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Justification for Class III Permit Modification April2001 SWMU81D Operable Unit 1333 Northern Cable Area

Sandia National Laboratories/NM

Sandia National Laboratories

Justification for Class III Permit Modification

April 2001

SWMU 81D
Operable Unit 1333
Northern Cable Area

NFA Originally Submitted September 2000

Environmental Restoration Project

United States Department of Energy
Albuquerque Operations Office

Justification for
Class III Permit Modification

April 2001

Solid Waste Management Unit 81D
Operable Unit 1333
Round 14

(RCRA Permit No. NM5890110518)

NFA Originally Submitted September 2000

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Solid Waste Management Unit 81D
Operable Unit 1333
Round 14

NFA Originally Submitted September 2000

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7.0 SOLID WASTE MANAGEMENT UNIT 81D: NORTHERN CABLE AREA

7.1 Summary

Sandia National Laboratories/New Mexico (SNL/NM) is proposing a risk-based no further action (NFA) decision for Environmental Restoration (ER) Solid Waste Management Unit (SWMU) 81D, Northern Cable Area, Operable Unit (OU) 1333 on Kirtland Air Force Base (KAFB). SWMU 81D is an active subunit located in the northern portion of the New Aerial Cable Facility (Figure 7.1-1). This NFA decision is based on environmental sampling documenting that historic operations at the site did not cause contamination that poses a threat to human health or the environment. Current operations at the site are conducted in accordance with applicable laws and regulations that are protective of the environment. The Northern Cable Area was constructed in 1984 and 1985 to provide a dedicated area for antiarmor tests. The area is used for engineering simulations in which test articles are dropped from the cable onto a target array positioned on the ground (SNL/NM and DoD May 1992).

This NFA addresses possible releases from the Northern Cable Area. Review and analysis of all relevant data for SWMU 81D indicate that concentrations of constituents of concern (COC) at this site are below applicable risk assessment action levels. Thus, SWMU 81D is proposed for an NFA decision based upon baseline sampling data demonstrating that COCs that may have been released from the SWMU-into the environment pose an acceptable level of risk under current and projected future land uses as set forth by Criterion 5, which states, "The SWMU/AOC [area of concern] has been characterized or remediated in accordance with current applicable state or federal regulations, and the available data indicate that contaminants pose an acceptable level of risk under current and projected future land use" (NMED March 1998).

7.2 Description and Operational History

Section 7.2 describes SWMU 81D and discusses its operational history.

7.2.1 Site Description

SWMU 81D is a subunit of SWMU-81, identified as the Northern Cable Area on the Resource Conservation and Recovery Act (RCRA) Hazardous and Solid Waste Amendments (HSWA) permit. SWMU 81D is located on U.S. Air Force (USAF) land withdrawn from the U.S. Forest Service (USFS) and permitted to the U.S. Department of Energy (DOE). The site is located along the floor of the Sol se Mete Canyon at an elevation of approximately 6,345 feet above sea level. The Sol se Mete Canyon drains to the north into the Lurance Canyon, which, in turn, drains to the west into the Arroyo del Coyote. Coyote Springs Road follows the drainage of the Lurance Canyon and is the main access to the service road into Sol se Mete Canyon (Figure 7.2.1-1).

SWMU 81D is an active subunit located in the northern portion of SWMU-81 and comprises approximately 4.3 acres (SNL/NM April 1995). The New Aerial Cable Site was constructed in 1970 in support of impact testing conducted in the southern cable area.

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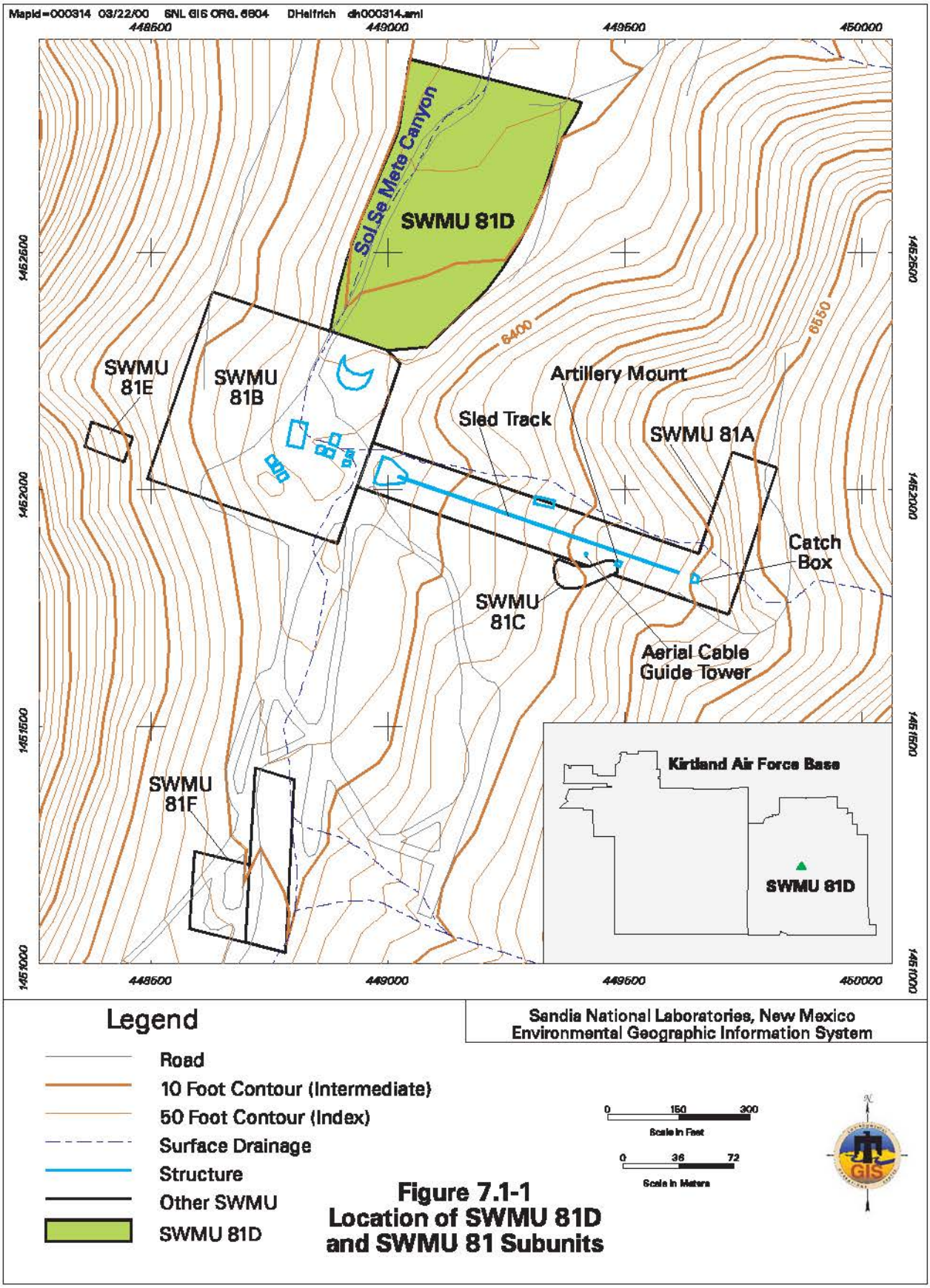
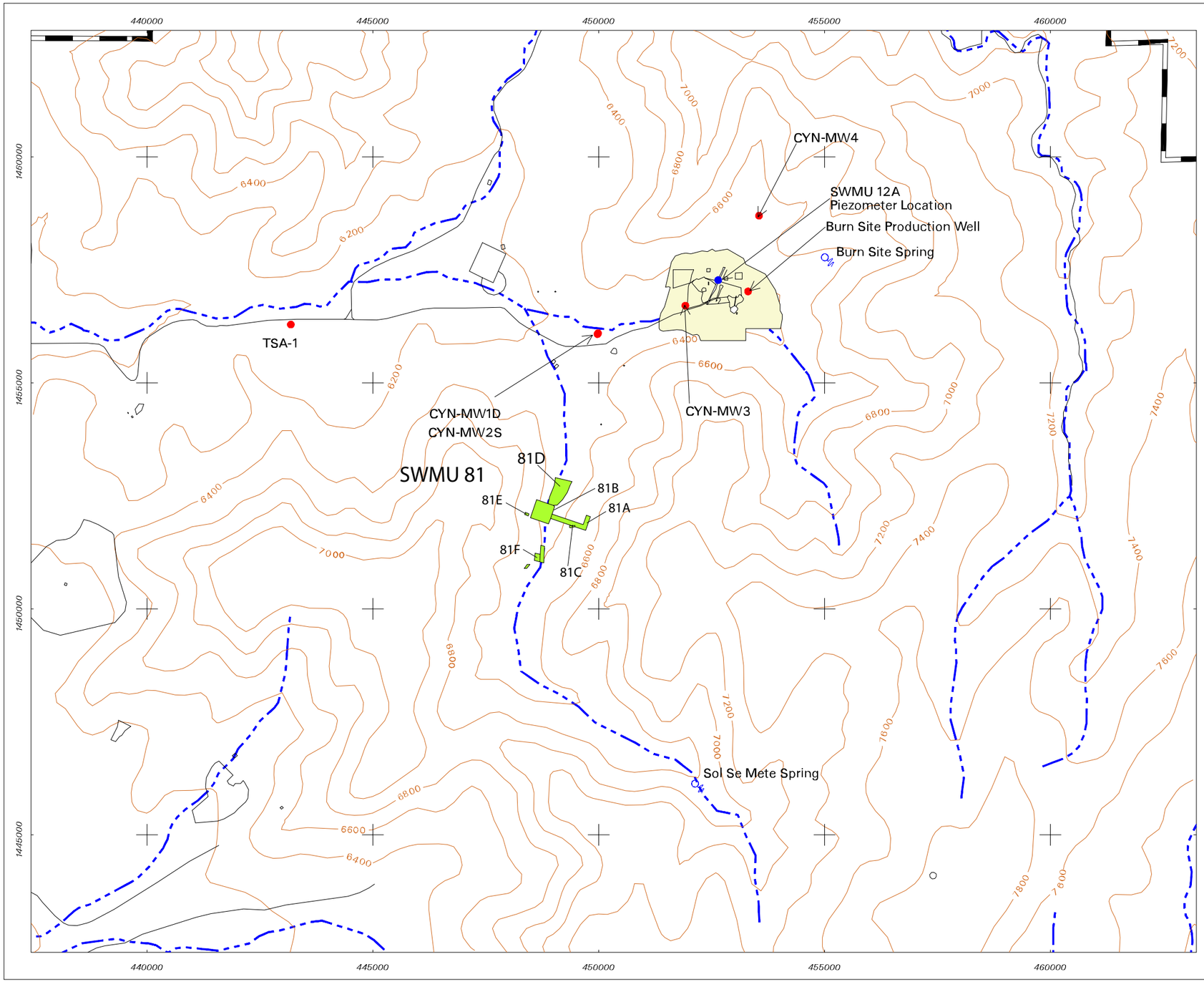


Figure 7.1-1
Location of SWMU 81D and SWMU 81 Subunits



Legend

- Spring
- Well
- Piezometer Location
- Surface-Water Features
- Road
- Kirtland Air Force Base Boundary
- 200 Foot Contour Interval
- SWMUs 94 & 65 Burn Site
- SWMU 81

0 2400 4800

Scale in Feet

0 576 1152

Scale in Meters

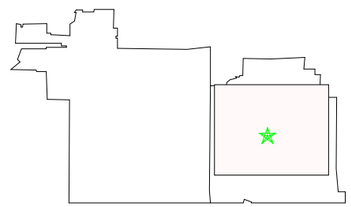


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Figure 7.2.1-1
Location of SWMU 81D
within Operable Unit 1333

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

	1:28800	MAPID=9000315
Unclassified		SNL GIS ORG. 6804
Rachel Loehman	rl000315.aml	03/16/00

SWMU 81D was constructed in 1984 and 1985 to provide a dedicated area for antiarmor tests. The SWMU-consists of a lightweight steel cable and anchors, a camera cable and anchor system, and a winch site independent of the winch sites used in the Southern Cable Area (SNL/NM May 1992). This area is used for engineering simulations in which test articles are dropped from the cable onto a target array positioned on the ground. No debris is visible at the surface at SWMU 81D. Past testing at this site could have deposited small metal shrapnel on surface soil resulting from airfall after test unit detonations.

Historical published information regarding the hydrogeology of Sol se Mete and Lurance Canyons was summarized in the "RCRA Facility Investigation (RFI) Work Plan for Operable Unit 1333, Canyons Test Area" (SNL/NM September 1995). Since that time, additional bedrock wells and alluvial piezometers have been installed in Lurance Canyon, and data collected from the new wells have supported the hydrologic model of semiconfined to confined groundwater conditions.

A groundwater monitoring well nest was installed in November and December 1997 approximately 3,600 feet north of SWMU 81D (Figure 7.2.1-1). The groundwater wells were installed in conformance with the documents of understanding between SNL/NM and the New Mexico Environment Department (NMED) Oversight Bureau (SNL/NM July 1997, SNL/NM September 1997) and the Request for Supplemental Information (RSI), RFI Work Plan for OU 1333, Canyons Test Area (SNL/NM October 1997). The monitoring well nest is comprised of a shallow underflow piezometer (CYN-MW2S) and a deep groundwater well (CYN-MW1D). The subsurface geology at the nest location is characterized by approximately 25 feet of alluvial sand, silt, and gravel, unconformably overlying the fractured Manzanita Gneiss. No water was encountered while drilling through the alluvium, and no water has been recorded at CYN-MW2S since its installation. Groundwater was first encountered in CYN-MW1D at a depth of 372 feet below ground surface (bgs) and the static level rose to 320 feet bgs. This indicates semiconfined to confined groundwater conditions similar to those encountered in the Burn Site Production Well.

Two additional monitoring wells, CYN-MW3 and CYN-MW4, were installed in June 1999 at the Burn Site. CYN-MW3 is approximately 4,950 feet northeast of SWMU 81D, and CYN-MW4 is approximately 7,875 feet northeast of SWMU 81D (Figure 7.2.1-1). The downgradient monitoring well (CYN-MW3) is located within SWMU-65E, immediately west of where the Burn Site access road crosses the main arroyo of Lurance Canyon. The background monitoring well (CYN-MW4) is located approximately 1,350 feet northeast of the Burn Site within the secondary drainage northeast of the Burn Site. The subsurface geology at the monitoring well locations is characterized by approximately 20 to 35 feet of alluvial sand, silt, clay, and gravel, unconformably overlying a fractured phyllite schist and quartzite referred to as the Coyote Metasediments. In CYN-MW4, approximately 65 feet of limestone was encountered above the schist. Groundwater was first encountered in CYN-MW3 at a depth of 124 feet bgs, and the static level rose to 104 feet bgs. Groundwater was first encountered in CYN-MW4 at a depth of 308 feet bgs, and the static level rose to 209 feet bgs. This indicates semiconfined to confined groundwater conditions similar to those encountered in the Burn Site Production well and CYN-MW1D.

In summary, based upon data from the nearby Lurance Canyon wells, the groundwater beneath the floor of the Sol se Mete Canyon occurs under semiconfined to confined conditions in fractured metamorphic rock.

For a detailed discussion regarding the local setting at SWMU 81D, refer to the RFI Work Plan for OU 1333 (SNL/NM September 1995). This discussion includes details on the history of the other subunits of SWMU-81, as well as conceptual models and proposed sampling plans.

7.2.2 Operational History

SWMU-81, identified as the New Aerial Cable Site/Burial Site/Dump/Test Area in the HSWA Module, is located on USAF land withdrawn from the USFS and permitted to the DOE (SNL/NM July 1994). SWMU-81 consists of six subunits (SWMU-81A: New Aerial Cable Site: Catcher Box/Sled Track; SWMU-81B: New Aerial Cable Site: Impact Pad; SWMU-81C: New Aerial Cable Site: Former Burial Location; SWMU 81D: New Aerial Cable Site: Northern Cable Area; SWMU-81E: New Aerial Cable Site: Gun Impact Area; and SWMU-81F: New Aerial Cable Site: Scrap Yard) (Refer to Figure 7.1-1). Construction of the New Aerial Cable Site began in 1970 in response to the need to upgrade the aerial cable facilities that existed at the Old Aerial Cable Site (SWMU-82) (SNL/NM September 1995). The new aerial cable facilities support impact testing on weapons and other test units that could be subject to detonation (SNL/NM, September 1995). The initial construction activity at SWMU-81 was at the southern cable area and included the placement of the aerial cable anchors on the ridge crests east and west of Sol se Mete Canyon.

Testing activities at the Aerial Cable Facility include gravitational accelerated (drop) tests and rocket sled pull-down tests. The rocket pull-down technique uses rocket sleds to accelerate test items via towing cables. As the rockets are ignited, the test items are released from the overhead cable and directed toward a target. Multiple types of targets can be simulated for worst-case scenarios involving weapons systems, defensive systems, shipping containers, and transportation systems.

No debris is visible at the surface at SWMU 81D. Past testing at this site could have deposited small metal shrapnel on surface soil resulting from airfall after test unit detonations.

7.3 Land Use

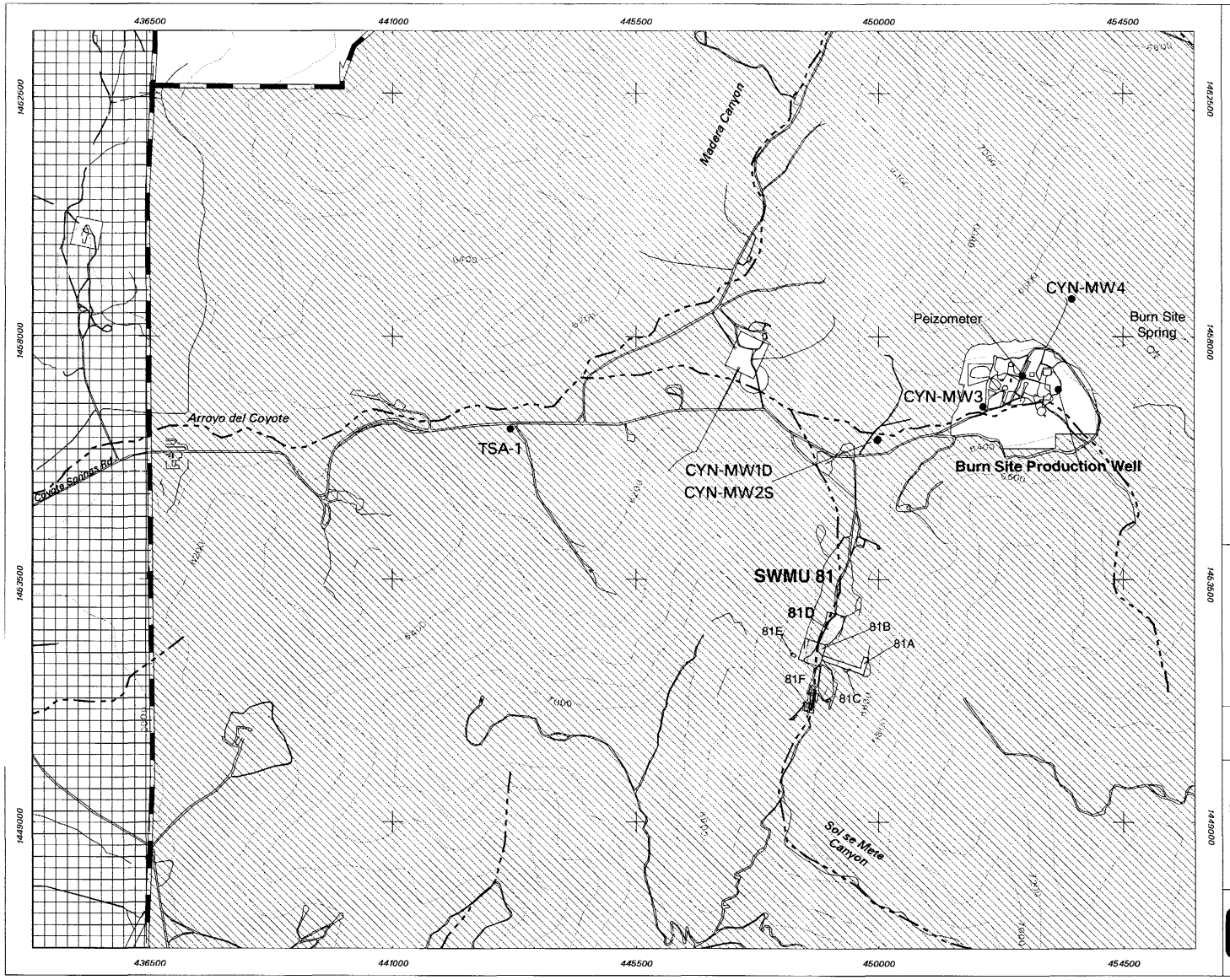
This section discusses the current and future land uses for SWMU 81D.

7.3.1 Current Land Use

SWMU 81D is located on withdrawn lands within the boundaries of KAFB (refer to Figure 7.3.1-1) within the active industrial New Aerial Cable Facility.

7.3.2 Future/Proposed Land Use

The projected land use for SWMU 81D is recreational (DOE et al. October 1995).



Legend

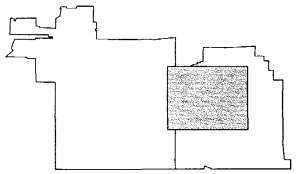
- Well
- Spring
- Piezometer Location
- Surface Water
- KAFB/USFS Boundary
- 200 Foot Contour Interval
- Road
- SWMU 81
- OU 1333 SWMU Site
- Future Proposed Recreational Land Use
- Industrial Land Use

0 2000 4000

Scale in Feet

0 480 960

Scale in Meters



Sandia National Laboratories, New Mexico
Environmental Geographic Information System

Figure 7.3.1-1
SWMU 81D, OU1333 SWMU Sites, and Associated Land Uses within KAFB Boundary & Vicinity

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

	1:24000	MAPID=000316
Unclassified		SNL GIS ORG. 6804
dahelfrich	dh000308.aml	03/22/00

7.4 Investigatory Activities

SWMU 81D has been investigated in a series of three investigations. This section discusses the investigatory activities at SWMU 81D.

7.4.1 Summary

SWMU 81D was originally investigated under the DOE Comprehensive Environmental Assessment and Response Program (CEARP) in the mid-1980s (Investigation #1) in conformance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). In 1993, preliminary investigations included background information reviews, interviews, field surveys, and scoping sampling (Investigation #2). In 1998, baseline sampling was conducted to determine if COCs exist at the site (Investigation #3).

7.4.2 Investigation #1—CEARP

7.4.2.1 Nonsampling Data Collection

SWMU-81 was evaluated during investigations conducted under the CEARP (DOE September 1987) and the RCRA Facility Assessment (RFA) (EPA April 1987). The RFA and CEARP Phase I reports state that debris from testing operations was deposited and partially buried in the arroyo on the south side of the sled track (SWMU-81C). Materials included old rockets (some possibly containing unburned propellant), sleds, cables, scrap metal, and wood. Additionally, the Phase I report noted that the area around the test facility may be contaminated with lead, beryllium, depleted uranium (DU), and rocket propellants from test operations.

7.4.2.2 Sampling Data Collection

No sampling activities were conducted at SWMU 81D as part of the CEARP or RFA.

7.4.2.3 Data Gaps

The calculated Hazard Ranking System (HRS) and Modified HRS air and surface water migration scores were zero (no surface-water use within 3 miles). The groundwater HRS migration score was 6.1, far below the 28.5 required for inclusion on the National Priorities List.

7.4.2.4 Results and Conclusions

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

7.4.3 Investigation #2—SNL/NM ER Preliminary Investigations

7.4.3.1 SNL/NM ER Nonsampling Data Collection

This section describes the nonsampling data collected at SWMU 81D.

7.4.3.1.1 Background Review

A background review was conducted in order to gain available and relevant information regarding SWMU 81D. Background information sources included interviews with SNL/NM staff and contractors familiar with the site's operational history and reviews of existing historical site records and reports. The study was documented completely and has provided traceable references that sustain the integrity of the NFA proposal. Table 7.4.3-1 lists the information sources that were used to assist in evaluating SWMU 81D.

7.4.3.1.2 Unexploded Ordnance/High Explosives Survey

In December 1993, KAFB Explosive Ordnance Disposal personnel conducted a visual survey for the presence of unexploded ordnance on the ground surface at SWMU-81. The live ordnance found and removed in June 1994 included two experimental flares near the sled track. Ordnance debris at the site included several hundred spent rocket motors and rocket parts that have since been removed from the site.

Table 7.4.3-1
Summary of Background Information Review for SWMU 81D

Information Source	Reference
Technical test reports and project log books	Bickel September 1980
Site inspections (field notes, aerial photograph review, site photographs, radiological, UXO/HE, biological, and cultural resource surveys)	SNL/NM April 1985 SNL/NM August 1994 Sullivan August 1994 DOE March 1996
Employee interviews, three interviews with two facility personnel (current and retired)	Martz September 1985 Martz November 1985 Palmieri May 1992

DOE = U.S. Department of Energy.
HE = High explosive(s).
SNL/NM = Sandia National Laboratories/New Mexico.
SWMU = Solid Waste Management Unit.
UXO = Unexploded ordnance.

7.4.3.1.3 Radiological Survey(s)

SNL/NM Radiation Protection Operations (RPO) has historically performed surveys after impact tests were conducted at SWMU-81 and has found no radioactive material. In April and May 1993, SNL/NM RPO performed a radiation survey of the service road that passes through SWMU-81. The survey consisted of driving the road, performing periodic contamination surveys

of the vehicles, and collecting air samples from behind the vehicle. No contamination was detected in the dust kicked up by the vehicle (Oldewage May 1993).

SNL/NM RPO conducted a surface gamma radiation survey in January 1994 that included a survey of debris and shrapnel at the site. No anomalies were found in the impact area and no contamination was detected on the debris. One metal fragment, high in natural thorium series, was found buried 2 to 3 inches deep. The metal was of unknown origin. The metal fragment was removed for analysis, effectively decontaminating the area.

In March 1994, RUST Geotech Inc. conducted a surface gamma radiation survey of SWMU-81. The background gamma exposure rates ranged from 9 to 13 microroentgens per hour. Four areas of gamma activity greater than 30 percent above natural background levels were identified. All four anomalies were attributed to outcrops of bedrock. The outcrops exhibited no visible evidence of DU. The elevated readings are consistent with outcrops of similar appearance found at other SWMUs and appear to be a natural characteristic of the rock and soil in the area (RUST Geotech Inc. December 1994).

Based upon the historical use of DU at SWMU-81, the site had been classified as a radioactive material management area (RMMA). However, based upon the results of the radiological surveys described above, the site was removed from RMMA status in April 1998 (Vigil April 1998).

7.4.3.1.4 Cultural Resources Survey

A cultural resources survey of SWMU-81 was conducted. No cultural resources were found during this survey (DOE March 1996).

7.4.3.1.5 Sensitive-Species Survey

A sensitive-species survey and biological field investigation of SWMU-81 and surrounding support facilities was conducted in September and October 1991. No threatened, endangered, or sensitive species of plants were found at SWMU-81 (Sullivan August 1994).

7.4.3.2 Sampling Data Collection

In July 1995, SWMU 81D was investigated as part of a sitewide scoping sampling program. The purpose of this effort was to obtain preliminary analytical data to support the ER Project site ranking and prioritization. Three sampling locations were selected within the boundaries of SWMU 81D. Surface (0 to 6 inches) samples were collected at three locations. The SNL/NM ER Chemistry Laboratory analyzed the three environmental samples and one duplicate sample for RCRA metals (plus beryllium) using modified U.S. Environmental Protection Agency (EPA) Method 6010 (EPA November 1986).

7.4.3.3 Data Gaps

Information gathered from process knowledge, reviewing historical site files, and personal interviews aided in identifying the most likely COCs at SWMU 81D and in selecting the types of analyses to be performed on soil samples. However, the preliminary scoping sampling data are not adequate to support a risk screening assessment.

7.4.3.4 Results and Conclusions

Only barium and lead were detected in the soil samples. None of the four barium concentrations were above the background concentration limit of 246 milligrams (mg)/kilogram (kg). Lead was detected in two of the four samples at estimated concentrations of 12 and 16 mg/kg, neither of the two detections exceeded the background concentration limit of 18.9 mg/kg. Arsenic, cadmium, mercury, selenium, and silver were not detected; however, the method detection limits (MDL) ranged from 0.2 to 50 mg/kg (for mercury and for arsenic and selenium, respectively). One duplicate sample was analyzed.

7.4.4 Investigation #3—Baseline Sampling

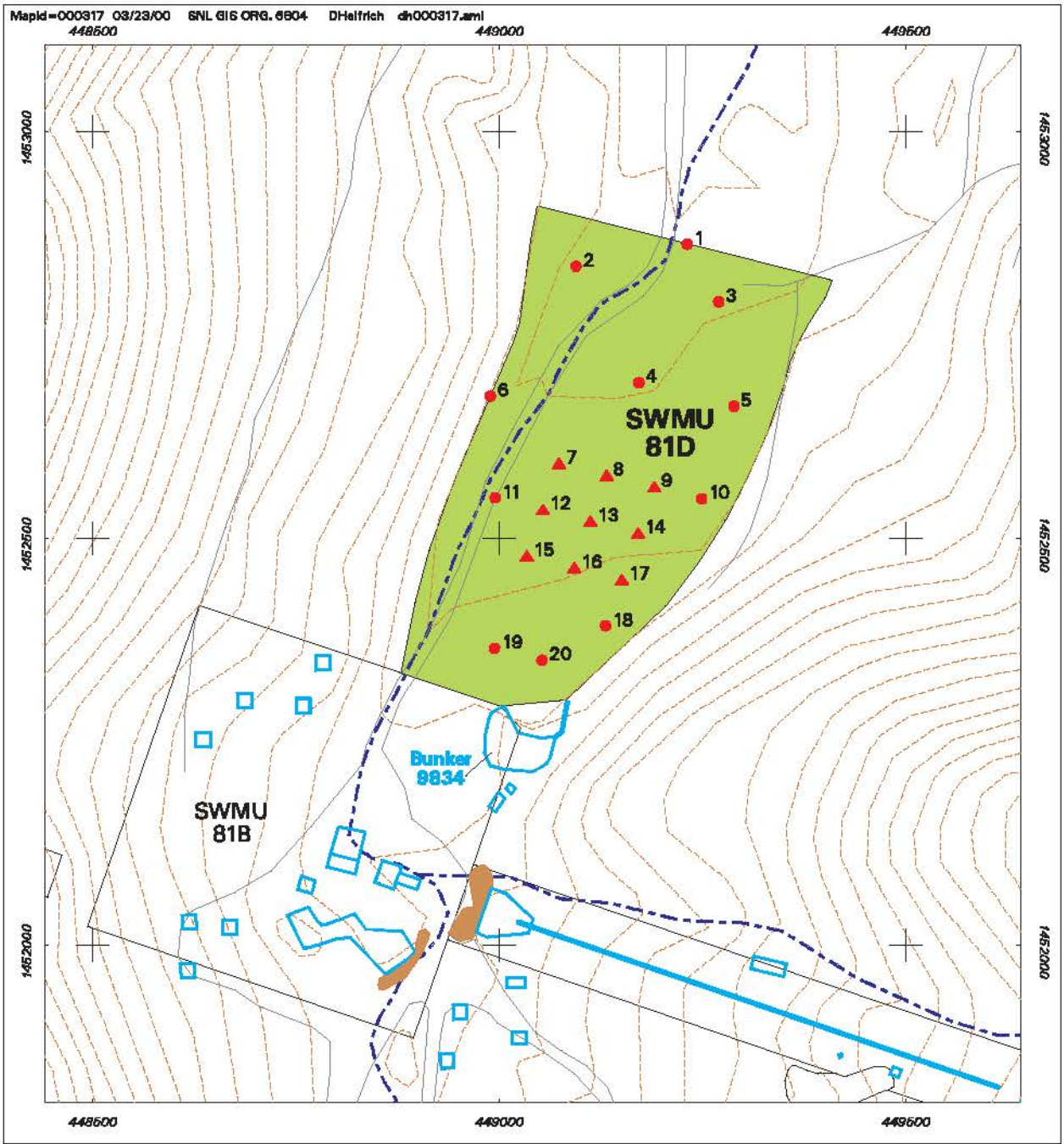
7.4.4.1 Nonsampling Data Collection

There were no nonsampling data collection activities associated with Investigation #3 of SWMU 81D.

7.4.4.2 Sample Data Collection

SNL/NM conducted baseline soil sampling at SWMU 81D in September 1998 to determine whether potential COCs were present at levels exceeding background limits at the site and/or at levels sufficient to pose a risk to human health or the environment. All sampling activities were performed in accordance with the rationale and procedures described in the RFI work plan for OU 1333 (SNL/NM September 1995) and the SNL/NM response to the RSI on the OU 1333 Work Plan (SNL/NM October 1997). Based on the RSI high explosives (HE), gross alpha, gross beta, and gamma spectroscopy were added to the analyte list and the number of sample locations was increased from five to 20. SNL/NM chain of custody and sample documentation procedures were followed for all samples that were collected. Figure 7.4.4-1 shows the baseline sample location associated with SWMU 81D.

In September 1998, surface (0 to 1.0 foot bgs) and shallow subsurface (0.5 to 1.0 foot bgs) soil samples were collected at SWMU 81D from 20 locations. Sample locations were chosen within a 50-foot grid that was established within the boundary of the site. Biased samples were collected from 0.5 to 1.0 foot bgs at nine judgmental grid locations beneath the cable where test objects would have impacted. Biased sample locations were selected with input from the NMED. Eleven other random locations were selected from within the grid, and samples were collected from 0 to 1.0 foot bgs. Quality assurance (QA)/quality control (QC) samples collected included two duplicate samples and one equipment blank.



Legend

- Random Baseline Sample 0-12" depth (11)
- Biased Baseline Sample 6-12" depth (9)
- Road
- 10 Foot Contour
- Surface Drainage
- Concrete Pad / Structure
- Soil Berm
- SWMU 81D

Figure 7.4.4-1
Baseline Sampling Locations at SWMU 81D, Northern Cable Area

0 100 200
Scale in Feet

0 24 48
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

All soil samples collected in September 1998 were analyzed off site for volatile organic compounds (VOCs), metals, HE, and gross alpha and gross beta activity. General Engineering Laboratories of Charleston, South Carolina, analyzed the samples for VOCs using EPA Method 8260, RCRA metals plus beryllium using EPA Method 6010/7000, HE using EPA Method 8330, and gross alpha and gross beta using EPA Method 900.0 (EPA November 1986). In addition, SNL/NM Department 7713 Radiation Protection Sample Diagnostics [RPSD] Laboratory also used gamma spectroscopy to analyze the samples for radionuclides.

7.4.4.2.1 Data Gaps

Analytical data from baseline sampling are sufficient to characterize the nature and extent of historical releases of COCs at the site. There are no further data gaps regarding characterization of SWMU 81D.

7.4.4.2.2 Results and Conclusions

In September 1998, soil samples were collected from 20 locations at SWMU 81D in conformance with the RFI Work Plan (SNL/NM September 1995) as reviewed by NMED and the SNL/NM response to the RSI on the OU 1333 Work Plan (SNL/NM October 1997).

Tables 7.4.4-1, 7.4.4-2, 7.4.4-3, and 7.4.4-4 summarize the metals, VOC, and radionuclide (i.e., gamma spectroscopy, gross alpha, and gross beta) analytical results for all of the baseline soil samples collected at SWMU 81D. Annex 7-A contains complete results for the gamma spectroscopy analyses. Tables 7.4.4-5 and 7.4.4-6 summarize the analytical MDLs for the target analyte list for VOC and HE compounds, respectively.

Sample numbers are coded to identify specific information regarding the samples. For example, for CY81D-GR-001-SS, CY81D designates a sample collected from SWMU 81D in the Canyons Test Area of SNL/NM. GR indicates that a grab sample was collected from Location 001, and SS designates a surface soil sample. The remainder of this section describes the results of confirmatory sampling at SWMU 81D.

Metals

Table 7.4.4-1 summarizes the metals analysis results for the 20 baseline soil samples and two duplicate samples collected from SWMU 81D.

Arsenic and beryllium were detected above the background concentration limits in one sample. Lead was detected above the background concentration limits in less than 20 percent of the samples collected at SWMU 81D. Arsenic was detected above the 9.8 mg/kg background concentration limit in sample CY81D-GR-006-SS at a concentration of 14.8 mg/kg. Beryllium was detected above the 0.75 mg/kg background concentration limit in sample CY81D-GR-006-SS at a concentration of 0.812 mg/kg. Lead was detected above the 18.9 mg/kg background concentration limit in 4 samples (CY81D-GR-006-SS, CY81D-GR-017-SS, CY81D-GR-017-DU, and CY81D-GR-018-SS), ranging in concentration from 19.2 mg/kg to 24.0 mg/kg. All concentrations were less than two times their respective background concentration limits.

Table 7.4.4-1
Summary of SWMU 81D Baseline Soil Sampling Metals Analytical Results, September 1998
(Off-Site Laboratory)

Sample Attributes			Metals (EPA Method 6010)[a] (mg/kg)								
Record Number[b]	ER Sample ID (Figure 7.4.4-1)	Sample Depth (ft)	Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
600784	CY81D-GR-001-SS	0.0–1.0	4.05 J	145 J	0.505 J (0.505)	ND (0.019)	11.7	11.4 J	0.00848 J (0.0301)	0.378 J (0.505)	ND (0.031)
600784	CY81D-GR-002-SS	0.0–1.0	4.65 J	135 J	0.533	ND (0.019)	10	13.2 J	0.0368 J	0.38 J (0.482)	ND (0.031)
600784	CY81D-GR-003-SS	0.0–1.0	4.56 J	141 J	0.672	ND (0.019)	11.5	16 J	0.00796 J (0.0289)	0.653 J	ND (0.031)
600784	CY81D-GR-004-SS	0.0–1.0	4.1 J	158 J	0.584	0.062 J (0.497)	12.3	13.2 J	0.00961 J (0.0345)	0.459 J (0.497)	ND (0.031)
600784	CY81D-GR-005-SS	0.0–1.0	3.81	190 J	0.741	ND (0.019)	11.4	14.5	0.00516 J (0.0333)	0.657 J	ND (0.031)
600784	CY81D-GR-006-SS	0.0–1.0	**14.8**	148 J	**0.812**	0.0857 J (0.511)	12.1	**24**	0.0106 J (0.0341)	0.82 J	0.104 J (0.511)
600784	CY81D-GR-007-DU	0.5–1.0	3.41	140 J	0.548	ND (0.019)	9.28	11.1	0.0159 J (0.0293)	0.565 J	ND (0.031)
600784	CY81D-GR-007-SS	0.5–1.0	3.17	126 J	0.479 J (0.493)	ND (0.019)	8.47	9.28	0.0057 J (0.0295)	0.363 J (0.493)	ND (0.031)
600784	CY81D-GR-008-SS	0.5–1.0	3.59	169 J	0.628	ND (0.019)	10.7	12.8	0.0089 J (0.0343)	0.513 J (0.529)	ND (0.031)
600784	CY81D-GR-009-SS	0.5–1.0	4.01	152 J	0.644	ND (0.019)	10.5	16	0.0216 J (0.0358)	0.66 J	ND (0.031)
600784	CY81D-GR-010-SS	0.0–1.0	3.12	134 J	0.431 J (0.494)	ND (0.019)	7.2	10	0.011 J (0.0327)	0.593 J	ND (0.031)
600784	CY81D-GR-011-SS	0.0–1.0	2.84	117 J	0.299 J (0.481)	0.0709 J (0.481)	6.86	6.81	0.00283 J (0.0304)	0.309 J (0.481)	ND (0.031)
600784	CY81D-GR-012-SS	0.5–1.0	4.09	136 J	0.487 J (0.502)	ND (0.019)	15.5	8.7	ND (0.00225)	0.333 J (0.502)	ND (0.031)
600784	CY81D-GR-013-SS	0.5–1.0	4.64	154 J	0.657	0.0955 J (0.528)	12.7	14.7	0.00409 J (0.0321)	0.703 J	ND (0.031)
600784	CY81D-GR-014-SS	0.5–1.0	3.16	127 J	0.504 J (0.532)	ND (0.019)	7.53	17.1	0.00422 J (0.0295)	0.49 J (0.532)	ND (0.031)
600784	CY81D-GR-015-SS	0.5–1.0	4.85	113 J	0.49 J (0.517)	0.078 J (0.517)	10.2	11.2	0.00571 J (0.032)	0.578 J	ND (0.031)
600784	CY81D-GR-016-SS	0.5–1.0	4.88	154 J	0.658	0.0569 J (0.511)	13.3	16.4	0.00842 J (0.0355)	0.775 J	ND (0.031)
600784	CY81D-GR-017-DU	0.5–1.0	4.9	157 J	0.715	ND (0.019)	11.3	**19.9**	0.0292 J (0.0342)	0.678 J	ND (0.031)
Background Soil Concentrations—Canyons Area[c]			9.8	246	0.75	0.64	18.8	18.9	0.055	2.7	<0.5

Refer to footnotes at end of table.

Tables 7.4.4-1 (Concluded)
Summary of SWMU 81D Baseline Soil Sampling Metals Analytical Results, September 1998
(Off-Site Laboratory)

Sample Attributes			Metals (EPA Method 6010[a]) (mg/kg)								
Record Number[b]	ER Sample ID	Sample Depth(ft)	Arsenic	Barium	Beryllium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
600784	CY81D-GR-017-SS	0.5–1.0	4.63	162 J	0.695	ND (0.019)	10.6	**19.9**	0.00504 J (0.0368)	0.787 J	ND (0.031)
600784	CY81D-GR-018-SS	0.0–1.0	4.4	122 J	0.468 J (0.483)	0.0747 J (0.483)	8.94	**19.2**	ND (0.00225)	0.504 J	ND (0.031)
600784	CY81D-GR-019-SS	0.0–1.0	5.03	147 J	0.526 J (0.534)	0.104 J (0.534)	13.7	10.2	0.0152 J (0.0362)	0.403 J (0.534)	0.195 J (0.534)
600784	CY81D-GR-020-SS	0.0–1.0	2.98	109 J	0.396 J (0.496)	ND (0.019)	8.29	8.53	0.00943 J (0.032)	0.351 J (0.496)	0.175 J (0.496)
Background Soil Concentrations—Canyons Area[c]			9.8	246	0.75	0.64	18.8	18.9	0.055	2.7	<0.5
Quality Assurance/Quality Control Sample (mg/L)											
600784	CY81D-GR-001-EB	NA	ND (0.00451)	0.00051J (0.005)	ND (0.00026)	ND (0.00044)	0.00107 J (0.005)	ND (0.00159)	0.00004 J ((0.0002)	ND (0.00271)	ND (0.00073)

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

[a]EPA November 1986.

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

[c]From Garcia November 1998.

CY = Canyon.
DU = Duplicate.
EB = Equipment blank.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab sample.
ID = Identification.
J = Analyte qualified during data validation.
J ( ) = The reported value is greater than or equal to the MDL but is less than the practical quantitation limit, shown in parentheses.
MDL = Method detection limit.
mg/L = Milligram(s) per liter.
mg/kg = Milligram(s) per kilogram.
NA = Not applicable.
ND ( ) = Not detected above the method detection limit, shown in parentheses.
SS = Surface soil sample.
SWMU = Solid Waste Management Unit.

Table 7.4.4-2
Summary of SWMU 81D Baseline Soil Sampling VOC Analytical Results
September 1998
(Off-Site Laboratory)

Sample Attributes			VOCs (EPA Method 8260)[a] (µg/kg)				
Record Number[b]	ER Sample ID (Figure 7.4.4-1)	Sample Depth (ft)	Acetone	Carbon Disulfide	Tetrachloroethene	Toluene	Xylene
600784	CY81D-GR-001-SS	0.0–1.0	ND (10.3)	ND (0.3)	ND (0.4)	ND (0.9)	ND (0.7)
600784	CY81D-GR-002-SS	0.0–1.0	ND (10.3)	ND (0.3)	ND (0.4)	ND (0.9)	ND (0.7)
600784	CY81D-GR-003-SS	0.0–1.0	ND (10.3)	**0.58 J (5.1)**	ND (0.4)	**0.98 J (1.02)**	**1.0 J (2.04)**
600784	CY81D-GR-004-SS	0.0–1.0	ND (10.3)	ND (0.3)	ND (0.4)	ND (0.9)	ND (0.7)
600784	CY81D-GR-005-SS	0.0–1.0	ND (10.3)	ND (0.3)	ND (0.4)	ND (0.9)	ND (0.7)
600784	CY81D-GR-006-SS	0.0–1.0	ND (10.3)	ND (0.3)	ND (0.4)	ND (0.9)	ND (0.7)
600784	CY81D-GR-007-DU	0.5–1.0	ND (10.3)	ND (0.3)	ND (0.4)	ND (0.9)	ND (0.7)
600784	CY81D-GR-007-SS	0.5–1.0	ND (10.3)	ND (0.3)	ND (0.4)	ND (0.9)	ND (0.7)
600784	CY81D-GR-008-SS	0.5–1.0	ND (10.3)	ND (0.3)	ND (0.4)	ND (0.9)	ND (0.7)
600784	CY81D-GR-009-SS	0.5–1.0	ND (10.3)	ND (0.3)	ND (0.4)	ND (0.9)	ND (0.7)
600784	CY81D-GR-010-SS	0.0–1.0	ND (10.3)	**0.73 J (5.41)**	**0.82 J (1.08)**	ND (0.9)	ND (0.7)
600784	CY81D-GR-011-SS	0.0–1.0	ND (10.3)	ND (0.3)	ND (0.4)	ND (0.9)	ND (0.7)
600784	CY81D-GR-012-SS	0.5–1.0	ND (10.3)	**0.77 J (5.29)**	ND (0.4)	ND (0.9)	ND (0.7)
600784	CY81D-GR-013-SS	0.5–1.0	ND (10.3)	ND (0.3)	ND (0.4)	ND (0.9)	ND (0.7)
600784	CY81D-GR-014-SS	0.5–1.0	ND (10.3)	ND (0.3)	ND (0.4)	ND (0.9)	ND (0.7)
600784	CY81D-GR-015-SS	0.5–1.0	ND (10.3)	ND (0.3)	ND (0.4)	ND (0.9)	ND (0.7)
600784	CY81D-GR-016-SS	0.5–1.0	ND (10.3)	ND (0.3)	ND (0.4)	ND (0.9)	ND (0.7)
600784	CY81D-GR-017-DU	0.5–1.0	ND (10.3)	ND (0.3)	ND (0.4)	ND (0.9)	ND (0.7)
600784	CY81D-GR-017-SS	0.5–1.0	ND (10.3)	ND (0.3)	ND (0.4)	ND (0.9)	ND (0.7)
600784	CY81D-GR-018-SS	0.0–1.0	ND (10.3)	ND (0.3)	ND (0.4)	ND (0.9)	ND (0.7)
600784	CY81D-GR-019-SS	0.0–1.0	ND (10.3)	ND (0.3)	ND (0.4)	ND (0.9)	ND (0.7)
600784	CY81D-GR-020-SS	0.0–1.0	ND (10.3)	ND (0.3)	ND (0.4)	ND (0.9)	ND (0.7)
Quality Assurance/Quality Control Samples (µg/L)							
600784	CY81D-GR-001-EB	NA	**3.8 J (5)**	ND (1.8)	ND (0.7)	ND (0.5)	ND (1.1)
600784	CY81D-GR-001-TB	NA	ND (3.7)	ND (1.8)	ND (0.7)	ND (0.5)	ND (1.1)

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

[a]EPA November 1986.

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

CY = Canyon.
DU = Duplicate sample.
EB = Equipment blank.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab sample.
ID = Identification.
J ( ) = The reported value is greater than or equal to the MDL but is less than the practical quantitation limit, shown in parentheses.
MDL = Method detection limit.
µg/kg = Microgram(s) per kilogram.
µg/L = Microgram(s) per liter.
NA = Not applicable.
ND ( ) = Not detected above the MDL, shown in parentheses.
SS = Surface soil sample.
SWMU = Solid Waste Management Unit.
TB = Trip blank.
VOC = Volatile organic compound.

Table 7.4.4-3
Summary of SWMU 81D Baseline Soil Sampling Gamma Spectroscopy Analytical Results
September 1998
(On-Site Laboratory)

Sample Attributes			Activity (pCi/g)							
			Cesium-137		Thorium-232		Uranium-235		Uranium-238	
Record Number[a]	ER Sample ID (Figure 7.4.4-1)	Sample Depth (ft)	Result	Error[b]	Result	Error[b]	Result	Error[b]	Result	Error[b]
600814	CY81D-GR-001-SS	0.0–1.0	ND (0.0253)	--	0.488	0.277	ND (0.196)	--	0.453	0.377
600814	CY81D-GR-002-SS	0.0–1.0	0.0651	0.024	0.713	0.395	ND (0.237)	--	0.913	0.442
600814	CY81D-GR-003-SS	0.0–1.0	0.0569	0.0376	0.855	0.436	ND (0.225)	--	0.882	0.485
600814	CY81D-GR-004-SS	0.0–1.0	ND (0.0295)	--	0.627	0.334	0.149	0.185	ND (0.719)	--
600814	CY81D-GR-005-SS	0.0–1.0	0.0815	0.0304	0.99	0.463	**0.222**	0.208	0.863	0.791
600814	CY81D-GR-006-SS	0.0–1.0	0.7	0.112	0.884	0.454	**0.183**	0.205	0.644	0.431
600814	CY81D-GR-007-DU	0.5–1.0	0.0149	0.0117	0.908	0.429	ND (0.23)	--	1.07	0.513
600814	CY81D-GR-007-SS	0.5–1.0	0.0173	0.0153	0.804	0.384	ND (0.232)	--	0.845	0.468
600814	CY81D-GR-008-SS	0.5–1.0	0.0596	0.044	0.72	0.369	0.0917	0.0997	0.926	0.405
600814	CY81D-GR-009-SS	0.5–1.0	0.0287	0.0209	0.837	0.473	ND (0.23)	--	0.818	0.587
600814	CY81D-GR-010-SS	0.0–1.0	ND (0.0268)	--	0.68	0.323	ND (0.193)	--	ND (0.514)	--
600814	CY81D-GR-011-SS	0.0–1.0	ND (0.0239)	--	0.439	0.226	0.0926	0.155	ND (0.55)	--
600814	CY81D-GR-012-SS	0.5–1.0	ND (0.0316)	--	0.521	0.296	ND (0.217)	--	0.51	0.374
600814	CY81D-GR-013-SS	0.5–1.0	0.0191	0.0183	0.711	0.346	ND (0.24)	--	0.454	0.386
600814	CY81D-GR-014-SS	0.5–1.0	0.115	0.0306	0.754	0.785	ND (0.237)	--	0.402	0.394
600814	CY81D-GR-015-SS	0.5–1.0	ND (0.0196)	--	0.629	0.332	0.133	0.19	0.89	0.899
600814	CY81D-GR-016-SS	0.5–1.0	0.222	0.0561	0.634	0.355	ND (0.227)	--	ND (0.765)	--
600814	CY81D-GR-017-DU	0.5–1.0	ND (0.0302)	--	0.84	0.42	0.131	0.201	0.367	0.458
600814	CY81D-GR-017-SS	0.5–1.0	ND (0.0305)	--	0.748	0.361	ND (0.231)	--	ND (0.789)	--
600814	CY81D-GR-018-SS	0.0–1.0	0.0396	0.0199	0.705	0.371	0.0938	0.18	ND (0.715)	--
600814	CY81D-GR-019-SS	0.0–1.0	ND (0.0363)	--	0.774	0.402	**0.164**	0.212	0.959	0.497
600814	CY81D-GR-020-SS	0.0–1.0	0.0116	0.0117	0.625	0.298	**0.221**	0.176	0.332	0.364
Background Soil Activities—Canyons Area[c]			0.515	NA	1.03	NA	0.16	NA	2.31	NA

Refer to footnotes at end of table.

Table 7.4.4-3 (Concluded)
Summary of SWMU 81D Baseline Soil Sampling Gamma Spectroscopy Analytical Results
September 1998
(On-Site Laboratory)

Note: Values in **bold** exceed background soil activities.
[a]Analysis request/chain-of-custody record.
[b]Two standard deviations about the mean detected activity.
[c]From Dinwiddie September 1997.
CY = Canyon.
DU = Duplicate sample.
ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab sample.
ID = Identification.
NA = Not applicable.
ND ( ) = Not detected above the minimum detectable activity, shown in parentheses.
pCi/g = Picocurie(s) per gram.
SS = Surface soil sample.
SWMU = Solid Waste Management Unit.
-- = Error not calculated for nondetectable results.

Table 7.4.4-4
Summary of SWMU 81D Baseline Soil Sampling Gross Alpha and Beta Analyses
September 1998
(Off-Site Laboratory)

Sample Attributes			Activity (pCi/g)			
			Gross Alpha		Gross Beta	
Record Number [a]	ER Sample ID (Figure 7.4.4-1)	Sample Depth (ft)	Result	Error[b]	Result	Error[b]
600784	CY81D-GR-001-SS	0.0–1.0	11.1	3.44	19.3	3.64
600784	CY81D-GR-002-SS	0.0–1.0	13.9	3.93	19.7	3.7
600784	CY81D-GR-003-SS	0.0–1.0	15.2	4.14	21.4	3.56
600784	CY81D-GR-004-SS	0.0–1.0	9.27	3.18	23.8	3.78
600784	CY81D-GR-005-SS	0.0–1.0	14	3.82	26.9	3.92
600784	CY81D-GR-006-SS	0.0–1.0	12.3	3.64	25.1	3.78
600784	CY81D-GR-007-DU	0.5–1.0	12	3.74	23.1	3.94
600784	CY81D-GR-007-SS	0.5–1.0	11.6	3.46	17.7	3.55
600784	CY81D-GR-008-SS	0.5–1.0	10.7	3.2	20.3	3.62
600784	CY81D-GR-009-SS	0.5–1.0	8.84	2.92	17.9	3.61
600784	CY81D-GR-010-SS	0.0–1.0	9.95	3.25	22.1	3.59
600784	CY81D-GR-011-SS	0.0–1.0	10.1	3.32	16.7	3.36
600784	CY81D-GR-012-SS	0.5–1.0	12.2	3.57	24.4	3.72
600784	CY81D-GR-013-SS	0.5–1.0	14.5	3.95	21.2	3.6
600784	CY81D-GR-014-SS	0.5–1.0	7.38	2.88	19.4	3.6
600784	CY81D-GR-015-SS	0.5–1.0	10.3	3.34	20.5	3.66
600784	CY81D-GR-016-SS	0.5–1.0	14.3	3.87	20.2	3.69
600784	CY81D-GR-017-DU	0.5–1.0	12	3.44	20.3	3.81
600784	CY81D-GR-017-SS	0.5–1.0	12.4	3.55	23.4	4.16
600784	CY81D-GR-018-SS	0.0–1.0	13.3	3.81	18.9	3.66
600784	CY81D-GR-019-SS	0.0–1.0	13.9	4.08	16.5	3.52
600784	CY81D-GR-020-SS	0.0–1.0	12.8	3.46	21	3.65
Background Soil Activities—Canyons Area[c]			18.3	NA	52.7	NA

[a]Analysis request/chain-of-custody record.
[b]Two standard deviations about the mean detected activity.
[c]From Tharp July 1998.
CY = Canyon.
DU = Duplicate sample.
ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab sample.
ID = Identification.
NA = Not applicable.
pCi/g = Picocurie(s) per gram.
SS = Surface soil sample.
SWMU = Solid Waste Management Unit.

Table 7.4.4-5
VOC Analytical Detection Limits Used for SWMU 81D Baseline Soil Sampling
September 1998
(Off-Site Laboratory)

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

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

Table 7.4.4-6
HE Analysis Detection Limits Used for SWMU 81D Baseline Soil Sampling
September 1998
(Off-Site Laboratory)

Analyte	Method Detection Limit (µg/kg)
1,3,5-Trinitrobenzene	6.6
1,3-Dinitrobenzene	4.1
2,4,6-Trinitrotoluene	5.7
2,4-Dinitrotoluene	6.2
2,6-Dinitrotoluene	6.5
2-Amino-4,6-dinitrotoluene	6.6
2-Nitrotoluene	7.8
3-Nitrotoluene	11
4-Amino-2,6-dinitrotoluene	5.5
4-Nitrotoluene	11
HMX	5.3
Nitrobenzene	5.2
RDX	9.7
Tetryl	7.5

HE = High explosive(s).
HMX = 1,3,5,7-Tetranitro-1,3,5,7-tetrazacyclooctane.
µg/kg = Microgram(s) per kilogram.
RDX = 1,3,5-Trinitro-1,3,5-triazacyclohexane.
SWMU = Solid Waste Management Unit.
Tetryl = 2,4,6-Trinitrophenylmethylnitramine.

VOCs

Because there are no background concentrations for VOCs in soil, any detectable VOCs in the samples collected at SWMU 81D may be considered an indication of contamination. The following briefly describes the VOC analytical results for SWMU 81D.

Table 7.4.4-5 summarizes the off-site VOC analysis for the 20 soil samples and two duplicate sample collected. Four VOCs (carbon disulfide, tetrachloroethene, toluene, and xylene) were detected at very low concentrations in a less than 25 percent of the samples at SWMU 81D. All the VOCs detected at SWMU 81D were reported with values at concentrations less than the practical quantitation limit and were, thus, qualified J (estimated values).

Carbon disulfide was detected in three samples (CY81D-GR-003-SS, CY81D-GR-010-SS, and CY81D-GR-012-SS); the concentrations ranged from 0.58 J microgram (μg)/kg to 0.77 J μg/kg. Tetrachloroethene was detected in one sample (CY81D-GR-010-SS), at a concentration of 0.82 J μg/kg. Toluene was detected in one sample (CY81D-GR-003-SS) at a concentration of 0.98 J μg/kg. Xylene was detected in one sample (CY81D-GR-003-SS) at a concentration of 1.0 J μg/kg.

Table 7.4.4-5 summarizes the detection limits used for analyzing VOCs by the off-site laboratory.

SVOCs

Semivolatile organic compounds (SVOCs) were not a COC at SWMU 81D and were not analyzed for.

HE

Because there are no applicable background concentrations for HE in soil, any detectable HE in the samples collected at SWMU 81D may be considered an indicator of contamination. However, no HE compounds were detected in any of the samples collected at SWMU 81D.

Table 7.4.4-6 summarizes the detection limits used for analyzing HE compounds by the off-site laboratory.

Radionuclides

Table 7.4.4-3 summarizes the on-site gamma spectroscopy analysis results for the 20 soil samples and two duplicate samples collected at SWMU 81D (see Annex 7-A for all gamma spectroscopy results). Gamma activity attributable to uranium-235 was above the 0.16 picocurie per gram background level in four of the 20 samples (CY81D-GR-005-SS, CY81D-GR-006-SS, CY81D-GR-019-SS, and CY81D-GR-020-SS), all levels were less than two times background. The minimum detectable activities (MDAs) associated with nondetectable results for uranium-235 exceeded background in all instances. Although this situation inhibits any comparison to background, uranium-238 and uranium-235 results can be compared because both coexist in DU. As a result, any elevated uranium-238 activity would be

accompanied by a corresponding elevation in uranium-235 activity. Using this comparison, the nondetectable results obtained for uranium 235 that have MDAs above background in the samples do not show corresponding elevated activities in the results for uranium-238. Gamma activity attributable to uranium-238, thorium-232, and cesium-137 was either not detected above the MDA or was not detected above background.

Gross Alpha and Gross Beta

Table 7.4.4-4 summarizes the off-site gross alpha and gross beta analysis results for 20 soil samples and two duplicate samples collected at SWMU 81D. Gross alpha and gross beta activity did not exceed background in any of the samples collected at SWMU 81D.

7.4.4.3 Data Quality

QA/QC Results

Tables 7.4.4-1 and 7.4.4-2 present results of the analyses of metals and VOCs QA/QC samples that were collected during the baseline sampling program at SWMU 81D. These QA/QC samples consisted of one equipment blank and one trip blank. The equipment blank was analyzed off site for metals and VOCs, and the trip blank was analyzed for VOCs. Acetone was detected in the equipment blank at a low estimated concentration (3.8 J μg/L). No HE compounds were detected in the equipment blank. Metals concentrations in the equipment blank were at less than detection limits for all analytes except barium, chromium, and mercury. The concentrations were below the practical quantitation limit and were qualified J (estimated value). No QA/QC samples were collected for radionuclide analyses.

To assess the precision of soil sampling procedures, two soil samples were collected and analyzed in replicate off site. Relative percent differences (RPD) were calculated from the data and are shown in Table 7.4.4-7. Because some results for the sample pairs are nondetect, RPDs could not be calculated for both sample pairs for beryllium, cadmium, mercury, selenium, and silver. The corresponding RPDs are 5.6 and 7.3 percent for arsenic, 3.1 and 10.5 percent for barium, 6.4 and 9.1 percent for chromium, and 0 and 17.8 percent for lead in the two sample duplicate pairs. All of the results obtained for the two sample duplicate pairs are in good agreement for an inhomogeneous soil matrix.

Data Validation

All off-site laboratory results were reviewed and verified/validated according to "Data Validation Procedure for Chemical and Radiochemical Data," SNL/NM ER Project Analytical Operating Procedure 00-03, Rev. 0 (SNL/NM December 1999). In addition, SNL/NM Department 7713 (RPSD Laboratory) reviewed all gamma spectroscopy results according to "Laboratory Data Review Guidelines," Procedure No. RPSD-02-11, Issue No. 2 (SNL/NM July 1996). The verification/validation process confirmed that the data are acceptable for use in this NFA proposal for SWMU 81D. See Annex 7-B for the off-site data validation results.

Table 7.4.4-7
Summary of SWMU 81D Field Duplicate Relative Percent Differences

Sample Attributes			Relative Percent Difference			
Record Number[a]	ER Sample ID (Figure 7.4.4-4)	Sample Depth (ft)	Arsenic	Barium	Chromium	Lead
600784	CY81D-GR-007-SS CY81D-GR-007-DU (off-site laboratory)	0.0–1.0	7.3	10.5	9.1	17.8
600784	CY81D-GR-017-SS CY81D-GR-017-DU (off-site laboratory)	0.5–1.0	5.6	3.1	6.4	0

[a]Analysis request/chain-of-custody record.
CY = Canyon.
DU = Duplicate sample.
ER = Environmental Restoration.
ft = Foot (feet).
GR = Grab sample.
ID = Identification.
SS = Surface soil sample.
SWMU = Solid Waste Management Unit.

During data validation, qualifications were applied to VOC sample data due to inappropriate preservation and high continuing calibration verification RPD. Qualifications were applied to inorganic sample data due to the continuing calibration verification percent differences being high, affecting lead, arsenic, and selenium in four samples. Selenium was detected in the method blank; all positive results were qualified. Mercury was detected in the initial calibration blank; all positive results were qualified. The soil matrix recovery for barium was low; all positive results were qualified.

7.5 Site Conceptual Model

The site conceptual model for SWMU 81D is based upon residual COCs identified in the soil samples collected from throughout the site. This section summarizes the nature and extent of contamination and the environmental fate of COCs.

7.5.1 Nature and Extent of Contamination

The primary COCs at SWMU 81D are metals associated with past testing at the Site. Low estimated concentrations of four VOCs were also detected in a few samples. Gamma activity attributable to uranium-235 was detected above background in four samples. Metal and radionuclide COCs were determined by comparing sample results to background concentrations and to activities established for the Canyons Area (Dinwiddie September 1997, Garcia November 1998). Any metal or radionuclide found to exceed background in any sample is considered a potential COC for the site. Because the MDAs for uranium-235 analyses exceed background activity limits (see Table 7.4.4-3), nondetect sample results are also considered in identifying potential COCs. In the case of radionuclides, the MDA is used for comparison to background. As a result, metal COCs include arsenic, beryllium, and lead. The radionuclide

COC is uranium-235. Table 7.5.1-1 lists the COCs and the sample locations where they were detected.

Twenty samples and two duplicate samples were collected from throughout SWMU 81D. In most cases, the COCs are only slightly elevated above background concentrations or activity limits specified for the Canyons Area (Dinwiddie September 1997, Garcia November 1998). The COCs that exceed background limits typically occur as isolated "hot spots," with no particular COC associations or correlation to particular locations or areas within the boundary of the site. However, the metal COCs and the radiological COC were above background at sample location CY81D-GR-006-SS on the northwest side of the site.

Potential COCs were determined on the basis of detectable concentrations of VOCs in any soil sample. Because background concentrations for these constituents are not applicable, any detectable VOCs are considered potential contamination. Conversely, analytical results of samples that yielded no detections were not considered in evaluating potential COCs at SWMU 81D. As a result, VOC COCs include carbon disulfide, tetrachloroethene, toluene, and xylene. Table 7.5.1-1 lists these COCs and the sample locations where they were detected.

Because the concentrations of VOCs detected were below the laboratory practical quantitation limit, all four of the VOCs detected were qualified as estimated values. The concentrations do not vary much with sample location and are extremely low, so it believed that the VOCs do not result from contamination from activities conducted at SWMU 81D.

The MDA associated with most uranium-235 analyses were above background. All elevated activities are believed to be naturally occurring at SWMU 81D due to the natural characteristic of the rock and soil in the area (RUST Geotech Inc. December 1994).

7.5.2 Environmental Fate

The primary source of COCs at SWMU 81D was antiarmor tests at the site (Figure 7.5.2-1). The primary release mechanism of COCs to the surface soil was fallout and scattering of test material after test unit detonations from striking the ground or a target below the steel cable. SWMU 81D lies within the floor of Sol se Mete Canyon. During intense rainfall events surface runoff can actively erode the site and could be considered a release mechanism.

Table 7.5.2-1 summarizes potential COCs for SWMU 81D. Based upon the nature and extent of contamination at the site (Section 7.5.1), metals and VOC COCs occur sporadically at low concentrations in surface soil throughout the site boundary. No distinct horizontal distribution of contamination is present. As discussed in Section 7.5.1, radionuclides are also potential COCs for SWMU 81D. All potential COCs were retained in the conceptual model and were evaluated in the human health and ecological risk assessments.

The current land use for SWMU 81D is industrial. However, because the future land use for SWMU 81D is recreational (DOE et al. October 1995), the potential human receptor is considered a recreational user of the site. For all applicable pathways, the exposure route for the recreational user is dermal contact and ingestion/inhalation. Only ingestion of soil is considered a major exposure route for the recreational user. Potential biota receptors include flora and fauna at the site. Similar to the recreational user, direct ingestion of soil is considered the major exposure route for biota, in addition to ingestion through food chain transfers or direct

Table 7.5.1-1
Summary of COCs for SWMU 81D

COC Type	Number of Samples	COCs Greater Than Background	Maximum Background Limit/Canyons Area[a] (mg/kg, except where noted)	Maximum Concentration (mg/kg, except where noted)	Average Concentration[b] (mg/kg, except where noted)	Sampling Locations Where Background Concentration Exceeded[c]
Metals	20 environmental, 2 duplicates	Arsenic	9.8	14.8	4.53	CY81D-GR-006-SS
		Beryllium	0.75	0.812	0.567	CY81D-GR-006-SS
		Lead	18.9	24	13.824	CY81D-GR-006-SS CY81D-GR-017-SS CY81D-GR-017-DU CY81D-GR-018-SS
VOC	20 environmental, 2 duplicates	Carbon disulfide	NA	0.77 J (5.29) µg/kg	Not calculated	CY81D-GR-003-SS CY81D-GR-010-SS CY81D-GR-012-SS
		Tetrachloroethene	NA	0.82 J (1.08) µg/kg	Not calculated	CY81D-GR-010-SS
		Toluene	NA	0.98 J (2.5) µg/kg	Not calculated	CY81D-GR-003-SS
		Xylene	NA	1.0 J (2.04) µg/kg	Not calculated	CY81D-GR-003-SS
Radionuclides	20 environmental, 2 duplicates	Uranium-235	0.16 pCi/g	0.222 pCi/g	Not Calculated[d]	CY81D-GR-005-SS CY81D-GR-006-SS CY81D-GR-019-SS CY81D-GR-020-SS

[a]From Garcia November 1998 (for metals); from Dinwiddie September 1997 (for radionuclides).

[b]Average concentration includes all samples. For nondetectable results, the detection limit is used to calculate the average.

[c]Includes all samples with detectable concentrations (for VOCs and SVOCs) or all samples with nondetectable results where the MDA exceeds background (for radionuclides).

[d]An average MDA is not calculated because of the variability in instrument counting error and the number of reported nondetectable activities.

COC = Constituent of concern.
CY = Canyon.
DU = Duplicate sample.
GR = Grab sample.
J ( ) = Reported value is greater than or equal to the method detection limit but is less than the practical quantitation limit, shown in parentheses.
µg/kg = Microgram(s) per kilogram.
MDA = Minimum detectable activity.
mg/kg = Milligram(s) per kilogram.
NA = Not applicable.
pCi/g = Picocurie(s) per gram.
SS = Surface soil sample.
SVOC = Semivolatile organic compounds.
SWMU = Solid Waste Management Unit.
VOC = Volatile organic compound.

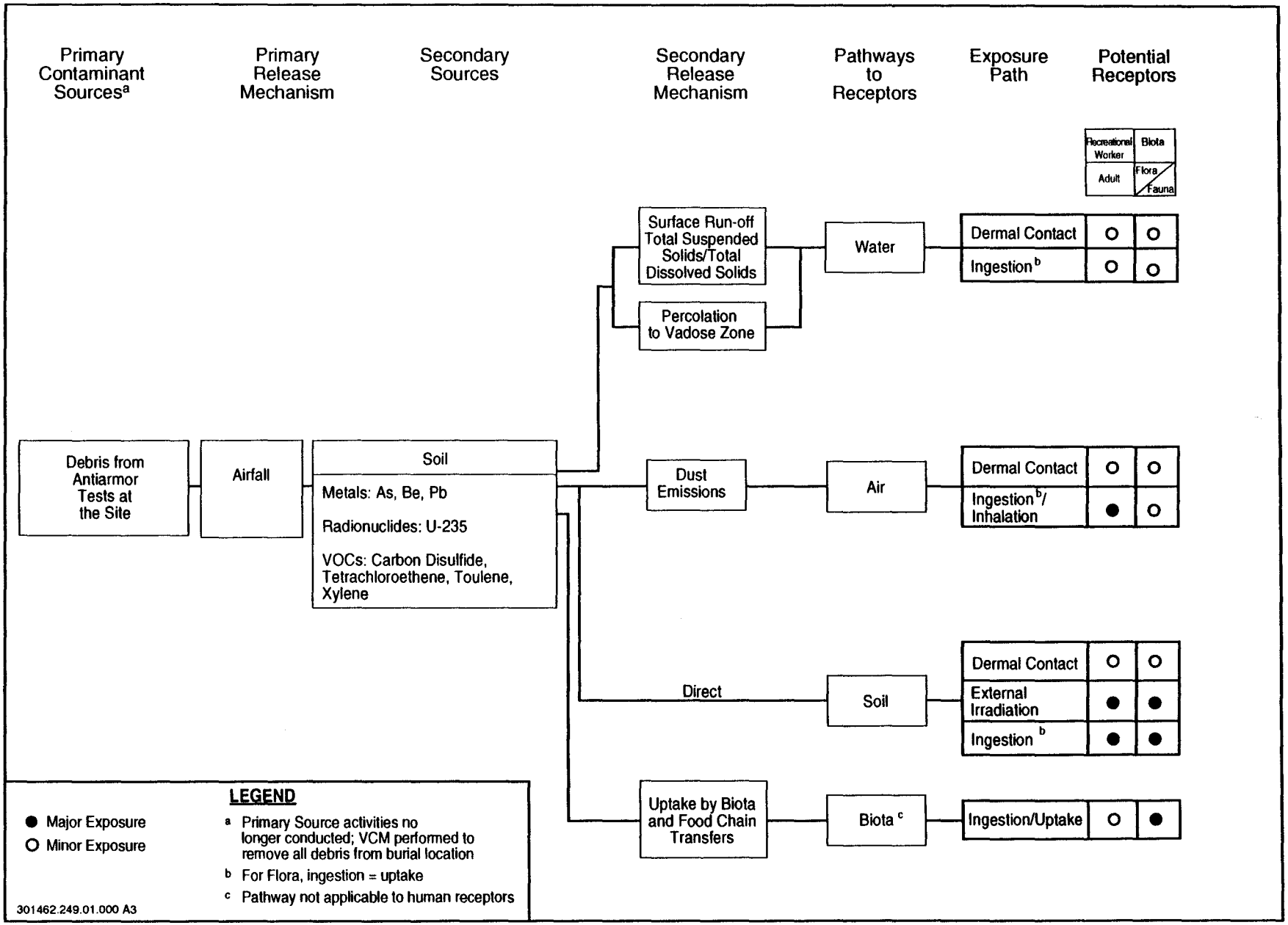


Figure 7.5.2-1

Conceptual Model Flow Diagram for SWMU 81D, Northern Cable Area

uptake. Annex 7-C, Section V, provides additional discussion of the exposure routes and receptors at SWMU 81D.

7.6 Site Assessments

Site assessment at SWMU 81D includes risk screening assessments followed by risk baseline assessments (as required) for both human health and ecological risk. The following sections summarize the site assessment results. Annex 7-C provides details of the site assessment.

7.6.1 Summary

The site assessment concludes that SWMU 81D has no significant potential to affect human health under a recreational land use scenario. After considering the uncertainties associated with the available data and modeling assumptions, ecological risks associated with SWMU 81D were found to be very low. Section 0 briefly describes and Annex 7-C provides details of the site screening assessments.

7.6.2 Screening Assessments

Risk screening assessments were performed for both human health risk and ecological risk for SWMU 81D. This section briefly summarizes the risk screening assessments.

7.6.2.1 Human Health

SWMU 81D has been recommended for recreational land use (DOE et al. October 1995). Annex 7-C provides a complete discussion of the risk assessment process, results, and uncertainties. Because COCs are present in concentrations or activities greater than background levels, it was necessary to perform a health risk assessment analysis for the site. This assessment included any detected VOCs and any radionuclides detected either above background levels and/or above MDAs. The risk assessment process provides a quantitative evaluation of the potential adverse human health effects caused by constituents in the site's soil. The Risk Assessment Report calculated the hazard index (HI) and excess cancer risk for a recreational land use setting. The excess cancer risk from nonradiological COCs and the radiological COCs is not additive (EPA 1989).

In summary, the HI calculated for SWMU 81D nonradiological COCs for a recreational land use setting is 0.00, which is less than the numerical standard of 1.0 suggested by risk assessment guidance (EPA 1989). Incremental risk is determined by subtracting risk associated with background from potential nonradiological COC risk. The incremental HI is 0.00. The excess cancer risk for SWMU 81D nonradiological COCs is 9E-7 for a recreational land use setting. Guidance from the NMED indicates that excess lifetime risk of developing cancer by an individual must be less than 1E-6 for Class A and B carcinogens and less than 1E-5 for Class C carcinogens (NMED March 1998). Thus, the excess cancer risk for this site is below the suggested acceptable risk value (1E-6). The incremental excess cancer risk is 3.00E-7.

The incremental total effective dose equivalent for radionuclides for a recreational land use setting for SWMU 81D is 1.5E-2 millirems (mrem)/year (yr), which is well below the recommended dose limit of 15 mrem/yr found in EPA's OSWER Directive No. 9200.4-18 (1997a) and reflected in a document entitled "Sandia National Laboratories/New Mexico Environmental Restoration Project—RESRAD Input Parameter Assumptions and Justification" (SNL/NM February 1998). The incremental excess cancer risk for the radionuclides for the recreational land-use scenario is 2.0E-7, which is much less than risk values calculated from naturally occurring radiation and from intakes considered as background concentration values.

The residential land use scenarios for this site are provided only for comparison in the Risk Assessment Report (Annex 7-C). The report concludes that SWMU 81D does not have potential to affect human health under a recreational land use scenario.

7.6.2.2 Ecological

An ecological screening assessment that corresponds with the screening procedures (NMED March 1998) in the EPA's Ecological Risk Assessment Guidance for Superfund (EPA 1997b) was performed as set forth by the NMED Risk-Based Decision Tree. An early step in the evaluation compared COC concentrations and identified potentially bioaccumulative constituents (see Annex 7-C, Sections III, VI, VII.2, and VII.3). This methodology also required developing a site conceptual model and a food web model, as well as selecting ecological receptors. Each of these items was presented in the "Predictive Ecological Risk Assessment Methodology for SNL/NM ER Program, Sandia National Laboratories/New Mexico" (IT July 1998) and will not be duplicated here. The screening also includes the estimation of exposure and ecological risk.

Tables 15, 16, 17, and 18 of Annex 7-C present the results of the ecological risk assessment screen. Site-specific information was incorporated into the screening assessment when such data were available. Hazard quotients greater than unity were originally predicted; however, closer examination of the exposure assumptions revealed an overestimation of risk primarily attributed to exposure concentration (maximum COC concentration was used in estimating risk), exposure setting (area use factors of one were assumed), and background risk. Based upon an evaluation of these uncertainties, ecological risks associated with this site are expected to be very low.

7.6.3 Baseline Risk Assessments

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

7.6.3.1 Human Health

Based upon the fact that human health results of the screening assessment summarized in Section 7.6.2.1 indicate that SWMU 81D does not have potential to affect human health under a recreational land use setting, a baseline human health risk assessment is not required for SWMU 81D.

7.6.3.2 Ecological

Based upon the fact that ecological results of the screening assessment summarized in Section 7.6.2.2 indicate that SWMU 81D has very low ecological risk, a baseline ecological risk assessment is not required for SWMU 81D.

7.6.4 Other Applicable Assessments

A Surface Water Site Assessment was conducted at SWMU 81D in August 1998 (SNL/NM August 1998). The surface water assessment guidance was developed jointly by Los Alamos National Laboratory and the NMED Surface Water Quality Bureau. The assessment evaluated the potential for erosion from SWMU 81D. SWMU 81D received a score of 80.3 indicating that it has high erosion potential. The high erosion potential is due to its location on the floor of Sol se Mete Canyon and the fact that the area is graded and relatively devoid of native vegetation. Although the graded site may be subject to some erosion during significant rainstorm events, no localized areas of contamination were found at the site during baseline sampling. The few COCs detected at the site were at scattered locations (Table 7.5.1-1) indicating that surface water runoff is not causing contaminant migration at SWMU 81B. Additionally, as discussed under the Results and Conclusions (Section 7.4.4.2.2) and Screening Assessments (Section 7.6) sections, COCs detected are not at levels that pose a threat to human health or the environment or could adversely affect surface water quality.

7.7 No Further Action Proposal

7.7.1 Rationale

Based upon field investigation data and the human health risk assessment analysis, an NFA is recommended for SWMU 81D because no COCs (particularly VOCs or radionuclides) were present in concentrations considered hazardous to human health for a recreational land use scenario.

7.7.2 Criterion

Based upon the evidence provided above, SWMU 81D is proposed for an NFA decision in conformance with Criterion 5 (NMED March 1998), which states, "The SWMU/AOC has been characterized or remediated in accordance with current applicable state or federal regulations, and that available data indicate that contaminants pose an acceptable level of risk under current and projected future land use."

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Annex 7-A

ANNEX 7-A
Gamma Spectroscopy Results

SF 2001-COC (10-97)

Supersedes (5-97) issue

Internal Lab Batch No. 801929 SAR/WR No.

ANALYSIS REQUEST AND CHAIN OF CUSTODY

Press F1 for instructions for each field.

AR/COC- 600814

RECEIVED SEP 16 1998 LAB USE

Dept. No./Mail Stop: 6134/1148
Project/Task Manager: Paul Freshour
Project Name: 81D Baseline Sampling
Record Center Code: ER/OU1333/DAT
Logbook Ref. No.: ER-012
Service Order No.: CF0608

Date Samples Shipped: 9/16/98 SMO USE
Carrier/Waybill No.: HC
Lab Contact: Fernando Dominguez
Lab Destination: RPSD Building 881
SMO Contact/Phone: Doug Salmi/844-3110
Send Report to SMO: Doug Salmi

Contract No.:
Case No.: 7214/1300
SMO Authorization
Bill to: Sandia National Laboratories
Supplier Services, Dept.
P.O. Box 5800 MS 0154

Location Tech Area Canyons
Building NA Room NA

Sample No. - Fraction	ER Sample ID or Sample Location Detail	Beginning Depth in Ft.	ER Site No.	Date/Time Collected	Reference LOV (available at SMO): Sample Matrix	Container: Type	Container: Volume	Preservative	Sample Collection Method	Sample Type	Parameter & Method Requested	Lab Sample ID
042307 - 004	CY81D-GR-001-SS	0.0	81D	9/15/98 0915	S	M	500 ml	None	G	SA	GAMMA SPECTROSCOPY	
042308 - 004	CY81D-GR-002-SS	0.0	81D	9/15/98 0920	S	M	500 ml	None	G	SA	GAMMA SPECTROSCOPY	
042309 – 004	CY81D-GR-003-SS	0.0	81D	9/15/98 0933	S	M	500 ml	None	G	SA	GAMMA SPECTROSCOPY	
042310 - 004	CY81D-GR-004-SS	0.0	81D	9/15/98 0944	S	M	500 ml	None	G	SA	GAMMA SPECTROSCOPY	
042311 - 004	CY81D-GR-005-SS	0.0	81D	9/15/98 0950	S	M	500 ml	None	G	SA	GAMMA SPECTROSCOPY	
042312 - 004	CY81D-GR-006-SS	0.0	81D	9/15/98 1000	S	M	500 ml	None	G	SA	GAMMA SPECTROSCOPY	
042313 - 004	CY81D-GR-007-SS	0.5	81D	9/15/98 1020	S	M	500 ml	None	G	SA	GAMMA SPECTROSCOPY	
042239-004	CY81D-GR-007-DU	0.5	81D	9/15/98 1020	S	M	500 ml	None	G	DU	GAMMA SPECTROSCOPY	
042314 - 004	CY81D-GR-008-SS	0.5	81D	9/15/98 1025	S	M	500 ml	None	G	SA	GAMMA SPECTROSCOPY	
042315 - 004	CY81D-GR-009-SS	0.5	81D	9/15/98 1030	S	M	500 ml	None	G	SA	GAMMA SPECTROSCOPY	

RMMA ☐Yes ☒No Ref. No.
Sample Disposal ☐Return to Client ☒Disposal by lab

Sample Tracking SMO USE
Date Entered (mm/dd/yy)
Entered by:

Special Instructions/QC Requirements
EDD ☒Yes ☐No
Raw data package ☒Yes ☐No

Abnormal Conditions on Receipt LAB USE

Turnaround Time ☒Normal ☐Rush Required Report Date

QC Inits.

	Name	Signature	Init	Company/Organization/Phone
Sample Team Members	Concetta Cacciato		CC	MDM/6131/540-9143
	Gill Baltazar		GB	Weston/6131/971-2769
	Catechis Chris		CC	MDM/6131/884-2249

Please list as separate report.

1. Relinquished by		Org. 6131	Date 9/16/98	Time 0941	4. Relinquished by	Org.	Date
1. Received by		Org. 7577	Date 9/16/98	Time 0945	4. Received by	Org.	Date
2. Relinquished by		Org. 7577	Date 9/16/98	Time 1315	5. Relinquished by	Org.	Date
2. Received by		Org. SNL7578	Date 9/16/98	Time 1315	5. Received by	Org.	Date
3. Relinquished by		Org. 7578	Date 9/21/98	Time 1537	6. Relinquished by	Org.	Date
3. Received by		Org. 7577	Date 9/21/98	Time 1537	6. Received by	Org.	Date

Original To Accompany Samples, Laboratory Copy (White) **1st Copy** To Accompany Samples, Return to SMO (Blue) **2nd Copy** SMO Suspense Copy (Yellow) **3rd Copy** Field Copy (Pink)

SF 2001-COC (10-97)
Supersedes (5-97) Issue

BATCH # 801929

ANALYSIS REQUEST AND CHAIN OF CUSTODY (Continuation)

Press F1 for instructions for each field.

AR/COC- 600814

Project Name: 81D Baseline Sampling | Project/Task Manager: Paul Freshour | Case No.: 7214/1300

Location Tech Area Canyons

Building NA Room NA

Sample No. - Fraction	ER Sample ID or Sample Location Detail	Beginning Depth in Ft.	ER Site No.	Date/Time Collected	Sample Matrix	Container Type	Container Volume	Preservative	Sample Collection Method	Sample Type	Parameter & Method Requested	LAB USE Lab Sample ID
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042317 - 004	CY81D-GR-011-SS	0.0	81D	9/15/98 1045	S	M	500 ml	None	G	SA	GAMMA SPECTROSCOPY	
042318 - 004	CY81D-GR-012-SS	0.5	81D	9/15/98 1055	S	M	500 ml	None	G	SA	GAMMA SPECTROSCOPY	
042319 - 004	CY81D-GR-013-SS	0.5	81D	9/15/98 1320	S	M	500 ml	None	G	SA	GAMMA SPECTROSCOPY	
042320 – 004	CY81D-GR-014-SS	0.5	81D	9/15/98 1323	S	M	500 ml	None	G	SA	GAMMA SPECTROSCOPY	
042321 - 004	CY81D-GR-015-SS	0.5	81D	9/15/98 1330	S	M	500 ml	None	G	SA	GAMMA SPECTROSCOPY	
042322 - 004	CY81D-GR-016-SS	0.5	81D	9/15/98 1350	S	M	500 ml	None	G	SA	GAMMA SPECTROSCOPY	
042323 - 004	CY81D-GR-017-SS	0.5	81D	9/15/98 1405	S	M	500 ml	None	G	SA	GAMMA SPECTROSCOPY	
043940-004	CY81D-GR-017-DU	0.5	81D	9/15/98 1405	S	M	500 ml	None	G	DU	GAMMA SPECTROSCOPY	
042324 - 004	CY81D-GR-018-SS	0.0	81D	9/15/98 1415	S	M	500 ml	None	G	SA	GAMMA SPECTROSCOPY	
042325 - 004	CY81D-GR-019-SS	0.0	81D	9/15/98 1425	S	M	500 ml	None	G	SA	GAMMA SPECTROSCOPY	
042326 - 004	CY81D-GR-020-SS	0.0	81D	9/15/98 1420	S	M	500 ml	None	G	SA	GAMMA SPECTROSCOPY	

Abnormal Conditions on Receipt **LAB USE**

Recipient Initials _____

Original To Accompany Samples, Laboratory Copy (White) | 1st Copy To Accompany Samples, Return to SMO (Blue) | 2nd Copy SMO Suspense Copy (Yellow) | 3rd Copy Field Copy (Pink)

Sandia National Laboratories
Radiation Protection Sample Diagnostics

Sample Analysis Request Form
Page 1 of 2

To be completed by Customer

Shaded areas are for RPSD use only

Customer : PAUL FROSHOUR
Organization: 6134 / 1148
Project Location: SITE 81D
Phone: 971-2767
Date Results Needed: NORMAL
Suspect Isotopes: N/A
Case Number: 7214.1300

Hazards/Special Instructions:
SITE 81D

CoC 600814

Batch Log Number: 801929
Logged By: JM

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

Customer Sample ID	Sample Type	Date/Time Collected	Sample Quantity	Requested Analysis	RPSD Sample ID	Screen cpm	Sample Mass	Remarks / Aliquot Amount
042307-004	S	9/15/98 0915	500ml	G SPEC	01	<300	851 g	
042308-004		0920			02		655 g	
042309-004		0933			03		838 g	
042310-004		0944			04		764 g	
042311-004		0950			05		770 g	
042312-004		1000			06		738 g	
042313-004		1020			07		730 g	
042239-004		1020			08		777 g	
042314-004		1025			09		755 g	
042315-004		1030			10		693 g	
042316-004		1040			11		892 g	
042317-004		1045			12		1061 g	
042318-004		1055			13	<300	691 g	

Relinquished by _____ Date 9/16/98 Received by _____ Date 9/16/98
Relinquished by _____ Date 9/21/98 Received by _____ Date 9-21-98
Relinquished by _____ Date _____ Received by _____ Date _____
Relinquished by _____ Date _____ Received by _____ Date _____

Sandia National Laboratories
Radiation Protection Sample Diagnostics

Sample Analysis Request Form
Page 2 of 2

To be completed by Customer

Shaded areas are for RPSD use only

Customer: Fresnouk
Organization: 6134
Project Location: Site 81D
Phone: 845-0768
Date Results Needed: NoRm
Suspect Isotopes: unk
Case Number: 7214.130

Hazards/Special Instructions:

CoC 600 814

Batch Log Number: 801929
Logged By: FM

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

Customer Sample ID	Sample Type	Date/Time Collected	Sample Quantity	Requested Analysis	RPSD Sample ID	Screen cpm	Sample Mass	Remarks / Aliquot Amount
042319-004	S	9/15/98 1320	500ml	γ SPEC	14	<300	685g	
042320-004	↓	1323	↓	↓	15	↓	700g	
042321-004		1330			16		751g	
042322-004		1350			17		703g	
042323-004		1405			18		707g	
042940-004		1405			19		749g	
042324-004		1415			20		811g	
042325-004		1425			21	↓	605g	
042326-004	↓	1420	↓	↓	22	<300	860g	
LCS	—	1NOV98	—	γ spec	23	N/A	N/A	

Relinquished by _____ Date _____ Received by _____ Date _____
Relinquished by _____ Date _____ Received by _____ Date _____
Relinquished by _____ Date _____ Received by _____ Date _____
Relinquished by _____ Date _____ Received by _____ Date _____

****
* Sandia National Laboratories *
* Radiation Protection Sample Diagnostics Program [806 Laboratory] *
* 9-16-98 3:30:46 PM *
****
*
* Analyzed by: 9/20/98 Reviewed by: 9/21/98 *
****

Customer : P.FRESHOUR/D.PERRY (6134/SMO)
Customer Sample ID : 042307-004
Lab Sample ID : 80192901

Sample Description : MARINELLI SOLID SAMPLE
Sample Quantity : 851.000 gram
Sample Date/Time : 9-15-98 9:15:00 AM
Acquire Start Date/Time : 9-16-98 1:48:01 PM
Detector Name : LAB02
Elapsed Live/Real Time : 6000 / 6002 seconds

Comments:
****

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	4.53E-01	3.77E-01	5.33E-01
RA-226	1.74E+00	3.24E-01	4.60E-01
PB-214	7.30E-01	2.76E-01	3.73E-02
BI-214	7.20E-01	1.27E-01	3.36E-02
PB-210	Not Detected	---------	2.86E+01
TH-232	4.88E-01	2.77E-01	1.15E-01
RA-228	6.05E-01	1.89E-01	1.03E-01
AC-228	5.67E-01	1.88E-01	2.13E-01
TH-228	5.10E-01	1.75E-01	3.53E-01
RA-224	4.91E-01	2.53E-01	5.21E-02
PB-212	5.26E-01	9.20E-02	3.08E-02
BI-212	6.13E-01	3.03E-01	2.24E-01
TL-208	4.90E-01	1.33E-01	5.35E-02
U-235	Not Detected	---------	1.96E-01
TH-231	Not Detected	---------	1.88E+00
PA-231	Not Detected	---------	3.18E+00
TH-227	Not Detected	---------	2.74E-01
RA-223	Not Detected	---------	1.73E-01
RN-219	Not Detected	---------	3.04E-01
PB-211	Not Detected	---------	6.95E-01
TL-207	Not Detected	---------	1.04E+01
AM-241	Not Detected	---------	3.97E-01
PU-239	Not Detected	---------	3.64E+02
NP-237	Not Detected	---------	3.19E-01
PA-233	Not Detected	---------	4.69E-02
TH-229	Not Detected	---------	2.10E-01

[Summary Report] - Sample ID: : 80192901

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
AG-108m	Not Detected	---------	3.16E-02
AG-110m	Not Detected	---------	2.29E-02
BA-133	Not Detected	---------	5.99E-02
BE-7	Not Detected	---------	2.04E-01
CD-109	Not Detected	---------	1.01E+00
CD-115	Not Detected	---------	7.49E-02
CE-139	Not Detected	---------	2.45E-02
CE-141	Not Detected	---------	4.49E-02
CE-144	Not Detected	---------	2.01E-01
CO-56	Not Detected	---------	2.70E-02
CO-57	Not Detected	---------	2.45E-02
CO-58	Not Detected	---------	2.50E-02
CO-60	Not Detected	---------	2.94E-02
CR-51	Not Detected	---------	1.93E-01
CS-134	Not Detected	---------	4.36E-02
CS-137	Not Detected	---------	2.53E-02
EU-152	Not Detected	---------	7.37E-02
EU-154	Not Detected	---------	1.45E-01
EU-155	Not Detected	---------	1.24E-01
FE-59	Not Detected	---------	5.35E-02
GD-153	Not Detected	---------	8.74E-02
HG-203	Not Detected	---------	2.54E-02
I-131	Not Detected	---------	2.46E-02
IR-192	Not Detected	---------	2.21E-02
K-40	9.47E+00	2.34E+00	2.18E-01
KR-85	Not Detected	---------	6.43E+00
MN-52	Not Detected	---------	2.64E-02
MN-54	Not Detected	---------	2.72E-02
MO-99	Not Detected	---------	2.53E-01
NA-22	Not Detected	---------	3.24E-02
NA-24	Not Detected	---------	8.76E-02
NB-95	Not Detected	---------	1.59E-01
ND-147	Not Detected	---------	1.70E-01
NI-57	Not Detected	---------	3.69E-02
NP-239	Not Detected	---------	1.11E-01
RU-103	Not Detected	---------	2.22E-02
RU-106	Not Detected	---------	2.21E-01
SB-122	Not Detected	---------	4.08E-02
SB-124	Not Detected	---------	2.21E-02
SB-125	Not Detected	---------	6.34E-02
SN-113	Not Detected	---------	2.98E-02
TA-182	Not Detected	---------	1.25E-01
TA-183	Not Detected	---------	4.02E-01
TC-99m	Not Detected	---------	7.08E-01
TL-201	Not Detected	---------	1.97E-01
XE-133	Not Detected	---------	1.73E-01
Y-88	Not Detected	---------	2.00E-02
ZN-65	Not Detected	---------	8.57E-02
ZR-95	Not Detected	---------	4.23E-02

Sandia National Laboratories
Radiation Protection Sample Diagnostics Program [806 Laboratory]
9-16-98 5:15:44 PM

Analyzed by: 9/20/98 Reviewed by: 9/21/98

Customer : P.FRESHOUR/D.PERRY (6134/SMO)
Customer Sample ID : 042308-004
Lab Sample ID : 80192902

Sample Description : MARINELLI SOLID SAMPLE
Sample Quantity : 655.000 gram
Sample Date/Time : 9-15-98 9:20:00 AM
Acquire Start Date/Time : 9-16-98 3:32:55 PM
Detector Name : LAB02
Elapsed Live/Real Time : 6000 / 6002 seconds

Comments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	9.13E-01	4.42E-01	6.60E-01
RA-226	1.90E+00	8.49E-01	5.81E-01
PB-214	8.28E-01	2.72E-01	4.50E-02
BI-214	7.08E-01	4.90E-01	4.43E-02
PB-210	Not Detected	---	3.54E+01
TH-232	7.13E-01	3.95E-01	1.41E-01
RA-228	6.84E-01	4.48E-01	1.83E-01
AC-228	7.38E-01	4.82E-01	2.76E-01
TH-228	7.73E-01	2.43E-01	4.55E-01
RA-224	7.68E-01	2.76E-01	7.67E-02
PB-212	7.14E-01	2.11E-01	3.99E-02
BI-212	8.15E-01	3.53E-01	2.83E-01
TL-208	6.01E-01	1.27E-01	6.58E-02
U-235	Not Detected	---	2.37E-01
TH-231	Not Detected	---	2.35E+00
PA-231	Not Detected	---	3.97E+00
TH-227	Not Detected	---	3.55E-01
RA-223	Not Detected	---	2.19E-01
RN-219	Not Detected	---	3.91E-01
PB-211	Not Detected	---	8.68E-01
TL-207	Not Detected	---	1.32E+01
AM-241	Not Detected	---	4.87E-01
PU-239	Not Detected	---	4.50E+02
NP-237	~~4.73E-01~~	~~2.07E-01~~	3.21E-01 Not detected
PA-233	Not Detected	---	5.89E-02
TH-229	Not Detected	---	2.58E-01

9/20/98

[Summary Report] - Sample ID: : 80192902

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
AG-108m	Not Detected	---	3.95E-02
AG-110m	Not Detected	---	3.77E-02
BA-133	Not Detected	---	7.30E-02
BE-7	Not Detected	---	1.43E-01
CD-109	Not Detected	---	1.09E+00
CD-115	Not Detected	---	9.86E-02
CE-139	Not Detected	---	2.98E-02
CE-141	Not Detected	---	5.45E-02
CE-144	Not Detected	---	2.49E-01
CO-56	Not Detected	---	3.42E-02
CO-57	Not Detected	---	3.14E-02
CO-58	Not Detected	---	3.19E-02
CO-60	Not Detected	---	3.46E-02
CR-51	Not Detected	---	2.42E-01
CS-134	Not Detected	---	5.06E-02
CS-137	6.51E-02	2.40E-02	2.30E-02
EU-152	Not Detected	---	9.45E-02
EU-154	Not Detected	---	1.81E-01
EU-155	Not Detected	---	1.49E-01
FE-59	Not Detected	---	6.90E-02
GD-153	Not Detected	---	1.07E-01
HG-203	Not Detected	---	3.13E-02
I-131	Not Detected	---	3.25E-02
IR-192	Not Detected	---	2.77E-02
K-40	1.26E+01	2.02E+00	2.69E-01
KR-85	Not Detected	---	8.39E+00
MN-52	Not Detected	---	3.53E-02
MN-54	Not Detected	---	3.40E-02
MO-99	Not Detected	---	3.19E-01
NA-22	Not Detected	---	3.96E-02
NA-24	Not Detected	---	1.32E-01
NB-95	Not Detected	---	2.09E-01
ND-147	Not Detected	---	2.09E-01
NI-57	Not Detected	---	4.78E-02
NP-239	Not Detected	---	1.34E-01
RU-103	Not Detected	---	3.04E-02
RU-106	Not Detected	---	2.93E-01
SB-122	Not Detected	---	5.36E-02
SB-124	Not Detected	---	2.87E-02
SB-125	Not Detected	---	8.35E-02
SN-113	Not Detected	---	3.70E-02
TA-182	Not Detected	---	1.62E-01
TA-183	Not Detected	---	4.94E-01
TC-99m	Not Detected	---	1.06E+00
TL-201	Not Detected	---	2.45E-01
XE-133	Not Detected	---	2.13E-01
Y-88	Not Detected	---	2.75E-02
ZN-65	Not Detected	---	1.09E-01
ZR-95	Not Detected	---	5.56E-02

****
* Sandia National Laboratories *
* Radiation Protection Sample Diagnostics Program [806 Laboratory] *
* 9-16-98 7:00:54 PM *
****
* *
* Analyzed by: 9/20/98 Reviewed by: 9/21/98 *
****

Customer : P.FRESHOUR/D.PERRY (6134/SMO)
Customer Sample ID : 042309-004
Lab Sample ID : 80192903

Sample Description : MARINELLI SOLID SAMPLE
Sample Quantity : 838.000 gram
Sample Date/Time : 9-15-98 9:33:00 AM
Acquire Start Date/Time : 9-16-98 5:18:01 PM
Detector Name : LAB02
Elapsed Live/Real Time : 6000 / 6003 seconds

Comments:
****

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	8.82E-01	4.85E-01	6.21E-01
RA-226	1.91E+00	7.57E-01	5.53E-01
PB-214	9.17E-01	1.59E-01	3.96E-02
BI-214	8.19E-01	2.50E-01	3.70E-02
PB-210	Not Detected	---	3.37E+01
TH-232	8.55E-01	4.36E-01	1.34E-01
RA-228	8.05E-01	1.92E-01	1.30E-01
AC-228	8.12E-01	2.29E-01	2.20E-01
TH-228	9.57E-01	2.59E-01	4.47E-01
RA-224	7.80E-01	2.37E-01	7.05E-02
PB-212	8.05E-01	1.66E-01	3.78E-02
BI-212	7.52E-01	2.93E-01	2.77E-01
TL-208	7.11E-01	1.32E-01	5.77E-02
U-235	Not Detected	---	2.25E-01
TH-231	Not Detected	---	2.18E+00
PA-231	Not Detected	---	3.64E+00
TH-227	Not Detected	---	3.30E-01
RA-223	Not Detected	---	2.03E-01
RN-219	Not Detected	---	3.51E-01
PB-211	Not Detected	---	7.84E-01
TL-207	Not Detected	---	1.21E+01
AM-241	Not Detected	---	4.42E-01
PU-239	Not Detected	---	4.20E+02
NP-237	Not Detected	---	3.76E-01
PA-233	Not Detected	---	5.39E-02
TH-229	Not Detected	---	2.42E-01

[Summary Report] - Sample ID: : 80192903

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
AG-108m	Not Detected	---	3.58E-02
AG-110m	Not Detected	---	3.42E-02
BA-133	Not Detected	---	6.78E-02
BE-7	Not Detected	---	1.37E-01
CD-109	~~2.23E+00~~	~~9.16E-01~~	1.16E+00
CD-115	Not Detected	---	9.37E-02
CE-139	Not Detected	---	2.87E-02
CE-141	Not Detected	---	5.14E-02
CE-144	Not Detected	---	2.31E-01
CO-56	Not Detected	---	3.16E-02
CO-57	Not Detected	---	2.89E-02
CO-58	Not Detected	---	2.92E-02
CO-60	Not Detected	---	3.05E-02
CR-51	Not Detected	---	2.27E-01
CS-134	Not Detected	---	4.59E-02
CS-137	5.69E-02	3.76E-02	2.09E-02
EU-152	Not Detected	---	8.70E-02
EU-154	Not Detected	---	1.64E-01
EU-155	Not Detected	---	1.44E-01
FE-59	Not Detected	---	6.21E-02
GD-153	Not Detected	---	1.02E-01
HG-203	Not Detected	---	2.94E-02
I-131	Not Detected	---	2.91E-02
IR-192	Not Detected	---	2.59E-02
K-40	1.51E+01	2.24E+00	2.38E-01
KR-85	Not Detected	---	7.46E+00
MN-52	Not Detected	---	3.12E-02
MN-54	Not Detected	---	3.14E-02
MO-99	Not Detected	---	3.01E-01
NA-22	Not Detected	---	3.92E-02
NA-24	Not Detected	---	1.31E-01
NB-95	Not Detected	---	1.97E-01
ND-147	Not Detected	---	1.86E-01
NI-57	Not Detected	---	4.75E-02
NP-239	Not Detected	---	1.30E-01
RU-103	Not Detected	---	2.74E-02
RU-106	Not Detected	---	2.49E-01
SB-122	Not Detected	---	4.97E-02
SB-124	Not Detected	---	2.52E-02
SB-125	Not Detected	---	7.35E-02
SN-113	Not Detected	---	3.49E-02
TA-182	Not Detected	---	1.42E-01
TA-183	Not Detected	---	4.50E-01
TC-99m	Not Detected	---	1.19E+00
TL-201	Not Detected	---	2.32E-01
XE-133	Not Detected	---	2.14E-01
Y-88	Not Detected	---	2.09E-02
ZN-65	Not Detected	---	9.65E-02
ZR-95	Not Detected	---	5.11E-02

Not detected
5/20/98

****
* Sandia National Laboratories *
* Radiation Protection Sample Diagnostics Program [806 Laboratory] *
* 9-16-98 9:35:40 PM *
****

* Analyzed by: 9/20/98 Reviewed by: 9/21/98 *

Customer : P.FRESHOUR/D.PERRY (6134/SMO)
Customer Sample ID : 042310-004
Lab Sample ID : 80192904

Sample Description : MARINELLI SOLID SAMPLE
Sample Quantity : 764.000 gram
Sample Date/Time : 9-15-98 9:44:00 AM
Acquire Start Date/Time : 9-16-98 7:53:01 PM
Detector Name : LAB02
Elapsed Live/Real Time : 6000 / 6002 seconds

Comments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	Not Detected	---	7.19E-01
RA-226	2.01E+00	8.50E-01	4.83E-01
PB-214	7.64E-01	7.35E-01	3.80E-02
BI-214	7.20E-01	1.07E+00	3.82E-02
PB-210	Not Detected	---	3.12E+01
TH-232	6.27E-01	3.34E-01	1.21E-01
RA-228	5.37E-01	1.89E-01	1.39E-01
AC-228	6.12E-01	5.28E-01	2.40E-01
TH-228	5.98E-01	2.16E-01	4.80E-01
RA-224	6.05E-01	2.32E-01	6.15E-02
PB-212	6.24E-01	1.78E-01	3.54E-02
BI-212	6.44E-01	2.57E-01	2.45E-01
TL-208	5.84E-01	1.44E-01	5.81E-02
U-235	1.49E-01	1.85E-01	2.17E-01
TH-231	Not Detected	---	1.99E+00
PA-231	Not Detected	---	3.50E+00
TH-227	Not Detected	---	3.12E-01
RA-223	Not Detected	---	2.00E-01
RN-219	Not Detected	---	3.26E-01
PB-211	Not Detected	---	7.21E-01
TL-207	Not Detected	---	1.14E+01
AM-241	Not Detected	---	4.27E-01
PU-239	Not Detected	---	4.00E+02
NP-237	Not Detected	---	2.90E-01
PA-233	Not Detected	---	5.03E-02
TH-229	Not Detected	---	2.24E-01

[Summary Report] - Sample ID: : 80192904

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
AG-108m	Not Detected	---------	3.46E-02
AG-110m	Not Detected	---------	2.69E-02
BA-133	Not Detected	---------	6.52E-02
BE-7	Not Detected	---------	2.37E-01
CD-109	Not Detected	---------	9.86E-01
CD-115	Not Detected	---------	9.09E-02
CE-139	Not Detected	---------	2.71E-02
CE-141	Not Detected	---------	4.94E-02
CE-144	Not Detected	---------	2.19E-01
CO-56	Not Detected	---------	2.95E-02
CO-57	Not Detected	---------	2.80E-02
CO-58	Not Detected	---------	2.71E-02
CO-60	Not Detected	---------	2.93E-02
CR-51	Not Detected	---------	2.05E-01
CS-134	Not Detected	---------	4.64E-02
CS-137	Not Detected	---------	2.95E-02
EU-152	Not Detected	---------	8.42E-02
EU-154	Not Detected	---------	1.58E-01
EU-155	Not Detected	---------	1.36E-01
FE-59	Not Detected	---------	6.29E-02
GD-153	Not Detected	---------	9.45E-02
HG-203	Not Detected	---------	2.78E-02
I-131	Not Detected	---------	2.83E-02
IR-192	Not Detected	---------	2.41E-02
K-40	1.21E+01	1.85E+00	2.14E-01
KR-85	Not Detected	---------	7.20E+00
MN-52	Not Detected	---------	2.92E-02
MN-54	Not Detected	---------	3.13E-02
MO-99	Not Detected	---------	3.08E-01
NA-22	Not Detected	---------	3.56E-02
NA-24	Not Detected	---------	1.34E-01
NB-95	Not Detected	---------	1.90E-01
ND-147	Not Detected	---------	1.87E-01
NI-57	Not Detected	---------	4.05E-02
NP-239	Not Detected	---------	1.23E-01
RU-103	Not Detected	---------	2.54E-02
RU-106	Not Detected	---------	2.49E-01
SB-122	Not Detected	---------	4.88E-02
SB-124	Not Detected	---------	2.56E-02
SB-125	Not Detected	---------	7.16E-02
SN-113	Not Detected	---------	3.40E-02
TA-182	Not Detected	---------	1.34E-01
TA-183	Not Detected	---------	4.47E-01
TC-99m	Not Detected	---------	1.48E+00
TL-201	Not Detected	---------	2.33E-01
XE-133	Not Detected	---------	2.07E-01
Y-88	Not Detected	---------	2.13E-02
ZN-65	Not Detected	---------	9.16E-02
ZR-95	Not Detected	---------	4.89E-02

****
* Sandia National Laboratories *
* Radiation Protection Sample Diagnostics Program [806 Laboratory] *
* 9-16-98 11:20:38 PM *
****

* Analyzed by: 9/20/98 Reviewed by: 9/21/98 *

Customer : P.FRESHOUR/D.PERRY (6134/SMO)
Customer Sample ID : 042311-004
Lab Sample ID : 80192905

Sample Description : MARINELLI SOLID SAMPLE
Sample Quantity : 770.000 gram
Sample Date/Time : 9-15-98 9:50:00 AM
Acquire Start Date/Time : 9-16-98 9:37:49 PM
Detector Name : LAB02
Elapsed Live/Real Time : 6000 / 6003 seconds

Comments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	8.63E-01	7.91E-01	6.99E-01
RA-226	2.05E+00	6.10E-01	5.38E-01
PB-214	8.54E-01	1.76E-01	4.65E-02
BI-214	7.49E-01	2.37E-01	4.24E-02
PB-210	Not Detected	---	3.52E+01
TH-232	9.90E-01	4.63E-01	1.54E-01
RA-228	1.08E+00	3.99E-01	1.48E-01
AC-228	9.03E-01	2.37E-01	2.39E-01
TH-228	8.57E-01	3.23E-01	5.08E-01
RA-224	1.16E+00	3.54E-01	5.93E-02
PB-212	9.48E-01	2.43E-01	4.17E-02
BI-212	1.01E+00	3.36E-01	2.71E-01
TL-208	9.18E-01	2.60E-01	6.46E-02
U-235	2.22E-01	2.08E-01	2.42E-01
TH-231	Not Detected	---	2.28E+00
PA-231	Not Detected	---	3.98E+00
TH-227	Not Detected	---	3.70E-01
RA-223	Not Detected	---	2.25E-01
RN-219	Not Detected	---	3.69E-01
PB-211	Not Detected	---	8.34E-01
TL-207	Not Detected	---	1.27E+01
AM-241	Not Detected	---	4.81E-01
PU-239	Not Detected	---	4.53E+02
NP-237	Not Detected	---	4.08E-01
PA-233	Not Detected	---	5.72E-02
TH-229	Not Detected	---	2.63E-01

[Summary Report] - Sample ID: : 80192905

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
AG-108m	Not Detected	---------	4.05E-02
AG-110m	Not Detected	---------	3.79E-02
BA-133	Not Detected	---------	7.13E-02
BE-7	Not Detected	---------	2.46E-01
CD-109	~~2.09E+00~~	~~9.73E-01~~	1.03E+00
CD-115	Not Detected	---------	1.09E-01
CE-139	Not Detected	---------	2.95E-02
CE-141	Not Detected	---------	5.59E-02
CE-144	Not Detected	---------	2.54E-01
CO-56	Not Detected	---------	3.22E-02
CO-57	Not Detected	---------	3.16E-02
CO-58	Not Detected	---------	3.09E-02
CO-60	Not Detected	---------	3.37E-02
CR-51	Not Detected	---------	2.41E-01
CS-134	Not Detected	---------	4.88E-02
CS-137	8.15E-02	3.04E-02	2.09E-02
EU-152	Not Detected	---------	9.51E-02
EU-154	Not Detected	---------	1.86E-01
EU-155	Not Detected	---------	1.56E-01
FE-59	Not Detected	---------	6.67E-02
GD-153	Not Detected	---------	1.09E-01
HG-203	Not Detected	---------	3.24E-02
I-131	Not Detected	---------	3.27E-02
IR-192	Not Detected	---------	2.79E-02
K-40	1.63E+01	2.43E+00	2.51E-01
KR-85	Not Detected	---------	8.28E+00
MN-52	Not Detected	---------	3.60E-02
MN-54	Not Detected	---------	3.61E-02
MO-99	Not Detected	---------	3.43E-01
NA-22	Not Detected	---------	3.99E-02
NA-24	Not Detected	---------	1.80E-01
NB-95	Not Detected	---------	2.28E-01
ND-147	Not Detected	---------	2.08E-01
NI-57	Not Detected	---------	4.95E-02
NP-239	Not Detected	---------	1.40E-01
RU-103	Not Detected	---------	2.76E-02
RU-106	Not Detected	---------	2.87E-01
SB-122	Not Detected	---------	5.45E-02
SB-124	Not Detected	---------	2.87E-02
SB-125	Not Detected	---------	8.18E-02
SN-113	Not Detected	---------	3.69E-02
TA-182	Not Detected	---------	1.49E-01
TA-183	Not Detected	---------	5.11E-01
TC-99m	Not Detected	---------	2.00E+00
TL-201	Not Detected	---------	2.63E-01
XE-133	Not Detected	---------	2.36E-01
Y-88	Not Detected	---------	2.63E-02
ZN-65	Not Detected	---------	1.03E-01
ZR-95	Not Detected	---------	5.40E-02

Not detected
9/20/98

****
* Sandia National Laboratories *
* Radiation Protection Sample Diagnostics Program [806 Laboratory] *
* 9-17-98 1:05:43 AM *
****

* Analyzed by: 9/20/98 Reviewed by: 9/21/98 *

Customer : P.FRESHOUR/D.PERRY (6134/SMO)
Customer Sample ID : 042312-004
Lab Sample ID : 80192906

Sample Description : MARINELLI SOLID SAMPLE
Sample Quantity : 738.000 gram
Sample Date/Time : 9-15-98 10:00:00 AM
Acquire Start Date/Time : 9-16-98 11:22:54 PM
Detector Name : LAB02
Elapsed Live/Real Time : 6000 / 6003 seconds

Comments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	6.44E-01	4.31E-01	6.14E-01
RA-226	2.08E+00	6.27E-01	5.24E-01
PB-214	8.21E-01	2.74E-01	4.60E-02
BI-214	7.80E-01	1.38E-01	4.21E-02
PB-210	Not Detected	---	3.77E+01
TH-232	8.84E-01	4.54E-01	1.51E-01
RA-228	8.42E-01	2.35E-01	1.44E-01
AC-228	8.68E-01	1.37E+00	2.46E-01
TH-228	8.48E-01	2.73E-01	5.04E-01
RA-224	9.87E-01	4.14E-01	6.17E-02
PB-212	9.18E-01	1.57E-01	4.01E-02
BI-212	Not Detected	---	2.98E-01
TL-208	8.82E-01	2.25E-01	6.23E-02
U-235	1.83E-01	2.05E-01	2.40E-01
TH-231	Not Detected	---	2.46E+00
PA-231	Not Detected	---	4.05E+00
TH-227	Not Detected	---	3.74E-01
RA-223	Not Detected	---	2.26E-01
RN-219	Not Detected	---	3.95E-01
PB-211	Not Detected	---	8.94E-01
TL-207	Not Detected	---	1.25E+01
AM-241	Not Detected	---	5.04E-01
PU-239	Not Detected	---	4.60E+02
NP-237	Not Detected	---	3.55E-01
PA-233	Not Detected	---	6.07E-02
TH-229	Not Detected	---	2.62E-01

[Summary Report] - Sample ID: : 80192906

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
AG-108m	Not Detected	---------	4.12E-02
AG-110m	Not Detected	---------	7.55E-02
BA-133	Not Detected	---------	7.14E-02
BE-7	Not Detected	---------	2.88E-01
CD-109	Not Detected	---------	1.21E+00
CD-115	Not Detected	---------	1.12E-01
CE-139	Not Detected	---------	3.01E-02
CE-141	Not Detected	---------	5.54E-02
CE-144	Not Detected	---------	2.52E-01
CO-56	Not Detected	---------	3.16E-02
CO-57	Not Detected	---------	3.09E-02
CO-58	Not Detected	---------	3.09E-02
CO-60	Not Detected	---------	3.37E-02
CR-51	Not Detected	---------	2.47E-01
CS-134	Not Detected	---------	4.87E-02
CS-137	7.00E-01	1.12E-01	2.46E-02
EU-152	Not Detected	---------	9.29E-02
EU-154	Not Detected	---------	1.90E-01
EU-155	Not Detected	---------	1.56E-01
FE-59	Not Detected	---------	6.61E-02
GD-153	Not Detected	---------	1.08E-01
HG-203	Not Detected	---------	3.43E-02
I-131	Not Detected	---------	3.32E-02
IR-192	Not Detected	---------	2.86E-02
K-40	1.34E+01	2.03E+00	2.46E-01
KR-85	Not Detected	---------	8.44E+00
MN-52	Not Detected	---------	3.34E-02
MN-54	Not Detected	---------	3.34E-02
MO-99	Not Detected	---------	3.16E-01
NA-22	Not Detected	---------	3.67E-02
NA-24	Not Detected	---------	1.79E-01
NB-95	Not Detected	---------	2.34E-01
ND-147	Not Detected	---------	2.23E-01
NI-57	Not Detected	---------	9.40E-02
NP-239	Not Detected	---------	1.40E-01
RU-103	Not Detected	---------	3.13E-02
RU-106	Not Detected	---------	2.77E-01
SB-122	Not Detected	---------	5.86E-02
SB-124	Not Detected	---------	2.81E-02
SB-125	Not Detected	---------	9.19E-02
SN-113	Not Detected	---------	3.90E-02
TA-182	Not Detected	---------	1.46E-01
TA-183	Not Detected	---------	5.32E-01
TC-99m	Not Detected	---------	2.40E+00
TL-201	Not Detected	---------	2.71E-01
XE-133	Not Detected	---------	2.49E-01
Y-88	Not Detected	---------	2.56E-02
ZN-65	Not Detected	---------	1.02E-01
ZR-95	Not Detected	---------	5.65E-02

Sandia National Laboratories
Radiation Protection Sample Diagnostics Program [806 Laboratory]
9-17-98 2:50:46 AM

Analyzed by: 9/20/98 Reviewed by: 9/21/98

Customer : P.FRESHOUR/D.PERRY (6134/SMO)
Customer Sample ID : 042313-004
Lab Sample ID : 80192907

Sample Description : MARINELLI SOLID SAMPLE
Sample Quantity : 730.000 gram
Sample Date/Time : 9-15-98 10:20:00 AM
Acquire Start Date/Time : 9-17-98 1:07:59 AM
Detector Name : LAB02
Elapsed Live/Real Time : 6000 / 6003 seconds

Comments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	8.45E-01	4.68E-01	6.31E-01
RA-226	1.94E+00	6.68E-01	4.80E-01
PB-214	7.34E-01	9.52E-01	4.47E-02
BI-214	Not Detected	---	3.74E-02
PB-210	Not Detected	---	3.42E+01
TH-232	8.04E-01	3.84E-01	1.49E-01
RA-228	8.61E-01	8.27E-01	1.50E-01
AC-228	8.02E-01	2.47E-01	2.50E-01
TH-228	7.10E-01	2.67E-01	4.93E-01
RA-224	8.76E-01	2.52E-01	6.71E-02
PB-212	8.43E-01	1.46E-01	3.89E-02
BI-212	8.65E-01	3.08E-01	2.72E-01
TL-208	7.32E-01	1.75E-01	6.21E-02
U-235	Not Detected	---	2.32E-01
TH-231	Not Detected	---	2.25E+00
PA-231	Not Detected	---	3.84E+00
TH-227	Not Detected	---	3.56E-01
RA-223	Not Detected	---	2.14E-01
RN-219	Not Detected	---	3.51E-01
PB-211	Not Detected	---	8.23E-01
TL-207	Not Detected	---	1.27E+01
AM-241	Not Detected	---	4.86E-01
PU-239	Not Detected	---	4.42E+02
NP-237	Not Detected	---	3.41E-01
PA-233	Not Detected	---	5.60E-02
TH-229	Not Detected	---	2.53E-01

[Summary Report] - Sample ID: : 80192907

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
AG-108m	Not Detected	---	3.79E-02
AG-110m	Not Detected	---	3.10E-02
BA-133	Not Detected	---	6.75E-02
BE-7	Not Detected	---	2.43E-01
CD-109	~~1.42E+00~~	~~6.55E-01~~	1.16E+00
CD-115	Not Detected	---	1.09E-01
CE-139	Not Detected	---	2.90E-02
CE-141	Not Detected	---	5.31E-02
CE-144	Not Detected	---	2.36E-01
CO-56	Not Detected	---	3.20E-02
CO-57	Not Detected	---	3.08E-02
CO-58	Not Detected	---	2.93E-02
CO-60	Not Detected	---	3.36E-02
CR-51	Not Detected	---	2.35E-01
CS-134	Not Detected	---	4.79E-02
CS-137	1.73E-02	1.53E-02	1.83E-02
EU-152	Not Detected	---	9.26E-02
EU-154	Not Detected	---	1.75E-01
EU-155	Not Detected	---	1.47E-01
FE-59	Not Detected	---	7.15E-02
GD-153	Not Detected	---	1.04E-01
HG-203	Not Detected	---	3.22E-02
I-131	Not Detected	---	3.11E-02
IR-192	Not Detected	---	2.62E-02
K-40	1.52E+01	2.33E+00	2.39E-01
KR-85	Not Detected	---	7.83E+00
MN-52	Not Detected	---	3.51E-02
MN-54	Not Detected	---	3.29E-02
MO-99	Not Detected	---	3.40E-01
NA-22	Not Detected	---	4.00E-02
NA-24	Not Detected	---	1.80E-01
NB-95	Not Detected	---	2.25E-01
ND-147	Not Detected	---	1.98E-01
NI-57	Not Detected	---	5.21E-02
NP-239	Not Detected	---	1.33E-01
RU-103	Not Detected	---	2.76E-02
RU-106	Not Detected	---	2.67E-01
SB-122	Not Detected	---	5.82E-02
SB-124	Not Detected	---	2.73E-02
SB-125	Not Detected	---	7.88E-02
SN-113	Not Detected	---	3.52E-02
TA-182	Not Detected	---	1.47E-01
TA-183	Not Detected	---	5.14E-01
TC-99m	Not Detected	---	2.75E+00
TL-201	Not Detected	---	2.59E-01
XE-133	Not Detected	---	2.35E-01
Y-88	Not Detected	---	2.72E-02
ZN-65	Not Detected	---	9.83E-02
ZR-95	Not Detected	---	5.46E-02

Not detected
9/20/98

Sandia National Laboratories

Radiation Protection Sample Diagnostics Program [806 Laboratory]

9-17-98 4:35:52 AM

Analyzed by: 9/20/98 Reviewed by: 9/21/98

Customer : P.FRESHOUR/D.PERRY (6134/SMO)
Customer Sample ID : 042239-004
Lab Sample ID : 80192908

Sample Description : MARINELLI SOLID SAMPLE
Sample Quantity : 777.000 gram
Sample Date/Time : 9-15-98 10:20:00 AM
Acquire Start Date/Time : 9-17-98 2:53:03 AM
Detector Name : LAB02
Elapsed Live/Real Time : 6000 / 6003 seconds

Comments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	1.07E+00	5.13E-01	6.33E-01
RA-226	1.57E+00	5.32E-01	4.92E-01
PB-214	7.57E-01	1.23E-01	3.93E-02
BI-214	7.09E-01	1.43E-01	3.84E-02
PB-210	Not Detected	---	3.38E+01
TH-232	9.08E-01	4.29E-01	1.32E-01
RA-228	Not Detected	---	1.63E-01
AC-228	8.62E-01	3.78E-01	2.36E-01
TH-228	8.09E-01	1.22E+00	4.38E-01
RA-224	8.57E-01	3.02E-01	6.73E-02
PB-212	8.30E-01	1.43E-01	3.76E-02
BI-212	1.05E+00	4.07E-01	2.83E-01
TL-208	8.04E-01	1.48E-01	6.14E-02
U-235	Not Detected	---	2.30E-01
TH-231	Not Detected	---	2.23E+00
PA-231	Not Detected	---	3.70E+00
TH-227	Not Detected	---	3.46E-01
RA-223	Not Detected	---	2.09E-01
RN-219	Not Detected	---	3.50E-01
PB-211	Not Detected	---	7.78E-01
TL-207	Not Detected	---	1.25E+01
AM-241	Not Detected	---	4.65E-01
PU-239	Not Detected	---	4.35E+02
NP-237	Not Detected	---	2.98E-01
PA-233	Not Detected	---	5.40E-02
TH-229	Not Detected	---	2.46E-01

[Summary Report] - Sample ID: : 80192908

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
AG-108m	Not Detected	---------	3.91E-02
AG-110m	Not Detected	---------	2.87E-02
BA-133	Not Detected	---------	6.56E-02
BE-7	Not Detected	---------	2.43E-01
CD-109	~~2.09E+00~~	~~7.04E-01~~	1.01E+00 Not detected 9/20/98
CD-115	Not Detected	---------	1.07E-01
CE-139	Not Detected	---------	2.83E-02
CE-141	Not Detected	---------	5.29E-02
CE-144	Not Detected	---------	2.36E-01
CO-56	Not Detected	---------	2.97E-02
CO-57	Not Detected	---------	2.95E-02
CO-58	Not Detected	---------	3.14E-02
CO-60	Not Detected	---------	3.15E-02
CR-51	Not Detected	---------	2.33E-01
CS-134	Not Detected	---------	4.62E-02
CS-137	1.49E-02	1.17E-02	1.59E-02
EU-152	Not Detected	---------	8.88E-02
EU-154	Not Detected	---------	1.80E-01
EU-155	Not Detected	---------	1.46E-01
FE-59	Not Detected	---------	6.95E-02
GD-153	Not Detected	---------	1.03E-01
HG-203	Not Detected	---------	3.05E-02
I-131	Not Detected	---------	3.20E-02
IR-192	Not Detected	---------	2.64E-02
K-40	1.55E+01	2.30E+00	2.45E-01
KR-85	Not Detected	---------	7.97E+00
MN-52	Not Detected	---------	3.24E-02
MN-54	Not Detected	---------	3.24E-02
MO-99	Not Detected	---------	3.19E-01
NA-22	Not Detected	---------	3.62E-02
NA-24	Not Detected	---------	2.03E-01
NB-95	Not Detected	---------	2.21E-01
ND-147	Not Detected	---------	2.08E-01
NI-57	Not Detected	---------	5.48E-02
NP-239	Not Detected	---------	1.32E-01
RU-103	Not Detected	---------	2.75E-02
RU-106	Not Detected	---------	2.75E-01
SB-122	Not Detected	---------	5.70E-02
SB-124	Not Detected	---------	2.70E-02
SB-125	Not Detected	---------	7.37E-02
SN-113	Not Detected	---------	3.54E-02
TA-182	Not Detected	---------	1.44E-01
TA-183	Not Detected	---------	4.96E-01
TC-99m	Not Detected	---------	3.32E+00
TL-201	Not Detected	---------	2.61E-01
XE-133	Not Detected	---------	2.37E-01
Y-88	Not Detected	---------	2.22E-02
ZN-65	Not Detected	---------	9.81E-02
ZR-95	Not Detected	---------	5.34E-02

****
* Sandia National Laboratories *
* Radiation Protection Sample Diagnostics Program [806 Laboratory] *
* 9-17-98 6:20:53 AM *
****

* Analyzed by: 9/20/98 Reviewed by: 9/21/98 *

Customer : P.FRESHOUR/D.PERRY (6134/SMO)
Customer Sample ID : 042314-004
Lab Sample ID : 80192909

Sample Description : MARINELLI SOLID SAMPLE
Sample Quantity : 755.000 gram
Sample Date/Time : 9-15-98 10:25:00 AM
Acquire Start Date/Time : 9-17-98 4:38:07 AM
Detector Name : LAB02
Elapsed Live/Real Time : 6000 / 6002 seconds

Comments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	9.26E-01	4.05E-01	5.95E-01
RA-226	Not Detected	---	5.35E-01
PB-214	7.21E-01	1.25E-01	4.44E-02
BI-214	6.63E-01	1.33E-01	4.00E-02
PB-210	Not Detected	---	3.17E+01
TH-232	7.20E-01	3.69E-01	1.31E-01
RA-228	6.91E-01	2.83E-01	1.24E-01
AC-228	7.21E-01	3.29E-01	2.39E-01
TH-228	Not Detected	---	7.74E-01
RA-224	7.15E-01	2.69E-01	6.75E-02
PB-212	7.05E-01	1.18E-01	3.63E-02
BI-212	7.53E-01	5.46E-01	2.79E-01
TL-208	6.42E-01	1.43E-01	5.68E-02
U-235	9.17E-02	9.97E-02	1.32E-01
TH-231	Not Detected	---	2.13E+00
PA-231	Not Detected	---	3.55E+00
TH-227	Not Detected	---	3.21E-01
RA-223	Not Detected	---	2.04E-01
RN-219	Not Detected	---	3.35E-01
PB-211	Not Detected	---	7.55E-01
TL-207	Not Detected	---	1.12E+01
AM-241	Not Detected	---	4.49E-01
PU-239	Not Detected	---	4.11E+02
NP-237	Not Detected	---	3.13E-01
PA-233	Not Detected	---	5.29E-02
TH-229	Not Detected	---	2.34E-01

[Summary Report] - Sample ID: : 80192909

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
AG-108m	Not Detected	---	3.61E-02
AG-110m	Not Detected	---	3.36E-02
BA-133	Not Detected	---	6.48E-02
BE-7	Not Detected	---	2.27E-01
CD-109	~~1.54E+00~~	~~6.43E-01~~	1.06E+00 Not detected 9/20/18
CD-115	Not Detected	---	1.06E-01
CE-139	Not Detected	---	2.81E-02
CE-141	Not Detected	---	3.09E-02
CE-144	Not Detected	---	2.28E-01
CO-56	Not Detected	---	2.98E-02
CO-57	Not Detected	---	2.84E-02
CO-58	Not Detected	---	3.06E-02
CO-60	Not Detected	---	3.04E-02
CR-51	Not Detected	---	2.30E-01
CS-134	Not Detected	---	4.48E-02
CS-137	5.96E-02	4.40E-02	2.10E-02
EU-152	Not Detected	---	8.54E-02
EU-154	Not Detected	---	1.67E-01
EU-155	Not Detected	---	1.38E-01
FE-59	Not Detected	---	6.20E-02
GD-153	Not Detected	---	9.86E-02
HG-203	Not Detected	---	2.94E-02
I-131	Not Detected	---	2.97E-02
IR-192	Not Detected	---	2.58E-02
K-40	1.22E+01	1.85E+00	2.35E-01
KR-85	Not Detected	---	7.45E+00
MN-52	Not Detected	---	3.19E-02
MN-54	Not Detected	---	1.39E-02
MO-99	Not Detected	---	3.37E-01
NA-22	Not Detected	---	3.74E-02
NA-24	Not Detected	---	1.97E-01
NB-95	Not Detected	---	2.08E-01
ND-147	Not Detected	---	2.07E-01
NI-57	Not Detected	---	5.71E-02
NP-239	Not Detected	---	1.25E-01
RU-103	Not Detected	---	2.69E-02
RU-106	Not Detected	---	2.62E-01
SB-122	Not Detected	---	5.34E-02
SB-124	Not Detected	---	2.65E-02
SB-125	Not Detected	---	7.43E-02
SN-113	Not Detected	---	3.35E-02
TA-182	Not Detected	---	1.39E-01
TA-183	Not Detected	---	4.87E-01
TC-99m	Not Detected	---	3.86E+00
TL-201	Not Detected	---	2.51E-01
XE-133	Not Detected	---	2.34E-01
Y-88	Not Detected	---	2.33E-02
ZN-65	Not Detected	---	9.59E-02
ZR-95	Not Detected	---	4.88E-02

****
* Sandia National Laboratories *
* Radiation Protection Sample Diagnostics Program [806 Laboratory] *
* 9-17-98 8:05:51 AM *
****

* Analyzed by: 9/20/98 Reviewed by: 9/21/98 *

Customer : P.FRESHOUR/D.PERRY (6134/SMO)
Customer Sample ID : 042315-004
Lab Sample ID : 80192910

Sample Description : MARINELLI SOLID SAMPLE
Sample Quantity : 693.000 gram
Sample Date/Time : 9-15-98 10:30:00 AM
Acquire Start Date/Time : 9-17-98 6:23:02 AM
Detector Name : LAB02
Elapsed Live/Real Time : 6000 / 6002 seconds

Comments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	8.18E-01	5.87E-01	6.19E-01
RA-226	2.01E+00	9.73E-01	6.36E-01
PB-214	7.91E-01	1.35E-01	4.40E-02
BI-214	7.11E-01	1.77E-01	3.77E-02
PB-210	Not Detected	---	3.61E+01
TH-232	8.37E-01	4.73E-01	1.51E-01
RA-228	8.10E-01	2.30E-01	1.40E-01
AC-228	8.15E-01	3.13E-01	2.61E-01
TH-228	8.62E-01	2.90E-01	4.97E-01
RA-224	8.01E-01	3.18E-01	6.85E-02
PB-212	8.05E-01	1.33E-01	3.99E-02
BI-212	8.14E-01	4.74E-01	3.06E-01
TL-208	7.65E-01	4.46E-01	6.09E-02
U-235	Not Detected	---	2.30E-01
TH-231	Not Detected	---	2.24E+00
PA-231	Not Detected	---	3.88E+00
TH-227	Not Detected	---	3.62E-01
RA-223	Not Detected	---	2.27E-01
RN-219	Not Detected	---	3.76E-01
PB-211	Not Detected	---	8.53E-01
TL-207	Not Detected	---	1.35E+01
AM-241	Not Detected	---	4.93E-01
PU-239	Not Detected	---	4.51E+02
NP-237	Not Detected	---	3.55E-01
PA-233	Not Detected	---	5.83E-02
TH-229	Not Detected	---	2.60E-01

[Summary Report] - Sample ID: : 80192910

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
AG-108m	Not Detected	---	3.98E-02
AG-110m	Not Detected	---	3.28E-02
BA-133	Not Detected	---	7.03E-02
BE-7	Not Detected	---	2.63E-01
CD-109	~~2.02E+00~~	~~9.03E-01~~	1.20E+00
CD-115	Not Detected	---	1.20E-01
CE-139	Not Detected	---	2.96E-02
CE-141	Not Detected	---	5.43E-02
CE-144	Not Detected	---	2.45E-01
CO-56	Not Detected	---	3.28E-02
CO-57	Not Detected	---	3.05E-02
CO-58	Not Detected	---	3.04E-02
CO-60	Not Detected	---	3.41E-02
CR-51	Not Detected	---	2.39E-01
CS-134	Not Detected	---	4.84E-02
CS-137	2.87E-02	2.09E-02	2.18E-02
EU-152	Not Detected	---	9.16E-02
EU-154	Not Detected	---	1.82E-01
EU-155	Not Detected	---	1.49E-01
FE-59	Not Detected	---	6.64E-02
GD-153	Not Detected	---	1.08E-01
HG-203	Not Detected	---	3.21E-02
I-131	Not Detected	---	3.33E-02
IR-192	Not Detected	---	2.71E-02
K-40	1.41E+01	2.14E+00	2.34E-01
KR-85	Not Detected	---	8.09E+00
MN-52	Not Detected	---	3.49E-02
MN-54	Not Detected	---	3.56E-02
MO-99	Not Detected	---	3.59E-01
NA-22	Not Detected	---	4.21E-02
NA-24	Not Detected	---	2.60E-01
NB-95	Not Detected	---	2.38E-01
ND-147	Not Detected	---	2.16E-01
NI-57	Not Detected	---	1.17E-01
NP-239	Not Detected	---	1.34E-01
RU-103	Not Detected	---	2.94E-02
RU-106	Not Detected	---	2.84E-01
SB-122	Not Detected	---	6.15E-02
SB-124	Not Detected	---	2.76E-02
SB-125	Not Detected	---	7.91E-02
SN-113	Not Detected	---	3.68E-02
TA-182	Not Detected	---	1.54E-01
TA-183	Not Detected	---	5.42E-01
TC-99m	Not Detected	---	5.02E+00
TL-201	Not Detected	---	2.80E-01
XE-133	Not Detected	---	2.59E-01
Y-88	Not Detected	---	2.51E-02
ZN-65	Not Detected	---	1.06E-01
ZR-95	Not Detected	---	5.80E-02

Not detected
5/20/98

Sandia National Laboratories
Radiation Protection Sample Diagnostics Program [806 Laboratory]
9-17-98 1:48:42 PM

Analyzed by: 9/20/98 Reviewed by: 9/21/98

Customer : P.FRESHOUR/D.PERRY (6134/SMO)
Customer Sample ID : 042316-004
Lab Sample ID : 80192911

Sample Description : MARINELLI SOLID SAMPLE
Sample Quantity : 892.000 gram
Sample Date/Time : 9-15-98 10:40:00 AM
Acquire Start Date/Time : 9-17-98 12:05:53 PM
Detector Name : LAB02
Elapsed Live/Real Time : 6000 / 6003 seconds

Comments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	Not Detected	---------	5.14E-01
RA-226	Not Detected	---------	4.66E-01
PB-214	6.49E-01	1.11E-01	3.75E-02
BI-214	5.84E-01	1.10E-01	3.44E-02
PB-210	Not Detected	---------	2.87E+01
TH-232	6.80E-01	3.23E-01	1.11E-01
RA-228	6.25E-01	1.93E-01	1.10E-01
AC-228	6.26E-01	2.02E-01	2.06E-01
TH-228	6.28E-01	4.79E-01	3.93E-01
RA-224	6.62E-01	2.16E-01	5.81E-02
PB-212	6.64E-01	2.20E-01	3.08E-02
BI-212	7.67E-01	3.92E-01	2.57E-01
TL-208	6.29E-01	1.33E-01	4.88E-02
U-235	Not Detected	---------	1.93E-01
TH-231	Not Detected	---------	1.91E+00
PA-231	Not Detected	---------	3.17E+00
TH-227	Not Detected	---------	2.86E-01
RA-223	Not Detected	---------	1.87E-01
RN-219	Not Detected	---------	3.07E-01
PB-211	Not Detected	---------	6.91E-01
TL-207	Not Detected	---------	1.05E+01
AM-241	Not Detected	---------	4.02E-01
PU-239	Not Detected	---------	3.78E+02
NP-237	Not Detected	---------	2.79E-01
PA-233	Not Detected	---------	4.68E-02
TH-229	Not Detected	---------	2.18E-01

[Summary Report] - Sample ID: : 80192911

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
AG-108m	Not Detected	---------	3.25E-02
AG-110m	Not Detected	---------	2.47E-02
BA-133	Not Detected	---------	5.59E-02
BE-7	Not Detected	---------	2.04E-01
CD-109	Not Detected	---------	9.47E-01
CD-115	Not Detected	---------	1.04E-01
CE-139	Not Detected	---------	2.44E-02
CE-141	Not Detected	---------	4.51E-02
CE-144	Not Detected	---------	2.04E-01
CO-56	Not Detected	---------	2.76E-02
CO-57	Not Detected	---------	2.57E-02
CO-58	Not Detected	---------	2.57E-02
CO-60	Not Detected	---------	2.77E-02
CR-51	Not Detected	---------	1.93E-01
CS-134	Not Detected	---------	4.00E-02
CS-137	Not Detected	---------	2.68E-02
EU-152	Not Detected	---------	7.73E-02
EU-154	Not Detected	---------	1.49E-01
EU-155	Not Detected	---------	1.29E-01
FE-59	Not Detected	---------	5.78E-02
GD-153	Not Detected	---------	8.98E-02
HG-203	Not Detected	---------	2.66E-02
I-131	Not Detected	---------	2.80E-02
IR-192	Not Detected	---------	2.25E-02
K-40	1.30E+01	2.16E+00	2.09E-01
KR-85	Not Detected	---------	6.52E+00
MN-52	Not Detected	---------	2.96E-02
MN-54	Not Detected	---------	2.91E-02
MO-99	Not Detected	---------	3.27E-01
NA-22	Not Detected	---------	3.35E-02
NA-24	Not Detected	---------	2.42E-01
NB-95	Not Detected	---------	1.97E-01
ND-147	Not Detected	---------	1.80E-01
NI-57	Not Detected	---------	5.13E-02
NP-239	Not Detected	---------	1.15E-01
RU-103	Not Detected	---------	2.37E-02
RU-106	Not Detected	---------	2.30E-01
SB-122	Not Detected	---------	5.36E-02
SB-124	Not Detected	---------	2.33E-02
SB-125	Not Detected	---------	6.70E-02
SN-113	Not Detected	---------	3.03E-02
TA-182	Not Detected	---------	1.26E-01
TA-183	Not Detected	---------	4.56E-01
TC-99m	Not Detected	---------	7.90E+00
TL-201	Not Detected	---------	2.38E-01
XE-133	Not Detected	---------	2.38E-01
Y-88	Not Detected	---------	1.99E-02
ZN-65	Not Detected	---------	8.56E-02
ZR-95	Not Detected	---------	4.74E-02

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* Sandia National Laboratories *
* Radiation Protection Sample Diagnostics Program [806 Laboratory] *
* 9-17-98 3:33:38 PM *
****

* Analyzed by: 9/20/98 Reviewed by: 9/21/98 *

Customer : P.FRESHOUR/D.PERRY (6134/SMO)
Customer Sample ID : 042317-004
Lab Sample ID : 80192912

Sample Description : MARINELLI SOLID SAMPLE
Sample Quantity : 1061.000 gram
Sample Date/Time : 9-15-98 10:45:00 AM
Acquire Start Date/Time : 9-17-98 1:50:55 PM
Detector Name : LAB02
Elapsed Live/Real Time : 6000 / 6003 seconds

Comments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	Not Detected	---	5.50E-01
RA-226	1.66E+00	4.98E-01	4.22E-01
PB-214	8.77E-01	1.34E-01	3.26E-02
BI-214	7.81E-01	2.45E-01	2.99E-02
PB-210	Not Detected	---	2.55E+01
TH-232	4.39E-01	2.26E-01	9.96E-02
RA-228	4.75E-01	1.68E-01	9.76E-02
AC-228	3.87E-01	6.23E-01	1.73E-01
TH-228	3.20E-01	4.57E-01	3.40E-01
RA-224	4.02E-01	1.30E-01	4.47E-02
PB-212	4.10E-01	4.66E-01	2.79E-02
BI-212	4.63E-01	2.50E-01	1.99E-01
TL-208	3.77E-01	8.07E-02	4.30E-02
U-235	9.26E-02	1.55E-01	1.80E-01
TH-231	Not Detected	---	1.69E+00
PA-231	Not Detected	---	2.91E+00
TH-227	Not Detected	---	2.28E-01
RA-223	Not Detected	---	1.71E-01
RN-219	Not Detected	---	2.81E-01
PB-211	Not Detected	---	6.24E-01
TL-207	Not Detected	---	9.55E+00
AM-241	Not Detected	---	3.54E-01
PU-239	Not Detected	---	3.40E+02
NP-237	Not Detected	---	2.92E-01
PA-233	Not Detected	---	4.21E-02
TH-229	Not Detected	---	1.93E-01

[Summary Report] - Sample ID: : 80192912

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
AG-108m	Not Detected	---	2.78E-02
AG-110m	Not Detected	---	2.15E-02
BA-133	Not Detected	---	5.69E-02
BE-7	Not Detected	---	1.88E-01
CD-109	Not Detected	---	9.68E-01
CD-115	Not Detected	---	8.76E-02
CE-139	Not Detected	---	2.25E-02
CE-141	Not Detected	---	4.19E-02
CE-144	Not Detected	---	1.85E-01
CO-56	Not Detected	---	2.39E-02
CO-57	Not Detected	---	2.38E-02
CO-58	Not Detected	---	2.31E-02
CO-60	Not Detected	---	2.47E-02
CR-51	Not Detected	---	1.78E-01
CS-134	Not Detected	---	3.97E-02
CS-137	Not Detected	---	2.39E-02
EU-152	Not Detected	---	7.15E-02
EU-154	Not Detected	---	1.28E-01
EU-155	Not Detected	---	1.12E-01
FE-59	Not Detected	---	4.80E-02
GD-153	Not Detected	---	7.93E-02
HG-203	Not Detected	---	2.33E-02
I-131	Not Detected	---	2.39E-02
IR-192	Not Detected	---	1.98E-02
K-40	1.05E+01	1.57E+00	1.85E-01
KR-85	Not Detected	---	5.52E+00
MN-52	Not Detected	---	2.69E-02
MN-54	Not Detected	---	2.37E-02
MO-99	Not Detected	---	2.74E-01
NA-22	Not Detected	---	3.02E-02
NA-24	Not Detected	---	2.40E-01
NB-95	Not Detected	---	1.59E-01
ND-147	Not Detected	---	1.60E-01
NI-57	Not Detected	---	5.21E-02
NP-239	Not Detected	---	9.99E-02
RU-103	Not Detected	---	2.07E-02
RU-106	Not Detected	---	1.96E-01
SB-122	Not Detected	---	4.55E-02
SB-124	Not Detected	---	2.06E-02
SB-125	Not Detected	---	5.99E-02
SN-113	Not Detected	---	2.63E-02
TA-182	Not Detected	---	1.19E-01
TA-183	Not Detected	---	4.09E-01
TC-99m	Not Detected	---	8.87E+00
TL-201	Not Detected	---	2.16E-01
XE-133	Not Detected	---	2.17E-01
Y-88	Not Detected	---	1.89E-02
ZN-65	Not Detected	---	8.11E-02
ZR-95	Not Detected	---	3.94E-02

Sandia National Laboratories

Radiation Protection Sample Diagnostics Program [806 Laboratory]

9-17-98 5:44:14 PM

Analyzed by: 9/20/98 Reviewed by: 9/21/98

Customer : P.FRESHOUR/D.PERRY (6134/SMO)
Customer Sample ID : 042318-004
Lab Sample ID : 80192913

Sample Description : MARINELLI SOLID SAMPLE
Sample Quantity : 691.000 gram
Sample Date/Time : 9-15-98 10:55:00 AM
Acquire Start Date/Time : 9-17-98 4:01:29 PM
Detector Name : LAB02
Elapsed Live/Real Time : 6000 / 6002 seconds

Comments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	5.10E-01	3.74E-01	5.49E-01
RA-226	1.62E+00	5.50E-01	5.25E-01
PB-214	7.61E-01	8.03E-01	4.27E-02
BI-214	7.06E-01	2.81E-01	3.36E-02
PB-210	Not Detected	---	3.21E+01
TH-232	5.21E-01	2.96E-01	1.38E-01
RA-228	5.19E-01	2.18E-01	1.28E-01
AC-228	6.20E-01	2.45E-01	2.60E-01
TH-228	5.02E-01	2.03E-01	4.60E-01
RA-224	5.03E-01	2.12E-01	5.66E-02
PB-212	5.11E-01	1.02E-01	3.82E-02
BI-212	6.92E-01	3.57E-01	2.71E-01
TL-208	4.69E-01	1.22E-01	5.46E-02
U-235	Not Detected	---	2.17E-01
TH-231	Not Detected	---	2.14E+00
PA-231	Not Detected	---	3.58E+00
TH-227	Not Detected	---	3.04E-01
RA-223	Not Detected	---	2.09E-01
RN-219	Not Detected	---	3.42E-01
PB-211	Not Detected	---	7.75E-01
TL-207	Not Detected	---	1.23E+01
AM-241	Not Detected	---	4.40E-01
PU-239	Not Detected	---	4.08E+02
NP-237	Not Detected	---	3.27E-01
PA-233	Not Detected	---	5.26E-02
TH-229	Not Detected	---	2.32E-01

[Summary Report] - Sample ID: : 80192913

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
AG-108m	Not Detected	---	3.64E-02
AG-110m	Not Detected	---	2.75E-02
BA-133	Not Detected	---	6.80E-02
BE-7	Not Detected	---	2.23E-01
CD-109	Not Detected	---	1.11E+00
CD-115	Not Detected	---	1.20E-01
CE-139	Not Detected	---	2.72E-02
CE-141	Not Detected	---	5.11E-02
CE-144	Not Detected	---	2.25E-01
CO-56	Not Detected	---	2.91E-02
CO-57	Not Detected	---	2.72E-02
CO-58	Not Detected	---	2.85E-02
CO-60	Not Detected	---	3.04E-02
CR-51	Not Detected	---	2.29E-01
CS-134	Not Detected	---	4.80E-02
CS-137	Not Detected	---	3.16E-02
EU-152	Not Detected	---	8.17E-02
EU-154	Not Detected	---	1.67E-01
EU-155	Not Detected	---	1.35E-01
FE-59	Not Detected	---	6.26E-02
GD-153	Not Detected	---	9.88E-02
HG-203	Not Detected	---	2.96E-02
I-131	Not Detected	---	3.15E-02
IR-192	Not Detected	---	2.58E-02
K-40	9.65E+00	1.62E+00	2.42E-01
KR-85	Not Detected	---	7.53E+00
MN-52	Not Detected	---	3.65E-02
MN-54	Not Detected	---	3.30E-02
MO-99	Not Detected	---	3.91E-01
NA-22	Not Detected	---	3.55E-02
NA-24	Not Detected	---	3.51E-01
NB-95	Not Detected	---	2.15E-01
ND-147	Not Detected	---	2.02E-01
NI-57	Not Detected	---	1.35E-01
NP-239	Not Detected	---	1.22E-01
RU-103	Not Detected	---	2.82E-02
RU-106	Not Detected	---	2.42E-01
SB-122	Not Detected	---	6.14E-02
SB-124	Not Detected	---	2.75E-02
SB-125	Not Detected	---	7.58E-02
SN-113	Not Detected	---	3.35E-02
TA-182	Not Detected	---	1.40E-01
TA-183	Not Detected	---	5.07E-01
TC-99m	Not Detected	---	1.34E+01
TL-201	Not Detected	---	2.78E-01
XE-133	Not Detected	---	2.72E-01
Y-88	Not Detected	---	2.42E-02
ZN-65	Not Detected	---	9.20E-02
ZR-95	Not Detected	---	5.01E-02

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* Sandia National Laboratories *
* Radiation Protection Sample Diagnostics Program [806 Laboratory] *
* 9-17-98 7:29:16 PM *
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* Analyzed by: 9/20/98 Reviewed by: 9/21/98 *

Customer : P.FRESHOUR/D.PERRY (6134/SMO)
Customer Sample ID : 042319-004
Lab Sample ID : 80192914

Sample Description : MARINELLI SOLID SAMPLE
Sample Quantity : 685.000 gram
Sample Date/Time : 9-15-98 1:20:00 PM
Acquire Start Date/Time : 9-17-98 5:46:23 PM
Detector Name : LAB02
Elapsed Live/Real Time : 6000 / 6002 seconds

Comments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	4.54E-01	3.86E-01	5.99E-01
RA-226	Not Detected	---	5.24E-01
PB-214	8.11E-01	2.42E-01	4.52E-02
BI-214	7.74E-01	4.16E-01	4.52E-02
PB-210	Not Detected	---	3.70E+01
TH-232	7.11E-01	3.46E-01	1.41E-01
RA-228	7.65E-01	2.36E-01	1.41E-01
AC-228	7.91E-01	2.47E-01	2.68E-01
TH-228	7.31E-01	2.37E-01	4.76E-01
RA-224	7.31E-01	2.20E-01	7.49E-02
PB-212	7.93E-01	1.41E-01	3.96E-02
BI-212	6.98E-01	3.20E-01	2.93E-01
TL-208	6.99E-01	1.56E-01	6.30E-02
U-235	Not Detected	---	2.40E-01
TH-231	Not Detected	---	2.28E+00
PA-231	Not Detected	---	3.84E+00
TH-227	Not Detected	---	3.57E-01
RA-223	Not Detected	---	2.25E-01
RN-219	Not Detected	---	3.63E-01
PB-211	Not Detected	---	8.25E-01
TL-207	Not Detected	---	1.30E+01
AM-241	Not Detected	---	4.90E-01
PU-239	Not Detected	---	4.38E+02
NP-237	~~5.26E-01~~	~~2.25E-01~~	3.39E-01
PA-233	Not Detected	---	5.75E-02
TH-229	Not Detected	---	2.56E-01

Not detected 9/20/98

[Summary Report] - Sample ID: : 80192914

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
AG-108m	Not Detected	---------	3.98E-02
AG-110m	Not Detected	---------	3.16E-02
BA-133	Not Detected	---------	7.18E-02
BE-7	Not Detected	---------	2.58E-01
CD-109	Not Detected	---------	1.15E+00
CD-115	Not Detected	---------	1.30E-01
CE-139	Not Detected	---------	2.96E-02
CE-141	Not Detected	---------	5.58E-02
CE-144	Not Detected	---------	2.45E-01
CO-56	Not Detected	---------	3.29E-02
CO-57	Not Detected	---------	3.04E-02
CO-58	Not Detected	---------	3.26E-02
CO-60	Not Detected	---------	3.36E-02
CR-51	Not Detected	---------	2.40E-01
CS-134	Not Detected	---------	5.04E-02
CS-137	1.91E-02	1.83E-02	1.75E-02
EU-152	Not Detected	---------	9.12E-02
EU-154	Not Detected	---------	1.84E-01
EU-155	Not Detected	---------	1.51E-01
FE-59	Not Detected	---------	7.15E-02
GD-153	Not Detected	---------	1.09E-01
HG-203	Not Detected	---------	3.21E-02
I-131	Not Detected	---------	3.30E-02
IR-192	Not Detected	---------	2.66E-02
K-40	1.36E+01	2.08E+00	2.51E-01
KR-85	Not Detected	---------	8.20E+00
MN-52	Not Detected	---------	3.82E-02
MN-54	Not Detected	---------	3.43E-02
MO-99	Not Detected	---------	3.96E-01
NA-22	Not Detected	---------	3.96E-02
NA-24	Not Detected	---------	3.93E-01
NB-95	Not Detected	---------	2.51E-01
ND-147	Not Detected	---------	2.25E-01
NI-57	Not Detected	---------	7.04E-02
NP-239	Not Detected	---------	1.36E-01
RU-103	Not Detected	---------	2.99E-02
RU-106	Not Detected	---------	2.67E-01
SB-122	Not Detected	---------	6.52E-02
SB-124	Not Detected	---------	2.86E-02
SB-125	Not Detected	---------	7.95E-02
SN-113	Not Detected	---------	3.70E-02
TA-182	Not Detected	---------	1.56E-01
TA-183	Not Detected	---------	5.60E-01
TC-99m	Not Detected	---------	1.37E+01
TL-201	Not Detected	---------	3.07E-01
XE-133	Not Detected	---------	2.95E-01
Y-88	Not Detected	---------	2.72E-02
ZN-65	Not Detected	---------	1.08E-01
ZR-95	Not Detected	---------	5.56E-02

****

Sandia National Laboratories

Radiation Protection Sample Diagnostics Program [806 Laboratory]

9-17-98 9:14:23 PM

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Analyzed by: 9/20/98 Reviewed by: 9/21/98

****

Customer : P.FRESHOUR/D.PERRY (6134/SMO)
Customer Sample ID : 042320-004
Lab Sample ID : 80192915

Sample Description : MARINELLI SOLID SAMPLE
Sample Quantity : 700.000 gram
Sample Date/Time : 9-15-98 1:23:00 PM
Acquire Start Date/Time : 9-17-98 7:31:31 PM
Detector Name : LAB02
Elapsed Live/Real Time : 6000 / 6002 seconds

Comments:

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Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	4.02E-01	3.94E-01	6.06E-01
RA-226	1.34E+00	1.14E+00	5.57E-01
PB-214	6.82E-01	1.38E-01	4.56E-02
BI-214	6.64E-01	1.34E-01	3.84E-02
PB-210	Not Detected	---	3.49E+01
TH-232	7.54E-01	7.85E-01	1.40E-01
RA-228	8.87E-01	2.23E-01	1.34E-01
AC-228	8.14E-01	2.63E-01	2.59E-01
TH-228	7.33E-01	2.43E-01	4.58E-01
RA-224	8.32E-01	2.79E-01	6.50E-02
PB-212	7.65E-01	1.36E-01	3.89E-02
BI-212	8.18E-01	3.18E-01	2.72E-01
TL-208	6.57E-01	1.30E-01	6.14E-02
U-235	Not Detected	---	2.37E-01
TH-231	Not Detected	---	2.26E+00
PA-231	Not Detected	---	3.83E+00
TH-227	Not Detected	---	3.51E-01
RA-223	Not Detected	---	2.25E-01
RN-219	Not Detected	---	3.71E-01
PB-211	Not Detected	---	8.07E-01
TL-207	Not Detected	---	1.30E+01
AM-241	Not Detected	---	4.66E-01
PU-239	Not Detected	---	4.43E+02
NP-237	~~4.30E-01~~	~~2.11E-01~~	3.47E-01 Not detected
PA-233	Not Detected	---	5.54E-02
TH-229	Not Detected	---	2.56E-01

9/20/98

[Summary Report] - Sample ID: : 80192915

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
AG-108m	Not Detected	---------	3.91E-02
AG-110m	Not Detected	---------	4.08E-02
BA-133	Not Detected	---------	6.72E-02
BE-7	Not Detected	---------	2.52E-01
CD-109	Not Detected	---------	1.18E+00
CD-115	Not Detected	---------	1.32E-01
CE-139	Not Detected	---------	2.87E-02
CE-141	~~1.93E-02~~	~~7.33E-03~~	2.21E-02
CE-144	Not Detected	---------	2.35E-01
CO-56	Not Detected	---------	3.36E-02
CO-57	Not Detected	---------	2.99E-02
CO-58	Not Detected	---------	3.10E-02
CO-60	Not Detected	---------	3.59E-02
CR-51	Not Detected	---------	2.39E-01
CS-134	Not Detected	---------	4.66E-02
CS-137	1.15E-01	3.06E-02	2.22E-02
EU-152	Not Detected	---------	8.98E-02
EU-154	Not Detected	---------	1.80E-01
EU-155	Not Detected	---------	1.50E-01
FE-59	Not Detected	---------	7.17E-02
GD-153	Not Detected	---------	1.08E-01
HG-203	Not Detected	---------	3.17E-02
I-131	Not Detected	---------	3.33E-02
IR-192	Not Detected	---------	2.68E-02
K-40	1.33E+01	2.02E+00	2.54E-01
KR-85	Not Detected	---------	8.05E+00
MN-52	Not Detected	---------	3.79E-02
MN-54	Not Detected	---------	3.34E-02
MO-99	Not Detected	---------	3.89E-01
NA-22	Not Detected	---------	3.90E-02
NA-24	Not Detected	---------	3.63E-01
NB-95	Not Detected	---------	2.51E-01
ND-147	Not Detected	---------	2.23E-01
NI-57	Not Detected	---------	6.92E-02
NP-239	Not Detected	---------	1.33E-01
RU-103	Not Detected	---------	2.84E-02
RU-106	Not Detected	---------	2.56E-01
SB-122	Not Detected	---------	6.47E-02
SB-124	Not Detected	---------	2.76E-02
SB-125	Not Detected	---------	8.13E-02
SN-113	Not Detected	---------	3.76E-02
TA-182	Not Detected	---------	1.45E-01
TA-183	Not Detected	---------	5.40E-01
TC-99m	Not Detected	---------	1.63E+01
TL-201	Not Detected	---------	3.01E-01
XE-133	Not Detected	---------	2.93E-01
Y-88	Not Detected	---------	2.66E-02
ZN-65	Not Detected	---------	9.87E-02
ZR-95	Not Detected	---------	5.61E-02

Not detected
9/20/98

****
* Sandia National Laboratories *
* Radiation Protection Sample Diagnostics Program [806 Laboratory] *
* 9-17-98 10:59:33 PM *
****
* *
* Analyzed by: 9/20/98 Reviewed by: 9/21/98 *
****

Customer : P.FRESHOUR/D.PERRY (6134/SMO)
Customer Sample ID : 042321-004
Lab Sample ID : 80192916

Sample Description : MARINELLI SOLID SAMPLE
Sample Quantity : 751.000 gram
Sample Date/Time : 9-15-98 1:30:00 PM
Acquire Start Date/Time : 9-17-98 9:16:41 PM
Detector Name : LAB02
Elapsed Live/Real Time : 6000 / 6002 seconds

Comments:
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Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	8.90E-01	8.99E-01	5.94E-01
RA-226	1.73E+00	7.10E-01	5.62E-01
PB-214	8.01E-01	3.24E-01	4.38E-02
BI-214	7.26E-01	1.87E-01	3.63E-02
PB-210	Not Detected	---	3.27E+01
TH-232	6.29E-01	3.32E-01	1.26E-01
RA-228	7.50E-01	2.56E-01	1.33E-01
AC-228	6.46E-01	3.72E-01	2.41E-01
TH-228	6.71E-01	4.69E-01	4.24E-01
RA-224	6.04E-01	1.85E-01	5.71E-02
PB-212	6.38E-01	1.21E-01	3.70E-02
BI-212	6.47E-01	2.06E-01	2.73E-01
TL-208	6.39E-01	1.48E-01	5.73E-02
U-235	1.33E-01	1.90E-01	2.21E-01
TH-231	Not Detected	---	2.18E+00
PA-231	Not Detected	---	3.58E+00
TH-227	Not Detected	---	3.11E-01
RA-223	Not Detected	---	2.12E-01
RN-219	Not Detected	---	3.48E-01
PB-211	Not Detected	---	7.89E-01
TL-207	Not Detected	---	1.18E+01
AM-241	Not Detected	---	4.45E-01
PU-239	Not Detected	---	4.15E+02
NP-237	Not Detected	---	3.46E-01
PA-233	Not Detected	---	5.49E-02
TH-229	Not Detected	---	2.37E-01

[Summary Report] - Sample ID: : 80192916

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
AG-108m	Not Detected	---	3.50E-02
AG-110m	Not Detected	---	3.45E-02
BA-133	Not Detected	---	6.82E-02
BE-7	Not Detected	---	2.29E-01
CD-109	Not Detected	---	1.18E+00
CD-115	Not Detected	---	1.22E-01
CE-139	Not Detected	---	2.76E-02
CE-141	Not Detected	---	5.23E-02
CE-144	Not Detected	---	2.26E-01
CO-56	Not Detected	---	2.94E-02
CO-57	Not Detected	---	2.82E-02
CO-58	Not Detected	---	2.88E-02
CO-60	Not Detected	---	3.05E-02
CR-51	Not Detected	---	2.25E-01
CS-134	Not Detected	---	4.58E-02
CS-137	Not Detected	---	1.96E-02
EU-152	Not Detected	---	8.45E-02
EU-154	Not Detected	---	1.61E-01
EU-155	Not Detected	---	1.41E-01
FE-59	Not Detected	---	6.47E-02
GD-153	Not Detected	---	9.88E-02
HG-203	Not Detected	---	3.05E-02
I-131	Not Detected	---	3.22E-02
IR-192	Not Detected	---	2.62E-02
K-40	1.24E+01	1.89E+00	2.29E-01
KR-85	Not Detected	---	7.49E+00
MN-52	Not Detected	---	3.39E-02
MN-54	Not Detected	---	3.16E-02
MO-99	Not Detected	---	3.98E-01
NA-22	Not Detected	---	3.89E-02
NA-24	Not Detected	---	4.30E-01
NB-95	Not Detected	---	2.25E-01
ND-147	Not Detected	---	2.14E-01
NI-57	Not Detected	---	7.08E-02
NP-239	Not Detected	---	1.26E-01
RU-103	Not Detected	---	2.69E-02
RU-106	Not Detected	---	2.51E-01
SB-122	Not Detected	---	6.34E-02
SB-124	Not Detected	---	2.50E-02
SB-125	Not Detected	---	7.43E-02
SN-113	Not Detected	---	3.50E-02
TA-182	Not Detected	---	1.40E-01
TA-183	Not Detected	---	5.29E-01
TC-99m	Not Detected	---	1.81E+01
TL-201	Not Detected	---	2.90E-01
XE-133	Not Detected	---	2.82E-01
Y-88	Not Detected	---	2.28E-02
ZN-65	Not Detected	---	9.53E-02
ZR-95	Not Detected	---	4.96E-02

****
* Sandia National Laboratories *
* Radiation Protection Sample Diagnostics Program [806 Laboratory] *
* 9-18-98 12:44:37 AM *
****

* Analyzed by: 9/20/98 Reviewed by: 9/21/98 *

Customer : P.FRESHOUR/D.PERRY (6134/SMO)
Customer Sample ID : 042322-004
Lab Sample ID : 80192917

Sample Description : MARINELLI SOLID SAMPLE
Sample Quantity : 703.000 gram
Sample Date/Time : 9-15-98 1:50:00 PM
Acquire Start Date/Time : 9-17-98 11:01:52 PM
Detector Name : LAB02
Elapsed Live/Real Time : 6000 / 6002 seconds

Comments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	Not Detected	---	7.65E-01
RA-226	1.73E+00	6.12E-01	5.47E-01
PB-214	7.65E-01	4.75E-01	4.19E-02
BI-214	6.63E-01	1.43E-01	4.37E-02
PB-210	Not Detected	---	3.48E+01
TH-232	6.34E-01	3.55E-01	1.41E-01
RA-228	7.29E-01	2.35E-01	1.40E-01
AC-228	6.95E-01	8.30E-01	2.58E-01
TH-228	4.43E-01	3.90E-01	4.33E-01
RA-224	7.83E-01	2.70E-01	6.74E-02
PB-212	7.36E-01	1.28E-01	3.87E-02
BI-212	7.28E-01	4.66E-01	3.05E-01
TL-208	6.67E-01	1.36E-01	6.24E-02
U-235	Not Detected	---	2.27E-01
TH-231	Not Detected	---	2.21E+00
PA-231	Not Detected	---	3.88E+00
TH-227	Not Detected	---	3.45E-01
RA-223	Not Detected	---	2.26E-01
RN-219	Not Detected	---	3.69E-01
PB-211	Not Detected	---	8.39E-01
TL-207	Not Detected	---	1.32E+01
AM-241	Not Detected	---	4.64E-01
PU-239	Not Detected	---	4.36E+02
NP-237	Not Detected	---	3.82E-01
PA-233	Not Detected	---	5.68E-02
TH-229	Not Detected	---	2.44E-01

[Summary Report] - Sample ID: : 80192917

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
AG-108m	Not Detected	---	3.87E-02
AG-110m	Not Detected	---	4.94E-02
BA-133	Not Detected	---	6.86E-02
BE-7	Not Detected	---	2.54E-01
CD-109	Not Detected	---	1.26E+00
CD-115	Not Detected	---	1.35E-01
CE-139	Not Detected	---	2.88E-02
CE-141	Not Detected	---	5.36E-02
CE-144	Not Detected	---	2.39E-01
CO-56	Not Detected	---	3.17E-02
CO-57	Not Detected	---	2.98E-02
CO-58	Not Detected	---	2.89E-02
CO-60	Not Detected	---	3.26E-02
CR-51	Not Detected	---	2.40E-01
CS-134	Not Detected	---	4.83E-02
CS-137	2.22E-01	5.61E-02	2.30E-02
EU-152	Not Detected	---	8.93E-02
EU-154	Not Detected	---	1.79E-01
EU-155	Not Detected	---	1.44E-01
FE-59	Not Detected	---	6.19E-02
GD-153	Not Detected	---	1.02E-01
HG-203	Not Detected	---	3.09E-02
I-131	Not Detected	---	3.47E-02
IR-192	Not Detected	---	2.70E-02
K-40	1.20E+01	1.89E+00	2.39E-01
KR-85	Not Detected	---	8.10E+00
MN-52	Not Detected	---	3.69E-02
MN-54	Not Detected	---	3.33E-02
MO-99	Not Detected	---	3.95E-01
NA-22	Not Detected	---	3.59E-02
NA-24	Not Detected	---	4.23E-01
NB-95	Not Detected	---	2.53E-01
ND-147	Not Detected	---	2.26E-01
NI-57	~~1.56E-01~~	~~7.89E-02~~	6.64E-02 Not detected 9/20/98
NP-239	Not Detected	---	1.30E-01
RU-103	Not Detected	---	2.85E-02
RU-106	Not Detected	---	2.79E-01
SB-122	Not Detected	---	6.67E-02
SB-124	Not Detected	---	3.02E-02
SB-125	Not Detected	---	8.16E-02
SN-113	Not Detected	---	3.63E-02
TA-182	Not Detected	---	1.49E-01
TA-183	Not Detected	---	5.53E-01
TC-99m	Not Detected	---	2.26E+01
TL-201	Not Detected	---	3.03E-01
XE-133	Not Detected	---	2.96E-01
Y-88	Not Detected	---	2.54E-02
ZN-65	Not Detected	---	1.03E-01
ZR-95	Not Detected	---	5.20E-02

****
* Sandia National Laboratories *
* Radiation Protection Sample Diagnostics Program [806 Laboratory] *
* 9-18-98 2:29:27 AM *
****

* Analyzed by: 9/20/98 Reviewed by: 9/21/98 *

Customer : P.FRESHOUR/D.PERRY (6134/SMO)
Customer Sample ID : 042323-004
Lab Sample ID : 80192918

Sample Description : MARINELLI SOLID SAMPLE
Sample Quantity : 707.000 gram
Sample Date/Time : 9-15-98 2:05:00 PM
Acquire Start Date/Time : 9-18-98 12:46:46 AM
Detector Name : LAB02
Elapsed Live/Real Time : 6000 / 6002 seconds

Comments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	Not Detected	---	7.89E-01
RA-226	1.85E+00	6.01E-01	5.71E-01
PB-214	6.92E-01	1.21E-01	4.38E-02
BI-214	6.44E-01	1.73E-01	3.96E-02
PB-210	Not Detected	---	3.43E+01
TH-232	7.48E-01	3.61E-01	1.33E-01
RA-228	8.15E-01	3.02E-01	1.42E-01
AC-228	7.99E-01	4.86E-01	2.57E-01
TH-228	Not Detected	---	4.12E-01
RA-224	9.37E-01	3.85E-01	6.43E-02
PB-212	8.25E-01	1.34E-01	3.97E-02
BI-212	8.33E-01	4.06E-01	2.76E-01
TL-208	8.04E-01	1.85E-01	6.23E-02
U-235	Not Detected	---	2.31E-01
TH-231	Not Detected	---	2.26E+00
PA-231	Not Detected	---	3.73E+00
TH-227	Not Detected	---	3.60E-01
RA-223	Not Detected	---	2.26E-01
RN-219	Not Detected	---	3.68E-01
PB-211	Not Detected	---	8.47E-01
TL-207	Not Detected	---	1.28E+01
AM-241	Not Detected	---	4.68E-01
PU-239	Not Detected	---	4.42E+02
NP-237	Not Detected	---	3.92E-01
PA-233	Not Detected	---	5.61E-02
TH-229	Not Detected	---	2.51E-01

[Summary Report] - Sample ID: : 80192918

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
AG-108m	Not Detected	---	3.92E-02
AG-110m	Not Detected	---	2.73E-02
BA-133	Not Detected	---	6.59E-02
BE-7	Not Detected	---	2.50E-01
CD-109	Not Detected	---	1.07E+00
CD-115	Not Detected	---	1.38E-01
CE-139	Not Detected	---	2.99E-02
CE-141	Not Detected	---	5.44E-02
CE-144	Not Detected	---	2.46E-01
CO-56	Not Detected	---	3.14E-02
CO-57	Not Detected	---	3.06E-02
CO-58	Not Detected	---	3.02E-02
CO-60	Not Detected	---	3.33E-02
CR-51	Not Detected	---	2.32E-01
CS-134	Not Detected	---	4.75E-02
CS-137	Not Detected	---	3.05E-02
EU-152	Not Detected	---	9.17E-02
EU-154	Not Detected	---	1.80E-01
EU-155	Not Detected	---	1.44E-01
FE-59	Not Detected	---	6.96E-02
GD-153	Not Detected	---	1.06E-01
HG-203	Not Detected	---	3.18E-02
I-131	Not Detected	---	3.40E-02
IR-192	Not Detected	---	2.64E-02
K-40	1.40E+01	2.09E+00	2.31E-01
KR-85	Not Detected	---	8.11E+00
MN-52	Not Detected	---	4.28E-02
MN-54	Not Detected	---	3.31E-02
MO-99	Not Detected	---	4.23E-01
NA-22	Not Detected	---	3.99E-02
NA-24	Not Detected	---	4.49E-01
NB-95	Not Detected	---	2.66E-01
ND-147	Not Detected	---	2.30E-01
NI-57	Not Detected	---	8.05E-02
NP-239	Not Detected	---	1.29E-01
RU-103	Not Detected	---	2.73E-02
RU-106	Not Detected	---	2.73E-01
SB-122	Not Detected	---	6.84E-02
SB-124	Not Detected	---	2.90E-02
SB-125	Not Detected	---	8.17E-02
SN-113	Not Detected	---	3.55E-02
TA-182	Not Detected	---	1.50E-01
TA-183	Not Detected	---	5.52E-01
TC-99m	Not Detected	---	2.68E+01
TL-201	Not Detected	---	3.24E-01
XE-133	Not Detected	---	3.09E-01
Y-88	Not Detected	---	2.47E-02
ZN-65	Not Detected	---	1.02E-01
ZR-95	Not Detected	---	5.55E-02

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Sandia National Laboratories

Radiation Protection Sample Diagnostics Program [806 Laboratory]

9-18-98 4:14:25 AM

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Analyzed by: 9/20/98 Reviewed by: 9/21/98

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Customer : P.FRESHOUR/D.PERRY (6134/SMO)
Customer Sample ID : 042940-004
Lab Sample ID : 80192919

Sample Description : MARINELLI SOLID SAMPLE
Sample Quantity : 749.000 gram
Sample Date/Time : 9-15-98 2:05:00 PM
Acquire Start Date/Time : 9-18-98 2:31:36 AM
Detector Name : LAB02
Elapsed Live/Real Time : 6000 / 6003 seconds

Comments:

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Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	3.67E-01	4.58E-01	5.99E-01
RA-226	2.13E+00	7.73E-01	5.90E-01
PB-214	7.90E-01	1.32E-01	4.25E-02
BI-214	7.30E-01	2.89E-01	4.41E-02
PB-210	Not Detected	---------	3.52E+01
TH-232	8.40E-01	4.20E-01	1.35E-01
RA-228	8.38E-01	2.65E-01	1.30E-01
AC-228	8.75E-01	2.42E-01	2.44E-01
TH-228	6.21E-01	2.34E-01	4.41E-01
RA-224	8.79E-01	2.81E-01	6.18E-02
PB-212	8.20E-01	1.34E-01	3.92E-02
BI-212	1.11E+00	6.29E-01	3.52E-01
TL-208	7.29E-01	1.57E-01	6.36E-02
U-235	1.31E-01	2.01E-01	2.34E-01
TH-231	Not Detected	---------	2.26E+00
PA-231	Not Detected	---------	3.74E+00
TH-227	Not Detected	---------	3.49E-01
RA-223	Not Detected	---------	2.32E-01
RN-219	Not Detected	---------	3.47E-01
PB-211	Not Detected	---------	7.65E-01
TL-207	Not Detected	---------	1.26E+01
AM-241	Not Detected	---------	4.78E-01
PU-239	Not Detected	---------	4.39E+02
NP-237	~~5.23E-01~~	~~2.16E-01~~	3.16E-01 Not detected 9/20/98
PA-233	Not Detected	---------	5.63E-02
TH-229	Not Detected	---------	2.47E-01

[Summary Report] - Sample ID: : 80192919

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
AG-108m	Not Detected	---	4.05E-02
AG-110m	Not Detected	---	2.93E-02
BA-133	Not Detected	---	6.80E-02
BE-7	Not Detected	---	2.45E-01
CD-109	Not Detected	---	1.07E+00
CD-115	Not Detected	---	1.44E-01
CE-139	Not Detected	---	2.91E-02
CE-141	Not Detected	---	5.57E-02
CE-144	Not Detected	---	2.42E-01
CO-56	Not Detected	---	3.20E-02
CO-57	Not Detected	---	3.03E-02
CO-58	Not Detected	---	3.07E-02
CO-60	Not Detected	---	3.35E-02
CR-51	Not Detected	---	2.36E-01
CS-134	Not Detected	---	4.81E-02
CS-137	Not Detected	---	3.02E-02
EU-152	Not Detected	---	9.08E-02
EU-154	Not Detected	---	1.86E-01
EU-155	Not Detected	---	1.49E-01
FE-59	Not Detected	---	6.72E-02
GD-153	Not Detected	---	1.05E-01
HG-203	Not Detected	---	3.19E-02
I-131	Not Detected	---	3.27E-02
IR-192	Not Detected	---	2.70E-02
K-40	1.50E+01	2.23E+00	2.35E-01
KR-85	Not Detected	---	7.79E+00
MN-52	Not Detected	---	3.74E-02
MN-54	Not Detected	---	3.35E-02
MO-99	Not Detected	---	4.25E-01
NA-22	Not Detected	---	4.13E-02
NA-24	Not Detected	---	5.07E-01
NB-95	Not Detected	---	2.62E-01
ND-147	Not Detected	---	2.22E-01
NI-57	Not Detected	---	8.21E-02
NP-239	Not Detected	---	1.33E-01
RU-103	Not Detected	---	2.87E-02
RU-106	Not Detected	---	2.71E-01
SB-122	Not Detected	---	7.31E-02
SB-124	Not Detected	---	2.91E-02
SB-125	Not Detected	---	7.68E-02
SN-113	Not Detected	---	3.61E-02
TA-182	Not Detected	---	1.47E-01
TA-183	Not Detected	---	5.79E-01
TC-99m	Not Detected	---	3.29E+01
TL-201	Not Detected	---	3.22E-01
XE-133	Not Detected	---	3.15E-01
Y-88	Not Detected	---	2.36E-02
ZN-65	Not Detected	---	9.97E-02
ZR-95	Not Detected	---	5.14E-02

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* Sandia National Laboratories *
* Radiation Protection Sample Diagnostics Program [806 Laboratory] *
* 9-18-98 5:59:25 AM *
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* Analyzed by: 9/20/98 Reviewed by: 9/21/98 *

Customer : P.FRESHOUR/D.PERRY (6134/SMO)
Customer Sample ID : 042324-004
Lab Sample ID : 80192920

Sample Description : MARINELLI SOLID SAMPLE
Sample Quantity : 811.000 gram
Sample Date/Time : 9-15-98 2:15:00 PM
Acquire Start Date/Time : 9-18-98 4:16:40 AM
Detector Name : LAB02
Elapsed Live/Real Time : 6000 / 6002 seconds

Comments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	Not Detected	---	7.15E-01
RA-226	1.47E+00	6.16E-01	5.12E-01
PB-214	6.96E-01	1.26E-01	3.70E-02
BI-214	6.37E-01	2.92E-01	3.59E-02
PB-210	Not Detected	---	3.05E+01
TH-232	7.05E-01	3.71E-01	1.26E-01
RA-228	7.47E-01	2.51E-01	1.20E-01
AC-228	6.45E-01	5.92E-01	2.26E-01
TH-228	5.33E-01	2.25E-01	4.31E-01
RA-224	7.17E-01	2.07E-01	5.84E-02
PB-212	6.83E-01	1.21E-01	3.55E-02
BI-212	6.22E-01	7.82E-01	2.59E-01
TL-208	5.77E-01	1.41E-01	5.89E-02
U-235	9.38E-02	1.80E-01	2.09E-01
TH-231	Not Detected	---	1.96E+00
PA-231	Not Detected	---	3.39E+00
TH-227	Not Detected	---	3.10E-01
RA-223	Not Detected	---	2.08E-01
RN-219	Not Detected	---	3.22E-01
PB-211	Not Detected	---	7.32E-01
TL-207	Not Detected	---	1.15E+01
AM-241	Not Detected	---	4.24E-01
PU-239	Not Detected	---	3.90E+02
NP-237	Not Detected	---	3.00E-01
PA-233	Not Detected	---	5.17E-02
TH-229	Not Detected	---	2.21E-01

[Summary Report] - Sample ID: : 80192920

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
AG-108m	Not Detected	---	3.40E-02
AG-110m	Not Detected	---	3.00E-02
BA-133	Not Detected	---	6.02E-02
BE-7	Not Detected	---	2.21E-01
CD-109	Not Detected	---	1.02E+00
CD-115	Not Detected	---	1.28E-01
CE-139	Not Detected	---	2.62E-02
CE-141	Not Detected	---	4.88E-02
CE-144	Not Detected	---	2.09E-01
CO-56	Not Detected	---	2.91E-02
CO-57	Not Detected	---	2.74E-02
CO-58	Not Detected	---	2.95E-02
CO-60	Not Detected	---	2.88E-02
CR-51	Not Detected	---	2.10E-01
CS-134	Not Detected	---	4.23E-02
CS-137	3.96E-02	1.99E-02	1.77E-02
EU-152	Not Detected	---	8.20E-02
EU-154	Not Detected	---	1.56E-01
EU-155	Not Detected	---	1.36E-01
FE-59	Not Detected	---	5.97E-02
GD-153	Not Detected	---	9.23E-02
HG-203	Not Detected	---	2.87E-02
I-131	Not Detected	---	3.13E-02
IR-192	Not Detected	---	2.43E-02
K-40	1.27E+01	3.45E+00	2.38E-01
KR-85	Not Detected	---	7.18E+00
MN-52	Not Detected	---	3.50E-02
MN-54	Not Detected	---	3.08E-02
MO-99	Not Detected	---	3.91E-01
NA-22	Not Detected	---	3.68E-02
NA-24	Not Detected	---	5.10E-01
NB-95	Not Detected	---	2.36E-01
ND-147	Not Detected	---	1.95E-01
NI-57	Not Detected	---	1.46E-01
NP-239	Not Detected	---	1.21E-01
RU-103	Not Detected	---	2.51E-02
RU-106	Not Detected	---	2.47E-01
SB-122	Not Detected	---	6.64E-02
SB-124	Not Detected	---	2.48E-02
SB-125	Not Detected	---	7.10E-02
SN-113	Not Detected	---	3.17E-02
TA-182	Not Detected	---	1.34E-01
TA-183	Not Detected	---	5.21E-01
TC-99m	Not Detected	---	3.67E+01
TL-201	Not Detected	---	2.96E-01
XE-133	Not Detected	---	2.95E-01
Y-88	Not Detected	---	2.14E-02
ZN-65	Not Detected	---	9.02E-02
ZR-95	Not Detected	---	5.04E-02

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* Sandia National Laboratories *
* Radiation Protection Sample Diagnostics Program [806 Laboratory] *
* 9-18-98 7:44:19 AM *
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* Analyzed by: 9/20/98 Reviewed by: 9/21/98 *

Customer : P.FRESHOUR/D.PERRY (6134/SMO)
Customer Sample ID : 042325-004
Lab Sample ID : 80192921

Sample Description : MARINELLI SOLID SAMPLE
Sample Quantity : 605.000 gram
Sample Date/Time : 9-15-98 2:25:00 PM
Acquire Start Date/Time : 9-18-98 6:01:34 AM
Detector Name : LAB02
Elapsed Live/Real Time : 6000 / 6002 seconds

Comments:

Nuclide Name	Activity (pCi/gram.)	2-sigma Error	MDA (pCi/gram)
U-238	9.59E-01	4.97E-01	6.91E-01
RA-226	1.95E+00	6.34E-01	5.74E-01
PB-214	8.28E-01	1.58E-01	4.84E-02
BI-214	7.08E-01	1.38E-01	4.26E-02
PB-210	Not Detected	---	3.62E+01
TH-232	7.74E-01	4.02E-01	1.57E-01
RA-228	6.44E-01	2.23E-01	1.41E-01
AC-228	7.15E-01	9.88E-01	2.98E-01
TH-228	6.23E-01	2.34E-01	5.22E-01
RA-224	7.57E-01	3.47E-01	6.38E-02
PB-212	6.65E-01	1.25E-01	4.40E-02
BI-212	8.10E-01	3.65E-01	2.86E-01
TL-208	6.65E-01	1.75E-01	7.24E-02
U-235	1.64E-01	2.12E-01	2.49E-01
TH-231	Not Detected	---	2.35E+00
PA-231	Not Detected	---	4.03E+00
TH-227	Not Detected	---	3.60E-01
RA-223	Not Detected	---	2.39E-01
RN-219	Not Detected	---	3.94E-01
PB-211	Not Detected	---	8.62E-01
TL-207	Not Detected	---	1.41E+01
AM-241	Not Detected	---	4.95E-01
PU-239	Not Detected	---	4.60E+02
NP-237	Not Detected	---	4.00E-01
PA-233	Not Detected	---	5.82E-02
TH-229	Not Detected	---	2.68E-01

[Summary Report] - Sample ID: : 80192921

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
AG-108m	Not Detected	---------	4.09E-02
AG-110m	Not Detected	---------	3.26E-02
BA-133	Not Detected	---------	7.59E-02
BE-7	Not Detected	---------	2.51E-01
CD-109	~~1.59E+00~~	~~7.32E-01~~	1.19E+00 Not detected 9/20/94
CD-115	Not Detected	---------	1.63E-01
CE-139	Not Detected	---------	3.15E-02
CE-141	Not Detected	---------	5.83E-02
CE-144	Not Detected	---------	2.52E-01
CO-56	Not Detected	---------	3.48E-02
CO-57	Not Detected	---------	3.03E-02
CO-58	Not Detected	---------	3.33E-02
CO-60	Not Detected	---------	3.43E-02
CR-51	Not Detected	---------	2.47E-01
CS-134	Not Detected	---------	5.12E-02
CS-137	Not Detected	---------	3.63E-02
EU-152	Not Detected	---------	9.10E-02
EU-154	Not Detected	---------	1.88E-01
EU-155	Not Detected	---------	1.54E-01
FE-59	Not Detected	---------	7.05E-02
GD-153	Not Detected	---------	1.11E-01
HG-203	Not Detected	---------	3.33E-02
I-131	Not Detected	---------	3.77E-02
IR-192	Not Detected	---------	2.83E-02
K-40	1.19E+01	3.51E+00	2.69E-01
KR-85	Not Detected	---------	8.32E+00
MN-52	Not Detected	---------	4.45E-02
MN-54	Not Detected	---------	1.78E-02
MO-99	Not Detected	---------	4.78E-01
NA-22	Not Detected	---------	4.09E-02
NA-24	Not Detected	---------	6.01E-01
NB-95	Not Detected	---------	2.77E-01
ND-147	Not Detected	---------	2.38E-01
NI-57	Not Detected	---------	1.02E-01
NP-239	Not Detected	---------	1.40E-01
RU-103	Not Detected	---------	2.93E-02
RU-106	Not Detected	---------	2.84E-01
SB-122	Not Detected	---------	8.24E-02
SB-124	Not Detected	---------	2.91E-02
SB-125	Not Detected	---------	8.31E-02
SN-113	Not Detected	---------	4.02E-02
TA-182	Not Detected	---------	1.56E-01
TA-183	Not Detected	---------	6.03E-01
TC-99m	Not Detected	---------	5.20E+01
TL-201	Not Detected	---------	3.57E-01
XE-133	Not Detected	---------	3.46E-01
Y-88	Not Detected	---------	3.01E-02
ZN-65	Not Detected	---------	1.08E-01
ZR-95	Not Detected	---------	5.74E-02

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* Sandia National Laboratories *
* Radiation Protection Sample Diagnostics Program [806 Laboratory] *
* 9-18-98 9:29:18 AM *
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* Analyzed by: 9/20/98 Reviewed by: 9/21/98 *

Customer : P.FRESHOUR/D.PERRY (6134/SMO)
Customer Sample ID : 042326-004
Lab Sample ID : 80192922

Sample Description : MARINELLI SOLID SAMPLE
Sample Quantity : 860.000 gram
Sample Date/Time : 9-15-98 2:20:00 PM
Acquire Start Date/Time : 9-18-98 7:46:28 AM
Detector Name : LAB02
Elapsed Live/Real Time : 6000 / 6003 seconds

Comments:

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
U-238	3.32E-01	3.64E-01	5.11E-01
RA-226	1.59E+00	5.25E-01	5.22E-01
PB-214	7.83E-01	2.47E-01	3.72E-02
BI-214	7.12E-01	6.17E-01	3.46E-02
PB-210	Not Detected	---	2.99E+01
TH-232	6.25E-01	2.98E-01	1.10E-01
RA-228	6.14E-01	2.03E-01	1.20E-01
AC-228	5.99E-01	3.99E-01	2.14E-01
TH-228	6.78E-01	2.14E-01	4.33E-01
RA-224	6.05E-01	1.98E-01	4.22E-02
PB-212	6.42E-01	1.10E-01	3.67E-02
BI-212	6.14E-01	2.90E-01	2.57E-01
TL-208	6.08E-01	1.21E-01	5.12E-02
U-235	2.21E-01	1.76E-01	2.06E-01
TH-231	Not Detected	---	1.94E+00
PA-231	Not Detected	---	3.35E+00
TH-227	Not Detected	---	2.89E-01
RA-223	Not Detected	---	2.04E-01
RN-219	Not Detected	---	3.16E-01
PB-211	Not Detected	---	7.05E-01
TL-207	Not Detected	---	1.13E+01
AM-241	Not Detected	---	4.09E-01
PU-239	Not Detected	---	3.90E+02
NP-237	Not Detected	---	2.93E-01
PA-233	Not Detected	---	4.78E-02
TH-229	Not Detected	---	2.17E-01

[Summary Report] - Sample ID: : 80192922

Nuclide Name	Activity (pCi/gram)	2-sigma Error	MDA (pCi/gram)
AG-108m	Not Detected	---------	3.25E-02
AG-110m	Not Detected	---------	2.70E-02
BA-133	Not Detected	---------	6.18E-02
BE-7	Not Detected	---------	2.12E-01
CD-109	Not Detected	---------	9.95E-01
CD-115	Not Detected	---------	1.27E-01
CE-139	Not Detected	---------	2.63E-02
CE-141	Not Detected	---------	4.88E-02
CE-144	Not Detected	---------	2.12E-01
CO-56	Not Detected	---------	2.87E-02
CO-57	Not Detected	---------	2.65E-02
CO-58	Not Detected	---------	2.68E-02
CO-60	Not Detected	---------	2.97E-02
CR-51	Not Detected	---------	2.08E-01
CS-134	Not Detected	---------	4.31E-02
CS-137	1.16E-02	1.17E-02	1.63E-02
EU-152	Not Detected	---------	7.93E-02
EU-154	Not Detected	---------	1.50E-01
EU-155	Not Detected	---------	1.32E-01
FE-59	Not Detected	---------	6.06E-02
GD-153	Not Detected	---------	9.18E-02
HG-203	Not Detected	---------	2.68E-02
I-131	Not Detected	---------	3.12E-02
IR-192	Not Detected	---------	2.31E-02
K-40	1.39E+01	2.05E+00	2.06E-01
KR-85	Not Detected	---------	6.58E+00
MN-52	Not Detected	---------	3.33E-02
MN-54	Not Detected	---------	2.94E-02
MO-99	Not Detected	---------	3.97E-01
NA-22	Not Detected	---------	3.44E-02
NA-24	Not Detected	---------	5.58E-01
NB-95	Not Detected	---------	2.26E-01
ND-147	Not Detected	---------	2.01E-01
NI-57	Not Detected	---------	8.19E-02
NP-239	Not Detected	---------	1.18E-01
RU-103	Not Detected	---------	2.49E-02
RU-106	Not Detected	---------	2.35E-01
SB-122	Not Detected	---------	6.21E-02
SB-124	Not Detected	---------	2.38E-02
SB-125	Not Detected	---------	6.84E-02
SN-113	Not Detected	---------	3.11E-02
TA-182	Not Detected	---------	1.33E-01
TA-183	Not Detected	---------	5.07E-01
TC-99m	Not Detected	---------	5.19E+01
TL-201	Not Detected	---------	2.94E-01
XE-133	Not Detected	---------	3.01E-01
Y-88	Not Detected	---------	2.25E-02
ZN-65	Not Detected	---------	8.97E-02
ZR-95	Not Detected	---------	4.91E-02

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* Sandia National Laboratories *
* Radiation Protection Sample Diagnostics Program [806 Laboratory] *
* 9-18-98 9:48:43 AM *
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* Analyzed by: 9/20/98 Reviewed by: 9/21/98 *

Customer : P.FRESHOUR/D.PERRY (6134/SMO)
Customer Sample ID : LAB CONTROL SAMPLE USING CG134
Lab Sample ID : 80192923

Sample Description : MIXED_GAMMA_STANDARD_CG134
Sample Quantity : 1.000 Each
Sample Date/Time : 11-01-90 12:00:00 PM
Acquire Start Date/Time : 9-18-98 9:36:48 AM
Detector Name : LAB02
Elapsed Live/Real Time : 600 / 605 seconds

Comments:

Nuclide Name	Activity (pCi/Each)	2-sigma Error	MDA (pCi/Each)
U-238	Not Detected	---------	4.55E+03
RA-226	Not Detected	---------	6.11E+03
PB-214	Not Detected	---------	7.09E+02
BI-214	Not Detected	---------	6.24E+02
PB-210	Not Detected	---------	2.64E+05
TH-232	Not Detected	---------	2.25E+03
RA-228	Not Detected	---------	2.52E+03
AC-228	Not Detected	---------	1.51E+03
TH-228	Not Detected	---------	1.21E+05
RA-224	Not Detected	---------	4.00E+03
PB-212	Not Detected	---------	8.78E+03
BI-212	Not Detected	---------	7.43E+04
TL-208	Not Detected	---------	1.62E+04
U-235	Not Detected	---------	1.73E+03
TH-231	Not Detected	---------	2.10E+04
PA-231	Not Detected	---------	3.50E+04
TH-227	Not Detected	---------	2.50E+03
RA-223	Not Detected	---------	1.00E+26
RN-219	Not Detected	---------	5.94E+03
PB-211	Not Detected	---------	1.33E+04
TL-207	Not Detected	---------	2.16E+05
AM-241	8.12E+04	1.45E+04	3.00E+03
PU-239	Not Detected	---------	3.13E+06
NP-237	Not Detected	---------	2.38E+03
PA-233	Not Detected	---------	6.21E+02
TH-229	Not Detected	---------	1.75E+03

[Summary Report] - Sample ID: : 80192923

Nuclide Name	Activity (pCi/Each)	2-sigma Error	MDA (pCi/Each)
AG-108m	Not Detected	---------	3.27E+02
AG-110m	Not Detected	---------	4.91E+06
BA-133	Not Detected	---------	7.44E+02
BE-7	Not Detected	---------	6.41E+19
CD-109	Not Detected	---------	5.76E+05
CD-115	Not Detected	---------	1.00E+26
CE-139	Not Detected	---------	4.49E+08
CE-141	Not Detected	---------	1.00E+26
CE-144	Not Detected	---------	1.94E+06
CO-56	Not Detected	---------	6.27E+13
CO-57	Not Detected	---------	3.34E+05
CO-58	Not Detected	---------	5.59E+14
CO-60	8.07E+04	1.10E+04	4.09E+02
CR-51	Not Detected	---------	1.00E+26
CS-134	Not Detected	---------	4.01E+03
CS-137	7.24E+04	9.63E+03	2.60E+02
EU-152	Not Detected	---------	9.80E+02
EU-154	Not Detected	---------	2.72E+03
EU-155	Not Detected	---------	3.34E+03
FE-59	Not Detected	---------	2.32E+22
GD-153	Not Detected	---------	2.79E+06
HG-203	Not Detected	---------	1.15E+21
I-131	Not Detected	---------	1.00E+26
IR-192	Not Detected	---------	1.58E+14
K-40	Not Detected	---------	1.60E+03
KR-85	Not Detected	---------	1.20E+05
MN-52	Not Detected	---------	1.00E+26
MN-54	Not Detected	---------	2.14E+05
MO-99	Not Detected	---------	1.00E+26
NA-22	Not Detected	---------	1.75E+03
NA-24	Not Detected	---------	1.00E+26
NB-95	Not Detected	---------	1.00E+26
ND-147	Not Detected	---------	1.00E+26
NI-57	Not Detected	---------	1.00E+26
NP-239	Not Detected	---------	9.26E+02
RU-103	Not Detected	---------	1.00E+26
RU-106	Not Detected	---------	6.72E+05
SB-122	Not Detected	---------	1.00E+26
SB-124	Not Detected	---------	6.98E+16
SB-125	Not Detected	---------	7.87E+03
SN-113	Not Detected	---------	1.45E+10
TA-182	Not Detected	---------	3.88E+10
TA-183	Not Detected	---------	1.00E+26
TC-99m	Not Detected	---------	1.00E+26
TL-201	Not Detected	---------	1.00E+26
XE-133	Not Detected	---------	1.00E+26
Y-88	Not Detected	---------	2.20E+10
ZN-65	Not Detected	---------	3.03E+06
ZR-95	Not Detected	---------	1.82E+16

****
*
Sandia National Laboratories
Radiation Protection Sample Diagnostics Program
Quality Assurance Report
*
****

Report Date : 9-18-98 9:49:23 AM
QA File : C:\GENIEPC\CAMFILES\LCS2.QAF
Analyst : FCD
Sample ID : 80192923
Sample Quantity : 1.00 Each
Sample Date : 11-01-90 12:00:00 PM
Measurement Date : 9-18-98 9:36:48 AM
Elapsed Live Time : 600 seconds
Elapsed Real Time : 605 seconds

Parameter	Mean	1S Error	New Value	<	LU	SD	UD	BS
AM-241 Activity	8.224E-02	4.261E-03	8.121E-02	<				
CS-137 Activity	7.043E-02	2.030E-03	7.237E-02	<				
CO-60 Activity	7.836E-02	2.214E-03	8.046E-02	<				

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

Reviewed by: 9/20/98

Annex 7-B

ANNEX 7-B
Data Validation Results

MEMORANDUM

DATE: December 10, 1999

TO: Tina Sanchez, MS-1089 (6135)

FROM: Kevin Lambert, MS-1088 (6134) KAL

SUBJECT: **Laboratory Correction**
Site 81D, ARCOC No. 600784, and Project/Task No. 7214.01.03

At the request of Mark Thacker (ATL), I have reviewed data validation of the data package for ARCOC #600784 associated with Site 81D. The original data validation was performed April 6, 1999.

The analytical sample results on carbon disulfide for three samples require laboratory correction. The carbon disulfide results reported by GEL are less than the detection limit provided. Therefore, carbon disulfide results from GEL should be qualified "U" not "J". A corrective action has been initiated by SMO requesting GEL submit documentation on the appropriate revision to the hard copy report and EDD.

No other specific issues were identified which affect the original data validation and review. See the original Data Validation Worksheets for supporting documentation on the data review and validation.

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

KAL

Copy to:
MS-1088 Mark Thacker (6134)

MEMORANDUM

DATE: January 14, 2000

TO: Tina Sanchez, MS-1089 (6135)

FROM: Kevin Lambert, MS-1088 (6134) KAL

SUBJECT: **Laboratory Correction – GEL Response**
Site 81D, ARCOC No. 600784, and Project/Task No. 7214.01.03

A corrective action was initiated by SMO on a GEL data package for ARCOC #600784 associated with Site 81D. Laboratory correction was requested on carbon disulfide results for three samples. The original results reported by GEL were less than the detection limit (DL) and appeared as though they should be qualified "U" not "J".

GEL has submitted revised documentation (hard copy only) that includes revised DL values for carbon disulfide. Consequently, the original results are greater than the revised DL values and were appropriately qualified "J" by the laboratory.

Finally, the documentation submitted by GEL includes revised DL values for other compounds. These revised DL values do not affect the original data validation and review; however DL values in the database will require revision.

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

KAL

Copy to:
MS-1088 Mark Thacker (6134)

Data Validation Qualifiers and Descriptive Flags*

Note: Qualifiers may be used in conjunction with descriptive flags [e.g., J,A; UJ,P; U,B].

Qualifiers	Comment
J	The associated value is an estimated quantity.
J1	The method requirements for sample preservation/temperature were not met for the sample analysis. The associated value is an estimated quantity.
J2	The holding time was exceeded for the associated sample analysis. The associated value is an estimated quantity.
UJ	The analyte was analyzed for but was not detected. The associated value is an estimate and may be inaccurate or imprecise.
U	The associated result is less than ten times the concentration in any blank and is determined to be non-detect. The analyte is a common laboratory contaminant.
U1	The associated result is less than five times the concentration in any blank and is determined to be non-detect.
R	The data are unusable for their intended purpose. The analyte may or may not be present. (Note: Resampling and reanalysis is necessary for verification.)

Descriptive Flags	
A	Laboratory accuracy and/or bias measurements for the associated Laboratory Control Sample and/or duplicate (LCS/LCSD) do not meet acceptance criteria.
A1	Laboratory accuracy and/or bias measurements for the associated Surrogate Spike do not meet acceptance criteria.
A2	Laboratory accuracy and/or bias measurements for the associated Matrix Spike and/or duplicate (MS/MSD) do not meet acceptance criteria.
A3	Insufficient quality control data to determine laboratory accuracy.
B	Analyte present in laboratory method blank
B1	Analyte present in trip blank.
B2	Analyte present in equipment blank.
B3	Analyte present in calibration blank.
P	Laboratory precision measurements for the Laboratory Control Sample and duplicate (LCS/LCSD) do not meet acceptance criteria.
P1	Laboratory precision measurements for the Matrix Spike Sample and associated duplicate (MS/MSD) do not meet acceptance criteria.
P2	Insufficient quality control data to determine laboratory precision.

* This is not a definitive list. Other qualifiers are potentially available, see TOP 94-03. Notify Tina Sanchez to revise list. **Updated: September 14, 1999**

SAMPLE FINDINGS SUMMARY

Site: 81D

AR/COC: 600784 Data Classification: Organic, Metals

Sample/ Fraction No.	Analysis	DV Qualifiers	Comments
	See Attached		Tables

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

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

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

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

Test Methods - Anions_CE, EPA6010, EPA6020, EPA7470/1, EPA8015B, EPA8081, EPA8260, EPA8260-M3, EPA8270, HACH_ALK, HACH_ NO2, HACH_NO3, MEKC_HE, PCBRISC

Reviewed by: _____ Date: 4/6/99 Information Only

ORGANICS

SAMPLE FINDINGS SUMMARY

COC: 600784

Sample Number	VOC EPA8260 all analytes except 67-64-1	2-butanone (78-93-3)	2-hexanone (591-78-6)	acetone (67-64-1)	vinyl acetate (108-05-4)	SVOC	phenol (108-95-2)	2-chlorophenol (95-57-8)	2-methylphenol (95-48-7)	4-methylphenol (106-44-5)	2-nitrophenol (88-75-5)	2,4-dinimethylphenol (105-67-9)	2,4-dichlorophenol (120-83-2)	4-chloro-3-methylphenol (59-50-7)	2,4,6-trichlorophenol (88-06-2)	2,4,5-trichlorophenol (95-95-4)	4-nitrophenol (100-02-7)	2,4-dinitrophenol (51-28-5)	4,6-dinitro-2-mehtylphenol (534-52-	pentachlorophenol (87-86-5)	2-methylnaphthalene (91-57-6)	3,3'-dichlorobenzidine (91-94-1)				
CY81D-GR-003-SS		UJ	UJ	UJ																						
CY81D-GR-008-SS					UJ																					
CY81D-GR-010-SS					UJ																					
CY81D-GR-011-SS					UJ																					
CY81D-GR-012-SS					UJ																					
CY81D-GR-013-SS					UJ		UJ A1	UJ A1	UJ A1	UJ A1	UJ A1	UJ A1	UJ A1	UJ A1	UJ A1	UJ A1	UJ A1	UJ A1	UJ A1	UJ A1	UJ	R				
CY81D-GR-014-SS					UJ														UJ		UJ	R				
CY81D-GR-015-SS					UJ																					
CY81D-GR-016-SS					UJ																					
CY81D-GR-017-SS					UJ																					
CY81D-GR-017-DU					UJ																					
CY81D-GR-018-SS					UJ																					
CY81D-GR-019-SS					UJ																					
CY81D-GR-020-SS					UJ																					
CY81D-GR-001-EB	UJ1			J1																						
CY81D-GR-001-TB	UJ1			UJ1																						

4/6/99

INORGANIC METALS

SAMPLE FINDINGS SUMMARY

COC:600784 Sample Number		Ba (7440-39-3)	Be (7440-41-7)	Cd (7440-43-9)	Cr (7440-47-3)	Ag (7440-22-4)	Pb (7439-92-1)	Se (7782-49-2)	As (7440-38-2)	Hg (7439-97-6)
CY81D-GR-001-SS		JA2					J	JB	J	JB3
CY81D-GR-002-SS		JA2					J	JB	J	JB3
CY81D-GR-003-SS		JA2					J	J	J	
CY81D-GR-004-SS		JA2					J	JB	J	JB3
CY81D-GR-005-SS		JA2						JB		JB3
CY81D-GR-006-SS		JA2					M1	JB		JB3
CY81D-GR-007-SS		JA2						JB		JB3
CY81D-GR-007-DU		JA2						JB		JB3
CY81D-GR-008-SS		JA2						JB		JB3
CY81D-GR-009-SS		JA2						JB		JB3
CY81D-GR-010-SS		JA2						JB		JB3
CY81D-GR-011-SS		JA2						JB		JB3
CY81D-GR-012-SS		JA2						JB		
CY81D-GR-013-SS		JA2						JB		JB3
CY81D-GR-014-SS		JA2						JB		JB3
CY81D-GR-015-SS		JA2						JB		JB3
CY81D-GR-016-SS		JA2						JB		JB3
CY81D-GR-017-SS		JA2						JB		JB3
CY81D-GR-017-DU		JA2					M1	JB		JB3
CY81D-GR-018-SS		JA2						JB		JB3
CY81D-GR-019-SS		JA2						JB		JB3
CY81D-GR-020-SS		JA2					M1	JB		JB3
CY81D-GR-001-EB										

4/6/99

DATA VALIDATION SUMMARY:

SITE/PROJECT: SID CASE #: 7214.1300
ARCOC #: 600784
LABORATORY: GEL
LABORATORY REPORT #: 85L01

OF SAMPLES: 66 MATRIX: Soil
LAB SAMPLE IDs: 9809546-01 thru - 66

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

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

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

INFORMATION ONLY

REVIEWED BY: _____ DATE: 4/6/99

DATA VALIDATION SUMMARY:

SITE/PROJECT: 81D CASE #: 7214.1300
ARCOC #: 600784
LABORATORY: CEL
LABORATORY REPORT #: 85401

OF SAMPLES: 4 MATRIX: aqueous
LAB SAMPLE IDs: 9809546-67 thru -70

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

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

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

REVIEWED BY: _____ DATE: 4/6/99

Memorandum

Date: 04/06/99

To: File

From: Marcia Hilchey

Subject: Organic Data Review and Validation
Site: 81D
AR/COC: 600784
Case: 7214.1300
Laboratory: GEL
SDG: 8S201
L mH

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

Summary

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

Qualifications were applied to VOC sample data due to inappropriate preservation, high CCV RPD, and ~~high ICV RSD.~~ mH

Qualifications were applied to SVOC sample data due to low surrogate recovery, high CCV RPD, and high ICV RSD.

No qualifications were applied to HE sample data.

Note: Due to low-quality copies of the sample result summary pages, the sample results for styrene for some VOC samples were illegible. Review of the raw data indicated that these results were all non-detects.

Note: According to the general case narrative and the Sample Receipt Review, one of the 5 shipped coolers arrived at the laboratory a day late and at 10 deg. C. It was not noted, however, which samples were in the late cooler. No sample data are qualified as a result, but it should be noted by the sample data user that some of the samples were inadequately preserved.

Holding Times

The samples were analyzed within the prescribed holding times.

Preservation

According to the AR/COC, the aqueous samples (CY81D-GR-001-EB and CY81D-GR-001-TB) for VOC analysis were preserved with HCL and not chilled to 4 deg. C. All non-detects in these samples are UJ-qualified, detected results are J-qualified.

Calibration

Initial and continuing calibration met acceptance criteria for HE analyses.

VOC: In the aqueous VOC analyses, the following analytes had high RPD CCV values: bromomethane, acetone, 2-butanone, 2-hexanone, and vinyl acetate. No further qualifications were applied (see Preservation section above). Initial calibration for these analyses were acceptable.

In the solid (soil) VOC analyses, the CCV associated with sample CY81D-GR-003-SS had high RPD for the following analytes: 2-butanone, 2-hexanone, and acetone. These sample results are UJ-qualified. The CCV associated with samples analyzed beginning 9/23/99 had high RPD for vinyl acetate. All associated sample results are UJ-qualified (see Sample Findings Summary).

No CCV RPD information was submitted for samples analyzed beginning 9/21/99. No sample results are qualified as a result.

SVOC: The CCV RPD for 2-methylnaphthalene was high, warranting application of the UJ qualifier to sample results. The CCV RPD for 3,3'dichlorobenzidine was >60%, warranting application of the R qualifier to sample results. The ICV RSD and CCV RPD were high for 4,6-dinitro-2-methylphenol, warranting application of the UJ qualifier to sample results.

Blanks

No target analytes were detected above the reporting limit in any blank for any organic method.

Surrogates

All surrogate recoveries met acceptance criteria for the HE and VOC methods.

Sample CY81D-GR-013-SS had low recovery for 2 acid-fraction surrogates in the SVOC analysis. All acid-fraction analytes for that sample are UJ-qualified.

Matrix Spike/Matrix Spike Duplicates (MS/MSD)

Matrix spike sample analyses for soil VOC met acceptance criteria.

No MS/MSD samples were analyzed in association with the aqueous VOC samples. No data were qualified as a result.

MS/MSD sample analyses for SVOC met acceptance criteria.

The MS sample in the aqueous HE analysis for 4-amino-2,6-dinitrotoluene had low recovery (62.0%). The MSD and LCS/LCSD analyses met acceptance criteria. No data were qualified. The MS/MSD for soil HE analyses met acceptance criteria.

Internal Standards

Internal standard recovery for the VOC and SVOC methods met acceptance criteria.

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

The laboratory indicated that recovery for 4-nitrophenol was low in the SVOC soil analysis, but the %R for this analyte meets data assessment acceptance criteria. No data are qualified as a result. All other SVOC LCS/LCSD acceptance criteria were met.

No LCSD data were provided for the aqueous VOC analysis. No data were qualified as a result. All other VOC LCS/LCSD acceptance criteria were met.

All soil HE LCS/LCSD acceptance criteria were met. For the aqueous HE analysis, the LCS and LCSD recoveries were low for:2-nitrotoluene, 4-nitrotoluene, and 3-nitrotoluene. Recoveries for these analytes in the MS/MSD analyses met acceptance criteria. No data were qualified as a result.

Other QC

Soil field duplicate RPDs met acceptance criteria for HE and VOC analyses. No field duplicate samples were submitted for SVOC analysis.

No other specific issues were identified which affect data quality.

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

4/6/99

VOLATILE ORGANICS:
SW-846 - Method 8260

SITE/PROJECT: 81 D ARCOC #: 600784 soils
LABORATORY: GEL LABORATORY REPORT #: 85101

IS	GC/MS		Min RF	Intercept	Calib RF	Calib RSD / R^2	CCV RPD (9/23)	Method Blks	LCS	LCSD	LCS RPD	MS	MSD	MS RPD	Field Dup RPD	Eq. Blks (mg/l)	Trip Blks	ccv RPD (9/24)		
	Name	CAS #			>.05	<20% / 0.99	<20%													
1	Chloromethane	74-87-3	0.10		✓	✓	✓	✓							✓	✓	✓			
1	Bromomethane	74-83-9	0.10		✓	✓														
1	vinyl chloride	75-01-4	0.10		✓	✓														
1	Chloroethane	75-00-3	0.01		✓	✓	24.3	2↑												
1	methylene chloride (10xblk)	75-09-2	0.01		✓	✓	✓									⊥				
1	acetone(10xblk)	67-64-1	0.01		✓	✓										8.2				
1	carbon disulfide	75-15-0	0.10		✓	✓										✓				
1	1,1-dichloroethene	75-35-4	0.20		✓	✓			✓											
1	1,1-dichloroethane	75-34-3	0.10		✓	✓														
1	Chloroform	67-66-3	0.20		✓	✓														
1	1,2-dichloroethane	107-06-2	0.10		✓	✓														
1	2-butanone(10xblk)	78-93-3	0.01		✓	✓	21.9													
2	1,1,1-trichloroethane	71-55-6	0.10		✓	✓	✓													
2	carbon tetrachloride	56-23-5	0.10		✓	✓														
2	Bromodichloromethane	75-27-4	0.20		✓	✓														
2	1,2-dichloropropane	78-87-5	0.01		✓	✓														
2	cis-1,3-dichloropropene	10061-01-5	0.20																	
2	Trichloroethene	79-01-6	0.10		.26															
2	Dibromochloromethane	124-48-1	0.10		✓	✓														
2	1,1,2-trichloroethane	79-00-5	0.10		✓	✓														
2	Benzene	71-43-2	0.70		✓	✓									✓					
2	trans-1,3-dichloropropene	10061-02-6	0.10																	
2	Bromoform	75-25-2	0.10		✓	✓														
3	4-methyl-2-pentanone	108-10-1	0.10		✓	✓	⊥											20.6		
3	2-hexanone	591-78-6	0.01		✓	✓	24.9											40.9		
3	Tetrachloroethene	127-18-4	0.20		✓	✓														
3	1,1,2,2-tetrachloroethane	79-34-5	0.30		✓	✓														
3	toluene(10xblk)	108-88-3	0.40		✓	✓			✓	✓	✓	✓	✓	✓						
3	Chlorobenzene	108-90-7	0.50		✓	✓			✓	✓	✓	✓	✓	✓	✓					
3	Ethylbenzene	100-41-4	0.10		✓	✓		⊥												
3	Styrene	100-42-5	0.30		✓	✓		.51												
3	xylenes(total)	1330-20-7	0.30		✓	✓		✓												
	1,2-dichloroethylene(total)	540-59-0	0.01		✓															
	2-chloroethyl vinyl ether	110-75-8																		
	1,2-cis-dichloroethene				✓	✓														
	1,2-trans-dichloroethene				✓	✓	⊥													
	vinyl acetate	108-05-4			✓	✓	45.9	⊥							⊥	⊥	⊥			

Comments:
1, Meth blk 9/23

REVIEWED BY: _____ DATE: 9/6/99

VOLATILE ORGANICS: page 2
SW-846 - Method 8260

SITE/PROJECT: 81D ARCOC #: 600784 soils
LABORATORY: GEL LABORATORY REPORT #: 8801

Surrogate Recovery and Internal Standard Outliers

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

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

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

Comments:

REVIEWED BY: _____ DATE: 4/6/09

VOLATILE ORGANICS:
SW-846 - Method 8260

SITE/PROJECT: 81D ARCOC #: 600784 aqueous
LABORATORY: GEL LABORATORY REPORT #: 85601

IS	GC/MS		Min RF	Intercept	Calib RF	Calib RSD / R^2	CCV RPD	Method Blks	LCS	LCSD	LCS RPD	MS	MSD	MS RPD	Field Dup RPD	Eq. Blks	Trip Blks			
	Name	CAS #			>.05	<20% / 0.99	<20%			n/a					n/a	*	*			
1	Chloromethane	74-87-3	0.10	✓	✓	✓	24.2	✓												
1	Bromomethane	74-83-9	0.10	✓	.02	✓	77													
1	vinyl chloride	75-01-4	0.10																	
1	Chloroethane	75-00-3	0.01	✓	✓	✓	✓													
1	methylene chloride (10xblk)	75-09-2	0.01	✓	✓	✓	✓													
1	acetone(10xblk)	67-64-1	0.01																	
1	carbon disulfide	75-15-0	0.10		✓	✓	✓													
1	1,1-dichloroethene	75-35-4	0.20																	
1	1,1-dichloroethane	75-34-3	0.10																	
1	Chloroform	67-66-3	0.20																	
1	1,2-dichloroethane-d4	107-06-2	0.10																	
1	2-butanone(10xblk)	78-93-3	0.01																	
2	1,1,1-trichloroethane	71-55-6	0.10		✓	✓	✓													
2	carbon tetrachloride	56-23-5	0.10																	
2	Bromodichloromethane	75-27-4	0.20		✓	✓														
2	1,2-dichloropropane	78-87-5	0.01																	
2	cis-1,3-dichloropropene	10061-01-5	0.20																	
2	Trichloroethene	79-01-6	0.30																	
2	Dibromochloromethane	124-48-1	0.10		✓	✓														
2	1,1,2-trichloroethane	79-00-5	0.10		✓	✓														
2	Benzene	71-43-2	0.50																	
2	trans-1,3-dichloropropene	10061-02-6	0.10																	
2	Bromoform	75-25-2	0.10		✓	✓														
3	4-methyl-2-pentanone	108-10-1	0.10		✓	✓	29.1													
3	2-hexanone	591-78-6	0.01	✓	✓	✓	42.4													
3	Tetrachloroethene	127-18-4	0.20																	
3	1,1,2,2-tetrachloroethane	79-34-5	0.30		✓	✓														
3	toluene(10xblk)	108-88-3	0.40		✓	✓			✓											
3	Chlorobenzene	108-90-7	0.50																	
3	Ethylbenzene	100-41-4	0.10		✓	✓														
3	Styrene	100-42-5	0.30		✓	✓														
3	xylenes(total)	1330-20-7	0.30		✓	✓														
	1,2-dichloroethylene(total)	540-59-0	0.01		✓															
	2-chloroethyl vinyl ether	110-75-8																		
	1,2 cis-dichloroethene				✓	✓														
	1,2-trans-dichloroethene				✓	✓														
	vinyl acetate	108-05-4			✓	✓	119													

Comments:
* - field samples are EB & TB

REVIEWED BY: _____ DATE: 4/6/99

VOLATILE ORGANICS: page 2
SW-846 - Method 8260

SITE/PROJECT: 81D ARCOC #: 600784 aqueous
LABORATORY: GEL LABORATORY REPORT #: 85L01

Surrogate Recovery and Internal Standard Outliers

Sample	SMC 1	SMC 2	SMC 3	IS 1-area	IS 1-RT	IS 2-area	IS 2-RT	IS 3- area	IS 3- RT			
					01<							

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

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

Comments:

REVIEWED BY: _____ DATE: 4/6/99

HOLDING TIME/PRESERVATION:

SITE/PROJECT: 81D ARCOC #: 600784
LABORATORY: GEL LABORATORY REPORT #: 85L01

Sample ID	Analysis	Holding Time Criteria	Days Holding Time was Exceeded	Preservation Criteria	Preservation Deficiency	Comments
9809546-68	8260 VOC			4°C	no cooling	aqueous QC samples
" -70						

Comments:

REVIEWED BY: _____ DATE: 4/6/99

HIGH EXPLOSIVES:
SW846 Method 8330

SITE/PROJECT: 81 D ARCOC #: 600784 aqueous
LABORATORY: GEL LABORATORY REPORT #: 85101

NAME	CAS #	Intercept	Curve R^2	CCV RPD	Method Blks	LCS	LCSD	LCS RPD	MS	MSD	MS RPD	Field Dup RPD (n/a)	Eq. Blks (n/a*)	Field Blks (n/a)		
		✓	.99 ✓	20% ✓	U ✓	✓	✓	20% ✓	✓	✓	20% ✓		U	U		
HMX	2691-41-0															
RDX	121-82-4															
~~1,3,5~~-Trinitrobenzene	99-35-4															
1,3-dinitrobenzene	99-64-0															
Nitrobenzene	98-95-3					66.9										
Tetryl	479-45-8															
2,4,6-trinitrotoluene	118-96-7															
2-amino-4,6-dinitrotoluene	35572-78-2															
4-amino-2,6-dinitrotoluene	1946-51-0								62.0							
2,4-dinitrotoluene	121-14-2															
2,6-dinitrotoluene	606-20-2															
2-nitrotoluene	88-72-2					69.0	62.9									
4-nitrotoluene	99-99-0					60.6	65.2									
3-nitrotoluene	99-08-1					68.9	64.8									
PETN	78-11-5															

Sample	SMC %REC	SMC RT		Sample	SMC %REC	SMC RT
	n/a					

Comments:

Confirmation

Sample	CAS #	RPD > 25%		Sample	CAS #	RPD > 25%
	n/a					

*Sample is equip. blk.

REVIEWED BY: _____ DATE: 4/6/99

HIGH EXPLOSIVES:
SW846 Method 8330

SITE/PROJECT: 8ID ARCOC #: 600784 soils
LABORATORY: GEL LABORATORY REPORT #: 8SL01

10/5+10 n/9

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

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

Comments:

Confirmation

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

REVIEWED BY: _____ DATE: 4/6/99

Memorandum

Date: 04/06/99

To: File

From: Marcia Hilchey

Subject: Inorganic Data Review and Validation
Site: 81D
AR/COC: 600784
Case: 7214.1300
Laboratory: GEL
SDG: 8SL01

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

Summary

All samples were prepared and analyzed with accepted procedures and with specified methods (ICP EPA6010, CVAA EPA7470). All components were successfully analyzed.

Qualifications were applied to metals sample results due to low MS recovery, high CCV RPD, and blank contamination.

Note: According to the general case narrative and the Sample Receipt Review, one of the 5 shipped coolers arrived at the laboratory a day late and at 10 deg. C. It was not noted, however, which samples were in the late cooler. No sample data are qualified as a result, but it should be noted by the sample data user that some of the samples were inadequately preserved. In the case of inorganic analyses, this would only affect Hg sample results.

Holding Times

The samples were analyzed within the prescribed holding times.

Calibration

ICP: In the analysis of aqueous samples, several CCV %Ds were high, but as all affected sample results were non-detect, no data were qualified.

The CCV %Ds associated with soil samples CY81D-GR-001-SS, CY81D-GR-002-SS, CY81D-GR-003-SS, and CY81D-GR-004-SS were high for lead, arsenic, and selenium. These sample results were J-qualified (see Blank section below for selenium qualification information).

All other ICV and CCV acceptance criteria were met.

CVAA: ICV and CCV met QC acceptance criteria for all Hg sample results.

Blanks

ICP: Levels of analytes in the ICB and CCBs did not warrant application of qualifications to sample data.

Selenium was detected in the method blank at .289 mg/kg. All positive Se results were JB-qualified. Chromium was detected in the equipment blank at 1.07 mg/l. As all chromium results were >5X the blank value, no sample results were qualified.

CVAA: Mercury was detected in the ICB at .042mg/kg. All positive Hg sample results were JB3-qualified.

Matrix Spike Analysis

No aqueous matrix spike samples from this SDG were analyzed for either method. No sample results were qualified.

The soil matrix spike recovery for barium was low, resulting in the J-qualification of all positive barium sample results.

The MS recovery for mercury was very low. The MSD and LCS/LCSD recovery values met acceptance criteria. No qualifications were applied.

All other MS recoveries met acceptance criteria

Laboratory Control/Laboratory Control Duplicate Samples

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

ICP Interference check sample (ICS) Analysis

The ICS met all QC acceptance criteria.

Laboratory Replicate Analysis

The MSD sample was used to assess the laboratory precision. The MSD recovery for barium was low, but no further qualifications were applied to barium results (see MS section above).

The MSD RPD for mercury was high due to the low MS recovery. No qualifications were applied (see MS section above).

All other laboratory duplicate acceptance criteria were met.

Other QC

Serial dilutions met acceptance criteria for analytes with values > 50X the PQLs.

Field duplicate comparisons met acceptance criteria for both methods.

No other specific issues were identified which affect data quality.

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

9/6/99

INORGANIC METALS:

SITE/PROJECT: 81 D ARCOC #: 600784
LABORATORY: GEL LABORATORY REPORT #: 85L01
METHODS: CVAA, ICP

QC Element/ Analyte	ICV	CCV	ICB	CCB	Method Blks	LCS	LCSD	LCSD RPD	MS	MSD	MSD RPD	REP RPD	ICS AB	Serial Dilution	Field Dup RPD	Eq. Blks	Field Blks			
7429-90-5 Al																				
7440-39-3 Ba																				
7440-41-7 Be	✓			2.5		✓	✓	✓					✓	—	✓					
7440-43-9 Cd																				
7440-70-2 Ca																				
7440-47-3 Cr																				
7440-48-4 Co																				
7440-50-8 Cu																				
7439-89-6 Fe																				
7439-95-4 Mg																				
7439-96-5 Mn			✓																	
7440-02-0 Ni																				
7440-09-7 K																				
7440-22-4 Ag																				
7440-23-5 Na																				
7440-62-2 V																				
7440-66-6 Zn																				
7439-92-1 Pb																				
7782-49-2 Se																				
7440-38-2 As																				
7440-36-0 Sb																				
7440-28-0 Tl																				
7439-97-6 Hg																				
Cyanide CN																				

n/a n/a mg/l n/a

Comments:

REVIEWED BY: _____ DATE: 4/6/99

MEMORANDUM

Date: 04/06/99

To: File

From: Marcia Hilchey

Subject: Radiometric Data Review and Validation
Site: 81D
AR/COC: 600784
Case: 7214.1300
Laboratory: GEL
SDG: 8S201
(mtl

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

Summary

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

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

Holding Times

The samples were analyzed within the prescribed holding times.

Calibration

Calibration met acceptance criteria.

Laboratory Control Sample Analyses

The LCS met acceptance criteria.

Blanks

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

Matrix Spike Analysis

The matrix spike sample met acceptance criteria.

Replicate

The laboratory duplicate met the QC acceptance criteria.

Test for Detection

All acceptance criteria were met for the Test for Detection.

Other QC

Field duplicate acceptance criteria were met. No field blank samples were submitted with this AR/COC.

No other specific issues were identified which affect data quality.

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

4/6/99

RADIOCHEMISTRY:

SITE/PROJECT: 81D ARCOC #: 600784
LABORATORY: GEL LABORATORY REPORT #: 8S201
METHODS:

n/a n/a

QC Element/ Analyte	Method Blks	LCS	MS	Rep RER	Eq. Blks	Field Dup RER	Field Blks	-	Sample ID	Isotope	IS/Trace	Sample	Isotope	IS/Trace			
CRITERIA	U	20%	25%	<1.0	U	<1.0	U	-			50-105			50-105			
H3								-									
U-238																	
U-234																	
U-235/236								-									
Th-232																	
Th-228																	
Th-230								-									
Pu-239/240																	
Gross Alpha	.0041	✓	✓	✓		✓		-									
Nonvolatile Beta	.1263	✓	✓	✓		✓											
Ra226								-									
Ra228								-									
Gamma Spec								-									
Ni-63								-									
								-									
								-									

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

Comments:

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

REVIEWED BY: _____ DATE: 4/6/99

SF 2001-COC (10-97)
Supersedes (5-97) issue

Internal Lab Batch No. N/A

ANALYSIS REQUEST AND CHAIN OF CUSTODY

SAR/WR No.

Press F1 for instructions for each field.

AR/COC- 600784

Dept. No./Mail Stop: 6134/1148
Project/Task Manager: Paul Freshour
Project Name: 81D Baseline Sampling
Record Center Code: ER/)OU1333/DAT
Logbook Ref. No.: ER-012
Service Order No.: CF0608

Date Samples Shipped: 9/16/98 SMO Use
Carrier/Waybill No.: 712271 712271

Lab Contact: Edie Kent
Lab Destination: GEL
SMO Contact/Phone: Doug Salmi/844-3110
Send Report to SMO: Doug Salmi

Contract No.: AJ-2480A
Case No.: 7214/1380
SMO Authorization
Bill to: Sandia National Laboratories
Supplier Services, Dept.
P.O. Box 5800 MS 0154

RECEIVED
SEP 16 1998

Location — Tech Area: Canyons — Building: NA — Room: NA

Sample No. - Fraction	ER Sample ID or Sample Location Detail	Beginning Depth in Ft.	ER Site No.	Date/Time Collected	Sample Matrix	Container Type	Container Volume	Preservative	Sample Collection Method	Sample Type	Parameter & Method Requested	Lab Sample ID
042307 - 001	CY81D-GR-001-SS	0.0	81D	9/15/98 0915	SA	G	500 ml	4 C	G	MSMSD	METALS, HE	015
042307 - 002	CY81D-GR-001-SS	0.0	81D	9/15/98 0915	SA	G	120 ml	4 C	G	MSMSD	VOC	034
042307 - 003	CY81D-GR-001-SS	0.0	81D	9/15/98 0915	SA	G	250 ml	4 C	G	SA	GROSS ALPHA/BETA	053
042308 - 001	CY81D-GR-002-SS	0.0	81D	9/15/98 0920	SA	G	500 ml	4 C	G	SA	METALS, HE	041
042308 - 002	CY81D-GR-002-SS	0.0	81D	9/15/98 0920	SA	G	120 ml	4 C	G	SA	VOC	051
042308 - 003	CY81D-GR-002-SS	0.0	81D	9/15/98 0920	SA	G	250 ml	4 C	G	SA	GROSS ALPHA/BETA	062
042309 - 001	CY81D-GR-003-SS	0.0	81D	9/15/98 0933	SA	G	500 ml	4 C	G	SA	METALS, HE	071
042309 - 002	CY81D-GR-003-SS	0.0	81D	9/15/98 0933	SA	G	120 ml	4 C	G	SA	VOC	082
042309 - 003	CY81D-GR-003-SS	0.0	81D	9/15/98 0933	SA	G	250 ml	4 C	G	SA	GROSS ALPHA/BETA	093
042310 - 001	CY81D-GR-004-SS	0.0	81D	9/15/98 0944	SA	G	500 ml	4 C	G	SA	METALS, HE	104

LAB USE 9809546

RMMA ☐Yes ☒No Ref. No.
Sample Disposal ☐Return to Client ☒Disposal by lab

Sample Tracking SMO Use
Date Entered (mm/dd/yy)
Entered by

Special Instructions/QC Requirements
EDD ☒Yes ☐No
Raw data package ☒Yes ☐No
METALS = RCRA METALS + Be
HE = SW 8330
VOC = SW 8260
SVOC = SW 8270
Please list as separate report.

Abnormal Conditions on Receipt LAB USE
cooler = 3.5 5.9°C

Turnaround Time ☒Normal ☐Rush Required Report Date
QC Limits

	Name	Signature	Init	Company/Organization/Phone
Sample Team Members	Concetta Cacciato	Concetta Cacciato	CC	MDM/6131/540-9143
	Gill Baltazar	Gill Baltazar	GB	Weston/6131/971-2769
	Catechis Chris	Chris Catechis	CC	MDM/6131/884-2249

1. Relinquished by		Org. 6131	Date 9/16/98	Time 1030	4. Relinquished by		Org.	Date	
1. Received by		Org. 7577	Date 9/16/98	Time 1030	4. Received by		Org.	Date	
2. Relinquished by		Org. 7577	Date 9/16/98	Time 1230	5. Relinquished by		Org.	Date	
2. Received by	Bonnie Hervey	Org.	Date 9/17/98	Time 0930	5. Received by		Org.	Date	
3. Relinquished by		Org.	Date	Time	6. Relinquished by		Org.	Date	
3. Received by		Org.	Date	Time	6. Received by		Org.	Date	

Original To Accompany Samples, Laboratory Copy (White) — **1st Copy** To Accompany Samples, Return to SMO (Blue) — **2nd Copy** SMO Suspense Copy (Yellow) — **3rd Copy** Field Copy (Pink)

SF 2001-COC (10-97)

Supersedes (5-97) Issue

ANALYSIS REQUEST AND CHAIN OF CUSTODY (Continuation)

Press F1 for instructions for each field.

AR/COC- 600784

Project Name: 81D Baseline Sampling | Project/Task Manager: Paul Freshour | Case No.: 7214/1300

Location | Tech Area Canyons | Building NA | Room NA

Sample No. - Fraction	ER Sample ID or Sample Location Detail	Beginning Depth in Ft.	ER Site No.	Date/Time Collected	Reference LOV (available at SMO) Sample Matrix	Container Type	Container Volume	Preservative	Sample Collection Method	Sample Type	Parameter & Method Requested	LAB USE Lab Sample ID
042310 - 002	CY81D-GR-004-SS	0.0	81D	9/15/98 0944	S	G	120 ml	4 C	G	SA	VOC	1
042310 - 003	CY81D-GR-004-SS	0.0	81D	9/15/98 0944	S	G	250 ml	4 C	G	SA	GROSS ALPHA/BETA	2
042311 - 001	CY81D-GR-005-SS	0.0	81D	9/15/98 0950	S	G	500 ml	4 C	G	SA	METALS, HE	3
042311 - 002	CY81D-GR-005-SS	0.0	81D	9/15/98 0950	S	G	120 ml	4 C	G	SA	VOC	4
042311 - 003	CY81D-GR-005-SS	0.0	81D	9/15/98 0950	S	G	250 ml	4 C	G	SA	GROSS ALPHA/BETA	5
042312 - 001	CY81D-GR-006-SS	0.0	81D	9/15/98 1000	S	G	500 ml	4 C	G	SA	METALS, HE,	6
042312 - 002	CY81D-GR--006-SS	0.0	81D	9/15/98 1000	S	G	120 ml	4 C	G	SA	VOC	7
042312 - 003	CY81D-GR-006-SS	0.0	81D	9/15/98 1000	S	G	250 ml	4 C	G	SA	GROSS ALPHA/BETA	8
042313 - 001	CY81D-GR-007-SS	0.5	81D	9/15/98 1020	S	G	500 ml	4 C	G	SA	METALS, HE,	9
042313 - 002	CY81D-GR-007-SS	0.5	81D	9/15/98 1020	S	G	120 ml	4 C	G	SA	VOC	20
042313 - 003	CY81D-GR-007-SS	0.5	81D	9/15/98 1020	S	G	250 ml	4 C	G	SA	GROSS ALPHA/BETA	21
042239-001	CY81D-GR-007-DU	0.5	81D	9/15/98 1020	S	G	500 ml	4 C	G	DU	METALS, HE,	22
042239-002	CY81D-GR-007-DU	0.5	81D	9/15/98 1020	S	G	120 ml	4 C	G	DU	VOC	23
042239-003	CY81D-GR-007-DU	0.5	81D	9/15/98 1020	S	G	250 ml	4 C	G	DU	GROSS ALPHA/BETA	24
042314 - 001	CY81D-GR-008-SS	0.5	81D	9/15/98 1025	S	G	500 ml	4 C	G	SA	METALS, HE,	25
042314 - 002	CY81D-GR-008-SS	0.5	81D	9/15/98 1025	S	G	120 ml	4 C	G	SA	VOC	26
042314 - 003	CY81D-GR-008-SS	0.5	81D	9/15/98 1025	S	G	250 ml	4 C	G	SA	GROSS ALPHA/BETA	27
042315 - 001	CY81D-GR-009-SS	0.5	81D	9/15/98 1030	S	G	500 ml	4 C	G	SA	METALS, HE,	28
042315 - 002	CY81D-GR-009-SS	0.5	81D	9/15/98 1030	S	G	120 ml	4 C	G	SA	VOC	29
042315 - 003	CY81D-GR-009-SS	0.5	81D	9/15/98 1030	S	G	250 ml	4 C	G	SA	GROSS ALPHA/BETA	30
042316 - 001	CY81D-GR-010-SS	0.0	81D	9/15/98 1040	S	G	500 ml	4 C	G	SA	METALS, HE	31
042316 - 002	CY81D-GR-010-SS	0.0	81D	9/15/98 1040	S	G	120 ml	4 C	G	SA	VOC	32
042316 - 003	CY81D-GR-010-SS	0.0	81D	9/15/98 1040	S	G	250 ml	4 C	G	SA	GROSS ALPHA/BETA	33
042317 - 001	CY81D-GR-011-SS	0.0	81D	9/15/98 1045	S	G	500 ml	4 C	G	SA	METALS, HE,	34
042317 - 002	CY81D-GR-011-SS	0.0	81D	9/15/98 1045	S	G	120 ml	4 C	G	SA	VOC	35

Abnormal Conditions on Receipt: [illegible] LAB USE

Recipient Initials: [illegible]

Original To Accompany Samples, Laboratory Copy (White) | 1st Copy To Accompany Samples, Return to SMO (Blue) | 2nd Copy SMO Suspense Copy (Yellow) | 3rd Copy Field Copy (Pink)

SF 2001-COC (10-97)

Supersedes (5-97) Issue

ANALYSIS REQUEST AND CHAIN OF CUSTODY (Continuation)

Press F1 for instructions for each field.

AR/COC- 600784

Project Name: 81D Baseline Sampling | Project/Task Manager: Paul Freshour | Case No.: 7214/1300

Location Tech Area Canyons | Building NA | Room NA

Sample No. - Fraction	ER Sample ID or Sample Location Detail	Beginning Depth in FL	ER Site No.	Date/Time Collected	Reference LOV (available at SMO)						LAB USE	
					Sample Matrix	Container Type	Container Volume	Preservative	Sample Collection Method	Sample Type	Parameter & Method Requested	Lab Sample ID
042317 - 003	CY81D-GR-011-SS	0.0	81D	9/15/98 1045	S	G	250 ml	4 C	G	SA	GROSS ALPHA/BETA	36
042318 - 001	CY81D-GR-012-SS	0.5	81D	9/15/98 1055	S	G	500 ml	4 C	G	SA	METALS, HE,	37
042318 - 002	CY81D-GR-012-SS	0.5	81D	9/15/98 1055	S	G	120 ml	4 C	G	SA	VOC	38
042318 - 003	CY81D-GR-012-SS	0.5	81D	9/15/98 1055	S	G	250 ml	4 C	G	SA	GROSS ALPHA/BETA	39
042319 - 001	CY81D-GR-013-SS	0.5	81D	9/15/98 1320	S	G	500 ml	4 C	G	SA	METALS, HE, SVOC	40
042319 - 002	CY81D-GR-013-SS	0.5	81D	9/15/98 1320	S	G	120 ml	4 C	G	SA	VOC	41
042319 - 003	CY81D-GR-013-SS	0.5	81D	9/15/98 1320	S	G	250 ml	4 C	G	SA	GROSS ALPHA/BETA	42
042320 – 001	CY81D-GR-014-SS	0.5	81D	9/15/98 1323	S	G	500 ml	4 C	G	SA	METALS, HE, SVOC	43
042320 - 002	CY81D-GR-014-SS	0.5	81D	9/15/98 1323	S	G	120 ml	4 C	G	SA	VOC	44
042320 - 003	CY81D-GR-014-SS	0.5	81D	9/15/98 1323	S	G	250 ml	4 C	G	SA	GROSS ALPHA/BETA	45
042321 - 001	CY81D-GR-015-SS	0.5	81D	9/15/98 1330	S	G	500 ml	4 C	G	SA	METALS, HE	46
042321 - 002	CY81D-GR-015-SS	0.5	81D	9/15/98 1330	S	G	120 ml	4 C	G	SA	VOC	47
042321 - 003	CY81D-GR-015-SS	0.5	81D	9/15/98 1330	S	G	250 ml	4 C	G	SA	GROSS ALPHA/BETA	48
042322 - 001	CY81D-GR-016-SS	0.5	81D	9/15/98 1350	S	G	500 ml	4 C	G	SA	METALS, HE	49
042322 - 002	CY81D-GR-016-SS	0.5	81D	9/15/98 1350	S	G	120 ml	4 C	G	SA	VOC	50
042322 - 003	CY81D-GR-016-SS	0.5	81D	9/15/98 1350	S	G	250 ml	4 C	G	SA	GROSS ALPHA/BETA	51
042323 - 001	CY81D-GR-017-SS	0.5	81D	9/15/98 1405	S	G	500 ml	4 C	G	SA	METALS, HE	52
042323 - 002	CY81D-GR-017-SS	0.5	81D	9/15/98 1405	S	G	120 ml	4 C	G	SA	VOC	53
042323 - 003	CY81D-GR-017-SS	0.5	81D	9/15/98 1405	S	G	250 ml	4 C	G	SA	GROSS ALPHA/BETA	54
042240-001	CY81D-GR-017-DU	0.0	81D	9/15/98 1405	S	G	500 ml	4 C	G	DU	METALS, HE	55
042240-002	CY81D-GR-017-DU	0.0	81D	9/15/98 1405	S	G	120 ml	4 C	G	DU	VOC	56
042240-003	CY81D-GR-017-DU	0.0	81D	9/15/98 1405	S	G	250 ml	4 C	G	DU	GROSS ALPHA/BETA	57
042324 - 001	CY81D-GR-018-SS	0.0	81D	9/15/98 1415	S	G	500 ml	4 C	G	SA	METALS, HE	58
042324 - 002	CY81D-GR-018-SS	0.0	81D	9/15/98 1415	S	G	120 ml	4 C	G	SA	VOC	59
042324 - 003	CY81D-GR-018-SS	0.0	81D	9/15/98 1415	S	G	250 ml	4 C	G	SA	GROSS ALPHA/BETA	60

Abnormal Conditions on Receipt: LAB USE

Receipt Initials:

Original To Accompany Samples, Laboratory Copy (White) | 1st Copy To Accompany Samples, Return to SMO (Blue) | 2nd Copy SMO Suspense Copy (Yellow) | 3rd Copy Field Copy (Pink)

SF 2001-COC (10-97)

Supersedes (5-97) Issue

ANALYSIS REQUEST AND CHAIN OF CUSTODY (Continuation)

Press F1 for instructions for each field.

AR/COC- 600784

Project Name: 81D Baseline Sampling | Project/Task Manager: Paul Freshour | Case No.: 7214/1300

Location | Tech Area: Canyons | Building: NA | Room: NA

Sample No. - Fraction	ER Sample ID or Sample Location Detail	Beginning Depth in FL	ER Site No.	Date/Time Collected	Reference LOV (available at SMO): Sample Matrix	Container: Typ	Container: Volume	Preservative	Sample Collection Method	Sample Type	Parameter & Method Requested	LAB USE: Lab Sample ID
042325 - 001	CY81D-GR-019-SS	0.0	81D	9/15/98 1425	S	G	500 ml	4 C	G	SA	METALS, HE	161
042325 - 002	CY81D-GR-019-SS	0.0	81D	9/15/98 1425	S	G	120 ml	4 C	G	SA	VOC	162
042325 - 003	CY81D-GR-019-SS	0.0	81D	9/15/98 1425	S	G	250 ml	4 C	G	SA	GROSS ALPHA/BETA	163
042326 - 001	CY81D-GR-020-SS	0.0	81D	9/15/98 1420	S	G	500 ml	4 C	G	SA	METALS, HE	164
042326 - 002	CY81D-GR-020-SS	0.0	81D	9/15/98 1420	S	G	120 ml	4 C	G	SA	VOC	165
042326 - 003	CY81D-GR-020-SS	0.0	81D	9/15/98 1420	S	G	250 ml	4 C	G	SA	GROSS ALPHA/BETA	166
042327 - 001	CY81D-GR-001-EB	NA	81D	9/15/98 1442	DIW	P	500 ml	HNO3	G	EB	METALS	167
042327 - 002	CY81D-GR-001-EB	NA	81D	9/15/98 1442	DIW	G	2x40 ml	HCL	G	EB	VOC	168
042327 - 003	CY81D-GR-001-EB	NA	81D	9/15/98 1442	DIW	G	4x1 L	None	G	EB	HE	169
042328 - 001	CY81D-GR-001-TB	NA	81D	9/15/98 1442	DIW	G	3x40ml	HCL	G	TB	VOC	170

(Abnormal Conditions on Receipt) | LAB USE

Recipient Initials

Original: To Accompany Samples, Laboratory Copy (White) | 1st Copy: To Accompany Samples, Return to SMO (Blue) | 2nd Copy: SMO Suspense Copy (Yellow) | 3rd Copy: Field Copy (Pink)

Contract Verification Review (CVR)

Project Leader P. FRESHOUR Project Name 81D BASELINE SAMPLING Case No. 7214.130000

AR/COC No. 600784 Analytical Lab GEL SDG No. 8SLO1 (9809546)

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

1.0 Analysis Request and Chain of Custody Record and Log-In Information

Line No.	Item	Complete? Yes	Complete? No	If no, explain	Resolved? Yes	Resolved? No
1.1	All items on COC complete - data entry clerk initialed and dated	X				
1.2	Container type(s) correct for analyses requested	X				
1.3	Sample volume adequate for # and types of analyses requested	X				
1.4	Preservative correct for analyses requested		X	DIW samples VOCs require 4°C Preservative; shipped chilled by Sandia.	X	
1.5	Custody records continuous and complete		X	Sample Team Members should hand write their initials in Initial Box of COC section, not type them in. GEL shipment receiver left Org. blank in COC section.		X
1.6	Lab sample number(s) provided	X				
1.7	Date samples received	X				
1.8	Condition upon receipt information provided	X				

2.0 Analytical Laboratory Report

Line No.	Item	Complete? Yes	Complete? No	If no, explain	Resolved? Yes	Resolved? No
2.1	Data reviewed, signature	X				
2.2	Method reference number(s) complete and correct	X				
2.3	QC analysis and acceptance limits provided (MB, LCS, LCD)	X				
2.4	Matrix spike/matrix spike duplicate data provided(if requested)	X				
2.5	Detection Limits provided; PQL and MDL(or IDL)	X				
2.6	QC batch numbers provided	X				
2.7	Dilution Factors provided	X				
2.8	Data reported using correct sig. fig. (2 for org.; 3 for inorg.)	X				
2.9	Rad analysis uncertainty provided (2 sigma error)	X				
2.10	Narrative provided	X				
2.11	TAT met	X				
2.12	Hold times met	X				
2.13	Were contractual qualifiers provided	X				
2.14	All requested result data provided	X				

b) Sampling blank (e.g., field, trip, and equipment) data reported and met?		X	Equip. Blank Sample 042327-001 (9809546-67) detected the presence of Chromium (J) (Metals). Equip. Blank Sample 042327-002 (9809546-68) detected the presence of Acetone (J) (VOCs).
3.6)Contractual qualifiers provided: "J"- estimated quantity; "B"-analyte found in method blank; "U"- analyte undetected (results are below the MDL or L_c (rad)); "H"-analysis done beyond the holding time.	X		
3.7)Narrative included, correct, and complete?	X		

4.0 Data Quality Evaluation Continuation

Summarize the findings in the table below. List only samples/fractions for which deficiencies have been noted.

Sample/ Fraction No.	Analysis	Qualifiers	Comments

Were deficiencies noted. ☹ Yes ☺ No

Based on the review, this data package is complete. ☺ Yes ☹ No

If no, provide : nonconformance report or correction request number _____ and date correction request was submitted _____

Reviewed by: TERRY MACDONALD Date: 10/26/98 Closed by: _____ Date: _____

Annex 7-C

ANNEX 7-C
Risk Screening Assessment

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LIST OF TABLES

SWMU 81D: RISK SCREENING ASSESSMENT REPORT

I. Site Description and History

Solid Waste Management Unit (SWMU) 81D is a subunit of SWMU 81 identified as the New Aerial Cable Facility on the Resource Conservation and Recovery Act (RCRA) Hazardous and Solid Waste Amendment permit. SWMU 81D is located on U.S. Air Force land withdrawn from the U.S. Forest Service and permitted to the U.S. Department of Energy (DOE). The site is located on the floor of Sol se Mete Canyon, approximately 300 feet north of the base of the sled track (SWMU 81A). The Sol se Mete Canyon drains to the north into Lurance Canyon, which in turn drains to the west to Arroyo del Coyote. Coyote Springs Road follows the drainage of Lurance Canyon and is the main access to the service road in Sol se Mete Canyon. SWMU 81D is an active subunit. Testing activities at the Aerial Cable Facility include gravitational accelerated (drop) tests and rocket sled pull-down tests. The rocket pull-down technique uses towing cables to accelerate rocket sleds carrying the test items. The test items are released from the overhead cable as the rockets are ignited and directed toward a target, which is usually located on the canyon floor.

Historical published information regarding the hydrogeology of Sol se Mete and Lurance Canyon has been summarized in the "RCRA Facility Investigation (RFI) Work Plan for the Operable Unit (OU) 1333, Canyons Test Area" (SNL/NM September 1995). Since that time, additional bedrock wells and alluvial piezometers have been installed in the Lurance Canyon, and data collected from the new bedrock wells have supported the hydrologic model of semiconfined to confined groundwater conditions at a depth of approximately 150 feet below ground surface (bgs) beneath the Lurance Canyon SWMUs. The data collected from the alluvial piezometers support the absence of alluvial groundwater. Hydrologic data have been based upon the Burn Site Well, CYN-MW1D, 12AUP01 (piezometer), CYN-MW2S (piezometer), CYN-MW3, and CYN-MW4.

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

For a detailed discussion regarding the local setting at SWMU 81D, refer to the OU 1333 RFI Work Plan (SNL/NM September 1995).

Construction of the New Aerial Cable Site, SWMU 81, began in 1970 in response to the need to upgrade the aerial cable facilities that existed at the Old Aerial Cable Site (SWMU 82) (SNL/NM September 1995). The new aerial cable facilities provide impact testing on weapons and other test units that may be subject to detonation (SNL/NM September 1995). The initial construction activity at SWMU 81 was at the southern cable area and included the placement of the aerial cable anchors on the ridge crests east and west of Sol se Mete Canyon.

A 1971 historical aerial photograph shows that SWMU 81 was active and had three main features: cables suspended between the east and west ridge tops, a concrete impact pad, and a 600-foot-long sled track (SNL/NM August 1994). The southern aerial cable is 4,800 feet long

and can raise items up to 600 feet (Palmieri May 1992). A smooth-track cable was added to the southern cable Area I in 1977 to allow additional trolley simulated aerial flight tests by all three branches of the military service.

A 1983 historical aerial photograph shows that the site had several additional features such as a storage shed, concrete pads, winches, pulleys, cables, and a fire scar caused by a runaway rocket motor to the east of the sled track (SNL/NM August 1994). The sheds, trailers, and camera bunkers in the southern cable area (referred to in other documents as the arena) were used for equipment storage and had never been used for tests. There were no visible signs of spill or contamination in or near these support structures (SNL/NM September 1995). Several of the concrete blocks around the impact pad were used as anchors for a net that was suspended at the impact pad. The net was later moved to SWMU 63 (SNL/NM September 1995). Three cables and their associated anchors in the southern cable area of SWMU 81 are used in test operations: a main cable (constructed in 1970), the trolley cable (constructed in 1977), and a camera cable. Support structures associated with the aerial cables include winches, guide pulleys, and utility trucks (with winches). No hazardous materials were ever stored or noted at the winch sites associated with SWMU 81. There is no evidence that hazardous constituents had ever been used or released at these support structures. No fuel storage areas or fuel spills have been identified (SNL/NM September 1995).

II. Data Quality Objectives

The baseline sampling conducted at SWMU 81D was designed to collect adequate samples to:

- Determine whether hazardous waste or hazardous constituents have been released at the site,
- Characterize the nature and extent of any releases, and
- Provide sufficient definitive analytical data to support screening risk assessments.

Tables 1 and 2 summarize the sampling design at SWMU 81D. The source of potential constituents of concern (COCs) is small metal shrapnel on surface soil resulting from air fall after antiarmor test unit detonations. Table 3 summarizes the analytical methods and data quality requirements necessary (1) to adequately characterize hazardous waste or hazardous constituents associated with metal and debris and (2) to support screening risk assessments.

All off-site laboratory results were reviewed and verified/validated according to "Data Validation Procedure for Chemical and Radiochemical Data" Sandia National Laboratories/New Mexico (SNL/NM) Environmental Restoration (ER) Project Analytical Operating Procedure 00-03, Rev. 0 (SNL/NM December 1999). All gamma spectroscopy data were reviewed by SNL/NM Department 7713 Radiation Protection Sample Diagnostic Laboratory (RPSD) according to "Laboratory Data Review Guidelines," Procedure No. RPSD-02-11, Issue No. 02 (SNL/NM July 1996). These reviews confirmed that the data are acceptable for use in the no further action (NFA) proposal for SWMU 81D. The data quality objectives (DQOs) for SWMU 81D have been met.

Table 1
Summary of Sampling Performed to Meet Data Quality Objectives

SWMU 81D	Potential COC Source	Area of Site (acres)	Number of Sampling Locations	Sample Density (samples/acre)	Sampling Location Rationale
81D	Small metal shrapnel from antiarmor tests	4.3	20	4.65	Sample locations based upon a random grid within the site boundary with nine biased sample locations under the cable drop area.

COC = Constituent of concern.
SWMU = Solid Waste Management Unit.

Table 2
Number of Baseline Soil Samples Collected at SWMU 81D

Sample Type	Number of Samples	Radionuclides	Radionuclides	RCRA Metals	VOCs	SVOCs	HE
Baseline	20	20	20	20	20	–	20
Duplicates	2	2	2	2	2	–	2
VOC Trip Blanks	1	–	–	–	1	–	–
Equipment Blanks	1	–	–	1	1	–	1
Total Samples	24	22	22	23	24	–	23
Analytical laboratory	–	GEL	RPSD	GEL	GEL	GEL	GEL

Sampling date: 9/8/98.
GEL = General Engineering Laboratories, Inc.
HE = High explosive compound.
RCRA = Resource Conservation and Recovery Act.
RPSD = Radiation Protection Sample Diagnostic (RPSD) Laboratory.
SVOC = Semivolatile organic compound.
SWMU = Solid Waste Management Unit.
VOC = Volatile organic compound.
– = Information not available.

Table 3
Summary of Data Quality Requirements

Analytical Requirement	Data Quality Level	GEL	Radiation Protection Sample Diagnostics Laboratory Department 7713 SNL/NM
TAL metals EPA Method 6010/7000[a]	Definitive	20 samples 2 duplicates	Not applicable
VOCs EPA Method 8260[a]	Definitive	20 samples 2 duplicates	Not applicable
SVOCs EPA Method 8270[a]	Definitive	0 samples 0 duplicates	Not applicable
HE Compounds EPA Method 8330[a]	Definitive	20 samples 2 duplicates	Not applicable
Gross alpha/gross beta EPA Method 900.0[a]	Definitive	20 samples 2 duplicates	Not applicable
Gamma spectroscopy EPA Method 901.1[a]	Definitive	Not applicable	20 samples 2 duplicates

[a]EPA (November 1986).
EPA = U.S. Environmental Protection Agency.
GEL = General Engineering Laboratories, Inc.
HE = High explosive(s).
SNL/NM = Sandia National Laboratories/New Mexico.
SVOC = Semivolatile organic compounds.
TAL = Target Analyte List.
VOC = Volatile organic compound.

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

III.1 Introduction

The determination of the nature, rate, and extent of contamination at SWMU 81D was based upon an initial conceptual model validated with baseline sampling at the site. The initial conceptual model was developed from historical background information including site inspections, personal interviews, historical photographs, historical operating records, and radiological and explosives surveys. The DQOs contained in the Work Plan for OU 1333 (SNL/NM September 1995) and the SNL/NM response to the Request for Supplemental Information on the OU 1333 Work Plan (SNL/NM October 1997) identified the sample locations, sample density, sample depth and analytical requirements. The sample data collected were subsequently used to develop the final conceptual model for SWMU 81D that is presented in the associated NFA proposal. This section describes the quality of the data specifically used to determine the nature, rate and extent of contamination.

III.2 Nature of Contamination

The nature of contamination at SWMU 81D was determined by analytical testing of soil media. The analytical testing (volatile organic compound, high explosive, and metals analyses) was performed to characterize potential releases of COCs. Gamma spectroscopy and gross alpha/gross beta were also performed to determine whether any radioactive materials were present at the site. These analytical methods are appropriate to characterize the COCs and potential degradation products associated with the historical activities at SWMU 81D.

III.3 Rate of Contaminant Migration

Primary sources of COCs were removed from SWMU 81D after testing activities were completed. Currently, only very minor amounts of metallic debris remain at the site. The rate of COC migration is dependent predominantly on site meteorological and surface hydrologic processes as described in Section V. Data available from the Site-Wide Hydrogeologic Characterization Project (published annually); numerous SNL/NM air, surface water, and radiological monitoring programs; biological surveys; and other governmental atmospheric monitoring at the Kirtland Air Force Base (i.e., National Oceanographic and Atmospheric Administration) are adequate to characterize the rate of COCs migration at SWMU 81D.

III.4 Extent of Contamination

Twenty soil samples were collected throughout SWMU 81D. The sample collection points were selected based upon a random grid within the site boundary with nine biased sample locations under the cable drop area. The number of samples collected was deemed sufficient to establish the presence of detectable COCs related to tests conducted at SWMU 81D. The sample density was 4.65 samples per acre.

Because of the relatively low solubility of most metals and organic compounds, limited precipitation and high evapotranspiration, the vertical rate of contaminant migration is expected to be extremely low. Soil samples were collected from the surface at all sampling locations at SWMU 81D. The sample collection depth was considered representative of the media potentially affected by surface disposal of debris and sufficient to determine the extent of COC migration.

In summary, the design of the baseline sampling was appropriate and adequate to determine the nature, rate, and extent of contamination.

IV. Comparison of COCs to Background Screening Levels

Site history and characterization activities are used to identify potential COCs. The SWMU 81D NFA proposal describes the identification of COCs and the sampling that was conducted in order to determine the concentration levels of those COCs across the site. Generally, COCs evaluated in this risk assessment included all detected organics and all inorganic and radiological COCs for which samples were analyzed. If the detection limit of an organic compound was too high (i.e., could possibly cause an adverse effect to human health or the environment), the compound was retained. Nondetect organics not included in this assessment were determined to have sufficiently low detection limits to ensure protection of human health and the environment. In order to provide conservatism in this risk assessment, the calculation used only the maximum concentration value of each COC found for the entire site. The SNL/NM maximum background concentration (Dinwiddie September 1997, Garcia 1998) was selected to provide the background screening listed in Tables 4 and 5. Human health nonradiological COCs were also compared to SNL/NM proposed Subpart S action levels (Table 4) (IT July 1994).

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

Table 4 lists nonradiological COCs for the human health and ecological risk assessment at SWMU 81D. Table 5 lists radiological COCs for the human health and ecological risk assessment. All tables show the associated SNL/NM maximum background concentration values (Dinwiddie September 1997, Garcia 1998). Sections VI.4, VII.2 and VII.3 discuss Tables 4 and 5.

V. Fate and Transport

The primary releases of COCs at SWMU 81D were to the surface soil. Wind, water, and biota are natural mechanisms of COC transport from the primary release point. Winds at this site, however, are moderated by the canyon topography and by the woodland vegetation. Therefore, wind erosion is probably not significant as a transport mechanism at this site.

Table 4
Nonradiological COCs for Human Health and Ecological Risk Assessment at SWMU 81D with Comparison to the Associated SNL/NM Background Screening Value, BCF, Log K_{ow}, and Subpart S Screening Value

COC Name	Maximum Concentration (mg/kg)	SNL/NM Background Concentration (mg/kg)[a]	Is Maximum COC Concentration Less Than or Equal to the Applicable SNL/NM Background Screening Value?	BCF (maximum aquatic)	Log K_{ow} (for organic COCs)	Bioaccumulator?[b] (BCF > 40, log K_{ow} >4)	Subpart S Screening Value[c]	Is Individual COC less than 1/10 of the Action Level?
Arsenic	14.8	9.8	**No**	44[d]	NA	**Yes**	0.5	**No**
Barium	190 J	246	Yes	170[e]	NA	**Yes**	6000	Yes
Beryllium	0.812	0.75	**No**	19[d]	NA	No	0.2	**No**
Cadmium	0.104 J	0.64	Yes	64[d]	NA	**Yes**	80	Yes
Chromium, total[f]	15.5	18.8	Yes	16[d]	NA	No	400	Yes
Lead	24	18.9	**No**	49[d]	NA	**Yes**	–	–
Mercury	0.0368 J	0.055	Yes	5500[d]	NA	**Yes**	20	Yes
Selenium	0.82 J	2.7	Yes	800[g]	NA	**Yes**	400	Yes
Silver	0.195 J	<0.5	**Unknown**	0.5[d]	NA	No	400	Yes
Carbon disulfide	0.00077 J	NA	**NA**	7.9[h]	2.93[h]	No	8000	Yes
Tetrachloroethene	0.00082 J	NA	**NA**	49[h]	2.67[i]	**Yes**	10	Yes
Toluene	0.00098 J	NA	**NA**	10.7[d]	2.69[d]	No	20,000	Yes
Xylene	0.001 J	NA	**NA**	23.4[h]	1.5[i]	No	200,000	Yes

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

[a] From Garcia (1998) Canyon Area Soils.
[b] NMED (March 1998).
[c] IT Corporation (July 1994).
[d] Yanicak (March 1997).
[e] Neumann (1976).
[f] Assumed to be chromium VI for Subpart S screening procedure.
[g] Callahan et al. (1979).
[h] Howard (1990).
[i] Micromedex, Inc (1998).

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

Table 5
Radiological COCs for Human Health and Ecological Risk Assessment at SWMU 81D with Comparison to the Associated SNL/NM Background Screening Value and BCF

COC Name	Maximum Concentration (pCi/g)	SNL/NM Background Concentration (pCi/g)[a]	Is Maximum COC Concentration Less Than or Equal to the Applicable SNL/NM Background Screening Value?	BCF (maximum aquatic)	Is COC a Bioaccumulator?[b] (BCF >40)
Th-232	0.99	1.03	Yes	3000[d]	No[c]
U-238	1.07	2.31	Yes	900[d]	**Yes**
U-235	**0.22**	0.16	**No**	900[d]	**Yes**
Cs-137	**0.70**	0.515	**No**	3000[e]	**Yes**

Note: **Bold** indicates COCs that exceed background screening values and/or are bioaccumulators.
[a]From Dinwiddie (September 1997), Canyons Area Soils.
[b]NMED (March 1998).
[c]Yanicak (March 1997).
[d]Baker and Soldat (1992).
[e]BCF from Whicker and Schultz (1982).
BCF = Bioconcentration factor.
COC = Constituent of concern.
NMED = New Mexico Environment Department.
pCi/g = Picocurie(s) per gram.
SNL/NM = Sandia National Laboratories/New Mexico.
SWMU = Solid Waste Management Unit.

Water at SWMU 81D is received as precipitation (rain or occasional snow). Precipitation will either evaporate at or near the point of contact, infiltrate into the soil, or form runoff. Infiltration at the site is enhanced by the coarse nature of the soil (the soil in the area of the site is primarily Tesajo-Millett stony sandy loam [USDA 1977]); however, surface runoff can occur during intense rainfall events and during extended rainfall periods. Surface-water runoff from SWMU 81D will flow into the main arroyo channel that drains Sol se Mete Canyon, which in turn discharges into Arroyo del Coyote in Lurance Canyon. Runoff can carry surface soil particles with adsorbed COCs. The distance of transport will depend upon the size of the particle and the velocity of the water.

Water that infiltrates into the soil will continue to percolate through the soil until field capacity is reached. COCs desorbed from the soil particles into the soil solution may be leached into the subsurface soil with this percolation. The effective rooting depths of the soil at SWMU 81D is about 60 inches [USDA 1977]. This indicates the depth of the system's transient water cycling zone (the dynamic balance between percolation/infiltration and evapotranspiration). Because groundwater at this site is approximately 222 feet bgs and is in a semiconfined or confined aquifer, the potential for COCs to reach groundwater through the unsaturated zone above the watertable is very small. As water from the surface evaporates, the direction of COC movement may be reversed with capillary rise of the soil water.

Plant roots can take up COCs that are in the soil. These COCs may then be transported to the above-ground tissues with the xylem stream. Above-ground tissues can also take up constituents from direct contact with dust particles Volatilized constituents can be taken up by plants directly from the air; however, volatile COCs can also be lost to the air from the plant tissues. Organic COCs in plant tissues can be metabolized or undergo other types biotransformations. That which remains in the tissue may be consumed by herbivores or eventually be returned to the soil as litter. Above-ground litter could be transported by wind and water until it is decomposed. Constituents in plant tissues that are consumed by herbivores can be absorbed or be returned to the soil in feces (at the site or possibly transported from the site in the herbivore). COCs that are absorbed can be held in tissues, biotransformed, or later excreted. The herbivore may be eaten by a predator or scavenger and the constituents still held in the tissues will repeat the potential fates of excretion, transformation, or eventual consumption by higher predators, scavengers, and decomposers. The potential for transport of the constituents within the food chain is dependent upon the mobility of the species that comprise the food chain and the potential for the constituent to be transferred across the links in the food chain.

Degradation of COCs at SWMU 81D can result from biotic or abiotic processes. COCs that are inorganic and elemental in form are not considered to be degradable. Radiological COCs, however, undergo decay to stable isotopes or radioactive daughter elements. Other transformations of inorganics could include changes in valence (oxidation/reduction reactions) or incorporation into organic forms (e.g., the conversion of selenite or selenate from soil to seleno-amino acids in plants). Degradation processes for organic COCs may include photolysis, hydrolysis, and biotransformation. Photolysis requires light and, therefore, takes place in the air, at the ground surface, or in surface water. Hydrolysis includes chemical transformations in water, and can occur in the soil solution. Biotransformation (i.e., transformation caused by plants, animals, and microorganisms) can occur; however, biological activity may be limited by the aridity of the environment at this site.

Table 6 summarizes the fate and transport processes that can occur at SWMU 81D. COCs at this site include both inorganics (metals and radionuclides) and organics in surface soil. Because of the local topography and woodland vegetation, the potential for transport of COCs by wind is low. The potential for transport by surface-water runoff is moderate for COCs currently at or near the soil surface. Significant leaching of COCs into the subsurface soil is unlikely and leaching to the groundwater at this site is highly unlikely. For inorganic COCs, the potential for degradation is low and the potential for uptake into the food chain is considered moderate to low because of the terrestrial nature of the habitat and the arid climate. Degradation and/or biotransformation of organics and their loss by volatilization can be significant. The potential for uptake into the food chain by most other organic COCs at SWMU 81D is considered moderate to low because of the terrestrial nature of the habitat and the arid climate. Decay of radiological COCs is insignificant because of their long half lives.

Table 6
Summary of Fate and Transport at SWMU 81D

Transport and Fate Mechanism	Existence at Site	Significance
Wind	Yes	Low
Surface runoff	Yes	Moderate
Migration to groundwater	No	None
Food chain uptake	Yes	Moderate to low
Transformation/degradation	Yes	Moderate (organics) Low (inorganics and radionuclides)

SWMU = Solid Waste Management Unit.

VI. Human Health Risk Screening Assessment

VI.1 Introduction

Human health risk screening assessment of this site includes a number of steps that culminate in a quantitative evaluation of the potential adverse human health effects caused by constituents located at the site. The steps to be discussed include the following:

Step 1.	Site data are described that provide information on the potential COCs, as well as the relevant physical characteristics and properties of the site.
Step 2.	Potential pathways are identified by which a representative population might be exposed to the COCs.
Step 3.	The potential intake of these COCs by the representative population is calculated using a tiered approach. The first component of the tiered approach includes two screening procedures. One screening procedure compares the maximum concentration of the COC to an SNL/NM maximum background screening value. COCs that are not eliminated during the first screening procedure are subjected to a second screening procedure that compares the maximum concentration of the COC to the SNL/NM proposed Subpart S action level.
Step 4.	Toxicological parameters are identified and referenced for COCs that were not eliminated during the screening steps.

Step 5.	Potential toxicity effects (specified as a hazard index [HI]) and estimated excess cancer risks are calculated for nonradiological COCs and background. For radiological COCs, the incremental total effective dose equivalent (TEDE) and incremental estimated cancer risk are calculated by subtracting applicable background concentrations directly from maximum on-site contaminant values. This background subtraction only occurs when a radiological COC occurs as contamination and exists as a natural background radionuclide.
Step 6.	These values are compared with guidelines established by the U.S. Environmental Protection Agency (EPA) and the DOE to determine whether further evaluation, and potential site cleanup, is required. Nonradiological COC risk values are also compared to background risk so that an incremental risk can be calculated.
Step 7.	Uncertainties of the above steps are discussed.

VI.2 Step 1. Site Data

Section I provides the description and history for SWMU 81D. Section II presents comparison of results to DQOs. Section III discusses the determination of the nature, rate, and extent of contamination.

VI.3 Step 2. Pathway Identification

SWMU 81D has been designated a future land use scenario of recreational (DOE et al. October 1995) (see Appendix 1 for default exposure pathways and parameters). Because of the location and the characteristics of the potential contaminants, the primary pathway for human exposure is considered to be soil ingestion for the nonradiological COCs and direct gamma exposure for the radiological COCs. The inhalation pathway for both nonradiological and radiological COCs is included because the potential exists to inhale dust and volatiles. Soil ingestion is included for the radiological COCs as well. No water pathways to the groundwater are considered. Depth to groundwater at SWMU 81D is in excess of 200 feet bgs. Because of the lack of surface water or other significant mechanisms for dermal contact, the dermal exposure pathway is considered not to be significant. No intake routes through plant, meat, or milk ingestion are considered appropriate for the recreational land use scenario. However, plant uptake is considered for the residential land use scenario.

Pathway Identification

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

VI.4 Step 3. COC Screening Procedures

Step 3 is discussed in this section and includes two screening procedures. The first compares the maximum COC concentration to the background screening level. The second compares maximum COC concentrations to SNL/NM proposed Subpart S action levels. This second

procedure was applied only to COCs that were not eliminated during the first screening procedure.

VI.4.1 Background Screening Procedure

VI.4.1.1 Methodology

Maximum concentrations of nonradiological COCs were compared to the approved SNL/NM maximum screening level for this area. The SNL/NM maximum background concentration was selected to provide the background screen in Table 4 and was used to calculate risk attributable to background in Table 10. Only the COCs that were detected above their respective SNL/NM maximum background screening levels or did not have either a quantifiable or calculated background screening level were considered in further risk assessment analyses.

For radiological COCs that exceeded the SNL/NM background screening levels, background values were subtracted from the individual maximum radionuclide concentrations. Those that did not exceed these background levels were not carried any further in the risk assessment. This approach is consistent with DOE Order 5400.5, "Radiation Protection of the Public and the Environment" (DOE 1993). Radiological COCs that did not have a background value and were detected above the analytical minimum detectable activity were carried through the risk assessment at their maximum levels. The resultant radiological COCs remaining after this step are referred to as background-adjusted radiological COCs.

VI.4.1.2 Results

Tables 4 and 5 show SWMU 81D maximum COC concentrations that were compared to the SNL/NM maximum background values (Dinwiddie September 1997, Garcia 1998) for the human health risk assessment. For the nonradiological COCs, three constituents were measured at concentrations greater than their respective background. One nonradiological COC had no quantifiable background concentration, so it is not known whether that COC exceeded background. Four COCs were organic compounds and did not have background-screening levels.

The maximum concentration value for lead is 24 milligrams (mg) per kilogram (/kg). The EPA intentionally does not provide any human health toxicological data on lead; therefore, no risk parameter values could be calculated. However, EPA Region 6 guidance for the screening value for lead for the industrial land use scenario is 2,000 mg/kg (EPA 1996a); for the residential land use scenario, the EPA screening guidance value is 400 mg/kg (EPA July 1994). The maximum concentration value for lead at this site is less than both screening values; therefore, lead is eliminated from further consideration in the human health risk assessment.

For the radiological COCs, two constituents had measured activity concentration slightly greater than their respective backgrounds (Cs-137 and U-235)

VI.4.2 Subpart S Screening Procedure

VI.4.2.1 Methodology

The maximum concentrations of nonradiological COCs not eliminated during the background screening process were compared with action levels (IT July 1994) calculated using methods and equations promulgated in the proposed RCRA Subpart S (EPA 1990) and Risk Assessment Guidance for Superfund (RAGS) (EPA 1989) documentation. Accordingly, all calculations were based upon the assumption that receptor doses from both toxic and potentially carcinogenic compounds result most significantly from ingestion of contaminated soil. Because the samples were all taken from the surface and near surface, this assumption is considered valid. If there were ten or fewer COCs and each had a maximum concentration of less than 1/10 the action level, then the site was judged to pose no significant health hazard to humans. If there were more than ten COCs, then the Subpart S screening procedure was not performed.

VI.4.2.2 Results

Table 4 shows the COCs and the associated proposed Subpart S action level. The table compares the maximum concentration values to 1/10 the proposed Subpart S action level. This methodology was guidance given to SNL/NM from the EPA (EPA 1996a). Two COCs that failed the background screen were above 1/10 the Subpart S action level. Therefore, all constituents with maximum concentrations above background were carried forward in the risk assessment process, and an individual COC hazard quotient (HQ), HI, and an excess cancer risk value were calculated.

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

VI.5 Step 4. Identification of Toxicological Parameters

Tables 7 (nonradiological) and 8 (radiological) list the COCs retained in the risk assessment and the values for the available toxicological information. The toxicological values used for nonradiological COCs in Table 7 were from the Integrated Risk Information System (IRIS) (EPA 1998a) and the Region 9 (EPA 1996c) electronic database. Dose conversion factors (DCF) used in determining the excess TEDE values for radiological COCs for the individual pathways were the default values provided in the RESRAD computer code (Yu et al. 1993a) as developed in the following documents:

- DCFs for ingestion and inhalation are taken from "Federal Guidance Report No. 11, Limiting Values of Radionuclide Intake and Air Concentration and [DCFs] 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).

Table 7
Toxicological Parameter Values for SWMU 81D Nonradiological COCs

COC Name	RfD_o (mg/kg-d)	Confidence[a]	RfD_{inh} (mg/kg-d)	Confidence[a]	SF_o $(mg/kg\text{-}day)^{-1}$	SF_{inh} $(mg/kg\text{-}day)^{-1}$	Cancer Class[b]
Arsenic	3E-4[c]	M	–	–	1.5E+0[c]	1.5E+1[c]	A
Beryllium	2E-3[c]	L to M	5.7E-6[c]	M	–	8.4E+0[c]	B1
Silver	5E-3[c]	L	–	–	–	–	D
Carbon disulfide	1E-1[c]	M	2E-1[c]	M	–	–	–
Tetrachloro-ethene	1E-2[c]	M	1E-2[d]	–	5.2E-2[d]	2E-3[d]	–
Toluene	2E-1[c]	M	1.1E-1[c]	M	–	–	D
Xylene	2E+0[c]	M	2E-1[d]	–	–	–	D

[a]Confidence associated with IRIS (EPA 1998a) database values. Confidence: L = low, M = medium.

[b]EPA weight-of-evidence classification system for carcinogenicity (EPA 1989) taken from IRIS (EPA 1998a) with the exception of 1,2-dibromo-3-chloropropane which was taken from HEAST (EPA 1997a):

A = Human carcinogen
B1 = Probable human carcinogen. Limited human data available.
D = Not classifiable as to human carcinogenicity.

[c]Toxicological parameter values from IRIS electronic database (EPA 1998a).

[d]Toxicological parameter values from EPA Region 9 electronic database (EPA 1996c).

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

Table 8
Radiological Toxicological Parameter Values for SWMU 81D COCs Obtained from RESRAD Risk Coefficients[a]

COC Name	SF_o (1/pCi)	SF_{inh} (1/pCi)	SF_{ev} (g/pCi-yr)	Cancer Class[b]
U-235	4.70E-11	1.30E-08	2.70E-07	A
Cs-137	3.20E-11	1.90E-11	2.10E-06	A

[a]From 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 volume contamination (exposure to contamination deeper than the immediate surface of the site) were calculated using the methods discussed in "Dose-Rate Conversion Factors for External Exposure to Photon Emitters in Soil" (Kocher 1983) and in ANL/EAIS-8, *Data Collection Handbook to Support Modeling the Impacts of Radioactive Material in Soil* (Yu et al. 1993b).

VI.6 Step 5. Exposure Assessment and Risk Characterization

Section VI.6.1 describes the exposure assessment for this risk assessment. Section VI.6.2 provides the risk characterization, including the HI and the excess cancer risk for both the potential nonradiological COCs and associated background for recreational and residential land uses. The incremental TEDE and incremental estimated cancer risk are provided for the background-adjusted radiological COCs for both recreational and residential land uses.

VI.6.1 Exposure Assessment

Appendix 1 shows the equations and parameter input values used in calculating intake values and subsequent HI and excess cancer risk values for the individual exposure pathways. The appendix shows parameters for both recreational and residential land use scenarios. The equations for nonradiological COCs are based upon the RAGS (EPA 1989). Parameters are based upon information from the RAGS (EPA 1989) and other EPA guidance documents and reflect the reasonable maximum exposure (RME) approach advocated by the RAGS (EPA 1989). For radiological COCs, the coded equations provided in RESRAD computer code are used to estimate the incremental TEDE and cancer risk for individual exposure pathways.

Further discussion of this process is provided in the *Manual for Implementing Residual Radioactive Material Guidelines Using RESRAD* (Yu et al. 1993a).

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

VI.6.2 Risk Characterization

Table 9 shows a HI of 0.00 for the SWMU 81D nonradiological COCs and an estimated excess cancer risk of 9E-7 for the designated recreational land use scenario. The numbers presented included exposure from soil ingestion and dust and volatile inhalation for nonradiological COCs. Table 10 shows a HI of 0.00 and an excess cancer risk of 6E-7 assuming the maximum background concentrations of the SWMU 81D associated background constituents for the designated recreational land use scenario.

For the radiological COCs, contribution from the direct gamma exposure pathway is included. For the recreational land use scenario, a TEDE was calculated for an individual who spends 4 hours per week on the site. This resulted in an incremental TEDE of 1.5E-2 millirem (mrem) per year (/yr). In accordance with EPA guidance found in Office of Solid Waste and Emergency Response Directive No. 9200.4-18 (EPA 1997b), an incremental TEDE of 15 mrem/yr is used for the probable land use scenario (recreational in this case); the calculated dose value for SWMU 81D for the recreational land use is well below this guideline. The estimated excess cancer risk is 2.0E-7.

For the residential land use scenario nonradioactive COCs, the HI is 0.9, and the excess cancer risk is 2E-4 (Table 9). The numbers in the table included exposure from soil ingestion, dust and volatile inhalation, and plant uptake. Although the EPA (1991) generally recommends that inhalation not be included in a residential land use scenario, this pathway is included because of the potential for soil in Albuquerque, New Mexico, to be eroded and, subsequently, for dust to be present in predominantly residential areas. Because of the nature of the local soil, other exposure pathways are not considered (see Appendix 1). Table 10 shows that for the SWMU 81D associated background constituents, the HI is 0.6 and the excess cancer risk is 1E-4.

For the radiological COCs, the incremental TEDE for the residential land use scenario is 3.0E-1 mrem/yr. The guideline being used is an excess TEDE of 75 mrem/yr (SNL/NM February 1998) for a complete loss of institutional controls (residential land use in this case); the calculated dose value for SWMU 81D for the residential land use scenario is well below this guideline. Consequently, SWMU 81D 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 3.8E-6. The excess cancer risk from the nonradiological COCs and the radiological COCs is not additive, as noted in the RAGS (EPA 1989).

Table 9
Risk Assessment Values for SWMU 81D Nonradiological COCs

COC Name	Maximum Concentration (mg/kg)	Recreational Land Use Scenario[a]		Residential Land Use Scenario[a]	
		Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Arsenic	14.8	0.00	9E-7	0.85	2E-4
Beryllium	0.812	0.00	2E-11	0.00	6E-10
Silver	0.195 J	0.00	–	0.01	–
Carbon disulfide	0.00077 J	0.00	–	0.00	–
Tetrachloroethene	0.00082 J	0.00	4E-12	0.00	8E-9
Toluene	0.00098 J	0.00	–	0.00	–
Xylene	0.001 J	0.00	–	0.00	–
Total		**0.00**	**9E-7**	**0.9**	**2E-4**

[a]From EPA (1989).
COC = Constituent of concern.
EPA = U.S. Environmental Protection Agency.
J = Estimated concentration.
mg/kg = Milligram(s) per kilogram.
SWMU = Solid Waste Management Unit.
– = Information not available.

Table 10
Risk Assessment Values for SWMU 81D Nonradiological Background Constituents

COC Name	Background Concentration[a] (mg/kg)	Recreational Land Use Scenario[b]		Residential Land Use Scenario[b]	
		Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Arsenic	9.8	0.00	6E-7	0.56	1E-4
Beryllium	0.75	0.00	2E-11	0.00	6E-10
Silver	<0.5	–	–	–	–
Total		**0.00**	**6E-7**	**0.6**	**1E-4**

[a]From Garcia (1998), Canyons Area.
[b]From EPA (1989).
COC = Constituent of concern.
EPA = U.S. Environmental Protection Agency.
mg/kg = Milligram(s) per kilogram.
SWMU = Solid Waste Management Unit.
– = Information not available.

VI.7 Step 6. Comparison of Risk Values to Numerical Guidelines.

The human health risk assessment analysis evaluated the potential for adverse health effects for both the recreational land use scenario (the designated land use scenario for this site) and the residential land use scenario.

For the recreational land use scenario nonradiological COCs, the HI is 0.00 (less than the numerical guideline of 1 suggested in the RAGS [EPA 1989]). Excess cancer risk is estimated at 9E-7. Guidance from the New Mexico Environment Department (NMED) indicates that excess lifetime risk of developing cancer by an individual must be less than 1E-6 for Class A and B carcinogens and less than 1E-5 for Class C carcinogens (NMED March 1998). The excess cancer risk is driven by arsenic. Arsenic is a Class A carcinogen. Thus, the excess cancer risk for this site is below the suggested acceptable risk value (1E-6). This assessment also determined risks considering background concentrations of the potential nonradiological COCs for both recreational and residential land use scenarios. Assuming the recreational land use scenario, for nonradiological COCs the HI is 0.00 and the excess cancer risk is 6E-7. Incremental risk is determined by subtracting risk associated with background from potential COC risk. These numbers are not rounded before the difference is determined and, therefore, may appear to be inconsistent with numbers presented in tables and within the text. For conservatism, the background constituent that does not have a quantified background concentration (silver) is assumed to have an HQ of 0.00. Incremental HI is 0.00 and estimated incremental cancer risk is 3.00E-7 for the recreational land use scenario. These incremental risk calculations indicate insignificant risk to human health from nonradiological COCs considering the recreational land use scenario.

For radiological COCs of the recreational land use scenario, incremental TEDE is 1.5E-2 mrem/yr, which is significantly less than the EPA's numerical guideline of 15 mrem/yr. Incremental estimated excess cancer risk is 2.0E-7.

The calculated HI for the residential land use scenario nonradiological COCs is 0.9, which is below the numerical guidance. Excess cancer risk is estimated at 2E-4. The excess cancer risk is driven by arsenic which is a Class A carcinogen. Therefore, the excess cancer risk for this site is above the suggested acceptable risk value (1E-6). The HI for associated background for the residential land use scenario is 0.6; the excess cancer risk is estimated at 1E-4. The incremental HI is 0.3 and the estimated incremental cancer risk is 1.00E-4 for the residential land use scenario. The incremental excess cancer risk to human health risk from the COCs is above proposed guidelines considering the residential land use scenario.

The incremental TEDE for a residential land use scenario from the radiological components is 3.0E-1 mrem/yr, which is significantly less than the numerical guideline of 75 mrem/yr suggested in the SNL/NM RESRAD Input Parameter Assumptions and Justification (SNL/NM February 1998). The estimated excess cancer risk is 3.8E-6.

VI.8 Step 7. Uncertainty Discussion

The determination of the nature, rate, and extent of contamination at SWMU 81D was based upon an initial conceptual model validated with baseline sampling conducted at the site. The baseline sampling was implemented in accordance with the RFI work plan for OU 1333

(SNL/NM September 1995) and the SNL/NM response to the Request for Supplemental Information on the OU 1333 Work Plan (SNL/NM October 1997). The DQOs contained in the RFI work plan are appropriate for use in screening risk assessments. The data collected, based upon sample location, density, and depth, are representative of the site. The analytical requirements and results satisfy the DQOs. Data quality was validated in accordance with SNL/NM procedures (SNL/NM December 1999). Therefore, there is no uncertainty associated with the data quality used to perform the screening risk assessment at SWMU 81D.

Because of the location, history of the site, and future land use (DOE et al. October 1995), there is low uncertainty in the land use scenario and the potentially affected populations that were considered in performing the risk assessment analysis. Because the COCs are found in surface and near-surface soils and because of the location and physical characteristics of the site, there is little uncertainty in the exposure pathways relevant to the analysis.

An RME approach was used to calculate the risk assessment values. This means that the parameter values in the calculations are conservative and that calculated intakes are probably overestimates. Maximum measured values of COC concentrations are used to provide conservative results.

Table 7 shows the uncertainties (confidence) in nonradiological toxicological parameter values. There is a mixture of estimated values and values from the IRIS (EPA 1998a) and the EPA Region 9 (EPA 1996c) electronic database. Where values are not provided, information is not available from the Health Effects Assessment Summary Tables (EPA 1997a), IRIS (EPA 1998a), or the EPA regions (EPA 1996c, 1997c). Because of the conservative nature of the RME approach, uncertainties in toxicological values are not expected to change the conclusion from the risk assessment analysis.

Risk assessment values for nonradiological COCs are within the human health acceptable range for the recreational land use scenario compared to established numerical guidance.

For radiological COCs, the conclusion of the risk assessment is that potential effects on human health for both recreational and residential land use scenarios are within guidelines and are a small fraction of the estimated 360 mrem/yr received by the average U.S. population (NCRP 1987).

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

VI.9 Summary

SWMU 81D has identified COCs consisting of some inorganic, organic, and radiological compounds. Because of the location of the site, the designated recreational land use scenario, and the nature of contamination, potential exposure pathways identified for this site included soil ingestion and dust and volatile inhalation for chemical constituents and soil ingestion, dust inhalation, and direct gamma exposure for radionuclides. Plant uptake was included as an exposure pathway for the residential land use scenario.

Using conservative assumptions and an RME approach to risk assessment, calculations for nonradiological COCs show that for the recreational land use scenario the HI (0.00) is significantly less than the accepted numerical guidance from the EPA. Excess cancer risk (9E-7) is also below the acceptable risk value provided by the NMED for a recreational land use scenario (NMED March 1998). The incremental HI is 0.00, and the incremental cancer risk is 3.00E-7 for the recreational land use scenario. Incremental risk calculations indicate insignificant risk to human health for a recreational land use scenario.

Incremental TEDE and corresponding estimated cancer risk from radiological COCs are much less than EPA guidance values; the estimated TEDE is 1.5E-2 mrem/yr for the recreational land use scenario. This value is much less than the numerical guidance of 15 mrem/yr in EPA guidance (EPA 1997b). The corresponding incremental estimated cancer risk value is 2.0E-7 for the recreational land use scenario. Furthermore, the incremental TEDE for the residential land use scenario that results from a complete loss of institutional control is only 3.0E-1 mrem/yr with an associated risk of 3.8E-6. The guideline for this scenario is 75 mrem/yr (SNL/NM February 1998). Therefore, SWMU 81D is eligible for unrestricted radiological release.

Uncertainties associated with the calculations are considered small relative to the conservativeness of risk assessment analysis. It is, therefore, concluded that this site poses insignificant risk to human health under the recreational land use scenario.

VII. Ecological Risk Screening Assessment

VII.1 Introduction

This section addresses the ecological risks associated with exposure to constituents of potential ecological concern (COPEC) in soils at SWMU 81D. A component of the NMED Risk-Based Decision Tree (March 1998) is to conduct an ecological screening assessment that corresponds with that presented in the EPA's Ecological Risk Assessment Guidance for Superfund (EPA 1997d). The current methodology is tiered and contains an initial scoping assessment followed by a more detailed screening assessment. Initial components of NMED's decision tree (a discussion of DQOs, a data assessment, and evaluations of bioaccumulation and fate-and-transport potential) are addressed in previous sections of this report. Following the completion of the scoping assessment, a determination is made as to whether a more detailed examination of potential ecological risk is necessary. If deemed necessary, the scoping assessment proceeds to a screening assessment whereby a more quantitative estimate of ecological risk is conducted. Although this assessment incorporates conservatisms in the estimation of ecological risks, ecological relevance and professional judgment are also used as recommended by the EPA (1998b) to ensure that predicted exposures of selected ecological receptors reflect those reasonably expected to occur at the site.

VII.2 Scoping Assessment

The scoping assessment focuses primarily on the likelihood of exposure of biota at/or adjacent to the site to be exposed to constituents associated with site activities. Included in this section

are an evaluation of existing data and a comparison of maximum detected concentrations to background concentrations, examination of bioaccumulation potential, and fate and transport potential. A scoping risk management decision (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 3 and 4), inorganic constituents in soil within the 0- to 5-foot depth interval that exceeded background concentrations were as follows:

- Arsenic
- Beryllium
- Lead
- Cs-137
- U-235.

One constituent (silver) does not have a quantified background screening concentration. Thus, it is unknown if this constituent exceeds background.

Organic analytes detected in soil were as follows:

- Carbon disulfide
- Tetrachloroethene
- Toluene
- Xylenes.

VII.2.2 Bioaccumulation

Among the COPECs listed in Section VII.2.1, the following were considered to have bioaccumulation potential in aquatic environments (Section IV, Tables 3 and 4):

- Arsenic
- Lead
- Cs-137
- U-235
- Tetrachloroethene.

It should be noted, however, that as directed by the NMED (NMED March 1998), bioaccumulation for inorganics is assessed exclusively based upon maximum reported bioconcentration factors (BCF) for aquatic species. Because only aquatic BCFs are used to evaluate the bioaccumulation potential for metals, bioaccumulation in terrestrial species is likely to be overpredicted.

VII.2.3 Fate and Transport Potential

The potential for the COPECs to move from the source of contamination to other media or biota is discussed in Section V. As noted in Table 6 (Section V), wind is expected to be of low significance as a transport mechanism for COPECs at this site, but surface-water runoff may be of moderate significance. Migration to groundwater is not anticipated. Food chain uptake is expected to be of moderate to low significance. Degradation/transformation for inorganic COPECs and radionuclides is expected to be of low significance. For the organic COPECs, the potential for biotransformation/degradation is moderate, and loss by volatilization is also expected to occur.

VII.2.4 Scoping Risk-Management Decision

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

VII.3 Screening Assessment

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

Components within the screening assessment include the following:

- Problem Formulation—sets the stage for the evaluation of potential exposure and risk.
- Exposure Estimation—provides a quantitative estimate of potential exposure.
- Ecological Effects Evaluation—presents benchmarks used to gauge the toxicity of COPECs to specific receptors.
- Risk Characterization—characterizes the ecological risk associated with exposure of the receptors to environmental media at the site.
- Uncertainty Assessment—discusses uncertainties associated with the estimation of exposure and risk.

- Risk Interpretation—evaluates ecological risk in terms of HQs and ecological significance.

- Screening Assessment Scientific/Management Decision Point—presents the decision to risk managers based upon the results of the screening assessment.

VII.3.1 Problem Formulation

Problem formulation is the initial stage of the screening assessment that provides the introduction to the risk evaluation process. Components that are addressed in this section include a discussion of ecological pathways and the ecological setting, identification of COPECs, and selection of ecological receptors. The conceptual model, ecological food webs, and ecological endpoints (other components commonly addressed in a screening assessment) are presented in the "Predictive Ecological Risk Assessment Methodology for SNL/NM ER Program" (IT July 1998) and are not duplicated here.

VII.3.1.1 Ecological Pathways and Setting

SWMU 81D is approximately 4.3 acres in size. The site, located in Sol se Mete Canyon, is dominated by woodland habitat; however, much of the habitat at this site was disturbed during active use. The site is open to use by wildlife of the canyon. Some small mammals and birds may reside on the site, at least seasonally. A biological and sensitive species survey of the entire Aerial Cable Facility was conducted in 1991 (Sullivan 1994); and in 1993 and 1994, the area was included in a basewide threatened and endangered species survey conducted by the New Mexico Natural Heritage Program for the U.S. Air Force (NMNHP 1995). Although the gray vireo (*Vireo vicinior*), a New Mexico threatened species, was observed in the upper part of Sol se Mete Canyon in 1991 (probably a migrating individual) and three singing males were observed in Lurance Canyon near the mouth of Sol se Mete Canyon during the New Mexico Natural Heritage Program surveys, the species is not known to occur at SWMU 81D.

Complete ecological pathways may exist at this site through the exposure of plants and wildlife to COPECs in surface soil. It was 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 was therefore 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 was considered insignificant. Inhalation and dermal contact were also considered insignificant pathways with respect to ingestion (Sample and Suter 1994). Groundwater is not expected to be affected by COCs at this site.

VII.3.1.2 COPECs

Inorganic and organic COPECs for SWMU 81D are listed in Section VII.2.1. The inorganic COPECs include both radiological and nonradiological analytes. The inorganic analytes were screened against background concentrations and those that exceeded the approved SNL/NM background screening levels (Dinwiddie September 1997) for the area were considered to be

COPECs. All organic analytes detected were considered to be COPECs for the site. In order to provide conservatism, this ecological risk assessment was based upon the maximum soil concentrations of the COPECs measured in the surface soil at this site. Tables 4 and 5 present maximum concentrations for the COPECs. Nonradiological inorganics that are essential nutrients, such as iron, magnesium, calcium, potassium, and sodium, were not included in this risk assessment as set forth by the EPA (1989).

VII.3.1.3 Ecological Receptors

As described in detail in IT (July 1998), a nonspecific perennial plant was selected as the receptor to represent plant species at the site. Vascular plants are the principal primary producers at the site and are key to the diversity and productivity of the wildlife community associated with the site. The deer mouse (*Peromyscus maniculatus*) and the burrowing owl (*Speotyto cunicularia*) were used to represent wildlife use. Because of its opportunistic food habits, the deer mouse was used to represent a mammalian herbivore, omnivore, and insectivore. The burrowing owl was selected to represent a top predator at this site. Although burrowing owls are not expected to occur in the woodland habitat at SWMU 81D, it is used to conservatively represent exposure and risk to other small, predatory birds such as the western screech owl (*Otus kennicottii*) that may inhabit this site. The burrowing owl is present at SNL/NM and is designated a species of management concern by the U.S. Fish and Wildlife Service in Region 2, which includes the state of New Mexico (USFWS September 1995).

VII.3.2 Exposure Estimation

For nonradiological COPECs, direct uptake from the soil was considered the only significant route of exposure for terrestrial plants. Exposure modeling for the wildlife receptors was limited to food and soil ingestion pathways. Inhalation and dermal contact were considered insignificant pathways with respect to ingestion (Sample and Suter 1994). Drinking water was also considered an insignificant pathway because of the lack of surface water at this site. The deer mouse was modeled under three dietary regimes: as an herbivore (100 percent of its diet as plant material), as an omnivore (50 percent of its diet as plants and 50 percent as soil invertebrates), and as an insectivore (100 percent of its diet as soil invertebrates). The burrowing owl was modeled as a strict predator on small mammals (100 percent of its diet as deer mice). Because the exposure in the burrowing owl from a diet consisting of equal parts of herbivorous, omnivorous, and insectivorous mice would be equivalent to the exposure consisting of only omnivorous mice, the diet of the burrowing owl was modeled with intake of omnivorous mice only. Both species were modeled with soil ingestion comprising 2 percent of the total dietary intake. Table 11 presents the species-specific factors used in modeling exposures in the wildlife receptors. Justification for use of the factors presented in this table is described in the ecological risk assessment methodology document (IT July 1998).

Although home range is also included in this table, exposures for this risk assessment were modeled using an area use factor of 1, implying that all food items and soil ingested are from the site being investigated. The maximum measured COPEC concentrations from surface soil samples were used to conservatively estimate potential exposures and risks to plants and wildlife at this site.

Table 11
Exposure Factors for Ecological Receptors at SWMU 81D

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]From Silva and Downing (1995).
[e]EPA (1993), based upon the average home range measured in semiarid shrubland in Idaho.
[f]From Dunning (1993).
[g]From Haug et al. (1993).
EPA = U.S. Environmental Protection Agency.
kg = Kilogram(s).
kg/day = Kilogram(s) per day.
SWMU = Solid Waste Management Unit.

For the radiological dose rate calculations, the deer mouse was modeled as an herbivore (100 percent of its diet as plants), and the burrowing owl was modeled as a strict predator on small mammals (100 percent of its diet as deer mice). Both were modeled with soil ingestion comprising 2 percent of the total dietary intake. Receptors are exposed to radiation both internally and externally from Cs-137 and U-235. 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 tissues to contribute to the absorbed dose. Alpha and beta emitters are assumed to transfer 100 percent of their energy to the receptor as they pass through tissues. Gamma-emitting radionuclides only transfer a fraction of their energy to the tissues because gamma rays interact less with matter than do beta or alpha emitters. The external and internal dose rate results are summed to calculate a total dose rate from exposure to Cs-137 and U-235 in soil.

Table 12 presents the transfer factors used in modeling the concentrations of COPECs through the food chain. Table 13 presents maximum concentrations in soil and derived concentrations in tissues of the various food chain elements that are used to model dietary exposures for each of the wildlife receptors.

VII.3.3 Ecological Effects Evaluation

Table 14 shows benchmark toxicity values for the plant and wildlife receptors. For plants, the benchmark soil concentrations are based upon the lowest-observed-adverse-effect level (LOAEL). For wildlife, the toxicity benchmarks are based upon the no-observed-adverse-effect level (NOAEL) for chronic oral exposure in a taxonomically similar test species. Insufficient toxicity information was found to estimate the LOAELs or NOAELs for some COPECs for terrestrial plant life and for the burrowing owl, respectively.

The benchmark used for exposure of terrestrial receptors to radiation was 0.1 rad/day. This value has been recommended by the International Atomic Energy Agency (IAEA 1992) for the protection of terrestrial populations. Because plants and insects are less sensitive to radiation than vertebrates (Whicker and Schultz 1982), the dose of 0.1 rad/day should also offer sufficient protection to other components within the terrestrial habitat of SWMU 81D.

Table 12
Transfer Factors Used in Exposure Models for
Constituents of Potential Ecological Concern at SWMU 81D

Constituent of Potential Ecological Concern	Soil-to-Plant Transfer Factor	Soil-to-Invertebrate Transfer Factor	Food-to-Muscle Transfer Factor
Inorganic			
Arsenic	4.0E-2[a]	1.0E+0[b]	2.0E-3[a]
Beryllium	1.0E-2[a]	1.0E+0[b]	1.0E-3[a]
Lead	9.0E-2[c]	4.0E-2[d]	8.0E-4[c]
Silver	1.0E+0[c]	2.5E-1[d]	5.0E-3[c]
Organic[e]			
Carbon disulfide	3.9E+1	1.3E+1	1.8E-8
Tetrachloroethene	1.1E+0	1.8E+1	1.1E-5
Toluene	1.0E+0	1.8E+1	1.3E-5
Xylenes	5.5E-1	1.9E+1	3.7E-5

[a]From Baes et al. (1984).
[b]Default value.
[c]From NCRP (January 1989).
[d]From Stafford et al. (1991).
[e]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.

K_{ow} = Octanol-water partition coefficient.
Log = Logarithm (base 10).
NCRP = National Council on Radiation Protection and Measurements.
SWMU = Solid Waste Management Unit.

Table 13
Media Concentrations[a] for Constituents of Potential Ecological Concern at SWMU 81D

Constituent of Potential Ecological Concern	Soil (maximum)[a]	Plant Foliage[b]	Soil Invertebrate[b]	Deer Mouse Tissues[c]
Inorganic				
Arsenic	1.5E+1	5.9E-1	1.5E+1	5.0E-2
Beryllium	8.1E-1	8.1E-3	8.1E-1	1.3E-3
Lead	2.4E+1	2.2E+0	9.6E-1	5.1E-3
Silver	2.0E-1[d]	2.0E-1	4.9E-2	2.0E-3
Organic				
Carbon disulfide	7.7E-4[d]	3.0E-2	1.0E-2	1.2E-9
Tetrachloroethene	8.2E-4[d]	9.1E-4	1.5E-2	2.6E-7
Toluene	9.8E-4[d]	9.8E-4	1.8E-2	3.7E-7
Xylenes	1.0E-3[d]	5.5E-4	1.9E-2	1.1E-6

[a]In milligram(s) per kilogram. All biotic media are based upon dry weight of the media. Soil concentration measurements are assumed to have been based upon dry weight. Values have been rounded to two significant digits after calculation.
[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]Based upon an estimated concentration.
EPA = U.S. Environmental Protection Agency.
SWMU = Solid Waste Management Unit.

Table 14
Toxicity Benchmarks for Ecological Receptors at SWMU 81D

Constituent of Potential Ecological Concern	Plant Benchmark[a,b]	Mammalian NOAELs			Avian NOAELs		
		Mammalian Test Species[c,d]	Test Species NOAEL[d,e]	Deer Mouse NOAEL[e,f]	Avian Test Species[d]	Test Species NOAEL[d,e]	Burrowing Owl NOAEL[e,g]
Inorganic							
Arsenic	10	Mouse	0.126	0.13	Mallard	5.14	5.14
Beryllium	10	Rat	0.66	1.29	–	–	–
Lead	50	Rat	8.0	15.7	American kestrel	3.85	3.85
Silver	2	Rat	17.8[h]	34.8	–	–	–
Organic							
Carbon disulfide	–	Rabbit	1.1[i]	3.91	–	–	–
Tetrachloroethene	–	Mouse	1.4	1.48	–	–	–
Toluene	200	Mouse	26	27.5	–	–	–
Xylenes	–	Mouse	2.1	2.22	–	–	–

[a]In milligram(s) per kilogram soil dry weight.
[b]From Efroymson et al. (1997).
[c]Body weights (in kilogram[s]) for the NOAEL conversion are as follows: lab mouse, 0.030; lab rat, 0.350; rabbit, 3.8.
[d]From Sample et al. (1996), except where noted.
[e]In milligram(s) per kilogram body weight per day.
[f]Based upon NOAEL conversion methodology presented in Sample et al. (1996), using a deer mouse body weight of 0.0239 kilogram and a mammalian scaling factor of 0.25.
[g]Based upon NOAEL conversion methodology presented in Sample et al. (1996). The avian scaling factor of 0.0 was used, making the NOAEL independent of body weight.
[h]Based upon a rat LOAEL of 89 mg/kg/d (EPA 1998a) and an uncertainty factor of 0.2.
[i]From EPA (1998a), estimated from a fatal inhalation dose and an uncertainty factor of 0.1.
EPA = U.S. Environmental Protection Agency.
LOAEL = Lowest-observed-adverse-effect level.
mg/kg/d = Milligrams per kilogram per day.
NOAEL = No-observed-adverse-effect level.
SWMU = Solid Waste Management Unit.
– = Insufficient toxicity data.

VII.3.4 Risk Characterization

Maximum concentrations in soil and estimated dietary exposures were compared to plant and wildlife benchmark values, respectively. Table 15 presents results of these comparisons. HQs are used to quantify the comparison with benchmarks for plants and wildlife exposure.

Arsenic was the only analytes with HQs exceeding unity. HQs for arsenic exceeded unity for plants and for both the omnivorous and insectivorous deer mice. HQs for plants could not be determined for three of the four organic COPECs at this site (the exception being toluene). HQs could not be determined for beryllium, silver, and the 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 receptors except the burrowing owl had total HIs greater than unity, with a maximum HI of 18 for the insectivorous deer mouse. All HIs were dominated by the HQs for arsenic, with very little contribution from the organic COPECs.

Tables 16 and 17 summarize the internal and external dose rate model results for Cs-137 and U-235. The total radiation dose rate to the deer mouse was predicted to be 6.0E-5 rad/day. Total dose rate to the burrowing owl was predicted to be 5.1E-5 rad/day. The dose rates for the deer mouse and the burrowing owl are considerably less than the benchmark of 0.1 rad/day.

VII.3.5 Uncertainty Assessment

Many uncertainties are associated with the characterization of ecological risks at SWMU 81D. These uncertainties result from assumptions used in calculating risk that could overestimate or underestimate true risk presented at a site. For this risk assessment, assumptions are made that are more likely to overestimate exposures and risk rather than to underestimate them. These conservative assumptions are used to be more protective of the ecological resources potentially affected by the site. Conservatisms incorporated into this risk assessment include the use of maximum measured analyte concentrations in soil to evaluate risk, the use of wildlife toxicity benchmarks based upon NOAEL values, the incorporation of strict herbivorous and strict insectivorous diets for predicting the extreme HQ values for the deer mouse, and the use of 1.0 as the area use factor for wildlife receptors regardless of seasonal use or home range size. Each of these uncertainties, which are consistent among each of the SWMU-specific ecological risk assessments, is discussed in greater detail in the uncertainty section of the ecological risk assessment methodology document for the SNL/NM ER Project (IT July 1998).

Uncertainties associated with the estimation of risk to ecological receptors following exposure to Cs-137 and U-235 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.

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 18, HQs associated with exposures to

Table 15
HQs for Ecological Receptors at SWMU 81D

Constituent of Potential Ecological Concern	Plant HQ	Deer Mouse HQ (Herbivorous)	Deer Mouse HQ (Omnivorous)	Deer Mouse HQ (Insectivorous)	Burrowing Owl HQ
Inorganic					
Arsenic	**1.5E+0**	1.0E+0	**9.3E+0**	**1.8E+1**	7.5E-3
Beryllium	8.1E-2	2.9E-3	5.1E-2	1.0E-1	–
Lead	4.8E-1	2.6E-2	2.0E-2	1.4E-2	1.4E-2
Silver	9.8E-2	8.9E-4	5.6E-4	2.4E-4	–
Organic					
Carbon disulfide	–	1.2E-3	8.0E-4	4.0E-4	–
Tetrachloroethene	–	9.7E-5	8.2E-4	1.5E-3	–
Toluene	4.9E-6	5.6E-6	5.3E-5	1.0E-4	–
Xylenes	–	4.0E-5	6.9E-4	1.3E-3	–
HI[a]	**2.1E+0**	**1.1E+0**	**9.4E+0**	**1.8E+1**	2.2E-2

Note: **Bold** text indicates HQ or HI exceeds unity.
[a]The HI is the sum of individual HQs using the value for organic mercury as a conservative estimate of the HI.
HI = Hazard index.
HQ = Hazard quotient.
SWMU = Solid Waste Management Unit.
– = Insufficient toxicity data available for risk estimation purposes.

Table 16
Internal and External Dose Rates for
Deer Mice Exposed to Radionuclides at SWMU 81D

Radionuclide	Maximum Concentration (pCi/g)	Internal Dose (rad/day)	External Dose (rad/day)	Total Dose (rad/day)
Cs-137	0.70	2.2E-5	3.2E-5	5.4E-5
U-235	0.22	2.4E-6	3.6E-6	6.0E-6
Total		2.4E-5	3.6E-5	6.0E-5

pCi/g = Picocurie(s) per gram.
SWMU = Solid Waste Management Unit.

Table 17
Internal and External Dose Rates for
Burrowing Owls Exposed to Radionuclides at SWMU 81D

Radionuclide	Maximum Concentration (pCi/g)	Internal Dose (rad/day)	External Dose (rad/day)	Total Dose (rad/day)
Cs-137	0.70	1.4E-5	3.2E-5	4.6E-5
U-235	0.22	1.0E-6	3.6E-6	4.6E-6
Total		1.5E-5	3.6E-5	5.1E-5

pCi/g = Picocurie(s) per gram.
SWMU = Solid Waste Management Unit.

Table 18
HQs for Ecological Receptors Exposed to Background Concentrations at SWMU 81D

Constituent of Potential Ecological Concern	Plant HQ	Deer Mouse HQ (Herbivorous)	Deer Mouse HQ (Omnivorous)	Deer Mouse HQ (Insectivorous)	Burrowing Owl HQ
Inorganic					
Arsenic	9.8E-1	6.9E-1	**6.2E+0**	**1.2E+1**	5.0E-3
Beryllium	7.5E-2	2.7E-3	4.8E-2	9.2E-2	–
Lead	3.8E-1	2.1E-2	1.6E-2	1.1E-2	1.1E-2
Silver	1.3E-1	1.1E-3	7.2E-4	3.0E-4	–
HI[a]	**1.6E+0**	7.1E-1	**6.2E+0**	**1.2E+1**	1.6E-2

Note: **Bold** text indicates HQ or HI exceeds unity.
[a]The HI is the sum of individual HQs using the value for organic mercury as a conservative estimate of the HI.
HI = Hazard index.
HQ = Hazard quotients.
SWMU = Solid Waste Management Unit.
– = Insufficient toxicity data available for risk estimation purposes.

background are greater than 1.0 for arsenic. Background may account for as much as 66 percent of the HQs for arsenic at this site. It is, therefore, likely that actual risk from arsenic at SWMU 81D is overestimated by the HQs calculated in this screening assessment because of conservatisms incorporated into the exposure assessment and in the toxicity benchmarks for these COPECs (e.g., the use of NOAELs for wildlife receptors).

A significant source of uncertainty associated with the prediction of ecological risks at this site is the use of the maximum measured concentrations to evaluate risk. This results in a conservative exposure scenario that does not necessarily reflect actual site conditions. To assess the potential degree of overestimation caused by using the maximum measured soil concentration for arsenic in the exposure assessment, the average arsenic concentration was calculated to determine whether the HQs exceeding unity can be accounted for by the magnitude of the extreme measurement. The average concentrations of arsenic was determined to be 4.53 mg/kg, which is less than the background screening value for arsenic. This indicates that the actual risks for the site as a whole are probably within the range of the background risks that are presented in Table 18.

Based upon this uncertainty analysis, ecological risks at SWMU 81D are expected to be very low. HQs greater than unity were initially predicted; however, closer examination of the exposure assumptions revealed an overestimation of risk primarily attributed to the use of highly conservative exposure concentrations and the contribution of background concentrations to the estimated risk.

VII.3.6 Risk Interpretation

Ecological risks associated with SWMU 81D were estimated through a screening assessment that incorporated site-specific information when available. Overall, risks to ecological receptors are expected to be low because predicted risks from exposure to arsenic were attributed to using maximum detected values. The average arsenic concentration at the site was within the range of background concentrations. Based upon this final analysis, ecological risks associated with SWMU 81D are expected to be very low.

VII.3.7 Screening Assessment Scientific/Management Decision Point

After potential ecological risks associated with the site have been assessed, a decision is made regarding whether the site should be recommended for NFA or whether additional data should be collected to assess actual ecological risk at the site more thoroughly. With respect to this site, ecological risks are predicted to be low. The scientific/management decision is to recommend this site for NFA.

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APPENDIX 1
EXPOSURE PATHWAY DISCUSSION FOR CHEMICAL AND RADIONUCLIDE CONTAMINATION

Introduction

Sandia National Laboratories/New Mexico (SNL/NM) proposes that a default set of exposure routes and associated default parameter values be developed for each future land use designation being considered for SNL/NM Environmental Restoration (ER) project sites. This default set of exposure scenarios and parameter values would be invoked for risk assessments unless site-specific information suggested other parameter values. Because many SNL/NM solid waste management units (SWMU) have similar types of contamination and physical settings, SNL/NM believes that the risk assessment analyses at these sites can be similar. A default set of exposure scenarios and parameter values will facilitate the risk assessments and subsequent review.

The default exposure routes and parameter values suggested are those that SNL/NM views as resulting in a Reasonable Maximum Exposure (RME) value. Subject to comments and recommendations by the U.S. Environmental Protection Agency (EPA) Region VI and New Mexico Environment Department (NMED), SNL/NM proposes that these default exposure routes and parameter values be used in future risk assessments.

At SNL/NM, all SWMUs exist within the boundaries of the Kirtland Air Force Base (KAFB). Approximately 157 potential waste and release sites have been identified where hazardous, radiological, or mixed materials may have been released to the environment. Evaluation and characterization activities have occurred at all of these sites to varying degrees. Among other documents, the SNL/NM ER draft Environmental Assessment (DOE 1996) presents a summary of the hydrogeology of the sites, the biological resources present and proposed land use scenarios for the SNL/NM SWMUs. At this time, all SNL/NM SWMUs have been tentatively designated for either industrial or recreational future land use. The NMED has also requested that risk calculations be performed based upon a residential land use scenario. All three land use scenarios will be addressed in this document.

The SNL/NM ER project has screened the potential exposure routes and identified default parameter values to be used for calculating potential intake and subsequent Hazard index (HI), excess cancer risk and dose values. The EPA (EPA 1989a) provides a summary of exposure routes that could potentially be of significance at a specific waste site. These potential exposure routes consist of:

- Ingestion of contaminated drinking water
- Ingestion of contaminated soil
- Ingestion of contaminated fish and shell fish
- Ingestion of contaminated fruits and vegetables

- Ingestion of contaminated meat, eggs, and dairy products
- Ingestion of contaminated surface water while swimming
- Dermal contact with chemicals in water
- Dermal contact with chemicals in soil
- Inhalation of airborne compounds (vapor phase or particulate)
- External exposure to penetrating radiation (immersion in contaminated air; immersion in contaminated water and exposure from ground surfaces with photon-emitting radionuclides).

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

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

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

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

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

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

Table 1
Exposure Pathways Considered for Various Land Use Scenarios

Industrial	Recreational	Residential
Ingestion of contaminated drinking water	Ingestion of contaminated drinking water	Ingestion of contaminated drinking water
Ingestion of contaminated soil	Ingestion of contaminated soil	Ingestion of contaminated soil
Inhalation of airborne compounds (vapor phase or particulate)	Inhalation of airborne compounds (vapor phase or particulate)	Inhalation of airborne compounds (vapor phase or particulate)
Dermal contact	Dermal contact	Dermal contact
External exposure to penetrating radiation from ground surfaces	External exposure to penetrating radiation from ground surfaces	Ingestion of fruits and vegetables
		External exposure to penetrating radiation from ground surfaces

Equations and Default Parameter Values for Identified Exposure Routes

In general, SNL/NM expects that ingestion of compounds in drinking water and soil will be the more significant exposure routes for chemicals; external exposure to radiation may also be significant for radionuclides. All of the above routes will, however, be considered for their appropriate land use scenarios. The general equations for calculating potential intakes via these routes are shown below. The equations are from the Risk Assessment Guidance for Superfund (RAGS): Volume 1 (EPA 1989a, 1991). These general equations also apply to calculating potential intakes for radionuclides. A more in-depth discussion of the equations used in performing radiological pathway analyses with the RESRAD code may be found in the RESRAD Manual (ANL 1993). Also shown are the default values SNL/NM ER suggests for use in RME risk assessment calculations for industrial, recreational, and residential scenarios, based upon EPA and other governmental agency guidance. The pathways and values for chemical contaminants are discussed first, followed by those for radionuclide contaminants. RESRAD input parameters that are left as the default values provided with the code are not discussed. Further information relating to these parameters may be found in the RESRAD Manual (ANL 1993).

Generic Equation for Calculation of Risk Parameter Values

The equation used to calculate the risk parameter values (i.e., hazard quotients/hazard index [HI], excess cancer risk, or radiation total effective dose equivalent [dose]) is similar for all exposure pathways and is given by:

Risk (or Dose) = Intake x Toxicity Effect (either carcinogenic, noncarcinogenic, or radiological)

$$= C \times (CR \times EFD/BW/AT) \times \text{Toxicity Effect} \quad (1)$$

where

C = contaminant concentration (site specific)
CR = contact rate for the exposure pathway
EFD = exposure frequency and duration
BW = body weight of average exposure individual
AT = time over which exposure is averaged.

The total risk/dose (either cancer risk or HI) is the sum of the risks/doses for all of the site-specific exposure pathways and contaminants.

The evaluation of the carcinogenic health hazard produces a quantitative estimate for excess cancer risk resulting from the constituents of concern (COC) present at the site. This estimate is evaluated for determination of further action by comparison of the quantitative estimate with the potentially acceptable risk range of 1E-6 for Class A and B carcinogens and 1E-5 for Class C carcinogens. The evaluation of the noncarcinogenic health hazard produces a quantitative estimate (i.e., the HI) for the toxicity resulting from the COCs present at the site. This estimate is evaluated for determination of further action by comparison of this quantitative estimate with the EPA standard HI of unity (1). The evaluation of the health hazard due to radioactive compounds produces a quantitative estimate of doses resulting from the COCs present at the site.

The specific equations used for the individual exposure pathways can be found in RAGS (EPA 1989a) and the RESRAD Manual (ANL 1993). Table 2 shows the default parameter values suggested for used by SNL/NM at SWMUs, based upon the selected land use scenario. References are given at the end of the table indicating the source for the chosen parameter values. The intention of SNL/NM is to use default values that are consistent with regulatory guidance and consistent with the RME approach. Therefore, the values chosen will, in general, provide a conservative estimate of the actual risk parameter. These parameter values are suggested for use for the various exposure pathways based upon the assumption that a particular site has no unusual characteristics that contradict the default assumptions. For sites for which the assumptions are not valid, the parameter values will be modified and documented.

Summary

SNL/NM proposes the described default exposure routes and parameter values for use in risk assessments at sites that have an industrial, recreational or residential future land use scenario. There are no current residential land use designations at SNL/NM ER sites, but this scenario has been requested to be considered by the NMED. For sites designated as industrial or recreational land use, SNL/NM will provide risk parameter values based upon a residential land use scenario to indicate the effects of data uncertainty on risk value calculations or in order to potentially mitigate the need for institutional controls or restrictions on SNL/NM ER sites. The parameter values are based upon EPA guidance and supplemented by information from other government sources. The values are generally consistent with those proposed by Los Alamos National Laboratory, with a few minor variations. If these exposure routes and parameters are acceptable, SNL/NM will use them in risk assessments for all sites where the assumptions are consistent with site-specific conditions. All deviations will be documented.

Table 2
Default Parameter Values for Various Land Use Scenarios

Parameter	Industrial	Recreational	Residential
General Exposure Parameters			
Exposure frequency	8 hr/day for 250 day	4 hr/wk for 52 wk/yr	350 day/yr
Exposure duration (yr)	25[a,b]	30[a,b]	30[a,b]
Body weight (kg)	70[a,b]	70 adult[a,b] 15 child	70 adult[a,b] 15 child
Averaging Time (days) for carcinogenic compounds (= 70 y x 365 day/yr) for noncarcinogenic compounds (= ED x 365 day/yr)	 25,550[a] 9,125	 25,550[a] 10,950	 25,550[a] 10,950
Soil Ingestion Pathway			
Ingestion rate	100 mg/day[c]	200 mg/day child 100 mg/day adult	200 mg/day child 100 mg/day adult
Inhalation Pathway			
Inhalation rate (m^3/yr)	5,000[a,b]	260[d]	7,000[a,b,d]
Volatilization factor (m^3/kg)	chemical specific	chemical specific	chemical specific
Particulate emission factor (m^3/kg)	1.32E9[a]	1.32E9[a]	1.32E9[a]
Water Ingestion Pathway			
Ingestion rate (liter/day)	2[a,b]	2[a,b]	2[a,b]
Food Ingestion Pathway			
Ingestion rate (kg/yr)	NA	NA	138[b,d]
Fraction ingested	NA	NA	0.25[b,d]
Dermal Pathway			
Surface area in water (m^2)	2[b,e]	2[b,e]	2[b,e]
Surface area in soil (m^2)	0.53[b,e]	0.53[b,e]	0.53[b,e]
Permeability coefficient	chemical specific	chemical specific	chemical specific

[a]Risk Assessment Guidance for Superfund, Vol. 1, Part B (EPA 1991).
[b]Exposure Factors Handbook (EPA 1989b).
[c]EPA Region VI guidance.
[d]For radionuclides, RESRAD (Argonne National Laboratory, 1993. *Manual for Implementing Residual Radioactive Material Guidelines Using RESRAD*, Version 5.0, ANL/EAD/LD-2, Argonne National Laboratory, Argonne, IL. 1993) is used for human health risk calculations; default parameters are consistent with RESRAD guidance.
[e]Dermal Exposure Assessment (EPA 1992).
ED = Exposure duration.
EPA = U.S. Environmental Protection Agency.
hr = Hour.
kg = Kilogram(s).
m = Meter(s).
mg = Milligram(s).
NA = Not available.
wk = Week.
yr = Year.

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