Samples (mg/L)						
604761	TJAOU-46-BH-02-EB1	NA	ND (0.00413)	ND (0.00109)	0.0129	ND (0.00289)

Note: Values in **bold** indicate concentrations or MDLs greater than background.
[a]General Engineering Laboratories, Inc.
[b]EPA November 1986.
[c]Analysis request/chain-of-custody record.
[d]Dinwiddie September 1997.
[e]Surface samples defined as 0 to 6 inches; subsurface samples are greater than 6 inches.

A2 = Laboratory accuracy and/or bias measurements for the associated matrix spike and/or duplicate do not meet acceptance criteria.
B = Analyte present in laboratory method blank.
B3 = Analyte present in calibration blank.
BH = Borehole.
EB = Equipment Blank.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
ID = Identification.
J ( ) = Estimated value less than the laboratory reporting limit, shown in parentheses.
[J] = The associated value is an estimated quantity.
mg/kg = Milligram(s) per kilogram.
mg/L = Milligram(s) per liter.
MDL = Method detection limit.
NA = Not applicable.
NC = Not calculated by Dinwiddie (September 1997).
ND ( ) = Not detected above the MDL, shown in parentheses.
OU = Operable Unit.
P1 = Laboratory precision measurements for the matrix spike sample and associated duplicate do not meet acceptance criteria.
S = Soil Sample.
SWMU = Solid Waste Management Unit.
TJA = Tijeras Arroyo.
UJ = The analyte was analyzed for but was not detected. The associated value is an estimate and may be inaccurate or imprecise.

Table B-2
Summary of SWMU 46 Characterization Soil Sampling
Metals Analytical Detection Limits
August 2001
(Off-Site Laboratory[a])

Analyte	Method Detection Limit (mg/kg)
Aluminum	1.95–2.14
Antimony	0.431–0.474
Arsenic	0.249–0.274
Barium	0.027–0.0297
Beryllium	0.0139–0.0153
Cadmium	0.0236–0.0259
Calcium	3.53–17.8
Chromium	0.396–0.436
Cobalt	0.099–0.109
Copper	0.0457–0.0503
Iron	3.56–9.23
Lead	0.31–0.341
Magnesium	0.559–1.51
Manganese	0.0435–0.0479
Mercury	0.00343–0.00451
Nickel	0.181–0.199
Potassium	1.57–7.87
Selenium	0.246–0.27
Silver	0.105–0.116
Sodium	2.27–2.5
Thallium	0.858–2.36
Vanadium	0.108–0.119
Zinc	0.237–0.26
Cyanide (total)	0.0691–0.691

[a]General Engineering Laboratories, Inc.
mg/kg = Milligram(s) per kilogram.
SWMU= Solid Waste Management Unit.

Table B-3
Summary of SWMU 46 Characterization Soil Sampling
PCB Analytical Results for Geoprobe Investigation
August 2001
(Off-Site Laboratory[a])

Sample Attributes			PCBs (EPA Method SW846 8082[b]) (µg/kg)				
Record Number[c]	ER Sample ID	Sample Depth(ft)	Aroclor-1242	Aroclor-1248	Aroclor-1254	Aroclor-1260	Total PCBs
604760	TJAOU-46-BH-02-13.5-S	13.5	ND (1.67)	ND (0.907)	ND (1.37)	ND (1.43)	NA
604760	TJAOU-46-BH-02-17.5-S	17.5	ND (1.67)	ND (0.907)	ND (1.37)	ND (1.43)	NA
604760	TJAOU-46-BH-02-5.0-S	5.0	ND (1.67)	**2.6 J (3.33)**	ND (1.37)	ND (1.43)	2.6 J
604760	TJAOU-46-BH-02-8.5-S	8.5	ND (1.67)	ND (0.907)	ND (1.37)	ND (1.43)	NA
604760	TJAOU-46-BH-03-4.5-S	4.5	ND (1.67)	ND (0.907)	ND (1.37)	ND (1.43)	NA
604760	TJAOU-46-BH-03-7.0-S	7.0	ND (1.67)	ND (0.907)	ND (1.37)	ND (1.43)	NA
604760	TJAOU-46-BH-04-11.5-S	11.5	**203**	ND (9.07)	**293**	ND (14.3)	496
604760	TJAOU-46-BH-04-4.0-S	4.0	**6.9**	ND (0.907)	ND (1.37)	ND (1.43)	6.9
604760	TJAOU-46-BH-04-8.5-S	8.5	ND (1.67)	ND (0.907)	ND (1.37)	ND (1.43)	NA
604762	TJAOU-46-BH-05-5.5-S	5.5	ND (1.67)	ND (0.907)	ND (1.37)	ND (1.43)	NA
604762	TJAOU-46-BH-05-8.0-S	8.0	ND (1.67)	ND (0.907)	ND (1.37)	ND (1.43)	NA
604762	TJAOU-46-BH-06-5.5-S	5.5	ND (1.67)	ND (0.907)	ND (1.37)	ND (1.43)	NA
604762	TJAOU-46-BH-06-9.5-S	9.5	ND (1.67)	ND (0.907)	ND (1.37)	ND (1.43)	NA
604762	TJAOU-46-BH-07-12.5-S	12.5	ND (1.67)	ND (0.907)	ND (1.37)	ND (1.43)	NA
604762	TJAOU-46-BH-07-5.5-S	5.5	ND (1.67)	ND (0.907)	ND (1.37)	ND (1.43)	NA
604762	TJAOU-46-BH-07-9.5-S	9.5	ND (1.67)	ND (0.907)	ND (1.37)	ND (1.43)	NA
604762	TJAOU-46-BH-08-13.5-S	13.5	ND (1.67)	ND (0.907)	ND (1.37)	ND (1.43)	NA
604762	TJAOU-46-BH-08-5.5-S	5.5	**242**	ND (9.07)	**425**	**174**	841
604762	TJAOU-46-BH-08-9.5-S	9.5	ND (1.67)	ND (0.907)	ND (1.37)	ND (1.43)	NA
604764	TJAOU-46-BH-09-5.5-S	5.5	ND (1.67) [P2]	ND (0.907) [P2]	ND (1.37) [P2]	ND (1.43) [P2]	NA
604764	TJAOU-46-BH-09-8.5-S	8.5	ND (1.67) [P2]	ND (0.907) [P2]	ND (1.37) [P2]	ND (1.43) [P2]	NA
604764	TJAOU-46-BH-010-5.5-S	5.5	ND (1.67) [P2]	ND (0.907) [P2]	ND (1.37) [P2]	ND (1.43) [P2]	NA
604764	TJAOU-46-BH-010-8.0-S	8.0	ND (1.67) [P2]	ND (0.907) [P2]	ND (1.37) [P2]	ND (1.43) [P2]	NA
604764	TJAOU-46-BH-011-5.5-S	5.5	ND (1.67) [P2]	ND (0.907) [P2]	ND (1.37) [P2]	ND (1.43) [P2]	NA
604764	TJAOU-46-BH-011-8.0-S	8.0	ND (1.67) [P2]	ND (0.907) [P2]	ND (1.37) [P2]	ND (1.43) [P2]	NA
604764	TJAOU-46-BH-012-5.5-S	5.5	ND (1.67) [P2]	ND (0.907) [P2]	ND (1.37) [P2]	ND (1.43) [P2]	NA
604764	TJAOU-46-BH-012-9.0-S	9.0	ND (1.67) [P2]	ND (0.907) [P2]	ND (1.37) [P2]	ND (1.43) [P2]	NA

Refer to footnotes at end of table.

Table B-3 (Concluded)
Summary of SWMU 46 Characterization Soil Sampling
PCB Analytical Results for Geoprobe Investigation
August 2001
(Off-Site Laboratory[a])

Sample Attributes			PCBs (EPA Method SW846 8082[b]) (µg/kg)				
Record Number[c]	ER Sample ID	Sample Depth(ft)	Aroclor-1242	Aroclor-1248	Aroclor-1254	Aroclor-1260	Total PCBs (µg/kg)
Quality Assurance/Quality Control Samples (µg/L)							
604761	TJAOU-46-BH-02-EB1	NA	ND (0.0444) [A1,UJ]	ND (0.027) [A1,UJ]	ND (0.0251) [A1,UJ]	ND (0.0134) [A1,UJ]	NA

Note: Values in **bold** indicate detected analytes.
[a]General Engineering Laboratories, Inc.
[b]EPA November 1986.
[c]Analysis request/chain-of-custody record.
A1 = Laboratory accuracy and/or bias measurements for the associated surrogate spike do not meet acceptance criteria.
BH = Borehole.
EB = Equipment Blank.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
ID = Identification.
J = The associated value is an estimated quantity.
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.
OU = Operable Unit.
P2 = Insufficient quality control data to determine laboratory precision.
PCB = Polychlorinated biphenyl.
S = Soil Sample.
SWMU = Solid Waste Management Unit.
TJA = Tijeras Arroyo.
UJ = The analyte was analyzed for but was not detected. The associated value is an estimate and may be inaccurate or imprecise.

Table B-4
Summary of SWMU 46 Characterization Soil Sampling
PCB Analytical Detection Limits
August 2001
(Off-Site Laboratory[a])

Analyte	Method Detection Limit (µg/kg)
Aroclor-1016	0.79–7.9
Aroclor-1221	2.82–28.2
Aroclor-1232	0.727–7.27
Aroclor-1242	1.67–16.7
Aroclor-1248	0.907–9.07
Aroclor-1254	1.37–13.7
Aroclor-1260	1.43–14.3

[a]General Engineering Laboratories, Inc.
µg/kg = Microgram(s) per kilogram.
PCB = Polychlorinated biphenyl.
SWMU= Solid Waste Management Unit.

Table B-5
Summary of SWMU 46 Characterization Soil Sampling
VOC Analytical Results for Geoprobe Investigation
August 2001
(Off-Site Laboratory[a])

Sample Attributes			VOCs (EPA Method SW846 8260[b]) (µg/kg)				
Record Number[c]	ER Sample ID	Sample Depth (ft)	Acetone	2-Butanone	1,2-Dichloropropane	Methylene Chloride	Toluene
604760	TJAOU-46-BH-02-6.0-S	6.0	ND (1.02)	ND (0.776)	ND (0.327)	ND (0.449)	ND (0.51)
604760	TJAOU-46-BH-02-9.5-S	9.5	ND (1.02)	**11**	ND (0.327)	ND (0.449)	**0.961 J (1.02)**
604760	TJAOU-46-BH-02-14.0-S	14.0	**1.61 J (5.1)**	**27.4**	ND (0.327)	ND (0.449)	**6.16**
604760	TJAOU-46-BH-02-18.0-S	18.0	**1.7 J (5)**	**47.8**	ND (0.32)	ND (0.44)	**3.44**
604760	TJAOU-46-BH-03-5.0-S	5.0	**2.35 J (5.1)**	**107**	ND (0.327)	ND (0.449)	**8**
604760	TJAOU-46-BH-03-8.0-S	8.0	ND (1)	**52.7**	ND (0.32)	ND (0.44)	**2.38**
604760	TJAOU-46-BH-04-5.0-S	5.0	ND (0.98)	**55.8**	ND (0.314)	ND (0.431)	**2**
604760	TJAOU-46-BH-04-9.0-S	9.0	ND (0.98)	**15.1**	ND (0.314)	ND (0.431)	**17**
604760	TJAOU-46-BH-04-12.0-S	12.0	ND (1)	**12.4**	ND (0.32)	ND (0.44)	**1.09**
604762	TJAOU-46-BH-05-8.5-S	8.5	**5.87 [B,UJ]**	**2.11 J (5) [J]**	ND (0.32)	**2.63 J (5) [B1,UX]**	ND (0.5)
604762	TJAOU-46-BH-05-6.0-S	6.0	**6.59 [B,UJ]**	**2.86 J (5) [J]**	ND (0.32)	**3.28 J (5) [B1,UX]**	**0.866 J (1) [B2,UX]**
604762	TJAOU-46-BH-06-6.0-S	6.0	**5.92 [B,UJ]**	**11.8 [J]**	ND (0.32)	**2.65 J (5) [B1,UX]**	**1.03 [B2,U]**
604762	TJAOU-46-BH-06-10.0-S	10.0	**5.62 [B,UJ]**	**2.78 J (5) [J]**	ND (0.32)	**2.07 J (5) [B1,UX]**	ND (0.5)
604762	TJAOU-46-BH-07-6.0-S	6.0	**5.91 [B,UJ]**	**32.3 [J]**	ND (0.32)	**2.5 J (5) [B1,UX]**	**1.89 [B2,U]**
604762	TJAOU-46-BH-07-10.0-S	10.0	**5.56 [B,UJ]**	**10.4 [J]**	ND (0.32)	**2.3 J (5) [B1,UX]**	ND (0.5)
604762	TJAOU-46-BH-07-13.0-S	13.0	**5.72 [B,UJ]**	**13.7 [J]**	ND (0.32)	**2.49 J (5) [B1,UX]**	**1.01 [B2,U]**
604762	TJAOU-46-BH-08-6.0-S	6.0	**5.63 [B,UJ]**	**2.7 J (5) [J]**	ND (0.32)	**2.15 J (5) [B1,UX]**	ND (0.5)
604762	TJAOU-46-BH-08-10.0-S	10.0	**5.5 [B,UJ]**	**2.85 J (5) [J]**	ND (0.32)	**1.98 J (5) [B1,UX]**	ND (0.5)
604762	TJAOU-46-BH-08-14.0-S	14.0	**7.01 [B,UJ]**	**23.2 [J]**	ND (0.32)	**2.25 J (5) [B1,UX]**	ND (0.5)
604764	TJAOU-46-BH-09-6.0-S	6.0	**6.45 [B,B2,P2,UX]**	**7.46 [P2]**	ND (0.32) [P2]	**1.65 J (5) [B,P2,UX]**	ND (0.5) [P2]
604764	TJAOU-46-BH-09-9.0-S	9.0	**7.17 [B,B2,P2,UX]**	**11.3 [P2]**	ND (0.32) [P2]	**1.85 J (5) [B,P2,UX]**	ND (0.5) [P2]
604764	TJAOU-46-BH-010-6.0-S	6.0	**7.06 [B,B2,P2,UX]**	**12.4 [P2]**	ND (0.32) [P2]	**1.88 J (5) [B,P2,UX]**	ND (0.5) [P2]
604764	TJAOU-46-BH-010-8.5-S	8.5	**7.11 [B,B2,P2,UX]**	**15.8 [P2]**	ND (0.32) [P2]	**2.43 J (5) [B,P2,UX]**	ND (0.5) [P2]
604764	TJAOU-46-BH-011-6.0-S	6.0	**7.18 [B,B2,P2,UX]**	**22.7 [P2]**	ND (0.32) [P2]	**2.09 J (5) [B,P2,UX]**	ND (0.5) [P2]
604764	TJAOU-46-BH-011-8.5-S	8.5	**6.95 [B,B2,P2,UX]**	**6.96 [P2]**	ND (0.32) [P2]	**1.98 J (5) [B,P2,UX]**	ND (0.5) [P2]
604764	TJAOU-46-BH-012-6.0-S	6.0	**6.95 [B,B2,P2,UX]**	**11.8 [P2]**	ND (0.32) [P2]	**2.98 J (5) [B,P2,UX]**	ND (0.5) [P2]
604764	TJAOU-46-BH-012-9.5-S	9.5	**7.39 [B,B2,P2,UX]**	**10.9 [P2]**	ND (0.32) [P2]	**2.32 J (5) [B,P2,UX]**	ND (0.5) [P2]

Refer to footnotes at end of table.

Table B-5 (Concluded)
Summary of SWMU 46 Characterization Soil Sampling
VOC Analytical Results for Geoprobe Investigation
August 2001
(Off-Site Laboratory[a])

Sample Attributes			VOCs (EPA Method SW846 8260[b]) (µg/kg)				
Record Number[c]	ER Sample ID	Sample Depth (ft)	Acetone	2-Butanone	1,2-Dichloropropane	Methylene Chloride	Toluene
Quality Assurance/Quality Control Samples (µg/L)							
604761	TJAOU-46-BH-02-EB1	NA	**3.74 J (5)**	ND (0.81)	ND (0.16)	**4.65 J (5)**	**0.231 J (1)**
604764	TJAOU-46-BH-02-TB	NA	**4.57 J (5) [P2]**	ND (0.81) [P2]	**7.1 [P2]**	ND (0.63) [P2]	ND (0.22) [P2]
604760	TJAOU-46-BH-02-TB1	NA	**4.31 J (5)**	ND (0.81)	**7.94**	ND (0.63)	ND (0.22)
604762	TJAOU-46-BH-08-TB	NA	**4.13 J (5)**	ND (0.81)	**6.31**	**7.04**	ND (0.22)

Note: Values in **bold** indicate detected analytes.
[a]General Engineering Laboratories, Inc.
[b]EPA November 1986.
[c]Analysis request/chain-of-custody record.

B = Analyte present in laboratory method blank.
B1 = Analyte present in trip blank.
B2 = Analyte present in equipment blank.
BH = Borehole.
EB = Equipment Blank.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
ID = Identification.
J ( ) = Estimated value less than the laboratory reporting limit, shown in parentheses.
[J] = The associated value is an estimated quantity.
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.
OU = Operable Unit.
P2 = Insufficient quality control data to determine laboratory precision.
S = Soil Sample.
SWMU = Solid Waste Management Unit.
TB = Trip Blank.
TJA = Tijeras Arroyo.
U = The analyte was analyzed for but was not detected.
UJ = The analyte was analyzed for but was not detected. The associated value is an estimate and may be inaccurate or imprecise.
UX = Secondary (lower) detection limit applied.
VOC = Volatile organic compound.

Table B-6
Summary of SWMU 46 Characterization Soil Sampling
VOC Analytical Detection Limits
August 2001
(Off-Site Laboratory[a])

Analyte	Method Detection Limit (µg/kg)
Acetone	0.98–1.02
Benzene	0.382–0.398
Bromodichloromethane	0.343–0.357
Bromoform	0.353–0.367
Bromomethane	0.304–0.316
2-Butanone	0.745–0.776
Carbon disulfide	0.608–0.633
Carbon tetrachloride	0.255–0.265
Chlorobenzene	0.392–0.408
Chloroethane	0.275–0.286
Chloroform	0.461–0.48
bis-Chloroisopropyl ether	37.2
Chloromethane	0.343–0.357
Dibromochloromethane	0.402–0.418
1,1-Dichloroethane	0.402–0.418
1,2-Dichloroethane	0.265–0.276
1,1-Dichloroethene	0.257–0.267
cis-1,2-Dichloroethene	0.402–0.418
trans-1,2-Dichloroethene	0.363–0.378
1,2-Dichloropropane	0.314–0.327
cis-1,3-Dichloropropene	0.275–0.286
trans-1,3-Dichloropropene	0.235–0.245
Ethyl benzene	0.343–0.357
2-Hexanone	0.922–0.959
4-Methyl-2-pentanone	1.31–1.37
Methylene chloride	0.431–0.449
Styrene	0.314–0.327
Tetrachloroethene	0.392–0.408
Toluene	0.49–0.51
1,1,2,2-Tetrachloroethane	0.294–0.306
1,1,1-Trichloroethane	0.284–0.296
1,1,2-Trichloroethane	0.353–0.367
Trichloroethene	0.706–0.735
Vinyl acetate	0.755–0.786
Vinyl chloride	0.294–0.306
Xylene	1.03–1.07

[a]General Engineering Laboratories, Inc.
µg/kg = Microgram(s) per kilogram.
SWMU = Solid Waste Management Unit.
VOC = Volatile organic compound.

Table B-7
Summary of SWMU 46 Characterization Soil Sampling
SVOC Analytical Results for Geoprobe Investigation
August 2001
(Off-Site Laboratory[a])

Sample Attributes			SVOCs (EPA Method SW846 8270[b]) (µg/kg)				
Record Number[c]	ER Sample ID	Sample Depth (ft)	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene
604764	TJAOU-46-BH-010-5.5-S	5.5	ND (4) [UJ]	ND (3.67)	ND (4.67)	ND (6)	ND (2)
604764	TJAOU-46-BH-010-8.0-S	8.0	ND (4) [UJ]	ND (3.67)	ND (4.67)	ND (6)	ND (2)
604764	TJAOU-46-BH-011-5.5-S	5.5	ND (4) [UJ]	ND (3.67)	ND (4.67)	ND (6)	ND (2)
604764	TJAOU-46-BH-011-8.0-S	8.0	ND (4) [UJ]	ND (3.67)	ND (4.67)	ND (6)	ND (2)
604764	TJAOU-46-BH-012-5.5-S	5.5	ND (4) [UJ]	ND (3.67)	ND (4.67)	ND (6)	ND (2)
604764	TJAOU-46-BH-012-9.0-S	9.0	ND (4) [UJ]	ND (3.67)	ND (4.67)	ND (6)	ND (2)
604760	TJAOU-46-BH-02-13.5-S	13.5	ND (4)	ND (3.67)	ND (4.67)	ND (6)	ND (2)
604760	TJAOU-46-BH-02-17.5-S	17.5	ND (4)	ND (3.67)	ND (4.67)	ND (6)	ND (2)
604760	TJAOU-46-BH-02-5.0-S	5.0	ND (4)	ND (3.67)	ND (4.67)	ND (6)	**5.79 J (33.3)**
604760	TJAOU-46-BH-02-8.5-S	8.5	ND (4)	**4.06 J (33.3)**	ND (4.67)	ND (6)	ND (2)
604760	TJAOU-46-BH-03-4.5-S	4.5	ND (4)	ND (3.67)	ND (4.67)	ND (6)	ND (2)
604760	TJAOU-46-BH-03-7.0-S	7.0	ND (4)	ND (3.67)	ND (4.67)	ND (6)	ND (2)
604760	TJAOU-46-BH-04-11.5-S	11.5	ND (4)	ND (3.67)	ND (4.67)	ND (6)	ND (2)
604760	TJAOU-46-BH-04-4.0-S	4.0	ND (4)	ND (3.67)	ND (4.67)	ND (6)	ND (2)
604760	TJAOU-46-BH-04-8.5-S	8.5	ND (4)	ND (3.67)	ND (4.67)	ND (6)	ND (2)
604762	TJAOU-46-BH-05-5.5-S	5.5	ND (4)	ND (3.67)	ND (4.67)	ND (6)	ND (2)
604762	TJAOU-46-BH-05-8.0-S	8.0	ND (4)	ND (3.67)	ND (4.67)	ND (6)	ND (2)
604762	TJAOU-46-BH-06-5.5-S	5.5	ND (4)	ND (3.67)	ND (4.67)	ND (6)	ND (2)
604762	TJAOU-46-BH-06-9.5-S	9.5	ND (4)	ND (3.67)	**12.1 J (33.3)**	ND (6)	ND (2)
604762	TJAOU-46-BH-07-12.5-S	12.5	ND (4)	ND (3.67)	ND (4.67)	ND (6)	ND (2)
604762	TJAOU-46-BH-07-5.5-S	5.5	ND (4)	ND (3.67)	ND (4.67)	ND (6)	ND (2)
604762	TJAOU-46-BH-07-9.5-S	9.5	ND (4)	ND (3.67)	ND (4.67)	ND (6)	ND (2)
604762	TJAOU-46-BH-08-13.5-S	13.5	ND (4)	ND (3.67)	ND (4.67)	ND (6)	ND (2)
604762	TJAOU-46-BH-08-5.5-S	5.5	**5.69 J (33.3)**	ND (3.67)	**12.1 J (33.3)**	**49.5**	**66.3**
604762	TJAOU-46-BH-08-9.5-S	9.5	ND (4)	ND (3.67)	ND (4.67)	ND (6)	ND (2)
604764	TJAOU-46-BH-09-5.5-S	5.5	ND (4) [UJ]	ND (3.67)	**18.5 J (33.3)**	ND (6)	**82.4**
604764	TJAOU-46-BH-09-8.5-S	8.5	ND (4) [UJ]	ND (3.67)	ND (4.67)	ND (6)	ND (2)
Quality Assurance/Quality Control Samples (µg/L)							
604761	TJAOU-46-BH-02-EB1	NA	ND (0.068)	ND (0.0971)	ND (0.126)	ND (0.0971)	ND (0.126)

Refer to footnotes at end of table.

Table B-7 (Continued)
Summary of SWMU 46 Characterization Soil Sampling
SVOC Analytical Results for Geoprobe Investigation
August 2001
(Off-Site Laboratory[a])

Sample Attributes			SVOCs (EPA Method SW846 8270[b]) (µg/kg)				
Record Number[c]	ER Sample ID	Sample Depth (ft)	Benzo(b) fluoranthene	Benzo(g,h,i) perylene	Benzo(k)fluoranthene	Butylbenzyl phthalate	Carbazole
604764	TJAOU-46-BH-010-5.5-S	5.5	ND (2.33)	ND (5)	ND (5)	ND (12.7)	ND (5)
604764	TJAOU-46-BH-010-8.0-S	8.0	ND (2.33)	ND (5)	ND (5)	ND (12.7)	ND (5)
604764	TJAOU-46-BH-011-5.5-S	5.5	ND (2.33)	ND (5)	ND (5)	ND (12.7)	ND (5)
604764	TJAOU-46-BH-011-8.0-S	8.0	ND (2.33)	ND (5)	ND (5)	ND (12.7)	ND (5)
604764	TJAOU-46-BH-012-5.5-S	5.5	ND (2.33)	ND (5)	ND (5)	ND (12.7)	ND (5)
604764	TJAOU-46-BH-012-9.0-S	9.0	ND (2.33)	ND (5)	ND (5)	ND (12.7)	ND (5)
604760	TJAOU-46-BH-02-13.5-S	13.5	ND (2.33)	ND (5)	ND (5)	ND (12.7)	ND (5)
604760	TJAOU-46-BH-02-17.5-S	17.5	ND (2.33)	ND (5)	ND (5)	ND (12.7)	ND (5)
604760	TJAOU-46-BH-02-5.0-S	5.0	**149**	ND (5)	**6 J (33.3)**	**15.9 J (333)**	ND (5)
604760	TJAOU-46-BH-02-8.5-S	8.5	ND (2.33)	ND (5)	ND (5)	ND (12.7)	ND (5)
604760	TJAOU-46-BH-03-4.5-S	4.5	ND (2.33)	ND (5)	ND (5)	ND (12.7)	ND (5)
604760	TJAOU-46-BH-03-7.0-S	7.0	ND (2.33)	ND (5)	ND (5)	ND (12.7)	ND (5)
604760	TJAOU-46-BH-04-11.5-S	11.5	ND (2.33)	ND (5)	ND (5)	ND (12.7)	ND (5)
604760	TJAOU-46-BH-04-4.0-S	4.0	ND (2.33)	ND (5)	ND (5)	ND (12.7)	ND (5)
604760	TJAOU-46-BH-04-8.5-S	8.5	ND (2.33)	ND (5)	ND (5)	ND (12.7)	ND (5)
604762	TJAOU-46-BH-05-5.5-S	5.5	ND (2.33)	ND (5)	ND (5)	ND (12.7)	ND (5)
604762	TJAOU-46-BH-05-8.0-S	8.0	ND (2.33)	ND (5)	ND (5)	ND (12.7)	ND (5)
604762	TJAOU-46-BH-06-5.5-S	5.5	ND (2.33)	ND (5)	ND (5)	ND (12.7)	ND (5)
604762	TJAOU-46-BH-06-9.5-S	9.5	ND (2.33)	ND (5)	ND (5)	**18.4 J (333)**	ND (5)
604762	TJAOU-46-BH-07-12.5-S	12.5	ND (2.33)	ND (5)	ND (5)	ND (12.7)	ND (5)
604762	TJAOU-46-BH-07-5.5-S	5.5	ND (2.33)	ND (5)	ND (5)	ND (12.7)	ND (5)
604762	TJAOU-46-BH-07-9.5-S	9.5	ND (2.33)	ND (5)	ND (5)	ND (12.7)	ND (5)
604762	TJAOU-46-BH-08-13.5-S	13.5	ND (2.33)	ND (5)	ND (5)	ND (12.7)	ND (5)
604762	TJAOU-46-BH-08-5.5-S	5.5	**62**	**47.1**	**64.1**	**56.5 J (333)**	ND (5)
604762	TJAOU-46-BH-08-9.5-S	9.5	ND (2.33)	ND (5)	ND (5)	ND (12.7)	ND (5)
604764	TJAOU-46-BH-09-5.5-S	5.5	**27.1 J (33.3)**	ND (5)	**13.6 J (33.3)**	ND (12.7)	**10.9 J (333)**
604764	TJAOU-46-BH-09-8.5-S	8.5	ND (2.33)	ND (5)	ND (5)	ND (12.7)	ND (5)
Quality Assurance/Quality Control Samples (µg/L)							
604761	TJAOU-46-BH-02-EB1	NA	ND (0.126)	ND (0.0777)	ND (0.223)	ND (1.77)	ND (1.22)

Refer to footnotes at end of table.

Table B-7 (Continued)
Summary of SWMU 46 Characterization Soil Sampling
SVOC Analytical Results for Geoprobe Investigation
August 2001
(Off-Site Laboratory[a])

Sample Attributes			SVOCs (EPA Method SW846 8270[b]) (µg/kg)			
Record Number[c]	ER Sample ID	Sample Depth (ft)	2-Chlorophenol	Chrysene	Di-n-butyl phthalate	Dibenzofuran
604764	TJAOU-46-BH-010-5.5-S	5.5	ND (5)	ND (6.33)	ND (20.7)	ND (2.67)
604764	TJAOU-46-BH-010-8.0-S	8.0	ND (5)	ND (6.33)	ND (20.7)	ND (2.67)
604764	TJAOU-46-BH-011-5.5-S	5.5	ND (5)	ND (6.33)	ND (20.7)	ND (2.67)
604764	TJAOU-46-BH-011-8.0-S	8.0	ND (5)	ND (6.33)	ND (20.7)	ND (2.67)
604764	TJAOU-46-BH-012-5.5-S	5.5	ND (5)	ND (6.33)	ND (20.7)	ND (2.67)
604764	TJAOU-46-BH-012-9.0-S	9.0	ND (5)	ND (6.33)	ND (20.7)	ND (2.67)
604760	TJAOU-46-BH-02-13.5-S	13.5	ND (5)	ND (6.33)	ND (20.7)	ND (2.67)
604760	TJAOU-46-BH-02-17.5-S	17.5	ND (5)	ND (6.33)	ND (20.7)	ND (2.67)
604760	TJAOU-46-BH-02-5.0-S	5.0	ND (5)	ND (6.33)	ND (20.7)	ND (2.67)
604760	TJAOU-46-BH-02-8.5-S	8.5	**7.5 J (333)**	ND (6.33)	ND (20.7)	**3.91 J (333)**
604760	TJAOU-46-BH-03-4.5-S	4.5	ND (5)	ND (6.33)	ND (20.7)	ND (2.67)
604760	TJAOU-46-BH-03-7.0-S	7.0	ND (5)	ND (6.33)	ND (20.7)	ND (2.67)
604760	TJAOU-46-BH-04-11.5-S	11.5	ND (5)	ND (6.33)	**22.9 J (333)**	ND (2.67)
604760	TJAOU-46-BH-04-4.0-S	4.0	ND (5)	ND (6.33)	ND (20.7)	ND (2.67)
604760	TJAOU-46-BH-04-8.5-S	8.5	ND (5)	ND (6.33)	ND (20.7)	ND (2.67)
604762	TJAOU-46-BH-05-5.5-S	5.5	ND (5)	ND (6.33)	ND (20.7)	ND (2.67)
604762	TJAOU-46-BH-05-8.0-S	8.0	ND (5)	ND (6.33)	ND (20.7)	ND (2.67)
604762	TJAOU-46-BH-06-5.5-S	5.5	ND (5)	ND (6.33)	ND (20.7)	ND (2.67)
604762	TJAOU-46-BH-06-9.5-S	9.5	ND (5)	ND (6.33)	ND (20.7)	**5.23 J (333)**
604762	TJAOU-46-BH-07-12.5-S	12.5	ND (5)	ND (6.33)	ND (20.7)	ND (2.67)
604762	TJAOU-46-BH-07-5.5-S	5.5	ND (5)	ND (6.33)	ND (20.7)	ND (2.67)
604762	TJAOU-46-BH-07-9.5-S	9.5	ND (5)	ND (6.33)	ND (20.7)	ND (2.67)
604762	TJAOU-46-BH-08-13.5-S	13.5	ND (5)	ND (6.33)	ND (20.7)	ND (2.67)
604762	TJAOU-46-BH-08-5.5-S	5.5	ND (5)	**68.8**	**49.5 J (333)**	ND (2.67)
604762	TJAOU-46-BH-08-9.5-S	9.5	ND (5)	ND (6.33)	ND (20.7)	ND (2.67)
604764	TJAOU-46-BH-09-5.5-S	5.5	**8.35 J (333)**	**24.6 J (33.3)**	**31.2 J (333)**	**9.4 J (333)**
604764	TJAOU-46-BH-09-8.5-S	8.5	ND (5)	ND (6.33)	ND (20.7)	ND (2.67)
Quality Assurance/Quality Control Samples (µg/L)						
604761	TJAOU-46-BH-02-EB1	NA	ND (1.2)	ND (0.117)	ND (1.77)	ND (0.961)

Refer to footnotes at end of table.

Table B-7 (Continued)
Summary of SWMU 46 Characterization Soil Sampling
SVOC Analytical Results for Geoprobe Investigation
August 2001
(Off-Site Laboratory[a])

Sample Attributes			SVOCs (EPA Method SW846 8270[b]) (µg/kg)			
Record Number[c]	ER Sample ID	Sample Depth (ft)	1,2-Dichlorobenzene	1,3-Dichlorobenzene	Diphenyl amine	bis(2-Ethylhexyl) phthalate
604764	TJAOU-46-BH-010-5.5-S	5.5	ND (4.33)	ND (3.33)	ND (7)	ND (7)
604764	TJAOU-46-BH-010-8.0-S	8.0	ND (4.33)	ND (3.33)	ND (7)	ND (7)
604764	TJAOU-46-BH-011-5.5-S	5.5	ND (4.33)	ND (3.33)	ND (7)	ND (7)
604764	TJAOU-46-BH-011-8.0-S	8.0	ND (4.33)	ND (3.33)	ND (7)	ND (7)
604764	TJAOU-46-BH-012-5.5-S	5.5	ND (4.33)	ND (3.33)	ND (7)	ND (7)
604764	TJAOU-46-BH-012-9.0-S	9.0	ND (4.33)	ND (3.33)	ND (7)	ND (7)
604760	TJAOU-46-BH-02-13.5-S	13.5	ND (4.33)	ND (3.33)	ND (7)	ND (7)
604760	TJAOU-46-BH-02-17.5-S	17.5	ND (4.33)	ND (3.33)	ND (7)	ND (7)
604760	TJAOU-46-BH-02-5.0-S	5.0	ND (4.33)	ND (3.33)	ND (7)	**63.2 J (333)**
604760	TJAOU-46-BH-02-8.5-S	8.5	ND (4.33)	ND (3.33)	ND (7)	ND (7)
604760	TJAOU-46-BH-03-4.5-S	4.5	ND (4.33)	ND (3.33)	ND (7)	ND (7)
604760	TJAOU-46-BH-03-7.0-S	7.0	ND (4.33)	ND (3.33)	ND (7)	ND (7)
604760	TJAOU-46-BH-04-11.5-S	11.5	ND (4.33)	ND (3.33)	ND (7)	**104 J (333)**
604760	TJAOU-46-BH-04-4.0-S	4.0	ND (4.33)	ND (3.33)	ND (7)	**12.9 J (333)**
604760	TJAOU-46-BH-04-8.5-S	8.5	ND (4.33)	ND (3.33)	ND (7)	ND (7)
604762	TJAOU-46-BH-05-5.5-S	5.5	ND (4.33)	ND (3.33)	ND (7)	ND (7)
604762	TJAOU-46-BH-05-8.0-S	8.0	ND (4.33)	ND (3.33)	ND (7)	ND (7)
604762	TJAOU-46-BH-06-5.5-S	5.5	ND (4.33)	ND (3.33)	ND (7)	ND (7)
604762	TJAOU-46-BH-06-9.5-S	9.5	ND (4.33)	ND (3.33)	ND (7)	**80.6 J (333)**
604762	TJAOU-46-BH-07-12.5-S	12.5	ND (4.33)	ND (3.33)	ND (7)	ND (7)
604762	TJAOU-46-BH-07-5.5-S	5.5	ND (4.33)	ND (3.33)	ND (7)	**7.04 J (333) [B2,UX]**
604762	TJAOU-46-BH-07-9.5-S	9.5	ND (4.33)	ND (3.33)	ND (7)	ND (7)
604762	TJAOU-46-BH-08-13.5-S	13.5	ND (4.33)	ND (3.33)	ND (7)	ND (7)
604762	TJAOU-46-BH-08-5.5-S	5.5	ND (4.33)	ND (3.33)	ND (7)	**2,040**
604762	TJAOU-46-BH-08-9.5-S	9.5	ND (4.33)	ND (3.33)	ND (7)	ND (7)
604764	TJAOU-46-BH-09-5.5-S	5.5	**4.51 J (333)**	**4.86 J (333)**	**7.3 J (333)**	**50.1 J (333)**
604764	TJAOU-46-BH-09-8.5-S	8.5	ND (4.33)	ND (3.33)	ND (7)	ND (7)
Quality Assurance/Quality Control Samples (µg/L)						
604761	TJAOU-46-BH-02-EB1	NA	ND (1.58)	ND (1.47)	ND (0.99)	**0.913 J (9.71)**

Refer to footnotes at end of table.

Table B-7 (Continued)
Summary of SWMU 46 Characterization Soil Sampling
SVOC Analytical Results for Geoprobe Investigation
August 2001
(Off-Site Laboratory[a])

Sample Attributes			SVOCs (EPA Method SW846 8270[b]) (µg/kg)			
Record Number[c]	ER Sample ID	Sample Depth (ft)	Fluoranthene	Fluorene	Hexachlorobenzene	Indeno(1,2,3-cd)pyrene
604764	TJAOU-46-BH-010-5.5-S	5.5	ND (3.33)	ND (3)	ND (4.67)	ND (6.67)
604764	TJAOU-46-BH-010-8.0-S	8.0	ND (3.33)	ND (3)	ND (4.67)	ND (6.67)
604764	TJAOU-46-BH-011-5.5-S	5.5	**6.24 J (33.3)**	ND (3)	ND (4.67)	ND (6.67)
604764	TJAOU-46-BH-011-8.0-S	8.0	ND (3.33)	ND (3)	ND (4.67)	ND (6.67)
604764	TJAOU-46-BH-012-5.5-S	5.5	ND (3.33)	ND (3)	ND (4.67)	ND (6.67)
604764	TJAOU-46-BH-012-9.0-S	9.0	ND (3.33)	ND (3)	ND (4.67)	ND (6.67)
604760	TJAOU-46-BH-02-13.5-S	13.5	ND (3.33)	ND (3)	ND (4.67)	ND (6.67)
604760	TJAOU-46-BH-02-17.5-S	17.5	ND (3.33)	ND (3)	ND (4.67)	ND (6.67)
604760	TJAOU-46-BH-02-5.0-S	5.0	**10.9 J (33.3)**	ND (3)	**5.7 J (333)**	ND (6.67)
604760	TJAOU-46-BH-02-8.5-S	8.5	**4.03 J (33.3)**	**3.42 J (33.3)**	ND (4.67)	ND (6.67)
604760	TJAOU-46-BH-03-4.5-S	4.5	ND (3.33)	ND (3)	ND (4.67)	ND (6.67)
604760	TJAOU-46-BH-03-7.0-S	7.0	**4.76 J (33.3)**	ND (3)	ND (4.67)	ND (6.67)
604760	TJAOU-46-BH-04-11.5-S	11.5	**10.4 J (33.3)**	ND (3)	ND (4.67)	ND (6.67)
604760	TJAOU-46-BH-04-4.0-S	4.0	ND (3.33)	ND (3)	ND (4.67)	ND (6.67)
604760	TJAOU-46-BH-04-8.5-S	8.5	ND (3.33)	ND (3)	ND (4.67)	ND (6.67)
604762	TJAOU-46-BH-05-5.5-S	5.5	ND (3.33)	ND (3)	ND (4.67)	ND (6.67)
604762	TJAOU-46-BH-05-8.0-S	8.0	ND (3.33)	ND (3)	ND (4.67)	ND (6.67)
604762	TJAOU-46-BH-06-5.5-S	5.5	ND (3.33)	ND (3)	ND (4.67)	ND (6.67)
604762	TJAOU-46-BH-06-9.5-S	9.5	**47.7**	ND (3)	ND (4.67)	ND (6.67)
604762	TJAOU-46-BH-07-12.5-S	12.5	ND (3.33)	ND (3)	ND (4.67)	ND (6.67)
604762	TJAOU-46-BH-07-5.5-S	5.5	ND (3.33)	ND (3)	ND (4.67)	ND (6.67)
604762	TJAOU-46-BH-07-9.5-S	9.5	**4.18 J (33.3)**	ND (3)	ND (4.67)	ND (6.67)
604762	TJAOU-46-BH-08-13.5-S	13.5	ND (3.33)	ND (3)	ND (4.67)	ND (6.67)
604762	TJAOU-46-BH-08-5.5-S	5.5	**106**	ND (3)	ND (4.67)	**39**
604762	TJAOU-46-BH-08-9.5-S	9.5	ND (3.33)	ND (3)	ND (4.67)	ND (6.67)
604764	TJAOU-46-BH-09-5.5-S	5.5	**62.5**	**14 J (33.3)**	**4.9 J (333)**	ND (6.67)
604764	TJAOU-46-BH-09-8.5-S	8.5	ND (3.33)	ND (3)	ND (4.67)	ND (6.67)
Quality Assurance/Quality Control Samples (µg/L)						
604761	TJAOU-46-BH-02-EB1	NA	ND (0.117)	ND (0.117)	ND (1.04)	ND (0.0971)

Refer to footnotes at end of table.

Table B-7 (Continued)
Summary of SWMU 46 Characterization Soil Sampling
SVOC Analytical Results for Geoprobe Investigation
August 2001
(Off-Site Laboratory[a])

Sample Attributes			SVOCs (EPA Method SW846 8270[b]) (µg/kg)			
Record Number[c]	ER Sample ID	Sample Depth (ft)	Naphthalene	Phenanthrene	Phenol	Pyrene
604764	TJAOU-46-BH-010-5.5-S	5.5	ND (3.33) [UJ]	ND (4)	**504**	ND (8.67)
604764	TJAOU-46-BH-010-8.0-S	8.0	ND (3.33) [UJ]	ND (4)	**583**	ND (8.67)
604764	TJAOU-46-BH-011-5.5-S	5.5	ND (3.33) [UJ]	**7.32 J (33.3)**	ND (3.67)	ND (8.67)
604764	TJAOU-46-BH-011-8.0-S	8.0	ND (3.33) [UJ]	ND (4)	**822**	ND (8.67)
604764	TJAOU-46-BH-012-5.5-S	5.5	ND (3.33) [UJ]	ND (4)	ND (3.67)	ND (8.67)
604764	TJAOU-46-BH-012-9.0-S	9.0	ND (3.33) [UJ]	ND (4)	ND (3.67)	ND (8.67)
604760	TJAOU-46-BH-02-13.5-S	13.5	ND (3.33)	ND (4)	ND (3.67)	ND (8.67)
604760	TJAOU-46-BH-02-17.5-S	17.5	ND (3.33)	ND (4)	ND (3.67)	ND (8.67)
604760	TJAOU-46-BH-02-5.0-S	5.0	ND (3.33)	**10.4 J (33.3)**	ND (3.67)	**11.9 J (33.3)**
604760	TJAOU-46-BH-02-8.5-S	8.5	ND (3.33)	**4.8 J (33.3)**	ND (3.67)	ND (8.67)
604760	TJAOU-46-BH-03-4.5-S	4.5	ND (3.33)	ND (4)	ND (3.67)	ND (8.67)
604760	TJAOU-46-BH-03-7.0-S	7.0	ND (3.33)	ND (4)	ND (3.67)	ND (8.67)
604760	TJAOU-46-BH-04-11.5-S	11.5	ND (3.33)	ND (4)	ND (3.67)	ND (8.67)
604760	TJAOU-46-BH-04-4.0-S	4.0	ND (3.33)	ND (4)	ND (3.67)	ND (8.67)
604760	TJAOU-46-BH-04-8.5-S	8.5	ND (3.33)	ND (4)	ND (3.67)	ND (8.67)
604762	TJAOU-46-BH-05-5.5-S	5.5	ND (3.33)	ND (4)	ND (3.67)	ND (8.67)
604762	TJAOU-46-BH-05-8.0-S	8.0	ND (3.33)	ND (4)	ND (3.67)	ND (8.67)
604762	TJAOU-46-BH-06-5.5-S	5.5	ND (3.33)	ND (4)	ND (3.67)	ND (8.67)
604762	TJAOU-46-BH-06-9.5-S	9.5	ND (3.33)	**54.7**	ND (3.67)	**36.6**
604762	TJAOU-46-BH-07-12.5-S	12.5	ND (3.33)	ND (4)	ND (3.67)	ND (8.67)
604762	TJAOU-46-BH-07-5.5-S	5.5	ND (3.33)	ND (4)	ND (3.67)	ND (8.67)
604762	TJAOU-46-BH-07-9.5-S	9.5	ND (3.33)	ND (4)	ND (3.67)	ND (8.67)
604762	TJAOU-46-BH-08-13.5-S	13.5	ND (3.33)	ND (4)	**1,590**	ND (8.67)
604762	TJAOU-46-BH-08-5.5-S	5.5	**3.45 J (33.3)**	**65.7**	**279 J (333)**	**98**
604762	TJAOU-46-BH-08-9.5-S	9.5	ND (3.33)	ND (4)	**413**	ND (8.67)
604764	TJAOU-46-BH-09-5.5-S	5.5	ND (3.33) [UJ]	**68.2**	**374**	**54.2**
604764	TJAOU-46-BH-09-8.5-S	8.5	ND (3.33) [UJ]	ND (4)	ND (3.67)	ND (8.67)

Refer to footnotes at end of table.

Table B-7 (Concluded)
Summary of SWMU 46 Characterization Soil Sampling
SVOC Analytical Results for Geoprobe Investigation
August 2001
(Off-Site Laboratory[a])

Sample Attributes			SVOCs (EPA Method SW846 8270[b]) (µg/kg)			
Record Number[c]	ER Sample ID	Sample Depth (ft)	Naphthalene	Phenanthrene	Phenol	Pyrene
Quality Assurance/Quality Control Samples (µg/L)						
604761	TJAOU-46-BH-02-EB1	NA	ND (0.117)	ND (0.117)	ND (0.816)	ND (0.136)

Note: Values in **bold** indicate detected analytes.
[a]General Engineering Laboratories, Inc.
[b]EPA November 1986.
[c]Analysis request/chain-of-custody record.
B2 = Analyte present in equipment blank.
BH = Borehole.
EB = Equipment Blank.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
ID = Identification.
J ( ) = Estimated value less than the laboratory 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.
OU = Operable Unit.
S = Soil Sample.
SWMU = Solid Waste Management Unit.
SVOC = Semivolatile organic compound.
TJA = Tijeras Arroyo.
UJ = The analyte was analyzed for but was not detected. The associated value is an estimate and may be inaccurate or imprecise.
UX = Secondary (lower) detection limit applied.

Table B-8
Summary of SWMU Characterization Soil Sampling
SVOC Analytical Detection Limits
August 2001
(Off-Site Laboratory[a])

Analyte	Method Detection Limit (µg/kg)
Acenaphthene	4
Acenaphthylene	3.67
Anthracene	4.67
Benzo(a)anthracene	6
Benzo(a)pyrene	2
Benzo(b)fluoranthene	2.33
Benzo(g,h,i)perylene	5
Benzo(k)fluoranthene	5
4-Bromophenyl phenyl ether	4.67
Butylbenzyl phthalate	12.7
Carbazole	5
4-Chloro-3-methylphenol	36.7
4-Chlorobenzenamine	59
bis(2-Chloroethoxy)methane	6
bis(2-Chloroethyl)ether	6.67
2-Chloronaphthalene	3.67
2-Chlorophenol	5
4-Chlorophenyl phenyl ether	3.33
Chrysene	6.33
o-Cresol	47.7
p-Cresol	5.67
Di-n-butyl phthalate	20.7
Di-n-octyl phthalate	9
Dibenz[a,h]anthracene	2.67
Dibenzofuran	2.67
1,2-Dichlorobenzene	4.33
1,3-Dichlorobenzene	3.33
1,4-Dichlorobenzene	6
3,3'-Dichlorobenzidine	143
2,4-Dichlorophenol	8
2,4-Dimethylphenol	72
2,4-Dinitrophenol	15
2,4-Dinitrotoluene	5
2,6-Dinitrotoluene	3
Diethylphthalate	19.7
Dimethylphthalate	11.7
Dinitro-o-cresol	16
Diphenyl amine	7
bis(2-Ethylhexyl)phthalate	7
Fluoranthene	3.33
Fluorene	3
Hexachlorobenzene	4.67
Hexachlorobutadiene	6.67

Refer to footnotes at end of table.

Table B-8 (Concluded)
Summary of SWMU Characterization Soil Sampling
SVOC Analytical Detection Limits
August 2001
(Off-Site Laboratory[a])

Analyte	Method Detection Limit (µg/kg)
Hexachlorocyclopentadiene	33
Hexachloroethane	4.33
Indeno(1,2,3-cd)pyrene	6.67
Isophorone	2.33
2-Methylnaphthalene	4
Naphthalene	3.33
2-Nitroaniline	81
3-Nitroaniline	86.7
4-Nitroaniline	84
Nitrobenzene	36.7
2-Nitrophenol	46.3
4-Nitrophenol	21
n-Nitrosodipropylamine	33
Pentachlorophenol	61
Phenanthrene	4
Phenol	3.67
Pyrene	8.67
1,2,4-Trichlorobenzene	4.67
2,4,5-Trichlorophenol	42.3
2,4,6-Trichlorophenol	24.7

[a]General Engineering Laboratories, Inc.
µg/kg = Microgram(s) per kilogram.
SVOC = Semivolatile organic compound.
SWMU= Solid Waste Management Unit.

Table B-9
Summary of SWMU 46 Characterization Soil Sampling
HE Analytical Results for Geoprobe Investigation
August 2001
(Off-Site Laboratory[a])

Sample Attributes			HE (EPA Method SW846 8330[b]) (µg/kg)
Record Number[c]	ER Sample ID	Sample Depth (ft)	2-Nitrotoluene
604760	TJAOU-46-BH-02-13.5-S	13.5	ND (15.2)
604760	TJAOU-46-BH-02-17.5-S	17.5	ND (15.2)
604760	TJAOU-46-BH-02-5.0-S	5.0	ND (15.2)
604760	TJAOU-46-BH-02-8.5-S	8.5	ND (15.2)
604760	TJAOU-46-BH-03-4.5-S	4.5	ND (15.2)
604760	TJAOU-46-BH-03-7.0-S	7.0	ND (15.2)
604760	TJAOU-46-BH-04-11.5-S	11.5	ND (15.2)
604760	TJAOU-46-BH-04-4.0-S	4.0	**15.2**
604760	TJAOU-46-BH-04-8.5-S	8.5	ND (15.2)
604762	TJAOU-46-BH-05-5.5-S	5.5	ND (15.2)
604762	TJAOU-46-BH-05-8.0-S	8.0	ND (15.2)
604762	TJAOU-46-BH-06-5.5-S	5.5	ND (15.2)
604762	TJAOU-46-BH-06-9.5-S	9.5	ND (15.2)
604762	TJAOU-46-BH-07-12.5-S	12.5	ND (15.2)
604762	TJAOU-46-BH-07-5.5-S	5.5	ND (15.2)
604762	TJAOU-46-BH-07-9.5-S	9.5	ND (15.2)
604762	TJAOU-46-BH-08-13.5-S	13.5	ND (15.2)
604762	TJAOU-46-BH-08-5.5-S	5.5	ND (15.2)
604762	TJAOU-46-BH-08-9.5-S	9.5	ND (15.2)
604764	TJAOU-46-BH-09-5.5-S	5.5	ND (15.2)
604764	TJAOU-46-BH-09-8.5-S	8.5	ND (15.2)
604764	TJAOU-46-BH-010-5.5-S	5.5	ND (15.2)
604764	TJAOU-46-BH-010-8.0-S	8.0	ND (15.2)
604764	TJAOU-46-BH-011-5.5-S	5.5	ND (15.2)
604764	TJAOU-46-BH-011-8.0-S	8.0	ND (15.2)
604764	TJAOU-46-BH-012-5.5-S	5.5	ND (15.2)
604764	TJAOU-46-BH-012-9.0-S	9.0	ND (15.2)
Quality Assurance/Quality Control Samples (µg/L)			
604761	TJAOU-46-BH-02-EB1	NA	ND (0.0332)

Note: Values in **bold** indicate detected analytes.
[a]General Engineering Laboratories, Inc.
[b]EPA November 1986.
[c]Analysis request/chain-of-custody record.

BH = Borehole.
EB = Equipment Blank.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
HE = High Explosive(s).
ID = Identification.
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.
OU = Operable Unit.
S = Soil Sample.
SWMU = Solid Waste Management Unit.
TJA = Tijeras Arroyo.

Table B-10
Summary of SWMU 46 Characterization Soil Sampling
HE Analytical Detection Limits
August 2001
(Off-Site Laboratory[a])

Analyte	Method Detection Limit (µg/kg)
2-Amino-4,6-dinitrotoluene	13.4
4-Amino-2,6-dinitrotoluene	10.1
1,3-Dinitrobenzene	13.4
2,4-Dinitrotoluene	12
2,6-Dinitrotoluene	15.7
HMX	16.8
Nitrobenzene	14
2-Nitrotoluene	15.2
3-Nitrotoluene	11.6
4-Nitrotoluene	11.6
RDX	12.5
Tetryl	15.5
1,3,5-Trinitrobenzene	11.9
2,4,6-Trinitrotoluene	14.1

[a]General Engineering Laboratories, Inc.
HE = High Explosive(s).
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine.
µg/kg = Microgram(s) per kilogram.
RDX = Hexahydro-1,3,5-trinitro,1,3,5-triazine.
SWMU = Solid Waste Management Unit.
Tetryl = 2,4,6-Trinitrophenylmethylnitramine.

Table B-11
Summary of SWMU 46 Characterization Soil Sampling
Gamma Spectroscopy Analytical Results for Geoprobe Investigation
August 2001
(Off-Site Laboratory[a])

Sample Attributes			Activity (Gamma Spectroscopy by HASL 300) (pCi/g)							
Record Number[b]	ER Sample ID	Sample Depth (ft)	Cesium-137		Lead-212		Uranium-235		Uranium-238	
			Result	Error[c]	Result	Error[c]	Result	Error[c]	Result	Error[c]
604760	TJAOU-46-BH-02-12.5-S	12.5	0.0255 U	0.0159	0.709	0.0918	0.149 U	0.0825	0.822 U	0.915
604760	TJAOU-46-BH-02-16.5-S	16.5	0.026 U	0.0141	0.79	0.0961	0.162 U	0.121	0.732 U	1.08
604760	TJAOU-46-BH-02-4.0-S	4.0	0.0299 U [R]	0.0426	0.902	0.122	0.153 U [R]	0.0874	1.04	0.546
604760	TJAOU-46-BH-02-7.5-S	7.5	0.0257 U	0.017	1.07	0.127	0.142 U [R]	0.127	0.82 U	0.836
604760	TJAOU-46-BH-03-13.0-S	13.0	0.0278 U	0.016	1.19	0.138	0.172 U	0.124	**1.55**	1.1
604760	TJAOU-46-BH-03-9.0-S	9.0	0.0295 U	0.0171	1.06	0.13	**0.188 U**	0.097	1.15 U	1.32
604760	TJAOU-46-BH-04-10.5-S	10.5	0.0316 U	0.0177	0.938	0.128	0.168 U	0.145	1.26	0.615
604760	TJAOU-46-BH-04-13.0-S	13.0	0.0301 U	0.0162	1.01	0.145	0.179 U	0.141	**1.39 U**	1.4
604760	TJAOU-46-BH-04-3.0-S	3.0	0.0298 U	0.0157	0.871	0.0584	0.173 U	0.125	1.2 U	0.938
604762	TJAOU-46-BH-05-4.5-S	4.5	0.0324 U	0.0177	1.05	0.0706	**0.209 U**	0.106	**1.42 U**	1.26
604762	TJAOU-46-BH-05-7.0-S	7.0	0.0246 U	0.0157	1.06	0.126	0.158 U	0.121	1.21 U	1.4
604762	TJAOU-46-BH-06-4.5-S	4.5	0.0253 U	0.0155	0.922	0.112	0.15 U	0.126	1.09 U	1.16
604762	TJAOU-46-BH-06-8.5-S	8.5	0.026 U	0.0149	0.742	0.11	0.15 U	0.122	1.14 U	0.894
604762	TJAOU-46-BH-07-11.5-S	11.5	0.0267 U	0.0148	0.969	0.057	0.175	0.179	1.22	0.961
604762	TJAOU-46-BH-07-4.5-S	4.5	0.0336 U	0.0173	0.934	0.137	**0.198 U [R]**	0.103	**1.5 U**	1.49
604762	TJAOU-46-BH-07-8.5-S	8.5	0.0224 U	0.0135	0.912	0.108	0.143 U	0.0758	1.23	0.82
604762	TJAOU-46-BH-08-12.5-S	12.0	0.024 U	0.0134	1.29	0.149	0.166	0.129	0.845 U	0.784
604762	TJAOU-46-BH-08-4.5-S	4.5	0.0276 U	0.0171	1.06	0.128	0.158 U [R]	0.0856	1.05	0.886
604762	TJAOU-46-BH-08-8.5-S	8.5	0.0306 U	0.0163	0.886	0.138	**0.195**	0.129	**1.62**	0.584
604764	TJAOU-46-BH-09-4.5-S	4.5	0.0256 U [P2]	0.0149	0.989 [P2]	0.12	0.164 U [P2]	0.155	0.998 [P2]	0.91
604764	TJAOU-46-BH-09-7.5-S	7.5	0.0315 U [P2]	0.017	0.907 [P2]	0.126	0.162 U [P2]	0.14	1 [P2]	0.591
604764	TJAOU-46-BH-09-4.5-S	4.5	0.0175 U [P2]	0.0149	0.989 [P2]	0.12	0.129 U [P2]	0.155	0.998 [P2]	0.91
604764	TJAOU-46-BH-09-7.5-S	7.5	0.00273 U [P2]	0.017	0.907 [P2]	0.126	0.139 U [P2]	0.14	1 [P2]	0.591
604764	TJAOU-46-BH-010-4.5-S	4.5	0.00956 U [P2]	0.0159	0.997 [P2]	0.152	0.0315 U [P2]	0.11	0.887 [P2]	0.478
604764	TJAOU-46-BH-010-7.0-S	7	0.0126 U [P2]	0.0146	1.07 [P2]	0.126	0 U [R]	0.0794	0.515 U [P2]	0.937
604764	TJAOU-46-BH-011-4.5-S	4.5	0.015 U [P2]	0.0175	1.06 [P2]	0.0578	0 U [R]	0.0926	**2.07 [P2]**	1.29
Background Concentration[d] (surface/subsurface)[e]			0.836/0.084	NA	NC	NA	0.18/0.18	NA	1.3/1.3	NA

Refer to footnotes at end of table.

Table B-11 (Concluded)
Summary of SWMU 46 Characterization Soil Sampling
Gamma Spectroscopy Analytical Results for Geoprobe Investigation
August 2001
(Off-Site Laboratory[a])

Sample Attributes			Activity (Gamma Spectroscopy by HASL 300) (pCi/g)							
Record Number[b]	ER Sample ID	Sample Depth (ft)	Cesium-137		Lead-212		Uranium-235		Uranium-238	
			Result	Error[c]	Result	Error[c]	Result	Error[c]	Result	Error[c]
604764	TJAOU-46-BH-011-7.0-S	7	0.0192 U [P2]	0.0203	1.01 [P2]	0.119	0.0344 U [P2]	0.075	**1.94 [P2]**	1.52
604764	TJAOU-46-BH-012-4.5-S	4.5	0.00017 U [P2]	0.0185	1.07 [P2]	0.143	0.139 U [P2]	0.177	**1.47 [P2]**	0.627
604764	TJAOU-46-BH-012-8.0-S	8	0.00434 U [P2]	0.0162	0.789 [P2]	0.114	0.028 U [P2]	0.0771	0.705 U [P2]	1.13
Background Concentration[d] (surface/subsurface)[e]			0.836/0.084	NA	NC	NA	0.18/0.18	NA	1.3/1.3	NA
Quality Assurance/Quality Control Sample (pCi/L)										
604761	TJAOU-46-BH-02-EB1	NA	3.18 U	1.8	4.89 U	5.99	18 U	19.2	175 U	111

Note: Values in **bold** indicate concentrations greater than background.
[a]General Engineering Laboratories, Inc.
[b]Analysis request/chain-of-custody record.
[c]Two standard deviations about the mean detected activity.
[d]Dinwiddie September 1997.
[e]Surface samples defined as 0 to 6 inches; subsurface samples are greater than 6 inches.

BH = Borehole.
EB = Equipment Blank.
ER = Environmental Restoration.
ft = Foot (feet).
HASL = Health and Safety Lab Method.
ID = Identification.
NA = Not applicable.
NC = Not calculated by Dinwiddie (September 1997).
OU = Operable Unit.
P2 = Insufficient quality control data to determine laboratory precision.
pCi/g = Picocurie(s) per gram.
pCi/L = Picocurie(s) per liter.
R = Value is unusable.
S = Soil Sample.
SWMU = Solid Waste Management Unit.
TJA = Tijeras Arroyo.
U = The analyte was analyzed for but was not detected.

ATTACHMENT C
Summary of Analytical Results for Confirmatory Soil Samples from SWMU 46 VCA

LIST OF TABLES

Table C-1
Summary of SWMU 46 Confirmatory Soil Sampling
Metals Analytical Results for VCA Samples
August 2003
(Off-Site Laboratory[a])

Sample Attributes			Metals (EPA Methods SW846 3005/SW846 3050/SW846 7196/SW846 7470/ SW846 7471/SW846 9012[b]) (mg/kg)				
Record Number[c]	ER Sample ID	Sample Depth (ft)	Antimony	Arsenic	Barium	Beryllium	Cadmium
606675	TJAOU-46-GR-06-2.0-S	2.0	ND (0.312) [A2,UJ]	3.46	114	0.433 J (0.455)	**3.75**
606675	TJAOU-46-GR-07-2.0-S	2.0	ND (0.321) [A2,UJ]	3.19	107	0.445 J (0.467)	**1.61**
606675	TJAOU-46-GR-07-5.0-S	5.0	ND (0.34) [A2,UJ]	2.04	116	0.29 J (0.495)	0.108 J (0.495) [B3,J]
606675	TJAOU-46-GR-08-1.5-S	1.5	ND (0.337) [A2,UJ]	2.4	196	0.248 J (0.49)	**28.7**
606675	TJAOU-46-GR-09-2.0-S	2.0	ND (0.337) [A2,UJ]	3.11	**311**	0.318 J (0.49)	**2.3**
606675	TJAOU-46-GR-10-1.3-S	1.3	ND (0.34) [A2,UJ]	3.69	105	0.463 J (0.495)	**8**
606675	TJAOU-46-GR-11-1.5-S	1.5	ND (0.343) [A2,UJ]	4.13	122	0.465 J (0.5)	**54.6**
606675	TJAOU-46-GR-12-1.3-S	1.3	ND (0.33) [A2,UJ]	3.11	97.6	0.441 J (0.481)	**7.75**
606675	TJAOU-46-GR-12-5.0-S	5.0	0.334 J (0.926) [A2,J]	1.95	76.4	0.239 J (0.463)	0.153 J (0.463) [B3,J]
606676	TJAOU-46-GR-13-1.5-S	1.5	ND (0.333) [A2,UJ]	3.49	117	0.552	**213**
606676	TJAOU-46-GR-14-1.0-S	1.0	0.442 J (0.952) [A2,J]	3.49	112	0.413 J (0.476)	**3.56**
606676	TJAOU-46-GR-15-1.0-S	1.0	0.724 J (0.99) [A2,J]	2.98	102	0.404 J (0.495)	**8.13**
606676	TJAOU-46-GR-16-0.8-S	0.8	ND (0.315) [A2,UJ]	3.64	113	0.468	**3.24**
606676	TJAOU-46-GR-17-0.7-S	0.7	0.38 J (0.99) [A2,J]	2.7	90.2	0.343 J (0.495)	**3.63**
606676	TJAOU-46-GR-17-0.7-DU	0.7	0.395 J (0.935) [A2,J]	3.07	102	0.411 J (0.467)	**4.46**
606676	TJAOU-46-GR-17-5.0-S	5.0	ND (0.327) [A2,UJ]	2.87	113	0.398 J (0.476)	**2.17**
606676	TJAOU-46-GR-18-0.5-S	0.5	ND (0.312) [A2,UJ]	3.43	119	0.382 J (0.455)	**42.3**
606676	TJAOU-46-GR-19-0.5-S	0.5	ND (0.327) [A2,UJ]	3.28	116	0.408 J (0.476)	0.144 J (0.476) [B3,J]
606677	TJAOU-46-GR-20-2.5-S	2.5	0.47 J (1) [A2,B,J]	3.88	100	0.505	**31.9 [A2,J]**
606677	TJAOU-46-GR-21-0.0-S	0.0	0.709 J (0.98) [A2,B,J]	2.98	96.6	0.361 J (0.49)	**5.01 [A2,J]**
606677	TJAOU-46-GR-22-0.0-S	0.0	0.471 J (0.952) [A2,B,J]	3.11	93.6	0.557	0.636 [A2,J]
606677	TJAOU-46-GR-23-0.0-S	0.0	ND (0.312) [A2,R]	3.38	117	0.519	**9.67 [A2,J]**
Background Concentration[d] (surface/subsurface)[e]			3.9/3.9	5.6/4.4	200/200	0.8/0.8	<1/0.9

Refer to footnotes at end of table.

Table C-1 (Continued)
Summary of SWMU 46 Confirmatory Soil Sampling
Metals Analytical Results for VCA Samples
August 2003
(Off-Site Laboratory[a])

Sample Attributes			Metals (EPA Methods SW846 3005/SW846 3050/SW846 7196/SW846 7470/ SW846 7471/SW846 9012[b]) (mg/kg)				
Record Number[c]	ER Sample ID	Sample Depth (ft)	Antimony	Arsenic	Barium	Beryllium	Cadmium
606674	TJAOU-46-GR-24-0.0-S	0.0	ND (0.337) [A2,UJ]	2.51	71.1 [A2,J]	0.267 J (0.49)	0.808 [B2,B3,J]
606674	TJAOU-46-GR-24-2.0-S	2.0	ND (0.333) [A2,UJ]	1.41 [B3,J]	105 [A2,J]	0.233 J (0.485)	0.489 [B2,B3,J]
606674	TJAOU-46-GR-24-5.0-S	0.0	ND (0.337) [A2,UJ]	2.65	**229 [A2,J]**	0.225 J (0.49)	ND (0.0469)
606674	TJAOU-46-GR-24-5.0-DU	5.0	ND (0.337) [A2,UJ]	1.74	**280 [A2,J]**	0.249 J (0.49)	0.0473 J (0.49) [B2,B3,J]
606674	TJAOU-46-GR-25-0.0-S	0.0	0.326 J (0.926) [A2,J]	2.08	73.7 [A2,J]	0.308 J (0.463)	0.83 [B2,B3,J]
606674	TJAOU-46-GR-25-2.0-S	2.0	0.381 J (0.971) [A2,J]	2.48	101 [A2,J]	0.279 J (0.485)	**2.48 [B3,J]**
606674	TJAOU-46-GR-25-5.0-S	5.0	ND (0.324) [A2,UJ]	2.58	**330 [A2,J]**	0.195 J (0.472)	0.706 [B2,B3,J]
606674	TJAOU-46-GR-25-10.0-S	10.0	0.583 J (0.98) [A2,J]	**5.23**	**266 [A2,J]**	0.611	0.189 J (0.49) [B2,B3,J]
Background Concentration[d] (surface/subsurface)[e]			3.9/3.9	5.6/4.4	200/200	0.8/0.8	<1/0.9
Quality Assurance/Quality Control Samples (mg/L)							
604209	TJAOU-46-GR-EB1	NA	ND (0.0038)	ND (0.00457) [B3,UJ]	0.0013 J (0.005)	ND (0.0002)	ND (0.00025) [B3,UJ]
604211	TJAOU-46-GR-EB2	NA	ND (0.0038)	ND (0.00457)	0.00034 J (0.005)	ND (0.0002) [B3,UJ]	ND (0.00025)
606674	TJAOU-46-GR-06.0.0-EB	NA	ND (0.00508) [B3,UJ]	ND (0.00224) [B3,UJ]	0.000682 J (0.005) [B,B3,J]	0.000193 J (0.005) [B3,J]	0.000462 J (0.005) [B3,J]
606677	TJAOU-46-GR-06-0.0-EB	NA	ND (0.00508) [B3,UJ]	ND (0.00224) [B3,UJ]	0.000396 J (0.005) [B,B3,J]	ND (0.000158)	ND (0.000313)

Refer to footnotes at end of table.

Table C-1 (Continued)
Summary of SWMU 46 Confirmatory Soil Sampling
Metals Analytical Results for VCA Samples
August 2003
(Off-Site Laboratory[a])

Sample Attributes			Metals (EPA Methods SW846 3005/SW846 3050/SW846 7196/SW846 7470/ SW846 7471/SW846 9012[b]) (mg/kg)				
Record Number[c]	ER Sample ID	Sample Depth (ft)	Chromium	Chromium (VI)	Cobalt	Copper	Iron
606675	TJAOU-46-GR-06-2.0-S	2.0	**21.7**	0.345	5.73	**50.4 [A2,J,P1]**	13,000
606675	TJAOU-46-GR-07-2.0-S	2.0	**29.1**	0.716	4.73	**133 [A2,J,P1]**	13,300
606675	TJAOU-46-GR-07-5.0-S	5.0	5.75	0.388	3.5	5.26 [A2,J,P1]	9,420
606675	TJAOU-46-GR-08-1.5-S	1.5	10.8	0.484	3.94	**103 [A2,J,P1]**	7,670
606675	TJAOU-46-GR-09-2.0-S	2.0	10.7	0.414	3.39	16.4 [A2,J,P1]	9,960
606675	TJAOU-46-GR-10-1.3-S	1.3	**19.4**	0.916	4.57	**21 [A2,J,P1]**	12,000
606675	TJAOU-46-GR-11-1.5-S	1.5	**26.6**	0.765	5.13	**90.1 [A2,J,P1]**	11,500
606675	TJAOU-46-GR-12-1.3-S	1.3	**19.8**	0.493	4.29	**22.4 [A2,J,P1]**	11,500
606675	TJAOU-46-GR-12-5.0-S	5.0	5	0.504	5.39	10.7 [A2,J,P1]	11,500
606676	TJAOU-46-GR-13-1.5-S	1.5	**62.7**	1.61	4.77	**132 [A2,J,P1]**	12,300
606676	TJAOU-46-GR-14-1.0-S	1.0	**27.4**	0.584	4.27	**24.1 [A2,J,P1]**	11,400
606676	TJAOU-46-GR-15-1.0-S	1.0	**41.2**	1.23	4.36	**49.3 [A2,J,P1]**	11,000
606676	TJAOU-46-GR-16-0.8-S	0.8	**19.2**	0.2	4.96	**20 [A2,J,P1]**	11,800
606676	TJAOU-46-GR-17-0.7-S	0.7	**16.1**	0.402	4.23	**22.6 [A2,J,P1]**	10,300
606676	TJAOU-46-GR-17-0.7-DU	0.7	**19.4**	0.405	4.12	**24.7 [A2,J,P1]**	11,700
606676	TJAOU-46-GR-17-5.0-S	5.0	12.3	0.384	5.01	12.8 [A2,J,P1]	15,800
606676	TJAOU-46-GR-18-0.5-S	0.5	**21.8**	0.961	3.65	16.6 [A2,J,P1]	9,680
606676	TJAOU-46-GR-19-0.5-S	0.5	9.4	0.456	4.61	7.9 [A2,J,P1]	12,200
606677	TJAOU-46-GR-20-2.5-S	2.5	**62.1 [A2,J]**	0.643	4.51	**74.7 [A2,J]**	12,600
606677	TJAOU-46-GR-21-0.0-S	0.0	**78.7 [A2,J]**	1.1	5.5	**85.6 [A2,J]**	11,600
606677	TJAOU-46-GR-22-0.0-S	0.0	12.6 [A2,J]	0.315	4.14	13 [A2,J]	10,800
606677	TJAOU-46-GR-23-0.0-S	0.0	**26 [A2,J]**	0.295	5	**25.3 [A2,J]**	13,000
Background Concentration[d] (surface/subsurface)[e]			17.3/12.8	NC/NC	7.1/8.8	17/17	NC

Refer to footnotes at end of table.

Table C-1 (Continued)
Summary of SWMU 46 Confirmatory Soil Sampling
Metals Analytical Results for VCA Samples
August 2003
(Off-Site Laboratory[a])

Sample Attributes			Metals (EPA Methods SW846 3005/SW846 3050/SW846 7196/SW846 7470/ SW846 7471/SW846 9012[b]) (mg/kg)				
Record Number[c]	ER Sample ID	Sample Depth (ft)	Chromium	Chromium (VI)	Cobalt	Copper	Iron
606674	TJAOU-46-GR-24-0.0-S	0.0	8.89	ND (0.0532)	4.06	10.1	9,910
606674	TJAOU-46-GR-24-2.0-S	2.0	5.61	ND (0.0526)	4.1	10	10,100
606674	TJAOU-46-GR-24-5.0-S	5.0	4.87	0.215	2.53	6.32	5,130
606674	TJAOU-46-GR-24-5.0-DU	5.0	4.79	0.28	2.26	6.1	4,980
606674	TJAOU-46-GR-25-0.0-S	0.0	**26.4**	0.124	4.04	**18.2**	10,400
606674	TJAOU-46-GR-25-2.0-S	2.0	**13.2**	0.156	4.3	**28.3**	9,410
606674	TJAOU-46-GR-25-5.0-S	5.0	7.73	0.111	2.37	16	4,920
606674	TJAOU-46-GR-25-10.0-S	10.0	12.7	0.248	5.64	12.8	13,500
Background Concentration[d] (surface/subsurface)[e]			17.3/12.8	NC/NC	7.1/8.8	17/17	NC
Quality Assurance/Quality Control Samples (mg/L)							
604209	TJAOU-46-GR-EB1	NA	0.0008 J (0.005) [B3,J]	ND (0.0054) [HT,UJ]	0.000788 J (0.005) [B,B3,J]	ND (0.00139)	ND (0.0126)
604211	TJAOU-46-GR-EB2	NA	0.00104 J (0.005)	0.037 H[HT,J]	ND (0.0003)	ND (0.00139)	0.0172 J (0.1)
606674	TJAOU-46-GR-06.0.0-EB	NA	0.00205 J (0.005) [B,B3,J]	ND (0.0054) [HT,UJ]	0.000636 J (0.005) [B,B3,J]	ND (0.00267)	0.0887
606677	TJAOU-46-GR-06-0.0-EB	NA	0.00126 J (0.005) [B,B3,J]	ND (0.005) [HT,R]	ND (0.0003)	ND (0.00267)	0.0218 J (0.05) [B3,J]

Refer to footnotes at end of table.

Table C-1 (Continued)
Summary of SWMU 46 Confirmatory Soil Sampling
Metals Analytical Results for VCA Samples
August 2003
(Off-Site Laboratory[a])

Sample Attributes			Metals (EPA Methods SW846 3005/SW846 3050/SW846 7196/SW846 7470/ SW846 7471/SW846 9012[b]) (mg/kg)				
Record Number[c]	ER Sample ID	Sample Depth (ft)	Lead	Mercury	Nickel	Selenium	Silver
606675	TJAOU-46-GR-06-2.0-S	2.0	9.21	0.0219 [J,P1]	**379**	ND (0.147)	**4.06**
606675	TJAOU-46-GR-07-2.0-S	2.0	**32.1**	0.0702 [J,P1]	25.1	ND (0.151)	**2.79**
606675	TJAOU-46-GR-07-5.0-S	5.0	3.61	0.00442 J (0.00948) [J,P1]	4.95	ND (0.16)	ND (0.0893)
606675	TJAOU-46-GR-08-1.5-S	1.5	3.38	0.0192 [J,P1]	**136**	ND (0.159)	0.539
606675	TJAOU-46-GR-09-2.0-S	2.0	6.39	0.0125 [J,P1]	7.35	ND (0.159)	0.124 J (0.49)
606675	TJAOU-46-GR-10-1.3-S	1.3	9.62	0.0187 [J,P1]	13	ND (0.16)	0.385 J (0.495)
606675	TJAOU-46-GR-11-1.5-S	1.5	**25.5**	0.0307 [J,P1]	**92.6**	ND (0.162)	**1.09**
606675	TJAOU-46-GR-12-1.3-S	1.3	**13.9**	0.0175 [J,P1]	19.1	ND (0.156)	0.498
606675	TJAOU-46-GR-12-5.0-S	5.0	2.98	0.00254 J (0.00984) [J,P1]	5.16	ND (0.15)	ND (0.0835)
606676	TJAOU-46-GR-13-1.5-S	1.5	**41.8**	0.0285 [J,P1]	**71**	ND (0.157)	0.619
606676	TJAOU-46-GR-14-1.0-S	1.0	**12**	0.0282 [J,P1]	**26**	ND (0.154)	0.708
606676	TJAOU-46-GR-15-1.0-S	1.0	**28**	0.0242 [J,P1]	**38.9**	0.394 J (0.495) [B3,J]	**2**
606676	TJAOU-46-GR-16-0.8-S	0.8	**12.2**	0.0172 [J,P1]	20	ND (0.149)	0.333 J (0.459)
606676	TJAOU-46-GR-17-0.7-S	0.7	6.42	0.0123 [J,P1]	**36.4**	ND (0.16)	0.675
606676	TJAOU-46-GR-17-0.7-DU	0.7	6.97	0.0133 [J,P1]	**33.8**	ND (0.151)	0.383 J (0.467)
606676	TJAOU-46-GR-17-5.0-S	5.0	4.83	0.00773 J (0.00861) [J,P1]	16.3	ND (0.154)	0.107 J (0.476)
606676	TJAOU-46-GR-18-0.5-S	0.5	4.66	0.014 [J,P1]	**29.4**	ND (0.147)	ND (0.082)
606676	TJAOU-46-GR-19-0.5-S	0.5	5.08	0.00994 [J,P1]	6.87	ND (0.154)	ND (0.0859)
606677	TJAOU-46-GR-20-2.5-S	2.5	**43.5 [A2,J]**	0.0158	**108**	0.261 J (0.5)	0.784
606677	TJAOU-46-GR-21-0.0-S	0.0	**66.8 [A2,J]**	0.0766	**72.8**	ND (0.159)	**12.4**
606677	TJAOU-46-GR-22-0.0-S	0.0	12.7 [A2,J]	0.0206	9.56	ND (0.154)	0.624
606677	TJAOU-46-GR-23-0.0-S	0.0	21.4 [A2,J]	0.0194	22	0.154 J (0.455)	0.728
Background Concentration[d] (surface/subsurface)[e]			39/11.2	<0.25/<0.1	25.4/25.4	<1/<1	<1/<1

Refer to footnotes at end of table.

Table C-1 (Continued)
Summary of SWMU 46 Confirmatory Soil Sampling
Metals Analytical Results for VCA Samples
August 2003
(Off-Site Laboratory[a])

Sample Attributes			Metals (EPA Methods SW846 3005/SW846 3050/SW846 7196/SW846 7470/ SW846 7471/SW846 9012[b]) (mg/kg)				
Record Number[c]	ER Sample ID	Sample Depth (ft)	Lead	Mercury	Nickel	Selenium	Silver
606674	TJAOU-46-GR-24-0.0-S	0.0	6.94	0.0107	7.24	ND (0.159) [B3,UJ]	0.139 J (0.49)
606674	TJAOU-46-GR-24-2.0-S	2.0	2.88	0.00122 J (0.00965)	5.53	ND (0.157) [B3,UJ]	ND (0.0876)
606674	TJAOU-46-GR-24-5.0-S	5.0	2.27	0.00365 J (0.00984)	4.45	ND (0.159) [B3,UJ]	ND (0.0884)
606674	TJAOU-46-GR-24-5.0-DU	5.0	2.19	0.00392 J (0.00984)	4.37	ND (0.159) [B3,UJ]	ND (0.0884)
606674	TJAOU-46-GR-25-0.0-S	0.0	5.3	0.00555 J (0.00993)	8.88	ND (0.15) [B3,UJ]	0.498
606674	TJAOU-46-GR-25-10.0-S	10.0	6.82	0.00705 J (0.00952)	13.2	ND (0.159) [B3,UJ]	0.102 J (0.49)
606674	TJAOU-46-GR-25-2.0-S	2.0	4.79	0.00895 J (0.00969)	**30.3**	ND (0.157) [B3,UJ]	0.667
606674	TJAOU-46-GR-25-5.0-S	5.0	1.88	0.0108	11.5	ND (0.153) [B3,UJ]	0.599
Background Concentration[d] (surface/subsurface)[e]			39/11.2	<0.25/<0.1	25.4/25.4	<1/<1	<1/<1
Quality Assurance/Quality Control Samples (mg/L)							
604209	TJAOU-46-GR-EB1	NA	ND (0.00344)	ND (0.00007) [B3,UJ]	ND (0.00074) [B3,UJ]	ND (0.00309)	ND (0.0002)
604211	TJAOU-46-GR-EB2	NA	ND (0.00344)	ND (0.00007)	ND (0.00074)	ND (0.00309)	ND (0.0002)
606674	TJAOU-46-GR-06.0.0-EB	NA	ND (0.00172)	ND (0.000047)	ND (0.00069) [B3,UJ]	0.00292 J (0.005) [B,B3,J]	ND (0.000835)
606677	TJAOU-46-GR-06-0.0-EB	NA	ND (0.00172)	ND (0.000047)	ND (0.00069) [B3,UJ]	ND (0.00281)	ND (0.000835)

Refer to footnotes at end of table.

Table C-1 (Continued)
Summary of SWMU 46 Confirmatory Soil Sampling
Metals Analytical Results for VCA Samples
August 2003
(Off-Site Laboratory[a])

Sample Attributes			Metals (EPA Methods SW846 3005/SW846 3050/SW846 7196/SW846 7470/ SW846 7471/SW846 9012[b]) (mg/kg)			
Record Number[c]	ER Sample ID	Sample Depth (ft)	Thallium	Vanadium	Zinc	Total Cyanide
606675	TJAOU-46-GR-06-2.0-S	2.0	ND (0.909)	26	45.4 [A2,J]	NR
606675	TJAOU-46-GR-07-2.0-S	2.0	**ND (2.34)**	26.4	42 [A2,J]	NR
606675	TJAOU-46-GR-07-5.0-S	5.0	ND (0.99)	18.3	20.8 [A2,J]	NR
606675	TJAOU-46-GR-08-1.5-S	1.5	ND (0.98)	17.7	**114 [A2,J]**	NR
606675	TJAOU-46-GR-09-2.0-S	2.0	**ND (2.45)**	25.5	23.5 [A2,J]	NR
606675	TJAOU-46-GR-10-1.3-S	1.3	**ND (2.48)**	25.2	34.7 [A2,J]	NR
606675	TJAOU-46-GR-11-1.5-S	1.5	ND (1)	23.2	60.6 [A2,J]	NR
606675	TJAOU-46-GR-12-1.3-S	1.3	**ND (2.4)**	22.6	37.4 [A2,J]	NR
606675	TJAOU-46-GR-12-5.0-S	5.0	**ND (2.31)**	23	24.4 [A2,J]	NR
606676	TJAOU-46-GR-13-1.5-S	1.5	**ND (2.43)**	23.1	**149 [A2,J]**	NR
606676	TJAOU-46-GR-14-1.0-S	1.0	**ND (2.38)**	25.1	33.1 [A2,J]	NR
606676	TJAOU-46-GR-15-1.0-S	1.0	ND (0.99)	21.7	52 [A2,J]	NR
606676	TJAOU-46-GR-16-0.8-S	0.8	**ND (2.29)**	23.3	45.5 [A2,J]	NR
606676	TJAOU-46-GR-17-0.7-S	0.7	ND (0.99)	22	31 [A2,J]	NR
606676	TJAOU-46-GR-17-0.7-DU	0.7	ND (0.935)	25.4	34.8 [A2,J]	NR
606676	TJAOU-46-GR-17-5.0-S	5.0	**ND (2.38)**	**34.7**	27.4 [A2,J]	NR
606676	TJAOU-46-GR-18-0.5-S	0.5	**ND (2.27)**	23	**85 [A2,J]**	NR
606676	TJAOU-46-GR-19-0.5-S	0.5	ND (0.952)	27.3	25.4 [A2,J]	NR
606677	TJAOU-46-GR-20-2.5-S	2.5	ND (1)	22.3	53.3	NR
606677	TJAOU-46-GR-21-0.0-S	0.0	ND (0.98)	20.7	**95.8**	NR
606677	TJAOU-46-GR-22-0.0-S	0.0	ND (0.952)	20.7	31.9	NR
606677	TJAOU-46-GR-23-0.0-S	0.0	ND (0.909)	22.7	54.8	NR
606674	TJAOU-46-GR-24-0.0-S	0.0	**ND (2.45)**	21.5	31.6	NR
606674	TJAOU-46-GR-24-2.0-S	2.0	**ND (2.43)**	20.2	32.5	NR
606674	TJAOU-46-GR-24-5.0-S	5.0	ND (0.98)	12.9	12	NR
606674	TJAOU-46-GR-24-5.0-DU	5.0	ND (0.98)	12.5	11.7	NR
606674	TJAOU-46-GR-25-0.0-S	0.0	**ND (2.31)**	22.3	27.3	NR
606674	TJAOU-46-GR-25-2.0-S	2.0	**ND (2.43)**	19.4	27.6	NR
606674	TJAOU-46-GR-25-5.0-S	5.0	ND (0.943)	13.2	12.5	NR
606674	TJAOU-46-GR-25-10.0-S	10.0	**ND (2.45)**	**33.5**	33.6	NR
Background Concentration[d] (surface/subsurface)[e]			<1.1/<1.1	33/33	76/76	NC

Refer to footnotes at end of table.

Table C-1 (Concluded)
Summary of SWMU 46 Confirmatory Soil Sampling
Metals Analytical Results for VCA Samples
August 2003
(Off-Site Laboratory[a])

Sample Attributes			Metals (EPA Methods SW846 3005/SW846 3050/SW846 7196/SW846 7470/ SW846 7471/SW846 9012[b]) (mg/kg)			
Record Number[c]	ER Sample ID	Sample Depth (ft)	Thallium	Vanadium	Zinc	Total Cyanide
Quality Assurance/Quality Control Samples (mg/L)						
604209	TJAOU-46-GR-EB1	NA	ND (0.00413)	ND (0.00109)	0.00283 J (0.005)	ND (0.00276)
604211	TJAOU-46-GR-EB2	NA	ND (0.00413) [B3,UJ]	ND (0.00109)	ND (0.00281)	ND (0.00276)
606674	TJAOU-46-GR-06.0.0-EB	NA	ND (0.01)	0.00146 J (0.005) [B,B3,J]	0.00614	NR
606677	TJAOU-46-GR-06-0.0-EB	NA	ND (0.01)	0.00216 J (0.005) [B,B3,J]	0.00484 J (0.005)	NR

Note: Values in **bold** indicate concentrations or method detection limits greater than background.
[a]General Engineering Laboratories, Inc.
[b]EPA November 1986.
[c]Analysis request/chain-of-custody record.
[d]Dinwiddie September 1997.
[e]Surface samples defined as 0 to 6 inches; subsurface samples are greater than 6 inches.

A2 = Laboratory accuracy and/or bias measurements for the associated matrix spike and/or duplicate do not meet acceptance criteria.
B = Analyte present in laboratory method blank.
B2 = Analyte present in equipment blank.
B3 = Analyte present in calibration blank.
DU = Duplicate Sample.
EB = Equipment Blank.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab Sample.
H = Holding time was exceeded.
HT = The holding time was exceeded for the associated sample analysis.
ID = Identification.
J ( ) = Estimated value less than the laboratory reporting limit, shown in parentheses.
[J] = The associated value is an estimated quantity.
mg/kg = Milligram(s) per kilogram.
mg/L = Milligram(s) per liter.
NA = Not applicable.
NC = Not calculated by Dinwiddie (September 1997).
ND ( ) = Not detected above the method detection limit, shown in parentheses.
NR = Not reported.
OU = Operable Unit.
P1 = Laboratory precision measurements for the matrix spike sample and associated duplicate do not meet acceptance criteria.
R = Value is unusable.
S = Soil Sample.
SWMU = Solid Waste Management Unit.
TJA = Tijeras Arroyo.
UJ = The analyte was analyzed for but was not detected. The associated value is an estimate and may be inaccurate or imprecise.
VCA = Voluntary Corrective Action.

Table C-2
Summary of SWMU 46 Confirmatory Soil Sampling
Metals Analytical Detection Limits
August 2003
(Off-Site Laboratory[a])

Analyte	Method Detection Limit (mg/kg)
Aluminum	0.721–0.793
Antimony	0.312–0.343
Arsenic	0.188–0.974
Barium	0.0606–0.315
Beryllium	0.0455–0.05
Cadmium	0.0435–0.0478
Calcium	1.19–6.15
Chromium	0.146–0.161
Chromium (VI)	0.0516–0.108
Cobalt	0.0725–0.0798
Copper	0.185–0.203
Iron	1.42–1.57
Lead	0.258–0.284
Magnesium	0.532–2.76
Manganese	0.119–0.131
Mercury	0.000846–0.000976
Nickel	0.0776–0.0854
Potassium	3.25–16.9
Selenium	0.147–0.162
Silver	0.082–0.0902
Sodium	3.3–17.1
Thallium	0.909–2.48
Vanadium	0.0825–0.0908
Zinc	0.153–0.168

[a]General Engineering Laboratories, Inc.
mg/kg = Milligram(s) per kilogram.
SWMU = Solid Waste Management Unit.

Table C-3
Summary of SWMU 46 Confirmatory Soil Sampling
PCB Analytical Results for VCA Samples
August 2003
(Off-Site Laboratory[a])

Sample Attributes			PCBs (EPA Method SW846 8082[b]) (µg/kg)			
Record Number[c]	ER Sample ID	Sample Depth (ft)	Aroclor-1242	Aroclor-1254	Aroclor-1260	Total PCBs (µg/kg)
606675	TJAOU-46-GR-06-2.0-S	2.0	**70.9**	**44.8**	**9.3 [UX]**	125
606675	TJAOU-46-GR-07-2.0-S	2.0	**47.2 [UX]**	**62.8**	**19.8 [UX]**	129.8
606675	TJAOU-46-GR-07-5.0-S	5.0	ND (1.67)	ND (0.5)	ND (1)	ND
606675	TJAOU-46-GR-08-1.5-S	1.5	**10.4**	**5.4**	**2.4 J (3.33)**	18.2
606675	TJAOU-46-GR-09-2.0-S	2.0	**8.8 [UX]**	**7.3**	**1.7 J (3.33)**	17.8
606675	TJAOU-46-GR-10-1.3-S	1.3	ND (1.67)	**5.1**	**1.8 J (3.33)**	6.9
606675	TJAOU-46-GR-11-1.5-S	1.	ND (1.67)	**15.7**	**4.1 [UX]**	19.8
606675	TJAOU-46-GR-12-1.3-S	1.3	ND (1.67)	**9.9 [UX]**	**9.1**	19
606675	TJAOU-46-GR-12-5.0-S	5.0	ND (1.67)	ND (0.5)	ND (1)	ND
606676	TJAOU-46-GR-13-1.5-S	1.5	ND (1.67)	**5.9**	**3.1 J (3.33)**	9
606676	TJAOU-46-GR-14-1.0-S	1.0	ND (1.67)	**81.7**	**13.1[UX]**	94.8
606676	TJAOU-46-GR-15-1.0-S	1.0	ND (1.67)	**42.3**	**16.1[UX]**	58.4
606676	TJAOU-46-GR-16-0.8-S	0.8	ND (1.67)	ND (0.5)	ND (1)	NA
606676	TJAOU-46-GR-17-0.7-DU	0.7	ND (1.67)	ND (0.5)	ND (1)	NA
606676	TJAOU-46-GR-17-0.7-S	0.7	ND (1.67)	ND (0.5)	ND (1)	NA
606676	TJAOU-46-GR-17-5.0-S	5.0	ND (1.67)	ND (0.5)	ND (1)	NA
606676	TJAOU-46-GR-18-0.5-S	0.5	ND (1.67)	ND (0.5)	ND (1)	NA
606676	TJAOU-46-GR-19-0.5-S	0.5	ND (1.67)	ND (0.5)	ND (1)	NA
606677	TJAOU-46-GR-20-2.5-S	2.5	**31.9**	**43.9**	**11.8**	87.6
606677	TJAOU-46-GR-21-0.0-S	0.0	**916 [A1,J]**	**1760 [A1,J]**	**532 [A1,J]**	NR
607008	TJAOU-46-GR-21-0.1-S	0.1	ND (1.67)	ND (0.5)	**1.10 [J]**	1.10
607008	TJAOU-46-GR-21-0.1-D	0.1	ND (1.67)	ND (0.5)	**1.80 [J]**	1.80
606677	TJAOU-46-GR-22-0.0-S	0.0	ND (1.67)	**8.3**	**5.7**	14.0
606677	TJAOU-46-GR-23-0.0-S	0.0	ND (1.67)	**5.8**	**4.4 [UX]**	10.2
606674	TJAOU-46-GR-24-0.0-S	0.0	ND (1.67)	ND (0.5)	**3 J (3.33)**	3 J
606674	TJAOU-46-GR-24-2.0-S	2.0	ND (1.67)	ND (0.5)	ND (1)	NA
606674	TJAOU-46-GR-24-5.0-DU	5.0	ND (1.67)	ND (0.5)	ND (1)	NA
606674	TJAOU-46-GR-24-5.0-S	5.0	ND (1.67)	ND (0.5)	ND (1)	NA
606674	TJAOU-46-GR-25-0.0-S	0.0	ND (1.67)	ND (0.5)	ND (1)	NA
606674	TJAOU-46-GR-25-10.0-S	10.0	ND (1.67)	ND (0.5)	ND (1)	NA
606674	TJAOU-46-GR-25-2.0-S	2.0	ND (1.67)	ND (0.5)	ND (1)	NA
606674	TJAOU-46-GR-25-5.0-S	5.0	ND (1.67)	ND (0.5)	ND (1)	NA
607008	TJAOU-46-GR-26-0.0-S	0.0	ND (1.67)	**2.05 [J]**	**1.70 [J]**	3.75
Quality Assurance/Quality Control Samples (µg/L)						
604209	TJAOU-46-GR-EB1	NA	ND (0.0444) [A1,UJ]	ND (0.0251) [A1,UJ]	ND (0.0134) [A1,UJ]	NA
604211	TJAOU-46-GR-EB2	NA	ND (0.0444)	ND (0.0251)	ND (0.0134)	NA
606674	TJAOU-46-GR-06.0.0-EB	NA	ND (0.0594)	ND (0.0495)	ND (0.0495)	NA
606677	TJAOU-46-GR-06-0.0-EB	NA	ND (0.0606)	ND (0.0505)	ND (0.0505)	NA

Refer to footnotes at end of table.

Table C-3 (Concluded)
Summary of SWMU 46 Confirmatory Soil Sampling
PCB Analytical Results for VCA Samples
August 2003
(Off-Site Laboratory[a])

Sample Attributes			PCBs (EPA Method SW846 8082[b]) (µg/kg)			
Record Number[c]	ER Sample ID	Sample Depth (ft)	Aroclor-1242	Aroclor-1254	Aroclor-1260	Total PCBs (µg/kg)
607008	TJAOU-46-GR-21-0.0-EB	NA	ND (0.0495)	ND (0.0495)	ND (0.0495)	NA

Note: Values in **bold** indicate detected analytes.
[a]General Engineering Laboratories, Inc.
[b]EPA November 1986.
[c]Analysis request/chain-of-custody record.
A1 = Laboratory accuracy and/or bias measurements for the associated surrogate spike do not meet acceptance criteria.
D = Duplicate Sample.
DU = Duplicate Sample.
EB = Equipment Blank.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab Sample.
ID = Identification.
J = Estimated value.
[J] = The associated value is an estimated quantity.
µg/kg = Microgram(s) per kilogram.
µg/L = Microgram(s) per liter.
NA = Not applicable.
ND = Not detected.
ND ( ) = Not detected above the method detection limit, shown in parentheses.
NMED = New Mexico Environment Department.
NR = Not representative of site conditions (see Response to NMED Comment #2).
OU = Operable Unit.
PCB = Polychlorinated biphenyl.
S = Soil Sample.
SWMU = Solid Waste Management Unit.
TJA = Tijeras Arroyo.
UJ = The analyte was analyzed for but was not detected. The associated value is an estimate and may be inaccurate or imprecise.
UX = Secondary (lower) detection limit applied.
VCA = Voluntary Corrective Action.

Table C-4
Summary of SWMU 46 Confirmatory Soil Sampling
PCB Analytical Detection Limits
August 2003
(Off-Site Laboratory[a])

Analyte	Method Detection Limit (µg/kg)
Aroclor-1016	1–50
Aroclor-1221	2.82–141
Aroclor-1232	1.67–83.3
Aroclor-1242	1.67–83.3
Aroclor-1248	1–50
Aroclor-1254	0.5–25
Aroclor-1260	1–50

[a]General Engineering Laboratories, Inc.
µg/kg = Microgram(s) per kilogram.
PCB = Polychlorinated biphenyl.
SWMU = Solid Waste Management Unit.

Table C-5
Summary of SWMU 46 Confirmatory Soil Sampling
VOC Analytical Results for VCA Samples
August 2003
(Off-Site Laboratory[a])

Sample Attributes			VOCs (EPA Method SW846 8260[b]) (µg/kg)		
Record Number[c]	ER Sample ID	Sample Depth (ft)	Acetone	Dibromochloromethane	Toluene
606675	TJAOU-46-GR-06-2.0-S	2.0	ND (3.52)	ND (0.5)	ND (0.34)
606675	TJAOU-46-GR-07-2.0-S	2.0	**9.03 [B2,UX]**	ND (0.5)	ND (0.34)
606675	TJAOU-46-GR-07-5.0-S	5.0	ND (3.52)	ND (0.5)	ND (0.34)
606675	TJAOU-46-GR-08-1.5-S	1.5	ND (3.52)	ND (0.5)	ND (0.34)
606675	TJAOU-46-GR-09-2.0-S	2.0	ND (3.52)	ND (0.5)	ND (0.34)
606675	TJAOU-46-GR-10-1.3-S	1.3	ND (3.52)	ND (0.5)	ND (0.34)
606675	TJAOU-46-GR-11-1.5-S	1.5	ND (3.52)	ND (0.5)	ND (0.34)
606675	TJAOU-46-GR-12-1.3-S	1.3	ND (3.52)	ND (0.5)	ND (0.34)
606675	TJAOU-46-GR-12-5.0-S	5.0	ND (3.52)	ND (0.5)	ND (0.34)
606676	TJAOU-46-GR-13-1.5-S	1.5	ND (3.52)	ND (0.5)	**0.591 J (1) [B1,UX]**
606676	TJAOU-46-GR-14-1.0-S	1.0	ND (3.52)	ND (0.5)	ND (0.34)
606676	TJAOU-46-GR-15-1.0-S	1.0	ND (3.52)	ND (0.5)	**0.387 J (1) [B1,UX]**
606676	TJAOU-46-GR-16-0.8-S	0.8	ND (3.52)	ND (0.5)	ND (0.34)
606676	TJAOU-46-GR-17-0.7-S	0.7	ND (3.52)	ND (0.5)	ND (0.34)
606676	TJAOU-46-GR-17-0.7-DU	0.7	ND (3.52)	ND (0.5)	ND (0.34)
606676	TJAOU-46-GR-17-5.0-S	5.0	ND (3.52)	ND (0.5)	ND (0.34)
606676	TJAOU-46-GR-18-0.5-S	0.5	ND (3.52)	ND (0.5)	ND (0.34)
606676	TJAOU-46-GR-19-0.5-S	0.5	ND (3.52)	ND (0.5)	ND (0.34)
606677	TJAOU-46-GR-20-2.5-S	2.5	ND (3.52)	ND (0.5)	ND (0.34)
606677	TJAOU-46-GR-21-0.0-S	0.0	ND (3.52)	ND (0.5)	**1.12 [B1,UX]**
606677	TJAOU-46-GR-22-0.0-S	0.0	ND (3.52)	ND (0.5)	**1.19 [B1,UX]**
606677	TJAOU-46-GR-23-0.0-S	0.0	ND (3.52)	ND (0.5)	**1.14 [B1,UX]**
606674	TJAOU-46-GR-24-0.0-S	0.0	ND (3.52)	ND (0.5)	ND (0.34)
606674	TJAOU-46-GR-24-2.0-S	2.0	ND (3.52)	ND (0.5)	ND (0.34)
606674	TJAOU-46-GR-24-5.0-S	5.0	ND (3.52)	ND (0.5)	ND (0.34)
606674	TJAOU-46-GR-24-5.0-DU	5.0	ND (3.52)	ND (0.5)	ND (0.34)
606674	TJAOU-46-GR-25-0.0-S	0.0	ND (3.52)	ND (0.5)	ND (0.34)
606674	TJAOU-46-GR-25-2.0-S	2.0	ND (3.52)	ND (0.5)	ND (0.34)
606674	TJAOU-46-GR-25-5.0-S	5.0	ND (3.52)	ND (0.5)	ND (0.34)
606674	TJAOU-46-GR-25-10.0-S	10.0	ND (3.52)	ND (0.5)	ND (0.34)

Refer to footnotes at end of table.

Table C-5 (Concluded)
Summary of SWMU 46 Confirmatory Soil Sampling
VOC Analytical Results for VCA Samples
August 2003
(Off-Site Laboratory[a])

Sample Attributes			VOCs (EPA Method SW846 8260[b]) (µg/kg)		
Record Number[c]	ER Sample ID	Sample Depth (ft)	Acetone	Dibromochloromethane	Toluene
Quality Assurance/Quality Control Samples (µg/L)					
604209	TJAOU-46-GR-EB1	NA	ND (0.82)	ND (0.16)	ND (0.22)
604211	TJAOU-46-GR-EB2	NA	ND (0.82)	ND (0.16)	ND (0.22)
604209	TJAOU-46-GR-TB1	NA	ND (0.82)	ND (0.16)	ND (0.22)
604211	TJAOU-46-GR-TB2	NA	ND (0.82)	ND (0.16)	ND (0.22)
606674	TJAOU-46-GR-06.0.0-EB	NA	**8.32 [P2]**	**0.307 J (1) [P2]**	ND (0.39) [P2]
606677	TJAOU-46-GR-06-0.0-EB	NA	**8.15 [P2]**	ND (0.29) [P2]	ND (0.39) [P2]
606674	TJAOU-46-GR-06.0.0-TB	NA	ND (4.5) [P2]	ND (0.29) [P2]	**0.738 J (1) [P2]**
606677	TJAOU-46-GR-06-0.0-TB	NA	ND (4.5) [P2]	ND (0.29) [P2]	**0.587 J (1) [P2]**

Note: Values in **bold** indicate detected analytes.
[a]General Engineering Laboratories, Inc.
[b]EPA November 1986.
[c]Analysis request/chain-of-custody record.
B1 = Analyte present in trip blank.
B2 = Analyte present in equipment blank.
DU = Duplicate Sample.
EB = Equipment Blank.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab Sample.
ID = Identification.
J ( ) = Estimated value less than the laboratory reporting limit, shown in parentheses.
µg/L = Microgram(s) per liter.
µg/kg = Microgram(s) per kilogram.
NA = Not applicable.
ND ( ) = Not detected above the method detection limit, shown in parentheses.
OU = Operable Unit.
P2 = Insufficient quality control data to determine laboratory precision.
S = Soil Sample.
SWMU = Solid Waste Management Unit.
TB = Trip Blank.
TJA = Tijeras Arroyo.
UX = Secondary (lower) detection limit applied.
VCA = Voluntary Corrective Action.
VOC = Volatile organic compound.

Table C-6
Summary of SWMU 46 Confirmatory Soil Sampling
VOC Analytical Detection Limits
August 2003
(Off-Site Laboratory[a])

Analyte	Method Detection Limit (µg/kg)
Acetone	3.52
Benzene	0.45
Bromodichloromethane	0.49
Bromoform	0.49
Bromomethane	0.5
2-Butanone	3.74
Carbon disulfide	2.36
Carbon tetrachloride	0.49
Chlorobenzene	0.41
Chloroethane	0.81
Chloroform	0.52
Chloromethane	0.37
Dibromochloromethane	0.5
1,1-Dichloroethane	0.47
1,1-Dichloroethene	0.5
1,2-Dichloroethane	0.43
cis-1,2-Dichloroethene	0.47
trans-1,2-Dichloroethene	0.53
1,2-Dichloropropane	0.48
cis-1,3-Dichloropropene	0.43
trans-1,3-Dichloropropene	0.25
Ethyl benzene	0.38
2-Hexanone	3.77
4-Methyl-2-pentanone	4.03
Methylene chloride	1.35
Styrene	0.39
1,1,2,2-Tetrachloroethane	0.91
Tetrachloroethene	0.38
Toluene	0.34
1,1,1-Trichloroethane	0.53
1,1,2-Trichloroethane	0.54
Trichloroethene	0.45
Vinyl acetate	1.78
Vinyl chloride	0.56
Xylene	0.39

[a]General Engineering Laboratories, Inc.
µg/kg = Microgram(s) per kilogram.
SWMU = Solid Waste Management Unit.
VOC = Volatile organic compound.

Table C-7
Summary of SWMU 46 Confirmatory Soil Sampling
SVOC Analytical Results for VCA Samples
August 2003
(Off-Site Laboratory[a])

Sample Attributes			SVOCs (EPA Method SW846 8270[b]) (µg/kg)				
Record Number[c]	ER Sample ID	Sample Depth (ft)	Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b) fluoranthene	Benzo(g,h,i) perylene	Benzo(k) fluoranthene
606675	TJAOU-46-GR-06-2.0-S	2.0	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)
606675	TJAOU-46-GR-07-2.0-S	2.0	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)
606675	TJAOU-46-GR-07-5.0-S	5.0	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)
606675	TJAOU-46-GR-08-1.5-S	1.5	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)
606675	TJAOU-46-GR-09-2.0-S	2.0	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)
606675	TJAOU-46-GR-10-1.3-S	1.3	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)
606675	TJAOU-46-GR-11-1.5-S	1.5	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)
606675	TJAOU-46-GR-12-1.3-S	1.3	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)
606675	TJAOU-46-GR-12-5.0-S	5.0	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)
606676	TJAOU-46-GR-13-1.5-S	1.5	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)
606676	TJAOU-46-GR-14-1.0-S	1.0	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)
606676	TJAOU-46-GR-15-1.0-S	1.0	ND (16.7)	**21.2 J (33.3)**	ND (16.7)	ND (16.7)	ND (16.7)
606676	TJAOU-46-GR-16-0.8-S	0.8	ND (16.7)	**40.8**	**72.7**	**28.2 J (33.3)**	ND (16.7)
606676	TJAOU-46-GR-17-0.7-S	0.7	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)
606676	TJAOU-46-GR-17-0.7-DU	0.7	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)
606676	TJAOU-46-GR-17-5.0-S	5.0	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)
606676	TJAOU-46-GR-18-0.5-S	0.5	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)
606676	TJAOU-46-GR-19-0.5-S	0.5	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)
606677	TJAOU-46-GR-20-2.5-S	2.5	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)
606677	TJAOU-46-GR-21-0.0-S	0.0	**121**	**197**	**300**	**99.7**	**139**
606677	TJAOU-46-GR-22-0.0-S	0.0	**71.4**	**135**	**229**	**63.8**	**79.1**
606677	TJAOU-46-GR-23-0.0-S	0.0	**79.1**	**140**	**202**	**67.6**	**95**
606674	TJAOU-46-GR-24-0.0-S	0.0	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)
606674	TJAOU-46-GR-24-2.0-S	2.0	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)
606674	TJAOU-46-GR-24-5.0-S	5.0	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)
606674	TJAOU-46-GR-24-5.0-DU	5.0	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)
606674	TJAOU-46-GR-25-0.0-S	0.0	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)
606674	TJAOU-46-GR-25-2.0-S	2.0	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)
606674	TJAOU-46-GR-25-5.0-S	5.0	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)
606674	TJAOU-46-GR-25-10.0-S	10.0	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)	ND (16.7)

Refer to footnotes at end of table.

Table C-7 (Continued)
Summary of SWMU 46 Confirmatory Soil Sampling
SVOC Analytical Results for VCA Samples
August 2003
(Off-Site Laboratory[a])

Sample Attributes			SVOCs (EPA Method SW846 8270[b]) (µg/kg)				
Record Number[c]	ER Sample ID	Sample Depth (ft)	Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b) fluoranthene	Benzo(g,h,i) perylene	Benzo(k) fluoranthene
Quality Assurance/Quality Control Samples (µg/L)							
604209	TJAOU-46-GR-EB1	NA	ND (0.1)	ND (0.13)	ND (0.13)	ND (0.08)	ND (0.23)
604211	TJAOU-46-GR-EB2	NA	ND (0.1)	ND (0.13)	ND (0.13)	ND (0.08)	ND (0.23)
606674	TJAOU-46-GR-06.0.0-EB	NA	ND (0.495)	ND (0.495)	ND (0.495)	ND (0.495)	ND (0.495)
606677	TJAOU-46-GR-06-0.0-EB	NA	ND (0.5) [P2]	ND (0.5) [P2]	ND (0.5) [P2]	ND (0.5) [P2]	ND (0.5) [P2]

Refer to footnotes at end of table.

Table C-7 (Continued)
Summary of SWMU 46 Confirmatory Soil Sampling
SVOC Analytical Results for VCA Samples
August 2003
(Off-Site Laboratory[a])

Sample Attributes			SVOCs (EPA Method SW846 8270[b]) (µg/kg)				
Record Number[c]	ER Sample ID	Sample Depth (ft)	Chrysene	Di-n-butyl phthalate	Diethylphthalate	bis(2-Ethylhexyl)phthalate	Fluoranthene
606675	TJAOU-46-GR-06-2.0-S	2.0	ND (16.7)	ND (24)	ND (17.7)	**161 J (333)**	ND (16.7)
606675	TJAOU-46-GR-07-2.0-S	2.0	ND (16.7)	ND (24)	ND (17.7)	**221 J (333)**	ND (16.7)
606675	TJAOU-46-GR-07-5.0-S	5.0	ND (16.7)	ND (24)	ND (17.7)	**118 J (333)**	ND (16.7)
606675	TJAOU-46-GR-08-1.5-S	1.5	ND (16.7)	ND (24)	ND (17.7)	**124 J (333)**	ND (16.7)
606675	TJAOU-46-GR-09-2.0-S	2.0	ND (16.7)	ND (24)	ND (17.7)	**123 J (333)**	ND (16.7)
606675	TJAOU-46-GR-10-1.3-S	1.3	ND (16.7)	ND (24)	**64.5 J (333)**	**136 J (333)**	ND (16.7)
606675	TJAOU-46-GR-11-1.5-S	1.5	ND (16.7)	ND (24)	**83.4 J (333)**	**138 J (333)**	**267 J (33.3)**
606675	TJAOU-46-GR-12-1.3-S	1.3	ND (16.7)	ND (24)	**87.7 J (333)**	**132 J (333)**	ND (16.7)
606675	TJAOU-46-GR-12-5.0-S	5.0	ND (16.7)	ND (24)	**51.1 J (333)**	**119 J (333)**	ND (16.7)
606676	TJAOU-46-GR-13-1.5-S	1.5	ND (16.7)	ND (24)	**56.2J (333)**	**128 J (333)**	ND (16.7)
606676	TJAOU-46-GR-14-1.0-S	1.0	ND (16.7)	ND (24)	**49.8 J (333)**	**202 J (333)**	ND (16.7)
606676	TJAOU-46-GR-15-1.0-S	1.0	ND (16.7)	ND (24)	**49.5 J (333)**	**214 J (333)**	**24.4 J (33.3)**
606676	TJAOU-46-GR-16-0.8-S	0.8	ND (16.7)	ND (24)	**36.7 J (333)**	**125 J (333)**	**48.8**
606676	TJAOU-46-GR-17-0.7-S	0.7	ND (16.7)	ND (24)	**32.9 J (333)**	**131 J (333)**	**20.5 J (33.3)**
606676	TJAOU-46-GR-17-0.7-DU	0.7	ND (16.7)	ND (24)	**46.2 J (333)**	**122 J (333)**	ND (16.7)
606676	TJAOU-46-GR-17-5.0-S	5.0	ND (16.7)	ND (24)	**37.2 J (333)**	**116 J (333)**	ND (16.7)
606676	TJAOU-46-GR-18-0.5-S	0.5	ND (16.7)	ND (24)	**35.5 J (333)**	**117 J (333)**	ND (16.7)
606676	TJAOU-46-GR-19-0.5-S	0.5	ND (16.7)	ND (24)	**31 J (333)**	**119 J (333)**	ND (16.7)
606677	TJAOU-46-GR-20-2.5-S	2.5	ND (16.7)	ND (24)	ND (17.7)	**186 J (333)**	ND (16.7)
606677	TJAOU-46-GR-21-0.0-S	0.0	**220**	**26.2 J (333)**	ND (17.7)	**825**	**237**
606677	TJAOU-46-GR-22-0.0-S	0.0	**147**	ND (24)	ND (17.7)	**92.8 J (333)**	**162**
606677	TJAOU-46-GR-23-0.0-S	0.0	**143**	ND (24)	ND (17.7)	**53.5 J (333)**	**161**
606674	TJAOU-46-GR-24-0.0-S	0.0	ND (16.7)	ND (24)	ND (17.7)	ND (30)	ND (16.7)
606674	TJAOU-46-GR-24-2.0-S	2.0	ND (16.7)	ND (24)	ND (17.7)	ND (30)	ND (16.7)
606674	TJAOU-46-GR-24-5.0-S	5.0	ND (16.7)	ND (24)	ND (17.7)	ND (30)	ND (16.7)
606674	TJAOU-46-GR-24-5.0-DU	5.0	ND (16.7)	ND (24)	ND (17.7)	ND (30)	ND (16.7)
606674	TJAOU-46-GR-25-0.0-S	0.0	ND (16.7)	ND (24)	ND (17.7)	**36.2 J (333)**	ND (16.7)
606674	TJAOU-46-GR-25-2.0-S	2.0	ND (16.7)	ND (24)	ND (17.7)	**31.5 J (333)**	ND (16.7)
606674	TJAOU-46-GR-25-5.0-S	5.0	ND (16.7)	ND (24)	ND (17.7)	ND (30)	ND (16.7)
606674	TJAOU-46-GR-25-10.0-S	10.0	ND (16.7)	ND (24)	ND (17.7)	ND (30)	ND (16.7)

Refer to footnotes at end of table.

Table C-7 (Continued)
Summary of SWMU 46 Confirmatory Soil Sampling
SVOC Analytical Results for VCA Samples
August 2003
(Off-Site Laboratory[a])

Sample Attributes			SVOCs (EPA Method SW846 8270[b]) (µg/kg)				
Record Number[c]	ER Sample ID	Sample Depth (ft)	Chrysene	Di-n-butyl phthalate	Diethylphthalate	bis(2-Ethylhexyl) phthalate	Fluoranthene
Quality Assurance/Quality Control Samples (µg/L)							
604209	TJAOU-46-GR-EB1	NA	ND (0.12)	ND (1.82)	ND (1.23)	ND (0.04)	ND (0.12)
604211	TJAOU-46-GR-EB2	NA	ND (0.12)	ND (1.82)	ND (1.23)	ND (0.04)	ND (0.12)
606677	TJAOU-46-GR-06-0.0-EB	NA	ND (0.5) [P2]	ND (1) [P2]	ND (0.89) [P2]	**2.64 J (10) [B,UX]**	ND (0.5) [P2]
606674	TJAOU-46-GR-06.0.0-EB	NA	ND (0.495)	ND (0.99)	ND (0.881)	ND (1.29)	ND (0.495)

Refer to footnotes at end of table.

Table C-7 (Continued)
Summary of SWMU 46 Confirmatory Soil Sampling
SVOC Analytical Results for VCA Samples
August 2003
(Off-Site Laboratory[a])

Sample Attributes			SVOCs (EPA Method SW846 8270[b]) (µg/kg)			
Record Number[c]	ER Sample ID	Sample Depth (ft)	Fluorene	Indeno(1,2,3-cd)pyrene	Phenanthrene	Pyrene
606675	TJAOU-46-GR-06-2.0-S	2.0	ND (4)	ND (16.7)	ND (16.7)	ND (16.7) [P1,UJ]
606675	TJAOU-46-GR-07-2.0-S	2.0	ND (4)	ND (16.7)	ND (16.7)	ND (16.7) [P1,UJ]
606675	TJAOU-46-GR-07-5.0-S	5.0	ND (4)	ND (16.7)	ND (16.7)	ND (16.7) [P1,UJ]
606675	TJAOU-46-GR-08-1.5-S	1.5	ND (4)	ND (16.7)	ND (16.7)	ND (16.7) [P1,UJ]
606675	TJAOU-46-GR-09-2.0-S	2.0	ND (4)	ND (16.7)	ND (16.7)	ND (16.7) [P1,UJ]
606675	TJAOU-46-GR-10-1.3-S	1.3	ND (4)	ND (16.7)	ND (16.7)	ND (16.7) [P1,UJ]
606675	TJAOU-46-GR-11-1.5-S	1.5	ND (4)	ND (16.7)	ND (16.7)	**24.4 J (33.3) [J,P1]**
606675	TJAOU-46-GR-12-1.3-S	1.3	ND (4)	ND (16.7)	ND (16.7)	ND (16.7) [P1,UJ]
606675	TJAOU-46-GR-12-5.0-S	5.0	ND (4)	ND (16.7)	ND (16.7)	ND (16.7) [P1,UJ]
606676	TJAOU-46-GR-13-1.5-S	1.5	ND (4)	ND (16.7)	ND (16.7)	ND (16.7) [P1,UJ]
606676	TJAOU-46-GR-14-1.0-S	1.0	ND (4)	ND (16.7)	ND (16.7)	**17.9 J (33.3) [J,P1]**
606676	TJAOU-46-GR-15-1.0-S	1.0	ND (4)	ND (16.7)	ND (16.7)	**22 J (33.3) [J,P1]**
606676	TJAOU-46-GR-16-0.8-S	0.8	ND (4)	**22.4 J (33.3)**	**16.8 J (33.3)**	**52.8[J,P1]**
606676	TJAOU-46-GR-17-0.7-S	0.7	ND (4)	ND (16.7)	ND (16.7)	**19.7 J (33.3) [J,P1]**
606676	TJAOU-46-GR-17-0.7-DU	0.7	ND (4)	ND (16.7)	ND (16.7)	ND (16.7) [P1,UJ]
606676	TJAOU-46-GR-17-5.0-S	5.0	ND (4)	ND (16.7)	ND (16.7)	ND (16.7) [P1,UJ]
606676	TJAOU-46-GR-18-0.5-S	0.5	ND (4)	ND (16.7)	ND (16.7)	ND (16.7) [P1,UJ]
606676	TJAOU-46-GR-19-0.5-S	0.5	ND (4)	ND (16.7)	ND (16.7)	ND (16.7) [P1,UJ]
606677	TJAOU-46-GR-20-2.5-S	2.5	ND (4)	ND (16.7)	ND (16.7)	ND (16.7)
606677	TJAOU-46-GR-21-0.0-S	0.0	ND (4)	**90.9**	**81.8**	**213**
606677	TJAOU-46-GR-22-0.0-S	0.0	ND (4)	**58.8**	**51.7**	**149**
606677	TJAOU-46-GR-23-0.0-S	0.0	**4.79 J (33.3)**	**63.8**	**66.2**	**147**
606674	TJAOU-46-GR-24-0.0-S	0.0	ND (4)	ND (16.7)	ND (16.7)	ND (16.7)
606674	TJAOU-46-GR-24-2.0-S	2.0	ND (4)	ND (16.7)	ND (16.7)	ND (16.7)
606674	TJAOU-46-GR-24-5.0-S	5.0	ND (4)	ND (16.7)	ND (16.7)	ND (16.7)
606674	TJAOU-46-GR-24-5.0-DU	5.0	ND (4)	ND (16.7)	ND (16.7)	ND (16.7)
606674	TJAOU-46-GR-25-0.0-S	0.0	ND (4)	ND (16.7)	ND (16.7)	ND (16.7)
606674	TJAOU-46-GR-25-10.0-S	10.0	ND (4)	ND (16.7)	ND (16.7)	ND (16.7)
606674	TJAOU-46-GR-25-2.0-S	2.0	ND (4)	ND (16.7)	ND (16.7)	ND (16.7)
606674	TJAOU-46-GR-25-5.0-S	5.0	ND (4)	ND (16.7)	ND (16.7)	ND (16.7)

Refer to footnotes at end of table.

Table C-7 (Concluded)
Summary of SWMU 46 Confirmatory Soil Sampling
SVOC Analytical Results for VCA Samples
August 2003
(Off-Site Laboratory[a])

Sample Attributes			SVOCs (EPA Method SW846 8270[b]) (µg/kg)			
Record Number[c]	ER Sample ID	Sample Depth (ft)	Fluorene	Indeno(1,2,3-cd)pyrene	Phenanthrene	Pyrene
Quality Assurance/Quality Control Samples (µg/L)						
604209	TJAOU-46-GR-EB1	NA	ND (0.12)	ND (0.1)	ND (0.12)	ND (0.14)
604211	TJAOU-46-GR-EB2	NA	ND (0.12)	ND (0.1)	ND (0.12)	ND (0.14)
606674	TJAOU-46-GR-06.0.0-EB	NA	ND (0.495)	ND (0.495)	ND (0.495)	ND (0.495)
606677	TJAOU-46-GR-06-0.0-EB	NA	ND (0.5) [P2]	ND (0.5) [P2]	ND (0.5) [P2]	ND (0.5) [P2]

Note: Values in **bold** represent detected analytes.
[a]General Engineering Laboratories, Inc.
[b]EPA November 1986.
[c]Analysis request/chain-of-custody record.
B = Analyte present in laboratory method blank.
DU = Duplicate Sample.
EB = Equipment Blank.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
GR = Grab Sample.
ft = Foot (feet).
ID = Identification.
J ( ) = Estimated value less than the laboratory reporting limit, shown in parentheses.
[J] = The associated value is an estimated quantity.
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.
OU = Operable Unit.
P1 = Laboratory precision measurements for the matrix spike sample and associated duplicate do not meet acceptance criteria.
P2 = Insufficient quality control data to determine laboratory precision.
S = Soil Sample.
SVOC = Semivolatile organic compound.
SWMU = Solid Waste Management Unit.
TJA = Tijeras Arroyo.
UJ = The analyte was analyzed for but was not detected. The associated value is an estimate and may be inaccurate or imprecise.
UX = Secondary (lower) detection limit applied.
VCA = Voluntary Corrective Action.

Table C-8
Summary of SWMU 46 Confirmatory Soil Sampling
SVOC Analytical Detection Limits
August 2003
(Off-Site Laboratory[a])

Analyte	Method Detection Limit (µg/kg)
Acenaphthene	8
Acenaphthylene	16.7
Anthracene	16.7
Benzo(a)anthracene	16.7
Benzo(a)pyrene	16.7
Benzo(b)fluoranthene	16.7
Benzo(g,h,i)perylene	16.7
Benzo(k)fluoranthene	16.7
4-Bromophenyl phenyl ether	34
Butylbenzyl phthalate	28.7
Carbazole	16.7
4-Chloro-3-methylphenol	167
4-Chlorobenzenamine	167
bis(2-Chloroethoxy)methane	12.3
bis(2-Chloroethyl)ether	37.3
bis-Chloroisopropyl ether	11
2-Chloronaphthalene	13.7
2-Chlorophenol	15.3
4-Chlorophenyl phenyl ether	19.7
Chrysene	16.7
m-,p-Cresol	33.3
o-Cresol	26
Di-n-butyl phthalate	24
Di-n-octyl phthalate	30.3
Dibenz[a,h]anthracene	16.7
Dibenzofuran	17
1,2-Dichlorobenzene	10
1,3-Dichlorobenzene	11.3
1,4-Dichlorobenzene	15.7
3,3'-Dichlorobenzidine	167
2,4-Dichlorophenol	20.7
Diethylphthalate	17.7
2,4-Dimethylphenol	167
Dimethylphthalate	18.3
Dinitro-o-cresol	167
2,4-Dinitrophenol	167
2,4-Dinitrotoluene	25.3
2,6-Dinitrotoluene	33.3
Diphenyl amine	22.3
bis(2-Ethylhexyl)phthalate	30
Fluoranthene	16.7
Fluorene	4
Hexachlorobenzene	20

Refer to footnotes at end of table.

Table C-8 (Concluded)
Summary of SWMU 46 Confirmatory Soil Sampling
SVOC Analytical Detection Limits
August 2003
(Off-Site Laboratory[a])

Analyte	Method Detection Limit (µg/kg)
Hexachlorobutadiene	12.7
Hexachlorocyclopentadiene	167
Hexachloroethane	22
Indeno(1,2,3-cd)pyrene	16.7
Isophorone	16
2-Methylnaphthalene	16.7
Naphthalene	16.7
2-Nitroaniline	167
3-Nitroaniline	167
4-Nitroaniline	37
Nitrobenzene	20.3
2-Nitrophenol	17
4-Nitrophenol	167
n-Nitrosodipropylamine	22.7
Pentachlorophenol	167
Phenanthrene	16.7
Phenol	12.7
Pyrene	16.7
1,2,4-Trichlorobenzene	12.7
2,4,5-Trichlorophenol	17.3
2,4,6-Trichlorophenol	27.3

[a]General Engineering Laboratories, Inc.
µg/kg = Microgram(s) per kilogram.
SVOC = Semivolatile organic compound.
SWMU = Solid Waste Management Unit.

ATTACHMENT D
Summary of Analytical Results for Characterization Soil Samples from SWMU 46 Deep Boreholes

LIST OF TABLES

Table D-1
Summary of SWMU 46 Characterization Soil Sampling
Metals Analytical Results for Deep Boreholes
January–March 2001
(Off-Site Laboratory[a])

Sample Attributes			Metals (EPA Methods SW846 3005/SW846 3050/SW846 7196/SW846 7470/ SW846 7471[b]) (mg/kg)				
Record Number[c]	ER Sample ID	Sample Depth (ft)	Antimony	Arsenic	Barium	Beryllium	Cadmium
604191	TJA-6-BH-45-S	45	ND (0.237)	2.75	139	**0.891**	**0.205 J (0.463)**
604193	TJA-6-BH-145-S	145	ND (0.237) [A2,B3,UJ]	2.66 [J]	86.3 [A2,J]	0.418 J (0.485)	ND (0.013)
604193	TJA-6-BH-145-DU	145	ND (0.237) [A2,B3,UJ]	2.18 [J]	83 [A2,J]	0.427 J (0.481)	ND (0.013)
604198	TJAOU-46-VW-01-45-S	45	ND (0.237) [A2,UJ]	2.24	70.3	0.465	0.167 J (0.459)
604201	TJAOU-46-VW-01-145-S	145	ND (0.237) [A2,UJ]	2.8	97.5	0.456 J (0.467)	**0.976**
Background Concentration[d] (surface/subsurface)[e]			3.9/3.9	5.6/4.4	200/200	0.8/0.8	<1/0.9
Quality Assurance/Quality Control Samples (mg/L)							
604196	TJA-6-BH-EB1	NA	ND (0.0038)	ND (0.00457)	0.00277 J (0.005)	ND (0.0002)	0.00115 J (0.005)
604207	TJAOU-46-VW-01-EB1	NA	ND (0.0038)	ND (0.00457)	0.00032 J (0.005) [B,B3,J]	ND (0.0002)	ND (0.00025)

Record Number[c]	ER Sample ID	Sample Depth (ft)	Chromium	Chromium (VI)	Cobalt	Copper	Iron
604191	TJA-6-BH-45-S	45	9.39	0.14 J (0.2)	4.62	9.02	9,870
604193	TJA-6-BH-145-S	145	8.72	0.07 J (0.2)	6.23	9.61	16,100
604193	TJA-6-BH-145-DU	145	10.3	0.09 J (0.2)	5.46	10.9	16,100
604198	TJAOU-46-VW-01-45-S	45	8.56	0.133 J (0.2)	4.79	9.13	13,400
604201	TJAOU-46-VW-01-145-S	145	**18.5**	0.262	4.71	12.9	13,400
Background Concentration[d] (surface/subsurface)[e]			17.3/12.8	NC/NC	7.1/8.8	17/17	NC
Quality Assurance/Quality Control Samples (mg/L)							
604196	TJA-6-BH-EB1	NA	0.0015 J (0.005)	ND (0.005)	ND (0.0003)	ND (0.00267)	0.422
604207	TJAOU-46-VW-01-EB1	NA	ND (0.00078)	ND (0.005) [HT,UJ]	ND (0.0003)	ND (0.00267) [B3,UJ]	0.0219 J (0.05) [B3,J]

Refer to footnotes at end of table.

Table D-1 (Continued)
Summary of SWMU 46 Characterization Soil Sampling
Metals Analytical Results for Deep Boreholes
January–March 2001
(Off-Site Laboratory[a])

Sample Attributes			Metals (EPA Methods SW846 3005/SW846 3050/SW846 7196/SW846 7470/ SW846 7471[b]) (mg/kg)			
Record Number[c]	ER Sample ID	Sample Depth (ft)	Lead	Mercury	Nickel	Selenium
604191	TJA-6-BH-45-S	45	10.2	0.00642 J (0.009)	9.9	ND (0.135)
604193	TJA-6-BH-145-S	145	4.42	ND (0.00455) [B3,UJ]	7.49	**1.25**
604193	TJA-6-BH-145-DU	145	4.46	ND (0.00455) [B3,UJ]	8.5	**1.28**
604198	TJAOU-46-VW-01-45-S	45	5.76	0.0221 [B3,J]	6.93	ND (0.135)
604201	TJAOU-46-VW-01-145-S	145	6.13	0.021 [B3,J]	11.7	ND (0.135)
Background Concentration[d] (surface/subsurface)[e]			39/11.2	<0.25/<0.1	25.4/25.4	<1/<1
Quality Assurance/Quality Control Samples (mg/L)						
604196	TJA-6-BH-EB1	NA	ND (0.00344)	ND (0.00007) [B3,UJ]	ND (0.00074) [B3,UJ]	ND (0.00309)
604207	TJAOU-46-VW-01-EB1	NA	ND (0.00344) [B3,UJ]	ND (0.00007) [B3,UJ]	0.00077 J (0.005)	ND (0.00309)

Refer to footnotes at end of table.

Table D-1 (Concluded)
Summary of SWMU 46 Characterization Soil Sampling
Metals Analytical Results for Deep Boreholes
January–March 2001
(Off-Site Laboratory[a])

Sample Attributes			Metals (EPA Methods SW846 3005/SW846 3050/SW846 7196/SW846 7470/ SW846 7471[b]) (mg/kg)			
Record Number[c]	ER Sample ID	Sample Depth (ft)	Silver	Thallium	Vanadium	Zinc
604191	TJA-6-BH-45-S	45	ND (0.0578)	ND (0.472)	15.9	63.9
604193	TJA-6-BH-145-S	145	ND (0.0578)	**2.16**	25.3	32.6
604193	TJA-6-BH-145-DU	145	ND (0.0578)	**1.89**	27.4	33.9
604198	TJAOU-46-VW-01-45-S	45	ND (0.0578)	ND (0.472)	27.3	31.2
604201	TJAOU-46-VW-01-145-S	145	ND (0.0578)	**2.19**	24	32.1
Background Concentration[d] (surface/subsurface)[e]			<1/<1	<1.1/<1.1	33/33	76/76
Quality Assurance/Quality Control Samples (mg/L)						
604196	TJA-6-BH-EB1	NA	ND (0.0002)	0.00493 J (0.01)	ND (0.00109)	0.00959 [B3,J]
604207	TJAOU-46-VW-01-EB1	NA	ND (0.0002)	ND (0.00413)	ND (0.00109)	0.00589 [B,J]

Note: Values in **bold** indicate concentrations greater than background.
[a]General Engineering Laboratories, Inc.
[b]EPA November 1986.
[c]Analysis request/chain-of-custody record.
[d]Dinwiddie September 1997.
[e]Surface samples defined as 0 to 6 inches; subsurface samples are greater than 6 inches.

A2 = Laboratory accuracy and/or bias measurements for the associated matrix spike and/or duplicate do not meet acceptance criteria.
B = Analyte present in laboratory method blank.
B3 = Analyte present in calibration blank.
BH = Borehole.
DU = Duplicate Sample.
EB = Equipment Blank.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
HT = The holding time was exceeded for the associated sample analysis.
ID = Identification.
J ( ) = Estimated value less than the laboratory reporting limit, shown in parentheses.
[J] = The associated value is an estimated quantity.
mg/kg = Milligram(s) per kilogram.
mg/L = Milligram(s) per liter.
NA = Not applicable.
NC = Not calculated by Dinwiddie (September 1997).
ND ( ) = Not detected above the method detection limit, shown in parentheses.
OU = Operable Unit.
S = Soil Sample.
SWMU = Solid Waste Management Unit.
TJA = Tijeras Arroyo.
UJ = The analyte was analyzed for but was not detected. The associated value is an estimate and may be inaccurate or imprecise.
VW = Vapor Well.

Table D-2
Summary of SWMU 46 Characterization Soil Sampling
Metals Analytical Detection Limits
January–March 2001
(Off-Site Laboratory[a])

Analyte	Method Detection Limit (mg/kg)
Aluminum	1.07
Antimony	0.237
Arsenic	0.137
Barium	0.0148
Beryllium	0.00767
Cadmium	0.013
Calcium	1.94
Chromium	0.218
Chromium (VI)	0.007
Cobalt	0.0545
Copper	0.0251
Iron	1.96
Lead	0.17
Magnesium	0.308
Manganese	0.0239
Mercury	0.00455
Nickel	0.0995
Potassium	0.866
Selenium	0.135
Silver	0.0578
Sodium	1.25
Thallium	0.472
Vanadium	0.0594
Zinc	0.13

[a]General Engineering Laboratories, Inc.
mg/kg = Milligram(s) per kilogram.
SWMU = Solid Waste Management Unit.

Table D-3
Summary of SWMU 46 Characterization Soil Sampling
PCB Analytical Detection Limits
January–March 2001
(Off-Site Laboratory[a])

Analyte	Method Detection Limit (µg/kg)
Aroclor-1016	0.782
Aroclor-1221	2.79
Aroclor-1232	0.719
Aroclor-1242	1.65
Aroclor-1248	0.898
Aroclor-1254	1.36
Aroclor-1260	1.42

[a]General Engineering Laboratories, Inc.
µg/kg = Microgram(s) per kilogram.
PCB = Polychlorinated biphenyl.
SWMU = Solid Waste Management Unit.

Table D-4
Summary of SWMU 46 Characterization Soil Sampling
VOC Analytical Results for Deep Boreholes
January—March 2001
(Off-Site Laboratory[a])

Sample Attributes			VOCs (EPA Method SW846 8260[b]) (µg/kg)				
Record Number[c]	ER Sample ID	Sample Depth (ft)	Acetone	2-Butanone	Dibromochloromethane	Methylene Chloride	Toluene
604191	TJA-6-BH-45-S	45	**13.2**	ND (0.76)	ND (0.41)	**3.85 J (5)**	ND (0.5)
604191	TJA-6-BH-45-S	45	ND (0.82)	ND (0.81)	ND (0.16)	ND (0.63)	ND (0.22)
604193	TJA-6-BH-95-S	95	**10.7**	**56.9[J]**	ND (0.41)	**5.73[B1,UX]**	**0.998 J (2.13)**
604194	TJA-6-BH-95-S	95	**2.46 J (5) [J]**	**3.21 J (5) [J]**	ND (0.41)	ND (0.44)	ND (0.5)
604193	TJA-6-BH-145-S	145	**3.91 J (5)**	**10.9[J]**	ND (0.41)	**3.03 J (5) [B1,UX]**	ND (0.5)
604194	TJA-6-BH-245-S	245	**3.4 J (5.21)**	**3.89 J (5.21) [J]**	ND (0.41)	**3.28 J (5.21)**	ND (0.5)
604198	TJAOU-46-VW-01-45-S	45	**1.39 J (4.9) [B,UX]**	**4.25 J (4.9)**	ND (0.41)	**1.22 J (4.9) [B,UX]**	ND (0.5)
604198	TJAOU-46-VW-01-95-S	95	ND (1)	**2.32 J (5)**	ND (0.41)	**1.06 J (5) [B,UX]**	ND (0.5)
604201	TJAOU-46-VW-01-145-S	145	**2.6 J (5.1) [B,UX]**	**4.42 J (5.1)**	ND (0.41)	**0.593 J (5.1) [B,UX]**	ND (0.5)
604201	TJAOU-46-VW-01-195-S	195	ND (1)	ND (0.76)	ND (0.41)	**0.65 J (5) [B,UX]**	ND (0.5)
604201	TJAOU-46-VW-01-245-S	245	**3.85 J (4.81) [B,UX]**	**28.5**	ND (0.41)	**0.886 J (4.81) [B,UX]**	ND (0.5)
604203	TJAOU-46-VW-01-295-DU	295	**4.74 J (5) [B,UX]**	ND (0.76)	ND (0.41)	**0.923 J (5) [B,UX]**	ND (0.5)
604203	TJAOU-46-VW-01-295-S	295	**1.61 J (4.81) [B,UX]**	ND (0.76)	ND (0.41)	**1.3 J (4.81) [B,UX]**	ND (0.5)
Quality Assurance/Quality Control Samples (µg/L)							
604196	TJA-6-BH-EB1	NA	**2.66 J (5)**	ND (0.81)	ND (0.16)	**1.07 J (5)**	**0.337 J (1) [B,UX]**
604196	TJA-6-BH-TB	NA	ND (0.82)	ND (0.81)	ND (0.16)	ND (0.63)	**0.332 J (1) [B,UX]**
604193	TJA-6-BH-145-TB	NA	ND (0.82)	ND (0.81)	ND (0.16)	**1.03 J (5)**	ND (0.22)
604194	TJA-6-BH-245-TB	NA	ND (0.82)	ND (0.81)	ND (0.16)	ND (0.63)	**0.313 J (1) [B,UX]**
604207	TJAOU-46-VW-01-EB1	NA	**2.02 J (5)**	ND (0.81)	**0.393 J (1)**	ND (0.63)	ND (0.22)
604207	TJAOU-46-VW-01-EB1	NA	ND (0.82)	ND (0.81)	ND (0.16)	ND (0.63)	ND (0.22)
604198	TJAOU-46-VW-01-TB	NA	**1.59 J (5)**	ND (0.81)	ND (0.16)	ND (0.63)	ND (0.22)
604203	TJAOU-46-VW-01-295-TB	NA	ND (0.82)	ND (0.81)	ND (0.16)	ND (0.63)	ND (0.22)

Note: Values in **bold** represent detected analytes.
[a]General Engineering Laboratories, Inc.
[b]EPA November 1986.
[c]Analysis request/chain-of-custody record.

B = Analyte present in laboratory method blank.
B1 = Analyte present in trip blank.
BH = Borehole.
DU = Duplicate Sample.
EB = Equipment Blank.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
ID = Identification.
J ( ) = Estimated value less than the laboratory reporting limit, shown in parentheses.
[J] = The associated value is an estimated quantity.
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.
OU = Operable Unit.
S = Soil Sample.
SWMU = Solid Waste Management Unit.
TB = Trip Blank.
TJA = Tijeras Arroyo.
UX = Secondary (lower) detection limit applied.
VOC = Volatile organic compound.
VW = Vapor Well.

Table D-5
Summary of SWMU 46 Characterization Soil Sampling
VOC Analytical Detection Limits
January–March 2001
(Off-Site Laboratory[a])

Analyte	Method Detection Limit (µg/kg)
Acetone	1.0
Benzene	0.39
Bromodichloromethane	0.35
Bromoform	0.36
Bromomethane	0.31
2-Butanone	0.76
Carbon disulfide	0.62
Carbon tetrachloride	0.26
Chlorobenzene	0.4
Chloroethane	0.28
Chloroform	0.47
Chloromethane	0.35
Dibromochloromethane	0.41
1,1-Dichloroethane	0.41
1,2-Dichloroethane	0.27
1,1-Dichloroethene	0.262
cis-1,2-Dichloroethene	0.41
trans-1,2-Dichloroethene	0.37
1,2-Dichloropropane	0.32
cis-1,3-Dichloropropene	0.28
trans-1,3-Dichloropropene	0.24
Ethyl benzene	0.35
2-Hexanone	0.94
4-Methyl-2-pentanone	1.34
Methylene chloride	0.44
Styrene	0.32
1,1,1-Trichloroethane	0.29
1,1,2-Trichloroethane	0.36
1,1,2,2-Tetrachloroethane	0.3
Tetrachloroethene	0.4
Toluene	0.5
Trichloroethene	0.72
Vinyl acetate	0.77
Vinyl chloride	0.3
Xylene	1.05

[a]General Engineering Laboratories, Inc.
µg/kg = Microgram(s) per kilogram.
VOC = Volatile organic compound.
SWMU = Solid Waste Management Unit.

Table D-6
Summary of SWMU 46 Characterization Soil Sampling
SVOC Analytical Results for Deep Boreholes
January–March 2001
(Off-Site Laboratory[a])

Sample Attributes			SVOCs (EPA Method SW846 8270[b]) (µg/kg)	
Record Number[c]	ER Sample ID	Sample Depth (ft)	bis(2-Ethylhexyl)phthalate	Phenol
604191	TJA-6-BH-45-S	45	ND (6.99)	ND (3.66)
604193	TJA-6-BH-145-S	145	**1,070 [J]**	ND (3.66)
604193	TJA-6-BH-145-DU	145	**535 [J]**	ND (3.66)
604198	TJAOU-46-VW-01-45-S	45	**235 [B,UX]**	ND (3.66)
604201	TJAOU-46-VW-01-145-S	145	**627**	**6.69 J (333)**
Quality Assurance/Quality Control Samples (µg/L)				
604196	TJA-6-BH-EB1	NA	ND (0.04)	ND (0.84)
604207	TJAOU-46-VW-01-EB1	NA	ND (0.04)	ND (0.84)

Note: Values in **bold** indicate detected analytes.
[a]General Engineering Laboratories, Inc.
[b]EPA November 1986.
[c]Analysis request/chain-of-custody record.
B = Analyte present in laboratory method blank.
BH = Borehole.
DU = Duplicate Sample.
EB = Equipment Blank.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
ID = Identification.
J ( ) = Estimated value less than the laboratory reporting limit, shown in parentheses.
[J] = The associated value is an estimated quantity.
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.
OU = Operable Unit.
S = Soil Sample.
SVOC = Semivolatile organic compound.
SWMU = Solid Waste Management Unit.
TJA = Tijeras Arroyo.
UX = Secondary (lower) detection limit applied.
VW = Vapor Well.

Table D-7
Summary of SWMU 46 Characterization Soil Sampling
SVOC Analytical Detection Limits
January–March 2001
(Off-Site Laboratory[a])

Analyte	Method Detection Limit (µg/kg)
Acenaphthene	4.0
Acenaphthylene	3.66
Anthracene	4.66
Benzo(a)anthracene	5.99
Benzo(a)pyrene	2.0
Benzo(b)fluoranthene	2.33
Benzo(g,h,i)perylene	5.0
Benzo(k)fluoranthene	5.0
4-Bromophenyl phenyl ether	4.66
Butylbenzyl phthalate	12.7
Carbazole	5.0
4-Chloro-3-methylphenol	36.6
4-Chlorobenzenamine	58.9
bis(2-Chloroethoxy)methane	5.99
bis(2-Chloroethyl)ether	6.66
bis-Chloroisopropyl ether	37.1
2-Chloronaphthalene	34.0
2-Chlorophenol	5.0
4-Chlorophenyl phenyl ether	3.33
Chrysene	6.33
o-Cresol	47.6
p-Cresol	5.66
Di-n-butyl phthalate	20.6
Di-n-octyl phthalate	8.99
Dibenz[a,h]anthracene	2.66
Dibenzofuran	2.66
1,2-Dichlorobenzene	4.33
1,3-Dichlorobenzene	3.33
1,4-Dichlorobenzene	5.99
3,3'-Dichlorobenzidine	143.0
2,4-Dichlorophenol	7.99
Diethylphthalate	19.6
2,4-Dimethylphenol	71.9
Dimethylphthalate	11.7
Dinitro-o-cresol	16.0
2,4-Dinitrophenol	15.0
2,4-Dinitrotoluene	5.0
2,6-Dinitrotoluene	3.0
Diphenylamine	15.7
bis(2-Ethylhexyl)phthalate	6.99
Fluoranthene	3.33
Fluorene	3.0
Hexachlorobenzene	4.66

Refer to footnotes at end of table.

Table D-7 (Concluded)
Summary of SWMU 46 Characterization Soil Sampling
SVOC Analytical Detection Limits
January–March 2001
(Off-Site Laboratory[a])

Analyte	Method Detection Limit (µg/kg)
Hexachlorobutadiene	6.66
Hexachlorocyclopentadiene	33.0
Hexachloroethane	4.33
Indeno(1,2,3-cd)pyrene	6.66
Isophorone	2.33
2-Methylnaphthalene	4.0
Naphthalene	3.33
2-Nitroaniline	80.9
3-Nitroaniline	86.6
4-Nitroaniline	83.9
Nitrobenzene	36.6
2-Nitrophenol	46.3
4-Nitrophenol	21.0
n-Nitrosodipropylamine	33.0
Pentachlorophenol	60.9
Phenanthrene	4.0
Phenol	3.66
Pyrene	8.66
1,2,4-Trichlorobenzene	4.66
2,4,5-Trichlorophenol	42.3
2,4,6-Trichlorophenol	24.6

[a]General Engineering Laboratories, Inc.
µg/kg = Microgram(s) per kilogram.
SVOC = Semivolatile organic compound.
SWMU = Solid Waste Management Unit.

Table D-8
Summary of SWMU 46 Characterization Soil Sampling
HE Compounds Analytical Detection Limits
January–March 2001
(Off-Site Laboratory[a])

Analyte	Method Detection Limit (µg/kg)
2-Amino-4,6-dinitrotoluene	13.4
4-Amino-2,6-dinitrotoluene	10.1
1,3-Dinitrobenzene	13.4
2,4-Dinitrotoluene	12.0
2,6-Dinitrotoluene	15.7
HMX	16.8
2-Nitrotoluene	15.2
3-Nitrotoluene	11.6
4-Nitrotoluene	11.6
Nitrobenzene	14.0
RDX	12.5
Tetryl	15.5
1,3,5-Trinitrobenzene	11.9
2,4,6-Trinitrotoluene	14.1

[a]General Engineering Laboratories, Inc.
HE = High Explosive(s).
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine.
µg/kg = Microgram(s) per kilogram.
RDX = Hexahydro-1,3,5-trinitro,1,3,5-triazine.
Tetryl = 2,4,6-Trinitrophenylmethylnitramine.
SWMU = Solid Waste Management Unit.

Table D-9
Summary of SWMU 46 Characterization Soil Sampling
Gamma Spectroscopy Analytical Results for Deep Boreholes
January–March 2001
(On-[a] and Off-Site[b] Laboratories)

Sample Attributes			Activity (pCi/g)									
			Cesium-137		Lead-212		Thorium-232		Uranium-235		Uranium-238	
Record Number[c]	ER Sample ID	Sample Depth (ft)	Result	Error[d]	Result	Error[d]	Result	Error[d]	Result	Error[d]	Result	Error[d]
604190	TJA-6-BH-45-S	45	ND (0.0685)	--	1.63	0.239	**1.91**	0.897	**ND (0.316)**	--	ND (0.946)	--
604191	TJA-6-BH-45-S	45	NR	--	NR	--	NR	--	NR	--	0.742	0.159
604197	TJAOU-46-VW-01-145-S	145	ND (0.0232)	--	0.561	0.529	0.459	0.228	ND (0.165)	--	ND (0.562)	--
604201	TJAOU-46-VW-01-145-S	145	NR	--	NR	--	NR	--	NR	--	0.645	0.138
604197	TJAOU-46-VW-01-45-S	45	ND (0.0264)	--	0.836	0.345	0.871	0.413	**ND (0.187)**	--	ND (0.644)	--
604198	TJAOU-46-VW-01-45-S	145	NR	--	NR	--	NR	--	NR	--	0.614	0.132
Background Concentration[e] (surface/subsurface)[f]			0.836/0.084	NA	NC	NA	1.54/1.54	NA	0.18/0.18	NA	1.3/1.3	NA
Quality Assurance/Quality Control Samples (pCi/L)												
604195	TJA-6-BH-EB1	NA	ND (0.022)	--	ND (0.039)	--	ND (0.156)	--	ND (0.145)	--	ND (0.376)	--
604196	TJA-6-BH-EB1	NA	NR	--	NR	--	NR	--	NR	--	0.077 U	0.0231
604207	TJAOU-46-VW-01-EB1	NA	NR	--	NR	--	NR	--	NR	--	0.0155 U	0.0124

Note: Values in **bold** indicate concentrations or method detection limits greater than background.
[a]Sandia National Laboratories/New Mexico Radiation Protection Sample Diagnostics Laboratory performed analyses for Record Numbers 604190, 604195, and 604197 (gamma spectroscopy by EPA Method 901.1) (EPA November 1986).
[b]General Engineering Laboratories, Inc. performed analyses for Record Numbers 604191, 604196, 604198, 604201, 604207 (gamma spectroscopy by HASL 300).
[c]Two standard deviations about the mean detected activity.
[d]Analysis request/chain-of-custody record.
[e]Dinwiddie September 1997.
[f]Surface samples defined as 0 to 6 inches; subsurface samples are greater than 6 inches.

BH = Borehole.
EB = Equipment Blank.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
HASL = Health and Safety Lab Method.
ID = Identification.
NA = Not applicable.
NC = Not calculated by Dinwiddie (September 1997).
ND ( ) = Not detected above the method detection limit, shown in parentheses.
NR = Not reported.
OU = Operable Unit.
pCi/g = Picocurie(s) per gram.
pCi/L = Picocurie(s) per liter.
S = Soil Sample.
SWMU = Solid Waste Management Unit.
TJA = Tijeras Arroyo.
U = The analyte was analyzed for but was not detected.
VW = Vapor Well.
-- = Error not calculated for nondetect or not reported results.

Table D-10
Summary of SWMU 46 Characterization Soil Sampling
Tritium Analytical Results for Deep Boreholes
January–March 2001
(Off-Site Laboratory[a])

Sample Attributes			Tritium Activity (EPA Method 906.0[b]) (pCi/L)	
Record Number[c]	ER Sample ID	Sample Depth (ft)	Result	Error[d]
604198	TJAOU-46-VW-01-45-S	45	140	145
604201	TJAOU-46-VW-01-145-S	145	ND (70.7)	--
Background Activity[e] (surface/subsurface)[f]			420	NA
Quality Assurance/Quality Control Sample (pCi/g)				
604207	TJAOU-46-VW-01-EB1	NA	54.4	90.7

[a]General Engineering Laboratories, Inc..
[b]EPA November 1986.
[c]Analysis request/chain-of-custody record.
[d]Two standard deviations about the mean detected activity.
[e]Tharp (February 1999).
[f]Surface samples defined as 0 to 6 inches; subsurface samples are greater than 6 inches.
EB = Equipment Blank.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
ID = Identification.
NA = Not applicable.
ND ( ) = Not detected above the minimum detectable activity, shown in parentheses.
OU = Operable Unit.
pCi/g = Picocurie(s) per gram.
pCi/L = Picocurie(s) per liter.
S = Soil Sample.
SWMU = Solid Waste Management Unit.
TJA = Tijeras Arroyo.
VW = Vapor Well.
-- = Information not available.

ATTACHMENT E
Summary of Analytical Results for Characterization Soil Samples from SWMU 234 Applicable to SWMU 46

LIST OF TABLES

Table E-1
Summary of SWMU 234 Characterization Soil Sampling
Metals Analytical Results Relevant to SWMU 46
June 2001
(Off-Site Laboratory[a])

Sample Attributes			Metals (EPA Methods 3005/3050/7196/7470/7471[b]) (mg/kg)				
Record Number[c]	ER Sample ID	Sample Depth (ft)	Arsenic	Barium	Beryllium	Cadmium	Chromium
604316	TJAOU-234-GR-07-0.0-S	0.0	3.99	146	0.479 J (0.495)	0.536	12.5
604316	TJAOU-234-GR-07-0.0-DU	0.0	4.41	155	0.496	0.665	**17.7**
604316	TJAOU-234-GR-07-5.0-S	5.0	3.19	115	0.339 J (0.49)	0.437 J (0.49)	10.7
604316	TJAOU-234-GR-08-5.0-S	5.0	2.34	63.1	0.4 J (0.455)	0.151 J (0.455)	7.5
Background Concentration[d] (surface/subsurface)[e]			5.6/4.4	200/200	0.8/0.8	<1/0.9	17.3/12.8
Quality Assurance/Quality Control Sample (mg/L)							
604569	TJAOU-234-GR-EB1	NA	ND (0.00457)	0.00084 J (0.005)	ND (0.0002)	ND (0.00025 J)	ND (0.00078)

Sample Attributes			Metals (EPA Methods 3005/3050/7196/7470/7471[b]) (mg/kg)				
Record Number[c]	ER Sample ID	Sample Depth (ft)	Chromium (VI)	Lead	Mercury	Selenium	Silver
604316	TJAOU-234-GR-07-0.0-S	0.0	2.08	10.1	0.0603	ND (0.135)	0.139 J (0.495)
604316	TJAOU-234-GR-07-0.0-DU	0.0	ND (0.07)	12.2	0.0162	ND (0.135)	0.26 J (0.49)
604316	TJAOU-234-GR-07-5.0-S	5.0	ND (0.07)	5.37	0.0102	ND (0.135)	**1**
604316	TJAOU-234-GR-08-5.0-S	5.0	ND (0.07)	5.2	ND (0.00455)	ND (0.135)	ND (0.0578)
Background Concentration[d] (surface/subsurface)[e]			NC/NC	39/11.2	<0.25/<0.1	<1/<1	<1/<1
Quality Assurance/Quality Control Sample (mg/L)							
604569	TJAOU-234-GR-EB1	NA	0.007 J (0.01)	ND (0.00344)	ND (0.00007 J)	ND (0.00309 J)	0.00112 J (0.005)

Note: Values in **bold** indicate concentrations greater than background.

[a]General Engineering Laboratories, Inc.

[b]EPA November 1986.

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

[d]Dinwiddie September 1997.

[e]Surface samples defined as 0 to 6 inches; subsurface samples are greater than 6 inches.

DU = Duplicate Sample.
EB = Equipment Blank.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab Sample.
ID = Identification.
J ( ) = Estimated value less than the laboratory reporting limit, shown in parentheses.
mg/kg = Milligram(s) per kilogram.
mg/L = Milligram(s) per liter.
NA = Not applicable.
NC = Not calculated by Dinwiddie (September 1997).
ND ( ) = Not detected above the method detection limit, shown in parentheses.
ND (#J) = Nondetect, uncertainty in the detection limit, shown in parentheses.
OU = Operable Unit.
S = Soil Sample.
SWMU = Solid Waste Management Unit.
TJA = Tijeras Arroyo.

Table E-2
Summary of SWMU 234 Characterization Soil Sampling
Metals Analytical Detection Limits
June 2001
(Off-Site Laboratory[a])

Analyte	Method Detection Limit for Soil Samples (mg/kg)	Method Detection Limit for Aqueous Samples (mg/L)
Arsenic	0.137	0.00457
Barium	0.0148	0.00021
Beryllium	0.00767	0.0002
Cadmium	0.013	0.00025
Chromium	0.218	0.00078
Chromium (VI)	0.07	0.005
Lead	0.17	0.00344
Mercury	0.00455	0.00007
Selenium	0.135	0.00309
Silver	0.0578	0.0002

[a]General Engineering Laboratories, Inc.
mg/kg = Milligram(s) per kilogram.
mg/L = Milligram(s) per liter.
SWMU = Solid Waste Management Unit.

Table E-3
Summary of SWMU 234 Characterization Soil Sampling
VOC Analytical Detection Limits
June 2001
(Off-Site Laboratory[a])

Analyte	Method Detection Limit for Soil Samples (µg/kg)	Method Detection Limit for Aqueous Samples (µg/L)
Acetone	1	0.82
Benzene	0.39	0.14
Bromodichloromethane	0.35	0.15
Bromoform	0.36	0.1
Bromomethane	0.31	0.24
2-Butanone	0.76	0.81
Carbon disulfide	0.62	0.9
Carbon tetrachloride	0.26	0.16
Chlorobenzene	0.4	0.2
Chloroethane	0.28	0.32
Chloroform	0.47	0.17
Chloromethane	0.35	0.21
Dibromochloromethane	0.41	0.16
1,1-Dichloroethane	0.41	0.07
1,2-Dichloroethane	0.27	0.14
1,1-Dichloroethene	0.262	0.28
cis-1,2-Dichloroethene	0.41	0.18
trans-1,2-Dichloroethene	0.37	0.31
1,2-Dichloropropane	0.32	0.16
cis-1,3-Dichloropropene	0.28	0.18
trans-1,3-Dichloropropene	0.24	0.17
Ethylbenzene	0.35	0.15
2-Hexanone	0.94	0.79
4-Methyl-2-pentanone	1.34	0.7
Methylene chloride	0.44	0.63
Styrene	0.32	0.15
Tetrachloroethene	0.4	0.21
Toluene	0.5	0.22
Trichloroethene	0.72	0.16
Vinyl acetate	0.77	0.44
Vinyl chloride	0.3	0.26
Xylene	1.05	0.44
1,1,2,2-Tetrachloroethane	0.3	0.15
1,1,1-Trichloroethane	0.29	0.18
1,1,2-Trichloroethane	0.36	0.11

[a]General Engineering Laboratories, Inc.
µg/kg = Microgram(s) per kilogram.
µg/L = Microgram(s) per liter.
SWMU = Solid Waste Management Unit.
VOC = Volatile organic compound.

Table E-4
Summary of SWMU 234 Characterization Soil Sampling
SVOC Analytical Results Relevant to SWMU 46
June 2001
(Off-Site Laboratory[a])

Sample Attributes			SVOCs (EPA Method 8270[b]) (µg/kg)			
Record Number[c]	ER Sample ID	Sample Depth (ft)	Acenaphthene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene
604316	TJAOU-234-GR-07-0.0-S	0.0	**6.26 J**	**15.2 J (33.3)**	**171**	**275**
604316	TJAOU-234-GR-07-0.0-DU	0.0	ND (4 J)	**21.2 J (33.3)**	**258**	**435**
604316	TJAOU-234-GR-07-5.0-S	5.0	ND (4 J)	ND (4.66)	ND (5.99)	**13.1 J (33.3)**
604316	TJAOU-234-GR-08-5.0-S	5.0	ND (4 J)	**7.96 J (33.3)**	**17.1 J (33.3)**	ND (2)
Quality Assurance/Quality Control Sample (µg/L)						
604569	TJAOU-234-GR-EB1	NA	ND (0.07 J)	ND (0.13)	ND (0.1)	ND (0.13)

Sample Attributes			SVOCs (EPA Method 8270[b]) (µg/kg)			
Record Number[c]	ER Sample ID	Sample Depth (ft)	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Carbazole
604316	TJAOU-234-GR-07-0.0-S	0.0	**396**	**309**	**272**	**13.4 J (333)**
604316	TJAOU-234-GR-07-0.0-DU	0.0	**506**	ND (5 J)	**471**	**18.2 J (333)**
604316	TJAOU-234-GR-07-5.0-S	5.0	**14.7 J (33.3)**	ND (5)	**7.04 J (33.3)**	ND (5)
604316	TJAOU-234-GR-08-5.0-S	5.0	ND (2.33)	ND (5)	ND (5)	ND (5)
Quality Assurance/Quality Control Sample (µg/L)						
604569	TJAOU-234-GR-EB1	NA	ND (0.13)	ND (0.08)	ND (0.23)	ND (1.26)

Refer to footnotes at end of table.

Table E-4 (Concluded)
Summary of SWMU 234 Characterization Soil Sampling
SVOC Analytical Results Relevant to SWMU 46
June 2001
(Off-Site Laboratory[a])

Sample Attributes			SVOCs (EPA Method 8270[b]) (µg/kg)			
Record Number[c]	ER Sample ID	Sample Depth (ft)	Chrysene	Di-n-butyl phthalate	Di-n-octyl phthalate	bis(2-Ethylhexyl)phthalate
604316	TJAOU-234-GR-07-0.0-S	0.0	**294**	ND (20.6)	**10.2 J (333)**	**141 J**
604316	TJAOU-234-GR-07-0.0-DU	0.0	**435**	ND (20.6)	ND (8.99)	**80.3**
604316	TJAOU-234-GR-07-5.0-S	5.0	**12.5 J (33.3)**	ND (20.6)	ND (8.99)	**16.1 J**
604316	TJAOU-234-GR-08-5.0-S	5.0	**17.7 J (33.3)**	**20.7 J (333)**	ND (8.99)	**140 J**
Quality Assurance/Quality Control Sample (µg/L)						
604569	TJAOU-234-GR-EB1	NA	ND (0.12)	ND (1.82)	ND (2.12)	ND (0.04)

Sample Attributes			SVOCs (EPA Method 8270[b]) (µg/kg)				
Record Number[c]	ER Sample ID	Sample Depth (ft)	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Phenanthrene	Pyrene
604316	TJAOU-234-GR-07-0.0-S	0.0	**305**	**6.66 J (33.3)**	**248 J**	**110**	**436**
604316	TJAOU-234-GR-07-0.0-DU	0.0	**450**	ND (3)	**345 J**	**139**	**603**
604316	TJAOU-234-GR-07-5.0-S	5.0	**11.1 J (33.3)**	ND (3)	ND (6.66)	**4.24 J (33.3)**	**13.9 J (33.3)**
604316	TJAOU-234-GR-08-5.0-S	5.0	**33.3**	**3.02 J (33.3)**	ND (6.66)	**42.2**	**54.9**
Quality Assurance/Quality Control Sample (µg/L)							
604569	TJAOU-234-GR-EB1	NA	ND (0.12)	ND (0.12)	ND (0.1)	ND (0.12)	ND (0.14)

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

[a]General Engineering Laboratories, Inc.

[b]EPA November 1986.

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

DU = Duplicate Sample.
EB = Equipment Blank.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab Sample.
ID = Identification.
J = Estimated value.
J ( ) = Estimated value less than the laboratory 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.
ND (#J) = Not detected, uncertainty in the detection limit, shown in parentheses.
OU = Operable Unit.
S = Soil Sample.
SVOC = Semivolatile organic compound.
SWMU = Solid Waste Management Unit.
TJA = Tijeras Arroyo.

Table E-5
Summary of SWMU 234 Characterization Soil Sampling
SVOC Analytical Detection Limits
June 2001
(Off-Site Laboratory[a])

Analyte	Method Detection Limit for Soil Samples (µg/kg)	Method Detection Limit for Aqueous Samples (µg/L)
Acenaphthene	4	0.07
Acenaphthylene	3.66	0.1
Anthracene	4.66	0.13
Benzo(a)anthracene	5.99	0.1
Benzo(b)fluoranthene	2.33	0.13
Benzo(k)fluoranthene	5	0.23
Benzo(g,h,i)perylene	5	0.08
Benzo(a)pyrene	2	0.13
4-Bromophenyl phenyl ether	4.66	1.14
Butylbenzyl phthalate	12.7	1.82
Carbazole	5	1.26
4-Chlorobenzenamine	58.9	2.5
bis(2-Chloroethoxy)methane	5.99	1.39
bis(2-Chloroethyl)ether	6.66	1.4
bis-Chloroisopropyl ether	37.1	1.32
4-Chloro-3-methylphenol	36.6	1.39
2-Chloronaphthalene	3.66	0.13
2-Chlorophenol	5	1.24
4-Chlorophenyl phenyl ether	3.33	1.18
Chrysene	6.33	0.12
o-Cresol	47.6	1.26
Dibenz(a,h)anthracene	2.66	0.1
Dibenzofuran	2.66	0.99
1,2-Dichlorobenzene	4.33	1.63
1,3-Dichlorobenzene	3.33	1.51
1,4-Dichlorobenzene	5.99	1.83
3,3'-Dichlorobenzidine	143	1.1
2,4-Dichlorophenol	7.99	1.28
Diethylphthalate	19.6	1.23
2,4-Dimethylphenol	71.9	1.29
Dimethylphthalate	11.7	1.11
Di-n-butyl phthalate	20.6	1.82
2,4-Dinitrophenol	15	1.36
Dinitro-o-cresol	16	0.97
2,4-Dinitrotoluene	5	0.97
2,6-Dinitrotoluene	3	1.09
Di-n-octyl phthalate	8.99	2.12
Diphenyl amine	15.7	1.02
bis(2-Ethylhexyl)phthalate	6.99	0.04
Fluoranthene	3.33	0.12
Fluorene	3	0.12
Hexachlorobenzene	4.66	0.76

Refer to footnotes at end of table.

Table E-5 (Concluded)
Summary of SWMU 234 Characterization Soil Sampling
SVOC Analytical Detection Limits
June 2001
(Off-Site Laboratory[a])

Analyte	Method Detection Limit for Soil Samples (µg/kg)	Method Detection Limit for Aqueous Samples (µg/L)
Hexachlorobutadiene	6.66	1.76
Hexachlorocyclopentadiene	33	1.1
Hexachloroethane	4.33	1.7
Indeno(1,2,3-cd)pyrene	6.66	0.1
Isophorone	2.33	1.12
2-Methylnaphthalene	4	0.15
4-Methylphenol	5.66	1.07
Naphthalene	3.33	0.12
2-Nitroaniline	80.9	2.09
3-Nitroaniline	86.6	1.31
4-Nitroaniline	83.9	1.55
Nitrobenzene	36.6	1.42
2-Nitrophenol	46.3	1.33
4-Nitrophenol	21	0.18
n-Nitrosodipropylamine	33	1.32
Pentachlorophenol	60.9	1.58
Phenanthrene	4	0.12
Phenol	3.66	0.84
Pyrene	8.66	0.14
1,2,4-Trichlorobenzene	4.66	1.52
2,4,5-Trichlorophenol	42.3	1.18
2,4,6-Trichlorophenol	24.6	1.12

[a]General Engineering Laboratories, Inc.
µg/kg = Microgram(s) per kilogram.
µg/L = Microgram(s) per liter.
SVOC = Semivolatile organic compound.
SWMU = Solid Waste Management Unit.

Table E-6
Summary of SWMU 234 Characterization Soil Sampling
Gamma Spectroscopy Analytical Results Relevant to SWMU 46
June 2001
(On-[a] and Off-Site[b] Laboratories)

Sample Attributes			Activity (pCi/g)							
Record Number[c]	ER Sample ID	Sample Depth (ft)	Cesium-137		Thorium-232		Uranium-235		Uranium-238	
			Result	Error[d]	Result	Error[d]	Result	Error[d]	Result	Error[d]
604315	TJAOU-234-GR-07-0.0-S	0.0	0.032	0.0186	1.16	0.549	ND (0.244)	--	ND (0.73)	--
604315	TJAOU-234-GR-07-0.0-DU	0.0	0.0546	0.0353	0.935	0.467	ND (0.278)	--	ND (0.81)	--
604315	TJAOU-234-GR-07-5.0-S	5.0	ND (0.0327)	--	0.762	0.364	ND (0.184)	--	ND (0.496)	--
604315	TJAOU-234-GR-08-5.0-S	5.0	ND (0.0305)	--	0.71	0.338	ND (0.147)	--	ND (0.474)	--
604316	TJAOU-234-GR-07-0.0-S	0.0	0.0631	0.0427	0.907	0.115	ND (0.199)	--	ND (1.09)	--
604316	TJAOU-234-GR-07-0.0-DU	0.0	0.0508	0.0304	0.962	0.123	ND (0.198)	--	ND (1.07)	--
604316	TJAOU-234-GR-07-5.0-S	5.0	ND (0.0324)	--	1.09	0.133	ND (0.175)	--	ND (1.08)	--
604316	TJAOU-234-GR-08-5.0-S	5.0	ND (0.0267)	--	0.67	0.0878	0.154	0.132	ND (0.89)	--
Background Concentration[e] (surface/subsurface)[f]			0.836/0.084	NA	1.54/1.54	NA	0.18/0.18	NA	1.3/1.3	NA
Quality Assurance/Quality Control Samples (pCi/L)										
604568	TJAOU-234-GR-EB1	NA	ND (0.0274)	--	ND (0.163)	--	ND (0.133)	--	ND (0.308)	--
604569	TJAOU-234-GR-EB1	NA	ND (4.8)	--	ND (7.98)	--	ND (29.9)	--	ND (169)	--

[a]Sandia National Laboratories/New Mexico Radiation Protection Sample Diagnostics Laboratory performed analyses for Record Number 604315 (gamma spectroscopy by EPA Method 901.0) (EPA November 1986).
[b]General Engineering Laboratories, Inc. performed analyses for Record Number 604316 (gamma spectroscopy by HASL 300).
[c]Analysis request/chain-of-custody record.
[d]Two standard deviations about the mean detected activity.
[e]Dinwiddie September 1997.
[f]Surface samples defined as 0 to 6 inches; subsurface samples are greater than 6 inches.

DU = Duplicate Sample.
EB = Equipment Blank.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab Sample.
HASL = Health and Safety Lab Method.
ID = Identification.
NA = Not applicable.
ND ( ) = Not detected above the minimum detectable activity, shown in parentheses.
OU = Operable Unit.
pCi/g = Picocurie(s) per gram.
pCi/L = Picocuries per liter.
S = Soil Sample.
SWMU = Solid Waste Management Unit.
TJA = Tijeras Arroyo.
-- = Error not calculated for nondetect results.

Table E-7
Summary of SWMU 234 Characterization Soil Sampling
Tritium Analytical Results Relevant to SWMU 46
June 2001
(Off-Site Laboratory[a])

Sample Attributes			Tritium Activity (EPA Method 906.0[b]) (pCi/g)	
Record Number[c]	ER Sample ID	Sample Depth (ft)	Result	Error[d]
604316	TJAOU-234-GR-07-0.0-S	0.0	ND (0.004)	--
604316	TJAOU-234-GR-07-0.0-DU	0.0	ND (0.006)	--
604316	TJAOU-234-GR-07-5.0-S	5.0	ND (0.004)	--
604316	TJAOU-234-GR-08-5.0-S	5.0	ND (0.004)	--
Background Concentration[e] (surface/subsurface)[f]			0.021	NA
Quality Assurance/Quality Control Sample (pCi/L)				
604569	TJAOU-234-GR-EB1	NA	ND (0.004)	--

[a]General Engineering Laboratories, Inc.
[b]EPA November 1986.
[c]Analysis request/chain-of-custody record.
[d]Two standard deviations about the mean detected activity.
[e]The tritium background value of 0.021 pCi/g was calculated from the Tharp (February 1999) tritium background value of 420 pCi/L. The pCi/L value was converted to the pCi/g value using the assumption of 5 percent soil moisture and a soil density of 1 g/cubic centimeter.
[f]Surface samples defined as 0 to 6 inches; subsurface samples are greater than 6 inches.
DU = Duplicate Sample.
EB = Equipment Blank.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
g = Gram(s).
GR = Grab Sample.
ID = Identification.
NA = Not applicable.
ND ( ) = Not detected above the minimum detectable activity, shown in parentheses.
OU = Operable Unit.
pCi/g = Picocurie(s) per gram.
pCi/L = Picocurie(s) per liter.
S = Soil Sample.
SWMU = Solid Waste Management Unit.
TJA = Tijeras Arroyo.
-- = Error not calculated for nondetect results.

Table E-8
Summary of SWMU 234 Characterization Soil Sampling
Gross Alpha and Gross Beta Analytical Results Relevant to SWMU 46
June 2001
(Off-Site Laboratory[a])

Sample Attributes			Activity (EPA Method 900.0[b]) (pCi/g)			
			Gross Alpha		Gross Beta	
Record Number[c]	ER Sample ID	Sample Depth (ft)	Result	Error[d]	Result	Error[d]
604316	TJAOU-234-GR-07-0.0-S	0.0	**15.3**	6.55	**18.5**	3.25
604316	TJAOU-234-GR-07-0.0-DU	0.0	**11.6**	5.77	**16.1**	3.1
604316	TJAOU-234-GR-07-5.0-S	5.0	**18.4**	7.39	**25.1**	3.55
604316	TJAOU-234-GR-08-5.0-S	5.0	**14.3**	6.38	**21.7**	3.4
Quality Assurance/Quality Control Samples (pCi/L)						
604569	TJAOU-234-GR-EB1	NA	ND (78.7)	--	ND (0.325)	--

Note: Values in **bold** represent detected analytes. Background concentrations not available.
[a]General Engineering Laboratories, Inc.
[b]EPA November 1986.
[c]Analysis request/chain-of-custody record.
[d]Two standard deviations about the mean detected activity.
DU = Duplicate Sample.
EB = Equipment Blank.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab Sample.
ID = Identification.
NA = Not applicable
ND ( ) = Not detected above the method detection limit, shown in parentheses.
OU = Operable Unit.
pCi/g = Picocurie(s) per gram.
pCi/L = Picocurie(s) per liter.
S = Soil Sample.
SWMU = Solid Waste Management Unit.
TJA = Tijeras Arroyo.
-- = Error not calculated for nondetect results.

Attachment F

ATTACHMENT F
Summary of Analytical Results for SWMU 46 and SWMU 234
Characterization and Confirmatory Soil Samples

LIST OF TABLES

Table F-1
Summary of COCs for SWMU 46 Characterization and Confirmatory Soil Sampling

COC Type	Number of Samples	COCs Greater Than Background and Associated COCs	Maximum Background Limit North Supergroup[a]		Maximum Concentration	Sampling Locations Where Background Concentration was Exceeded[c]
			Surface[b]	Subsurface[b]		
Metals (mg/kg)	61 Environmental; 3 Duplicates; 8 EBs	Antimony	3.9	3.9	0.724 J	All sample concentrations are below background value.
		Arsenic	5.6	4.4	5.23	TJAOU-46-GR-25-10.0-S
		Barium	200	200	572	TJAOU-46-BH-02-13.5-S; TJAOU-46-BH-02-17.5-S; TJAOU-46-BH-06-9.5-S; TJAOU-46-BH-08-13.5-S; TJAOU-46-GR-09-2.0-S; TJAOU-46-GR-24-5.0-S; TJAOU-46-GR-24-5.0-DU; TJAOU-46-GR-25-5.0-S; TJAOU-46-GR-25-10.0-S
		Beryllium	0.8	0.8	0.891	TJA-6-BH-45-S
		Cadmium	<1	0.9	213	TJAOU-46-BH-03-7.0-S; TJAOU-46-BH-08-5.5-S; TJAOU-46-GR-06-2.0-S; TJAOU-46-GR-07-2.0-S; TJAOU-46-GR-08-1.5-S; TJAOU-46-GR-09-2.0-S; TJAOU-46-GR-10-1.3-S; TJAOU-46-GR-11-1.5-S; TJAOU-46-GR-12-1.3-S;TJAOU-46-GR-13-1.5-S; TJAOU-46-GR-14-1.0-S; TJAOU-46-GR-15-1.0-S; TJAOU-46-GR-16-0.8-S; TJAOU-46-GR-17-0.7-S; TJAOU-46-GR-17-0.7-DU; TJAOU-46-GR-17-5.0-S; TJAOU-46-GR-18-0.5-S; TJAOU-46-GR-20-2.5-S; TJAOU-46-GR-21-0.0-S; TJAOU-46-GR-23-0.0-S; TJAOU-46-GR-25-2.0-S; TJAOU-46-VW-01-145-S
		Chromium	17.3	12.8	120	TJAOU-46-BH-03-7.0-S; TJAOU-46-BH-04-11.5-S; TJAOU-46-BH-08-5.5-S; TJAOU-46-BH-09-8.5-S; TJAOU-46-VW-01-145-S
		Chromium (VI)	NA	NA	2.08	TJAOU-46-GR-06-2.0-S; TJAOU-46-GR-07-2.0-S; TJAOU-46-GR-07-5.0-S; TJAOU-46-GR-08-1.5-S; TJAOU-46-GR-09-2.0-S; TJAOU-46-GR-10-1.3-S; TJAOU-46-GR-11-1.5-S; TJAOU-46-GR-12-1.3-S; TJAOU-46-GR-12-5.0-S; TJAOU-46-GR-13-1.5-S; TJAOU-46-GR-14-1.0-S; TJAOU-46-GR-15-1.0-S; TJAOU-46-GR-16-0.8-S; TJAOU-46-GR-17-0.7-S; TJAOU-46-GR-17-0.7-DU; TJAOU-46-GR-17-5.0-S; TJAOU-46-GR-18-0.5-S; TJAOU-46-GR-19-0.5-S; TJAOU-46-GR-20-2.5-S; TJAOU-46-GR-21-0.0-S; TJAOU-46-GR-22-0.0-S; TJAOU-46-GR-23-0.0-S; TJAOU-46-GR-24-5.0-S; TJAOU-46-GR-24-5.0-DU; TJAOU-46-GR-25-0.0-S; TJAOU-46-GR-25-2.0-S; TJAOU-46-GR-25-5.0-S; TJAOU-46-GR-25-10.0-S TJA-6-BH-45-S; TJA-6-BH-145-S ; TJA-6-BH-145-DU; TJAOU-46-VW-01-45-S; TJAOU-46-VW-01-145-S

Refer to footnotes at end of table.

Table F-1 (Continued)
Summary of COCs for SWMU 46 Characterization and Confirmatory Soil Sampling

COC Type	Number of Samples	COCs Greater Than Background and Associated COCs	Maximum Background Limit North Supergroup[a]		Maximum Concentration	Sampling Locations Where Background Concentration was Exceeded[c]
			Surface[b]	Subsurface[b]		
Metals (mg/kg) (continued)	61 Environmental; 3 Duplicates; 8 EBs	Cobalt	7.1	8.8	7.93	All sample concentrations are below background value.
		Copper	17	17	133 J	TJAOU-46-BH-08-5.5-S; TJAOU-46-GR-06-2.0-S; TJAOU-46-GR-07-2.0-S; TJAOU-46-GR-08-1.5-S; TJAOU-46-GR-10-1.3-S; TJAOU-46-GR-11-1.5-S; TJAOU-46-GR-12-1.3-S; TJAOU-46-GR-13-1.5-S; TJAOU-46-GR-14-1.0-S; TJAOU-46-GR-15-1.0-S; TJAOU-46-GR-16-0.8-S; TJAOU-46-GR-17-0.7-S; TJAOU-46-GR-17-0.7-DU; TJAOU-46-GR-20-2.5-S; TJAOU-46-GR-21-0.0-S; TJAOU-46-GR-23-0.0-S; TJAOU-46-GR-25-0.0-S; TJAOU-46-GR-25-2.0-S
		Iron	NA	NA	20900	62 samples taken. All results indicate detections. See tables B-1, C-1, D-1, and E-1 for more information.
		Lead	39	11.2	66.8 J	TJAOU-46-BH-08-5.5-S; TJAOU-46-GR-07-2.0-S; TJAOU-46-GR-11-1.5-S; TJAOU-46-GR-12-1.3-S; TJAOU-46-GR-13-1.5-S; TJAOU-46-GR-14-1.0-S; TJAOU-46-GR-15-1.0-S; TJAOU-46-GR-16-0.8-S; TJAOU-46-GR-20-2.5-S; TJAOU-46-GR-21-0.0-S
		Mercury	<0.25	<0.1	0.0766	All sample concentrations are below background value.
		Nickel	25.4	25.4	379	TJAOU-46-BH-04-11.5-S; TJAOU-46-BH-08-5.5-S; TJAOU-46-BH-09-8.5-S; TJAOU-46-GR-06-2.0-S; TJAOU-46-GR-08-1.5-S; TJAOU-46-GR-11-1.5-S; TJAOU-46-GR-13-1.5-S; TJAOU-46-GR-14-1.0-S; TJAOU-46-GR-15-1.0-S; TJAOU-46-GR-17-0.7-S; TJAOU-46-GR-17-0.7-DU; TJAOU-46-GR-18-0.5-S; TJAOU-46-GR-20-2.5-S; TJAOU-46-GR-21-0.0-S; TJAOU-46-GR-25-2.0-S
		Selenium	<1	<1	1.28	TJA-6-BH-145-S; TJA-6-BH-145-DU
		Silver	<1	<1	16.2	TJAOU-46-BH-02-5.0-S; TJAOU-46-BH-08-5.5-S; TJAOU-46-GR-06-2.0-S; TJAOU-46-GR-07-2.0-S; TJAOU-46-GR-11-1.5-S; TJAOU-46-GR-15-1.0-S; TJAOU-46-GR-21-0.0-S; TJAOU-234-GR-07-5.0-S
		Thallium	<1.1	<1.1	2.19	TJAOU-46-BH-08-13.5-S TJA-6-BH-145-S; TJA-6-BH-145-DU; TJAOU-46-VW-01-145-S Note: There are an additional 26 sampling locations with ND results where the MDL exceeds background.

Refer to footnotes at end of table.

Table F-1 (Continued)
Summary of COCs for SWMU 46 Characterization and Confirmatory Soil Sampling

COC Type	Number of Samples	COCs Greater Than Background and Associated COCs	Maximum Background Limit North Supergroup[a]		Maximum Concentration	Sampling Locations Where Background Concentration was Exceeded[c]
			Surface[b]	Subsurface[b]		
Metals (mg/kg) (continued)	61 Environmental; 3 Duplicates; 8 EBs	Total Cyanide	NA	NA	12.7	TJAOU-46-BH-010-5.5-S; TJAOU-46-BH-010-8.0-S; TJAOU-46-BH-012-5.5-S; TJAOU-46-BH-012-9.0-S; TJAOU-46-BH-02-13.5-S; TJAOU-46-BH-02-17.5-S; TJAOU-46-BH-02-5.0-S; TJAOU-46-BH-02-8.5-S; TJAOU-46-BH-03-4.5-S; TJAOU-46-BH-04-4.0-S; TJAOU-46-BH-05-5.5-S; TJAOU-46-BH-05-8.0-S; TJAOU-46-BH-06-9.5-S; TJAOU-46-BH-07-12.5-S; TJAOU-46-BH-07-5.5-S; TJAOU-46-BH-07-9.5-S; TJAOU-46-BH-08-13.5-S; TJAOU-46-BH-08-5.5-S; TJAOU-46-BH-08-9.5-S; TJAOU-46-BH-09-5.5-S; TJAOU-46-BH-09-8.5-S
		Vanadium	33	33	46.5	TJAOU-46-BH-02-17.5-S; TJAOU-46-BH-02-5.0-S; TJAOU-46-BH-03-7.0-S; TJAOU-46-BH-04-4.0-S; TJAOU-46-BH-04-8.5-S; TJAOU-46-BH-05-5.5-S; TJAOU-46-BH-06-5.5-S; TJAOU-46-BH-07-5.5-S; TJAOU-46-BH-08-5.5-S; TJAOU-46-BH-08-9.5-S; TJAOU-46-GR-17-5.0-S; TJAOU-46-GR-25-10.0-S
		Zinc	76	76	149 J	TJAOU-46-GR-08-1.5-S; TJAOU-46-GR-13-1.5-S; TJAOU-46-GR-18-0.5-S; TJAOU-46-GR-21-0.0-S
Polychlorinated biphenyls (µg/kg)	57 Environmental; 3 Duplicates; 5 EBs	Aroclor-1016	NA	NA	ND	All sample concentrations are nondetect.
		Aroclor-1221	NA	NA	ND	All sample concentrations are nondetect.
		Aroclor-1232	NA	NA	ND	All sample concentrations are nondetect.
		Aroclor-1242	NA	NA	242	TJAOU-46-BH-04-11.5-S; TJAOU-46-BH-04-4.0-S; TJAOU-46-BH-08-5.5-S; TJAOU-46-GR-06-2.0-S; TJAOU-46-GR-07-2.0-S; TJAOU-46-GR-08-1.5-S; TJAOU-46-GR-09-2.0-S; TJAOU-46-GR-20-2.5-S
		Aroclor-1248	NA	NA	2.6 J	All sample concentrations are nondetect.
		Aroclor-1254	NA	NA	425	TJAOU-46-BH-04-11.5-S; TJAOU-46-BH-08-5.5-S; TJAOU-46-GR-06-2.0-S; TJAOU-46-GR-07-2.0-S; TJAOU-46-GR-08-1.5-S; TJAOU-46-GR-09-2.0-S; TJAOU-46-GR-10-1.3-S; TJAOU-46-GR-11-1.5-S; TJAOU-46-GR-12-1.3-S; TJAOU-46-GR-13-1.5-S; TJAOU-46-GR-14-1.0-S; TJAOU-46-GR-15-1.0-S; TJAOU-46-GR-20-2.5-S;; TJAOU-46-GR-22-0.0-S; TJAOU-46-GR-23-0.0-S; TJAOU-46-GR-26-0.0-S

Refer to footnotes at end of table.

Table F-1 (Continued)
Summary of COCs for SWMU 46 Characterization and Confirmatory Soil Sampling

COC Type	Number of Samples	COCs Greater Than Background and Associated COCs	Maximum Background Limit North Supergroup[a]		Maximum Concentration	Sampling Locations Where Background Concentration was Exceeded[c]
			Surface[b]	Subsurface[b]		
Polychlorinated biphenyls (µg/kg) (continued)	57 Environmental; 3 Duplicates; 5 EBs	Aroclor-1260	NA	NA	174	TJAOU-46-BH-04-11.5-S; TJAOU-46-BH-08-5.5-S; TJAOU-46-GR-06-2.0-S; TJAOU-46-GR-07-2.0-S; TJAOU-46-GR-08-1.5-S; TJAOU-46-GR-09-2.0-S; TJAOU-46-GR-10-1.3-S; TJAOU-46-GR-11-1.5-S; TJAOU-46-GR-12-1.3-S; TJAOU-46-GR-13-1.5-S; TJAOU-46-GR-14-1.0-S; TJAOU-46-GR-15-1.0-S; TJAOU-46-GR-20-2.5-S;TJAOU-46-GR-21-0.1-S; TJAOU-46-GR-21-0.1-D;TJAOU-46-GR-22-0.0-S; TJAOU-46-GR-23-0.0-S; TJAOU-46-GR-24-0.0-S; TJAOU-46-GR-26-0.0-S
Volatile Organic Compounds (µg/kg)	69 Environmental; 3 Duplicates; 9 EBs; 12 TBs	Acetone	NA	NA	13.2	TJA-6-BH-45-S; TJA-6-BH-95-S; TJA-6-BH-95-S; TJA-6-BH-145-S; TJA-6-BH-245-S; TJAOU-46-VW-01-45-S; TJAOU-46-VW-01-145-S; TJAOU-46-VW-01-245-S; TJAOU-46-VW-01-295-S; TJAOU-46-VW-01-295-DU
		2-Butanone	NA	NA	107	TJA-6-BH-95-S; TJA-6-BH-95-S; TJA-6-BH-145-S; TJA-6-BH-245-S; TJAOU-46-VW-01-45-S; TJAOU-46-VW-01-95-S; TJAOU-46-VW-01-145-S; TJAOU-46-VW-01-245-S
		Methylene chloride	NA	NA	3.85 J	TJA-6-BH-45-S; TJA-6-BH-95-S; TJA-6-BH-145-S; TJA-6-BH-245-S; TJAOU-46-VW-01-45-S; TJAOU-46-VW-01-95-S; TJAOU-46-VW-01-145-S; TJAOU-46-VW-01-195-S; TJAOU-46-VW-01-245-S; TJAOU-46-VW-01-295-S; TJAOU-46-VW-01-295-DU
		Toluene	NA	NA	17	TJA-6-BH-45-S
Semivolatile Organic Compounds (µg/kg)	61 Environmental; 3 Duplicates; 8 EBs	Acenaphthene	NA	NA	6.26 J	TJAOU-46-BH-08-5.5-S; TJAOU-234-GR-07-0.0-S
		Acenaphthylene	NA	NA	4.06 J	TJAOU-46-BH-02-8.5-S
		Anthracene	NA	NA	21.2 J	TJAOU-46-BH-06-9.5-S; TJAOU-46-BH-08-5.5-S; TJAOU-46-BH-09-5.5-S; TJAOU-234-GR-07-0.0-S; TJAOU-234-GR-07-0.0-DU; TJAOU-234-GR-08-5.0-S
		Benzo(a)anthracene	NA	NA	258	TJAOU-46-BH-08-5.5-S; TJAOU-46-GR-21-0.0-S; TJAOU-46-GR-22-0.0-S; TJAOU-46-GR-23-0.0-S TJAOU-234-GR-07-0.0-S; TJAOU-234-GR-07-0.0-DU; TJAOU-234-GR-08-5.0-S

Refer to footnotes at end of table.

Table F-1 (Continued)
Summary of COCs for SWMU 46 Characterization and Confirmatory Soil Sampling

COC Type	Number of Samples	COCs Greater Than Background and Associated COCs	Maximum Background Limit North Supergroup[a]		Maximum Concentration	Sampling Locations Where Background Concentration was Exceeded[c]
			Surface[b]	Subsurface[b]		
Semivolatile Organic Compounds (µg/kg) (continued)	61 Environmental; 3 Duplicates; 8 EBs	Benzo(a)pyrene	NA	NA	435	TJAOU-46-BH-02-5.0-S; TJAOU-46-BH-08-5.5-S; TJAOU-46-BH-09-5.5-S; TJAOU-46-GR-15-1.0-S; TJAOU-46-GR-16-0.8-S; TJAOU-46-GR-21-0.0-S; TJAOU-46-GR-22-0.0-S; TJAOU-46-GR-23-0.0-S TJAOU-234-GR-07-0.0-S; TJAOU-234-GR-07-0.0-DU; TJAOU-234-GR-07-5.0-S
		Benzo(b) fluoranthene	NA	NA	506	TJAOU-46-BH-02-5.0-S; TJAOU-46-BH-08-5.5-S; TJAOU-46-BH-09-5.5-S; TJAOU-46-GR-16-0.8-S; TJAOU-46-GR-21-0.0-S; TJAOU-46-GR-22-0.0-S; TJAOU-46-GR-23-0.0-S; TJAOU-234-GR-07-0.0-S; TJAOU-234-GR-07-0.0-DU; TJAOU-234-GR-07-5.0-S
		Benzo(g,h,i) perylene	NA	NA	309	TJAOU-46-BH-08-5.5-S; TJAOU-46-GR-16-0.8-S; TJAOU-46-GR-21-0.0-S; TJAOU-46-GR-22-0.0-S; TJAOU-46-GR-23-0.0-S TJAOU-234-GR-07-0.0-S
		Benzo(k)fluoranthene	NA	NA	471	TJAOU-46-BH-02-5.0-S; TJAOU-46-BH-08-5.5-S; TJAOU-46-BH-09-5.5-S; TJAOU-46-GR-21-0.0-S; TJAOU-46-GR-22-0.0-S; TJAOU-46-GR-23-0.0-S TJAOU-234-GR-07-0.0-S; TJAOU-234-GR-07-0.0-DU; TJAOU-234-GR-07-5.0-S
		Butylbenzyl phthalate	NA	NA	56.5 J	TJAOU-46-BH-02-5.0-S; TJAOU-46-BH-06-9.5-S; TJAOU-46-BH-08-5.5-S
		Carbazole	NA	NA	18.2 J	TJAOU-46-BH-09-5.5-S TJAOU-234-GR-07-0.0-S; TJAOU-234-GR-07-0.0-DU
		2-Chlorophenol	NA	NA	8.35 J	TJAOU-46-BH-02-8.5-S; TJAOU-46-BH-09-5.5-S
		Chrysene	NA	NA	435	TJAOU-46-BH-08-5.5-S; TJAOU-46-BH-09-5.5-S; TJAOU-46-GR-21-0.0-S; TJAOU-46-GR-22-0.0-S; TJAOU-46-GR-23-0.0-S TJAOU-234-GR-07-0.0-S; TJAOU-234-GR-07-0.0-DU; TJAOU-234-GR-07-5.0-S; TJAOU-234-GR-08-5.0-S
		Di-n-butyl phthalate	NA	NA	49.5 J	TJAOU-46-BH-04-11.5-S; TJAOU-46-BH-08-5.5-S; TJAOU-46-BH-09-5.5-S; TJAOU-46-GR-21-0.0-S TJAOU-234-GR-08-5.0-S
		Di-n-octlyl phthalate			10.2 J	TJAOU-234-GR-07-0.0-S
		Dibenzofuran	NA	NA	9.4 J	TJAOU-46-BH-02-8.5-S; TJAOU-46-BH-06-9.5-S; TJAOU-46-BH-09-5.5-S
		1,2-Dichlorobenzene	NA	NA	4.51 J	TJAOU-46-BH-09-5.5-S
		1,3-Dichlorobenzene	NA	NA	4.86 J	TJAOU-46-BH-09-5.5-S

Refer to footnotes at end of table.

Table F-1 (Continued)
Summary of COCs for SWMU 46 Characterization and Confirmatory Soil Sampling

COC Type	Number of Samples	COCs Greater Than Background and Associated COCs	Maximum Background Limit North Supergroup[a]		Maximum Concentration	Sampling Locations Where Background Concentration was Exceeded[c]
			Surface[b]	Subsurface[b]		
Semivolatile Organic Compounds (µg/kg) (continued)	61 Environmental; 3 Duplicates; 8 EBs	Diethylphtalate	NA	NA	87.7 J	TJAOU-46-GR-10-1.3-S; TJAOU-46-GR-11-1.5-S; TJAOU-46-GR-12-1.3-S; TJAOU-46-GR-12-5.0-S; TJAOU-46-GR-13-1.5-S; TJAOU-46-GR-14-1.0-S; TJAOU-46-GR-15-1.0-S; TJAOU-46-GR-16-0.8-S; TJAOU-46-GR-17-0.7-S; TJAOU-46-GR-17-0.7-DU; TJAOU-46-GR-17-5.0-S; TJAOU-46-GR-18-0.5-S; TJAOU-46-GR-19-0.5-S
		Diphenyl amine	NA	NA	7.3 J	TJAOU-46-BH-09-5.5-S
		bis(2-Ethylhexyl) phthalate	NA	NA	2040	TJAOU-46-GR-06-2.0-S; TJAOU-46-GR-07-2.0-S; TJAOU-46-GR-07-5.0-S; TJAOU-46-GR-08-1.5-S; TJAOU-46-GR-09-2.0-S; TJAOU-46-GR-10-1.3-S; TJAOU-46-GR-11-1.5-S; TJAOU-46-GR-12-1.3-S; TJAOU-46-GR-12-5.0-S; TJAOU-46-GR-13-1.5-S; TJAOU-46-GR-14-1.0-S; TJAOU-46-GR-15-1.0-S; TJAOU-46-GR-16-0.8-S; TJAOU-46-GR-17-0.7-S; TJAOU-46-GR-17-0.7-DU; TJAOU-46-GR-17-5.0-S; TJAOU-46-GR-18-0.5-S; TJAOU-46-GR-19-0.5-S; TJAOU-46-GR-20-2.5-S; TJAOU-46-GR-21-0.0-S; TJAOU-46-GR-22-0.0-S; TJAOU-46-GR-23-0.0-S; TJAOU-46-GR-25-0.0-S; TJAOU-46-GR-25-5.0-S TJAOU-234-GR-07-0.0-S; TJAOU-234-GR-07-0.0-DU; TJAOU-234-GR-07-5.0-S; TJAOU-234-GR-08-5.0-S; TJA-6-BH-145-S; TJA-6-BH-145-DU; TJAOU-46-VW-01-45-S; TJAOU-46-VW-01-145-S
		Fluoranthene	NA	NA	450	TJAOU-46-BH-011-5.5-S; TJAOU-46-BH-02-5.0-S; TJAOU-46-BH-02-8.5-S; TJAOU-46-BH-03-7.0-S; TJAOU-46-BH-04-11.5-S; TJAOU-46-BH-06-9.5-S; TJAOU-46-BH-07-9.5-S; TJAOU-46-BH-08-5.5-S; TJAOU-46-BH-09-5.5-S; TJAOU-46-GR-11-1.5-S; TJAOU-46-GR-15-1.0-S; TJAOU-46-GR-16-0.8-S; TJAOU-46-GR-17-0.7-DU; TJAOU-46-GR-21-0.0-S; TJAOU-46-GR-22-0.0-S; TJAOU-46-GR-23-0.0-S TJAOU-234-GR-07-0.0-S; TJAOU-234-GR-07-0.0-DU; TJAOU-234-GR-07-5.0-S; TJAOU-234-GR-08-5.0-S
		Fluorene	NA	NA	14 J	TJAOU-46-BH-02-8.5-S; TJAOU-46-BH-09-5.5-S; TJAOU-46-GR-23-0.0-S; TJAOU-234-GR-07-0.0-S; TJAOU-234-GR-08-5.0-S

Refer to footnotes at end of table.

Table F-1 (Continued)
Summary of COCs for SWMU 46 Characterization and Confirmatory Soil Sampling

COC Type	Number of Samples	COCs Greater Than Background and Associated COCs	Maximum Background Limit North Supergroup[a]		Maximum Concentration	Sampling Locations Where Background Concentration was Exceeded[c]
			Surface[b]	Subsurface[b]		
Semivolatile Organic Compounds (µg/kg) (continued)	61 Environmental; 3 Duplicates; 8 EBs	Hexachlorobenzene	NA	NA	5.7 J	TJAOU-46-BH-02-5.0-S; TJAOU-46-BH-09-5.5-S
		Indeno(1,2,3-cd) pyrene	NA	NA	345 J	TJAOU-46-BH-08-5.5-S; TJAOU-46-GR-16-0.8-S; TJAOU-46-GR-21-0.0-S; TJAOU-46-GR-22-0.0-S; TJAOU-46-GR-23-0.0-S; TJAOU-234-GR-07-0.0-S; TJAOU-234-GR-07-0.0-DU
		Naphthalene	NA	NA	3.45	TJAOU-46-BH-08-5.5-S
		Phenanthrene	NA	NA	139	TJAOU-46-BH-011-5.5-S; TJAOU-46-BH-02-5.0-S; TJAOU-46-BH-02-8.5-S; TJAOU-46-BH-06-9.5-S; TJAOU-46-BH-08-5.5-S; TJAOU-46-BH-09-5.5-S; TJAOU-46-GR-16-0.8-S; TJAOU-46-GR-21-0.0-S; TJAOU-46-GR-22-0.0-S; TJAOU-46-GR-23-0.0-S; TJAOU-234-GR-07-0.0-S; TJAOU-234-GR-07-0.0-DU; TJAOU-234-GR-07-5.0-S; TJAOU-234-GR-08-5.0-S
		Phenol	NA	NA	1590	TJAOU-46-BH-010-5.5-S TJAOU-46-BH-010-8.0-S; TJAOU-46-BH-011-8.0-S; TJAOU-46-BH-08-13.5-S; TJAOU-46-BH-08-5.5-S; TJAOU-46-BH-08-9.5-S; TJAOU-46-BH-09-5.5-S TJAOU-46-VW-01-145-S
		Pyrene	NA	NA	603	TJAOU-46-BH-02-5.0-S; TJAOU-46-BH-06-9.5-S; TJAOU-46-BH-08-5.5-S; TJAOU-46-BH-09-5.5-S; TJAOU-46-GR-11-1.5-S; TJAOU-46-GR-14-1.0-S; TJAOU-46-GR-15-1.0-S; TJAOU-46-GR-16-0.8-S; TJAOU-46-GR-17-0.7-DU; TJAOU-46-GR-21-0.0-S; TJAOU-46-GR-22-0.0-S; TJAOU-46-GR-23-0.0-S; TJAOU-234-GR-07-0.0-S; TJAOU-234-GR-07-0.0-DU; TJAOU-234-GR-07-5.0-S; TJAOU-234-GR-08-5.0-S
High Explosives (µg/kg)	27 Environmental; 1 Duplicate; 1 EB	2-Nitrotoluene	NA	NA	15.2	TJAOU-46-BH-04-4.0-S
Radionuclides (pCi/g)	33 Environmental; 2 Duplicates; 6 EBs	Cesium-137	0.836	0.084	0.0685 U	All sample concentrations are below background value.
		Lead-212	NA	NA	1.63	All sample concentrations are below background value.
		Thorium-232	1.54	1.54	1.91	TJA-6-BH-45-S; TJAOU-234-GR-07-0.0-S; TJAOU-234-GR-07-0.0-DU; TJAOU-234-GR-07-5.0-S; TJAOU-234-GR-08-5.0-S; TJAOU-234-GR-07-0.0-S; TJAOU-234-GR-07-0.0-D;TJAOU-234-GR-07-5.0-S; TJAOU-234-GR-08-5.0-S

Refer to footnotes at end of table.

Table F-1 (Concluded)
Summary of COCs for SWMU 46 Characterization and Confirmatory Soil Sampling

COC Type	Number of Samples	COCs Greater Than Background and Associated COCs	Maximum Background Limit North Supergroup[a]		Maximum Concentration	Sampling Locations Where Background Concentration was Exceeded[c]
			Surface[b]	Subsurface[b]		
Radionuclides (pCi/g) (continued)	33 Environmental; 2 Duplicates; 6 EBs	Uranium-235	0.18	0.18	0.316	TJAOU-46-BH-03-9.0-S; TJAOU-46-BH-05-4.5-S; TJAOU-46-BH-07-4.5-S; TJAOU-46-BH-08-8.5-S; TJAOU-234-GR-08-5.0-S. Plus an additional two sample locations with ND results where the MDL exceeds background.
		Uranium-238	1.3	1.3	2.07	TJAOU-46-BH-03-13.0-S; TJAOU-46-BH-04-13.0-S; TJAOU-46-BH-05-4.5-S; TJAOU-46-BH-07-4.5-S; TJAOU-46-BH-08-8.5-S
		Tritium	0.021	0.021	0.007	All sample concentrations are nondetect.
		Alpha	NA	NA	18.4	TJAOU-234-GR-07-0.0-S; TJAOU-234-GR-07-0.0-DU; TJAOU-234-GR-07-5.0-S; TJAOU-234-GR-08-5.0-S
		Beta	NA	NA	25.1	TJAOU-234-GR-07-0.0-S; TJAOU-234-GR-07-0.0-DU; TJAOU-234-GR-07-5.0-S; TJAOU-234-GR-08-5.0-S

[a]Dinwiddie September 1997.

[b]Surface samples defined as 0 to 6 inches; subsurface samples are greater than 6 inches.

[c]Includes sample locations with ND results where no approved background limit exists.

BH = Borehole.
COC = Contaminant of Concern.
DU = Duplicate Sample.
EB = Equipment Blank.
GR = Grab sample.
J = Estimated concentration.
MDL = Method detection limit
mg/kg = Milligram(s) per kilogram.
µg/kg = Microgram(s) per kilogram.
NA = Not applicable.
ND = Nondetect.
OU = Operable Unit.
pCi/g = Picocurie(s) per gram.
S = Soil Sample.
SWMU = Solid Waste Management Unit.
TB = Trip Blank.
TJA = Tijeras Arroyo.
U = Nondetect.
VW = Vapor Well.

ATTACHMENT G
Risk Assessment Summary for SWMU 46

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SWMU 46: RISK ASSESSMENT REPORT

I. Site Description and History

Solid Waste Management Unit (SWMU) 46, the Old Acid Waste Line Outfall, encompasses approximately 2.25 acres at the southwest corner of Technical Area (TA)-IV. The site consists of the inactive outfall (discharge point) for the Old Acid Waste Line (SWMU 226) that was connected to six research buildings in TA-I. The acid waste line is constructed of 8-inch-diameter vitrified clay pipe. SWMU 46 was identified during the 1987 Comprehensive Environmental Assessment and Response Program (CEARP) as the Old Acid Waste Line Outfall (DOE 1987). From about 1948 through late 1974, SWMU 46 discharged acid waste water that contained a variety of chemicals and possibly some radionuclides. The waste water discharged into three shallow, nearly parallel, earthen outfall ditches (OD-1, OD-2, and OD-3) that extended across the East Mesa. Each outfall ditch measured approximately 700 feet long. The confluence of these three outfall ditches is still present on the northern rim of Tijeras Arroyo.

The specific types and volumes of waste water discharged from the acid waste line are not clearly documented. According to the CEARP (DOE 1987), the "old acid waste line was used to discharge about 130,000 gallons per day (gpd) of acidic waste water from Area I to an open ditch that emptied into Tijeras Arroyo. Most of the water was from cooling tower blowdown; however, this line also carried some waste liquid from etching and photographic processing. The contaminants discharged were primarily chromic acid (approximately 200 gallons per day) and ferric chloride." The CEARP is the only historical document that cites a waste-water discharge rate for the acid waste line (DOE 1987). Assuming that 130,000 gpd were discharged at a constant rate for 27 years, the resulting total would be approximately 1.3 billion gallons of waste water.

Polychlorinated biphenyls (PCBs) and elevated concentrations of metals, such as arsenic, cadmium, and chromium, have been identified in SWMU 46 soil samples. Soil-vapor samples suggest SWMU 46 may be a release site for trichloroethylene (TCE) that has impacted groundwater.

SWMU 46 is located on land that the U.S. Department of Energy (DOE) leases from Kirtland Air Force Base (KAFB). Ground elevations at SWMU 46 range from approximately 5,390 feet above mean sea level (amsl) at the northern site boundary to about 5,370 feet amsl at the southern site boundary on the northern rim of Tijeras Arroyo. The site, approximately 2.25 acres, is not fenced. SWMU 46 is located in a relatively remote setting where the only foot traffic consists of the occasional jogger and walker. The fire-extinguisher training facility and the unpaved TA-IV perimeter road are nearby. Outdoor classes involving about a dozen trainees are held at the fire-extinguisher training facility about once per month. A few vehicles per day use the perimeter road. The southeastern end of SWMU 46 is situated on the steeply sloping rim of Tijeras Arroyo; however; the majority of the site is located on a flat portion of the East Mesa. SWMU 46 is on the east side of the inactive KAFB skeet range.

The annual precipitation at KAFB is 8.2 inches (SNL/NM February 2001). No springs or perennial surface-water bodies are located within two miles of SWMU 46. The site is situated approximately 2,000 feet north of the active channel of Tijeras Arroyo and outside of the

100-year floodplain. Storm water flows in the active channel at the nearby Pennsylvania Street Bridge approximately a dozen days per year and only as a result of significant precipitation events. Tijeras Arroyo is the most significant storm-water drainage feature on KAFB and originates in Tijeras Canyon, which is bounded by the Sandia Mountains to the north and the Manzano Mountains to the south. The arroyo contains a drainage basin that captures runoff from Tijeras Canyon and various storm-water channels at KAFB, Sandia National Laboratories/New Mexico (SNL/NM), and southeast Albuquerque. The arroyo eventually drains into the Rio Grande, approximately 8 miles west of SWMU 46.

The soil at SWMU 46 is poorly developed with high alkalinity. The subsurface geology consists of unconsolidated alluvial and colluvial deposits derived from the Sandia and Manzanita Mountains. These upper Santa Fe Group deposits consist of sediment ranging from clay to gravel, derived from the granitic rocks of the Sandia Mountains, and greenstone, limestone, and quartzite derived from the Manzanita Mountains. The depth to Pennsylvanian strata and/or Precambrian basement beneath TA-IV is approximately 3,000 feet below ground surface (bgs).

Groundwater data for SWMU 46 was obtained from the Tijeras Arroyo Groundwater (TAG) investigation. The hydrogeologic setting of the TAG study area is dominated by two water-bearing zones, the perched system and the regional aquifer, both of which are present within the upper Santa Fe Group. The perched system is not used as a water supply source. However, the City of Albuquerque, KAFB, and the Veterans Administration use the regional aquifer for water supply purposes.

At the northern end of SWMU 46, the depth to the perched system is approximately 303 feet bgs. However, the site extends across the southwestern boundary of the perched system, which covers approximately 3.5 square miles in the central part of the TAG study area. The direction of groundwater flow in the perched system is to the southeast. Discontinuous, yet overlapping, multiple lenses of unsaturated alluvial fan sediment serve as a perching horizon beneath the perched system and above the regional aquifer. The depth to the regional aquifer is approximately 499 feet bgs at the northern edge of the site. The direction of groundwater flow in the regional aquifer is principally to the northwest towards several water-supply wells. The nearest water-supply well (KAFB-1) is located approximately 1.3 miles northwest of the site. Groundwater from the perched system merges with the regional aquifer southeast of Tijeras Arroyo. The regional aquifer extends across the entire TAG study area and the Albuquerque Basin.

The vicinity of SWMU 46 is unpaved. During most rainfall events, rain quickly infiltrates the soil at SWMU 46. However, virtually all of the moisture undergoes evapotranspiration. Estimates of evapotranspiration for the KAFB area range from 95 to 99 percent of the annual rainfall (SNL/NM February 1998a).

The area around SWMU 46 originally consisted of desert grassland habitat, but this has been highly disturbed by various construction activities (IT 1995). The site is mostly barren but has some limited vegetation consisting of ruderal species, such as Russian thistle (tumbleweed). Grasslands are the dominant plant community west of SWMU 46 and include species such as blue and black grama and western cheatgrass (IT 1995). The indigenous wildlife includes reptiles, birds, and small mammals. However, wildlife use is limited by the degree of disturbance and proximity to operational facilities. The site was surveyed for sensitive species in 1994 (IT 1995); no threatened or endangered species, nor any other species of concern, were identified in the vicinity of SWMU 46. No riparian or wetland habitats are present within

4 miles of the site. No significant archaeological artifacts or cultural resources have been identified in the vicinity of SWMU 46 (Hoagland September 1994).

The Tijeras Arroyo Operable Unit manages SWMU 46. Other Operable Units (OUs) also have provided relevant information for the site. In the 1990s, TA-I OU personnel interviewed laboratory personnel, and various lateral extensions were excavated showing that the acid waste line was connected to Buildings 839, 840, 841, 860, 863, and 892. These buildings contained various shops (instrument repair, machining, ceramics, sheet metal, welding, paint, plating), a foundry, microelectronic clean rooms, office space, general research laboratories, environmental-conditions test chambers, storage rooms, and facilities for the assembly of weapon components (SNL/NM May 1997; DOE December 2001).

In addition to the various chemicals (cooling tower blowdown, chromic acid, ferric chloride, etching liquids, and photographic processing waste water) mentioned in the CEARP (DOE 1987), the acid waste line also received electroplating solutions and chromates (SNL/NM May 1997). Most of the chemicals used in the six buildings were typically containerized for off-site disposal. However, some waste water discharged to the acid waste line may have contained various organic compounds (acetone, TCE, and toluene); isopropyl alcohol; methyl alcohol; electroplating solutions containing nickel acetate, cadmium cyanide, copper cyanide, hydrogen sulfide, nickel sulfate, copper sulfate, and sodium dichromate; polyvinyl alcohol binder; various acids (acetic, chromic, sulfuric, nitric); sodium hydroxide; paints; paint strippers; machining coolant oils; metals (aluminum, depleted uranium, lead, and silver); and PCBs. Photographic laboratory waste water typically contains a variety of solutions, such as developers, washes, bleaches, fixers, conditioners, and stabilizers.

The acid waste line may have received a relatively minor amount of sanitary waste (sewage) from inadvertent cross-connections between various TA-I piping systems. However, the disposal of sewage in the outfall ditches was probably limited because of health concerns and odor problems. Storm-water systems were not connected to the acid waste line.

The outfall ditch, OD-1, was constructed in 1948. Soon after, the flow of waste water was apparently limited by the buildup of either vegetation and/or sloughed soil from the unlined ditch banks. The low slope (grade) of the acid waste line and outfall ditch aggravated the drainage problem. OD-2 was constructed about 1950; OD-3 was constructed in the mid-1960s. All three outfall ditches carried waste water until late 1974. Ponding visible in historic aerial photographs shows that all three outfall ditches were essentially linked together at the northern end of the site. As a result, the three outfall ditches carried the same types of waste water and constituents of concern (COCs).

II. Data Quality Objectives

The data quality objectives (DQOs) for SWMU 46 were presented in two documents: 1) the Tijeras Arroyo Outfalls Field Implementation Plan (FIP) (SNL/NM May 2001) and 2) the SWMU 46 Voluntary Corrective Action (VCA) Plan (SNL/NM August 2003). These two plans identified the site-specific confirmatory locations, sample depths, sampling procedures, and analytical requirements. The DQOs also outlined the quality assurance (QA)/quality control (QC) requirements necessary for producing defensible analytical data suitable for risk assessment purposes. In accordance with the FIP (SNL/NM May 2001) and the VCA Plan (SNL/NM August 2003), confirmatory soil samples were collected along the three outfall ditches

associated with the acid waste line. The confirmatory sampling was designed to evaluate the distribution of soil contamination resulting from the 1948 to 1975 discharge of TA-I waste water at SWMU 46. The VCA Plan (SNL/NM August 2003) also defined the confirmatory sampling requirements for determining whether the VCA activities had adequately removed all soil containing elevated concentrations of COCs.

As shown in Table 1, four confirmatory sampling events provide the analytical data relevant to SWMU 46. Sample locations, depth ranges, and collection techniques are also listed in Table 1. The first three events (Geoprobe®, VCA, and Deep Boreholes) were conducted as part of the 2001 and 2003 SWMU 46 confirmatory sampling activities. The fourth event (SWMU 234 Sampling) was conducted in 2001. The two SWMU 234 sample locations listed in Table 1 are relevant to SWMU 46 because these two sample locations are situated on the eastern end of the SWMU 46 Outfall Ditch OD-3. The northern boundary of SWMU 234 coincides with the eastern boundary of SWMU 46. The two SWMU 234 sample locations therefore serve to characterize the discharge of both SWMU 46 waste water and TA-IV storm water. SWMU 234 received storm water from the early 1980s until the early 1990s.

Table 1
Soil Sampling Locations for SWMU 46 Risk Assessments

Sampling Event	Soil Sample Locations	Sample Depth Range (ft bgs)	Collection Technique
SWMU 46 Geoprobe®	46-BH-02 through 46-BH-12	3–18	Split-spoon sampler with acetate sleeves
SWMU 46 VCA	Remediation trench: 46-GR-05 through 46-GR-23, and 46-GR-26. Confluence: 46-GR-24 and 46-GR-25	0–7 0–12	Hand trowel for 0- to 4-ft-bgs samples; backhoe or excavator bucket for 5- to 12-ft-bgs samples
SWMU 46 Deep Borehole	TJA-6 46-VW-01	45–245 45–295	Split-spoon sampler with stainless steel sleeves
SWMU 234 Sampling	234-GR-07 234-GR-08	5 5	Backhoe bucket

bgs = Below ground surface.
BH = Borehole.
ft = Foot (feet).
GR = Grab sample.
SWMU = Solid Waste Management Unit.
TJA = Tijeras Arroyo.
VCA = Voluntary Corrective Action.
VW = Vapor Well.

Soil samples from the four events were analyzed for metals (either Resource Conservation and Recovery Act metals [RCRA] or Target Analyte List [TAL] metals), chromium-VI, cyanide, PCBs, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), high-explosive (HE) compounds, gamma-emitting radionuclides, gross alpha/beta activity, and H-3. Approximately 98 percent of the soil samples were analyzed by the off-site General Engineering Laboratories, Inc. (GEL). As shown in Tables 2 and 3, a total of 323 off-site analyses

Table 2
Number of Analyses for Soil Samples Collected for SWMU 46 in 2001 and 2003

Sample Type	Metals[a]	PCBs	VOCs	SVOCs	HE Compounds	Radionuclides[b]	Radionuclides	Number of Analyses
Soil	61	57	69	61	27	33	4	312
Duplicate	3	3	3	3	1	2	0	15
Equipment Blank	7	5	9	8	1	6	2	38
VOC Trip Blank	–	–	12	–	–	–	–	12
Total Samples	71	65	93	72	29	41	6	377
Laboratory	GEL	GEL	GEL	GEL	GEL	GEL	RPSD	NA

[a]Includes analyses for RCRA or TAL metals, and includes chromium-VI and cyanide.
[b]Includes gamma-emitting radionuclides, gross alpha/beta activity, and H-3.
GEL = General Engineering Laboratories, Inc.
HE = High explosive(s).
NA = Not applicable.
PCB = Polychlorinated biphenyl.
RCRA = Resource Conservation and Recovery Act.
RPSD = Radiation Protection Sample Diagnostics.
SVOC = Semivolatile organic compound.
SWMU = Solid Waste Management Unit.
TAL = Target Analyte List.
VOC = Volatile organic compound.
– = Not analyzed.

Table 3
Summary of Data Quality Requirements and Total Number of Analyses (On- and Off-Site) for Confirmatory Soil Samples Relevant to SWMU 46

Analytical Method[a]	Data Quality Level	Analyses from Off-Site Laboratory[b]	Analyses from On-Site Laboratory[c]
Metals (RCRA/TAL), Chromium-VI, Cyanide EPA Method 6010/7000/9010	Defensible	64	–
PCBs EPA Method 8330	Defensible	60	–
VOCs EPA Method 8260	Defensible	72	–
SVOCs EPA Method 8270	Defensible	64	–
HE Compounds EPA Method 8330	Defensible	28	–
Gamma Spectroscopy HASL 300 or EPA Method 901.1	Defensible	25	4
H-3 EPA Method 906.0	Defensible	6	–
Gross Alpha/Beta Activity EPA Method 900.0	Defensible	4	–
Total number of analyses[d]		323	4

[a]EPA November 1986.
[b]General Engineering Laboratories, Inc. provided the off-site analyses.
[c]The SNL/NM RPSD Laboratory provided the on-site analyses.
[d]Includes duplicate samples, but not other QA/QC samples such as equipment blanks or VOC trip blanks.
HASL = Health and Safety Lab.
HE = High explosive(s).
PCB = Polychlorinated biphenyl.
QA = Quality assurance.
QC = Quality control.
RCRA = Resource Conservation and Recovery Act.
RPSD = Radiation Protection Sample Diagnostics.
SNL/NM = Sandia National Laboratories/New Mexico.
SVOC = Semivolatile organic compound.
SWMU = Solid Waste Management Unit.
TAL = Target Analyte List.
VOC = Volatile organic compound.
– = Not analyzed.

(environmental samples plus duplicates) were utilized for the SWMU 46 risk assessments. An additional four samples analyzed for gamma-emitting radionuclides by the on-site SNL/NM Radiation Protection Sample Diagnostics (RPSD) Laboratory also were used. These 327 soil samples characterize in situ conditions.

Highlights of the SWMU 46 analytical results for the four sampling events include:

- Thirteen metals (arsenic, barium, beryllium, cadmium, total chromium, copper, lead, nickel, selenium, silver, thallium, vanadium, zinc) were detected at levels above background concentrations.

- The maximum total PCB concentration was 0.1298 milligrams (mg)/kilogram (kg).
- Three radionuclides (Th-232, U-235, and U-238) were detected at levels slightly above background activities.
- Low concentrations of four VOCs (acetone, 2-butanone, methylene chloride, and toluene) were detected.
- Low concentrations of 26 SVOCs were detected.
- One HE compound, 2-nitrotoluence at 15.2 micrograms/kg, was detected.
- The maximum cyanide concentration was 12.7 mg/kg.

A total of 377 analyses are applicable to SWMU 46 (Table 2). As shown in Table 2, the QA/QC analyses consisted of 15 duplicates, 38 equipment blanks, and 12 VOC trip blanks. For each of the four sampling events, the duplicate soil samples were collected at ratios complying with the SNL/NM Environmental Restoration (ER) Project Quality Assurance Project Plan. The aqueous VOC trip blanks were supplied by the off-site analytical laboratory. The equipment (aqueous rinsate) blanks were prepared in the field as part of the sampling effort. No significant QA/QC problems were identified in the analyses for the duplicates, equipment blanks, or VOC trip blanks.

Table 3 summarizes the analytical methods and data quality requirements from the FIP (SNL/NM May 2001) and the VCA Plan (SNL/NM August 2003). The confirmatory analytical data were reviewed and verified/validated according to "Data Validation Procedure for Chemical and Radiochemical Data," in SNL/NM ER Project Administrative Operating Procedure (AOP) 00-03, Revision 0 (SNL/NM December 1999). In addition, the RPSD Laboratory reviewed all gamma spectroscopy results according to "Laboratory Data Review Guidelines," Procedure No. RPSD-02-11, Issue No. 2 (SNL/NM July 1996). Data packages from the two analytical laboratories were determined to be defensible and acceptable for use in this risk assessment. Therefore, the DQOs have been fulfilled.

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 46 was based upon an initial conceptual model validated with confirmatory sampling at the site. The initial conceptual model was developed from archival site research, site inspections, and soil sampling. The quality of the data specifically used to determine the nature, migration rate, and extent of contamination is described in the following sections.

III.2 Nature of Contamination

Both the nature of contamination and the potential for the degradation of COCs at SWMU 46 were evaluated using laboratory analyses of the soil samples. The analytical requirements included analyses for VOCs, SVOCs, HE compounds, PCBs, RCRA or TAL metals, hexavalent chromium, cyanide, radionuclides by gamma spectroscopy, and gross alpha and beta activities. The analytes and methods listed in Tables 2 and 3 are appropriate to characterize the COCs and potential degradation products at SWMU 46.

III.3 Rate of Contaminant Migration

SWMU 46 is an inactive site; therefore, all primary sources of COCs have been eliminated. As a result, only secondary sources of COCs potentially remain in the soil in the form of adsorbed COCs. The rate of COC migration from soil is therefore predominantly dependent upon precipitation and occasional surface-water flow. Data available from the TA-V Groundwater Investigation (SNL/NM November 2001); numerous SNL/NM monitoring programs for air, water, and radionuclides; and meteorological monitoring are adequate for characterizing the rate of COC migration at SWMU 46.

III.4 Extent of Contamination

Samples were collected from the surface and subsurface soil at SWMU 46 in order to determine the vertical and horizontal extent of contamination. Soil samples were collected from the surface to a maximum depth of 295 feet bgs during the drilling activities.

Extensive surface soil sampling was conducted within the boundaries of the surface in addition to the subsurface soil samples collected from four boreholes. These soil samples are considered to be representative of the soil directly beneath and adjacent to the surface impoundments and sufficient to determine the vertical extent, if any, of COCs.

In summary, the design of the confirmatory soil sampling plan was appropriate and adequate to determine the nature, migration rate, and extent of residual COCs in the surface and subsurface soil at SWMU 46.

IV. Comparison of COCs to Background Screening Levels

Site history and characterization activities are used to identify potential COCs. The SWMU 46 proposal for no further action (NFA) describes the identification of COCs and the sampling that was conducted in order to determine the concentration levels of those COCs across the site. Generally, COCs evaluated in this risk assessment include all detected organic and all inorganic and radiological COCs for which samples were analyzed. When 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. Nondetected organic compounds not included in this assessment were determined to have detection limits low enough to ensure protection of human health and the environment. In order to provide conservatism in this risk assessment, the calculation uses only the maximum concentration value of each COC found for

the entire site. The SNL/NM maximum background concentration (Dinwiddie September 1997) was selected to provide the background screen listed in Tables 4 through 7.

Nonradiological inorganic constituents that are essential nutrients, such as iron, magnesium, calcium, potassium, and sodium, are not included in this risk assessment (EPA 1989). Both radiological and nonradiological COCs are evaluated. The nonradiological COCs included in the risk assessment consist of both inorganic and organic compounds.

Tables 4 and 5 list the nonradiological COCs for the human health and the ecological risk assessments at SWMU 46, respectively. Tables 6 and 7 list the radiological COCs for the human health and ecological risk assessments, respectively. All tables show the associated SNL/NM maximum background concentration values (Dinwiddie September 1997). Section VI.4 discusses the results presented in Tables 4 and 6; Sections VII.2 and VII.3 discuss the results presented in Tables 5 and 7.

V. Fate and Transport

The primary releases of COCs at SWMU 46 were to the soil resulting from the waste water from six research facilities at TA-1. Wind, water, and biota are natural mechanisms of COC transport from the primary release point; however, because the discharge was to subsurface soil, none of these are considered to be of potential significance as transport mechanisms at this site. Because the system is no longer active, additional infiltration of water is not expected. Infiltration of precipitation is essentially nonexistent at SWMU 46, as virtually all of the moisture either drains away from the site or evaporates. Because groundwater at this site is approximately 499 feet bgs, the potential for COCs to reach groundwater through the unsaturated zone above the water table is extremely low.

COCs at SWMU 46 include both inorganic and organic constituents. The inorganic COCs include both radiological and nonradiological analytes. With the exception of cyanide, the inorganic COCs are elemental in form and are not considered to be degradable. Transformations of these inorganic COCs 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). Cyanide can be metabolized by soil biota. Radiological COCs will undergo decay to stable isotopes or radioactive daughter elements. However, because of the long half-lives of the radiological COCs, the aridity of the environment at this site, and the lack of potential contact with biota, none of these mechanisms are expected to result in significant losses or transformations of the inorganic COCs.

The organic COCs at SWMU 46 include VOCs and SVOCs. Organic compounds may be degraded through photolysis, hydrolysis, and biotransformation. Photolysis requires light and therefore takes place in the air, at the ground surface, or in surface water. Hydrolysis includes chemical transformations in water and may occur in the soil solution. Biotransformation (i.e., transformation caused by plants, animals, and microorganisms) may occur; however, biological activity may be limited by the arid environment at this site.

Table 4
Nonradiological COCs for Human Health Risk Assessment at SWMU 46 with Comparison to the Associated SNL/NM Background Screening Value, BCF, and Log K_{ow}

COC	Maximum Concentration (All Samples) (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)
Inorganic						
Antimony	0.724 J	3.9	Yes	16,000[c]	NA	**Yes**
Arsenic	5.23	4.4	**No**	44[d]	NA	**Yes**
Barium	572	200	**No**	170[e]	NA	**Yes**
Beryllium	0.891	0.80	**No**	19[d]	NA	No
Cadmium	213	0.9	**No**	64[d]	NA	**Yes**
Chromium VI	2.08	NC	**Unknown**	16[d]	NA	No
Chromium-total	120	12.8	**No**	16[d]	NA	No
Cobalt	7.93	8.8	Yes	10,000[f]	NA	**Yes**
Copper	133 J	17	**No**	6[d]	NA	No
Lead	66.8 J	11.2	**No**	49[d]	NA	**Yes**
Mercury	0.0766	<0.1	**Unknown**	5,500[d]	NA	**Yes**
Nickel	379	25.4	**No**	47[d]	NA	**Yes**
Selenium	1.28	<1	**Unknown**	800[c]	NA	**Yes**
Silver	16.2	<1	**Unknown**	0.5[d]	NA	No
Thallium	2.19	<1.1	**Unknown**	119[d]	NA	**Yes**
Vanadium	46.5	33	**No**	3,000[e]	NA	**Yes**
Zinc	149 J	76	**No**	47[d]	NA	**Yes**
Cyanide-total	12.7	NC	**Unknown**	NC	NA	No
VOCs						
Acetone	0.0132	NA	**NA**	0.69[g]	-0.24[g]	No
2-Butanone	0.107	NA	**NA**	1.0[g]	0.29[g]	No
Methylene chloride	0.00704	NA	**NA**	5.0[g]	1.25[g]	No
Toluene	0.017	NA	**NA**	10.7[d]	2.69[d]	No

Refer to footnotes at end of table.

Table 4 (Continued)
Nonradiological COCs for Human Health Risk Assessment at SWMU 46 with Comparison to the Associated SNL/NM Background Screening Value, BCF, and Log K_{ow}

COC	Maximum Concentration (All Samples) (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)
SVOCs						
Acenaphthene	0.00626 J	NA	**NA**	389[h]	3.92[h]	**Yes**
Acenaphthylene	0.00406 J	NA	**NA**	575[h]	4.07[h]	**Yes**
Anthracene	0.0212 J	NA	**NA**	917[d]	4.45[d]	**Yes**
Benzo(a)anthracene	0.258	NA	**NA**	10,000[h]	5.61[h]	**Yes**
Benzo(a)pyrene	0.435	NA	**NA**	3,000[d]	6.04[d]	**Yes**
Benzo(b)fluoranthene	0.506	NA	**NA**	–	6.12[h]	**Yes**
Benzo(g,h,i)perylene	0.309	NA	**NA**	58,884[h]	6.58[h]	**Yes**
Benzo(k)fluoranthene	0.471	NA	**NA**	93,325[h]	6.84[h]	**Yes**
Butylbenzylphthalate	0.0565 J	NA	**NA**	663[g]	4.77[h]	**Yes**
Carbazole	0.0182 J	NA	**NA**	–	–	No
2-Chlorophenol	0.00835 J	NA	**NA**	214[i]	2.15[i]	**Yes**
Chrysene	0.435	NA	**NA**	18,000[h]	5.91[h]	**Yes**
Di-n-butylphthalate	0.0495 J	NA	**NA**	6,761[i]	4.61[h]	**Yes**
Di-n-octylphthalate	0.0102 J	NA	**NA**	9,334[h]	5.22[h]	**Yes**
Diethylpthalate	0.0877 J	NA	**NA**	117[i]	2.47[i]	**Yes**
Dibenzofuran	0.0094 J	NA	**NA**	2,800[h]	4.12[h]	**Yes**
1,2-Dichlorobenzene	0.00451 J	NA	**NA**	560[i]	3.38[i]	**Yes**
1,3-Dichlorobenzene	0.00486 J	NA	**NA**	740[i]	3.53[h]	**Yes**
Diphenylamine	0.0073 J	NA	**NA**	217[h]	3.13[h]	**Yes**
bis(2-Ethylhexyl) phthalate	2.04	NA	**NA**	851[i]	7.6[h]	**Yes**
Fluoranthene	0.450	NA	**NA**	12,302[h]	4.90[h]	**Yes**
Fluorene	0.014 J	NA	**NA**	2,239[h]	4.18[h]	**Yes**
Hexachlorobenzene	0.0057 J	NA	**NA**	31,622[i]	5.31[i]	**Yes**
Indeno(1,2,3-cd)pyrene	0.345 J	NA	**NA**	59,407[h]	6.58[h]	**Yes**

Refer to footnotes at end of table.

Table 4 (Concluded)
Nonradiological COCs for Human Health Risk Assessment at SWMU 46 with Comparison to the Associated SNL/NM Background Screening Value, BCF, and Log K_{ow}

COC	Maximum Concentration (All Samples) (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)
Naphthalene	0.00345 J	NA	**NA**	1,000[h]	3.30[h]	**Yes**
Phenanthrene	0.139	NA	**NA**	23,800[h]	4.63[d]	**Yes**
Phenol	1.59	NA	**NA**	277[i]	1.46[i]	**Yes**
Pyrene	0.603	NA	**NA**	36,300[d]	5.32[h]	**Yes**
HE Compound						
2-Nitrotoluene	0.0152	NA	**NA**	<100[h]	2.37[h]	**Yes**
PCBs						
Aroclor-1242	0.242	NA	**NA**	31,200[d]	6.72[d]	**Yes**
Aroclor-1248	0.0026 J	NA	**NA**	31,200[d]	6.72[d]	**Yes**
Aroclor-1254	0.425	NA	**NA**	31,200[d]	6.72[d]	**Yes**
Aroclor-1260	0.174	NA	**NA**	31,200[d]	6.72[d]	**Yes**

Note: **Bold** indicates the COCs that exceed the background screening values and/or are bioaccumulators.
[a]Dinwiddie September 1997, North Area Supergroup.
[b]NMED March 1998.
[c]Callahan et al. 1979.
[d]Yanicak March 1997.
[e]Neumann 1976.
[f]Vanderploeg et al. 1975.
[g]Howard 1990.
[h]Micromedex, Inc. 1998.
[i]Howard 1989.

BCF = Bioconcentration factor.
COC = Constituent of concern.
HE = High explosive(s).
J = Estimated concentration.
K_{ow} = Octanol-water partition coefficient.
Log = Logarithm (base 10).
mg/kg = Milligram(s) per kilogram.
NA = Not applicable.
NC = Not calculated.
NMED = New Mexico Environment Department.
PCB = Polychlorinated biphenyl.
SNL/NM = Sandia National Laboratories/New Mexico.
SVOC = Semivolatile organic compound.
SWMU = Solid Waste Management Unit.
VOC = Volatile organic compound.
– = Information not available.

Table 5
Nonradiological COCs for Ecological Risk Assessment at SWMU 46 with Comparison to the Associated SNL/NM Background Screening Value, BCF, and Log K_{ow}

COC	Maximum Concentration (All Samples) (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)
Inorganic						
Antimony	0.724 J	3.9	Yes	16,000[c]	NA	**Yes**
Arsenic	**4.41**	4.4	**No**	44[d]	NA	**Yes**
Barium	**330 J**	200	**No**	170[e]	NA	**Yes**
Beryllium	0.557	0.80	Yes	19[d]	NA	No
Cadmium	**213**	0.9	**No**	64[d]	NA	**Yes**
Chromium VI	2.08	NC	**Unknown**	16[d]	NA	No
Chromium-total	**78.7 J**	12.8	**No**	16[d]	NA	No
Cobalt	5.73	8.8	Yes	10,000[f]	NA	**Yes**
Copper	133 J	17	**No**	6[d]	NA	No
Lead	**66.8 J**	11.2	**No**	49[d]	NA	**Yes**
Mercury	0.0766	<0.1	**Unknown**	5,500[d]	NA	**Yes**
Nickel	**379**	25.4	**No**	47[d]	NA	**Yes**
Selenium	0.261 J	<1	**Unknown**	800[c]	NA	**Yes**
Silver	**12.4**	<1	**Unknown**	0.5[d]	NA	No
Vanadium	**46.5**	33	**No**	3,000[e]	NA	**Yes**
Zinc	149 J	76	**No**	47[d]	NA	**Yes**
Cyanide-total	0.128 J	NC	**Unknown**	NC	NA	No
VOCs						
Acetone	0.00235 J	NA	**NA**	0.69[g]	-0.24[g]	No
2-Butanone	0.107	NA	**NA**	1.0[g]	0.29[g]	No
Toluene	0.008	NA	**NA**	10.7[d]	2.69[d]	No
SVOCs						
Acenaphthene	0.00626 J	NA	**NA**	389[h]	3.92[h]	**Yes**
Anthracene	0.0212 J	NA	**NA**	917[d]	4.45[d]	**Yes**

Refer to footnotes at end of table.

Table 5 (Continued)
Nonradiological COCs for Ecological Risk Assessment at SWMU 46 with Comparison to the Associated SNL/NM Background Screening Value, BCF, and Log K_{ow}

COC	Maximum Concentration (All Samples) (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)
Benzo(a)anthracene	0.258	NA	**NA**	10,000[h]	5.61[h]	**Yes**
Benzo(a)pyrene	0.435	NA	**NA**	3,000[d]	6.04[d]	**Yes**
Benzo(b)fluoranthene	0.506	NA	**NA**	–	6.12[h]	**Yes**
Benzo(g,h,i)perylene	0.309	NA	**NA**	58,884[h]	6.58[h]	**Yes**
Benzo(k)fluoranthene	0.471	NA	**NA**	93,325[h]	6.84[h]	**Yes**
Butylbenzylphthalate	0.0159 J	NA	**NA**	663[g]	4.77[h]	**Yes**
Carbazole	0.0182 J	NA	**NA**	–	–	No
Chrysene	0.435	NA	**NA**	18,000[h]	5.91[h]	**Yes**
Di-n-butylphthalate	0.0262 J	NA	**NA**	6,761[i]	4.61[h]	**Yes**
Di-n-octylphthalate	0.0102 J	NA	**NA**	9,334[h]	5.22[h]	**Yes**
Diethylpthalate	0.0877 J	NA	**NA**	117[i]	2.47[i]	**Yes**
1,3-Dichlorobenzene	0.00486 J	NA	**NA**	740[i]	3.53[h]	**Yes**
bis(2-Ethylhexyl) phthalate	0.825	NA	**NA**	851[i]	7.6[h]	**Yes**
Fluoranthene	0.450	NA	**NA**	12,302[h]	4.90[h]	**Yes**
Fluorene	0.00666 J	NA	**NA**	2,239[h]	4.18[h]	**Yes**
Hexachlorobenzene	0.0057 J	NA	**NA**	31,622[i]	5.31[i]	**Yes**
Indeno(1,2,3-cd)pyrene	0.345 J	NA	**NA**	59,407[h]	6.58[h]	**Yes**
Phenanthrene	0.139	NA	**NA**	23,800[h]	4.63[d]	**Yes**
Pyrene	0.603	NA	**NA**	36,300[d]	5.32[h]	**Yes**
HE Compound						
2-Nitrotoluene	0.0152	NA	**NA**	<100[h]	2.37[h]	**Yes**

Refer to footnotes at end of table.

Table 5 (Concluded)
Nonradiological COCs for Ecological Risk Assessment at SWMU 46 with Comparison to the Associated SNL/NM Background Screening Value, BCF, and Log K_{ow}

COC	Maximum Concentration (All Samples) (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)
PCBs						
Aroclor-1242	0.0709	NA	**NA**	31,200[d]	6.72[d]	**Yes**
Aroclor-1248	0.0026 J	NA	**NA**	31,200[d]	6.72[d]	**Yes**
Aroclor-1254	0.0817	NA	**NA**	31,200[d]	6.72[d]	**Yes**
Aroclor-1260	0.0198	NA	**NA**	31,200[d]	6.72[d]	**Yes**

Note: **Bold** indicates the COCs that exceed the background screening values and/or are bioaccumulators.
[a]Dinwiddie September 1997, North Area Supergroup.
[b]NMED March 1998.
[c]Callahan et al. 1979.
[d]Yanicak March 1997.
[e]Neumann 1976.
[f]Vanderploeg et al. 1975.
[g]Howard 1990.
[h] Micromedex, Inc. 1998.
[i]Howard 1989.

BCF = Bioconcentration factor.
COC = Constituent of concern.
HE = High explosive(s).
J = Estimated concentration.
K_{ow} = Octanol-water partition coefficient.
Log = Logarithm (base 10).
mg/kg = Milligram(s) per kilogram.
NA = Not applicable.
NC = Not calculated.
NMED = New Mexico Environment Department.
PCB = Polychlorinated biphenyl.
SNL/NM = Sandia National Laboratories/New Mexico.
SVOC = Semivolatile organic compound.
SWMU = Solid Waste Management Unit.
VOC = Volatile organic compound.
– = Information not available.

Table 6
Radiological COCs for Human Health Risk Assessment at SWMU 46 with Comparison to the Associated SNL/NM Background Screening Value and BCF

COC	Maximum Activity (All Samples) (pCi/g)	SNL/NM Background Activity (pCi/g)[a]	Is Maximum COC Activity Less Than or Equal to the Applicable SNL/NM Background Screening Value?	BCF (Maximum Aquatic)	Is COC a Bioaccumulator?[b] (BCF >40)
Cs-137	ND (0.0685)	0.084	Yes	3,000[c]	**Yes**
H-3	0.007	0.021	Yes	0	No
Th-232	**1.91**	1.54	**No**	3,000[c]	**Yes**
U-235	**ND (0.316)**	0.18	**No**	900[c]	**Yes**
U-238	**207**	1.3	**No**	900[c]	**Yes**

Note: **Bold** indicates COCs that exceed background screening values and/or are bioaccumulators.
[a]Dinwiddie September 1997, North Area Supergroup.
[b]NMED March 1998.
[c]Baker and Soldat 1992.
BCF = Bioconcentration factor.
COC = Constituent of concern.
MDA = Minimum detectable activity.
ND ( ) = Not detected above the MDA, shown in parentheses.
NMED = New Mexico Environment Department.
pCi/g = Picocurie(s) per gram.
SNL/NM = Sandia National Laboratories/New Mexico.
SWMU = Solid Waste Management Unit.

Table 7
Radiological COCs for Ecological Risk Assessment at SWMU 46 with Comparison to the Associated SNL/NM Background Screening Value and BCF

COC	Maximum Activity (All Samples) (pCi/g)	SNL/NM Background Activity (pCi/g)[a]	Is Maximum COC Activity Less Than or Equal to the Applicable SNL/NM Background Screening Value?	BCF (Maximum Aquatic)	Is COC a Bioaccumulator?[b] (BCF >40)
Cs-137	ND (0.0631)	0.084	Yes	3,000[c]	**Yes**
H-3	0.007	0.021	Yes	0	No
Th-232	1.06	1.54	Yes	3,000[c]	**Yes**
U-235	**ND (0.278)**	0.18	**No**	900[c]	**Yes**
U-238	**207**	1.3	**No**	900[c]	**Yes**

Note: **Bold** indicates COCs that exceed the background screening values and/or are bioaccumulators.
[a]Dinwiddie September 1997, North Area Supergroup.
[b]NMED March 1998.
[c]Baker and Soldat 1992.
BCF = Bioconcentration factor.
COC = Constituent of concern.
MDA = Minimum detectable activity.
ND ( ) = Not detected, above the MDA, shown in parentheses.
NMED = New Mexico Environment Department.
pCi/g = Picocurie(s) per gram.
SNL/NM = Sandia National Laboratories/New Mexico.
SWMU = Solid Waste Management Unit.

Table 8 summarizes the fate and transport processes that can occur at SWMU 46. The COCs at this site include radiological and nonradiological inorganic analytes as well as organic analytes. Wind, surface water, and biota are considered to be of low significance as potential transport mechanisms at this site. Significant leaching into the subsurface soil is unlikely, and leaching into the groundwater at this site is highly unlikely. The potential for transformation of COCs is low, and loss through decay of the radiological COCs is insignificant because of their long half-lives.

Table 8
Summary of Fate and Transport at SWMU 46

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 to medium

SWMU = Solid Waste Management Unit.

VI. Human Health Risk Assessment

VI.1 Introduction

The human health risk 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 is a screening procedure that 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 carried forward in the risk assessment process.
Step 4.	Toxicological parameters are identified and referenced for COCs that were not eliminated during the screening procedure.
Step 5.	Potential toxicity effects (specified as a hazard index [HI]) and estimated excess cancer risks are calculated for nonradiological COCs and background. For radiological COCs, the incremental total effective dose equivalent (TEDE) and incremental estimated cancer risk are calculated by subtracting applicable background concentrations directly from maximum on-site contaminant values. This background subtraction applies only when a radiological COC occurs as contamination and exists as a natural background radionuclide.
Step 6.	These values are compared with guidelines established by the U.S. Environmental Protection Agency (EPA), New Mexico Environment Department (NMED), and the DOE to determine whether further evaluation and potential site cleanup are required. Nonradiological COC risk values also are compared to background risk so that an incremental risk can be calculated.
Step 7.	Uncertainties of the above steps are addressed.

VI.2 Step 1. Site Data

Section I of this risk assessment provides the site description and history for SWMU 46. Section II presents a comparison of results to DQOs. Section III discusses the nature, rate, and extent of contamination.

VI.3 Step 2. Pathway Identification

SWMU 46 has been designated with a future land-use scenario of industrial (DOE et al. September 1995) (see Appendix 1 for default exposure pathways and parameters). However, the residential land-use scenario is also considered in the pathway analysis. Because of the location and characteristics of the potential contaminants, the primary pathway for human exposure is considered to be soil ingestion for the nonradiological COCs and direct gamma exposure for the radiological COCs. The inhalation pathway for both nonradiological and radiological COCs is included because the potential exists to inhale dust. Soil ingestion is included for the radiological COCs as well. The dermal pathway is included for the nonradiological COCs because of the potential for the receptor to be exposed to contaminated soil. No water pathways to the groundwater are considered; depth to groundwater at SWMU 46 is approximately 499 feet bgs. No intake routes through plant, meat, or milk ingestion are considered appropriate for either the industrial or residential land-use scenarios. Figure 1 shows the conceptual model flow diagram for SWMU 46.

Pathway Identification

Nonradiological Constituents	Radiological Constituents
Soil ingestion	Soil ingestion
Inhalation (dust)	Inhalation (dust)
Dermal contact	Direct gamma

VI.4 Step 3. Background Screening Procedure

This section discusses Step 3, the background screening procedure, which compares the maximum COC concentration to the background screening level. The methodology and results are described in the following sections.

VI.4.1 Methodology

Maximum concentrations of nonradiological COCs were compared to the approved SNL/NM maximum screening levels for this area. The SNL/NM maximum background concentration was selected to provide the background screen in Table 4 and used to calculate risk attributable to background in Section VI.6.2. Only the COCs that were detected above the corresponding SNL/NM maximum background screening levels or did not have either a quantifiable or calculated background screening level are considered in further risk assessment analyses.

For radiological COCs that exceed the SNL/NM background screening levels, background values are subtracted from the individual maximum radionuclide concentrations. Those that

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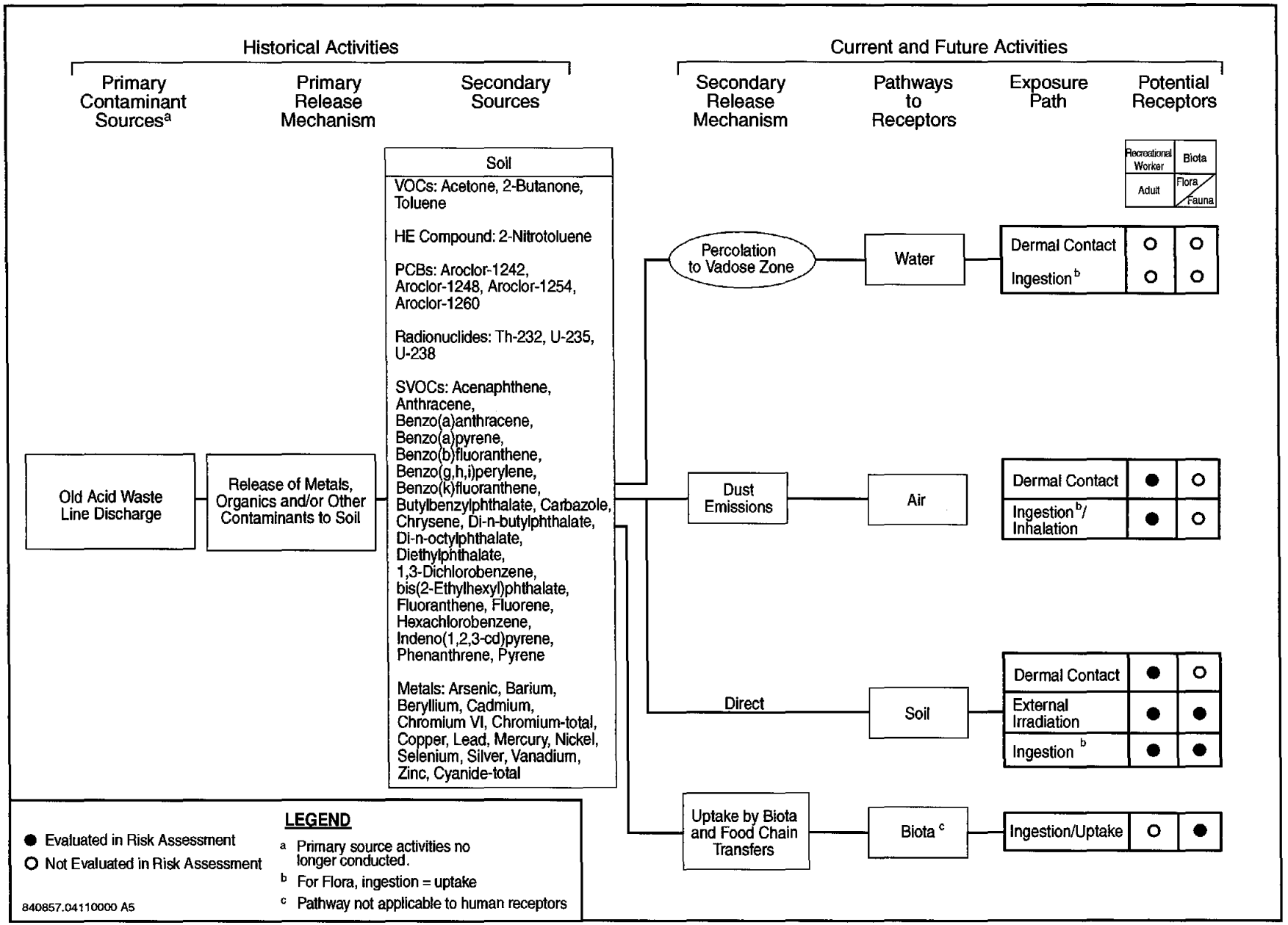

Figure 1

Conceptual Site Model Flow Diagram for SWMU 46, Old Acid Waste Line Outfall

do not exceed these background levels are not carried any further in the risk assessment. This approach is consistent with DOE Order 5400.5, "Radiation Protection of the Public and the Environment" (DOE 1993). Radiological COCs that do not have background screening values and were detected above the analytical minimum detectable activity (MDA) are carried through the risk assessment at the maximum levels. The resultant radiological COCs remaining after this step are referred to as background-adjusted radiological COCs.

VI.4.2 Results

Tables 4 and 6 show SWMU 46 maximum COC concentrations that were compared to the SNL/NM maximum background values (Dinwiddie September 1997) for the human health risk assessment. For the nonradiological COCs, 10 constituents were measured at concentrations greater than the background screening values. Six constituents do not have quantified background screening concentrations; therefore it is unknown whether these COCs exceed background values. Thirty-seven nonradiological COCs are organic compounds that do not have corresponding background screening values.

For the radiological COCs, three constituents (Th-232, U-235, and U-238) exhibited detections or MDA values greater than the background screening levels. These values are conservatively used in the risk assessment.

The maximum concentration value for PCBs (the sum of the maximum Aroclor detections across the entire site) total was 0.84 mg/kg. This concentration is less than the EPA screening level of 1 mg/kg (Title 40, Code of Federal Regulations, Part 761). Because the maximum concentration for PCBs at this site is less than the screening value, PCBs are eliminated from further consideration in the human health risk assessment.

The maximum concentration value for lead is 66.8 mg/kg. The EPA intentionally does not provide any human health toxicological data on lead; therefore, no risk parameter values could be calculated. However, the NMED guidance for lead screening concentrations for construction and industrial land-use scenarios are 750 and 1500 mg/kg, respectively (Olson and Moats March 2000). The EPA screening guidance value for a residential land-use scenario is 400 mg/kg (Laws July 1994). The maximum concentration value for lead at this site is less than all the screening values; therefore, lead is eliminated from further consideration in the human health risk assessment.

VI.5 Step 4. Identification of Toxicological Parameters

Tables 9 and 10 list the COCs retained in the risk assessment and provides the values for the available toxicological information. The toxicological values for the nonradiological COCs presented in Table 9 were obtained from the Integrated Risk Information System (IRIS) (EPA 2003), the Health Effects Assessment Summary Tables (HEAST) (EPA 1997a), and the Technical Background Document for Development of Soil Screening Levels (NMED December 2000). Dose conversion factors (DCFs) used in determining the excess TEDE values for radiological COCs for the individual pathways are the default values provided in the RESRAD computer code (Yu et al. 1993a) as developed in the following documents:

Table 9
Toxicological Parameter Values for SWMU 46 Nonradiological COCs

COC	RfD_o (mg/kg-d)	Confidence[a]	RfD_{inh} (mg/kg-d)	Confidence[a]	SF_o $(mg/kg\text{-}d)^{-1}$	SF_{inh} $(mg/kg\text{-}d)^{-1}$	Cancer Class[b]	ABS
Inorganic								
Arsenic	3.0E-04[c]	M	–	–	1.5E+00[c]	1.5E+01[c]	A	0.03[d]
Barium	7.0E-02[c]	M	1.4E-04[e]	–	–	–	D	0.01[d]
Beryllium	2.0E-03[c]	L to M	5.7E-06[c]	M	–	8.4E+00[c]	B1	0.01[d]
Cadmium	5.0E-04[c]	H	5.7E-05[f]	–	–	6.3E+00[c]	B1	0.001[d]
Chromium VI	3.0E-03[c]	L	2.3E-06[c]	L	–	4.2E+01[c]	A	0.01[d]
Chromium-total	1.5E+00[c]	L	–	–	–	–	D	0.01[d]
Copper	3.7E-02[f]	–	–	–	–	–	D	0.01[d]
Mercury	3.0E-04[e]	–	8.6E-05[c]	M	–	–	D	0.01[d]
Nickel	2.0E-02[c]	M	–	–	–	–	–	0.01[d]
Selenium	5.0E-03[c]	H	–	–	–	–	D	0.01[d]
Silver	5.0E-03[c]	L	–	–	–	–	D	0.01[d]
Thallium	6.6E-05[g]	–	–	–	–	–	–	0.01[d]
Vanadium	7.0E-03[e]	–	–	–	–	–	–	0.01[d]
Zinc	3.0E-01[c]	M	–	–	–	–	D	0.01[d]
Cyanide-total	2.0E-02[c]	M	–	–	–	–	D	0.1[d]
VOCs								
Acetone	1.0E-01[c]	L	1.0E-01[f]	–	–	–	D	0.01[h]
2-Butanone	6.0E-01[c]	L	2.9E-01[c]	L	–	–	D	0.1[d]
Methylene chloride	6.0E-02[c]	M	8.6E-01[e]	–	7.5E-03[c]	1.6E-03[c]	B2	0.1[d]
Toluene	2.0E-01[c]	M	1.1E-01[c]	M	–	–	D	0.1[d]
SVOCs								
Acenaphthene	6.0E-02[c]	L	6.0E-02[f]	–	–	–	–	0.13[d]
Acenaphthylene	2.0E-02[c]	L	8.6E-04[c]	M	–	–	C	0.1[d]
Anthracene	3.0E-01[c]	L	3.0E-01[f]	–	–	–	D	0.13[d]
Benzo(a)anthracene	–	–	–	–	7.3E-01[f]	3.1E-01[f]	B2	0.13[d]
Benzo(a)pyrene	–	–	–	–	7.3E+00[c]	3.1E+00[f]	B2	0.13[d]
Benzo(b)fluoranthene	–	–	–	–	7.3E-01[f]	3.1E-01[f]	B2	0.13[d]
Benzo(g,h,i)perylene	–	–	–	–	7.3E+00[f]	3.1E+00[f]	B2	0.13[d]
Benzo(k)fluoranthene	–	–	–	–	7.3E-02[f]	3.1E-02[f]	B2	0.13[d]

Refer to footnotes at end of table.

Table 9 (Continued)
Toxicological Parameter Values for SWMU 46 Nonradiological COCs

COC	RfD_o (mg/kg-d)	Confidence[a]	RfD_{inh} (mg/kg-d)	Confidence[a]	SF_o $(mg/kg\text{-}d)^{-1}$	SF_{inh} $(mg/kg\text{-}d)^{-1}$	Cancer Class[b]	ABS
Butylbenzylphthalate	2.0E-01[c]	L	2.0E-01[f]	–	–	–	C	0.01[h]
Carbazole	–	–	–	–	2.0E-02[e]	2.0E-02[f]	B2	0.01[h]
2-Chlorophenol	5.0E-03[c]	L	5.0E-03[f]	–	–	–	–	0.01[h]
Chrysene	–	–	–	–	7.3E-03[f]	3.1E-03[f]	B2	0.13[d]
Di-n-butylphthalate	1.0E-01[c]	L	1.0E-01[f]	–	–	–	D	0.1[d]
Di-n-octylphthalate	2.0E-02[e]	–	2.0E-02[f]	–	–	–	–	0.1[g]
Diethylpthalate	8.0E-01[c]	L	8.0E-01[f]	–	–	–	D	0.1[d]
Dibenzofuran	4.0E-03[f]	–	4.0E-03[f]	–	–	–	D	0.01[h]
1,2-Dichlorobenzene	9.0E-02[c]	L	5.7E-02[e]	–	–	–	D	0.1[d]
1,3-Dichlorobenzene	3.0E-02[f]	–	2.5E-03[f]	–	–	–	D	0.1[d]
Diphenylamine	2.5E-02[c]	M	2.5E-02[f]	–	–	–	–	0.01[h]
bis(2-Ethylhexyl) phthalate	2.0E-02[f]	–	2.0E-02[f]	–	1.4E-02[f]	1.4E-02[f]		0.01[h]
Fluoranthene	4.0E-02[c]	L	4.0E-02[f]	–	–	–	D	0.13[d]
Fluorene	4.0E-02[c]	L	4.0E-02[f]	–	–	–	D	0.1[d]
Hexachlorobenzene	8.0E-04[c]	M	8.0E-04[f]	–	1.6E+00[c]	1.6E+00[c]	B2	0.1[d]
Indeno(1,2,3-cd)pyrene	–	–	–	–	7.3E-01[f]	3.1E-01[f]	B2	0.13[d]
Naphthalene	2.0E-02[c]	L	8.6E-04[c]	M	–	–	C	0.1[d]
Phenanthrene	3.0E-01[c]	L	3.0E-01[f]	–	–	–	D	0.1[d]
Phenol	3.0E-01[c]	M to H	6.0E-01[g]	–	–	–	D	0.1[d]
Pyrene	3.0E-02[c]	L	3.0E-02[f]	–	–	–	D	0.1[d]
HE Compound								
2-Nitrotoluene	1.0E-02[e]	–	1.0E-02[f]	–	–	–	–	0.01[h]

[a]Confidence associated with IRIS (EPA 2003) database values. Confidence: L = low, M = medium, H = high.
[b]EPA weight-of-evidence classification system for carcinogenicity (EPA 1989) taken from IRIS (EPA 2003):
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.
[c]Toxicological parameter values from IRIS electronic database (EPA 2003).
[d]Toxicological parameter values from NMED (December 2000).
[e]Toxicological parameter values from HEAST (EPA 1997a).

Table 9 (Concluded)
Toxicological Parameter Values for SWMU 46 Nonradiological COCs

[f]Toxicological parameter values from EPA Region 6 (2002a).
[g]Toxicological parameter values from EPA Region 9 (2002b).
[h]Toxicological parameter values from Risk Assessment Information System (ORNL 2003).

ABS	= Gastrointestinal absorption coefficient.
COC	= Constituent of concern.
EPA	= U.S. Environmental Protection Agency.
HE	= High explosive(s).
HEAST	= Health Effects Assessment Summary Tables.
IRIS	= Integrated Risk Information System.
mg/kg-d	= Milligram(s) per kilogram day.
$mg/kg-d^{-1}$	= Per milligram per kilogram day.
NMED	= New Mexico Environment Department.
RfD_{inh}	= Inhalation chronic reference dose.
RfD_o	= Oral chronic reference dose.
SF_{inh}	= Inhalation slope factor.
SF_o	= Oral slope factor.
SVOC	= Semivolatile organic compound.
SWMU	= Solid Waste Management Unit.
VOC	= Volatile organic compound.
–	= Information not available.

Table 10
Toxicological Parameter Values for SWMU 46 Radiological COCs
Obtained from RESRAD Risk Coefficients[a]

COC	SF_o (1/pCi)	SF_{inh} (1/pCi)	SF_{ev} (g/pCi-yr)	Cancer Class[b]
Th-232	1.33E-10	4.33E-08	3.42E-10	A
U-235	4.70E-11	1.30E-08	2.70E-07	A
U-238	6.20E-11	1.20E-08	6.60E-08	A

[a]Yu et al. 1993a.
[b]EPA weight-of-evidence classification system for carcinogenicity (EPA 1989): A = Human carcinogen for high dose and high dose rate (i.e., greater than 50 rem per year). For low-level environmental exposures, the carcinogenic effect has not been observed and documented.
1/pCi = One per picocurie.
COC = Constituent of concern.
EPA = U.S. Environmental Protection Agency.
g/pCi-yr = Gram(s) per picocurie year.
SF_{ev} = External volume exposure slope factor.
SF_{inh} = Inhalation slope factor.
SF_o = Oral (ingestion) slope factor.
SWMU = Solid Waste Management Unit.

- DCFs for ingestion and inhalation were taken from "Federal Guidance Report No. 11, Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion" (EPA 1988).

- DCFs for surface contamination (contamination on the surface of the site) were taken from DOE/EH-0070, "External Dose-Rate Conversion Factors for Calculation of Dose to the Public" (DOE 1988).

- DCFs for volume contamination (exposure to contamination deeper than the immediate surface of the site) were calculated using the methods discussed in "Dose-Rate Conversion Factors for External Exposure to Photon Emitters in Soil" (Kocher 1983) and in ANL/EAIS-8, "Data Collection Handbook to Support Modeling the Impacts of Radioactive Material in Soil" (Yu et al. 1993b).

VI.6 Step 5. Exposure Assessment and Risk Characterization

Section VI.6.1 describes the exposure assessment for this risk assessment. Section VI.6.2 provides the risk characterization, including the HI and excess cancer risk for both the potential nonradiological COCs and associated background for the industrial and residential land-use scenarios. The incremental TEDE and incremental estimated cancer risk are provided for the background-adjusted radiological COCs for both industrial and residential land-use scenarios.

VI.6.1 Exposure Assessment

Appendix 1 provides 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 nonradiological COCs are based upon the Risk Assessment Guidance for Superfund (RAGS) (EPA 1989). Parameters are based upon information from the RAGS (EPA 1989), the Technical Background Document for Development of Soil Screening Levels (NMED December 2000), as well as other EPA and NMED guidance documents, and reflect the reasonable maximum exposure (RME) approach advocated by the RAGS (EPA 1989). For radiological COCs, the coded equations provided in RESRAD computer code are used to estimate the incremental TEDE and cancer risk for individual exposure pathways. Further discussion of this process is provided in the "Manual for Implementing Residual Radioactive Material Guidelines Using RESRAD" (Yu et al. 1993a).

Although the designated land-use scenario for this site is industrial, risk and TEDE values for a residential land-use scenario are also presented.

VI.6.2 Risk Characterization

Table 11 shows an HI of 0.52 for the SWMU 46 nonradiological COCs and an estimated excess cancer risk of 7E-6 for the designated industrial land-use scenario. The numbers presented include exposure from soil ingestion, dermal contact, and dust and volatile inhalation for nonradiological COCs. Table 12 shows an HI of 0.03 and an estimated excess cancer risk of 3E-6 for the SWMU 46 associated background constituents under the designated industrial land-use scenario.

For the radiological COCs, contribution from the direct gamma exposure pathway is included. For the industrial land-use scenario, a TEDE was calculated for an individual on the site, which resulted in an incremental TEDE of 2.14E+00 millirem (mrem)/year (yr). In accordance with EPA guidance found in Office of Solid Waste and Emergency Response (OSWER) Directive No. 9200.4-18 (EPA 1997b), an incremental TEDE of 15 mrem/yr is used for the probable land-use scenario (industrial in this case); the calculated dose value for SWMU 46 for the industrial land use is well below this guideline. The estimated excess cancer risk is 2.7E-5.

The HI is 6.72 with an estimated excess cancer risk of 3E-5 for the nonradiological COCs under the residential land-use scenario (Table 11). The numbers in the table include exposure from soil ingestion, dermal contact, and dust inhalation. 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 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 12 shows an HI of 0.36 and an estimated excess cancer risk of 1E-5 for the SWMU 46 associated background constituents under the residential land-use scenario.

For the radiological COCs, the incremental TEDE for the residential land-use scenario is 5.5E+0 mrem/yr. The guideline being used is an excess TEDE of 75 mrem/yr (SNL/NM February 1998b) for a complete loss of institutional controls (residential land use in this case);

Table 11
Risk Assessment Values for SWMU 46 Nonradiological COCs

COC	Maximum Concentration (All Samples) (mg/kg)	Industrial Land-Use Scenario[a]		Residential Land-Use Scenario[a]	
		Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Inorganic					
Arsenic	5.23	0.02	3E-6	0.24	1E-5
Barium	572	0.01	–	0.11	–
Beryllium	0.891	0.00	4E-10	0.01	8E-10
Cadmium	213	0.42	7E-8	5.46	1E-7
Chromium VI	2.08	0.00	4E-9	0.01	1E-8
Chromium-total	120	0.00	–	0.00	–
Copper	133 J	0.00	–	0.05	–
Mercury	0.0766	0.00	–	0.00	–
Nickel	379	0.02	–	0.25	–
Selenium	1.28	0.00	–	0.00	–
Silver	16.2	0.00	–	0.04	–
Thallium	2.19	0.03	–	0.44	–
Vanadium	46.5	0.01	–	0.09	–
Zinc	149 J	0.00	–	0.01	–
Cyanide-total	12.7	0.00	–	0.01	–
VOCs					
Acetone	0.0132	0.00	–	0.00	–
2-Butanone	0.107	0.00	–	0.00	–
Methylene chloride	0.00704	0.00	3E-8	0.00	5E-8
Toluene	0.017	0.00	–	0.00	–
SVOCs					
Acenaphthene	0.00626 J	0.00	–	0.00	–
Acenaphthylene	0.00406 J	0.00	–	0.00	–
Anthracene	0.0212 J	0.00	–	0.00	–
Benzo(a)anthracene	0.258	0.00	1E-7	0.00	4E-7
Benzo(a)pyrene	0.435	0.00	2E-6	0.00	7E-6
Benzo(b)fluoranthene	0.506	0.00	2E-7	0.00	8E-7
Benzo(g,h,i)perylene	0.309	0.00	1E-6	0.00	5E-6
Benzo(k)fluoranthene	0.471	0.00	2E-8	0.00	8E-8
Butylbenzylphthalate	0.0565 J	0.00	–	0.00	–
Carbazole	0.0182 J	0.00	1E-10	0.00	6E-10
2-Chlorophenol	0.00835 J	0.00	–	0.00	–
Chrysene	0.435	0.00	2E-9	0.00	7E-9
Di-n-butylphthalate	0.0495 J	0.00	–	0.00	–
Di-n-octylphthalate	0.0102 J	0.00	–	0.00	–
Diethylpthalate	0.0877 J	0.00	–	0.00	–
Dibenzofuran	0.0094 J	0.00	–	0.00	–
1,2-Dichlorobenzene	0.00451 J	0.00	–	0.00	–
1,3-Dichlorobenzene	0.00486 J	0.00	–	0.00	–
Diphenylamine	0.0073 J	0.00	–	0.00	–
bis(2-Ethylhexyl) phthalate	2.04	0.00	1E-8	0.00	5E-8

Refer to footnotes at end of table.

Table 11 (Concluded)
Risk Assessment Values for SWMU 46 Nonradiological COCs

COC	Maximum Concentration (All Samples) (mg/kg)	Industrial Land-Use Scenario[a]		Residential Land-Use Scenario[a]	
		Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Fluoranthene	0.450	0.00	–	0.00	–
Fluorene	0.014 J	0.00	–	0.00	–
Hexachlorobenzene	0.0057 J	0.00	5E-9	0.00	2E-8
Indeno(1,2,3-cd)pyrene	0.345 J	0.00	2E-7	0.00	6E-7
Naphthalene	0.00345 J	0.00	–	0.00	–
Phenanthrene	0.139	0.00	–	0.00	–
Phenol	1.59	0.00	–	0.00	–
Pyrene	0.603	0.00	–	0.00	–
HE Compound					
2-Nitrotoluene	0.0152	0.00	–	0.00	–
Total		**0.52**	**7E-6**	**6.72**	**3E-5**

[a]EPA 1989.
COC = Constituent of concern.
EPA = U.S. Environmental Protection Agency.
HE = High explosive(s).
J = Estimated concentration.
mg/kg = Milligram(s) per kilogram.
SVOC = Semivolatile organic compound.
SWMU = Solid Waste Management Unit.
VOC = Volatile organic compound.
– = Information not available.

Table 12
Risk Assessment Values for SWMU 46 Nonradiological Background Constituents

COC	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	0.02	3E-6	0.20	1E-5
Barium	200	0.00	–	0.04	–
Beryllium	0.80	0.00	3E-10	0.01	7E-10
Cadmium	0.9	0.00	3E-10	0.02	6E-10
Chromium VI	–	–	–	–	–
Chromium-total	12.8	0.00	–	0.00	–
Copper	17	0.00	–	0.01	–
Mercury	<0.1	–	–	–	–
Nickel	25.4	0.00	–	0.02	–
Selenium	<1	–	–	–	–
Silver	<1	–	–	–	–
Thallium	<1.1	–	–	–	–
Vanadium	33	0.00	–	0.06	–
Zinc	76	0.00	–	0.00	–
Cyanide-total	–	–	–	–	–
Total		**0.03**	**3E-6**	**0.36**	**1E-5**

[a]Dinwiddie September 1997, North Area Supergroup.
[b]EPA 1989.
COC = Constituent of concern.
EPA = U.S. Environmental Protection Agency.
mg/kg = Milligram(s) per kilogram.
SWMU = Solid Waste Management Unit.

the calculated dose value for SWMU 46 for the residential land-use scenario is well below this guideline. Consequently, SWMU 46 is eligible for unrestricted radiological release as the residential land-use scenario resulted in an incremental TEDE of less than 75 mrem/yr to the on-site receptor. The estimated excess cancer risk is 8.5E-5. The excess cancer risk from the nonradiological and radiological COCs should be summed to provide risk estimates for persons exposed to both types of carcinogenic contaminants, as noted in OSWER Directive No. 9200.4-18, "Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination" (EPA 1997b). This summation is tabulated in Section VI.9, "Summary."

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

For the nonradiological COCs under the industrial land-use scenario, the HI is 0.52 (less than the numerical guideline of 1 suggested in the RAGS [EPA 1989]). The excess cancer risk is 7E-6. NMED guidance states that cumulative excess lifetime cancer risk must be less than 1E-5 (Bearzi January 2001); thus the excess cancer risk for this site is below the suggested

acceptable risk value. This assessment also determined risks considering background concentrations of the potential nonradiological COCs for both the industrial and residential land-use scenarios. The 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 are assumed to have a hazard quotient (HQ) of 0.00. The incremental HI is 0.49 and the estimated incremental cancer risk is 4.71E-6 for the industrial land-use scenario. These incremental risk calculations indicate insignificant risk to human health from nonradiological COCs under an industrial land-use scenario.

For the radiological COCs under the industrial land-use scenario, the incremental TEDE is 2.1E+0 mrem/yr, which is significantly lower than EPA's numerical guideline of 15 mrem/yr. The incremental estimated excess cancer risk is 2.7E-5.

For the nonradiological COCs under the residential land-use scenario, the calculated HI is 6.72, which is above the numerical guidance. The excess cancer risk is 3E-5. NMED guidance states that cumulative excess lifetime cancer risk must be less than 1E-5 (Bearzi January 2001); thus the excess cancer risk for this site is above the suggested acceptable risk value. The incremental HI is 6.36 and the estimated incremental cancer risk is 1.63E-5 for the residential land-use scenario.

Although both the HI and estimated excess cancer risk are above the NMED guideline for the residential land-use scenario, maximum concentrations were used in the risk calculation. Because the site has been adequately characterized, average concentrations are more representative of actual site conditions. Using the 95% upper confidence limit (UCL) of the mean concentrations for the main contributors to excess cancer risk and HI values (summarized in Appendix 2) reduces the total HI and estimated excess cancer risk to 1.61 and 3.86E-6, respectively. The incremental HI and excess cancer risk are reduced to 1.45 and 3.86E-6, respectively. The 95% UCL concentrations include 2.8 mg/kg for arsenic (which is below background and therefore eliminates arsenic from further evaluation), 40.6 mg/kg for cadmium, 87.5 mg/kg for nickel, 1.1 mg/kg for thallium, 0.06 mg/kg for benzo(a)anthracene, and 0.05 mg/kg for benzo(a)perylene (Appendix 2). Thus, by using realistic concentrations in the risk calculations that more accurately depict actual site conditions, both the total and incremental estimated excess cancer risks are below NMED guidelines. In addition, only cadmium had an individual HQ for noncarcinogens that exceeds 1.0 under these conditions. The HQ for cadmium (1.03) is only slightly greater than 1.0. These incremental risk calculations indicate insignificant risk to human health from nonradiological COCs under a residential land-use scenario.

The incremental TEDE from the radiological components for a residential land-use scenario is 5.5E+0 mrem/yr, which is significantly lower than the numerical guideline of 75 mrem/yr suggested in the SNL/NM "RESRAD Input Parameter Assumptions and Justification" (SNL/NM February 1998b). The estimated excess cancer risk is 8.5E-5.

VI.8 Step 7. Uncertainty Discussion

Because of the location, history, and future land use (DOE et al. September 1995), there is low uncertainty in the land-use scenario and the potentially affected populations that were

considered in performing the risk assessment analysis. Based upon the COCs found in near-surface soil and 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. Specifically, the parameter values in the calculations are conservative and calculated intakes are probably overestimated. Maximum measured values of COC concentrations are used to provide conservative results.

Table 9 shows the uncertainties (confidence levels) in nonradiological toxicological parameter values. There is a mixture of estimated values and values from the IRIS (EPA 2003), HEAST (EPA 1997a), the Technical Background Document for Development of Soil Screening Levels (NMED December 2000), and the Risk Assessment Information System (ORNL 2003). Where values are not provided, information is not available from the HEAST (EPA 1997a), IRIS (EPA 2003), Technical Background Document for Development of Soil Screening Levels (NMED December 2000), the Risk Assessment Information System (ORNL 2003) or the EPA regions (EPA 2002a, EPA 2002b, EPA 2002c). Because of the conservative nature of the RME approach, uncertainties in toxicological values are not expected to change the conclusion from the risk assessment analysis.

Risk assessment values for nonradiological COCs are within the acceptable range for human health under both the industrial and residential land-use scenarios compared to established numerical guidance.

For the radiological COCs, the conclusion of the risk assessment is that potential effects on human health for both industrial and residential land-use scenarios are within guidelines and represent only a small fraction of the estimated 360 mrem/yr received by the average U.S. population (NCRP 1987).

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

VI.9 Summary

SWMU 46 contains identified COCs consisting of inorganic, organic, and radiological 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 include soil ingestion, dermal contact, and dust inhalation for chemical COCs and soil ingestion, dust inhalation, and direct gamma exposure for radionuclides. The same exposure pathways are applied to the residential land-use scenario.

Using conservative assumptions and an RME approach to risk assessment, calculations for nonradiological COCs show that for the industrial land-use scenario the HI (0.52) is significantly lower than the accepted numerical guidance from the EPA. The estimated excess cancer risk is 7E-6. Thus, excess cancer risk is also below the acceptable risk value provided by the NMED for an industrial land-use scenario (Bearzi January 2001). The incremental HI is 0.49, and the incremental excess cancer risk is 4.71E-6 for the industrial land-use scenario. Incremental risk calculations indicate insignificant risk to human health for the industrial land-use scenario.

Using conservative assumptions and an RME approach to risk assessment, calculations for nonradiological COCs show that for the residential land-use scenario the HI (6.72) is above the accepted numerical guidance from the EPA. The estimated excess cancer risk is 3E-5. Thus, excess cancer risk is slightly above the acceptable risk value provided by the NMED for a residential land-use scenario (Bearzi January 2001). The incremental HI is 6.36 and the incremental excess cancer risk is 1.63E-5 for the residential land-use scenario.

Although both the HI and estimated excess cancer risk are above the NMED guideline for the residential land-use scenario, maximum concentrations were used in the risk calculation. Because the site has been adequately characterized, average concentrations are more representative of actual site conditions. Using the 95% UCL of the mean concentrations for the main contributors to excess cancer risk and HI values (summarized in Appendix 2) reduces the total HI and estimated excess cancer risk to 1.61 and 3.86E-6, respectively. The incremental HI and excess cancer risk are reduced to 1.45 and 3.86E-6, respectively. The 95% UCL concentrations include 2.8 mg/kg for arsenic (which is below background and therefore eliminates arsenic from further evaluation), 40.6 mg/kg for cadmium, 87.5 mg/kg for nickel, 1.1 mg/kg for thallium, 0.06 mg/kg for benzo(a)anthracene, and 0.05 mg/kg for benzo(a)perylene (Appendix 2). Thus, by using realistic concentrations in the risk calculations that more accurately depict actual site conditions, both the total and incremental estimated excess cancer risks are below NMED guidelines. In addition, only cadmium had an individual HQ for noncarcinogens that exceeds 1.0 under these conditions. The HQ for cadmium (1.03) is only slightly greater than 1.0. These incremental risk calculations indicate insignificant risk to human health from nonradiological COCs under a residential land-use scenario.

The incremental TEDE and corresponding estimated cancer risk from radiological COCs are much lower than EPA guidance values. The estimated TEDE is 2.1E+0 mrem/yr for the industrial land-use scenario, which is much lower than the EPA's numerical guidance of 15 mrem/yr (EPA 1997b). The corresponding incremental estimated cancer risk value is 2.7E-5 for the industrial land-use scenario. Furthermore, the incremental TEDE for the residential land-use scenario that results from a complete loss of institutional control is 5.5E+0 mrem/yr with an associated risk of 8.5E-5. The guideline for this scenario is 75 mrem/yr (SNL/NM February 1998b). Therefore, SWMU 46 is eligible for unrestricted radiological release.

The summation of the nonradiological and radiological carcinogenic risks is tabulated in Table 13.

Table 13
Summation of Radiological and Nonradiological Risks from SWMU 46, Old Acid Waste Line Outfall Carcinogens

Scenario	Nonradiological Risk	Radiological Risk	Total Risk
Industrial	4.71E-6	2.7E-5	3.2E-5
Residential	3.86E-6	8.5E-5	8.9E-5

SWMU = Solid Waste Management Unit.

Uncertainties associated with the calculations are considered small relative to the conservatism of this risk assessment analysis. Therefore, it is concluded that this site poses insignificant risk to human health under both the industrial and residential land-use scenarios.

VII. Ecological Risk Assessment

VII.1 Introduction

This section addresses the ecological risks associated with exposure to constituents of potential ecological concern (COPECs) in the soil at SWMU 46. A component of the NMED Risk-Based Decision Tree (NMED March 1998) is to conduct an ecological 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 risk assessment. Initial components of NMED's decision tree (a discussion of DQOs, data assessment, and evaluations of bioaccumulation as well as 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 risk assessment whereby a more quantitative estimate of ecological risk is conducted. Although this assessment is conservative in the estimation of ecological risks, ecological relevance and professional judgment are also used as recommended by the EPA (1998) 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 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 (Tables 5 and 7), inorganic constituents in the soil within the 0- to 5-foot depth interval that either exceed the corresponding SNL/NM background screening values or do not have quantified background values are identified as COPECs for this site and include the following:

- Arsenic
- Barium
- Cadmium
- Chromium VI
- Chromium (total)
- Copper
- Cyanide (total)
- Lead
- Mercury

- Nickel
- Selenium
- Silver
- U-235
- U-238
- Vanadium
- Zinc

All organic constituents that were detected within the 0- to 5-foot depth interval of the soil are also identified as COPECs and include the following:

- Acenaphthene
- Acetone
- Anthracene
- Aroclor-1242
- Aroclor-1248
- Aroclor-1254
- Aroclor-1260
- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(g,h,i)perylene
- Benzo(k)fluoranthene
- 2-Butanone
- Butylbenzylphthalate
- Carbazole
- Chrysene
- Di-n-butylphthalate
- Di-n-octylphthalate
- Diethylphthalate
- 1,3-Dichlorobenzene
- bis(2-Ethylhexyl) phthalate
- Fluoranthene
- Fluorene
- Hexachlorobenzene
- Indeno(1,2,3-cd)pyrene
- 2-Nitrotoluene
- Phenanthrene
- Pyrene
- Toluene

VII.2.2 Bioaccumulation

Among the COPECs listed in Section VII.2.1, the following are considered to have bioaccumulation potential in aquatic environments (Section IV, Tables 5 and 7):

- Arsenic
- Barium
- Cadmium
- Lead
- Mercury
- Nickel
- Selenium
- U-235
- U-238
- Vanadium
- Zinc
- Acenaphthene
- Anthracene
- Aroclor-1242
- Aroclor-1248
- Aroclor-1254
- Aroclor-1260
- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(g,h,i)perylene
- Benzo(k)fluoranthene
- Butylbenzylphthalate
- Chrysene
- Di-n-butylphthalate
- Di-n-octylphthalate
- Diethylphthalate
- 1,3-Dichlorobenzene
- bis(2-Ethylhexyl) phthalate
- Fluoranthene
- Fluorene
- Hexachlorobenzene
- Indeno(1,2,3-cd)pyrene
- 2-Nitrotoluene
- Phenanthrene
- Pyrene

However, it should be noted that as directed by the NMED (March 1998), bioaccumulation for inorganic constituents is assessed exclusively based upon maximum reported bioconcentration factors (BCFs) 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 migrate from the source of contamination to other media or biota is discussed in Section V. As noted in Table 8 (Section V), wind, surface water, and biota (food chain uptake) are expected to be of low significance as transport mechanisms for COPECs at this site. Degradation, transformation, and radiological decay of the COPECs are also expected to be of low significance. VOCs (i.e., acetone, 2-butanone, and toluene) may be lost through near-surface volatilization.

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 site and that COPECs also exist at the site. As a consequence, a detailed ecological risk assessment was deemed necessary to predict the potential level of ecological risk associated with the site.

VII.3 Risk Assessment

As concluded in Section VII.2.4, both complete ecological pathways and COPECs are associated with this site. The ecological risk 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 risk 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.
- Risk Assessment Scientific/Management Decision Point—presents the decision to risk managers based upon the results of the risk assessment.

VII.3.1 Problem Formulation

Problem formulation is the initial stage of the risk 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 an ecological risk assessment) are presented in "Predictive Ecological Risk Assessment Methodology, Environmental Restoration Program, Sandia National Laboratories, New Mexico" (IT July 1998) and are not duplicated here.

VII.3.1.1 Ecological Pathways and Setting

SWMU 46 is 2.25 acres in size. The site is located in an area dominated by grassland habitat. The site is unpaved and open to use by wildlife. No threatened or endangered species are known to occur at this site (IT 1995), and no surface-water bodies, seeps, or springs are associated with the site.

Complete ecological pathways may exist through the exposure of plants and wildlife to COPECs in surface soil at this site. It is assumed that direct uptake of COPECs from soil is the major route of exposure for plants and that exposure of plants to wind-blown soil is minor. Exposure modeling for the wildlife receptors is limited to the food and soil ingestion pathways and external radiation. Because of the lack of surface water at this site, exposure to COPECs through the ingestion of surface water is considered insignificant. Inhalation and dermal contact also are 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

SWMU 46 is the outfall (now inactive) for the Old Acid Waste Line. COPECs identified for this site are listed in Section VII.2. These include both inorganic and organic analytes. The inorganic COPECs include both radiological and nonradiological analytes. The inorganic analytes were screened against background concentrations and those that either exceed the approved SNL/NM background screening levels (Dinwiddie September 1997) for the area or do not have quantified background values are considered to be COPECs. Nonradiological inorganic constituents that are essential nutrients, such as iron, magnesium, calcium, potassium, and sodium, are not included in this risk assessment as set forth by the EPA (1989). All detected organic analytes are also identified as COPECs. In order to provide conservatism, this ecological risk assessment is based upon the maximum soil concentrations of the COPECs measured in the upper 5 feet of soil at this site. Tables 5 and 7 present the maximum concentrations for the COPECs.

VII.3.1.3 Ecological Receptors

A nonspecific perennial plant was selected as the receptor to represent plant species at the site (IT July 1998). 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*) are used to represent wildlife use. Because of its opportunistic food habits, the deer mouse is 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).

VII.3.2 Exposure Estimation

For nonradiological COPECs, direct uptake from the soil is considered the only significant route of exposure for terrestrial plants. Exposure modeling for the wildlife receptors is limited to food and soil ingestion pathways. Inhalation and dermal contact are considered insignificant pathways with respect to ingestion (Sample and Suter 1994). Drinking water is also considered an insignificant pathway because of the lack of surface water at this site. The deer mouse is 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 is 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 is modeled with intake of omnivorous mice only. Both species are modeled with soil ingestion comprising 2 percent of the total dietary intake. Table 14 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 are modeled using an area use factor of 1.0, implying that all food items and soil ingested come from the site being investigated. The maximum COPEC concentrations measured in surface soil samples are used to conservatively estimate potential exposures and risks to plants and wildlife at this site.

For the radiological dose-rate calculations, the deer mouse is modeled as an herbivore (100 percent of its diet as plants), and the burrowing owl is modeled as a strict predator on small mammals (100 percent of its diet as deer mice). Both are modeled with soil ingestion comprising 2 percent of the total dietary intake. Receptors are exposed to radiation both internally and externally from U-235 and U-238. Internal and external dose rates to the deer mouse and the burrowing owl are approximated using modified dose-rate models from DOE (1995) as presented in the ecological risk assessment methodology document for the SNL/NM ER Project (IT July 1998). Radionuclide-dependent data for the dose-rate calculations were obtained from Baker and Soldat (1992). The external dose-rate model examines the total-body dose rate to a receptor residing in soil exposed to radionuclides. The soil surrounding the receptor is assumed to be an infinite medium uniformly contaminated with gamma-emitting radionuclides. The external dose-rate model is the same for both the deer mouse and the burrowing owl. The internal total-body dose-rate model assumes that a fraction of the radionuclide concentration ingested by a receptor is absorbed by the body and concentrated at the center of a spherical body shape. This provides for a conservative estimate for absorbed dose. This concentrated radiation source at the center of the body of the receptor is assumed to be a "point" source. Radiation emitted from this point source is absorbed by the body

Table 14
Exposure Factors for Ecological Receptors at SWMU 46

Receptor Species	Class/Order	Trophic Level	Body Weight (kg)[a]	Food Intake Rate (kg/day)[b]	Dietary Composition[c]	Home Range (acres)
Deer Mouse (*Peromyscus maniculatus*)	Mammalia/ Rodentia	Herbivore	2.39E-2[d]	3.72E-3	Plants: 100% (+ Soil at 2% of intake)	2.7E-1[e]
Deer Mouse (*Peromyscus maniculatus*)	Mammalia/ Rodentia	Omnivore	2.39E-2[d]	3.72E-3	Plants: 50% Invertebrates: 50% (+ Soil at 2% of intake)	2.7E-1[e]
Deer Mouse (*Peromyscus maniculatus*)	Mammalia/ Rodentia	Insectivore	2.39E-2[d]	3.72E-3	Invertebrates: 100% (+ Soil at 2% of intake)	2.7E-1[e]
Burrowing owl (*Speotyto cunicularia*)	Aves/ Strigiformes	Carnivore	1.55E-1[f]	1.73E-2	Rodents: 100% (+ Soil at 2% of intake)	3.5E+1[g]

[a]Body weights are in kg wet weight.
[b]Food intake rates are estimated from the allometric equations presented in Nagy (1987). Units are kg dry weight per day.
[c]Dietary compositions are generalized for modeling purposes. Default soil intake value of 2% of food intake.
[d]Silva and Downing 1995.
[e]EPA 1993, based upon the average home range measured in semiarid shrubland in Idaho.
[f]Dunning 1993.
[g]Haug et al. 1993.
EPA = U.S. Environmental Protection Agency.
kg = Kilogram(s).
SWMU = Solid Waste Management Unit.

tissues to contribute to the absorbed dose. Alpha and beta emitters are assumed to transfer 100 percent of their energy to the receptor as they pass through tissues. Gamma-emitting radionuclides transfer only a fraction of their energy to the tissues because gamma rays interact less with matter than do beta or alpha emitters. The external and internal dose-rate results are summed to calculate a total dose rate from exposure to U-235 and U-238 in soil.

Table 15 provides the transfer factors used in modeling the concentrations of COPECs through the food chain. Table 16 presents the 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 17 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. Sufficient toxicity information was not available to estimate the LOAELs or NOAELs for some COPECs.

The benchmark used for exposure of terrestrial receptors to radiation is 0.1 rad/day. This value has been recommended by the International Atomic Energy Agency (IAEA 1992) for the protection of terrestrial populations. Because plants and insects are less sensitive to radiation than vertebrates (Whicker and Schultz 1982), the dose of 0.1 rad/day should also protect other groups within the terrestrial habitat of SWMU 46.

VII.3.4 Risk Characterization

Maximum concentrations in soil and estimated dietary exposures are compared to plant and wildlife benchmark values, respectively. Table 18 presents the results of these comparisons. HQs are used to quantify the comparison with benchmarks for plant and wildlife exposure.

For plants, HQs exceed unity for cadmium, total chromium, chromium VI, copper, lead, nickel, silver, vanadium, and zinc. Because of a lack of sufficient toxicity information, HQs for plants could not be determined for cyanide and 10 of the 29 organic COPECs. HQs for cadmium exceed unity for all three dietary regimes of the deer mouse. HQs for arsenic, barium, vanadium, and Aroclor-1254 exceed unity for both the omnivorous and insectivorous deer mice, while those for Aroclor-1242, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, and indeno(1,2,3-cd)pyrene exceed unity only for the insectivorous deer mouse. Because of a lack of sufficient toxicity information, HQs for the deer mouse could not be determined for carbazole. For the burrowing owl, HQs greater than unity were limited to mercury, when it is assumed to be entirely in organic form, and bis(2-ethylhexyl) phthalate. However, because of a lack of sufficient toxicity information, HQs for the burrowing owl could not be determined for chromium VI, cyanide, silver, and 25 of the 29 organic COPECs. 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 of the HIs exceed unity, with a maximum HI of 200 for plants.

Table 15
Transfer Factors Used in Exposure Models for COPECs at SWMU 46

COPEC	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]
Chromium VI	4.0E-2[c]	1.3E-1[e]	3.0E-2[c]
Copper	8.0E-1[f]	2.5E-1[d]	1.0E-2[a]
Cyanide (total)	0.0E+0[g]	0.0E+0[g]	0.0E+0[g]
Lead	9.0E-2[c]	4.0E-2[d]	8.0E-4[c]
Mercury	1.0E+0[c]	1.0E+0[b]	2.5E-1[a]
Nickel	2.0E-1[c]	3.8E-1[e]	6.0E-3[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]
Vanadium	5.5E-3[a]	1.0E+0[b]	2.5E-3[a]
Zinc	1.5E+0[a]	3.0E-1[d]	1.0E-1[a]
Organic[h]			
Acenaphthene	2.1E-1	2.1E+1	2.1E-4
Acetone	5.3E+1	1.3E+1	1.0E-8
Anthracene	1.0E-1	2.2E+1	7.3E-4
Aroclor-1242	1.6E-1	2.1E+1	3.2E-4
Aroclor-1248	2.2E-2	2.5E+1	1.1E-2
Aroclor-1254	1.2E-2	2.6E+1	3.2E-2
Aroclor-1260	1.1E-2	2.7E+1	3.8E-2
Benzo(a)anthracene	2.2E-2	2.5E+1	1.1E-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
2-Butanone	2.6E+1	1.4E+1	3.7E-8
Butylbenzylphthalate	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
1,3-Dichlorobenzene	3.5E-1	2.0E+1	8.2E-5
Diethylphthalate	1.4E+0	1.7E+1	6.6E-6
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
bis(2-Ethylhexyl) phthalate	1.6E-3	3.2E+1	1.3E+0
Fluoranthene	5.7E-2	2.3E+1	2.1E-3
Fluorene	1.5E-1	2.1E+1	3.8E-4
Hexachlorobenzene	3.3E-2	2.4E+1	5.6E-3
Indeno(1,2,3-cd)pyrene	6.1E-3	2.8E+1	1.2E-1
2-Nitrotoluene	1.8E+0	1.7E+1	4.4E-6

Refer to footnotes at end of table.

Table 15 (Concluded)
Transfer Factors Used in Exposure Models for COPECs at SWMU 46

COPEC	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

[a]Baes et al. 1984.
[b]Default value.
[c]NCRP 1989.
[d]Stafford et al. 1991.
[e]Ma 1982.
[f]IAEA 1994.
[g]No data found for food chain transfers of cyanide; however, because of its high metabolic activity, cyanide is assumed not to transfer in the food chain.
[h]Soil-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.

COPEC = Constituent of potential ecological concern.
K_{ow} = Octanol-water partition coefficient.
Log = Logarithm (base 10).
SWMU = Solid Waste Management Unit.

Table 16
Media Concentrations[a] for COPECs at SWMU 46

COPEC	Soil (Maximum)[a]	Plant Foliage[b]	Soil Invertebrate[b]	Deer Mouse Tissues[c]
Inorganic				
Arsenic	4.4E+0	1.8E-1	4.4E+0	1.5E-2
Barium	3.3E+2[d]	5.0E+1	3.3E+2	1.2E-1
Cadmium	2.1E+2	1.2E+2	1.3E+2	2.2E-1
Chromium (total)	7.9E+1[d]	3.1E+0	1.0E+1	7.7E-1
Chromium VI	2.1E+0	8.3E-2	2.7E-1	2.0E-2
Copper	1.3E+2[d]	1.1E+2	3.3E+1	2.3E+0
Cyanide (total)	1.3E-1[d]	0.0E+0	0.0E+0	0.0E+0
Lead	6.7E+1[d]	6.0E+0	2.7E+0	1.4E-2
Mercury	7.7E-2	7.7E-2	7.7E-2	6.1E-2
Nickel	3.8E+2	7.6E+1	1.4E+2	2.2E+0
Selenium	2.6E-1[d]	1.3E-1	2.6E-1	6.3E-2
Silver	1.2E+1	1.2E+1	3.1E+0	1.2E-1
Vanadium	4.7E+1	2.6E-1	4.7E+1	1.9E-1
Zinc	1.5E+2[d]	2.2E+2	4.5E+1	4.3E+1
Organic				
Acenaphthene	6.3E-3[d]	1.3E-3	1.3E-1	4.2E-5
Acetone	2.4E-3[d]	1.3E-1	3.0E-2	2.5E-9
Anthracene	2.1E-2[d]	2.2E-3	4.7E-1	5.3E-4
Aroclor-1242	7.1E-2	1.2E-2	1.5E+0	7.7E-4
Aroclor-1248	2.6E-3[d]	5.8E-5	6.5E-2	1.1E-3
Aroclor-1254	8.2E-2	1.0E-3	2.2E+0	1.1E-1
Aroclor-1260	2.0E-2	2.3E-4	5.3E-1	3.1E-2
Benzo(a)anthracene	2.6E-1	5.7E-3	6.5E+0	1.2E-1
Benzo(a)pyrene	4.4E-1	5.0E-3	1.2E+1	6.8E-1
Benzo(b)fluoranthene	5.1E-1	3.1E-3	1.4E+1	2.5E+0
Benzo(g,h,i)perylene	3.1E-1	1.9E-3	8.7E+0	1.6E+0
Benzo(k)fluoranthene	4.7E-1	2.0E-3	1.4E+1	4.6E+0
bis(2-Ethylhexyl) phthalate	8.3E-1	1.3E-3	2.6E+1	5.3E+1
2-Butanone	1.1E-1	2.8E+0	1.5E+0	2.5E-7
Butylbenzylphthalate	1.6E-2[d]	1.1E-3	3.6E-1	8.9E-4
Carbazole	1.8E-2[d]	7.0E-1	2.4E-1	2.7E-8
Chrysene	4.4E-1	6.5E-3	1.1E+1	4.1E-1
1,3-Dichlorobenzene	4.9E-3[d]	1.7E-3	9.6E-2	1.2E-5
Diethylphthalate	8.8E-2[d]	1.3E-1	1.5E+0	1.7E-5
Di-n-butyl phthalate	2.6E-2[d]	2.2E-3	5.9E-1	9.8E-4
Di-n-octyl phthalate	1.0E-2[d]	3.8E-4	2.4E-1	1.7E-3
Fluoranthene	4.5E-1	2.6E-2	1.0E+1	3.5E-2
Fluorene	6.7E-3[d]	9.9E-4	1.4E-1	8.6E-5
Hexachlorobenzene	5.7E-3[d]	1.9E-4	1.4E-1	1.2E-3
Indeno(1,2,3-cd)pyrene	3.5E-1[d]	2.1E-3	9.7E+0	1.7E+0
2-Nitrotoluene	1.5E-2	2.8E-2	2.6E-1	2.0E-6

Refer to footnotes at end of table.

Table 16 (Concluded)
Media Concentrations[a] for COPECs at SWMU 46

COPEC	Soil (Maximum)[a]	Plant Foliage[b]	Soil Invertebrate[b]	Deer Mouse Tissues[c]
Phenanthrene	1.4E-1	1.2E-2	3.1E+0	4.7E-3
Pyrene	6.0E-1	2.0E-2	1.5E+1	1.3E-1
Toluene	8.0E-3	8.0E-3	1.4E-1	3.0E-6

[a]In milligrams 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.
[b]Product of the soil concentration and the corresponding transfer factor.
[c]Based upon the deer mouse with an omnivorous diet. Product of the average concentration 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).
[d]Estimated value.
COPEC = Constituent of potential ecological concern.
EPA = U.S. Environmental Protection Agency.
SWMU = Solid Waste Management Unit.

Table 17
Toxicity Benchmarks for Ecological Receptors at SWMU 46

COPEC	Plant Benchmark[a,b]	Mammalian NOAELs			Avian NOAELs		
		Mammalian Test Species[c,d]	Test Species NOAEL[d,e]	Deer Mouse NOAEL[e,f]	Avian Test Species[d]	Test Species NOAEL[d,e]	Burrowing Owl NOAEL[e,g]
Inorganic							
Arsenic	10	Mouse	0.126	0.133	Mallard	5.14	5.14
Barium	500	Rat[h]	5.1	10.5	Chicken	20.8	20.8
Cadmium	3.0	Rat[i]	1.0	1.9	Mallard	1.45	1.45
Chromium (total)	1.0	Rat	2737	5354	Black Duck	1.0	1.0
Chromium VI	1.0	Rat	3.28	6.42	–	–	–
Copper	100	Mink	11.7	29.8	Chicken	47	47
Cyanide	–	Rat[j]	68.7	126	–	–	–
Lead	50	Rat	8.0	16.6	American Kestrel	3.85	3.85
Mercury (organic)	0.3	Rat	0.032	0.063	Mallard	0.0064	0.0064
Mercury (inorganic)	0.3	Mouse	13.2	14.0	Japanese Quail	0.45	0.45
Nickel	30	Rat	40	78	Mallard	77.4	77.4
Selenium	1.0	Rat	0.20	0.39	Screech Owl	0.44	0.44
Silver	2.0	Rat	17.8[k]	34.8	–	–	–
Vanadium	2.0	Rat[l]	0.21	0.38	Mallard	11.4	11.4
Zinc	50	Rat	160	313	Chicken	14.5	14.5
Organic							
Acenaphthene	18[m]	Mouse	17.5[n]	18.5	–	–	–
Acetone	–	Rat	10.0	19.6	–	–	–
Anthracene	18[m]	Mouse	100[n]	106	–	–	–
Aroclor-1242	40	Mink	0.069	0.175	Screech Owl	0.41	0.41
Aroclor-1248	40	Rhesus Monkey	0.01	0.04	–	–	–
Aroclor-1254	40	Oldfield Mouse	0.068	0.059	Ring-Necked Pheasant	0.18	0.18
Aroclor-1260	40	Rat	0.04	0.08	–	–	–
Benzo(a)anthracene	18[m]	Mouse	1.0[o]	1.06	–	–	–
Benzo(a)pyrene	18[m]	Mouse	1.0	1.06	–	–	–

Refer to footnotes at end of table.

Table 17 (Continued)
Toxicity Benchmarks for Ecological Receptors at SWMU 46

COPEC	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]
Benzo(b)fluoranthene	18[m]	Mouse	1.0[o]	1.06	–	–	–
Benzo(g,h,i)perylene	18[m]	Mouse	1.0[o]	1.06	–	–	–
Benzo(k)fluoranthene	18[m]	Mouse	1.0[o]	1.06	–	–	–
2-Butanone	–	Rat	1771	3464	–	–	–
Butylbenzylphthalate	–	Rat	159[p]	311	–	–	–
Carbazole	–	–	–	–	–	–	–
Chrysene	18[m]	Mouse	1.0[o]	1.06	–	–	–
1,3-Dichlorobenzene	–	Rat	116[q]	227	–	–	–
Diethylphthalate	–	Mouse	75.3[r]	79.7	–	–	–
Di-n-butyl phthalate	200	Mouse	550	582	Ringed Dove	0.11	0.11
Di-n-octyl phthalate	–	Mouse	79.4[s]	84.0	–	–	–
bis(2-Ethylhexyl) phthalate	–	Mouse	18.3	19.4	Ringed Dove	1.1	1.1
Fluoranthene	18[m]	Mouse	12.5[n]	13.2	–	–	–
Fluorene	18[m]	Mouse	12.5[n]	13.2	–	–	–
Hexachlorobenzene	–	Rat	0.29[p]	0.57	–	–	–
Indeno(1,2,3-cd)pyrene	18[m]	Mouse	1.0[o]	1.06	–	–	–
2-Nitrotoluene	–	Rat	1.79[t]	3.50	–	–	–
Phenanthrene	18[m]	Mouse	1.0[o]	1.06	–	–	–
Pyrene	18[m]	Mouse	7.5[n]	7.9	–	–	–
Toluene	200	Mouse	26	27.5	–	–	–

[a]In mg/kg soil dry weight.
[b]Efroymson et al. 1997.
[c]Body weights (in kg) for the NOAEL conversion are as follows: mouse, 0.030; rat, 0.350; mink, 1.0; rhesus monkey, 5.0; oldfield mouse, 0.014 (except where noted).
[d]Sample et al. 1996, except where noted.
[e]In mg/kg body weight per day.
[f]Based upon NOAEL conversion methodology presented in Sample et al. (1996), using a deer mouse body weight of 0.0239 kg and a mammalian scaling factor of 0.25.

Table 17 (Concluded)
Toxicity Benchmarks for Ecological Receptors at SWMU 46

[g]Based upon NOAEL conversion methodology presented in Sample et al. (1996). The avian scaling factor of 0.0 was used, making the NOAEL independent of body weight.
[h]Body weight: 0.435 kg.
[i]Body weight: 0.303 kg.
[j]Body weight: 0.273 kg.
[k]Based upon a rat lowest-observed-adverse-effect level of 89 mg/kg/day (EPA 2003) and an uncertainty factor of 0.2.
[l]Body weight: 0.260 kg.
[m]From Sims and Overcash (1983).
[n]Based upon subchronic NOAEL from EPA (2003) and an uncertainty factor of 0.1.
[o]No data available. Toxicity value based upon NOAEL for benzo(a)pyrene.
[p]EPA 2003.
[q]NOAEL based upon rat NOAEL for 1,2-dichlorobenzene of 134 mg/kg/day (EPA 2003) and ratio of mouse intraperitoneal LD_{50} values (1,062/1,228) from RTECS (Micromedex, Inc. 1997).
[r]NOAEL based upon mouse NOAEL for bis(2-ethylhexyl) phthalate and ratio of LD_{50} values (6,800/1,500) from RTECS (Micromedex, Inc. 1997).
[s]NOAEL based upon mouse NOAEL for bis(2-ethylhexyl) phthalate and ratio of LD_{50} values (6,513/1,500) from RTECS (Micromedex, Inc. 1997).
[t]NOAEL based upon rat NOAEL for TNT of 1.6 mg/kg/day (Talmage and Opresko 1995) and ratio of LD_{50} values (891/795) from RTECS (Micromedex, Inc. 1997).

COPEC = Constituent of potential ecological concern.
EPA = U.S. Environmental Protection Agency.
kg = Kilogram(s).
LD_{50} = Acute lethal dose to 50 percent of the test population.
mg = Milligram(s).
NOAEL = No-observed-adverse-effect level.
RTECS = Registry of Toxic Effects of Chemical Substances.
SWMU = Solid Waste Management Unit.
TNT = 2,4,6-trinitrotoluene.
– = Insufficient toxicity data.

Table 18
HQs for Ecological Receptors at SWMU 46

COPEC	Plant HQ[a]	Deer Mouse HQ (Herbivorous)[a]	Deer Mouse HQ (Omnivorous)[a]	Deer Mouse HQ (Insectivorous)[a]	Burrowing Owl HQ[a]
Inorganic					
Arsenic	4.4E-1	3.1E-1	**2.8E+0**	**5.2E+0**	2.2E-3
Barium	6.6E-1	8.3E-1	**2.9E+0**	**5.0E+0**	3.6E-2
Cadmium	**7.1E+1**	**1.0E+1**	**1.0E+1**	**1.1E+1**	3.4E-1
Chromium (total)	**7.9E+1**	1.4E-4	2.4E-4	3.4E-4	2.6E-1
Chromium VI	**2.1E+0**	3.0E-3	5.3E-3	7.6E-3	–
Copper	**1.3E+0**	5.7E-1	3.8E-1	1.9E-1	1.2E-2
Cyanide (total)	–	3.2E-6	3.2E-6	3.2E-6	–
Lead	**1.3E+0**	7.3E-2	5.6E-2	4.0E-2	3.9E-2
Mercury (organic)	2.6E-1	1.9E-1	1.9E-1	1.9E-1	**1.1E+0**
Mercury (inorganic)	2.6E-1	8.7E-4	8.7E-4	8.7E-4	1.5E-2
Nickel	**1.3E+1**	1.7E-1	2.3E-1	3.0E-1	1.4E-2
Selenium	2.6E-1	5.4E-2	8.0E-2	1.1E-1	1.7E-2
Silver	**6.2E+0**	5.7E-2	3.6E-2	1.5E-2	–
Vanadium	**2.3E+1**	4.8E-1	**9.9E+0**	**1.9E+1**	1.1E-2
Zinc	**3.0E+0**	1.1E-1	6.8E-2	2.4E-2	3.5E-1
Organic					
Acenaphthene	3.5E-4	1.2E-5	5.5E-4	1.1E-3	–
Acetone	–	1.0E-3	6.2E-4	2.4E-4	–
Anthracene	1.2E-3	3.9E-6	3.4E-4	6.9E-4	–
Aroclor-1242	1.8E-3	1.2E-2	6.7E-1	**1.3E+0**	5.9E-4
Aroclor-1248	6.5E-5	4.5E-4	1.3E-1	2.7E-1	–
Aroclor-1254	2.0E-3	6.9E-3	**2.8E+0**	**5.6E+0**	6.8E-2
Aroclor-1260	5.0E-4	1.2E-3	5.2E-1	1.0E+0	–
Benzo(a)anthracene	1.4E-2	1.6E-3	4.8E-1	9.5E-1	–
Benzo(a)pyrene	2.4E-2	2.0E-3	8.5E-1	**1.7E+0**	–
Benzo(b)fluoranthene	2.8E-2	1.9E-3	1.0E+0	**2.1E+0**	–
Benzo(g,h,i)perylene	1.7E-2	1.2E-3	6.4E-1	**1.3E+0**	–
Benzo(k)fluoranthene	2.6E-2	1.7E-3	1.0E+0	**2.0E+0**	–

Refer to footnotes at end of table.

Table 18 (Concluded)
HQs for Ecological Receptors at SWMU 46

COPEC	Plant HQ[a]	Deer Mouse HQ (Herbivorous)[a]	Deer Mouse HQ (Omnivorous)[a]	Deer Mouse HQ (Insectivorous)[a]	Burrowing Owl HQ[a]
2-Butanone	–	1.3E-4	9.6E-5	6.5E-5	–
Butylbenzylphthalate	–	7.0E-7	9.1E-5	1.8E-4	–
Carbazole	–	–	–	–	–
Chrysene	2.4E-2	2.2E-3	8.3E-1	**1.7E+0**	–
1,3-Dichlorobenzene	–	1.2E-6	3.4E-5	6.6E-5	–
Diethylphthalate	–	2.5E-4	1.6E-3	3.0E-3	–
Di-n-butyl phthalate	1.3E-4	7.3E-7	7.9E-5	1.6E-4	1.5E-3
Di-n-octyl phthalate	–	1.1E-6	2.3E-4	4.5E-4	–
bis(2-Ethylhexyl) phthalate	–	1.4E-4	1.0E-1	2.1E-1	**5.4E+0**
Fluoranthene	2.5E-2	4.1E-4	6.1E-2	1.2E-1	–
Fluorene	3.7E-4	1.3E-5	8.4E-4	1.7E-3	–
Hexachlorobenzene	–	8.3E-5	1.9E-2	3.8E-2	–
Indeno(1,2,3-cd)pyrene	1.9E-2	1.3E-3	7.1E-1	**1.4E+0**	–
2-Nitrotoluene	–	1.2E-3	6.4E-3	1.2E-2	–
Phenanthrene	7.7E-3	2.2E-3	2.3E-1	4.6E-1	–
Pyrene	3.4E-2	6.2E-4	1.4E-1	2.9E-1	–
Toluene	4.0E-5	4.6E-5	4.3E-4	8.2E-4	–
HI[b]	**2.0E+2**	**1.3E+1**	**3.7E+1**	**6.2E+1**	**7.6E+0**

[a]**Bold** values indicate the HQ or HI exceeds unity.
[b]The HI is the sum of individual HQs.
COPEC = Constituent of potential ecological concern.
HI = Hazard index.
HQ = Hazard quotient.
SWMU = Solid Waste Management Unit.
– = Insufficient toxicity data available for risk estimation purposes.

Tables 19 and 20 summarize the internal and external dose-rate model results for U-235 and U-238 for the deer mouse and burrowing owl, respectively. The total radiation dose rate to the deer mouse was predicted to be 3.4E-4 rad/day and that for the burrowing owl was 3.3E-4 rad/day. The dose rates for the deer mouse and the burrowing owl are lower than the benchmark of 0.1 rad/day.

Table 19
Total Dose Rates for Deer Mice
Exposed to Radionuclides at SWMU 46

Radionuclide	Maximum Activity (pCi/g)	Total Dose (rad/day)
U-235	**ND (0.287)**	7.6E-6
U-238	**2.07**	3.4E-4
Total Dose		3.4E-4

MDA = Minimum detectable activity.
ND ( ) = Not detected above the MDA, shown in parentheses.
pCi/g = Picocurie(s) per gram.
SWMU = Solid Waste Management Unit.

Table 20
Total Dose Rates for Burrowing Owls
Exposed to Radionuclides at SWMU 46

Radionuclide	Maximum Activity (pCi/g)	Total Dose (rad/day)
U-235	**ND (0.287)**	5.8E-6
U-238	**2.07**	3.2E-4
Total Dose		3.3E-4

MDA = Minimum detectable activity.
ND ( ) = Not detected above the MDA, shown in parentheses.
pCi/g = Picocurie(s) per gram.
SWMU = Solid Waste Management Unit.

VII.3.5 Uncertainty Assessment

Many uncertainties are associated with the characterization of ecological risks at SWMU 46. These uncertainties result from assumptions used in calculating risk that could overestimate or underestimate true risk presented at the 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 analyte concentrations measured in soil to evaluate risk, the use of wildlife toxicity benchmarks based upon NOAEL values, and the incorporation of strict herbivorous and strict insectivorous diets for predicting the extreme HQ values for the deer mouse. Each of these uncertainties, which are consistent among each of the site-specific ecological risk

assessments, is discussed in greater detail in the uncertainty section of the ecological risk assessment methodology document for the SNL/NM ER Program (IT July 1998).

Uncertainties associated with the estimation of risk to ecological receptors following exposure to U-235 and U-238 are primarily related to those inherent in the radionuclide-specific data. Radionuclide-dependent data are measured values that have their associated errors. The dose-rate models used for these calculations are based upon conservative estimates on receptor shape, radiation absorption by body tissues, and intake parameters. The goal is to provide a realistic but conservative estimate of a receptor's internal and external exposure to radionuclides in soil. These dose estimates are conservatively based upon detection limits of the two radionuclides.

The assumption of an area use factor of 1.0 is a source of uncertainty for the burrowing owl at this site. Because SWMU 46 is approximately 2.25 acres in size and the home range of the burrowing owl is 35 acres, an area use factor of approximately 0.064 would be justified for this receptor. This is sufficient to reduce the burrowing owl HQ for mercury (based upon the organic form) from 1.1 to 0.070 and that for bis(2-ethylhexyl) phthalate from 5.4 to 0.35. Thus, the predictions of potential risk to this receptor can be attributed to the conservative assumption that all food and soil ingested comes from the site.

In the estimation of ecological risk, background concentrations are included as a component of maximum on-site concentrations. For some inorganic COPECs, conservatisms in the modeling of exposure and risk result in the prediction of risk to ecological receptors when exposed at background concentrations. As shown in Table 21, the HQs for plants associated with exposure to background concentrations of total chromium, vanadium, and zinc are greater than unity as are the HQs for the omnivorous and insectivorous deer mice from exposures to background levels of arsenic, barium, and vanadium. The maximum concentration of arsenic (4.41 mg/kg) is only very slightly above the background screening value of 4.4 mg/kg. Therefore, even though HQs greater than unity were found for the omnivorous and insectivorous deer mice from exposures to arsenic, it can be concluded that these exposures are essentially within the range of background. The HQs can be attributed to conservatisms in the modeling (e.g., the use of NOAELs as the toxicity benchmark and the assumption of 100-percent bioavailability). Similarly, in the cases of barium and vanadium, background may account for approximately 61 and 71 percent (respectively) of the HQ values shown in Table 18 for these two COPECs, and exposure to background levels also results in HQs greater than unity for the omnivorous and insectivorous deer mice. Again, it is likely that the actual risks to the omnivorous and insectivorous deer mice from exposure to barium and vanadium at SWMU 46 are overestimated by the HQs calculated in this risk assessment because of conservatisms incorporated into the exposure assessment and the toxicity benchmarks for these two COPECs.

Another significant source of uncertainty associated with the prediction of ecological risk at this site is the use of the maximum measured concentrations as the exposure point concentrations. This results in a conservative exposure scenario that does not necessarily reflect actual site conditions. The mean soil concentration of each COPEC, for example, is more likely to be representative of the average exposure experienced by receptors at this site. To assess the potential degree of overestimation caused by using the maximum measured soil concentrations in the exposure assessment, the 95% UCL of the mean soil concentration was calculated for each of the COPECs with HQs greater than unity to determine whether these HQs can be

Table 21
HQs for Ecological Receptors Exposed to Background Concentrations at SWMU 46

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 (total)	**1.3E+1**	2.2E-5	3.9E-5	5.6E-5	4.3E-2
Chromium VI	NA	NA	NA	NA	NA
Copper	1.7E-1	7.3E-2	4.8E-2	2.4E-2	1.5E-3
Cyanide (total)	NA	NA	NA	NA	NA
Lead	2.2E-1	1.2E-2	9.5E-3	6.7E-3	6.6E-3
Mercury (organic)	1.7E-1	1.3E-1	1.3E-1	1.3E-1	7.1E-1
Mercury (inorganic)	1.7E-1	5.7E-4	5.7E-4	5.7E-4	1.0E-2
Nickel	8.5E-1	1.1E-2	1.6E-2	2.0E-2	9.4E-4
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	–
Vanadium	**1.7E+1**	3.4E-1	**7.0E+0**	**1.4E+1**	7.8E-3
Zinc	**1.5E+0**	5.7E-2	3.5E-2	1.2E-2	1.8E-1

Note: **Bold** values indicate the HQ exceeds unity.
HQ = Hazard quotient.
NA = Not applicable (background value not calculated).
SWMU = Solid Waste Management Unit.
– = Insufficient toxicity data available for risk estimation purposes.

accounted for by the magnitude of the extreme measurement. It should be noted that the 95% UCL is itself a conservative estimate of the true mean soil concentration.

For the six polynuclear aromatic hydrocarbons (PAHs) that showed HQs greater than unity for the insectivorous deer mouse (i.e., benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, and indeno(1,2,3-cd)pyrene), exposures to the 95% UCLs (0.106, 0.145, 0.090, 0.102, 0.110, and 0.080, respectively) resulted in HQs less than unity for the insectivorous deer mouse. Therefore, predictions of risk from these COPECs can be attributed to the use of the maximum concentration value. It should be noted from Table 17 that for all of these PAHs, except benzo(a)pyrene, compound-specific toxicity information could not be found; the toxicity benchmark used to evaluate potential risk is conservatively based upon benzo(a)pyrene, which is considered to be among the most toxic of the PAHs. It is therefore concluded that the HQs for these compounds shown in Table 18 significantly overestimate the potential for risk to the deer mouse, and that the actual potential for risk is likely to be very low.

In the case of Aroclor-1242, the 95% UCL (0.017 mg/kg) is low enough to reduce the HQ for the insectivorous mouse to less than unity. For Aroclor-1254, the 95% UCL reduces the HQ for the omnivorous mouse to less than unity and that for the insectivorous mouse to 1.7, which indicates a low potential for risk. For bis(2-ethylhexyl) phthalate, exposure of the burrowing owl to the 95% UCL concentration (0.218 mg/kg) reduces its HQ to 1.4. When the area use factor of 0.064 (see above) is applied to this HQ, it is further reduced to 0.090. Therefore, the predicted risk to this receptor from exposure to bis(2-ethylhexyl) phthalate is accounted for by the conservative assumptions used in the initial calculation of the HQs.

The 95% UCL for barium (232 mg/kg) reduces the HQs for the omnivorous and insectivorous deer mice to 2.0 and 3.5, respectively, which are close to those based upon background exposures (Table 21). For cadmium, exposures of the herbivorous, omnivorous, and insectivorous deer mice to the 95% UCL (69.7 mg/kg) reduces the HQs to 3.3, 3.4, and 3.6, respectively, which indicate a low potential for risk. In plants, the HQ for cadmium is reduced from 71 to 23. For nickel and silver, the 95% UCLs (147 and 4.58 mg/kg, respectively) reduce the plant HQs to 4.9 and 2.3 (respectively), and for copper, the 95% UCL (90.0 mg/kg) reduces the plant HQ to less than unity. In the case of total chromium, however, the plant HQ based upon the 95% UCL (25 mg/kg) is 25. Thus, with the exceptions of plant exposures to cadmium and total chromium, all HQs based upon the 95% UCLs at SWMU 46 are less than 5, and therefore indicate a low potential for risk to ecological receptors.

For total chromium, it should be noted that the plant toxicity benchmark for this metal is based upon chromium VI, which may be more toxic to plants than the more common chromium III. The majority of the total chromium measured at SWMU 46 is expected to be chromium III. In fact, chromium VI was found to represent less than 1 percent of total chromium at this site (based upon the maximum concentrations) and the plant HQ for chromium VI (2.1) indicates a low potential for risk from this COPEC. For this reason, it is uncertain whether the calculated HQ for total chromium accurately predicts the potential risk to plants. Further, this benchmark is conservatively based upon laboratory tests using soil amendments with a highly available form of chromium (Efroymson et al. 1997). It is likely that only a small fraction of the chromium in the soil at SWMU 46 is in a form that is highly available for plant uptake; therefore, the plant toxicity benchmark for this metal probably overestimates risk to plants to a significant degree.

Similar uncertainty exists concerning the plant HQ for cadmium. Although several studies were used in the derivation of the plant toxicity benchmark for cadmium (Efroymson et al. 1997), most of these studies (including all that showed LOAEL values less than the accepted benchmark value) were based upon the addition of cadmium as cadmium chloride, which is expected to be highly available to plants. The LOAEL values from these studies range upwards to 300 mg/kg cadmium in soil, which encompasses the concentrations measured at SWMU 46. Therefore, the potential for significant risk to plants from exposure to cadmium at this site is probably low.

Based upon this uncertainty analysis, ecological risks at SWMU 46 are generally expected to be low. HQs greater than unity were initially predicted; however, closer examination of the exposure assumptions and toxicity benchmarks revealed an overestimation of risk primarily attributed to conservatism in the exposure concentrations, in the assumed area use factor, and in the toxicity benchmark values used in the HQ calculations for this site.

VII.3.6 Risk Interpretation

Ecological risks associated with SWMU 46 were estimated through a screening assessment that incorporated site-specific information when available. Initial calculations of HQs indicated a potential for risk for 12 inorganic and 9 organic COPECs. However, based upon the analysis of uncertainties associated with these HQs, the actual potential for risk to ecological receptors is expected to be low. This is primarily due to the use of maximum detected values as the exposure point concentrations for these HQs. Predicted risks from exposures based upon the 95% UCL concentrations are significantly lower. All HQs based upon the 95% UCLs were less than 5 and/or could be attributed to conservative toxicity benchmarks or conservative assumptions of bioavailability. Based upon this final analysis, ecological risks associated with SWMU 46 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) uses a default set of exposure routes and associated default parameter values 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 are invoked for risk assessments unless site-specific information suggests other parameter values. Because many SNL/NM solid waste management units (SWMUs) 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 facilitates the risk assessments and subsequent review.

The default exposure routes and parameter values used 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 will use these default exposure routes and parameter values in future risk assessments.

At SNL/NM, all SWMUs exist within the boundaries of the Kirtland Air Force Base. Approximately 240 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 and the biological resources present. When evaluating potential human health risk the current or reasonably foreseeable land use negotiated and approved for the specific SWMU/AOC, aggregate, or watershed will be used. The following references generally document these land uses: *Workbook: Future Use Management Area 2 (DOE et al. September 1995); Workbook: Future Use Management Area 1 (DOE et al. October 1995); Workbook: Future Use Management Areas 3, 4, 5, and 6 (DOE and USAF January 1996); Workbook: Future Use Management Area 7 (DOE and USAF March 1996)*. 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. Therefore, 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 1989) 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 shellfish
- 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 is currently no consumption of fish, shellfish, 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 five potential exposure routes from further risk assessment evaluations at any SNL/NM SWMU:

- Ingestion of contaminated fish and shellfish
- 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

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

Based upon this evaluation, for future risk assessments the exposure routes that will be considered are shown in Table 1.

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 (nonradiological constituents only) soil only	Dermal contact (nonradiological constituents only) soil only	Dermal contact (nonradiological constituents only) soil only
External exposure to penetrating radiation from ground surfaces	External exposure to penetrating radiation from ground surfaces	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 equation for calculating potential intakes via these routes is shown below. The equations are taken from "Assessing Human Health Risks Posed by Chemicals: Screening-Level Risk Assessment" (NMED March 2000) and "Technical Background Document for Development of Soil Screening Levels" (NMED December 2000). Equations from both documents are based upon the "Risk Assessment Guidance for Superfund" (RAGS): Volume 1 (EPA 1989, 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). RESRAD is the only code designated by the U.S. Department of Energy (DOE) in DOE Order 5400.5 for the evaluation of radioactively contaminated sites (DOE 1993). The Nuclear Regulatory Commission (NRC) has approved the use of RESRAD for dose evaluation by licensees involved in decommissioning, NRC staff evaluation of waste disposal requests, and dose evaluation of sites being reviewed by NRC staff. EPA Science Advisory Board reviewed the RESRAD model. EPA used RESRAD in their rulemaking on radiation site cleanup regulations. RESRAD code has been verified, undergone several benchmarking analyses, and been included in the International Atomic Energy Agency's VAMP and BIOMOVS II projects to compare environmental transport models.

Also shown are the default values SNL/NM ER will use in RME risk assessment calculations for industrial, recreational, and residential land-use 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) or by directly accessing the RESRAD websites at: http://web.ead.anl.gov/resrad/home2/ or http://web.ead.anl.gov/resrad/documents/.

Generic Equation for Calculation of Risk Parameter Values

The equation used to calculate the risk parameter values (i.e., hazard quotients/HI, excess cancer risk, or radiation total effective dose equivalent [TEDE] [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.

For nonradiological constituents of concern (COCs), 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. For radionuclides, the calculated radiation exposure, expressed as TEDE is compared directly to the exposure guidelines of 15 millirem per year (mrem/year) for industrial and recreational future use and 75 mrem/year for the unlikely event that institutional control of the site is lost and the site is used for residential purposes (EPA 1997).

The evaluation of the carcinogenic health hazard produces a quantitative estimate for excess cancer risk resulting from the COCs present at the site. This estimate is evaluated for determination of further action by comparison of the quantitative estimate with the potentially acceptable risk of 1E-5 for nonradiological 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 from radioactive compounds produces a quantitative estimate of doses resulting from the COCs present at the site. This estimated dose is used to calculate an assumed risk. However, this calculated risk is presented for illustration purposes only, not to determine compliance with regulations.

The specific equations used for the individual exposure pathways can be found in RAGS (EPA 1989) and are outlined below. The RESRAD Manual (ANL 1993) describes similar equations for the calculation of radiological exposures.

Soil Ingestion

A receptor can ingest soil or dust directly by working in the contaminated soil. Indirect ingestion can occur from sources such as unwashed hands introducing contaminated soil to food that is then eaten. An estimate of intake from ingesting soil will be calculated as follows:

$$I_s = \frac{C_s * IR * CF * EF * ED}{BW * AT}$$

where:

I_s = Intake of contaminant from soil ingestion (milligrams [mg]/kilogram [kg]-day)
C_s = Chemical concentration in soil (mg/kg)
IR = Ingestion rate (mg soil/day)
CF = Conversion factor (1E-6 kg/mg)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
BW = Body weight (kg)
AT = Averaging time (period over which exposure is averaged) (days)

It should be noted that it is conservatively assumed that the receptor only ingests soil from the contaminated source.

Soil Inhalation

A receptor can inhale soil or dust directly by working in the contaminated soil. An estimate of intake from inhaling soil will be calculated as follows (EPA August 1997):

$$I_s = \frac{C_s * IR * EF * ED * \left(1/VF \text{ or } 1/PEF\right)}{BW * AT}$$

where:

I_s = Intake of contaminant from soil inhalation (mg/kg-day)
C_s = Chemical concentration in soil (mg/kg)
IR = Inhalation rate (cubic meters [m^3]/day)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
VF = soil-to-air volatilization factor (m^3/kg)
PEF = particulate emission factor (m^3/kg)
BW = Body weight (kg)
AT = Averaging time (period over which exposure is averaged) (days)

Soil Dermal Contact

$$D_a = \frac{C_s * CF * SA * AF * ABS * EF * ED}{BW * AT}$$

where:

D_a = Absorbed dose (mg/kg-day)
C_s = Chemical concentration in soil (mg/kg)
CF = Conversion factor (1E-6 kg/mg)
SA = Skin surface area available for contact (cm^2/event)
AF = Soil to skin adherence factor (mg/cm^2)
ABS = Absorption factor (unitless)
EF = Exposure frequency (events/year)

ED = Exposure duration (years)
BW = Body weight (kg)
AT = Averaging time (period over which exposure is averaged) (days)

Groundwater Ingestion

A receptor can ingest water by drinking it or through using household water for cooking. An estimate of intake from ingesting water will be calculated as follows (EPA August 1997):

$$I_w = \frac{C_w * IR * EF * ED}{BW * AT}$$

where:

I_w = Intake of contaminant from water ingestion (mg/kg/day)
C_w = Chemical concentration in water (mg/liter [L])
IR = Ingestion rate (L/day)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
BW = Body weight (kg)
AT = Averaging time (period over which exposure is averaged) (days)

Groundwater Inhalation

The amount of a constituent taken into the body via exposure to volatilization from showering or other household water uses will be evaluated using the concentration of the constituent in the water source (EPA 1991 and 1992). An estimate of intake from volatile inhalation from groundwater will be calculated as follows (EPA 1991):

$$I_w = \frac{C_w * K * IR_i * EF * ED}{BW * AT}$$

where:

I_w = Intake of volatile in water from inhalation (mg/kg/day)
C_w = Chemical concentration in water (mg/L)
K = volatilization factor (0.5 L/m^3)
IR_i = Inhalation rate (m^3/day)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
BW = Body weight (kg)
AT = Averaging time (period over which exposure is averaged—days)

For volatile compounds, volatilization from groundwater can be an important exposure pathway from showering and other household uses of groundwater. This exposure pathway will only be evaluated for organic chemicals with a Henry's Law constant greater than 1x10^{-5} and with a molecular weight of 200 grams/mole or less (EPA 1991).

Tables 2 and 3 show the default parameter values suggested for use by SNL/NM at SWMUs, based upon the selected land-use scenarios for nonradiological and radiological COCs,

respectively. References are given at the end of the table indicating the source for the chosen parameter values. SNL/NM uses default values that are consistent with both regulatory guidance and 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 will use the described default exposure routes and parameter values 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 NMED has requested this scenario to be considered to provide perspective of the risk under the more restrictive land-use scenario. 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. 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 Nonradiological Exposure Parameter Values for Various Land-Use scenarios

Parameter	Industrial	Recreational	Residential
General Exposure Parameters			
Exposure Frequency (day/yr)	250[a,b]	8.7 (4 hr/wk for 52 wk/yr)[a,b]	350[a,b]
Exposure Duration (yr)	25[a,b,c]	30[a,b,c]	30[a,b,c]
Body Weight (kg)	70[a,b,c]	70 Adult[a,b,c] 15 Child[a,b,c]	70 Adult[a,b,c] 15 Child[a,b,c]
Averaging Time (days) for Carcinogenic Compounds (= 70 yr x 365 day/yr) for Noncarcinogenic Compounds (= ED x 365 day/yr)	25,550[a,b] 9,125[a,b]	25,550[a,b] 10,950[a,b]	25,550[a,b] 10,950[a,b]
Soil Ingestion Pathway			
Ingestion Rate (mg/day)	100[a,b]	200 Child[a,b] 100 Adult[a,b]	200 Child[a,b] 100 Adult[a,b]
Inhalation Pathway			
Inhalation Rate (m^3/day)	20[a,b]	15 Child[a] 30 Adult[a]	10 Child[a] 20 Adult[a]
Volatilization Factor (m^3/kg)	Chemical Specific	Chemical Specific	Chemical Specific
Particulate Emission Factor (m^3/kg)	1.36E9[a]	1.36E9[a]	1.36E9[a]
Water Ingestion Pathway			
Ingestion Rate (liter/day)	2.4[a]	2.4[a]	2.4[a]
Dermal Pathway			
Skin Adherence Factor (mg/cm^2)	0.2[a]	0.2 Child[a] 0.07 Adult[a]	0.2 Child[a] 0.07 Adult[a]
Exposed Surface Area for Soil/Dust (cm^2/day)	3,300[a]	2,800 Child[a] 5,700 Adult[a]	2,800 Child[a] 5,700 Adult[a]
Skin Adsorption Factor	Chemical Specific	Chemical Specific	Chemical Specific

[a]Technical Background Document for Development of Soil Screening Levels (NMED 2000).
[b]Risk Assessment Guidance for Superfund, Vol. 1, Part B (EPA 1991).
[c]Exposure Factors Handbook (EPA August 1997).
ED = Exposure duration.
EPA = U.S. Environmental Protection Agency.
hr = Hour(s).
kg = Kilogram(s).
m = Meter(s).
mg = Milligram(s).
NA = Not available.
wk = Week(s).
yr = Year(s).

Table 3
Default Radiological Exposure Parameter Values for Various Land-Use scenarios

Parameter	Industrial	Recreational	Residential
General Exposure Parameters			
Exposure Frequency	8 hr/day for 250 day/yr	4 hr/wk for 52 wk/yr	365 day/yr
Exposure Duration (yr)	25[a,b]	30[a,b]	30[a,b]
Body Weight (kg)	70 Adult[a,b]	70 Adult[a,b]	70 Adult[a,b]
Soil Ingestion Pathway			
Ingestion Rate	100 mg/day[c]	100 mg/day[c]	100 mg/day[c]
Averaging Time (days) (= 30 yr x 365 day/yr)	10,950[d]	10,950[d]	10,950[d]
Inhalation Pathway			
Inhalation Rate (m^3/yr)	7,300[d,e]	10,950[e]	7,300[d,e]
Mass Loading for Inhalation g/m^3	1.36 E-5[d]	1.36 E-5[d]	1.36 E-5[d]
Food Ingestion Pathway			
Ingestion Rate, Leafy Vegetables (kg/yr)	NA	NA	16.5[c]
Ingestion Rate, Fruits, Non-Leafy Vegetables & Grain (kg/yr)	NA	NA	101.8[b]
Fraction Ingested	NA	NA	0.25[b,d]

[a]Risk Assessment Guidance for Superfund, Vol. 1, Part B (EPA 1991).
[b]Exposure Factors Handbook (EPA August 1997).
[c]EPA Region VI guidance (EPA 1996).
[d]For radionuclides, RESRAD (ANL 1993).
[e]SNL/NM (February 1998).
EPA = U.S. Environmental Protection Agency.
g = Gram(s)
hr = Hour(s).
kg = Kilogram(s).
m = Meter(s).
mg = Milligram(s).
NA = Not applicable.
wk = Week(s).
yr = Year(s).

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APPENDIX 2
CALCULATION OF THE UPPER CONFIDENCE LIMITS OF MEAN CONCENTRATIONS

For conservatism, Sandia National Laboratories/New Mexico uses the maximum concentration of the constituents of concern (COCs) for initial risk calculation. If the maximum concentrations produce risk above New Mexico Environment Department (NMED) guidelines, conservatism with this approach is evaluated and, if appropriate, a more realistic approach is applied. When the site has been adequately characterized, an estimate of the mean concentration of the COCs is more representative of actual site conditions. The NMED has proposed the use of the 95% upper confidence limit (UCL) of the mean to represent average concentrations at a site (NMED December 2000). The 95% UCL is calculated according to NMED guidance (Tharp June 2002) using the U.S. Environmental Protection Agency ProUCL program (EPA April 2002). Attached are the outputs from that program and the calculated UCLs used in the risk analysis.

References

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ATTACHMENT

SWMU 46 Human Health			
Summary Statistics for	Arsenic	Summary Statistics for	ln(Arsenic)
Number of Samples	66	Minimum	0.24686
Minimum	1.28	Maximum	1.654411
Maximum	5.23	Mean	0.89948
Mean	2.595606	Standard Deviation	0.332914
Median	2.455	Variance	0.110832
Standard Deviation	0.868447		
Variance	0.7542	Lilliefors Test Statisitic	0.082024
Coefficient of Variation	0.334584	Lilliefors 5% Critical Value	0.109059
Skewness	0.629833	Data are Lognormal at 5% Significance Level	
95 % UCL (Assuming Normal Data)		Estimates Assuming Lognormal Distribution	
Student's-t	2.773981	MLE Mean	2.5984
		MLE Standard Deviation	0.889576
95 % UCL (Adjusted for Skewness)		MLE Coefficient of Variation	0.342355
Adjusted-CLT	2.780294	MLE Skewness	1.067193
Modified-t	2.775362	MLE Median	2.458324
		MLE 80% Quantile	3.256954
95 % Non-parametric UCL		MLE 90% Quantile	3.770753
CLT	2.771438	MLE 95% Quantile	4.250871
Jackknife	2.773981	MLE 99% Quantile	5.332598
Standard Bootstrap	2.765511		
Bootstrap-t	2.770146	MVU Estimate of Median	2.456261
Chebyshev (Mean, Std)	3.061566	MVU Estimate of Mean	2.596104
		MVU Estimate of Std. Dev.	0.885746
		MVU Estimate of SE of Mean	0.108934
		UCL Assuming Lognormal Distribution	
		95% H-UCL	2.794703
		95% Chebyshev (MVUE) UCL	3.070934
		99% Chebyshev (MVUE) UCL	3.67998
		Recommended UCL to use:	
		Student's-t or H-UCL	

SWMU 46 Human Health	
Summary Statistics for	Cadmium
Number of Samples	66
Minimum	0.0065
Maximum	213
Mean	6.858911
Median	0.323
Standard Deviation	27.53754
Variance	758.3159
Coefficient of Variation	4.014855
Skewness	6.781231
Lilliefors Test Statisitic	0.146118
Lilliefors 5% Critical Value	0.109059
Data not Lognormal at 5% Significance Level	
Data not Normal: Try Non-parametric UCL	
99% UCL (Assuming Normal Data)	
Student's-t	14.94352
99% UCL (Adjusted for Skewness)	
Adjusted-CLT	20.32003
Modified-t	15.41508
99% Non-parametric UCL	
CLT	14.74438
Jackknife	14.94352
Standard Bootstrap	14.61795
Bootstrap-t	41.35214
Chebyshev (Mean, Std)	40.58537

SWMU 46 Human Health		
Summary Statistics for	Nickel	
Number of Samples	66	
Minimum	3.64	
Maximum	379	
Mean	24.80106	
Median	8.12	
Standard Deviation	51.16346	
Variance	2617.7	
Coefficient of Variation	2.062955	
Skewness	5.534736	
Lilliefors Test Statisitic	0.197712	
Lilliefors 5% Critical Value	0.109059	
Data not Lognormal at 5% Significance Level		
Data not Normal: Try Non-parametric UCL		
99 % UCL (Assuming Normal Data)		
Student's-t	39.82189	
99 % UCL (Adjusted for Skewness)		
Adjusted-CLT	47.90699	
Modified-t	40.53698	
99 % Non-parametric UCL		
CLT	39.4519	
Jackknife	39.82189	
Standard Bootstrap	39.80941	
Bootstrap-t	61.14265	
Chebyshev (Mean, Std)	87.46325	

SWMU 46 Human Health	
Summary Statistics for	Thallium
Number of Samples	66
Minimum	0.236
Maximum	2.19
Mean	0.818644
Median	0.495
Standard Deviation	0.479358
Variance	0.229784
Coefficient of Variation	0.585551
Skewness	0.880509
Lilliefors Test Statisitic	0.249517
Lilliefors 5% Critical Value	0.109059
Data not Lognormal at 5% Significance Level	
Data not Normal: Try Non-parametric UCL	
95 % UCL (Assuming Normal Data)	
Student's-t	0.917102
95 % UCL (Adjusted for Skewness)	
Adjusted-CLT	0.922532
Modified-t	0.918167
95 % Non-parametric UCL	
CLT	0.915698
Jackknife	0.917102
Standard Bootstrap	0.915521
Bootstrap-t	0.922912
Chebyshev (Mean, Std)	1.07584

SWMU 46 Human Health		
Summary Statistics for	Benzo(a)pyrene	
Number of Samples	66	
Minimum	0.001	
Maximum	0.435	
Mean	0.025005152	
Median	0.00835	
Standard Deviation	0.069668967	
Variance	0.004853765	
Coefficient of Variation	2.786184567	
Skewness	4.326051941	
Lilliefors Test Statisitic	0.274223775	
Lilliefors 5% Critical Value	0.109059061	
Data not Lognormal at 5% Significance Level		
Data not Normal: Try Non-parametric UCL		
95 % UCL (Assuming Normal Data)		
Student's-t	0.039314798	
95 % UCL (Adjusted for Skewness)		
Adjusted-CLT	0.043990265	
Modified-t	0.040075888	
95 % Non-parametric UCL		
CLT	0.039110852	
Jackknife	0.039314798	
Standard Bootstrap	0.039218754	
Bootstrap-t	0.053401731	
Chebyshev (Mean, Std)	0.062385574	

SWMU 46 Human Health	
Summary Statistics for	Benzo(ghi)perylene
Number of Samples	66
Minimum	0.0025
Maximum	0.375
Mean	0.019545455
Median	0.005425
Standard Deviation	0.060064752
Variance	0.003607774
Coefficient of Variation	3.073080338
Skewness	5.102754949
Lilliefors Test Statisitic	0.276248162
Lilliefors 5% Critical Value	0.109059061
Data not Lognormal at 5% Significance Level	
Data not Normal: Try Non-parametric UCL	
95 % UCL (Assuming Normal Data)	
Student's-t	0.031882445
95 % UCL (Adjusted for Skewness)	
Adjusted-CLT	0.036668661
Modified-t	0.032656424
95 % Non-parametric UCL	
CLT	0.031706614
Jackknife	0.031882445
Standard Bootstrap	0.031696652
Bootstrap-t	0.062429922
Chebyshev (Mean, Std)	0.051772799

SWMU 46 Ecological					
Summary Statistics for	Arsenic		Summary Statistics for	ln(Arsenic)	
Number of Samples	36		Minimum	0.34359	
Minimum	1.41		Maximum	1.483875	
Maximum	4.41		Mean	1.046428	
Mean	2.942222		Standard Deviation	0.268088	
Median	3.09		Variance	0.071871	
Standard Deviation	0.723042				
Variance	0.522789		Shapiro-Wilk Test Statisitic	0.947403	
Coefficient of Variation	0.245747		Shapiro-Wilk 5% Critical Value	0.935	
Skewness	-0.188816		Data are Lognormal at 5% Significance Level		
95 % UCL (Assuming Normal Data)			Estimates Assuming Lognormal Distribution		
Student's-t	3.145827		MLE Mean	2.951647	
			MLE Standard Deviation	0.805735	
95 % UCL (Adjusted for Skewness)			MLE Coefficient of Variation	0.272978	
Adjusted-CLT	3.136386		MLE Skewness	0.839276	
Modified-t	3.145195		MLE Median	2.847461	
			MLE 80% Quantile	3.571417	
95 % Non-parametric UCL			MLE 90% Quantile	4.01855	
CLT	3.140438		MLE 95% Quantile	4.42572	
Jackknife	3.145827		MLE 99% Quantile	5.312173	
Standard Bootstrap	3.141374				
Bootstrap-t	3.136804		MVU Estimate of Median	2.84462	
Chebyshev (Mean, Std)	3.4675		MVU Estimate of Mean	2.948606	
			MVU Estimate of Std. Dev.	0.801763	
			MVU Estimate of SE of Mean	0.133583	
			UCL Assuming Lognormal Distribution		
			95% H-UCL	3.1979	
			95% Chebyshev (MVUE) UCL	3.530882	
			99% Chebyshev (MVUE) UCL	4.277743	
			Recommended UCL to use:		
			Student's-t or H-UCL		

SWMU 46 Ecological	
Summary Statistics for	Barium
Number of Samples	36
Minimum	63.1
Maximum	330
Mean	127.5722
Median	111.5
Standard Deviation	63.36472
Variance	4015.087
Coefficient of Variation	0.496697
Skewness	2.169397
Shapiro-Wilk Test Statisitic	0.847034
Shapiro-Wilk 5% Critical Value	0.935
Data not Lognormal at 5% Significance Level	
Data not Normal: Try Non-parametric UCL	
99 % UCL (Assuming Normal Data)	
Student's-t	153.3165
99 % UCL (Adjusted for Skewness)	
Adjusted-CLT	159.665
Modified-t	153.9529
99 % Non-parametric UCL	
CLT	152.1403
Jackknife	153.3165
Standard Bootstrap	151.9636
Bootstrap-t	175.1451
Chebyshev (Mean, Std)	232.6507

SWMU 46 Ecological					
Summary Statistics for	Cadmium		Summary Statistics for	ln(Cadmium)	
Number of Samples	36		Minimum	-3.75288	
Minimum	0.02345		Maximum	5.361292	
Maximum	213		Mean	0.479389	
Mean	12.30149		Standard Deviation	2.081831	
Median	1.89		Variance	4.334019	
Standard Deviation	36.61949				
Variance	1340.987		Shapiro-Wilk Test Statisitic	0.984982	
Coefficient of Variation	2.976833		Shapiro-Wilk 5% Critical Value	0.935	
Skewness	5.028173		Data are Lognormal at 5% Significance Level		
99% UCL (Assuming Normal Data)			Estimates Assuming Lognormal Distribution		
Student's-t	27.17952		MLE Mean	14.10315	
			MLE Standard Deviation	122.3404	
99% UCL (Adjusted for Skewness)			MLE Coefficient of Variation	8.674684	
Adjusted-CLT	36.57896		MLE Skewness	678.7952	
Modified-t	28.03197		MLE Median	1.615087	
			MLE 80% Quantile	9.379588	
99% Non-parametric UCL			MLE 90% Quantile	23.44228	
CLT	26.49977		MLE 95% Quantile	49.60048	
Jackknife	27.17952		MLE 99% Quantile	204.7372	
Standard Bootstrap	26.24675				
Bootstrap-t	79.82699		MVU Estimate of Median	1.520586	
Chebyshev (Mean, Std)	73.02804		MVU Estimate of Mean	11.95042	
			MVU Estimate of Std. Dev.	56.71224	
			MVU Estimate of SE of Mean	5.806036	
			UCL Assuming Lognormal Distribution		
			Confidence Level not supported for H-Statistic		
			99% Chebyshev (MVUE) UCL	69.71974	
			99% Chebyshev (MVUE) UCL	69.71974	

SWMU 46 Ecological					
Summary Statistics for	Chromium		Summary Statistics for	ln(Chromium)	
Number of Samples	36		Minimum	1.56653	
Minimum	4.79		Maximum	4.365643	
Maximum	78.7		Mean	2.701832	
Mean	19.615		Standard Deviation	0.723635	
Median	12.9		Variance	0.523648	
Standard Deviation	17.0839				
Variance	291.8598		Shapiro-Wilk Test Statisitic	0.957225	
Coefficient of Variation	0.870961		Shapiro-Wilk 5% Critical Value	0.935	
Skewness	2.110542		Data are Lognormal at 5% Significance Level		
95 % UCL (Assuming Normal Data)			Estimates Assuming Lognormal Distribution		
Student's-t	24.42575		MLE Mean	19.36866	
			MLE Standard Deviation	16.06752	
95 % UCL (Adjusted for Skewness)			MLE Coefficient of Variation	0.829563	
Adjusted-CLT	25.36861		MLE Skewness	3.059572	
Modified-t	24.59268		MLE Median	14.90702	
			MLE 80% Quantile	27.47576	
95 % Non-parametric UCL			MLE 90% Quantile	37.77711	
CLT	24.29842		MLE 95% Quantile	49.0192	
Jackknife	24.42575		MLE 99% Quantile	80.23883	
Standard Bootstrap	24.24921				
Bootstrap-t	26.74327		MVU Estimate of Median	14.79898	
Chebyshev (Mean, Std)	32.02617		MVU Estimate of Mean	19.19523	
			MVU Estimate of Std. Dev.	15.39993	
			MVU Estimate of SE of Mean	2.528181	
			UCL Assuming Lognormal Distribution		
			95% H-UCL	25.05617	
			95% Chebyshev (MVUE) UCL	30.21532	
			99% Chebyshev (MVUE) UCL	44.35032	
			Recommended UCL to use:		
			H-UCL		

SWMU 46 Ecological		
Summary Statistics for	Copper	
Number of Samples	36	
Minimum	5.26	
Maximum	133	
Mean	32.55472	
Median	19.1	
Standard Deviation	34.9046	
Variance	1218.331	
Coefficient of Variation	1.072182	
Skewness	1.831913	
Shapiro-Wilk Test Statisitic	0.93275	
Shapiro-Wilk 5% Critical Value	0.935	
Data not Lognormal at 5% Significance Level		
Data not Normal: Try Non-parametric UCL		
99 % UCL (Assuming Normal Data)		
Student's-t	46.73601	
99 % UCL (Adjusted for Skewness)		
Adjusted-CLT	49.58828	
Modified-t	47.03204	
99 % Non-parametric UCL		
CLT	46.0881	
Jackknife	46.73601	
Standard Bootstrap	45.71727	
Bootstrap-t	53.81437	
Chebyshev (Mean, Std)	90.43745	

SWMU 46 Ecological		
Summary Statistics for	Nickel	
Number of Samples	36	
Minimum	4.37	
Maximum	379	
Mean	36.16583	
Median	12.25	
Standard Deviation	66.64011	
Variance	4440.905	
Coefficient of Variation	1.842626	
Skewness	4.238098	
Shapiro-Wilk Test Statisitic	0.913486	
Shapiro-Wilk 5% Critical Value	0.935	
Data not Lognormal at 5% Significance Level		
Data not Normal: Try Non-parametric UCL		
99	% UCL (Assuming Normal Data)	
Student's-t	63.24085	
99	% UCL (Adjusted for Skewness)	
Adjusted-CLT	77.46385	
Modified-t	64.54838	
99	% Non-parametric UCL	
CLT	62.00385	
Jackknife	63.24085	
Standard Bootstrap	61.25393	
Bootstrap-t	105.8197	
Chebyshev (Mean, Std)	146.676	

SWMU 46 Ecological		
Summary Statistics for	Silver	
Number of Samples	36	
Minimum	0.0289	
Maximum	12.4	
Mean	0.992013	
Median	0.4415	
Standard Deviation	2.161655	
Variance	4.672753	
Coefficient of Variation	2.17906	
Skewness	4.543918	
Shapiro-Wilk Test Statisitic	0.933295	
Shapiro-Wilk 5% Critical Value	0.935	
Data not Lognormal at 5% Significance Level		
Data not Normal: Try Non-parametric UCL		
99 % UCL (Assuming Normal Data)		
Student's-t	1.870265	
99 % UCL (Adjusted for Skewness)		
Adjusted-CLT	2.367814	
Modified-t	1.915739	
99 % Non-parametric UCL		
CLT	1.830139	
Jackknife	1.870265	
Standard Bootstrap	1.838235	
Bootstrap-t	4.038601	
Chebyshev (Mean, Std)	4.576712	

ATTACHMENT H
Site Conceptual Model for SWMU 46

SWMU 46
Site Conceptual Model

Solid Waste Management Unit (SWMU) 46 encompasses approximately 2.25 acres at the southwest corner of Technical Area (TA)-IV. The site consists of the inactive outfall (discharge point) for the Old Acid Waste Line (SWMU 226) that was connected to six research buildings in TA-I. The acid waste line is constructed of 8-inch-diameter vitrified clay pipe (VCP). SWMU 46 was identified during the 1987 Comprehensive Environmental Assessment and Response Program (CEARP) as the Old Acid Waste Line Outfall (DOE 1987). From about 1948 through late 1974, SWMU 46 discharged acid waste water that contained a variety of chemicals and possibly some radionuclides. The waste water discharged into three shallow, nearly parallel, earthen outfall ditches (OD-1, OD-2, and OD-3) that extended across the East Mesa. Each outfall ditch measured approximately 700 feet long. The confluence of these three outfall ditches is still present on the northern rim of Tijeras Arroyo.

The specific types and volumes of waste water discharged from the acid waste line are not clearly documented. According to the CEARP (DOE 1987), the "old acid waste line was used to discharge about 130,000 gallons per day (gpd) of acidic waste water from Area I to an open ditch that emptied into Tijeras Arroyo. Most of the water was from cooling tower blowdown; however, this line also carried some waste liquid from etching and photographic processing. The contaminants discharged were primarily chromic acid (approximately 200 gallons per day) and ferric chloride." The CEARP is the only historical document that cites a waste-water discharge rate for the acid waste line (DOE 1987). Assuming that 130,000 gpd were discharged at a constant rate for 27 years, the resulting total would be approximately 1.3 billion gallons of waste water.

Polychlorinated biphenyls (PCBs) and elevated concentrations of metals, such as arsenic, cadmium, and chromium, have been identified in SWMU 46 soil samples. Soil-vapor samples suggest SWMU 46 may be a release site for trichloroethylene (TCE) that has impacted groundwater.

Operational History

The Tijeras Arroyo Operable Unit manages SWMU 46. Other Operable Units (OUs) also have provided relevant information for the site. In the 1990s, TA-I OU personnel interviewed laboratory personnel, and various lateral extensions were excavated showing that the acid waste line was connected to Buildings 839, 840, 841, 860, 863, and 892. These buildings contained various shops (instrument repair, machining, ceramics, sheet metal, welding, paint, plating), a foundry, microelectronic clean rooms, office space, general research laboratories, environmental-conditions test chambers, storage rooms, and facilities for the assembly of weapon components (SNL/NM May 1997; DOE December 2001).

In addition to the various chemicals (cooling tower blowdown, chromic acid, ferric chloride, etching liquids, and photographic processing waste water) mentioned in the CEARP (DOE 1987), the acid waste line also received electroplating solutions and chromates (SNL/NM May 1997). Most of the chemicals used in the six buildings were typically containerized for off-site

disposal. However, some waste water discharged to the acid waste line may have contained various organic compounds (acetone, TCE, and toluene); isopropyl alcohol; methyl alcohol; electroplating solutions containing nickel acetate, cadmium cyanide, copper cyanide, hydrogen sulfide, nickel sulfate, copper sulfate, and sodium dichromate; polyvinyl alcohol binder; various acids (acetic, chromic, sulfuric, nitric); sodium hydroxide; paints; paint strippers; machining coolant oils; metals (aluminum, depleted uranium, lead, and silver); and PCBs. Photographic laboratory waste water typically contains a variety of solutions, such as developers, washes, bleaches, fixers, conditioners, and stabilizers.

The acid waste line may have received a relatively minor amount of sanitary waste (sewage) from inadvertent cross-connections between various TA-I piping systems. However, the disposal of sewage in the outfall ditches was probably limited because of health concerns and odor problems. Storm-water systems were not connected to the acid waste line.

The outfall ditch, OD-1, was constructed in 1948. Soon after, the flow of waste water was apparently limited by the buildup of either vegetation and/or sloughed soil from the unlined ditch banks. The low slope (grade) of the acid waste line and outfall ditch aggravated the drainage problem. OD-2 was constructed around 1950; OD-3 was constructed in the mid-1960s. All three outfall ditches carried waste water until late 1974. Ponding visible in historic aerial photographs shows that all three outfall ditches were essentially linked together at the northern end of the site. As a result, the three outfall ditches carried the same types of waste water and constituents of concern (COCs).

Voluntary Corrective Action Remediation and Confirmatory Sampling

In August 2003, a Voluntary Corrective Action (VCA) was conducted at SWMU 46 for the purpose of removing contaminated soil and collecting additional confirmatory soil samples suitable for risk assessment purposes (SNL/NM August 2003). Preliminary remediation goals were calculated in accordance with New Mexico Environment Department guidance for an industrial land-use scenario, which is the designated land use for SWMU 46. The VCA was primarily designed to remove soil containing elevated concentrations of metals. The VCA also addressed the need to remove soil that contained PCBs exceeding the Sandia National Laboratories/New Mexico (SNL/NM) Environmental Restoration Project voluntary cleanup level for total PCBs of 1 milligram (mg)/kilogram (kg). Previous analytical results had demonstrated that two sampling locations from the interior of the acid waste line (sloughed soil samples 46-GR-02 and 46-GR-03) contained significant contamination. For example, soil samples from Locations 46-GR-02 and 46-GR-03 contained total PCBs at 49.9 and 6.17 mg/kg, respectively.

The principal VCA activity consisted of using an excavator to remove the exposed portion of the acid waste line along with the sloughed soil contained within the line. The resulting VCA remediation trench extended north to south and had a width of approximately 2.5 feet (the width of the excavator bucket). An underlying 0.5-foot layer of soil was removed from the beneath the line. As a result, the trench depth varied from 2 to 0.8 feet, becoming more shallow toward the southern end of the acid waste line where the waste water had previously discharged.

The VCA remediation trench cut across the starting point of all three outfall ditches (OD-1, OD-2 and OD-3) and had a length of approximately 275 feet. The northern limit of the trench was selected to be the approximate midpoint between Sample Location 46-GR-01 (where the waste line was known to be intact with no sloughed soil being present in the waste line) and Sample Location 46-GR-02 (where elevated concentrations of COCs were present in sloughed soil). The southern limit of the trench was the farthest end of the acid waste line as determined by historic aerial photographs.

A hand trowel was used to sample VCA confirmatory locations (46-GR-06 through 46-GR-20) from the trench floor at a lateral spacing of approximately 20 feet. Samples from the trench floor consisted of undisturbed, stiff, brownish, clayey sand. A backhoe was used to collect soil samples from 5 feet below the trench floor at three locations (46-GR-07, 46-GR-12, and 46-GR-17. Soil samples also were collected outside the trench at four undisturbed background locations (46-GR-21, 46-GR-22, 46-GR-23, and 46-GR-26). Samples from the background locations consisted of yellowish, aeolian sand.

Approximately 50 cubic yards of excavated soil and pieces of VCP were placed into a series of roll-off bins. After waste-characterization samples were evaluated, the roll-off bins were shipped to an off-site waste disposal facility. The waste was categorized as nonregulated. None of the excavated soil or VCP pieces were returned to the ground surface. In February 2004, the VCA remediation trench was backfilled with clean, off-site soil.

Confirmatory soil samples also were collected from the two surviving segments of outfall ditches at the southeast (confluence) end of the site in August 2003. Locations 46-GR-24 and 46-GR-25 were sampled at Outfall Ditches OD-1 and OD-2, respectively. Samples of loose sand were collected from the floor of each ditch with a hand trowel. A hard layer of stratified (undisturbed) gravel was present at a depth of 0.5 feet below ground surface (bgs), necessitating the use of heavy equipment for collecting deeper samples. A backhoe was used to sample Location 46-GR-24 at depths of 2 and 5 feet bgs. The samples consisted of undisturbed, stiff, brownish clay with caliche streaks. Subsurface samples at Outfall Ditch OD-2 were collected with an excavator because of the steep terrain. Location 46-GR-25 was sampled at depths of 2, 5, and 10 feet bgs; the three samples consisted of brownish-white, clayey sand.

Samples were not collected from Outfall Ditch OD-3 as part of the VCA activities because the ditch had been destroyed by TA-IV construction activities in the 1990s. However, certain soil samples from the SWMU 234 characterization sampling are applicable to OD-3.

During excavation and sampling activities, a photoionization detector was used for the field screening of confirmatory soil samples; no volatile organic compounds (VOCs) were detected. Fourteen field-screening soil samples collected from the trench floor were sent to a local off-site laboratory for 48-hour turnaround. The maximum total PCB concentration per was 0.25 mg/kg, which is below the voluntary SNL/NM cleanup level of 1 mg/kg.

Soil samples from the VCA remediation trench revealed nine metals above background levels. Of the nine metals, cadmium was the most significant having a maximum concentration of 213 mg/kg, which exceeds the background level of 0.9 mg/kg. The maximum total PCB

concentration was 129.8 micrograms (μg)/kg. No unqualified VOCs were detected. Low levels of 13 semivolatile organic compounds (SVOCs) were detected; bis(2-ethylhexyl) phthalate had the maximum concentration at 825 μg/kg.

Lower concentrations of contaminants were detected at the VCA confluence sampling locations (46-GR-24 and 46-GR-25). Soil samples collected at the confluence contained nine metals above background levels. The maximum cadmium concentration was 0.665 mg/kg, which is below the background level of 0.9 mg/kg. Of the nine metals, total chromium was the most significant having a maximum concentration of 26.4 mg/kg, which exceeds the background concentration of 12.8 mg/kg. No PCBs were detected. No VOCs were detected. Low levels of 17 SVOCs were detected; pyrene had the maximum concentration at 603 μg/kg.

COCs

Process knowledge indicates that the potential COCs for SWMU 46 consist of:

- Metals, including chromium-VI
- PCBs
- VOCs
- SVOCs
- Cyanide
- Nitrate
- Radionuclides (gamma-emitters and tritium)

Physical Setting

SWMU 46 is located on land that the U.S. Department of Energy leases from Kirtland Air Force Base (KAFB). Ground elevations at SWMU 46 range from approximately 5,390 feet above mean sea level (amsl) at the northern site boundary to about 5,370 feet amsl at the southern site boundary on the northern rim of Tijeras Arroyo. The site, approximately 2.25 acres, is not fenced. SWMU 46 is located in a relatively remote setting where the only foot traffic consists of the occasional jogger and walker. The fire-extinguisher training facility and the unpaved TA-IV perimeter road are nearby. Outdoor classes involving about a dozen trainees are held at the fire-extinguisher training facility about once per month. A few vehicles per day use the perimeter road. The southeastern end of SWMU 46 is situated on the steeply sloping rim of Tijeras Arroyo; however; the majority of the site is located on a flat portion of the East Mesa. SWMU 46 is on the east side of the inactive KAFB skeet range.

The annual precipitation at KAFB is 8.2 inches (SNL/NM February 2001). No springs or perennial surface-water bodies are located within two miles of SWMU 46. The site is situated approximately 2,000 feet north of the active channel of Tijeras Arroyo and outside of the 100-year floodplain. Storm water flows in the active channel at the nearby Pennsylvania Street Bridge approximately a dozen days per year and only as a result of significant precipitation events. Tijeras Arroyo is the most significant storm-water drainage feature on KAFB and originates in Tijeras Canyon, which is bounded by the Sandia Mountains to the north and the Manzano Mountains to the south. The arroyo contains a drainage basin that captures runoff

from Tijeras Canyon and various storm-water channels at KAFB, SNL/NM, and southeast Albuquerque. The arroyo eventually drains into the Rio Grande, approximately 8 miles west of SWMU 46.

The soil at SWMU 46 is poorly developed with high alkalinity. The subsurface geology consists of unconsolidated alluvial and colluvial deposits derived from the Sandia and Manzanita Mountains. These upper Santa Fe Group deposits consist of sediment ranging from clay to gravel, derived from the granitic rocks of the Sandia Mountains, and greenstone, limestone, and quartzite derived from the Manzanita Mountains. The depth to Pennsylvanian strata and/or Precambrian basement beneath TA-IV is approximately 3,000 feet bgs.

Groundwater data for SWMU 46 was obtained from the Tijeras Arroyo Groundwater (TAG) Investigation. The hydrogeologic setting of the TAG study area is dominated by two water-bearing zones, the perched system and the regional aquifer, both of which are present within the upper Santa Fe Group. The perched system is not used as a water supply source. However, the City of Albuquerque, KAFB, and the Veterans Administration use the regional aquifer for water supply purposes.

At the northern end of SWMU 46, the depth to the perched system is approximately 303 feet bgs. However, the site extends across the southwestern boundary of the perched system, which covers approximately 3.5 square miles in the central part of the TAG study area. The direction of groundwater flow in the perched system is to the southeast. Discontinuous, yet overlapping multiple lenses of unsaturated alluvial-fan sediment serve as a perching horizon beneath the perched system and above the regional aquifer. The depth to the regional aquifer is approximately 499 feet bgs at the northern edge of the site. The direction of groundwater flow in the regional aquifer is principally to the northwest towards several water-supply wells. The nearest water-supply well (KAFB-1) is located approximately 1.3 miles northwest of the site. Groundwater from the perched system merges with the regional aquifer southeast of Tijeras Arroyo. The regional aquifer extends across the entire TAG study area and the Albuquerque Basin.

The vicinity of SWMU 46 is unpaved. During most rainfall events, rain quickly infiltrates the soil at SWMU 46. However, virtually all of the moisture undergoes evapotranspiration. Estimates of evapotranspiration for the KAFB area range from 95 to 99 percent of the annual rainfall (SNL/NM February 1998).

The area around SWMU 46 originally consisted of desert grassland habitat, but this has been highly disturbed by various construction activities (IT 1995). The site is mostly barren but has some limited vegetation consisting of ruderal species, such as Russian thistle (tumbleweed). Grasslands are the dominant plant community west of SWMU 46 and include species such as blue and black grama and western cheatgrass (IT 1995). The indigenous wildlife includes reptiles, birds, and small mammals. However, wildlife use is limited by the degree of disturbance and proximity to operational facilities. The site was surveyed for sensitive species in 1994 (IT 1995); no threatened or endangered species, nor any other species of concern, were identified in the vicinity of SWMU 46. No riparian or wetland habitats are present within four

miles of the site. No significant archaeological artifacts or cultural resources have been identified in the vicinity of SWMU 46 (Hoagland September 1994).

References

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National Nuclear Security Administration
Sandia Site Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

MAY 2 2005

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

Mr. James Bearzi, Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Road East, Building 1
Santa Fe, NM 87505

Dear Mr. Bearzi:

On behalf of the Department of Energy (DOE) and Sandia Corporation, DOE is submitting the enclosed responses to NMED's Request for Supplemental Information, Environmental Restoration Project Supplemental and No Further Action for Various Solid Waste Management Units (SWMUs 1, 78, 196 and 46) dated October 2004 Sandia National Laboratories, New Mexico, EPA ID No. NM589011518, HWB-SNL-99-006, 99-021, and 99-013, dated March 2, 2005.

If you have any questions, please contact John Gould at (505) 845-6089.

Sincerely,

Patty Wagner

Patty Wagner
Manager

Enclosure

cc w/enclosure:
W. Moats, NMED-HWB (via Certified Mail)
L. King, EPA, Region 6 (Via Certified Mail)
M. Gardipe, NNSA/SC/ERD
J. Volkerding, NMED-OB
D. Pepe, NMED-OB

Sandia National Laboratories
Albuquerque, New Mexico
May 2005

Environmental Restoration Project Responses to NMED Request for Supplemental Information Environmental Restoration Project Supplemental and No Further Action Information for Various Solid Waste Management Units (SWMUs 1, 78, 196 and 46) Dated October 2004

INTRODUCTION

This document responds to a March 2, 2005 Request for Supplemental Information (RSI) letter from William P. Moats of the State of New Mexico Environment Department (NMED) Hazardous Waste Bureau (HWB) to the U.S. Department of Energy and Sandia National Laboratories/New Mexico (SNL/NM). A response to this RSI was due within sixty (60) days of receipt of the letter by SNL/NM, or by May 4, 2005.

In this document, the NMED comments (in bold font) are restated in the same order in which they were provided in the RSI. Following each comment, the word "Response" introduces the U.S. Department of Energy/SNL/NM reply (in normal font style).

1. **SWMU 78: Gas Cylinder Disposal Pit:**
   Please provide a copy of Appendix F, the data validation reports for the 2003 confirmation sampling. The appendix was not included in NMED's copy of the subject report.

Response: Enclosed in Annex A are the data validation reports for the 2003 confirmation sampling that was labeled Attachment F in the original document.

2. **SWMU 196: Building 6597 Cistern:**
   Please state whether the cistern has been backfilled. If it has not been backfilled, explain why this is the case.

Response: The Building 6597 Cistern has not been backfilled. The site has been adequately characterized to demonstrate that it poses no significant risk to human health or the environment in its present state. The cistern is located within an industrial area in Technical Area 5 and is fenced to prevent inadvertent or unauthorized access.

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

3. **SWMU 46: Old Acid Waste Line Outfall:**
Table 11 in Attachment G (Risk Assessment) provides the risk assessment values (hazard index and cancer risk) that were calculated using the maximum concentrations of contaminants at the site. However, the report states that the site meets residential risk standards based on risk assessment values that were calculated using the 95% Upper Confidence Limit (UCL) of the mean concentrations of contaminants. Please provide a table which shows the risk assessment values calculated using the UCLs. It does not appear that the site currently meets residential risk goals based on the UCLs.

Response: Enclosed in Annex B is a revised Table 11 that includes the risk assessment values calculated using UCLs. The total incremental excess cancer risk is 4E-6 which is below NMED guidance of 1E-5. The total hazard index is 1.61 which exceeds NMED guidance of 1. However, because the hazard indices do not provide additive affects for any specific health condition, the hazard index for each constituent of concern (COC) is compared to the NMED guidance of 1. All COCs with the exception of cadmium are below the NMED guidance of 1; cadmium has a hazard index of 1.03 that slightly exceeds the NMED guidance of 1.

4. **SWMU 1: Radioactive Waste Landfill:**

    a. **NMED understands that a factor was entered into the RESRAD equations to account for the placement of cover material at the site. NMED notes that the "clean fill" placed at this site contains both radiological and nonradiological contaminants. Please provide the values of the various parameters assumed for this cover soil, including the thickness of the fill and the chemical and radiological constituents in the fill. Any deviations from the typical assumptions used in risk assessments (e.g., exposure routes, parameter values) should be described in the text of the document. Please state how the placement of fill affects the results of the risk assessments and describe any other variances that were made during the calculations of the human health and ecological risk assessments.**

Response: Five feet of "clean fill" was assumed for the SWMU 1 radiological risk assessment based on the current onsite conditions at SWMU 1. Originally the "clean fill" was assumed to have no radiological contamination; therefore no radiological risk was completed for direct contact exposure with the clean backfill. There was no "clean fill" considered in the nonradiological calculations; the risk assessment for human health nonradiological contaminants used the "standard" assumptions and exposure parameters (i.e., the maximum chemical concentration were used in the risk evaluation). The ecological risk assessment process also was not affected by the assumption of the clean fill (i.e., the radiological and nonradiological contaminants within the 0 to 5 feet bgs horizon were evaluated at maximum concentrations and activities). The only deviation from the typical risk assessment process was the assumption of 5 feet of clean fill with no radiological contamination for the human health radiological risk assessment. Within the

human health radiological risk assessment calculations, the clean fill provides shielding from the soil that is below 5 feet. No other deviations from the typical risk assessment process occurred. All the receptors, exposure routes and parameter values remain consistent with the SNL risk assessment process.

To determine the human health radiological risk associated with direct contact with the clean fill, the maximum activities for the radiological COCs within the 0 to 5 feet bgs horizon were used; the results are included here. With the exception of the tritium activity which is discussed below, the maximum activities for the 0 to 5 feet bgs horizon are those that were reported in Annex A, Table A-5. The maximum activities are as follows:

Table 1
Summary of Maximum Radionuclide Activities Used in Direct Contact Exposure Calculations for 0-5 ft bgs Fill for SWMU 1

Radionuclide	Activity (pCi/g)	Sample ID	Table (SNL/NM October 2004)
Am-241	ND (<0.352)	TA2-1-GRAB4-5FT-2-S	Annex B, Table B-9
Cs-137	0.203	TA2-1-OVER-SLPE-030-S	Annex B, Table B-13
H-3	4.49	TA2-1-GRAB4-10FT-3-S	Annex B, Table B-11
Pu-238	0.184	TA2-1-OVER-SLPE-031-S	Annex B, Table B-14
Pu-239/240	2.55	TA2-1-OVER-SLPE-006-S	Annex B, Table B-14
Th-232	1.24*	TA2-1-OVER-SLPE-014-S	Annex B, Table B-13
U-235	0.351	TA2-1-OVER-SLPE-045-S	Annex B, Table B-13
U-238	25	TA2-1-OVER-SLPE-045-S	Annex B, Table B-13

*This value was below background and was screened out of risk calculations.

The incremental TEDE and corresponding estimated cancer risk associated with the activities of these radiological COCs are much less than EPA guidance values; the estimated TEDE is 8.3E-1 mrem/yr for the industrial land use scenario. This value is much less than the EPA numerical guidance of 15 mrem/yr. The corresponding incremental estimated cancer risk value is 6.8E-6 for the industrial land use scenario. Furthermore, the incremental TEDE for the residential land use scenario that results from a complete loss of institutional control is only 2.2 mrem/yr, with an associated risk of 2.0E-5. The guideline for this scenario is 75 mrem/yr. Therefore, SWMU 1 is eligible for unrestricted radiological release within the 0 to 5 feet bgs horizon.

b. **Please clarify what was the maximum value of tritium detected in the soil that was placed from 0 to 5 feet below ground surface. Table 4-2 gives a maximum value of 4.49 pCi/g, while Table A-6 in the Risk Assessment lists the maximum value as 0.2205 pCi/g. Please also provide the sample identification number for this maximum tritium value and state where it is listed in the analytical data included in the subject report. State which value was used for calculating the ecological risk for SWMU 1.**

Response: The value of 4.49 pCi/g is shown in Table B-11 of Appendix B. It corresponds to sample TA2-1-GRAB4-10FT-3-S; this sample was from the over-excavation soil that was used as backfill in Lifts 8 through 14 (approximately 11 to 3 ft bgs). The tritium value of 0.2205 pCi/g (or 4,410 pCi/L) corresponds to sample TA2-2-BLDG-901-004-S in Table B-15 of Appendix B; this sample was from soil placed in the excavation as Lifts 14 through 16 (approximately 4 ft to 1 ft bgs). The value of 0.2205 was erroneously used in the risk assessment for the 0 - 5 ft bgs backfill layer (SNL/NM October 2005); the intent was to use the value of 4.49 pCi/g. The human health and ecological risk assessment has been re-calculated using the tritium value of 4.49 pCi/g, which was listed in Table 4-2 (SNL/NM October 2005). Because these tritium activites contribute such meager amounts to the overall total doses and risks, the final results are numerically equivalent; therefore, no revision to the SWMU 1 risk assessment conclusion was necessary.

A revised version of Table B-11 is included in this RSI in Annex C. The tritium results from LCS (Liquid Scintillation Counting) for samples TA2-1-GRAB5-15FT-3-S through TA2-1-GRAB9-5FT-3-S that were originally listed as "NR" ("not reported") are now included.

Annex B
Revised Table 11 for SWMU 46

Revised Table 11
Risk Assessment Values for SWMU 46 Nonradiological COCs

COC	Maximum Concentration/UCL (mg/kg)	Industrial Land-Use Scenario[a]		Residential Land-Use Scenario[a]	
		Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Inorganic					
Arsenic	5.23 / **2.8**	0.02	3E-6	0.24 / **Below Background**	1E-5 / **Below Background**
Barium	572	0.01	–	0.11	–
Beryllium	0.891	0.00	4E-10	0.01	8E-10
Cadmium	213 / **40.6**	0.42	7E-8	5.46 / **1.03**	1E-7 / **3E-8**
Chromium VI	2.08	0.00	4E-9	0.01	1E-8
Chromium-total	120	0.00	–	0.00	–
Copper	133 J	0.00	–	0.05	–
Mercury	0.0766	0.00	–	0.00	–
Nickel	379 / **87.5**	0.02	–	0.25 / **0.03**	–
Selenium	1.28	0.00	–	0.00	–
Silver	16.2	0.00	–	0.04	–
Thallium	2.19 / **1.1**	0.03	–	0.44 / **0.22**	–
Vanadium	46.5	0.01	–	0.09	–
Zinc	149 J	0.00	–	0.01	–
Cyanide-total	12.7	0.00	–	0.01	–
VOCs					
Acetone	0.0132	0.00	–	0.00	–
2-Butanone	0.107	0.00	–	0.00	–
Methylene chloride	0.00385 J	0.00	3E-8	0.00	5E-8
Toluene	0.017	0.00	–	0.00	–
SVOCs					
Acenaphthene	0.00626 J	0.00	–	0.00	–
Acenaphthylene	0.00406 J	0.00	–	0.00	–
Anthracene	0.0212 J	0.00	–	0.00	–
Benzo(a)anthracene	0.258	0.00	1E-7	0.00	4E-7
Benzo(a)pyrene	0.435 / **0.06**	0.00	2E-6	0.00	7E-6 / **1E-6**
Benzo(b)fluoranthene	0.506	0.00	2E-7	0.00	8E-7
Benzo(ghi)perylene	0.309 / **0.05**	0.00	1E-6	0.00	5E-6 / **8E-7**
Benzo(k)fluoranthene	0.471	0.00	2E-8	0.00	8E-8
Butylbenzylphthalate	0.0565 J	0.00	–	0.00	–
Carbazole	0.0182 J	0.00	1E-10	0.00	6E-10
2-Chlorophenol	0.00835 J	0.00	–	0.00	–
Chrysene	0.435	0.00	2E-9	0.00	7E-9
Di-n-butylphthalate	0.0495 J	0.00	–	0.00	–
Di-n-octylphthalate	0.0102 J	0.00	–	0.00	–
Diethylpthalate	0.0877 J	0.00	–	0.00	–
Dibenzofuran	0.0094 J	0.00	–	0.00	–
1,2-Dichlorobenzene	0.00451 J	0.00	–	0.00	–
1,3-Dichlorobenzene	0.00486 J	0.00	–	0.00	–
Diphenylamine	0.0073 J	0.00	–	0.00	–

Refer to footnotes at end of table.

Revised Table 11 (Concluded)
Risk Assessment Values for SWMU 46 Nonradiological COCs

COC	Maximum Concentration/UCL (mg/kg)	Industrial Land-Use Scenario[a]		Residential Land-Use Scenario[a]	
		Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
bis(2-Ethylhexyl) phthalate[b]	2.04	0.00	1E-8	0.00	5E-8
Fluoranthene	0.450	0.00	–	0.00	–
Fluorene	0.014 J	0.00	–	0.00	–
Hexachlorobenzene	0.0057 J	0.00	5E-9	0.00	2E-8
Indeno(1,2,3-c,d)pyrene	0.345 J	0.00	2E-7	0.00	6E-7
Naphthalene	0.00345 J	0.00	–	0.00	–
Phenanthrene	0.139	0.00	–	0.00	–
Phenol	1.59	0.00	–	0.00	–
Pyrene	0.603	0.00	–	0.00	–
HE Compound					
2-Nitrotoluene	0.0152	0.00	–	0.00	–
Total		0.52	7E-6	6.72 / **1.61**	3E-5 / **4E-6**

[a]EPA 1989.

[b]The maximum concentration in this table previously was 0.00704. This value was from a trip blank. The hazard index and cancer risk included in this table and the previous table was for the 0.00385 J concentration for this COC.

COC = Constituent of concern.
EPA = U.S. Environmental Protection Agency.
HE = High explosive(s).
J = Estimated concentration.
mg/kg = Milligram(s) per kilogram.
SVOC = Semivolatile organic compound.
SWMU = Solid Waste Management Unit.
UCL = Upper Confidence Limit.
VOC = Volatile organic compound.
– = Information not available.

From

National Nuclear Security Administration
Sandia Site Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

AUG 3 0 2005

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

cc: Carolyn O [redacted] Amy MB

Mr James Bearzi, Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Road East, Building 1
Santa Fe, NM 87505

Dear Mr. Bearzi,

On behalf of the Department of Energy (DOE) and Sandia Corporation, DOE is submitting the enclosed responses to the New Mexico Environment Department's (NMED's) Request for Supplemental Information, Environmental Restoration Project Supplemental and No Further Action Information for Solid Waste Management Units 46 and 196 dated October 2004, Sandia National Laboratories, New Mexico, EPA ID No. NM589011518, HWB-SNL-99-006, 99-021, and 99-01, dated July 19, 2005.

If you have any questions, please contact John Gould at (505) 845-6089.

Sincerely,

Patty Wagner

Patty Wagner
Manager

Enclosure

cc w/enclosure:
W. Moats, NMED-HWB (via Certified Mail)
L. King, EPA, Region 6 (via Certified Mail)
M. Gardipe, NNSA/SC/ERD
J. Volkerding, DOE-NMED-OB (2 copies)

cc w/o enclosure:
J. Estrada, NNSA/SSO, MS 0184
F. Nimick, SNL, MS 1089
P. Freshour, SNL, MS 1089
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M. J. Davis, SNL, MS 1089
D. Stockham, SNL, MS 1087
B. Langkopf, SNL, MS 1087
S. Griffith, SNL, MS 1087

Sandia National Laboratories
Albuquerque, New Mexico
August 2005

Environmental Restoration Project
Responses to NMED Request for Supplemental Information
And Certificates of Completion: Environmental Restoration Project Supplemental and No Further Action Information for Various Sold Waste Management Units (SWMUs 1, 78, 196, 45, and 46); dated October 2004
Sandia National Laboratories, EPA ID#NM 5890110518
HWB-SNL-99-006, 99-021, AND 99-01

INTRODUCTION

This document responds to the July 19, 2005 Request for Supplemental Information (RSI) letter from William P. Moats of the State of New Mexico Environment Department (NMED) Hazardous Water Bureau (HWB) to the U.S. Department of Energy and Sandia Corporation (Sandia). A response to this RSI is due within 45 days of receipt of the letter by NMED, or by September 2, 2005.

In this document, the NMED comments (in bold font) are restated in the same order in which they were provided in the RSI. Following each comment, the "Response" introduces the U.S. Department of Energy/Sandia reply (in normal font style).

1. **NMED will not issue a Certificate for Corrective Action Complete for SWMU 196 until the cistern (a large seepage pit) is backfilled in accordance with the Septic System Abandonment Regulations at 20.7.3.410 NMAC. The DOE/Sandia Corporation should inform the NMED in writing as soon as possible after the backfilling of the cistern has been accomplished. The NMED will then reconsider issuance of a Certificate of Completion for SWMU 196 after said work is completed.**

Response: SWMU 196, the Building 6597 Cistern, will be backfilled to fulfill the requirement by NMED as stated in Comment 1. DOE/Sandia will inform the NMED in writing when this task has been completed.

2. **NMED requires additional ground water information to complete its review of the RCRA Facility Investigation (RFI) for SWMU 46. Please provide a table of all available ground-water data concerning the analysis of trichloroethene (TCE) and nitrate (and/or nitrate plus nitrite) for monitoring wells TJA-3, TJA-7, TJA-6, WYO-1, WYO-2, WYO-3, WYO-4, TA2-SW1-320, and TA2-W-19. Report also on the table for each sampling event for each well which of the data are representative of micropurge sampling, and which data are representative of conventional sampling and purging techniques.**

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under Contract DE-AC04-94AL85000.

Response: Please note that SWMU 46 was not investigated as part of a RCRA Facility Investigation (RFI). The first proposal for No Further Action was in June 1995, followed by two Notice of Deficiency letters (July 1996 and October 2004), and two Request for Supplemental Information letters (October 1999 and July 2005).

Enclosed in Annex A are tables of groundwater data for TCE (detections only), nitrate, and nitrate plus nitrite (all sample results) for monitoring wells TJA-3, TJA-7, TJA-6, WYO-1, WYO-2, WYO-3, WYO-4, TA2-SW1-320, and TA2-W-19. Information regarding the sampling and purging (method micropurge [low-flow] sampling or conventional sampling) is given for each well and each sampling event.

The tables also include the following information for each well: the well completion date, the aquifer system that it is completed in (perched or regional), the approximate distance from SWMU 46, and the relative location of the well to SWMU 46 regarding the direction of groundwater flow (upgradient, downgradient, or cross-gradient).

Enclosed in Annex B are potentiometric maps of each aquifer system for reference. The maps include the location of SWMU 46 and the groundwater monitoring wells in the area. Any additional information (beyond items requested above) can be found in the Corrective Measures Evaluation Work Plan Tijeras Arroyo Groundwater (July 2004), and the Tijeras Arroyo Groundwater Investigation Work Plan (June 2003).

ANNEX A
GROUNDWATER ANALYTICAL DATA RESULTS

Summary of Detected Trichloroethene Results
Tijeras Arroyo Groundwater Investigation

Well ID	ARCOC	Sampling Method	Sample Date	Result[a] (µg/L)	MDL[b] (µg/L)	PQL[c] (µg/L)	MCL[d] (µg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Analytical Method[g]
TA2-W-19	05740	Conventional	28-Aug-96	1.00	0.50	2.0	5.0	J	None	EPA8260
	05740	Conventional	28-Aug-96	1.00	0.50	2.0	5.0	J	None	EPA8260
Well completed 9-Nov-95 in the perched aquifer.	05740	Conventional	28-Aug-96	1.20	0.50	2.0	5.0	J	None	EPA8260
	06160	Conventional	22-Jan-97	2.60	0.50	2.0	5.0		None	EPA8260
	06160	Conventional	22-Jan-97	2.90	0.50	2.0	5.0		None	EPA8260
Distance from SWMU 46 is approximately 0.5 mile, cross-gradient.	06178	Conventional	23-Jan-97	4.40	0.50	2.0	5.0		None	EPA8260
	06178	Conventional	23-Jan-97	**5.20**	0.50	2.0	5.0		None	EPA8260
	06177	Low-flow	11-Mar-97	1.40	0.50	2.0	5.0	J	None	EPA8260
	06319	Low-flow	10-Jun-97	2.70	0.50	2.0	5.0		None	EPA8260
Conventional sampling method prior to Mar-97, and Jun-03 to present.	06974	Low-flow	29-Sep-97	1.90	0.50	2.0	5.0	J		EPA8260
	06956	Low-flow	10-Dec-97	2.40	0.50	2.0	5.0		None	EPA8260
	510395	Low-flow	06-Mar-98	2.50	0.50	2.0	5.0			EPA8260
	600177	Low-flow	15-Jun-98	2.70	0.50	2.0	5.0			EPA8260
	600177	Low-flow	15-Jun-98	2.80	0.50	2.0	5.0			EPA8260
	600642	Low-flow	16-Sep-98	2.80	0.50	2.0	5.0			EPA8260
	600642	Low-flow	16-Sep-98	2.90	0.50	2.0	5.0			EPA8260
	600924	Low-flow	02-Dec-98	3.10	0.50	2.0	5.0			EPA8260
	600924	Low-flow	02-Dec-98	3.40	0.50	2.0	5.0			EPA8260
	601262	Low-flow	09-Mar-99	3.20	0.50	2.0	5.0			EPA8260
	602286	Low-flow	24-Sep-99	1.80	0.50	2.0	5.0	J		EPA8260
	602473	Low-flow	15-Mar-00	1.90	0.50	2.0	5.0	J		EPA8260
	602705	Low-flow	04-Jan-01	2.30	0.50	2.0	5.0			EPA8260
	603483	Low-flow	08-Mar-01	1.70	0.20	0.8	5.0			EPA8260
	604101	Low-flow	06-Jul-01	0.960	0.10	0.4	5.0			EPA8260
	604777	Low-flow	02-Oct-01	1.40	0.10	0.4	5.0			EPA8260
	604979	Low-flow	21-Nov-01	1.40	0.10	0.4	5.0			EPA8260
	606806	Conventional	23-Sep-03	3.77	0.36	1.0	5.0			SW846 8260
	606834	Conventional	07-Oct-03	4.54	0.36	1.0	5.0			SW846 8260
	607090	Conventional	13-Jan-04	4.19	0.36	1.0	5.0			SW846 8260
	607406	Conventional	27-Apr-04	**5.20**	0.06	5.0	5.0			8260B
	607406	Conventional	27-Apr-04	**5.10**	0.06	5.0	5.0			8260B
	607685	Conventional	27-Jul-04	4.20	0.06	5.0	5.0	J		8260B
	607921	Conventional	04-Oct-04	4.56	0.36	1.0	5.0		J	SW846 8260
	607921	Conventional	04-Oct-04	4.65	0.36	1.0	5.0		J	SW846 8260
	608123	Conventional	04-Jan-05	**5.32**	0.36	1.0	5.0			SW846 8260
	608123	Conventional	04-Jan-05	**5.60**	0.36	1.0	5.0			SW846 8260
TJA-3	602712	Low-flow	08-Jan-01	0.510	0.50	2.0	5.0	J		EPA8260
Well completed 31-Aug-98 in the regional aquifer.	603489	Low-flow	28-Mar-01	0.860	0.20	0.8	5.0			EPA8260
	603489	Low-flow	28-Mar-01	0.870	0.20	0.8	5.0			EPA8260
	603955	Low-flow	28-Mar-01	0.880	0.16	1.0	5.0	J	None	SW846 8260
This well is located within the SWMU 46 boundary.	604107	Low-flow	05-Jul-01	1.20	0.10	0.4	5.0			EPA8260
	604783	Low-flow	03-Oct-01	0.830	0.10	0.4	5.0			EPA8260

Refer to footnotes at end of tables.

Summary of Detected Trichloroethene Results
Tijeras Arroyo Groundwater Investigation (Continued)

Well ID	ARCOC	Sampling Method	Sample Date	Result[a] (µg/L)	MDL[b] (µg/L)	PQL[c] (µg/L)	MCL[d] (µg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Analytical Method[g]
TJA-3 (con't) Conventional sampling method prior to Mar-99, and Jun-03 to present, low-flow from Mar-99 to Jun-03.	604783	Low-flow	03-Oct-01	0.790	0.10	0.4	5.0			EPA8260
	604806	Low-flow	03-Oct-01	0.862	0.16	1.0	5.0	J	None	SW846 8260
	604985	Low-flow	01-Dec-01	0.970	0.10	0.4	5.0			EPA8260
	605117	Low-flow	03-Dec-01	1.39	0.31	1.0	5.0		None	SW846 8260
	605328	Low-flow	20-Mar-02	0.639	0.31	1.0	5.0	J		SW846 8260
TJA-6 Well completed 04-Feb-01 in the regional aquifer. Distance from SWMU 46 is approximately 350 ft, downgradient. Low-flow sampling from Mar-01 to Jun-03, conventional Jul-03 to present.	607424	Conventional	22-Apr-04	1.20	0.06	5.0	5.0	B, J	5.0U, B	8260B
TJA-7 Well complete in 07-Mar-01 in the perched aquifer. This well is located within the SWMU 46 boundary. Low-flow sampling from Mar-01 to Jun-03, conventional Jul-03 to present.	606633	Conventional	12-Aug-03	1.46	0.36	1.0	5.0			SW846 8260
	607112	Conventional	22-Jan-04	0.430	0.36	1.0	5.0	J	J	SW846 8260
	607707	Conventional	06-Aug-04	0.530	0.06	5.0	5.0	J		8260B
	607707	Conventional	06-Aug-04	0.550	0.06	5.0	5.0	J		8260B
	608591	Conventional	13-May-05	0.355	0.25	1.0	5.0	J	J	SW846 8260
WYO-1 Well completed in 27-Aug-95 in the regional aquifer. Plugged and abandoned Jul-01. Distance from SWMU 46 was over 0.5 mile and was upgradient. Conventional sampling from Aug-95 to Mar-97, low-flow sampling from Mar-97 to Jul-01.	04704	Conventional	24-Jan-96	4.00	0.50	NR	5.0		None	8260
	04704	Conventional	24-Jan-96	4.00	5.0	NR	5.0	J	None	8260
	05738	Conventional	26-Aug-96	**5.60**	0.50	2.0	5.0		None	EPA8260
	06110	Conventional	21-Jan-97	**7.20**	0.50	2.0	5.0		None	EPA8260
	06160	Conventional	22-Jan-97	**8.00**	0.50	2.0	5.0		None	EPA8260
	06160	Conventional	22-Jan-97	**7.20**	0.50	2.0	5.0		None	EPA8260
	06178	Conventional	23-Jan-97	**6.60**	0.50	2.0	5.0		None	EPA8260
	06178	Conventional	23-Jan-97	**8.30**	0.50	2.0	5.0		None	EPA8260
	06162	Conventional	27-Jan-97	3.60	0.50	2.0	5.0		None	EPA8260
	06167	Low-flow	10-Mar-97	**5.00**	0.50	2.0	5.0		None	EPA8260
	06167	Low-flow	10-Mar-97	**5.20**	0.50	2.0	5.0		None	EPA8260
	06098	Low-flow	10-Mar-97	**6.50**	0.50	NR	5.0		None	8260
	06144	Low-flow	05-Jun-97	**8.64**	1.0	NR	5.0		None	8260
	06144	Low-flow	05-Jun-97	**8.42**	1.0	NR	5.0		None	8260
	06681	Low-flow	05-Jun-97	**5.60**	0.50	2.0	5.0		None	EPA8260
	06322	Low-flow	01-Oct-97	2.90	0.50	2.0	5.0			EPA8260
	510148	Low-flow	09-Dec-97	**5.10**	0.50	2.0	5.0			EPA8260
	510148	Low-flow	09-Dec-97	**5.40**	0.50	2.0	5.0			EPA8260

Refer to footnotes at end of tables.

Summary of Detected Trichloroethene Results
Tijeras Arroyo Groundwater Investigation (Continued)

Well ID	ARCOC	Sampling Method	Sample Date	Result[a] (µg/L)	MDL[b] (µg/L)	PQL[c] (µg/L)	MCL[d] (µg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Analytical Method[g]
	510385	Low-flow	05-Mar-98	**7.50**	0.40	1.0	5.0		P2	EPA 8260
WYO-1 (con't)	510385	Low-flow	05-Mar-98	**7.70**	0.40	1.0	5.0		P2	EPA 8260
	510422	Low-flow	05-Mar-98	**6.30**	0.03	1.0	5.0	H	R	EPA 8260
	510422	Low-flow	05-Mar-98	**7.90**	0.03	1.0	5.0			EPA 8260
	510386	Low-flow	05-Mar-98	**7.00**	0.50	2.0	5.0			EPA8260
	510386	Low-flow	05-Mar-98	**7.20**	0.50	2.0	5.0			EPA8260
	510388	Low-flow	05-Mar-98	**6.80**	0.50	2.0	5.0			EPA8260
	600164	Low-flow	10-Jun-98	**6.30**	0.50	2.0	5.0			EPA8260
	600626	Low-flow	14-Sep-98	**6.80**	0.50	2.0	5.0			EPA8260
	600939	Low-flow	01-Dec-98	**6.10**	0.50	2.0	5.0		J, P1	EPA8260
	601268	Low-flow	05-Mar-99	**6.10**	0.50	2.0	5.0			EPA8260
	601489	Low-flow	14-Jul-99	4.80	0.50	2.0	5.0			EPA8260
	601490	Low-flow	14-Jul-99	**5.30**	0.50	1.0	5.0		None	EPA 8260
	602316	Low-flow	16-Sep-99	**5.60**	0.50	2.0	5.0			EPA8260
	602316	Low-flow	16-Sep-99	**6.30**	0.50	2.0	5.0			EPA8260
	602317	Low-flow	16-Sep-99	**5.10**	0.50	1.0	5.0		None	EPA 8260
	602438	Low-flow	01-Dec-99	**5.90**	0.50	2.0	5.0		P2	EPA8260
	602483	Low-flow	01-Jun-00	**5.68**	0.15	1.0	5.0		UJ	SW846 8260
	602715	Low-flow	12-Jan-01	**6.00**	0.50	2.0	5.0			EPA8260
	603492	Low-flow	19-Mar-01	4.70	0.20	0.8	5.0			EPA8260
	604112	Low-flow	21-Jun-01	4.80	0.10	0.4	5.0			EPA8260
WYO-2 Well completed in 27-Aug-95 in the perched aquifer. Plugged and abandoned Jul-01. Distance from SWMU 46 was over 0.5 mile and was upgradient. Conventional sampling from Aug-95 to Mar-97, low-flow sampling from Mar-97 to Jul-01.	04704	Conventional	24-Jan-96	3.70	0.50	NR	5.0		None	8260
	04704	Conventional	24-Jan-96	3.50	0.50	NR	5.0	J	None	8260
	04609	Conventional	24-Jan-96	**6.70**	0.50	2.0	5.0		None	EPA8260
	05738	Conventional	26-Aug-96	3.70	0.50	2.0	5.0		None	EPA8260
	06167	Low-flow	10-Mar-97	**6.10**	0.50	2.0	5.0		None	EPA8260
	06167	Low-flow	10-Mar-97	**6.30**	0.50	2.0	5.0		None	EPA8260
	06098	Low-flow	10-Mar-97	**7.50**	0.50	NR	5.0		None	8260
	06681	Low-flow	05-Jun-97	**6.60**	0.50	2.0	5.0		None	EPA8260
	06322	Low-flow	01-Oct-97	**5.60**	0.50	2.0	5.0			EPA8260
	06325	Low-flow	01-Oct-97	**7.40**	1.0	2.0	5.0			EPA 8260
	510150	Low-flow	09-Dec-97	**5.90**	0.50	2.0	5.0			EPA8260
	510395	Low-flow	06-Mar-98	**6.40**	0.50	2.0	5.0			EPA8260
	600167	Low-flow	10-Jun-98	**7.00**	0.50	2.0	5.0			EPA8260
	600629	Low-flow	14-Sep-98	**6.30**	0.50	2.0	5.0			EPA8260
	600942	Low-flow	01-Dec-98	**7.50**	0.50	2.0	5.0		J, P1	EPA8260
	601265	Low-flow	05-Mar-99	**7.20**	0.50	2.0	5.0			EPA8260
	601493	Low-flow	19-Jul-99	**5.90**	0.60	1.0	5.0	B	None	EPA 8260
	601494	Low-flow	19-Jul-99	**5.20**	0.50	2.0	5.0			EPA8260
	602301	Low-flow	16-Sep-99	**6.90**	0.50	2.0	5.0			EPA8260
	602441	Low-flow	01-Dec-99	**6.90**	0.50	2.0	5.0		P2	EPA8260
	602441	Low-flow	01-Dec-99	**6.60**	0.50	2.0	5.0		P2	EPA8260
	602442	Low-flow	01-Dec-99	**6.60**	0.60	1.0	5.0		None	EPA 8260
	602716	Low-flow	16-Jan-01	**5.90**	0.50	2.0	5.0			EPA8260

Refer to footnotes at end of tables.

Summary of Detected Trichloroethene Results
Tijeras Arroyo Groundwater Investigation (Continued)

Well ID	ARCOC	Sampling Method	Sample Date	Result[a] (µg/L)	MDL[b] (µg/L)	PQL[c] (µg/L)	MCL[d] (µg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Analytical Method[g]
	602716	Low-flow	16-Jan-01	**6.50**	0.50	2.0	5.0			EPA8260
WYO-2 (con't)	602717	Low-flow	16-Jan-01	**5.50**	0.16	1.0	5.0		None	SW846 8260
	604113	Low-flow	21-Jun-01	**5.30**	0.10	0.4	5.0			EPA8260
WYO-4	605066	Low-flow	25-Oct-01	0.240	0.10	0.4	5.0	J	A, J	EPA8260
	605066	Low-flow	25-Oct-01	1.40	0.10	0.4	5.0		A, J	EPA8260
Well was completed 22-Jun-01 in the perched aquifer.	604991	Low-flow	28-Nov-01	4.00	0.10	0.4	5.0			EPA8260
	604991	Low-flow	28-Nov-01	4.50	0.10	0.4	5.0			EPA8260
	605121	Low-flow	28-Nov-01	**7.23**	0.31	1.0	5.0		None	SW846 8260
	605320	Low-flow	03-Apr-02	4.90	0.40	1.6	5.0			EPA8260
Distance from SWMU 46 is over 0.5 mile and is upgradient.	605320	Low-flow	03-Apr-02	**5.30**	0.40	1.6	5.0			EPA8260
	606638	Conventional	14-Aug-03	**6.57**	0.36	1.0	5.0			SW846 8260
	606638	Conventional	14-Aug-03	**6.39**	0.36	1.0	5.0			SW846 8260
	606852	Conventional	03-Nov-03	**6.06**	0.36	1.0	5.0		J	SW846 8260
	606852	Conventional	03-Nov-03	**7.05**	0.36	1.0	5.0		J	SW846 8260
Low-flow sampling from Aug-01 to Jun-03, conventional from Jul-03 to present.	607119	Conventional	03-Feb-04	**6.99**	0.36	1.0	5.0		J	SW846 8260
	607119	Conventional	03-Feb-04	**6.60**	0.36	1.0	5.0		J	SW846 8260
	607433	Conventional	30-Apr-04	**7.70**	0.06	5.0	5.0			8260B
	607433	Conventional	30-Apr-04	**7.60**	0.06	5.0	5.0			8260B
	607715	Conventional	03-Aug-04	**6.70**	0.09	5.0	5.0			8260B
	607715	Conventional	03-Aug-04	**6.00**	0.09	5.0	5.0			8260B
	607950	Conventional	06-Oct-04	**7.35**	0.36	1.0	5.0			SW846 8260
	607950	Conventional	06-Oct-04	**7.43**	0.36	1.0	5.0			SW846 8260
	608142	Conventional	11-Jan-05	**5.66**	0.36	1.0	5.0			SW846 8260
	608142	Conventional	11-Jan-05	**6.16**	0.36	1.0	5.0			SW846 8260
	608594	Conventional	03-May-05	4.26	0.25	1.0	5.0		J	SW846 8260

Refer to footnotes at end of tables.

Summary of Nitrate Results
Tijeras Arroyo Groundwater Investigation

Well ID	ARCOC	Sampling Method	Sample Date	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Analytical Method[g]
TA2-SW1-320	05251	Conventional	27-Aug-96	**29.0**	0.068	0.22	10		None	HACH_NO3
	06169	Low-flow	13-Mar-97	**28.0**	0.180	0.60	10		None	HACH_NO3
Well was completed 30-Nov-92 in the perched aquifer.	06317	Low-flow	09-Jun-97	**21.0**	0.280	1.12	10		None	HACH_NO3
	06317	Low-flow	09-Jun-97	**28.0**	0.280	1.12	10		None	HACH_NO3
	06929	Low-flow	30-Sep-97	**23.0**	0.300	1.10	10			HACH_NO3
	510136	Low-flow	08-Dec-97	**22.0**	0.280	1.10	10			HACH_NO3
Distance from SWMU 46 is approximately 0.5 mile and is upgradient.	510395	Low-flow	06-Mar-98	**26.0**	0.560	2.20	10			HACH_NO3
	600186	Low-flow	15-Jun-98	**26.5**	0.900	3.50	10			HACH_NO3
	600623	Low-flow	10-Sep-98	**21.9**	0.550	2.20	10			HACH_NO3
	600918	Low-flow	30-Nov-98	**20.0**	0.550	2.20	10			HACH_NO3
Conventional sampling prior to Mar-97, and from Jun-03 to present, low-flow Mar-97 to Jun-03.	601295	Low-flow	09-Mar-99	**26.0**	0.550	2.20	10			HACH_NO3
	601456	Low-flow	20-Jul-99	**22.0**	0.700	2.80	10			HACH_NO3
	602280	Low-flow	13-Sep-99	**27.0**	0.700	2.80	10			HACH_NO3
	602405	Low-flow	19-Nov-99	**44.0**	1.40	5.60	10			HACH_NO3
	602471	Low-flow	12-Apr-00	**30.0**	1.40	5.60	10			HACH_NO3
	602720	Low-flow	12-Jan-01	**36.0**	3.50	14.0	10			HACH_NO3
	603481	Low-flow	21-Mar-01	**36.0**	3.50	14.0	10			HACH_NO3
	604099	Low-flow	05-Jul-01	**34.0**	3.50	14.0	10			HACH_NO3
	604775	Low-flow	25-Sep-01	**29.0**	3.50	14.0	10			HACH_NO3
	604977	Low-flow	06-Dec-01	**29.0**	3.50	14.0	10		None	HACH_NO3
	605306	Low-flow	26-Mar-02	**26.0**	0.200	0.80	10			Nitrate_EP
	606615	Conventional	24-Jul-03	**22.9**	0.171	0.50	10	H	HT, J	SW846 9056
	606830	Conventional	11-Nov-03	**22.4**	0.171	0.50	10	H	HT, J	SW846 9056
	607085	Conventional	29-Jan-04	**23.0**	0.270	0.50	10			EPA 300.0
	607402	Conventional	14-MAY-04	**22.0**	0.270	0.50	10			EPA 300.0
	607680	Conventional	27-Jul-04	**24.0**	0.270	0.50	10		A2, J	EPA 300.0
	607916	Conventional	04-Oct-04	**25.0**	0.270	0.50	10			EPA 300.0
TA2-W-19	05740	Conventional	28-Aug-96	6.70	0.068	0.22	10		None	HACH_NO3
Well completed 9-Nov-95 in the perched aquifer.	05740	Conventional	28-Aug-96	9.00	0.068	0.22	10		None	HACH_NO3
	06177	Low-flow	11-Mar-97	5.90	0.090	0.30	10		None	HACH_NO3
	06319	Low-flow	10-Jun-97	7.30	0.280	1.12	10		None	HACH_NO3
Distance from SWMU 46 is approximately 0.5 mile, cross-gradient.	06974	Low-flow	29-Sep-97	6.70	0.120	0.44	10			HACH_NO3
	06956	Low-flow	10-Dec-97	6.30	0.280	1.10	10		None	HACH_NO3
	510395	Low-flow	06-Mar-98	5.40	0.110	0.43	10			HACH_NO3
	600177	Low-flow	15-Jun-98	8.40	0.180	0.70	10			HACH_NO3
	600177	Low-flow	15-Jun-98	8.10	0.180	0.70	10			HACH_NO3
Conventional sampling method prior to Mar-97, and Jun-03 to present, low-flow from Mar-97 to Jun-03.	600642	Low-flow	16-Sep-98	8.40	0.550	2.20	10			HACH_NO3
	600642	Low-flow	16-Sep-98	8.80	0.550	2.20	10			HACH_NO3
	600924	Low-flow	02-Dec-98	6.70	0.220	0.88	10			HACH_NO3
	600924	Low-flow	02-Dec-98	7.40	0.220	0.88	10			HACH_NO3
	601262	Low-flow	09-Mar-99	9.10	0.220	0.88	10			HACH_NO3
	602286	Low-flow	24-Sep-99	8.80	0.280	1.10	10			HACH_NO3
	602411	Low-flow	30-Nov-99	9.90	0.280	1.10	10			HACH_NO3
	602473	Low-flow	15-Mar-00	7.80	0.700	2.80	10			HACH_NO3

Refer to footnotes at end of tables.

Summary of Nitrate Results
Tijeras Arroyo Groundwater Investigation (Continued)

Well ID	ARCOC	Sampling Method	Sample Date	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Analytical Method[g]
TA2-W-19 (con't)	602705	Low-flow	04-Jan-01	13.0	1.40	5.60	10			HACH_NO3
	603483	Low-flow	08-Mar-01	24.0	1.80	7.00	10			HACH_NO3
	604101	Low-flow	06-Jul-01	7.20	1.80	7.00	10			HACH_NO3
	604777	Low-flow	02-Oct-01	7.80	0.700	2.80	10			HACH_NO3
	604979	Low-flow	21-Nov-01	3.80	0.350	1.40	10		None	HACH_NO3
	605308	Low-flow	18-Mar-02	8.80	0.200	0.80	10		None	Nitrate_EP
	606619	Conventional	04-Aug-03	9.58	0.0341	0.10	10	H		SW846 9056
	606834	Conventional	07-Oct-03	9.35	0.0682	0.20	10	H	HT, J	SW846 9056
	607091	Conventional	13-Jan-04	9.20	NR	0.10	10			EPA 300.0
	607408	Conventional	27-Apr-04	9.30	0.054	0.10	10			EPA 300.0
	607408	Conventional	27-Apr-04	9.30	0.054	0.10	10			EPA 300.0
	607686	Conventional	27-Jul-04	9.40	0.054	0.10	10		A2, J	EPA 300.0
	607922	Conventional	04-Oct-04	10.0	0.054	0.10	10			EPA 300.0
	607922	Conventional	04-Oct-04	10.0	0.054	0.10	10			EPA 300.0
TJA-3 Well completed 31-Aug-98 in the regional aquifer. This well is located within the SWMU 46 boundary. Conventional sampling method prior to Mar-99, and Jun-03 to present, low-flow from Mar-99 to Jun-03.	600671	Conventional	25-Aug-98	3.30	0.110	0.44	10			HACH_NO3
	600673	Conventional	01-Sep-98	1.00	0.110	0.44	10			HACH_NO3
	600674	Conventional	10-Sep-98	1.90	0.110	0.44	10		None	HACH_NO3
	600980	Conventional	07-Dec-98	3.30	0.110	0.44	10			HACH_NO3
	600955	Conventional	15-Dec-98	2.80	0.110	0.44	10		A2, J	HACH_NO3
	601277	Low-flow	08-Mar-99	2.00	0.110	0.44	10			HACH_NO3
	601480	Low-flow	16-Jun-99	2.20	0.110	0.44	10			HACH_NO3
	602307	Low-flow	20-Sep-99	2.30	0.140	0.56	10			HACH_NO3
	602429	Low-flow	29-Nov-99	3.50	0.140	0.56	10			HACH_NO3
	602480	Low-flow	11-Apr-00	2.70	0.140	0.56	10			HACH_NO3
	602480	Low-flow	11-Apr-00	2.90	0.140	0.56	10			HACH_NO3
	602712	Low-flow	08-Jan-01	3.30	0.350	1.40	10			HACH_NO3
	603489	Low-flow	28-Mar-01	3.70	0.350	1.40	10			HACH_NO3
	603489	Low-flow	28-Mar-01	3.60	0.350	1.40	10			HACH_NO3
	604107	Low-flow	05-Jul-01	3.70	0.350	1.40	10			HACH_NO3
	604783	Low-flow	03-Oct-01	1.90	0.350	1.40	10			HACH_NO3
	604783	Low-flow	03-Oct-01	2.10	0.350	1.40	10			HACH_NO3
	604985	Low-flow	01-Dec-01	0.84	0.350	1.40	10	J	None	HACH_NO3
	605314	Low-flow	20-Mar-02	2.80	0.200	0.80	10		None	Nitrate_EP
	606627	Conventional	06-Aug-03	2.52	0.0341	0.10	10			SW846 9056
	606842	Conventional	22-Oct-03	2.51	0.0341	0.10	10			SW846 9056
	607104	Conventional	27-Jan-04	2.90	0.054	0.10	10			EPA 300.0
	607420	Conventional	27-Apr-04	2.50	0.054	0.10	10			EPA 300.0
	607699	Conventional	09-Aug-04	2.70	0.054	0.10	10			EPA 300.0
	607935	Conventional	12-Oct-04	2.60	0.054	0.10	10			EPA 300.0
TJA-6 Well completed 04-Feb-01 in the regional aquifer.	603948	Low-flow	11-Apr-01	2.30	0.350	1.40	10			HACH_NO3
	604110	Low-flow	09-Jul-01	2.00	0.350	1.40	10			HACH_NO3
	604110	Low-flow	09-Jul-01	1.90	0.350	1.40	10			HACH_NO3
	604927	Low-flow	10-Oct-01	1.50	0.350	1.40	10			HACH_NO3

Refer to footnotes at end of tables.

Summary of Nitrate Results
Tijeras Arroyo Groundwater Investigation (Continued)

Well ID	ARCOC	Sampling Method	Sample Date	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Analytical Method[g]
TJA-6 (con't)	604988	Low-flow	04-Dec-01	0.91	0.350	1.40	10	J	None	HACH_NO3
Distance from SWMU 46 is approximately 350 ft, downgradient.	605317	Low-flow	18-Mar-02	2.20	0.200	0.80	10		None	Nitrate_EP
	606631	Conventional	11-Aug-03	2.17	0.0341	0.10	10			SW846 9056
Low-flow sampling from Mar-01 to Jun-03, conventional Jul-03 to present.	606846	Conventional	05-Nov-03	2.26	0.0341	0.10	10			SW846 8056
	607110	Conventional	04-Feb-04	2.50	0.054	0.10	10			EPA 300.0
	607426	Conventional	22-Apr-04	2.40	0.054	0.10	10			EPA 300.0
	607705	Conventional	04-Aug-04	2.50	0.054	0.10	10			EPA 300.0
	607941	Conventional	13-Oct-04	2.50	0.054	0.10	10			EPA 300.0
TJA-7	603949	Low-flow	11-Apr-01	**39.0**	3.50	14.0	10			HACH_NO3
	604111	Low-flow	09-Jul-01	**40.0**	3.50	14.0	10			HACH_NO3
Well complete in 07-Mar-01 in the perched aquifer.	604111	Low-flow	09-Jul-01	**40.0**	3.50	14.0	10			HACH_NO3
	604929	Low-flow	10-Oct-01	**41.0**	3.50	14.0	10			HACH_NO3
	604989	Low-flow	01-Dec-01	**27.0**	3.50	14.0	10		None	HACH_NO3
This well is located within the SWMU 46 boundary.	605318	Low-flow	20-Mar-02	**30.0**	0.200	0.80	10		None	Nitrate_EP
	606633	Conventional	12-Aug-03	**22.9**	0.0341	0.10	10	H	HT	SW846 9056
	606848	Conventional	28-Oct-03	**24.5**	0.341	10.0	10	H	HT, J	SW846 9056
Low-flow sampling from Mar-01 to Jun-03, conventional Jul-03 to present.	606872	Conventional	28-Oct-03	**26.0**	NR	0.50	10		P2	EPA 300.0
	607113	Conventional	22-Jan-04	**27.0**	NR	0.50	10			EPA 300.0
	607429	Conventional	30-Apr-04	**24.0**	0.270	0.50	10			EPA 300.0
	607708	Conventional	06-Aug-04	**24.0**	0.270	0.50	10	H	HT, J	EPA 300.0
	607708	Conventional	06-Aug-04	**27.0**	0.054	0.10	10	E	J	EPA 300.0
	607708	Conventional	06-Aug-04	**25.0**	0.270	0.50	10	H	HT, J	EPA 300.0
	607708	Conventional	06-Aug-04	**27.0**	0.054	0.10	10	E	J	EPA 300.0
	607944	Conventional	15-Oct-04	**25.0**	0.270	0.50	10			EPA 300.0
	607944	Conventional	15-Oct-04	**26.0**	0.054	0.10	10	E		EPA 300.0
	607944	Conventional	15-Oct-04	**25.0**	0.054	0.10	10	E		EPA 300.0
	607944	Conventional	15-Oct-04	**25.0**	0.270	0.50	10			EPA 300.0
WYO-1	4704	Conventional	24-Jan-96	2.60	0.050	NR	10		None	353.2
	05738	Conventional	26-Aug-96	4.10	0.068	0.22	10		None	HACH_NO3
Well completed in 27-Aug-95 in the regional aquifer. Plugged and abandoned Jul-01.	06167	Low-flow	10-Mar-97	1.50	0.090	0.30	10		None	HACH_NO3
	06098	Low-flow	10-Mar-97	1.11	0.013	NR	10		None	353.1
	06167	Low-flow	10-Mar-97	2.50	0.090	0.30	10		None	HACH_NO3
	06144	Low-flow	05-Jun-97	3.06	0.013	NR	10		None	353.1
	06681	Low-flow	05-Jun-97	2.80	0.056	0.224	10		None	HACH_NO3
Distance from SWMU 46 was over 0.5 mile and was upgradient.	06144	Low-flow	05-Jun-97	2.73	0.013	NR	10		None	353.1
	06322	Low-flow	01-Oct-97	2.70	0.060	0.22	10			HACH_NO3
	510148	Low-flow	09-Dec-97	1.50	0.056	0.22	10			HACH_NO3
	510148	Low-flow	09-Dec-97	1.40	0.056	0.22	10			HACH_NO3
Conventional sampling from Aug-95 to Mar-97, low-flow sampling from Mar-97 to Jul-01.	510388	Low-flow	05-Mar-98	2.20	0.0560	0.22	10			HACH_NO3
	600164	Low-flow	10-Jun-98	2.50	0.110	0.43	10			HACH_NO3
	600626	Low-flow	14-Sep-98	2.90	0.110	0.44	10			HACH_NO3
	600939	Low-flow	01-Dec-98	2.80	0.110	0.44	10			HACH_NO3
	601268	Low-flow	05-Mar-99	2.70	0.110	0.44	10			HACH_NO3

Refer to footnotes at end of tables.

Summary of Nitrate Results
Tijeras Arroyo Groundwater Investigation (Continued)

Well ID	ARCOC	Sampling Method	Sample Date	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Analytical Method[g]
WYO-1 (con't)	601489	Low-flow	14-Jul-99	2.60	0.140	0.56	10			HACH_NO3
	602316	Low-flow	16-Sep-99	2.30	0.140	0.56	10			HACH_NO3
	602316	Low-flow	16-Sep-99	2.00	0.140	0.56	10			HACH_NO3
	602438	Low-flow	01-Dec-99	3.80	0.140	0.56	10			HACH_NO3
	602715	Low-flow	12-Jan-01	3.00	0.350	1.40	10			HACH_NO3
	603492	Low-flow	19-Mar-01	4.00	0.350	1.40	10			HACH_NO3
	604112	Low-flow	21-Jun-01	2.10	0.350	1.40	10			HACH_NO3
WYO-2 Well completed in 27-Aug-95 in the perched aquifer. Plugged and abandoned Jul-01. Distance from SWMU 46 was over 0.5 mile and was upgradient. Conventional sampling from Aug-95 to Mar-97, low-flow sampling from Mar-97 to Jul-01.	4704	Conventional	24-Jan-96	2.70	0.050	NR	10		None	353.2
	05738	Conventional	26-Aug-96	3.80	0.300	1.00	10		None	HACH_NO3
	06167	Low-flow	10-Mar-97	2.80	0.090	0.30	10		None	HACH_NO3
	06098	Low-flow	10-Mar-97	1.16	0.013	NR	10		None	353.1
	06167	Low-flow	10-Mar-97	2.30	0.090	0.30	10		None	HACH_NO3
	06681	Low-flow	05-Jun-97	3.00	0.056	0.224	10		None	HACH_NO3
	06325	Low-flow	01-Oct-97	2.90	0.013	0.25	10			EPA 353.1
	06322	Low-flow	01-Oct-97	1.90	0.120	0.44	10			HACH_NO3
	06325	Low-flow	01-Oct-97	2.70	0.013	0.25	10			EPA 353.1
	510150	Low-flow	09-Dec-97	1.40	0.056	0.22	10			HACH_NO3
	510395	Low-flow	06-Mar-98	2.60	0.056	0.22	10			HACH_NO3
	600167	Low-flow	10-Jun-98	2.80	0.110	0.43	10			HACH_NO3
	600629	Low-flow	14-Sep-98	3.30	0.110	0.44	10			HACH_NO3
	600942	Low-flow	01-Dec-98	2.70	0.110	0.44	10			HACH_NO3
	601265	Low-flow	05-Mar-99	2.60	0.110	0.44	10			HACH_NO3
	601494	Low-flow	19-Jul-99	3.00	0.140	0.56	10			HACH_NO3
	602301	Low-flow	16-Sep-99	2.30	0.140	0.56	10			HACH_NO3
	602441	Low-flow	01-Dec-99	4.50	0.560	2.20	10			HACH_NO3
	602441	Low-flow	01-Dec-99	5.00	0.560	2.20	10			HACH_NO3
	602716	Low-flow	16-Jan-01	3.00	0.350	1.40	10			HACH_NO3
	602716	Low-flow	16-Jan-01	2.90	0.350	1.40	10			HACH_NO3
	604113	Low-flow	21-Jun-01	4.00	0.350	1.40	10			HACH_NO3
WYO-3 Well was completed 22-Jun-01 in the regional aquifer. Distance from SWMU 46 is over 0.5 mile and is upgradient. Low-flow sampling from Aug-01 to Jun-03, conventional from Jul-03 to present.	604990	Low-flow	28-Nov-01	2.10	0.350	1.40	10		None	HACH_NO3
	605319	Low-flow	02-Apr-02	1.90	0.200	0.80	10			Nitrate_EP
	605319	Low-flow	02-Apr-02	1.80	0.200	0.80	10			Nitrate_EP
	606636	Conventional	13-Aug-03	1.71	0.0341	0.10	10	H	HT	SW846 9056
	606850	Conventional	29-Oct-03	1.80	0.0341	0.10	10			SW846 9056
	606873	Conventional	29-Oct-03	2.00	NR	0.10	10		P2	EPA 300.0
	607117	Conventional	21-Jan-04	2.00	NR	0.10	10			EPA 300.0
	607432	Conventional	28-Apr-04	1.90	0.054	0.10	10			EPA 300.0
	607713	Conventional	11-Aug-04	2.00	0.054	0.10	10			EPA 300.0
	607948	Conventional	08-Oct-04	2.00	0.054	0.10	10			EPA 300.0
WYO-4 Well was completed 22-Jun-01 in the perched aquifer.	604991	Low-flow	28-Nov-01	1.10	0.350	1.40	10	J	None	HACH_NO3
	604991	Low-flow	28-Nov-01	1.20	0.350	1.40	10	J	None	HACH_NO3
	605320	Low-flow	03-Apr-02	2.90	0.200	0.80	10			Nitrate_EP
	605320	Low-flow	03-Apr-02	2.90	0.200	0.80	10			Nitrate_EP

Refer to footnotes at end of tables.

Summary of Nitrate Results
Tijeras Arroyo Groundwater Investigation (Continued)

Well ID	ARCOC	Sampling Method	Sample Date	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Analytical Method[g]
WYO-4 (con't) Distance from SWMU 46 is over 0.5 mile and is upgradient. Low-flow sampling from Aug-01 to Jun-03, conventional from Jul-03 to present.	606638	Conventional	14-Aug-03	2.54	0.0341	0.10	10			SW846 9056
	606852	Conventional	03-Nov-03	2.86	0.0341	0.10	10			SW846 9056
	606874	Conventional	03-Nov-03	3.00	NR	0.10	10			EPA 300.0
	607120	Conventional	03-Feb-04	2.90	0.054	0.10	10			EPA 300.0
	607120	Conventional	03-Feb-04	2.90	0.054	0.10	10			EPA 300.0
	607435	Conventional	30-Apr-04	2.70	0.054	0.10	10			EPA 300.0
	607435	Conventional	30-Apr-04	2.70	0.054	0.10	10			EPA 300.0
	607716	Conventional	03-Aug-04	2.80	0.054	0.10	10			EPA 300.0
	607716	Conventional	03-Aug-04	2.80	0.054	0.10	10			EPA 300.0
	607951	Conventional	06-Oct-04	2.80	0.054	0.10	10		P2	EPA 300.0
	607951	Conventional	06-Oct-04	2.80	0.054	0.10	10		P2	EPA 300.0

Refer to footnotes at end of tables.

Summary of Nitrate plus Nitrite Results
Tijeras Arroyo Groundwater Investigation

Well ID	ARCOC	Sampling Method	Sample Date	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Analytical Method[g]
TA2-SW1-320	606615	Conventional	24-Jul-03	**25.0**	0.2500	1.25	10			EPA 353.1
Well was completed 30-Nov-92 in the perched aquifer.	606830	Conventional	11-Nov-03	**24.0**	0.5000	2.50	10			EPA 353.1
	607084	Conventional	29-Jan-04	**25.0**	0.5000	2.50	10			EPA 353.1
Distance from SWMU 46 is approximately 0.5 mile and is upgradient.	607400	Conventional	14-May-04	**24.2**	3.60	50	10	H	HT, J	353.1
	607679	Conventional	27-Jul-04	**24.0**	3.60	50	10			353.1
Conventional sampling prior to Mar-97, and from Jun-03 to present, low-flow Ma4-97 to Jun-03.	607915	Conventional	04-Oct-04	**25.1**	0.0300	0.200	10		A2, J	EPA 353.1
	608119	Conventional	17-Jan-05	**20.1**	0.1500	1.00	10			EPA 353.1
	608581	Conventional	09-May-05	**18.9**	0.0300	0.200	10	B		EPA 353.1
TA2-W-19	606619	Conventional	04-Aug-03	**10.4**	0.1000	0.500	10			EPA 353.1
Well completed 9-Nov-95 in the perched aquifer.	606834	Conventional	07-Oct-03	9.50	0.1000	0.500	10			EPA 353.1
	607090	Conventional	13-Jan-04	10.0	0.0500	0.250	10		A2, J	EPA 353.1
Distance from SWMU 46 is approximately 0.5 mile, cross-gradient.	607685	Conventional	27-Jul-04	9.53	0.0036	0.050	10			353.1
	607406	Conventional	27-Apr-04	9.23	0.0359	0.500	10			353.1
	607406	Conventional	27-APR-04	9.39	0.0359	0.500	10			353.1
Conventional sampling method prior to Mar-97, and Jun-03 to present, low-flow from Mar-97 to Jun-03.	607921	Conventional	04-Oct-04	**10.3**	0.0300	0.200	10		A2, J	EPA 353.1
	607921	Conventional	04-Oct-04	9.93	0.0300	0.200	10		A2, J	EPA 353.1
	608123	Conventional	04-Jan-05	7.57	0.0300	0.200	10			EPA 353.1
	608123	Conventional	04-Jan-05	7.64	0.0300	0.200	10			EPA 353.1
	607406	Conventional	27-Apr-04	9.39	0.0359	0.500	10			353.1
TJA-3	600954	Conventional	15-Dec-98	2.97	0.0130	0.150	10		None	EPA 353.1
Well completed 31-Aug-98 in the regional aquifer.	603955	Low-flow	28-Mar-01	2.90	0.0069	0.250	10		None	EPA 353.1
	604806	Low-flow	03-Oct-01	3.12	0.0207	0.150	10	B	None	EPA 353.1
	605117	Low-flow	03-Dec-01	2.73	0.0207	0.150	10	B	None	EPA 353.1
	605328	Low-flow	20-Mar-02	2.75	0.0345	0.250	10			EPA 353.1
This well is located within the SWMU 46 boundary.	606627	Conventional	06-Aug-03	2.55	0.0100	0.050	10		B2, J	EPA 353.1
	606842	Conventional	22-Oct-03	2.75	0.0500	0.250	10			EPA 353.1
	607103	Conventional	27-Jan-04	1.89	0.0100	0.050	10			EPA 353.1
Conventional sampling method prior to Mar-99, and Jun-03 to present, low-flow from Mar-99 to Jun-03.	607418	Conventional	27-Apr-04	2.80	0.0359	0.500	10			353.1
	607698	Conventional	09-Aug-04	2.52	0.0144	0.200	10			353.1
	607934	Conventional	12-Oct-04	3.12	0.0030	0.020	10			EPA 353.1
	608131	Conventional	05-Jan-05	3.05	0.0030	0.020	10			EPA 353.1
	608588	Conventional	18-May-05	2.82	0.0030	0.020	10	B		EPA 353.1
TJA-6	604058	Low-flow	09-Jul-01	1.27	0.0069	0.050	10			EPA 353.1
Well completed 04-Feb-01 in the regional aquifer.	606631	Conventional	11-Aug-03	2.49	0.0300	0.150	10			EPA 353.1
	606846	Conventional	05-Nov-03	2.50	0.0500	0.250	10		B2, J	EPA 353.1
Distance from SWMU 46 is approximately 350 ft, downgrdient.	607109	Conventional	04-Feb-04	2.35	0.0500	0.250	10			EPA 353.1
	607424	Conventional	22-Apr-04	2.42	0.0359	0.500	10		B2, J	353.1
Low-flow sampling from	607704	Conventional	04-Aug-04	2.20	0.0144	0.200	10			353.1

Refer to footnotes at end of tables.

Summary of Nitrate plus Nitrite Results
Tijeras Arroyo Groundwater Investigation (Continued)

Well ID	ARCOC	Sampling Method	Sample Date	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Analytical Method[g]
TJA-6 (con't) Mar-01 to Jun-03, conventional Jul-03 to present.	607940	Conventional	13-Oct-04	2.94	0.0030	0.020	10			EPA 353.1
	608134	Conventional	06-Jan-05	2.88	0.0030	0.020	10			EPA 353.1
	608590	Conventional	16-May-05	2.62	0.0030	0.020	10	B		EPA 353.1
TJA-7 Well complete in 07-Mar-01 in the perched aquifer. This well is located within the SWMU 46 boundary. Low-flow sampling from Mar-01 to Jun-03, conventional Jul-03 to present.	604059	Low-flow	09-Jul-01	**30.5**	0.0069	2.50	10			EPA 353.1
	606633	Conventional	12-Aug-03	**26.0**	0.5000	2.50	10			EPA 353.1
	606848	Conventional	28-Oct-03	**25.0**	0.2500	1.25	10			EPA 353.1
	607112	Conventional	22-Jan-04	**29.8**	0.2500	1.25	10			EPA 353.1
	607427	Conventional	30-Apr-04	**17.9**	0.2870	4.00	10			353.1
	607707	Conventional	06-Aug-04	**24.3**	0.1440	2.00	10			353.1
	607707	Conventional	06-Aug-04	**24.6**	0.1440	2.00	10			353.1
	607943	Conventional	15-Oct-04	**27.1**	0.0300	0.200	10			EPA 353.1
	607943	Conventional	15-Oct-04	**23.2**	0.0300	0.200	10			EPA 353.1
	608138	Conventional	18-Jan-05	**21.2**	0.0300	0.200	10			EPA 353.1
	608138	Conventional	18-Jan-05	**21.7**	0.0300	0.200	10			EPA 353.1
	608591	Conventional	13-May-05	**22.3**	0.0300	0.200	10	B		EPA 353.1
WYO-1 Well completed in 27-Aug-95 in the regional aquifer. Plugged and abandoned Jul-01. Distance from SWMU 46 was over 0.5 mile and was upgradient. Conventional sampling from Aug-95 to Mar-97, low-flow sampling from Mar-97 to Jul-01.	601490	Low-flow	14-Jul-99	1.83	0.0086	0.050	10		None	EPA 353.1
	602317	Low-flow	16-Sep-99	3.10	0.0086	0.250	10		None	EPA 353.1
	602483	Low-flow	01-Jun-00	2.42	0.0090	0.050	10			EPA 353.1
WYO-2 Well completed in 27-Aug-95 in the perched aquifer. Plugged and abandoned Jul-01. Distance from SWMU 46 was over 0.5 mile and was upgradient. Conventional sampling from Aug-95 to Mar-97, low-flow sampling from Mar-97 to Jul-01.	601493	Low-flow	19-Jul-99	1.94	0.0086	0.050	10		None	EPA 353.1
	602442	Low-flow	01-Dec-99	3.15	0.0086	0.250	10		None	EPA 353.1
	602717	Low-flow	16-Jan-01	2.90	0.0069	0.250	10		None	EPA 353.1
WYO-3 Well was completed 22-Jun-01 in the regional	605331	Conventional	02-Apr-02	1.75	0.0345	0.250	10			EPA 353.1
	606636	Conventional	13-Aug-03	1.92	0.0100	0.050	10			EPA 353.1

Refer to footnotes at end of tables.

Summary of Nitrate plus Nitrite Results
Tijeras Arroyo Groundwater Investigation (Continued)

Well ID	ARCOC	Sampling Method	Sample Date	Result[a] (mg/L)	MDL[b] (mg/L)	PQL[c] (mg/L)	MCL[d] (mg/L)	Laboratory Qualifier[e]	Validation Qualifier[f]	Analytical Method[g]
WYO-3 (con't) aquifer. Distance from SWMU 46 is over 0.5 mile and is upgradient. Low-flow sampling from Aug-01 to Jun-03, conventional from Jul-03 to present.	606850	Conventional	29-Oct-03	1.61	0.0100	0.050	10			EPA 353.1
	607116	Conventional	21-Jan-04	1.38	0.0100	0.050	10		B2, J	EPA 353.1
	607430	Conventional	28-Apr-04	2.12	0.0359	0.500	10			353.1
	607712	Conventional	11-Aug-04	1.89	0.0144	0.200	10			353.1
	607947	Conventional	08-Oct-04	2.38	0.0030	0.020	10			EPA 353.1
	608141	Conventional	07-Jan-05	2.04	0.0030	0.020	10			EPA 353.1
	608593	Conventional	17-May-05	2.08	0.0030	0.020	10	B		EPA 353.1
WYO-4	605121	Low-flow	28-Nov-01	2.32	0.0069	0.050	10		None	EPA 353.1
Well was completed 22-Jun-01 in the perched aquifer. Distance from SWMU 46 is over 0.5 mile and is upgradient. Low-flow sampling from Aug-01 to Jun-03, conventional from Jul-03 to present.	605765	Low-flow	25-Oct-02	1.72	0.0100	0.050	10	B		EPA 353.1
	606638	Conventional	14-Aug-03	2.72	0.0100	0.050	10			EPA 353.1
	606638	Conventional	14-Aug-03	2.70	0.0100	0.050	10			EPA 353.1
	606852	Conventional	03-Nov-03	2.20	0.0100	0.050	10			EPA 353.1
	606852	Conventional	03-Nov-03	2.21	0.0100	0.050	10			EPA 353.1
	607119	Conventional	03-Feb-04	2.06	0.0100	0.050	10		A2, J	EPA 353.1
	607119	Conventional	03-Feb-04	2.11	0.0100	0.050	10			EPA 353.1
	607119	Conventional	03-Feb-04	2.09	0.0100	0.050	10		A2, J	EPA 353.1
	607119	Conventional	03-Feb-04	2.12	0.0100	0.050	10			EPA 353.1
	607433	Conventional	30-Apr-04	2.81	0.0359	0.500	10			353.1
	607433	Conventional	30-Apr-04	2.86	0.0359	0.500	10			353.1
	607715	Conventional	03-Aug-04	2.04	0.0144	0.200	10		B2, J	353.1
	607715	Conventional	03-Aug-04	2.71	0.0144	0.200	10		B2, J	353.1
	607950	Conventional	06-Oct-04	3.30	0.0030	0.020	10			EPA 353.1
	607950	Conventional	06-Oct-04	3.29	0.0030	0.020	10			EPA 353.1
	608142	Conventional	11-Jan-05	3.18	0.0030	0.020	10	B		EPA 353.1
	608142	Conventional	11-Jan-05	3.18	0.0030	0.020	10	B		EPA 353.1
	608594	Conventional	03-May-05	2.86	0.0030	0.020	10	B		EPA 353.1

Refer to footnotes at end of tables.

*Footnotes for **Tijeras Arroyo Groundwater Investigation***

[a]**Result**
- Values in **bold** exceed the established MCL.
- µg/L = micrograms per liter
- mg/L = milligrams per liter

[b]**MDL**
Method detection limit. The minimum concentration that can be measured and reported with 99% confidence that the analyte is greater than zero, analyte is matrix specific.
- NR = not reported

[c]**PQL**
Practical quantitation limit. The lowest concentration of analytes in a sample that can be reliably determined within specified limits of precision and accuracy by that indicated method under routine laboratory operating conditions.
- NR = not reported

[d]**MCL**
- Maximum contaminant level. Established by the U.S. Environmental Protection Agency Primary Water Regulations (40 CFR 141.11(b))., and subsequent amendments or the New Mexico Environmental Improvement Board in Title 20, Chapter 7, Part 1 of the New Mexico Administrative Code (20MAC 7.1).

[e]**Lab Qualifier**
If cell is blank, then all quality control samples met acceptance criteria with respect to submitted samples.
B = Analyte is detected in associated laboratory method blank.
E = Value above quantitation range.
J = Amount detected is below the practical quantitation limit (PQL).
H = Holding time was exceeded for associated analysis.

[f]**Validation Qualifier**
If cell is blank, then all quality control samples met acceptance criteria with respect to submitted samples.
A = Laboratory accuracy and or bias measurements for the associated laboratory control and/or laboratory control duplicate samples do not meet acceptance criteria
B = Analyte present in associated laboratory method blank sample.
HT = The holding time was exceeded for the associated sample analysis.
J = The associate value is an estimated quantity.
P1 = Laboratory precision measurements for the matrix spike and/or matrix spike duplicate do not meet acceptance criteria.
P2 = Insufficient quality control data to determine laboratory precision.
None = Data was not validated.
R = The data are unusable for their intended purpose.
UJ = Analyte was qualified as not detected, and is an estimated value.

[g]**Analytical Method**
- U.S. Environmental Protection Agency, 1990, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd ed.
- U.S. Environmental Protection Agency, 1983, "The Determination of Inorganic Anions in Water by Ion Chromatography-Method 300.0," EPA-600/4-84-017.

ANNEX B
POTENTIOMETRIC MAPS

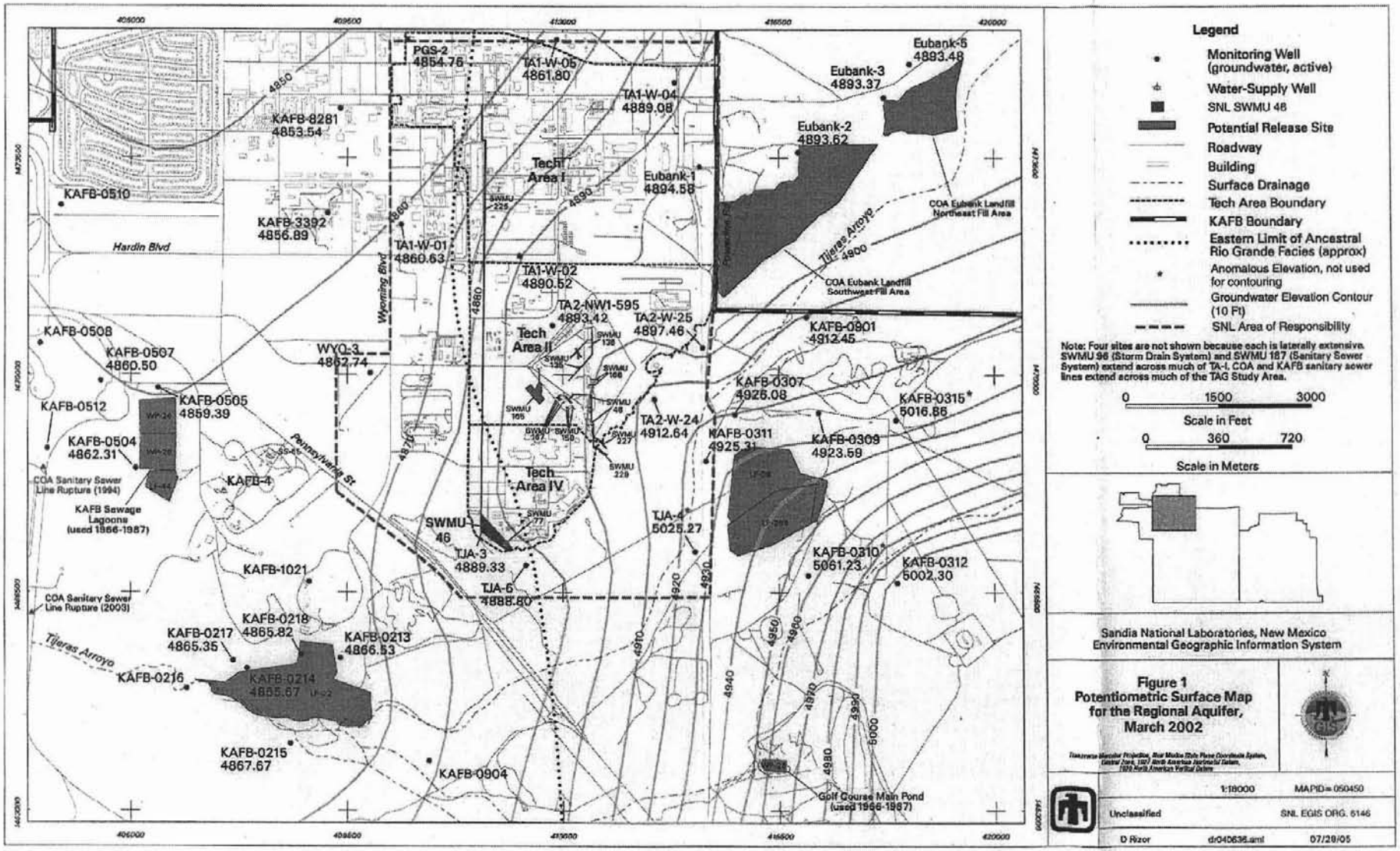

Figure 1. Potentiometric Surface Map for the Regional Aquifer, March 2002.

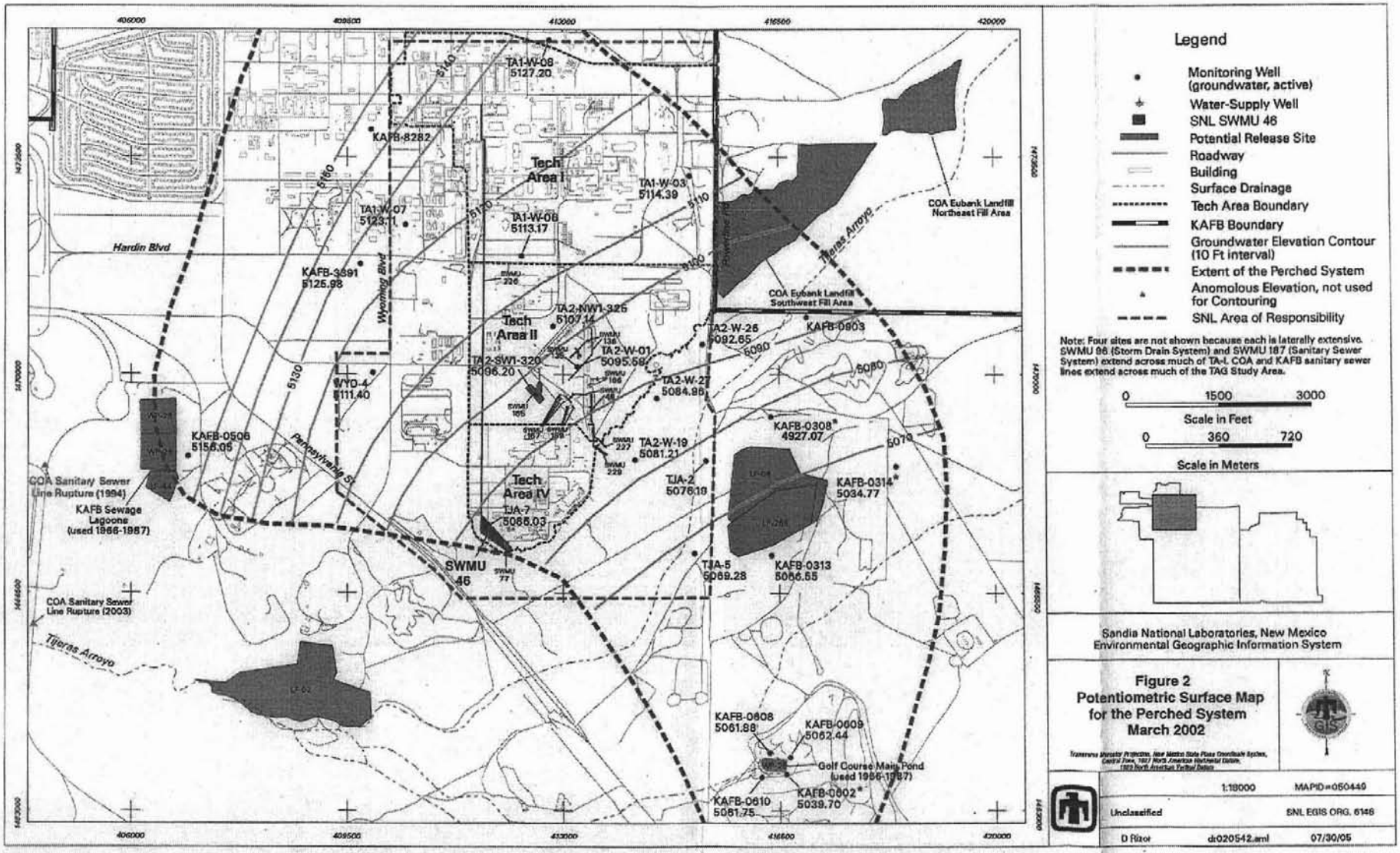

Figure 2. Potentiometric Surface Map for the Perched System, March 2002.