7-1-2004

Justification for Class III Permit Modification July 2004 DSS Site 1008 Operable Unit 1295 Building 6750 Septic System

Sandia National Laboratories/NM

Sandia National Laboratories

Justification for Class III Permit Modification

July 2004

DSS Site 1008
Operable Unit 1295
Building 6750 Septic System

NFA (SWMU Assessment Report) Submitted June 2003

Environmental
Restoration
Project

United States Department of Energy
Albuquerque Operations Office

Sandia National Laboratories

Justification for Class III Permit Modification

July 2004

DSS Site 1008
Operable Unit 1295
Building 6750 Septic System

NFA (SWMU Assessment Report) Submitted June 2003

Environmental
Restoration
Project

United States Department of Energy
Albuquerque Operations Office

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

JUL 10 2003

CERTIFIED MAIL- RETURN RECEIPT REQUESTED

Mr. John E. Kieling, Manager
Permits Management Program
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Rd., Building E
Santa Fe, NM 87505

Dear Mr. Kieling:

On behalf of the Department of Energy (DOE) and Sandia Corporation, DOE is submitting the enclosed SWMU Assessment Reports and Proposals for No Further Action (NFA) for Drain and Septic Systems (DSS) Sites 1003, 1008, 1072, 1082, and 1091, at Sandia National Laboratories, New Mexico, EPA ID No. NM5890110518.

This submittal includes descriptions of the site characterization work, soil characterization data, and risk assessments for DSS Sites 1003, 1008, 1072, and 1082. The risk assessments conclude that for these four sites (1) there is no significant risk to human health under both the industrial and residential land-use scenarios, and (2) that there are no ecological risks associated with these sites. A petition for an administrative NFA proposal is also made for DSS Site 1091 because this site was shown not to exist.

DOE and Sandia are requesting a determination that these DSS sites are acceptable for No Further Action.

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

Sincerely,

Karen L. Boardman
Manager

JUL 10 2003

cc w/enclosure:
W. Moats, NMED-HWB (via Certified Mail)
M. Gardipe, ERD
R. Kennett, NMED-OB
L. King, EPA, Region 6 (2 copies, via Certified Mail)

cc w/o enclosure:
J. Bearzi, NMED-HWB
J. Parker, NMED-OB
K. Thomas, EPA, Region 6
J. Estrada, SSO-AIP
F. Nimick, SNL, MS 1087
D. Stockham, SNL, MS 1087
SSO Legal File

JUL 10 2003

Sandia National Laboratories/New Mexico
Environmental Restoration Project

SWMU ASSESSMENT REPORT AND PROPOSAL FOR NO FURTHER ACTION BUILDING 6750 SEPTIC SYSTEM, DRAIN AND SEPTIC SYSTEMS SITE 1008

June 2003

United States Department of Energy
Sandia Site Office

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

LIST OF FIGURES

Figure

This page intentionally left blank.

LIST OF TABLES

Table

LIST OF TABLES (Concluded)

Table

LIST OF ANNEXES

Annex

This page intentionally left blank.

ACRONYMS AND ABBREVIATIONS

AOC	area of concern
BA	butyl acetate
bgs	below ground surface
COC	constituent of concern
DOE	U.S. Department of Energy
DSS	Drain and Septic Systems
EB	equipment blank
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration
ERCL	ER Chemistry Laboratory
FIP	Field Implementation Plan
GEL	General Engineering Laboratories, Inc.
GS	Gore-Sorber™
HE	high explosive(s)
HI	hazard index
HWB	Hazardous Waste Bureau
KAFB	Kirtland Air Force Base
kg	kilogram(s)
MDA	minimum detectable activity
MDL	method detection limit
µg	microgram(s)
mg	milligram(s)
NFA	no further action
NMED	New Mexico Environment Department
OU	Operable Unit
PCB	polychlorinated biphenyl
RCRA	Resource Conservation and Recovery Act
RPSD	Radiation Protection Sample Diagnostics
SAP	Sampling and Analysis Plan
SNL/NM	Sandia National Laboratories/New Mexico
SVOC	semivolatile organic compound
SWMU	Solid Waste Management Unit
TA	Technical Area
TB	trip blank
VOC	volatile organic compound

This page intentionally left blank.

1.0 PROJECT BACKGROUND

Environmental characterization of Sandia National Laboratories/New Mexico (SNL/NM) drain and septic systems (DSS) started in the early 1990s. These units consist of either septic systems (one or more septic tanks plumbed to either drainfields or seepage pits), or other types of miscellaneous drain units without septic tanks (including drywells or french drains, seepage pits, and surface outfalls). Initially, 23 of these sites were designated as Solid Waste Management Units (SWMUs) under Operable Unit (OU) 1295, Septic Tanks and Drainfields. Characterization work at 22 of these 23 SWMUs has taken place since 1994 as part of the SNL/NM Environmental Restoration (ER) Project activities. The 23rd site did not require any characterization, and an administrative proposal for no further action (NFA) was granted in July 1995.

It was also known that numerous other miscellaneous DSS sites that were not designated as SWMUs were present throughout SNL/NM. An initial list of these non-SWMU sites was compiled and summarized in an SNL/NM document dated July 8, 1996, and included a total of 101 sites, facilities, or systems (Bleakly July 1996). For tracking purposes, each of these 101 individual DSS sites was designated with a unique four-digit site identification number starting with 1001. This numbering scheme was devised to clearly differentiate these non-SWMU sites from existing SNL/NM SWMUs, which have been designated by one to three-digit numbers. As work progressed on the DSS site evaluation project, it became apparent that the original 1996 list was in need of field-verification and updating. This process included researching SNL/NM's extensive library of facilities engineering drawings, and conducting field verification inspections jointly with SNL/NM ER personnel and New Mexico Environment Department (NMED)/Hazardous Waste Bureau (HWB) regulatory staff from July 1999 through January 2000. The goals of this additional work included:

- Determine to the degree possible whether each of the 101 systems included on the 1996 list was still in existence, or had ever actually existed.
- For systems confirmed or believed to exist, determine the exact or apparent locations and components of those systems (septic tanks, drainfields, seepage pits, etc.).
- Identify which systems would, and would not, need initial shallow investigation work as required by NMED.
- For systems requiring characterization, determine the specific types of shallow characterization work (including passive soil-vapor sampling and/or shallow soil borings) that would be required by NMED.

A number of additional drain systems were identified from the engineering drawing and field inspection work. It was also determined that some of the sites on the 1996 list actually contained more than one individual drain or septic system, that had been combined under one four-digit site number. In order to reduce confusion, a decision was made to assign each individual system its own unique four-digit number. A new site list containing a total of 121 individual drain and septic systems was generated in 2000. Of these 121 sites, NMED required environmental assessment work at a total of 61; no evaluation of the remaining 60 systems was necessary. Subsequent backhoe excavation at DSS Site 1091 confirmed that the

system did not in fact exist, which decreased the number of DSS sites requiring characterization to 60.

Concurrent with the field inspection and site identification work, NMED/HWB and SNL/NM ER Project technical personnel worked closely together to reach consensus on a staged approach and specific procedures that would be used to characterize the DSS sites, as well as the remaining OU 1295 Septic Tanks and Drainfield SWMUs that had not been approved for no further action. These procedures are described in detail in the "Sampling and Analysis Plan [SAP] for Characterizing and Assessing Potential Releases to the Environment From Septic and Other Miscellaneous Drain Systems at Sandia National Laboratories/New Mexico" (SNL/NM October 1999), which was approved by NMED/HWB on January 28, 2000 (Bearzi January 2000). A follow-on document, the "Field Implementation Plan [FIP], Characterization of Non-Environmental Restoration Drain and Septic Systems" (SNL/NM November 2001) was then written to formally document the updated DSS site list and the specific site characterization work required by NMED for each of the 60 DSS sites. The FIP was approved by NMED in February 2002 (Moats February 2002).

2.0 BUILDING 6750 SEPTIC SYSTEM

2.1 Summary

The SNL/NM ER Project has conducted an assessment of DSS Site 1008, the Building 6750 septic system. There are no known or specific environmental concerns at this DSS site. It is one of many SNL/NM DSS sites at which environmental characterization is being required by NMED/HWB. An assessment was conducted to determine whether environmental contamination was released to the environment via the septic system present at the site. This report presents the results of the assessment and, based upon the findings, recommends a risk-based proposal for NFA for the Building 6750 septic system site. This NFA proposal provides documentation that the site was sufficiently characterized and that no significant releases of contaminants to the environment occurred via the Building 6750 septic system, and that it does not pose a threat to human health or the environment under industrial or residential scenarios. Current operations at the site are conducted in accordance with applicable laws and regulations that are protective of the environment, and septic system discharges are now directed to the City of Albuquerque sewer system.

Review and analysis of all relevant data for the Building 6750 septic system site indicate that concentrations of constituents of concern (COCs) at this site were found to be below applicable risk assessment action levels. Thus, DSS Site 1008, the Building 6750 septic system is proposed for an NFA decision based upon sampling data demonstrating that COCs released from the site into the environment pose an acceptable level of risk under current and projected future land uses as set forth by Criterion 5. Criterion 5 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).

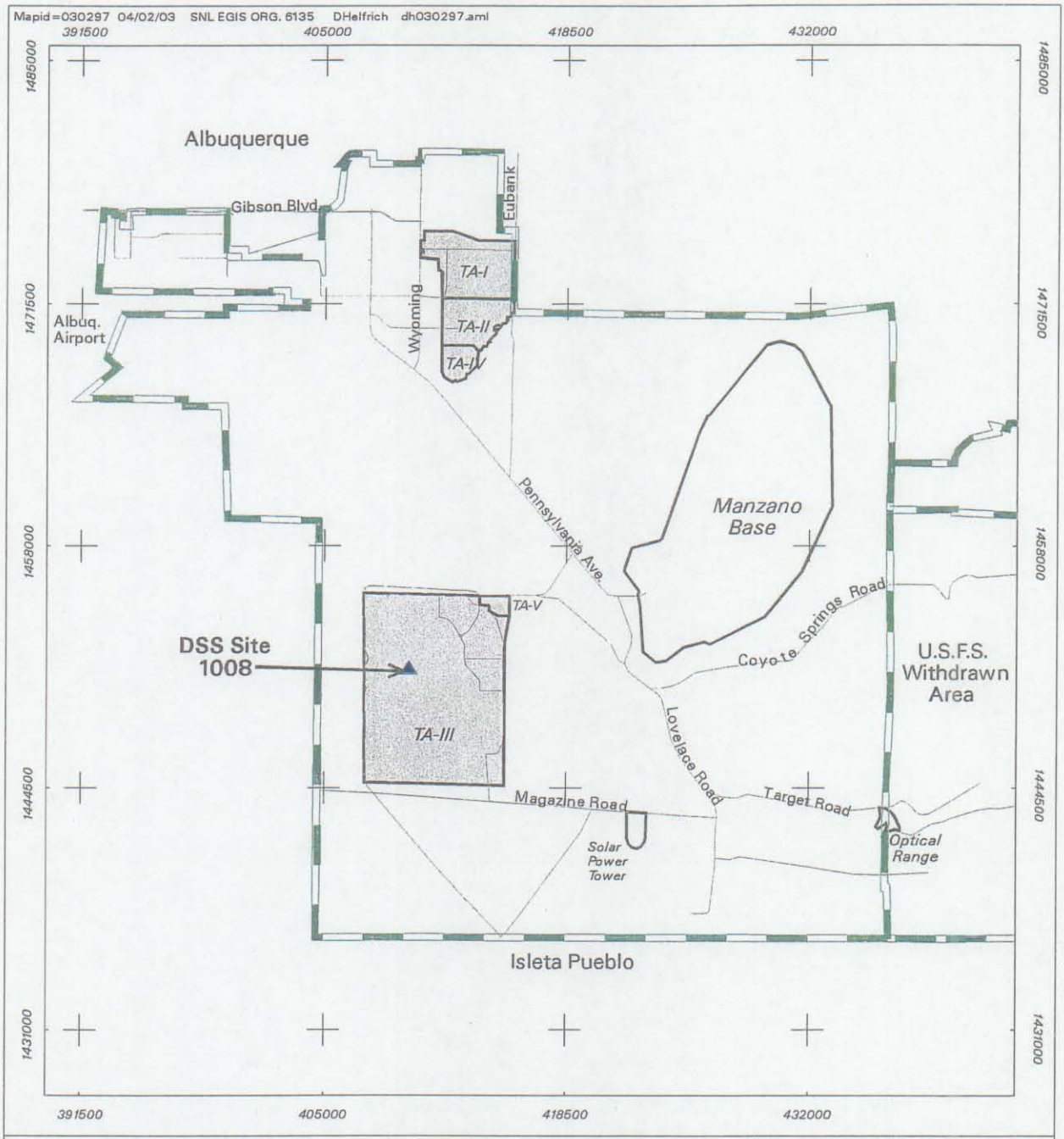
2.2 Site Description and Operational History

2.2.1 Site Description

The Building 6750 septic system is located in SNL/NM Technical Area (TA)-III on federally owned land, which is controlled by Kirtland Air Force Base (KAFB) and permitted to the U.S. Department of Energy (DOE) (Figure 2.2.1-1). DSS Site 1008 is located approximately 1.3 miles southwest of the northeast entrance into TA-III, on the northwest side of Building 6750 (Figure 2.2.1-2). As shown on Figure 2.2.1-2, this septic system consists of a 1,000-gallon septic tank with the output flowing to a junction that feeds two drainfield lines. The drainfield lines are approximately 50 feet long and flow away from each other in a "Y" configuration. Construction details of this system are based upon information presented on an SNL/NM engineering drawing (SNL/NM September 1971), site inspections, and backhoe excavations of the system.

The surface geology at DSS Site 1008 is characterized by a veneer of aeolian sediments that are underlain by Upper Santa Fe Group alluvial fan deposits that interfinger with sediments of the ancestral Rio Grande west of the site. These deposits extend to, and probably far below, the water table at this site. The alluvial fan materials originated in the Manzanita Mountains east of the site

This page intentionally left blank.



Legend

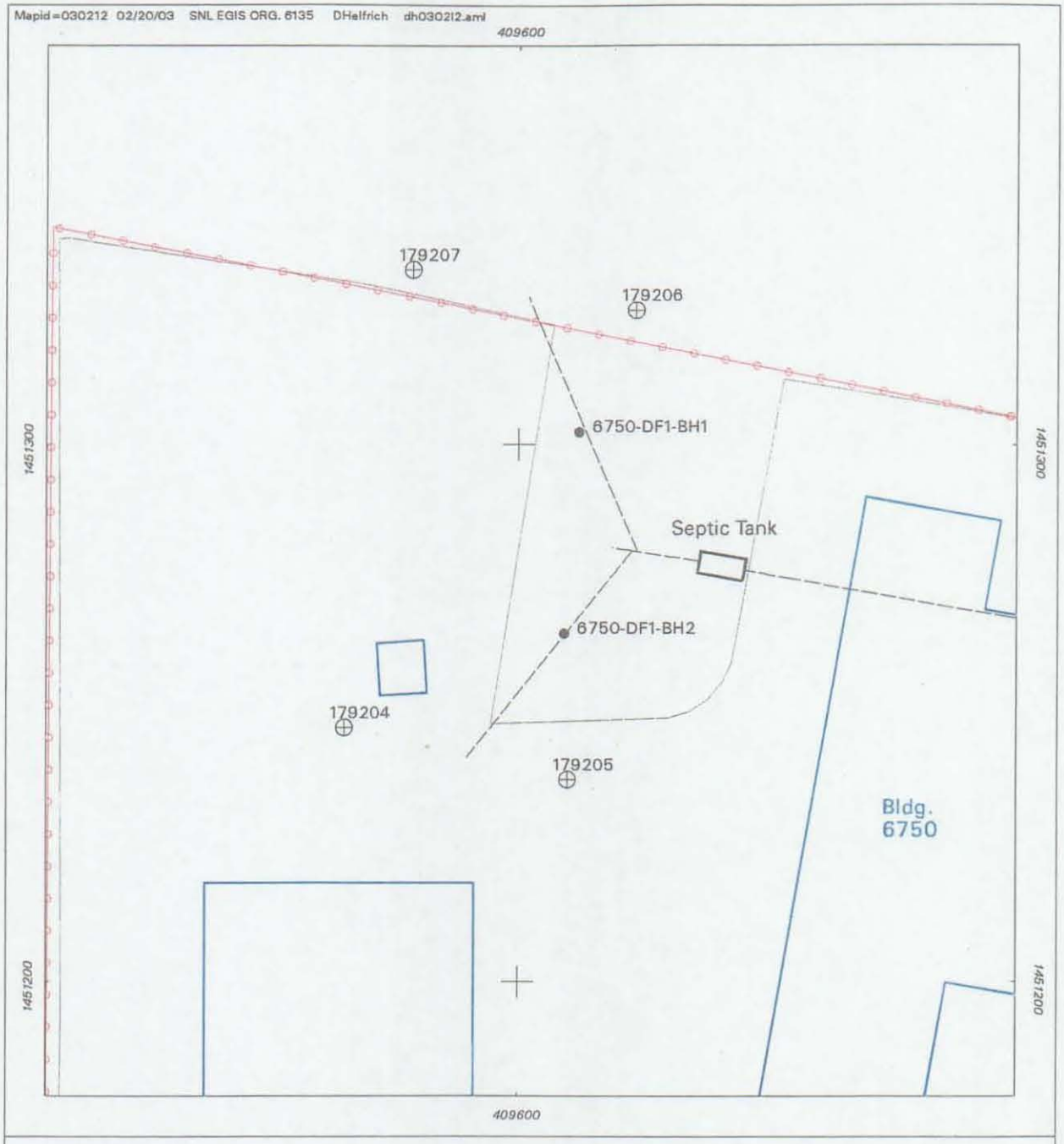
- DSS Site 1008
- Major Road
- KAFB Boundary
- SNL Technical Area (TA)

Figure 2.2.1-1
Location Map of the Building 6750 Septic System, TA-III, Drain and Septic Systems Site 1008

0 4500 9000
Scale in Feet

0 1080 2160
Scale in Meters

Sandia National Laboratories, New Mexico
Environmental Geographic Information System



Legend

- Soil Boring Location
- Gore-Sorber Sample Location
- Septic Tank
- Fence
- Edge of Pavement
- Building / Concrete Pad
- Septic Drain Line

Figure 2.2.1-2
Site Map of the Building 6750 Septic System, TA-III, Drain and Septic Systems Site 1008

0 15 30
Scale in Feet

0 3.6 7.2
Scale in Meters

N

Sandia National Laboratories, New Mexico
Environmental Geographic Information System

and typically consist of a mixture of silts, sands, and gravels that are poorly sorted, and exhibit moderately connected lenticular bedding. Individual beds range from 1 to 5 feet in thickness with a preferred east-west orientation, and have moderate to low hydraulic conductivities (SNL/NM March 1996). Vegetation primarily consists of desert grasses, shrubs, and cacti.

The ground surface in the vicinity of the site is flat to very slightly inclined to the west. The closest major drainage lies south of the site and terminates in a playa just west of KAFB. No perennial surface-water bodies are present in the vicinity of the site. Average annual rainfall in the SNL/NM and KAFB area, as measured at Albuquerque International Sunport is 8.1 inches (NOAA 1990). Infiltration of precipitation is almost nonexistent as virtually all of the moisture subsequently undergoes evapotranspiration. The estimates of evapotranspiration rates for the KAFB area range from 95 to 99 percent of the annual rainfall (Thompson and Smith 1985, SNL/NM March 1996).

The site lies at an average elevation of approximately 5,353 feet above mean sea level. Depth to groundwater is approximately 460 feet below ground surface (bgs) at the site. Groundwater flow direction is thought to be generally to the west in this area (SNL/NM March 2002). The nearest production wells are north of the site and include KAFB-4 and KAFB-7, which are 3.25 and 3.8 miles away, respectively. The nearest groundwater monitoring wells, MWL-MW5 and MWL-BW-1, are located approximately 2,000 to 2,250 feet northwest of the site (SNL/NM August 2002).

2.2.2 Operational History

Available information indicates that Building 6750 was constructed in 1965 (SNL/NM March 2003), and it is assumed that the septic system was also constructed at this time. The building served as a test facility used for studying impact phenomena. Building 6750 houses a small machine shop, office space, a control area, and an indoor firing range.

A firm date for the installation of the septic tank and drainfield system at Building 6750 is not known. Available information indicates that by the early 1990s, the septic tank system had been disconnected from the building, and septic system discharges were routed to the City of Albuquerque sanitary sewer system (Jones July 1993). Because operational records were not available, the investigation was planned to be consistent with other DSS site investigations and to sample for the most commonly anticipated COCs found at similar test facilities.

2.3 Land Use

2.3.1 Current Land Use

The current land use for DSS Site 1008 is industrial.

2.3.2 Future/Proposed Land Use

The projected land use for DSS Site 1008 is industrial (DOE et al. September 1995).

This page intentionally left blank.

3.0 INVESTIGATORY ACTIVITIES

Four investigations have been conducted at the Building 6750 septic system. Three of these investigations were required by NMED/HWB to adequately characterize this site, and were conducted in accordance with procedures presented in the 1999 SAP and 2001 FIP, described in Chapter 1.0. These investigations are discussed in the following sections.

3.1 Summary

Four assessments have been conducted at the site. In June 1992 and July 1995, waste characterization samples (Investigation 1) were collected from the Building 6750 septic system. In June 1997, a backhoe was used to physically locate the buried drainfield lines at the site (Investigation 2). Shallow subsurface soil samples were collected from borings in the drainfield in June 1998 and again in August 1999 (Investigation 3). In May 2002, a passive soil-vapor screening survey was conducted to determine whether areas of significant volatile organic compound (VOC) contamination were present in the soils around the drainfield (Investigation 4). These investigations are discussed in the following sections.

3.2 Investigation 1—Septic Tank Sampling

Investigation 1 consisted of sampling efforts to characterize the waste contents of all SNL/NM septic tanks for chemical and radiological contamination. The primary goal of the sampling effort was to identify types and concentrations of potential contaminants in the waste within the tanks so that the appropriate waste disposal and remedial activities could be planned.

On July 7, 1992 and July 12, 1995, as part of the SNL/NM Septic System Monitoring Program, aqueous and sludge samples were collected from the septic tank at this site (SNL/NM June 1993, SNL/NM December 1995). Aqueous samples were analyzed for VOCs, semivolatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), total metals, phenolic compounds, nitrates/nitrites, formaldehyde, fluoride, cyanide, oil and grease, and radiological constituents. Sludge samples were analyzed for metals and radiological constituents. Samples were submitted to an off-site laboratory for chemical and radiological analysis. A fraction of each sample was also submitted to the SNL/NM Radiation Protection Sample Diagnostics (RPSD) Laboratory for gamma spectroscopy analysis. The analytical results are presented in Annex A.

During March 25 and 26, 1996, the residual contents, approximately 958 gallons of waste and added water, were pumped out and disposed of properly (Shain August 1996).

3.3 Investigation 2—Backhoe Excavation

A backhoe was used on June 9, 1997 to determine the location, dimensions, and average depth of the DSS Site 1008 drainfield system. The drainfield was arranged as shown on Figure 2.2.1-2, with a drainline length of 50 feet and an average drainline depth of 3 feet bgs. No visible evidence of stained or discolored soil or odors indicating residual contamination was

observed during the excavation. No samples were collected during the backhoe excavation at the site.

3.4 Investigation 3—Soil Sampling

Once the system drainlines were located, soil sampling was conducted in accordance with the rationale and procedures described in the NMED-approved 1999 SAP (SNL/NM October 1999). An initial round of soil samples was collected from two drainfield borehole locations on June 22, 1998. On September 17, 1999, the two boreholes were sampled again for additional analyses. Soil boring locations at this site are shown on Figure 2.2.1-2. Figure 3.4-1 shows soil samples being collected at DSS Site 1008. A summary of the boreholes, sample depths, sample analyses, and sample collection dates is presented in Table 3.4-1.

3.4.1 Soil Sampling Methodology

An auger drill rig was used to sample all boreholes at two depth intervals. In the drainfield locations, the top of the shallow interval started at the bottom of the drainline trenches, as determined by the backhoe excavation. The lower (deep) interval started at 5 feet below the top sample interval. Once the auger rig had reached the top of the sampling interval, a 1.5-inch inside diameter by 3-foot long Geoprobe™ sampling tube lined with a butyl acetate (BA) sampling sleeve was inserted into the borehole and hydraulically driven 3 feet down to fill the tube with soil.

Once the sample tube was retrieved from the borehole, the sample for VOC analysis was immediately collected by slicing off a 3- to 4-inch section from the lower end of the BA sleeve, capping the section ends first with Teflon film and then a rubber end cap, and finally sealing the tube with tape.

For the non-VOC analyses, the remaining soil in the BA liner was emptied into a decontaminated mixing bowl, and aliquots of soil were transferred into appropriate sample containers for analysis. On occasion, the amount of soil recovered in the first sampling run was insufficient for sample volume requirements. In this case, additional sampling runs were completed until an adequate soil volume was recovered. Soil recovered from these additional runs was emptied into the mixing bowl and blended with the soil already collected. Aliquots of the blended soil were then transferred into sample containers and submitted for analysis.

Drainfield soil samples were submitted to the SNL/NM ER Chemistry Laboratory (ERCL) for VOCs, high explosives (HE), and Resource Conservation and Recovery Act (RCRA) metals analyses, and to the SNL/NM RPSD Laboratory for gamma spectroscopy analyses. Samples for SVOC, PCB, cyanide, gross alpha/beta activity, and hexavalent chromium analyses were sent to General Engineering Laboratories (GEL), Inc. in Charleston, South Carolina. All samples were documented and handled in accordance with applicable SNL/NM operating procedures and transported to on- and off-site laboratories for analysis.

VOCs were analyzed by U.S. Environmental Protection Agency (EPA) Method 8260; SVOCs by EPA Method 8270; HE by EPA Method 8330 (EPA 8095 equivalent at the on-site ERCL); PCBs by EPA Method 8082; RCRA metals and hexavalent chromium by EPA Methods 6020 and

Figure 3.4-1
Collecting Soil Samples with the Geoprobe™ from the
Building 6750 Septic System Drainfield, DSS Site 1008, August 17, 1999

Table 3.4-1
Summary of Soil Samples Collected at Building 6750 Septic System (DSS Site 1008)

Sampling Area	Analytical Parameters	Number of Borehole Locations	Top of Sampling Intervals in Each Borehole (ft bgs)	Total Number of Soil Samples	Total Number of Duplicate Samples	Date(s) Samples Collected
Drainfield	VOCs	2	5, 10	4	0	06-22-98
	SVOCs	2	5, 10	4	0	06-22-98
	PCBs	2	5, 10	4	0	08-17-99
	HE	2	5, 10	4	0	06-22-98
	RCRA metals	2	5, 10	4	0	06-22-98
	Hexavalent Chromium	2	5, 10	4	0	08-17-99
	Total Cyanide	2	5, 10	4	0	08-17-99
	Gamma Spectroscopy	2	5, 10	4	0	06-22-98
	Gross Alpha/Beta Activity	2	5, 10	4	0	06-22-98

bgs = Below ground surface.
DSS = Drain and Septic Systems.
ft = Foot (feet).
HE = High explosive(s).
PCB = Polychlorinated biphenyl.
RCRA = Resource Conservation and Recovery Act.
SVOC = Semivolatile organic compound.
VOC = Volatile organic compound.

7196A; total cyanide by EPA Method 9012A; gamma spectroscopy by EPA Method 901.1 (or equivalent at the on-site RPSD Laboratory); and gross alpha/beta activity by EPA Method 900.0, or equivalent (EPA November 1986).

3.4.2 Soil Sampling Results and Conclusions

Analytical results for the soil samples collected at DSS Site 1008 are presented and discussed below. Sample locations are shown on Figure 2.2.1-2.

VOCs

Analytical results for the four soil samples collected from the two drainfield boreholes are presented in Table 3.4.2-1. Method detection limits (MDLs) for the VOC analyses are presented in Table 3.4.2-2. No VOCs were detected in any of the soil samples.

Table 3.4.2-1
Summary of Building 6750 Septic System (DSS Site 1008)
Confirmatory Soil Sampling, VOC Analytical Results
June 1998
(On-Site Laboratory)

Sample Attributes			VOCs (Method 8260[a]) (µg/kg)
Record Number[b]	ER Sample ID	Sample Depth (ft)	
600395	6750-DF1-BH1-5-S	5	ND
600395	6750-DF1-BH1-10-S	10	ND
600395	6750-DF1-BH2-5-S	5	ND
600395	6750-DF1-BH2-10-S	10	ND
Quality Assurance/Quality Control Samples (µg/L)			
600395	6750-EB	NA	ND
600395	6750-TB	NA	ND

[a]EPA November 1986.
[b]Analysis Request/Chain-of-Custody Record.
BH = Borehole.
DF = Drainfield.
DSS = Drain and Septic Systems.
EB = Equipment blank.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
ID = Identification.
µg/kg = Microgram(s) per kilogram.
µg/L = Microgram(s) per liter.
NA = Not applicable.
ND = Not detected above the method detection limit.
S = Soil sample.
TB = Trip blank
VOC = Volatile organic compound.

Table 3.4.2-2
Summary of Building 6750 Septic System (DSS Site 1008)
Confirmatory Soil Sampling, VOC Analytical Method Detection Limits
June 1998
(On-Site Laboratory)

Analyte	Method 8260[a] Detection Limit (µg/kg)
Acetone	5.1–5.8
Benzene	1–1.2
Bromodichloromethane	1–1.2
Bromoform	1–1.2
Bromomethane	1–1.2
2-Butanone	5.1–5.8
Carbon disulfide	1–1.2
Carbon tetrachloride	1–1.2
Chlorobenzene	1–1.2
Chloroethane	1–1.2
Chloroform	1–1.2
Chloromethane	1–1.2
Dibromochloromethane	1–1.2
1,1-Dichloroethane	1–1.2
1,2-Dichloroethane	1–1.2
1,1-Dichloroethene	1–1.2
cis-1,2-Dichloroethene	1–1.2
trans-1,2-Dichloroethene	1–1.2
1,2-Dichloropropane	1–1.2
cis-1,3-Dichloropropene	0.51–0.58
trans-1,3-Dichloropropene	1–1.2
Ethyl benzene	2–2.3
2-Hexanone	5.1–5.8
4-methyl-, 2-Pentanone	5.1–5.8
Methylene chloride	1–1.2
Styrene	1–1.2
1,1,2,2-Tetrachloroethane	1–1.2
Tetrachloroethene	2–2.3
Toluene	1–1.2
1,1,1-Trichloroethane	1–1.2
1,1,2-Trichloroethane	1–1.2
Trichloroethene	1–1.2
Vinyl chloride	1–1.2
o-Xylene	2–2.3
p-Xylene, m-Xylene	3.1–3.5

[a]EPA November 1986.
DSS = Drain and Septic Systems.
EPA = U.S. Environmental Protection Agency.
µg/kg = Microgram(s) per kilogram.
VOC = Volatile organic compound.

SVOCs

Analytical results for the four soil samples collected from the two drainfield boreholes are presented in Table 3.4.2-3. MDLs for the SVOC analyses are presented in Table 3.4.2-4. No SVOCs were detected in any of the soil samples.

PCBs

Analytical results for the four soil samples collected from the two drainfield boreholes are presented in Table 3.4.2-5. MDLs for the PCB analyses are presented in Table 3.4.2-6. No PCBs were detected in any of the soil samples.

HE

Analytical results for the four soil samples collected from the two drainfield boreholes are presented in Table 3.4.2-7. MDLs for the HE analyses are presented in Table 3.4.2-8. No HE compounds were detected in any of the soil samples.

RCRA Metals and Hexavalent Chromium

Analytical results for the four soil samples collected from the two drainfield boreholes are presented in Table 3.4.2-9. MDLs for the metals analyses are presented in Table 3.4.2-10. Arsenic (4.6 milligrams [mg]/kilogram [kg]) and barium (240 J mg/kg) exceed their NMED-approved backgrounds of 4.4 and 214 mg/kg, respectively, in the 5-foot sample from borehole 6750-DF-BH2-5-5. All other metal detections were below their NMED-approved background concentrations.

Total Cyanide

Analytical results for the four soil samples collected from the two drainfield boreholes are presented in Table 3.4.2-11. MDLs for the cyanide analyses are presented in Table 3.4.2-12. No cyanide was detected in any of the soil samples.

Radionuclides

Analytical results for the gamma spectroscopy analysis of the four soil samples collected from the two drainfield boreholes are presented in Table 3.4.2-13. No readings above NMED-approved background were detected in any sample analyzed. However, although they were not detected, minimum detectable activities (MDAs) for uranium-235 and uranium-238 exceeded the background activities for those two radionuclides due to an insufficient gamma spectroscopy count time.

Table 3.4.2-3
Summary of Building 6750 Septic System (DSS Site 1008)
Confirmatory Soil Sampling, SVOC Analytical Results
June 1998
(Off-Site Laboratory)

Sample Attributes			SVOCs (Method 8270[a]) (µg/kg)
Record Number[b]	ER Sample ID	Sample Depth (ft)	
600396	6750-DF1-BH1-5-S	5	ND
600396	6750-DF1-BH1-10-S	10	ND
600396	6750-DF1-BH2-5-S	5	ND
600396	6750-DF1-BH2-10-S	10	ND

[a]EPA November 1986.
[b]Analysis Request/Chain-of-Custody Record.
BH = Borehole.
DF = Drainfield.
DSS = Drain and Septic Systems.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
ID = Identification.
µg/kg = Microgram(s) per kilogram.
ND = Not detected above the method detection limit.
S = Soil sample.
SVOC = Semivolatile organic compound.

Table 3.4.2-4
Summary of Building 6750 Septic System (DSS Site 1008)
Confirmatory Soil Sampling, SVOC Analytical Method Detection Limits
June 1998
(Off-Site Laboratory)

Analyte	Method 8270[a] Detection Limit (µg/kg)
Acenaphthene	170
Acenaphthylene	170
Anthracene	170
Benzo(a)anthracene	170
Benzo(a)pyrene	170
Benzo(b)fluoranthene	170
Benzo(ghi)perylene	170
Benzo(k)fluoranthene	170
Benzoic acid	330
Benzyl alcohol	170
4-Bromophenyl phenyl ether	170
Butylbenzyl phthalate	170
4-Chlorobenzenamine	330
bis(2-Chloroethoxy)methane	170
bis(2-Chloroethyl)ether	170
4-Chloro-3-methylphenol	170
bis-Chloroisopropyl ether	170
2-Chloronaphthalene	170
2-Chlorophenol	170
4-Chlorophenyl phenyl ether	170
Chrysene	170
m,p-Cresol	170
o-Cresol	170
Dibenz[a,h]anthracene	170
Dibenzofuran	170
Di-n-butyl phthalate	170
1,2-Dichlorobenzene	170
1,3-Dichlorobenzene	170
1,4-Dichlorobenzene	170
3,3'-Dichlorobenzidine	830
2,4-Dichlorophenol	170
Diethylphthalate	170
2,4-Dimethylphenol	170
Dimethylphthalate	170
2,4-Dinitrophenol	330
Dinitro-o-cresol	170
2,4-Dinitrotoluene	170
2,6-Dinitrotoluene	170
Di-n-octyl phthalate	170
1,2-Diphenylhydrazine	170
bis(2-Ethylhexyl)phthalate	170
Fluoranthene	170

Refer to footnotes at end of table.

Table 3.4.2-4 (Concluded)
Summary of Building 6750 Septic System (DSS Site 1008)
Confirmatory Soil Sampling, SVOC Analytical Method Detection Limits
June 1998
(Off-Site Laboratory)

Analyte	Method 8270[a] Detection Limit (µg/kg)
Fluorene	170
Hexachlorobenzene	170
Hexachlorobutadiene	170
Hexachlorocyclopentadiene	170
Hexachloroethane	170
Indeno(1,2,3-c,d)pyrene	170
Isophorone	170
2-Methylnaphthalene	170
Naphthalene	170
2-Nitroaniline	170
3-Nitroaniline	170
4-Nitroaniline	170
Nitro-benzene	170
2-Nitrophenol	170
4-Nitrophenol	330
n-Nitrosodiphenylamine	170
n-Nitrosodipropylamine	170
Pentachlorophenol	170
Phenanthrene	170
Phenol	170
Pyrene	170
1,2,4-Trichlorobenzene	170
2,4,5-Trichlorophenol	170
2,4,6-Trichlorophenol	170

[a]EPA November 1986.
DSS = Drain and Septic Systems.
EPA = U.S. Environmental Protection Agency.
µg/kg = Microgram(s) per kilogram.
SVOC = Semivolatile organic compound.

Table 3.4.2-5
Summary of Building 6750 Septic System (DSS Site 1008)
Confirmatory Soil Sampling, PCB Analytical Results
August 1999
(Off-Site Laboratory)

Sample Attributes			
Record Number[b]	ER Sample ID	Sample Depth (ft)	PCB (Method 8082[a]) (µg/kg)
602762	6750-DF1-BH1-5-S	5	ND
602762	6750-DF1-BH1-10-S	10	ND
602762	6750-DF1-BH2-5-S	5	ND
602762	6750-DF1-BH2-10-S	10	ND

[a]EPA November 1986.
[b]Analysis Request/Chain-of-Custody Record.
BH = Borehole.
DF = Drainfield.
DSS = Drain and Septic Systems.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
ID = Identification.
µg/kg = Microgram(s) per kilogram.
ND ( ) = Not detected above the method detection limit.
PCB = Polychlorinated biphenyls.
S = Soil sample.

Table 3.4.2-6
Summary of Building 6750 Septic System (DSS Site 1008)
Confirmatory Soil Sampling, PCB Analytical Method Detection Limits
August 1999
(Off-Site Laboratory)

Analyte	Method 8082[a] Detection Limit (µg/kg)
Aroclor-1016	1.21
Aroclor-1221	2.8
Aroclor-1232	1.62
Aroclor-1242	1.66
Aroclor-1248	0.901
Aroclor-1254	1.16
Aroclor-1260	0.937

[a]EPA November 1986.
DSS = Drain and Septic Systems.
EPA = U.S. Environmental Protection Agency.
µg/kg = Microgram(s) per kilogram.
PCB = Polychlorinated biphenyls.

Table 3.4.2-7
Summary of Building 6750 Septic System (DSS Site 1008)
Confirmatory Soil Sampling, HE Compounds Analytical Results
June 1998
(On-Site Laboratory)

Sample Attributes			HE (Method 8330[a]) (mg/kg)
Record Number[b]	ER Sample ID	Sample Depth (ft)	
600395	6750-DF1-BH1-5-S	5	ND
600395	6750-DF1-BH1-10-S	10	ND
600395	6750-DF1-BH2-5-S	5	ND
600395	6750-DF1-BH2-10-S	10	ND
Quality Assurance/Quality Control Samples (µg/L)			
600395	6750-EB		ND

[a]EPA November 1986.
[b]Analysis Request/Chain-of-Custody Record.
BH = Borehole.
DF = Drainfield.
DSS = Drain and Septic Systems.
EB = Equipment blank.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
HE = High explosive(s).
ID = Identification.
µg/L = Microgram(s) per liter.
mg/kg = Milligram(s) per kilogram.
ND = Not detected above the method detection limit.
S = Soil sample.

Table 3.4.2-8
Summary of Building 6750 Septic System (DSS Site 1008)
Confirmatory Soil Sampling, HE Compounds Analytical Method Detection Limits
June 1998
(On-Site Laboratory)

Analyte	Method 8330[a] Detection Limit (mg/kg)
2-Amino-4,6-dinitrotoluene	0.12–0.13
4-Amino-2,6-dinitrotoluene	0.097–0.1
1,3-Dinitrobenzene	0.068–0.074
2,4-Dinitrotoluene	0.22–0.24
2,6-Dinitrotoluene	0.26–0.28
HMX	0.12–0.13
Nitro-benzene	0.15–0.17
2-Nitrotoluene	0.14–0.15
3-Nitrotoluene	0.14–0.15
4-Nitrotoluene	0.12–0.13
Pentaerythritol tetranitrate	0.31–0.34
RDX	0.16–0.18
1,3,5-Trinitrobenzene	0.097–0.1
2,4,6-Trinitrotoluene	0.26–0.28

[a]EPA November 1986.
DSS = Drain and Septic Systems.
EPA = U.S. Environmental Protection Agency.
HE = High Explosive(s).
HMX = 1,3,5,7-tetranitro-1,3,5,7-tetrazacyclooctane.
mg/kg = Milligram(s) per kilogram.
RDX = 1,3,5-trinitro-1,3,5-triazacyclohexane.

Table 3.4.2-9
Summary of Building 6750 Septic System (DSS Site 1008)
Confirmatory Soil Sampling, Metals Analytical Results
June 1998 and August 1999
(On- and Off-Site Laboratories)

Sample Attributes			Metals (Method 6020/7196[a]) (mg/kg)								
Record Number[b]	ER Sample ID	Sample Depth (ft)	Arsenic	Barium	Cadmium	Chromium	Chromium (VI)	Lead	Mercury	Selenium	Silver
600395, 602762	6750-DF1-BH1-5-S	5	4.2	100 J	0.22	12	0.116 J (0.2)	7.8	ND (0.044)	0.69 J (1.3)	ND (0.044)
600395, 602762	6750-DF1-BH1-10-S	10	2 J (2.6)	65 J	ND (0.043)	6.6	ND (0.0338)	4.6	ND (0.043)	ND (0.32)	ND (0.043)
600395, 602762	6750-DF1-BH2-5-S	5	**4.6**	**240 J**	ND (0.045)	14	ND (0.0337)	9.3	ND (0.045)	0.74 J (1.4)	ND (0.045)
600395, 602762	6750-DF1-BH2-10-S	10	2.6 J (2.7)	70 J	ND (0.044)	6.8	ND (0.0338)	4.6	ND (0.044)	ND (0.33)	ND (0.044)
Background concentration (Southwest Area Supergroup)[c]			4.4	214	0.9	15.9	1	11.8	<0.1	<1	<1
Quality Assurance/Quality Control Samples (µg/L)											
600395	6750-EB	NA	ND (3.4)	4.8 J (16)	ND (0.23)	ND (8.5)	NS	ND (1.7)	ND (0.23)	ND (1.7)	ND (0.23)

Note: Values in **bold** represent analytes detected above their respective background concentration.

[a]EPA November 1986.

[b]Analysis Request/Chain-of-Custody Record.

[c]Dinwiddie September 1997.

BH = Borehole.
DF = Drainfield.
DSS = Drain and Septic Systems.
EB = Equipment blank.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
ID = Identification.
J ( ) = The reported value is greater than or equal to the method detection limit but is less than the practical quantitation limit, shown in parentheses.
J = Analytical result was qualified as an estimated value during data validation, see data validation report.
µg/L = Microgram(s) per liter.
NA = Not applicable.
mg/kg = Milligram(s) per kilogram.
ND ( ) = Not detected above the method detection limit, shown in parentheses.
NS = Not sampled.
S = Soil sample.

Table 3.4.2-10
Summary of Building 6750 Septic System (DSS Site 1008)
Confirmatory Soil Sampling, Metals Analytical Method Detection Limits
June 1998 and August 1999
(On-Site and Off-Site Laboratories)

Analyte	Method 6020/7196A[a] Detection Limit (mg/kg)
Arsenic	0.64–0.68
Barium	0.53–0.57
Cadmium	0.043–0.045
Chromium	0.75–0.8
Chromium (VI)	0.0337–0.0339
Lead	0.32–0.34
Mercury	0.043–0.045
Selenium	0.32–0.34
Silver	0.043–0.045

[a]EPA November 1986.
DSS = Drain and Septic Systems.
EPA = U.S. Environmental Protection Agency
mg/kg = Milligram(s) per kilogram.

Table 3.4.2-11
Summary of Building 6750 Septic System (DSS Site 1008)
Confirmatory Soil Sampling, Total Cyanide Analytical Results
August 1999
(Off-Site Laboratory)

Sample Attributes			Total Cyanide (Method 9012A[a]) (mg/kg)
Record Number[b]	ER Sample ID	Sample Depth (ft)	
602762	6750-DF1-BH1-5-S	5	ND
602762	6750-DF1-BH1-10-S	10	ND
602762	6750-DF1-BH2-5-S	5	ND
602762	6750-DF1-BH2-10-S	10	ND

[a]EPA November 1986.
[b]Analysis Request/Chain-of-Custody Record.
BH = Borehole.
DF = Drainfield.
DSS = Drain and Septic Systems.
EPA = U.S. Environmental Protection Agency.
ER = Environmental Restoration.
ft = Foot (feet).
ID = Identification.
mg/kg = Milligram(s) per kilogram.
ND = Not detected above the method detection limit.
S = Soil sample.

Table 3.4.2-12
Summary of Building 6750 Septic System (DSS Site 1008)
Confirmatory Soil Sampling, Total Cyanide Analytical Method Detection Limits
August 1999
(Off-Site Laboratory)

Analyte	Method 9012A[a] Detection Limit (mg/kg)
Total Cyanide	0.133–0.137

[a]EPA November 1986.
DSS = Drain and Septic Systems.
EPA = U.S. Environmental Protection Agency.
mg/kg = Milligram(s) per kilogram.

Table 3.4.2-13
Summary of Building 6750 Septic System (DSS Site 1008)
Confirmatory Soil Sampling, Gamma Spectroscopy Analytical Results
June 1998
(On-Site Laboratory)

Sample Attributes			Activity (pCi/g)							
Record Number[a]	ER Sample ID	Sample Depth (ft)	Cesium-137		Thorium-232		Uranium-235		Uranium-238	
			Result	Error[b]	Result	Error[b]	Result	Error[b]	Result	Error[b]
600398	6750-DF1-BH1-5-S	5	ND (0.0355)	--	0.688	0.348	**ND (0.247)**	--	**ND (1.64)**	--
600398	6750-DF1-BH1-10-S	10	ND (0.0350)	--	0.640	0.359	**ND (0.237)**	--	**ND (3.34)**	--
600398	6750-DF1-BH2-5-S	5	ND (0.0350)	--	0.726	0.368	**ND (0.248)**	--	**ND (3.59)**	--
600398	6750-DF1-BH2-10-S	10	ND (0.0330)	--	0.690	0.370	**ND (0.236)**	--	**ND (3.17)**	--
Background Concentration—Southwest Area Supergroup[c]			*0.079*	NA	*1.01*	NA	*0.16*	NA	1.4	NA

Note: Values in **bold** exceed background activities or had MDAs which exceeded background activities.

[a]Analysis Request/Chain-of-Custody Record.

[b]Two standard deviations about the mean detected activity.

[c]Dinwiddie September 1997.

BH = Borehole.
DF = Drainfield.
DSS = *Drain and Septic Systems.*
ER = Environmental Restoration.
ft = Foot (feet).
ID = *Identification.*
MDA = Minimum detectable activity.
NA = Not applicable.
ND ( ) = Not detected above the MDA, shown in parentheses.
pCi/g = Picocurie(s) per gram.
S = Soil sample.
-- = Error not calculated for nondetectable results.

Gross Alpha/Beta Activity

Analytical results for the four soil samples collected from the two drainfield boreholes are presented in Table 3.4.2-14. No elevated readings of gross alpha or beta were detected in any of the samples. These results indicate no significant levels of residual radioactive material in soil at the site.

3.4.3 Soil Sampling Data Quality

No duplicate soil samples were collected at this site.

3.4.4 Soil Sampling Quality Assurance/Quality Control Samples and Data Validation Results

Quality assurance (QA)/quality control (QC) samples were collected at an approximate frequency of 1 per 20 field samples. These included sample duplicates, and matrix spike/matrix spike duplicates. Typically, samples were shipped to the laboratory in batches of 20, so that any one shipment might contain samples from several sites. Aqueous equipment blanks (EBs) were collected at an approximate frequency of 1 per 20 samples and sent to the laboratory. The EBs were analyzed for the same analytical suite as the soil samples in that shipment. Aqueous trip blanks (TBs) were used for VOC analysis only, and were included in every sample cooler containing VOC soil samples. The analytical results for the EB and TB samples appear only on the data tables for the last site sampled in any one shipment, although the results were used in the data validation process for all the samples in that batch.

An aqueous TB was included in the sample coolers containing the VOC soil samples collected from the Building 6750 septic system and other DSS sites in June 1998. An aqueous EB sample for VOCs, HE, and metals was also collected following completion of soil sampling in the Building 6750 drainfield in June 1998. As shown in Tables 3.4.2-7 and 3.4.2-9, no VOCs, HE or metals were detected in the TB or EB samples.

All laboratory data were reviewed and verified/validated according to Data Verification/Validation Level 3 (SNL/NM July 1994) or "Data Validation Procedure for Chemical and Radiochemical Data," in SNL/NM Environmental Restoration Project Administrative Operating Procedure 00-03, Rev 0 (SNL/NM December 1999). In addition, the SNL/NM RPSD Laboratory (Department 7713) reviewed all gamma spectroscopy results according to "Laboratory Data Review Guidelines," Procedure No. RPSD-02-11, Issue No. 2 (SNL/NM July 1996). Annex B contains the data validation reports for the samples collected at DSS Site 1008. The data are acceptable for use in the DSS Site 1008 NFA proposal.

3.5 Investigation 4—Passive Soil-Vapor Sampling

In May 2001, a passive soil-vapor screening survey conducted in the Building 6750 drainfield area. This survey was required at this site by NMED/HWB regulators, and was conducted to determine if any areas of significant VOC contamination were present in soil at the site.

Table 3.4.2-14
Summary of Building 6750 Septic System (DSS Site 1008)
Confirmatory Soil Sampling, Gross Alpha/Beta Activity Analytical Results
June 1998
(Off-Site Laboratory)

Sample Attributes			Activity (pCi/g)			
Record Number[a]	ER Sample ID	Sample Depth (ft)	Gross Alpha		Gross Beta	
			Result	Error[b]	Result	Error[b]
600396	6750-DF1-BH1-5-S	5	14	3.84	17.6	3.59
600396	6750-DF1-BH1-10-S	10	5.24	2.35	15.7	3.44
600396	6750-DF1-BH2-5-S	5	11.5	3.94	18	3.68
600396	6750-DF1-BH2-10-S	10	8.53	2.95	14.8	3.48

[a]Analysis Request/Chain-of-Custody Record.
[b]Two standard deviations about the mean detected activity.
BH = Borehole.
DF = Drainfield.
DSS = Drain and Septic Systems.
ER = Environmental Restoration.
ft = Foot (feet).
ID = Identification.
pCi/g = Picocurie(s) per gram.
S = Soil sample.

3.5.1 Passive Soil-Vapor Sampling Methodology

A Gore-Sorber™ (GS) passive soil-vapor survey is a semi-quantitative screening procedure that can be used to identify many VOCs present in the vapor phase in soil. This technique is highly sensitive to organic vapors, and the result produces a qualitative measure of organic soil-vapor chemistry over a two- to three-week period, rather than at one point in time.

Each GS passive soil-vapor sampler consisted of a 1-foot-long by approximately ¼-inch-diameter tube of waterproof, vapor-permeable fabric containing 40 milligrams of absorbent material. At each sampling location, a 1½-inch by 3-foot deep borehole was drilled with the Geoprobe™ drilling rig. A sample identification tag and location string were attached to the GS sampler, and it was lowered into the open borehole to a depth of 1 to 2 feet bgs. The location string was attached to a numbered pin flag at the surface. A cork was placed in the borehole above the sampler as a seal, and the upper 1 foot of the borehole from the cork to the ground surface was then backfilled with site soil.

The vapor samplers were left in the ground for approximately two weeks before retrieval. After retrieval, each sampler was individually placed into a pre-cleaned jar, sealed, and sent to W.L. Gore and Associates for analysis by thermal desorption and gas chromatography using a modified EPA Method 8260. Analytical results for the VOCs of interest are reported as the quantity or mass (expressed in micrograms) of the individual VOCs that were absorbed by the sampler while it was in the ground (Gore June 2002). All samples were documented and handled in accordance with applicable SNL/NM operating procedures.

3.5.2 Soil-Vapor Survey Results and Conclusions

A total of four GS passive soil-vapor samplers were placed in the site drainfield (Figure 2.2.1-2). Samplers were installed at the site on May 1, 2002, and were retrieved on May 16, 2002. Sample locations are designated by the same six-digit sample number on Figure 2.2.1-2 and in the analytical result tables presented in Annex C.

As shown in the GS analytical results tables in Annex C, the GS samplers were analyzed for a total of 19 individual or groups of VOCs, including trichloroethene, tetrachloroethene, cis- and trans-dichloroethene, and benzene/toluene/ethylbenzene/xylene. Low to trace-level (but quantifiable) amounts of 15 VOCs were detected in the GS samplers installed at this site. However, the analytical results did not indicate any significant areas of VOC contamination at the site which would require additional characterization.

3.6 Site Sampling Data Gaps

Analytical data from the site assessment were sufficient for characterizing the nature and extent of possible COC releases. There are no further data gaps regarding characterization of DSS Site 1008, the Building 6750 septic system.

This page intentionally left blank.

4.0 CONCEPTUAL SITE MODEL

The conceptual site model for the Building 6750 septic system, DSS Site 1008, is based upon the COCs identified in the soil samples collected from beneath the drainfield. This section summarizes the nature and extent of contamination and the environmental fate of COCs.

4.1 Nature and Extent of Contamination

Potential COCs at DSS Site 1008 are VOCs, SVOCs, PCBs, HE compounds, cyanide, RCRA metals, hexavalent chromium, radionuclides detected by gamma spectroscopy, and gross alpha/beta activity. No VOCs, SVOCs, PCBs, HE, or cyanide were detected in any of the soil samples collected at the site. Arsenic and barium were detected above the concentrations for the Southwest Area Supergroup soils in Sample 6750-DF1-BH2-5-S, which was collected at 5 feet bgs. If metal concentrations exceeded the maximum background screening value or the nonquantifiable background value, that COC was carried forward in the risk assessment process. No radionuclides were detected above the concentrations for the Southwest Area Supergroup soils. However, the MDAs for U-235 and U-238 analyses did exceed these corresponding background activities. Finally, gross alpha/beta activity did not indicate any radioactive contamination at the site.

4.2 Environmental Fate

Potential COCs may have been released into the vadose zone via aqueous effluent discharged from the septic system drainfield. Possible secondary release mechanisms include uptake of COCs that may have been released to the soil beneath the drainfield lines (Figure 4.2-1). The depth to groundwater at the site (approximately 460 feet bgs) most likely precludes migration of residual COCs into the groundwater system. The potential pathways to receptors include soil ingestion, inhalation, or dermal contact, which could occur as a result of excavation of potentially contaminated soil that may take place at the site. Plant uptake was also considered a pathway as COCs can enter the food chain through uptake by plant roots. Plants can be consumed by herbivores, which can in turn be eaten by predators. Annex D provides additional discussion on the fate and transport of COCs at DSS Site 1008.

Table 4.2-1 summarizes residual COCs for DSS Site 1008. Only minor evidence of metal contamination was found in soil samples collected at the site. All potential COCs were retained in the conceptual model and were evaluated in the human health and ecological risk assessments. The current and future land use for DSS Site 1008 is industrial (DOE et al. September 1995).

The potential human receptors at the site are considered to be an industrial worker and resident. The exposure route for the receptors are dermal contact, ingestion and/or inhalation for all

This page intentionally left blank.

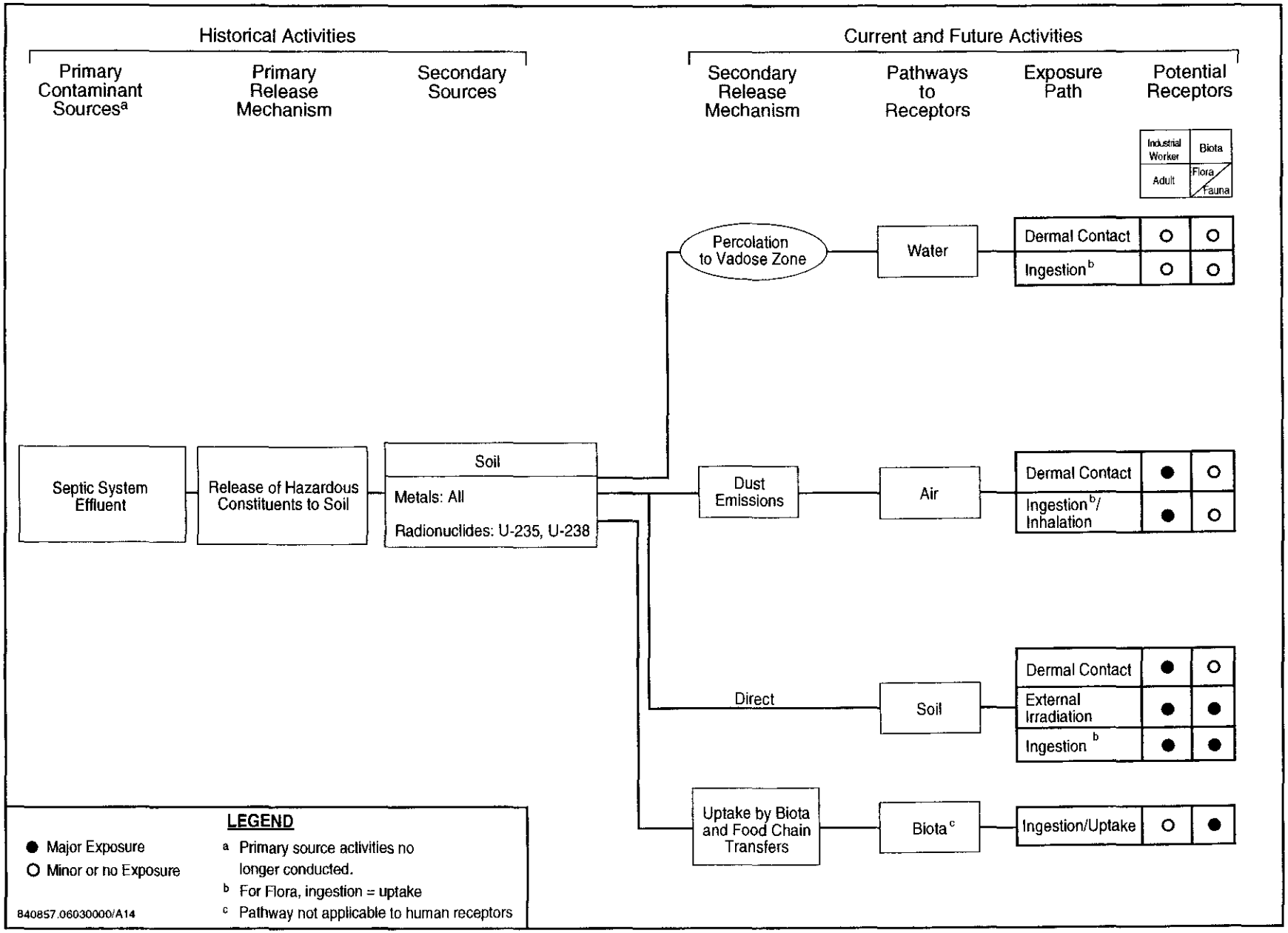


Figure 4.2-1

Conceptual Site Model Flow Diagram for Building 6750 Septic System, DSS Site 1008

Table 4.2-1
Summary of Potential COCs for Building 6750 Septic System (DSS Site 1008)

COC Type	Number of Samples[a]	COCs Greater than Background	Maximum Background Limit/Southwest Area Supergroup[b] (mg/kg)	Maximum Concentration[c] (mg/kg)	Average Concentration[d] (mg/kg)	Number of Samples Where Background Concentration Exceeded[e]
VOCs	4	None	NA	NA	NA	None
SVOCs	4	None	NA	NA	NA	None
PCB	4	None	NA	NA	NA	None
HE	4	None	NA	NA	NA	None
RCRA Metals	4	Arsenic	4.4	4.6 J	3.35	1
	4	Barium	214	240 J	118.75	1
Hexavalent chromium	4	None	NA	NA	NA	None
Cyanide	4	None	NA	NA	NA	None
Radionuclides (pCi/g)	4	U-235	0.16	ND (0.248)	Not calculated[f]	4
	4	U-238	1.4	ND (3.59)	Not calculated[f]	4

[a]Number of samples.
[b]From Dinwiddie September 1997.
[c]Maximum concentration is the maximum amount detected, or the maximum MDL or MDA if nothing was detected.
[d]Average concentration includes all samples except blanks. The average is calculated as the sum of detected amounts and one-half the MDLs for nondetect results, divided by the number of samples.
[e]See appropriate data table for sample locations.
[f]An average MDA is not calculated because of the variability in instrument counting error and the number of reported nondetect activities.

COC = Constituent of concern.
DSS = Drain and Septic Systems.
HE = High explosive(s).
J = Estimated concentration.
MDA = Minimum detectable activity.
MDL = Method detection limit.
mg/kg = Milligram(s) per kilogram.
ND ( ) = Not detected above the MDA, shown in parentheses.
PCB = Polychlorinated biphenyls.
pCi/g = Picocurie(s) per gram.
RCRA = Resource Conservation and Recovery Act.
SVOC = Semivolatile organic compound.
VOC = Volatile organic compound.

applicable pathways; however, this is a realistic possibility only if contaminated soil is excavated at the site. The major exposure route modeled in the human health risk assessment was soil ingestion for the nonradiological COCs and direct gamma exposure for radiological COCs. The inhalation pathway is also included because of the potential to inhale dust. The dermal pathway is included because of the potential for exposure of the receptor to the contaminated soil.

No pathways to groundwater are considered, and no intake routes through plant, meat, or milk ingestion are considered appropriate for either the industrial or residential land use scenarios. Annex D provides additional discussion of the exposure routes and receptors at DSS Site 1008.

4.3 Site Assessments

Site assessment at DSS Site 1008 included risk assessments for both human health and ecological risk. This section briefly summarizes the site assessment results, and Annex D presents the risk assessment performed for this site in more detail.

4.3.1 Summary

The site assessment concluded that DSS Site 1008 poses no significant threat to human health under either the industrial or residential land use scenarios. After considering the uncertainties associated with the available data and modeling assumptions, ecological risks associated with DSS Site 1008 are expected to be low.

4.3.2 Risk Assessments

Risk assessments were performed for both human health and ecological risks at DSS Site 1008. This section summarizes the results.

4.3.2.1 Human Health

DSS Site 1008 has been recommended for a future industrial land use scenario (DOE et al. September 1995). Because metals and radionuclides are present, it was necessary to perform a human health risk assessment analysis for the site, which included all COCs detected. Annex D provides a complete discussion of the risk assessment process, results, and uncertainties. The risk assessment process provides a quantitative evaluation of the potential adverse human health effects from constituents in the site's soil by calculating the hazard index (HI) and excess cancer risk for both industrial and residential land use scenarios.

In summary, the HI calculated for the nonradiological COCs is 0.02 at DSS Site 1008 under the industrial land use scenario, which is less than the numerical standard of 1.0 suggested by risk assessment guidance (EPA 1989). The excess cancer risk for DSS Site 1008 COCs is 3E-6 for an industrial land use setting. NMED guidance states that cumulative excess lifetime cancer risk must be less than 1E-5 (Bearzi January 2001). Thus, the excess cancer risk for this site is below the suggested acceptable risk value. The incremental HI risk, determined by subtracting

risk associated with background from potential nonradiological COC risk (without rounding), is 0.00, and there is no incremental excess cancer risk for the industrial land use scenario. The summation of the radiological and nonradiological risk from site carcinogens for the industrial land use is 3.6E-6.

In summary, the HI calculated for the nonradiological COCs is 0.3 at DSS Site 1008 under the residential land use scenario, which is less than the numerical standard of 1.0 suggested by risk assessment guidance (EPA 1989). The excess cancer risk for DSS Site 1008 nonradiological COCs is 1E-5 for a residential land use setting. NMED guidance states that cumulative excess lifetime cancer risk must be less than 1E-5 (Bearzi January 2001). Thus, the excess cancer risk for this site was slightly above the suggested acceptable risk value. The incremental HI risk, determined by subtracting risk associated with background from potential nonradiological COC risk (without rounding), is 0.02, and there is no incremental excess cancer risk for the residential land use scenario. Although the estimated excess cancer risk is at the NMED guideline for the residential land use scenario, a comparison of the maximum arsenic concentrations (4.6 mg/kilogram [kg]) to both the background screening value (4.4 mg/kg) and the range of arsenic background concentrations (0.033 to 17 mg/kg) indicates that the maximum concentration is most likely part of the background population. In addition, the calculated incremental excess cancer risk is zero. Therefore, considering the background screening value, the range of background concentrations, and the incremental estimated excess cancer risk, the maximum arsenic concentration does not indicate contamination. The summation of the radiological and nonradiological risk from site carcinogens for the residential land use is 1.2E-5.

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 either the industrial or residential land use scenarios.

4.3.2.2 Ecological

An ecological assessment that corresponds with the screening procedures in the EPA's Ecological Risk Assessment Guidance for Superfund (EPA 1997) also was performed as set forth by the NMED Risk-Based Decision Tree described in the "RPMP Document Requirement Guide" (NMED March 1998). An early step in the evaluation compared COC concentrations and identified potentially bioaccumulative constituents (see Annex D, 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, as presented in the "Predictive Ecological Risk Assessment Methodology for SNL/NM ER Program, Sandia National Laboratories/New Mexico" (IT July 1998). The screening also includes the estimation of exposure and ecological risk.

Table 15 of Annex D presents the results of the ecological risk assessment. Ecological risk associated with DSS Site 1008 was estimated through an assessment that incorporated site-specific information when available.

Hazard quotient values greater than 1 were originally predicted. However, closer examination of the exposure assumptions revealed an overestimation of risk primarily attributed to conservative toxicity benchmarks, the use of maximum concentrations, and the contribution of background risk. Based upon final analysis of the exposure assumptions, the potential for ecological risks associated with DSS Site 1008 is expected to be low.

4.4 Baseline Risk Assessments

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

4.4.1 Human Health

Because the results of the human health assessment summarized in Section 4.3.2.1 indicate that DSS Site 1008 poses insignificant risk to human health under both industrial and residential land use scenarios, a baseline human health risk assessment is not required for the DSS Site 1008.

4.4.2 Ecological

Because the results of the ecological assessment summarized in Section 4.3.2.2 indicate that ecological risks at DSS Site 1008 are expected to be low, a baseline ecological risk assessment is not required for the site.

5.0 NO FURTHER ACTION PROPOSAL

5.1 Rationale

Based upon field investigation data and the human health risk assessment analysis, an NFA decision is recommended for DSS Site 1008 for the following reasons:

- The soil has been sampled for all potential COCs.
- No COCs are present in soil at levels considered hazardous to human health for an industrial and residential land use scenario.
- None of the COCs warrant ecological concern after conservative exposure assumptions are analyzed.

5.2 Criterion

Based upon the evidence provided above, DSS Site 1008 is proposed for an NFA decision according to Criterion 5, which states, "the SWMU/AOC 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).

This page intentionally left blank.

6.0 REFERENCES

Bearzi, J. (New Mexico Environment Department/Hazardous Waste Bureau), January 2000. Letter to M.J. Zamorski (U.S. Department of Energy) and L. Shepard (Sandia National Laboratories/New Mexico) approving the "Sampling and Analysis Plan for Characterizing and Assessing Potential Releases to the Environment From Septic and Other Miscellaneous Drain Systems at Sandia National Laboratories/New Mexico." January 28, 2000.

Bearzi, J.P. (New Mexico Environment Department), January 2001. Memorandum to RCRA-Regulated Facilities, "Risk-Based Screening Levels for RCRA Corrective Action Sites in New Mexico," Hazardous Waste Bureau, New Mexico Environment Department, Santa Fe, New Mexico. January 23, 2001.

Bleakly, D. (Sandia National Laboratories/New Mexico), July 1996. Memorandum, "List of Non-ER Septic/Drain Systems for the Sites Identified Through the Septic System Inventory Program." July 8, 1996.

Dinwiddie, R.S. (New Mexico Environment Department), September 1997. Letter to M.J. Zamorski (U.S. Department of Energy), *Request for Supplemental Information: Background* Concentrations Report, SNL/KAFB, September 24, 1997.

Gore, see Gore, W.L. and Associates.

Gore, W.L. and Associates (Gore), June 2002. "Final Report, Gore-Sorber Screening Survey Results, Non-ER Drain and Septic, Kirtland Air Force Base, New Mexico," Gore Production Order No. 10960025, Sandia National Laboratories/New Mexico. June 6, 2002.

IT Corporation (IT), July 1998. "Predictive Ecological Risk Assessment Methodology, Environmental Restoration Program, Sandia National Laboratories, New Mexico," IT Corporation, Albuquerque, New Mexico.

Jones, J. (Sandia National Laboratories/New Mexico), July 1993. Internal Memorandum to B. Galloway listing the septic tanks that were removed from service with the Construction of the Area III sanitary sewer system. July 26, 1993.

Moats, W. (New Mexico Environment Department/Hazardous Waste Bureau), February 2002. Letter to M.J. Zamorski (U.S. Department of Energy) and P. Davies (Sandia National Laboratories/New Mexico) approving the "Field Implementation Plan, Characterization of Non-Environmental Restoration Drain and Septic Systems." February 21, 2001.

National Oceanographic and Atmospheric Administration (NOAA), 1990. Local Climatological Data, Annual Summary with Comparative Data, National Oceanographic and Atmospheric Administration, Albuquerque, New Mexico.

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

NMED, see New Mexico Environment Department.

NOAA, see National Oceanographic and Atmospheric Administration.

Sandia National Laboratories (SNL/NM), September 1971. SNL/NM Facilities Engineering Drawing #88213 showing the Building 6750 Septic System, Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories/New Mexico (SNL/NM), June 1993. "Sandia National Laboratories/New Mexico Septic Tank Monitoring Report, 1992 Report," Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories/New Mexico (SNL/NM), July 1994. "Verification and Validation of Chemical and Radiological Data," Technical Operating Procedure (TOP) 94-03, Rev. 0, Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories/New Mexico (SNL/NM), December 1995. "Sandia National Laboratories Septic Tank Characterization," Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories/New Mexico (SNL/NM), March 1996. "Site-Wide Hydrogeologic Characterization Project, Calendar Year 1995 Annual Report," Sandia National Laboratories Environmental Restoration Project, Albuquerque, New Mexico.

Sandia National Laboratories/New Mexico (SNL/NM), July 1996. "Laboratory Data Review Guidelines," Radiation Protection Sample Diagnostics Procedure No. RPSD-02-11, Issue No. 02, Sandia National Laboratories/New Mexico, Albuquerque, New Mexico.

Sandia National Laboratories/New Mexico (SNL/NM), February 1998. "Site-Wide Hydrogeologic Characterization Project, 1995 Annual Report," Rev., Environmental Restoration Project, Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories/New Mexico (SNL/NM), October 1999. "Sampling and Analysis Plan for Characterizing and Assessing Potential Releases to the Environment From Septic and Other Miscellaneous Drain Systems at Sandia National Laboratories/New Mexico," Sandia National Laboratories, Albuquerque, New Mexico, October 19, 1999.

Sandia National Laboratories/New Mexico (SNL/NM), December 1999. "Data Validation Procedure for Chemical and Radiochemical Data (AOP 00-003)," Rev. 0, Environmental Restoration Project, Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories/New Mexico (SNL/NM), November 2001. "Field Implementation Plan, Characterization of Non-Environmental Restoration Drain and Septic Systems," Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories/New Mexico (SNL/NM), March 2002. "Annual Groundwater Monitoring Report, Fiscal Year 2000–2001," Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories/New Mexico (SNL/NM), August 2002. "Well Locations, SNL SWMU Sites, Select USAF IRP Sites at Kirtland Air Force Base," SNL/NM Geographic Information Systems (GIS) Map Number 020562, Sandia National Laboratories, Albuquerque, New Mexico. August 28, 2002.

Sandia National Laboratories/New Mexico (SNL/NM), March 2003. Database printout provided by SNL/NM Facilities Engineering showing the years that numerous SNL/NM buildings were constructed, Sandia National Laboratories, Albuquerque, New Mexico.

Shain, M. (IT Corporation), August 1996. Memorandum and spreadsheet to J. Jones (Sandia National Laboratories/New Mexico) summarizing dates, locations, and volume of effluent pumped from numerous septic tanks at Sandia National Laboratories/New Mexico, Albuquerque, New Mexico. August 23, 1996.

Thompson, B. M. and G. J. Smith, 1985. "Investigation of Groundwater Contamination Potential at Sandia National Laboratories, Albuquerque, New Mexico" *in* Proceedings of the Fifth DOE Environmental Protection Information Meeting, Albuquerque, New Mexico, November 6-8, 1984 CONF-841187, pp. 531-540.

U.S. Department of Energy (DOE), U.S. Air Force, and U.S. Forest Service, September 1995. "Workbook: Future Use Management Area 2," prepared by the Future Use Logistics and Support Working Group in cooperation with U.S. Department of Energy Affiliates, the U.S. Air Force, and the U.S. Forest Service.

U.S. Environmental Protection Agency (EPA), November 1986. "Test Methods for Evaluating Solid Waste," 3rd ed., Update III, SW-846, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C.

U.S. Environmental Protection Agency (EPA), 1989. "Risk assessment Guidance for Superfund, Vol. 1: Human Health Evaluation Manual," EPA/540-1089/002, Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C.

U.S. Environmental Protection Agency (EPA), 1997. "Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risks," Interim Final, U.S. Environmental Protection Agency, Washington, D.C.

This page intentionally left blank.

ANNEX A
Septic Tank Sample Results

Building 6750
Area 3
Sample ID No. SNLA008422
Tank ID No. AD89024R

On July 4, 1992, aqueous and sludge samples were collected from the septic tank serving Building 6750. At the time of collection, it was noted that the sample had a strong odor of solvents. Analytical results of concern (which confirmed the field observation) are noted below.

- Trichloroethene (TCE) was detected in the aqueous sample at a level of 490 mg/L, which exceeds the New Mexico Water Quality Control Commission Regulations discharge limit (NMDL) of 0.1 mg/L, the City of Albuquerque (COA) discharge limit of 5.0 mg/L, and the Resource Conservation and Recovery Act (RCRA) toxicity characteristic (TC) limit of 0.5 mg/L.

- Phenol was detected in the aqueous sample at a level of 0.26 mg/L, and total phenolic compounds were detected in the aqueous sample at a level of 0.62 mg/L. These values exceed the NMDL of 0.005 mg/L for each.

No other parameters were detected in the aqueous fractions above NMDLs, COA discharge limits, or RCRA TC limits that identify hazardous waste.

During review of the radiological data, no parameters were detected that exceed U.S. Department of Energy (DOE) derived concentration guideline (DCG) limits or the investigation levels (IL) established during this investigation.

Septic Tank Data Review Form

(LIQUID SAMPLES)

Building No./Area:	6750 A-3
Tank ID No.:	AD69024R
Date Sampled:	7/7/92
Sample ID No.:	SNLA-008422

Analytical Parameter	Measured Concentration	State Discharge Limit	COA Discharge Limit	Comments
Volatile Organics (EPA 624)	(mg/l)	(mg/l)	(mg/l)	
1,2-Dichloroethene (total)	4.4	NR	NR	
Trichloroethene	490	0.1	(TTO=5.0)	Exceeds State and COA Limits; Exceeds RCRA TC limit of 0.5 mg/L
Semivolatile Organics (EPA 625)	(mg/l)	(mg/l)	(mg/l)	
bis (2-Ethylhexyl)phthlate	4.4	NR	(TTO=5.0)	Presence of laboratory contamination confirmed
Phenol	0.26	0.005	(TTO=5.0)	Exceeds State Limit
Pesticides (EPA 608)	(mg/l)	(mg/l)	(mg/l)	
None detected above laboratory		NR	(TTO=5.0)	
reporting limits				
PCBs (EPA 508)	(mg/l)	(mg/l)	(mg/l)	
None detected above laboratory		0.001	(TTO=5.0)	
reporting limits				
Metals	(mg/l)	(mg/l)	(mg/l)	
Arsenic	ND (0.010)	0.1	2.0	
Barium	0.15	1.0	20.0	
Cadmium	0.0030	0.01	2.8	
Chromium	ND (0.010)	0.05	20.0	
Copper	0.053	1.0	16.5	
Lead	ND (0.050)	0.05	3.2	
Manganese	0.18	0.20	20.0	
Mercury	ND (0.00040)	0.002	0.1	
Nickel	—	NR	12.0	
Selenium	ND (0.020)	0.05	2.0	
Silver	ND (0.010)	0.05	5.0	
Thallium	ND (0.050)	NR	NR	
Zinc	0.50	10.0	28.0	
Uranium	0.003	5.0	NR	
Miscellaneous Analytes	(mg/l)	(mg/l)	(mg/l)	
Phenolic Compounds	0.62	0.005	4.0	Exceeds State Limit
Nitrates/Nitrites	ND (1.0)	10.0	NR	
Formaldehyde	ND (1.0)	NR	260.0	
Fluoride	0.57	1.6	180.0	
Cyanide	ND (0.010)	0.2	8.0	
Oil and Grease	72.1	NR	150.0	
Radiological Analyses	(pCi/l)	(pCi/l)	(pCi/l)	
Radium 225	0.3 +/- 0.1	30.0	NR	
Radium 226	0 +/- 30	30.0	NR	
Gross Alpha	50 +/- 30	NR	NR	
Gross Beta	90 +/- 80	NR	NR	
Tritium	269 +/- 280	NR	NR	

NR = Not Regulated; ND(#,#) = Not Detected (Reporting Limit); TC = Toxicity Characteristic of Hazardous Waste

Note: City and State Discharge Limits are for comparison purposes only. City limits apply to discharge of sanitary effluent and not septic tank waste, state limits apply to effluent discharged onto or below the surface of the ground.

References - City of Albuquerque NM Sewer Use and Wastewater Control Ordinance (1990), Section 9-9-3, and New Mexico Water Quality Control Commision Regulations (1988), Section 3-109.

Results of Septic Tank Analyses (Sludge Sample)			
Building No./Area:	**6750 A-3**		
Tank ID No.:	**AD89024R**		
Date Sampled:	**7/792**		
Sample ID No.:	**SNLA008422**		
Analytical Parameter	**Measured Concentration**	**± 2 Sigma Uncertainty**	**Units**
Water Content	92.4	NA	%
Arsenic	ND(1.0)	NA	mg/kg
Barium	8.9	NA	mg/kg
Cadmium	1.5	NA	mg/kg
Chromium	1.5	NA	mg/kg
Copper	14.1	NA	mg/kg
Lead	12.1	NA	mg/kg
Manganese	3.3	NA	mg/kg
Mercury	ND(0.10)	NA	mg/kg
Nickel	---	NA	mg/kg
Selenium	ND(0.50)	NA	mg/kg
Silver	ND(1.0)	NA	mg/kg
Thallium	ND(0.50)	NA	mg/kg
Zinc	151	NA	mg/kg
Gross Alpha	4	10	pCi/g
Gross Beta	33	23	pCi/g
Gross Alpha	17	13	pCi/g
Gross Beta	8	22	pCi/g
Gross Alpha	16	13	pCi/g
Gross Beta	21	22	pCi/g
Gross Alpha	14	13	pCi/g
Gross Beta	21	24	pCi/g
Tritium	269	280	pCi/L
Bismuth-214	0.0316	0.00751	pCi/mL
Cesium-137	<0.0110	NA	pCi/mL
Potassium-40	0.304	0.0645	pCi/mL
Lead-212	0.0236	0.00558	pCi/mL
Lead-214	0.00341	0.00687	pCi/mL
Radium-226	0.305	0.00668	pCi/mL
Thorium-234	0.324	0.00590	pCi/mL
Thallium-208	0.00887	0.00277	pCi/mL

ND = Not Detected
NA = Not Applicable

Attachment 2

Sandia National Laboratories
Septic Tank Characterization
Summary Tables of Analytical Reports

December 1995

Building 6750

SANDIA NATIONAL LABORATORIES
SEPTIC TANK CHARACTERIZATION
SUMMARY TABLES OF ANALYTICAL REPORTS

December 1995

Prepared for:

Sandia National Laboratories
Waste Management and Regulatory Projects
Department 7583
Albuquerque, New Mexico 87185-1303

Prepared by:

IT Corporation
5301 Central Avenue NE, Suite 700
Albuquerque, New Mexico 87108

December 14, 1995

RESULTS OF SEPTIC TANK SAMPLING

CHEMICAL ANALYSES OF SLUDGE SAMPLE

Building ID: Bldg 6750
Sample ID Number: 024409
Date Sampled: 7-12-95
Percent Moisture: Not Reported

Parameter (Method)	Result	Detection Limit (DL)	NM Discharge Limit[a]	COA Discharge Limit[b]	Comments
Volatile Organics (8260)	*(µg/kg)*	*(µg/kg)*	*(mg/L)*	*(mg/L)*	
Methylene chloride	2,400,000J	18,000,000	0.1	TTO = 5.0	
Trichloroethene	110,000,000	18,000,000	NR	TTO = 5.0	
Tetrachloroethene	2,300,000J	18,000,000	NR	TTO = 5.0	
Semivolatile Organics (8270)	*(µg/kg)*	*(µg/kg)*	*(mg/L)*	*(mg/L)*	
di-N-Octylphthalate	640J	4700	NR	TTO = 5.0	
Naphthalene	2100J	4700	NR	TTO = 5.0	
n-Nitrosodiphenylamine	3500J	4700	NR	TTO = 5.0	
Phenanthrene	1000J	4700	NR	TTO = 5.0	
Di-N-Butylphthalate	710J	4700	NR	TTO = 5.0	
Pyrene	950J	4700	NR	TTO = 5.0	
ButylBenzylPhthalate	760J	4700	NR	TTO = 5.0	
4-Methylphenol (reanalyses)	230,000D	47,000	NR	NR	
bis(2-Ethylhexyl)Phthalate (reanalyses)	210,000D	47,000	NR	TTO = 5.0	
Pesticides/PCBs (8080)	*(µg/kg)*	*(µg/kg)*	*(mg/L)*	*(mg/L)*	
Aroclor-1260	18,000	12,000	0.001	TTO = 5.0	
Metals (6010/7)	*(mg/kg)*	*(mg/kg)*	*(mg/L)*	*(mg/L)*	
Arsenic	6.5J	15.0	0.1	2.0	
Barium	150J	299	1.0	20.0	
Cadmium	18.0	7.5	0.01	2.8	
Chromium	35.8	29.9	0.05	20.0	
Copper	212	37.4	1.0	16.5	
Lead	152	4.5	0.05	3.2	
Manganese	47.0	22.4	0.2	20.0	
Nickel	28.7J	59.8	0.2	12.0	

Refer to footnotes at end of table.

RESULTS OF SEPTIC TANK SAMPLING

CHEMICAL ANALYSES OF SLUDGE SAMPLE

Building ID: Bldg 6750
Sample ID Number: 024409
Date Sampled: 7-12-95
Percent Moisture: Not Reported

Parameter (Method)	Result	Detection Limit (DL)	NM Discharge Limit[a]	COA Discharge Limit[b]	Comments
Metals (6010/7470)	*(mg/kg)*	*(mg/kg)*	*(mg/L)*	*(mg/L)*	
Selenium	5.6J	7.5	0.05	2.0	
Silver	9.3J	15.0	0.05	5.0	
Thallium	ND	15.0	NR	NR	
Zinc	2560	29.9	10.0	28.0	
Mercury	9.1	1.5	0.002	0.1	

Notes:
[a] New Mexico Water Quality Control Commission Regulations (1990), Section 3-103.
[b] City of Albuquerque Sewer Use and Wastewater Control Ordinance (1993), Section 6-9-3 M – maximum allowable concentration for grab sample.
D = Sample was diluted.
DL = Detection limit indicated on laboratory report.
IDL = Instrument detection limit.
J = Estimated concentration of analyte, between DL and IDL.
ND = Not detected above DL indicated.
NR = Not regulated.

RESULTS OF SEPTIC TANK SAMPLING

RADIOLOGICAL ANALYSES OF SLUDGE SAMPLE

Building ID: Bldg 6750
Sample ID Number: 024409
Date Sampled: 7-12-95
Percent Moisture: Not Reported

Parameter (Method)	Result	MDA	Critical Level	NM Discharge Limit[a]	Comments
Isotopic Analyses[b]	*(pCi/g ± 2-σ)*	*(pCi/g)*	*(pCi/g)*	*(pCi/g)*	
Plutonium-239/240	-0.004 ± 0.004	0.023	0.014	NR	
Plutonium-238	-0.005 ± 0.002	0.021	0.013	NR	
Strontium-90	-0.05 ± 0.00	0.28	0.13	NR	
Thorium-232	0.068 ± 0.031	0.035	0.022	NR	
Thorium-230	0.12 ± 0.05	0.038	0.023	NR	
Thorium-228	0.055 ± 0.031	0.040	0.024	NR	
Uranium-238	6.68 ± 2.52	1.25	0.821	NR	
Uranium-235/236	0.74 ± 0.90	1.51	1.05	NR	
Uranium-234	12.3 ± 3.9	1.38	0.885	NR	
Dry Gamma Spectroscopy[c]	*(pCi/g ± 2-σ)*	*(pCi/g)*	*(pCi/g)*	*(pCi/g)*	
Cesium-137	ND	0.023	0.011	NR	
Cesium-134	ND	0.017	0.008	NR	
Potassium-40	4.90 ± 0.58	0.17	0.080	NR	
Chromium-51	ND	0.21	0.10	NR	
Iron-59	ND	0.053	0.025	NR	
Cobalt-60	ND	0.021	0.010	NR	
Zirconium-95	ND	0.039	0.019	NR	
Ruthenium-103	ND	0.028	0.013	NR	
Ruthenium-106	ND	0.16	0.078	NR	
Cerium-144	ND	0.084	0.041	NR	
Thallium-208	0.082 ± 0.024	0.020	NL	NR	
Lead-210	0.60 ± 0.32	0.34	NL	NR	
Lead-212	0.29 ± 0.04	0.02	0.012	NR	
Lead-214	0.23 ± 0.04	0.03	0.017	NR	
Bismuth-214	0.27 ± 0.05	0.04	NL	NR	
Radium-224	0.75 ± 0.32	0.29	NL	NR	

Refer to footnotes at end of table.

RESULTS OF SEPTIC TANK SAMPLING

RADIOLOGICAL ANALYSES OF SLUDGE SAMPLE

Building ID: Bldg 6750
Sample ID Number: 024439
Date Sampled: 7-12-95
Percent Moisture: Not Reported

Parameter (Method)	Result	MDA	Critical Level	NM Discharge Limit[a]	Comments
Dry Gamma Spectroscopy[c]	*(pCi/g ± 2-σ)*	*(pCi/g)*	*(pCi/g)*	*(pCi/g)*	
Radium-226	0.25 ± 0.03	0.04	0.020	30.0[d]	
Radium-228	0.27 ± 0.06	0.07	0.036	30.0[d]	
Actinium-228	0.27 ± 0.06	0.07	0.036	NR	
Thorium-231	ND	0.50	0.24	NR	
Thorium-232	0.27 ± 0.06	0.07	0.036	NR	
Thorium-234	3.74 ± 0.47	0.25	0.12	NR	
Uranium-235	0.19 ± 0.03	0.10	0.048	NR	
Uranium-238	3.74 ± 0.47	0.25	0.12	NR	
Americium-241	ND	0.030	0.015	NR	

Notes:
[a] New Mexico Water Quality Control Commission Regulations (1995), Section 3-103.
[b] Isotopic uranium analyzed by NAS-NS-3050; plutonium by SL13029/SL13033; strontium by 7500-SR; thorium by NAS-NS-3004.
[c] Analyzed by method HASL 300 at Quanterra, St. Louis.
[d] NMWQCCR standard for Ra-226 + Ra-228 combined in pCi/L.
MDA = Minimum detectable activity.
ND = Not detected above MDA indicated.
NR = Not regulated.
NL = Not listed.

RESULTS OF SEPTIC TANK SAMPLING
CHEMICAL ANALYSES OF AQUEOUS SAMPLE

Building ID: Building 6750 - Duplicate
Sample ID Number: 024423
Date Sampled: 07-12-95

Parameter (Method)	Result	Detection Limit (DL)	NM Discharge Limit[a]	COA Discharge Limit[b]	Comments
Volatile Organics (8260)	*(mg/L)*	*(mg/L)*	*(mg/L)*	*(mg/L)*	
Vinyl Chloride	0.039	0.010	0.0001	TTO = 5.0	Exceeds NM Discharge Limit.
Chloroethane	0.014	0.010	NR	TTO = 5.0	
1,1-Dichloroethene	0.014	0.010	0.005	TTO = 5.0	Exceeds NM Discharge Limit.
1,1-Dichloroethane	0.003J	0.010	0.025	TTO = 5.0	
1,2-Dichloroethane	0.006J	0.010	0.01	TTO = 5.0	
Trichloroethene	0.006J	0.010	NR	TTO = 5.0	
Toluene	0.002J	0.010	0.75	TTO = 5.0	
Semivolatile Organics (8270)	*(mg/L)*	*(mg/L)*	*(mg/L)*	*(mg/L)*	
4-Methylphenol	0.038	0.010	NR	NR	
bis(2-Ethylhexyl)Phthalate	0.003J	0.010	NR	TTO = 5.0	
Pesticides/PCBs (8080)	*(mg/L)*	*(mg/L)*	*(mg/L)*	*(mg/L)*	
gamma-BHC (Lindane)	0.00006	0.00005	NR	TTO = 5.0	
Metals (6010/7470)	*(mg/L)*	*(mg/L)*	*(mg/L)*	*(mg/L)*	
Arsenic	0.0028J	0.010	0.1	2.0	
Barium	0.0839J	0.200	1.0	20.0	
Cadmium	ND	0.005	0.01	2.8	
Chromium	ND	0.020	0.05	20.0	
Copper	0.0131J	0.025	1.0	16.5	
Lead	ND	0.003	0.05	3.2	
Manganese	0.0704	0.015	0.2	20.0	
Nickel	ND	0.040	0.2	12.0	
Selenium	0.0034J	0.005	0.05	2.0	
Silver	ND	0.010	0.05	5.0	
Thallium	ND	0.010	NR	NR	

Refer to footnotes at end of table.

RESULTS OF SEPTIC TANK SAMPLING

CHEMICAL ANALYSES OF AQUEOUS SAMPLE

Building ID: Building 6750 - Duplicate

Sample ID Number: 024423

Date Sampled: 07-12-95

Parameter (Method)	Result	Detection Limit (DL)	NM Discharge Limit[a]	COA Discharge Limit[b]	Comments
Metals (6010/7470)	*(mg/L)*	*(mg/L)*	*(mg/L)*	*(mg/L)*	
Zinc	0.0544	0.020	10.0	28.0	
Mercury	ND	0.0002	0.002	0.1	
Miscellaneous Analyses	*(mg/L)*	*(mg/L)*	*(mg/L)*	*(mg/L)*	
Field pH	7.8 pH units	0 - 14 pH units	6 – 9 pH units	5 – 11 pH units	
Formaldehyde (NIOSH 3500)	ND	0.25	NR	260.0	
Fluoride (300.0)	0.57	0.20	1.6	180.0	
Nitrate + Nitrite (353.1)	ND	0.050	10.0	NR	
Oil + Grease (9070)	1.45	0.97	NR	150.0	
Total Phenol (9065)	0.0688	0.050	0.005	4.0	Exceeds NM Discharge Limit.

Notes:

[a] New Mexico Water Quality Control Commission Regulations (1990), Section 3-103.

[b] City of Albuquerque Sewer Use and Wastewater Control Ordinance (1993), Section 8-9-3 M – maximum allowable concentration for grab sample.

DL = Detection limit indicated on laboratory report.

IDL = Instrument detection limit.

J = Estimated concentration of analyte, between DL and IDL.

ND = Not detected above DL indicated.

NR = Not regulated.

TTO = Total toxic organics.

Refer to footnotes at end of table.

RESULTS OF SEPTIC TANK SAMPLING

RADIOLOGICAL ANALYSES OF AQUEOUS SAMPLE

Building ID: Building 6750 - Duplicate
Sample ID Number: 024423
Date Sampled: 07-12-95

Parameter (Method)	Result	MDA	Critical Level	NM Discharge Limit[a]	Comments
Radiological Analyses	*(pCi/L ± 2-σ)*	*(pCi/L)*	*(pCi/L)*	*(pCi/L)*	
Gross Alpha (9310)	4.08 ± 2.26	3.88	1.69	NR	
Gross Beta (9310)	26.3 ± 3.7	3.8	1.84	NR	
Isotopic Analyses	*(pCi/L ± 2-σ)*	*(pCi/L)*	*(pCi/L)*	*(pCi/L)*	
Tritium (906.0)	-32.2 ± 48.7	83.5	41.3	NR	
Gamma Spectroscopy[b]	*(pCi/mL ± 2-σ)*	*(pCi/mL)*	*(pCi/L)*	*(pCi/L)*	
None detected above MDA	ND	various	NL	NR	

Notes:
[a] New Mexico Water Quality Control Commission *Regulations* (1990), Section 3-103.
[b] *Analyzed in-house by SNL/NM Department 7715.*
MDA = Minimum detectable activity.
ND = Not detected above MDA indicated.
NL = Not listed.
NR = Not regulated.

RESULTS OF SEPTIC TANK SAMPLING

CHEMICAL ANALYSES OF SLUDGE SAMPLE

Building ID: Building 6750 - Duplicate
Sample ID Number: 024423
Date Sampled: 07-12-95
Percent Moisture: Not Reported

Parameter (Method)	Result	Detection Limit (DL)	NM Discharge Limit[a]	COA Discharge Limit[b]	Comments
Volatile Organics (8260)	*(µg/kg)*	*(µg/kg)*	*(mg/L)*	*(mg/L)*	
Acetone	2,700,000BJ	2,800,000	NR	NR	
Trichloroethene	49,000,000	2,800,000	NR	TTO = 5.0	
Tetrachloroethene	790,000J	2,800,000	NR	TTO = 5.0	
Semivolatile Organics (8270)	*(µg/kg)*	*(µg/kg)*	*(mg/L)*	*(mg/L)*	
4-Methylphenol	130,000D	37,000	NR	NR	
Benzidine	1,700DJ	180,000	NR	TTO = 5.0	
bis(2-Ethylhexyl)Phthalate	94,000D	37,000	NR	TTO = 5.0	
1,2-Dichlorobenzene	560J	3700	NR	TTO = 5.0	
Naphthalene	1300J	3700	NR	TTO = 5.0	
n-Nitrosodiphenylamine	2900J	3700	NR	TTO = 5.0	
Phenanthrene	660J	3700	NR	TTO = 5.0	
Di-N-Butylphthalate	880J	3700	NR	TTO = 5.0	
Pyrene	450J	3700	NR	TTO = 5.0	
Pesticides/PCBs (8080)	*(µg/kg)*	*(µg/kg)*	*(mg/L)*	*(mg/L)*	
Aroclor-1260	12,000	9,600	0.001	TTO = 5.0	
Metals (6010 / 7470)	*(mg/kg)*	*(mg/kg)*	*(mg/L)*	*(mg/L)*	
Arsenic	8.5J	11.6	0.1	2.0	
Barium	184J	231	1.0	20.0	
Cadmium	19.4	5.8	0.01	2.8	
Chromium	28.5	23.1	0.05	20.0	
Copper	268	28.9	1.0	16.5	
Lead	178	3.5	0.05	3.2	

Refer to footnotes at end of table.

RESULTS OF SEPTIC TANK SAMPLING

CHEMICAL ANALYSES OF SLUDGE SAMPLE

Building ID: Building 6750 - Duplicate
Sample ID Number: 024423
Date Sampled: 07-12-95
Percent Moisture: Not Reported

Parameter (Method)	Result	Detection Limit (DL)	NM Discharge Limit[a]	COA Discharge Limit[b]	Comments
Metals (6010/7470)	*(mg/kg)*	*(mg/kg)*	*(mg/L)*	*(mg/L)*	
Manganese	44.8	17.3	0.2	20.0	
Nickel	32.5J	46.3	0.2	12.0	
Selenium	5.5J	5.8	0.05	2.0	
Silver	5.0J	11.6	0.05	5.0	
Thallium	ND	11.6	NR	NR	
Zinc	3210	23.1	10.0	26.0	
Mercury	8.4	1.2	0.002	0.1	

Notes:
[a] New Mexico Water Quality Control Commission Regulations (1990), Section 3-103.
[b] City of Albuquerque Sewer Use and Wastewater Control Ordinance (1993), Section 8-9-3 M – maximum allowable concentration for grab sample.
B = Analyte detected in method blank.
D = Sample diluted because of high values.
DL = *Detection limit indicated on laboratory report.*
IDL = Instrument detection limit.
J = Estimated concentration of analyte, between DL and IDL.
ND = Not detected above DL indicated.
NR = Not regulated.
TTO = *Total toxic organics.*

ANNEX B
Data Validation Report

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

Project Name 101 Non-ER Septic Fields

Case Number 7223.230

Sample Numbers 41 samples (see analytical report for specific sample #s)

AR/COC No. 600395 Analytical laboratory ERCL SDG No. NA

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

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

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

1.0 EVALUATION

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

Reviewed by: Jeffrey A. Rahe

Date: 10/19/98

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

Item	Yes	No	If no. Sample ID No./Fraction(s) and Analysis
c) Matrix spike recovery data reported and met for all samples for which it was requested?		✓	S198-15 ⇒ Ba no results ① S198-16 ⇒ Ba (biased low)
6) Precision a) Laboratory control sample precision reported and met for all samples?	NA		Not applicable; LCS duplicate not analyzed with submitted samples (VOA, HE, Metals)
b) Matrix spike duplicate RPD data reported and met for all samples for which it was requested?			S198-15 ⇒ Ba (No results) ①
7) Blank data a) Method or reagent blank data reported and met for all samples?		✓	S198-15 ⇒ Hg and Pb S198-16 ⇒ As ②
b) Sampling blank (e.g., field, trip, and equipment) data reported and met?		✓	ER-1295-6750-EB ⇒ Ba ③
8) Narrative included, correct, and complete?	✓		

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

① Percent recoveries and He relative percent difference were not reported for Ba in the MS/MSD samples (S198-15). Percent recoveries were biased low for Ba

Reviewed by: Jeffrey A. Rabe

Date: 10/19/98

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

2.0 COMMENTS CONTINUATION SHEET

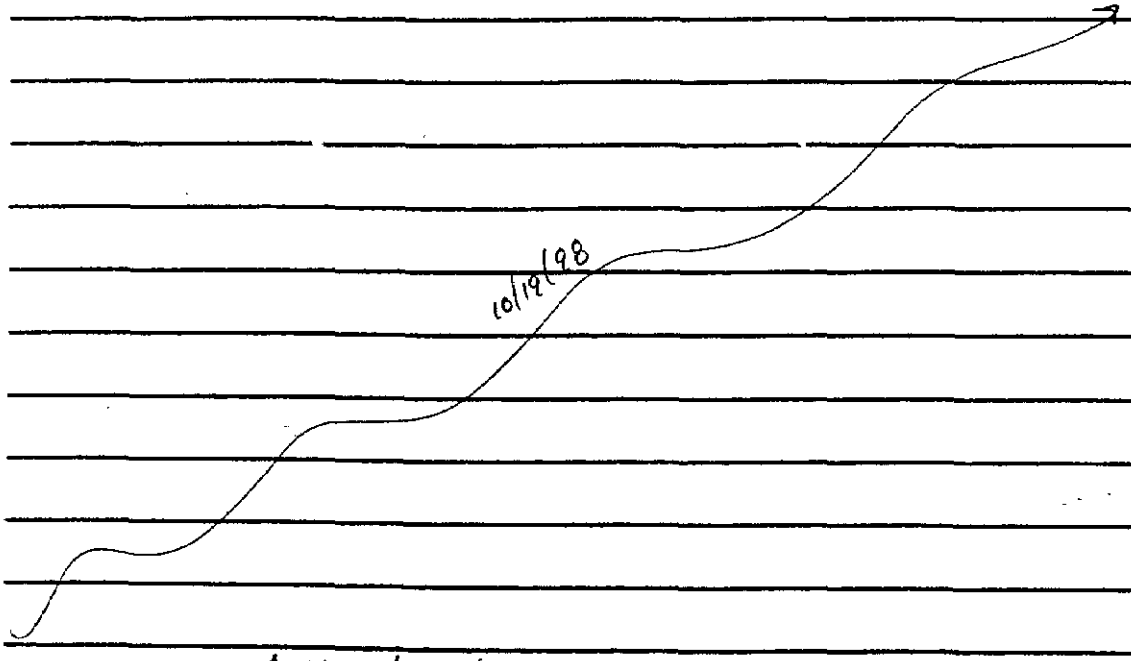
In the MS1 and MS0 samples for Ba (S198-16).

② "J" values were reported in the metals LMB samples

S198-15 ⇒ Hg and Pb

S198-16 ⇒ As

③ "J" value reported for Ba in the equipment blank.



Reviewed by: Jeffrey A Rale

Date: 10/19/98

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

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

Sample/ Fraction No.	Analysis	Qualifiers	Comments

see page 4 of 5

10/19/98 JK

Attach continuation sheet for additional samples

QUALIFIERS:

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

Reviewed by: Jeffrey A. Rabe

Date: 10/19/98

TOP QUAD
Attachment A
November 1995

Wmd 11-9-95

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

Project Leader: Tony Roybal | Project Name: 101 Non-ER Septic Fields | Case No: 7223.230

AR/COC No.: 600395 | Analytical Lab: ERCL | SDG No.: NA

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

1.0 Analysis Request and Chain of Custody Record

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

2.0 Analytical Laboratory Report

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

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

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

Reviewed by: Jeffrey J. Role Date: 10/19/98 Closed by: _____ Date: _____

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

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

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

SAMPLE FINDINGS SUMMARY

Site: 101 Non-ER Septic Fields

AR COC: 600395 Data Classification: DV-2

Sample Fraction No.	Analysis	DV Qualifiers	Comments
ER-1295-6750 -DF1	7440-39-3	J, A2	
-BH1-5-S			
-BH1-10-S			
-BH2-5-S			
-BH2-10-S			
ER-1295-6730 -DF1	7440-38-2	UI	
-BH1-4.5-S			
-BH1-9.5-S			
-BH2-4.5-S			
-BH2-9.5-S			
-BH3-4.5-S			
-BH3-9.5-S			
-BH4-4.5-S			
-BH4-9.5-S			
ER-1295-6730 -DF1	7440-39-3	J, A2	
-BH1-4.5-S			
-BH1-9.5-S			
-BH2-4.5-S			
-BH2-9.5-S			

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-MS, EPA8270, HACH_ALK, HACH_NO2, HACH_NO3, MEKC_HE, PCBRISC

Reviewed by: Jeffrey A. Rabe Date: 10/19/98

SAMPLE FINDINGS SUMMARY

Site: 101 Nam - ER Septic Fields

AR COC: 600395 Data Classification: DV-2

Sample Fraction No.	Analysis	DV Qualifiers	Comments
ER-1295-6620 -DF1	7439-97-6	B	
-BH1-5-S	↓	↓	
-BH1-10-S			
-BH2-5-S			
-BH2-10-S			
-BH3-5-S			
-BH3-10-S			
ER-1295-6620 -DF1	7440-39-3	J A2, P2	
-BH1-5-S	↓	↓	
-BH1-10-S			
-BH2-5-S			
-BH2-10-S			
-BH3-5-S			
-BH3-10-S			
ER-1295-6750 -DF1	7440-38-2	U1	
[redacted]	↓	↓	
[redacted]			10.30.00

Amt 3/4/99 Jeff Rohe 10.30.00

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: Jeffrey A. Rohe Date: 10/9/98

Site: 101 Non-ER Septic Fields

AR COC: 600395 Data Classification: DV-2

Sample Fraction No.	Analysis	DV Qualifiers	Comments
ER-1295-6730 -DF1	7440-39-3	J, A2	
- BH3-4.5-S -BH3-9.5-S	↓	↓	
-BH4-4.5-S -BH4-9.5-S	↓	↓	
EPA 6020	7440-39-3	B2	
ER-1295-6750-EB			

10/25/00 J. Rabe

JR 10/19/98

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, EPA7470A, EPA8015B, EPA8081, EPA8260, EPA8260-MS, EPA8270, HACH_ALK, HACH_NO2, HACH_NO3, MEKC_HE, PCBRISC

Reviewed by: Jeffrey J. Rabe Date: 10/19/98

SAMPLE FINDINGS SUMMARY

Site: ST4DF

AR/COC: 600396 Data Classification: Radiometrics

Sample Fraction No.	Analysis	DV Qualifiers	Comments
No Data is Qualified			
Data is Acceptable			
QC measures are adequate			

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, EPA7470A1, EPA8015B, EPA8081, EPA8260, EPA8260-M3, EPA8270, HACH_ALK, HACH_NO2, HACH_NO3, MEKC_HE, PCBRISC

Reviewed by: Kevin A Lambert Date: 8/4/98

verified

ANALYTICAL RADIOCHEMISTRY DATA VALIDATION CHECKLIST

Project Name	ST + DF			Site Name	Case # 7223.2300
Laboratory Name/Job No./Batch No.	GEL / 9806828			Chain of Custody No.	600396
Analysis Method	EPA 900.0, HASL 300.0			Parameter List:	Gross Alpha/Beta, Gamma Spec
REVIEW ITEM	YES	NO	NA	COMMENTS	
A. HOLDING TIMES					
1. Preparation and analysis holding times met?				SEE CVR Form	
2. Short-half life parameters analyzed for and checked?					
B. CALIBRATION VERIFICATION				Met criteria	
1. Detectors numbered and documented?	✓				
2. Frequency: Daily ✓, weekly ____, or monthly ____?	✓				
3. Acceptance criteria: Met?	✓				
C. LABORATORY CONTROL SAMPLES				Met acceptance criteria	
1. Standard: Independent, certified reference material?	✓				
2. Frequency: Each batch?	✓				
3. % Recovery 80-120% or ____?	✓				
METHOD BLANK				No target analytes were above acceptance limits	
1. Frequency: Each batch?	✓				
2. Matrix: Matrix specific?	✓				
3. Preparation: Entire procedure?	✓				
4. Blanks show contamination?		✓			
E. MATRIX SPIKE					
1. Frequency: Each batch?		✓		No MS/MSD for Gamma Spec. Dup analysis from another ARCOC group in batch met criteria. No data qualified. MS/MSD for Gross A/B met acceptance criteria	
2. Matrix: Matrix specific?	✓				
3. Preparation: Entire procedure?	✓				
4. % Recovery: 75-125% or ____?	✓				
F. ANALYTICAL YIELDS/OTHER				Not Applicable	
1. Tracer: Correct type, recovery met?			✓		
2. Ingrowth and/or decay: Correct factors applied?			✓		
3. Solids density: Planchette loading <5 mg/cm^2?			✓		
G. DUPLICATE				RPDs for Gross A/B did not met criteria, however, the DER which is the appropriate measure of Lab precision met criteria. No data is qualified. The duplicate analysis for G. Spec is from another ARCOC group in the batch and met criteria. No data is qualified	
1. Type: Lab or field?	✓				
2. Frequency: Each batch?	✓				
3. Matrix: Matrix specific?	✓				

SAMPLE FINDINGS SUMMARY

Site: ST + DF

AR/COC: 600396 Data Classification: Organic

Sample Fraction No.	Analysis	DV Qualifiers	Comments
No data were qualified			
Data is acceptable			
QC measures are adequate			

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: Kevin A Lambert Date: 8/6/98

ORGANIC DATA ASSESSMENT SUMMARY FORM
(Data Verification/Validation Level 3 DV-3)

SITE OR PROJECT ST4DF
ANALYTICAL LABORATORY GEL
LABORATORY REPORT # 9806828
CASE NO. 7223.2300
ARCOC# 600396

SAMPLE IDS 26:24soil, 2aqueous
NO. OF SAMPLES
ER-1295-6620-XXX, ER-1295-6730-XXX,
ER-1295-6750-XXX, ER-1295-6631-XXX,

DATA ASSESSMENT SUMMARY

Describe problems/qualifications below (Action Items and Areas of Concern)

		VOC	SVOC	PEST/PCB	~~OTHER~~ HE KHL 8/4/98
1.	HOLDING TIMES/PRESERVATION	✓	✓	NA	✓
2.	GC/MS INST. PERFORM.	✓	✓		✓
3.	CALIBRATIONS/WINDOWS	✓	✓		✓
4.	BLANKS	✓	✓		✓
5.	SURROGATES	✓	✓		✓
6.	MATRIX SPIKE/DUP	✓	✓		✓
7.	LABORATORY CONTROL SAMPLES	✓	✓		✓
8.	INTERNAL STANDARDS	✓	✓		✓
9.	COMPOUND IDENTIFICATION	✓	✓		✓
10.	SYSTEM PERFORMANCE	✓	✓		✓
11.	OVERALL ASSESSMENT	✓	✓	✓	✓

✓ (check mark) — Acceptable: Data had no problems or qualified due to minor problems
N - Data qualified due to major problems
X - Problems, but do not affect data
Qualifiers: J - Estimate
UJ - Undetected, estimated

NA - Not Applicable

KHL 8/4/98
~~ACTION ITEMS:~~ All samples were prepared and analyzed with accepted procedures and specified methods. All compounds were successfully analyzed. No problems were

KHL 8/6/98
~~AREAS OF CONCERN:~~ observed in the data package review that results in data qualification. The following sections discuss the data review and validation

Reviewed By: Kevin A Lambert
Date: 8/6/98

ORGANIC DATA ASSESSMENT SUMMARY FORM
(Data Verification/Validation Level 3 DV-3)

1.0 HOLDING TIMES AND PRESERVATION

Indicate the holding time criteria below that was used to evaluate the samples.

SW-846, 3rd. ed.
Other: _____

List below samples that were over holding time criteria.

Sample ID	VTSR	Date Analyzed	Action

See CVR FORM

NOTE: VTSR = Validated time of sample receipt.

Were the correct preservatives used? Yes ☐ No ☐

List below samples that were incorrectly preserved.

Sample No.	Type of Sample	Deficiency	Action

Reviewed By: Kevin A Lambert 8/4/98
Date:

ORGANIC DATA ASSESSMENT SUMMARY FORM
(Data Verification/Validation Level 3 DV-3)

3.3 DDT and Endrin Degradation *Not Applicable*

List below the standards that have a DDT or Endrin breakdown of >20% (or a combined breakdown of >20%).

Date/Time	Standard ID	DDT/Endrin	% Breakdown	Action	Affected Samples

3.4 DSC Retention Time Check

Is the %D between EVAL A and each analysis (quantitation and confirmation) DSC retention time within QC limits (2% for packed column, 0.3% capillary ID <0.32 mm, and 1% for megabore)?

Yes ☐ No ☐

Date	Sample ID	DSC %D	Action

For the above criteria outlined in Sections 8.1–8.4, check for transcription/calculation errors.

If errors are found, list below with necessary corrections: _____

Reviewed By: Kevin A Lambert
Date: 8/4/98

ORGANIC DATA ASSESSMENT SUMMARY FORM
(Data Verification/Validation Level 3 DV-3)

4.0 INITIAL CALIBRATION

Has initial calibration been performed as required in the EPA method? Yes ☑ No ☐

Were the correct number of standards used to calibrate the instrument? Yes ☑ No ☐

For GC analyses of PCBs and Pesticides, did the laboratory follow the correct 72-hour sequence of analysis?
Yes ☐ No ☐ Not Applicable

List below compounds which did not meet initial calibration criteria outlined by the EPA method.

Instrument ID	Date	Compound	RF/%RSD	Action	Samples Affected
VOC:	Several compounds are outside acceptance limits (see QC summary data). Majority are not on TCL. Those on TCL are non-detects in site samples. No data is qualified				
SVOC:	Met criteria				
HE:	Met criteria				

Check for transcription/calculation errors. If errors are present, summarize necessary corrections below:

Reviewed By: Kevin A Lambert
Date: 8/4/98

ORGANIC DATA ASSESSMENT SUMMARY FORM
(Data Verification/Validation Level 3 DV-3)

6.0 BLANK ANALYSES

6.1 Method/Reagent and Instrument Blanks

Has a method/reagent blank been analyzed for each set of samples or for every 20 samples of similar matrix, whichever is more frequent? Yes ☑ No ☐

Has an instrument blank been analyzed at least once every twelve hours for each GC/MS system used? Yes ☑ No ☐

6.2 Field/Rinse/Equipment Blanks

Are there field/rinse/equipment blanks associated with each sampling day or at frequency specified in the sampling plan. Yes ☑ No ☐ SVOCs Only

List below compounds for which analyses were requested that were detected in any of the blanks analyzed:

Date	Blank ID	Compound	Conc. ( )	PQL ( )	Action Level	Samples Affected (Action)
Batch 125500 7/7/98 1401	ER-1295-6631-TB-SD	methylene chloride	2.9 ug/l	1.0 ug/l	Not detected No data	in site sample is qualified
124879 6/30/98 1627	QC517681	2-Amino-4, 6-DNT	120 ug/kg	80 ug/kg	Not detected No data	in site sample is qualified
SVOC:	KAL 8/4/98					

PQL = Practical Quantitation Limit from EPA Method.

Note: VOCs - Methylene Chloride was observed at estimated values ("J" coded) in MBs. No detectable concentration was observed in site sample, no data is qualified.

Reviewed By: Kevin A Lambert
Date: 8/4/98

ORGANIC DATA ASSESSMENT SUMMARY FORM

(Data Verification/Validation Level 3 DV-3)

If surrogate recovery was outside of control limits, were the samples or method blank reanalyzed?

Yes ☐ No ☐ Not Applicable

Not Applicable

Are method blank surrogate recoveries outside of limits upon reanalysis? Yes ☐ No ☑ ~~Not Applic~~ KAL 8/4/98

KAL 8/4/98

Are transcription/calculation errors present? Yes ☐ No ☑

If yes, note necessary corrections. _____

_____

_____

_____

_____

Reviewed By: Kevin A Lambert 8/4/98

Date:

ORGANIC DATA ASSESSMENT SUMMARY FORM
(Data Verification/Validation Level 3 DV-3)

10.0 INTERNAL STANDARDS EVALUATION

List below the internal standard areas of samples or blanks which did not meet criteria.

Date	Sample ID	Internal Out	Acceptable Range	Action
		Met Criteria		

Are retention times of the internal standards within 30 seconds of the associated calibration standard?
Yes ☑ No ☐

11.0 TARGET COMPOUND LIST ANALYTES
11.1 GC/MS Analyses

Are the reconstructed ion chromatograms, the mass spectra for the identified compounds, and the data system printouts included? Yes ☑ No ☐

Is chromatographic performance acceptable with respect to:

Baseline stability? Yes ☑ No ☐

Resolution? Yes ☑ No ☐

Peak shape? Yes ☑ No ☐

Full-scale graph (attenuation)? Yes ☑ No ☐

Reviewed By: Kevin A Lambert
Date: 8/4/98

ORGANIC DATA ASSESSMENT SUMMARY FORM
(Data Verification/Validation Level 3 DV-3)

Other: _____

Is the RRT of each reported compound within the limits given in the method of the standard RRT in the continuing calibration? Yes ☑ No ☐

Are all the ions present in the standard mass spectrum at a relative intensity greater than 10% also present in the mass spectrum? Yes ☑ No ☐

Do sample and standard relative intensities agree within 20%? Yes ☑ No ☐

If no for any of the above, indicate below problems and qualifications made to data:

_____

_____

_____

11.2 GC Analyses Not Applicable

Are there any transcription/calculation errors between the raw data and the reporting forms?
Yes ☐ No ☐

If yes, review errors and necessary corrections below; if errors are large, resubmittal of laboratory package may be necessary.

_____

_____

_____

Are retention times of sample compounds within the calculated retention time windows for both quantitation and confirmation analysis? Yes ☐ No ☐

Was GC/MS confirmation performed when required by the EPA method? Yes ☐ No ☐

If no for any of the above, reject positive results except for retention time windows if associated standard compounds are similarly shifted.

Reviewed By: Kevin A Lambert
Date: 8/4/98

ORGANIC DATA ASSESSMENT SUMMARY FORM
(Data Verification/Validation Level 3 DV-3)

13.1 Chromatogram Quality

Were baselines stable? Yes ☑ No ☐

Were any negative peaks or unusual peaks present? Yes ☐ No ☑

Were early eluting peaks resolved to baseline? Yes ☑ No ☐

If incorrect quantitations are evident, note corrections necessary below: _____

_____

_____

Are the required quantitation limits (detection limits) adjusted to reflect sample dilutions and for soils, sample moisture? Yes ☑ No ☐

If no, make necessary corrections and note below.

_____

_____

_____

14.0 TENTATIVELY IDENTIFIED COMPOUNDS Not Applicable

Are Tentatively Identified Compounds (TIC) properly identified with scan number or retention time, estimated concentration, and J qualifier? Yes ☐ No ☐

Are the mass spectra for TICs and associated "best match" spectra included? Yes ☐ No ☐

Are any TCL compounds listed as TIC compounds? Yes ☐ No ☐

Are each of the ions present in the reference mass spectra with a relative intensity greater than 10% also present in the sample mass spectrum? Yes ☐ No ☐

Reviewed By: Kevin A Lambert
Date: 8/4/98

SAMPLE FINDINGS SUMMARY

Site: ST & DF

AR/COC: 600396 Data Classification: Inorganic

Sample Fraction No.	Analysis	DV Qualifiers	Comments
No data is qualified			
Data is acceptable			
QC measures are adequate			

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

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

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

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

Test Methods - Anions_CE, EPA6010, EPA6020, EPA7470'I, EPA8015B, EPA8081, EPA8260, EPA8260-M3, EPA8270, HACH_ALK, HACH_NO2, HACH_NO3, MEKC_HE, PCBRISC

Reviewed by: Kevin A Lambert Date: 8/4/98

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

SITE OR PROJECT 5T4DF
CASE NO. 7223.2300
ANALYTICAL LABORATORY GEL
SAMPLE IDS
LABORATORY REPORT # 9806828
ER-1295-6631-BH1-6-11-SD
~~TASK LEADER~~ ARCOC# 600396
NO. OF SAMPLES 1 soil

DATA ASSESSMENT SUMMARY

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

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

KHL 8/4/98
~~ACTION ITEMS:~~ ① All samples were prepared and analyzed with accepted procedures and specified methods. All compounds were successfully analyzed. No Major/minor problems
KHL 8/4/98
~~AREAS OF CONCERN:~~ were identified during data package review.
② Calibration met acceptance criteria. No target analytes were detected in the MB. LCS/LCSD met

REVIEWED BY: Kim A Lambert
DATE REVIEWED: 8/4/98

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

1.0 HOLDING TIMES

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

Parameter	Holding Time Criteria	Sample ID	Days Holding Time was Exceeded	Action

SEE CVR FORM

Were the correct preservatives used? Yes ☐ No ☐

List below samples that were incorrectly preserved.

Sample No.	Type of Samples	Deficiency	Action

Reviewed By: Kevin A Lambert Date: 8/4/98

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

3.2 Method Blank

Was one method blank analyzed for:

Each of 20 samples? Yes ☑ No ☐
Each digestion batch? Yes ☑ No ☐
Each matrix type? Yes ☑ No ☐
Both AA and ICP when both are used for the same analyte? Yes ☐ No ☐ Not Applicable
or
At the frequency indicated in the EPA method or QAPjP? Yes ☑ No ☐

NOTE: Method blank is the same as the calibration blank for mercury and for wet chemistry analysis.

List analytes detected in method blank samples below. NOTE: For soil samples, be sure to calculate blank values using digestion weights and volumes.

Preparation Date	Analyte	Conc.	Required Detection Limits	Action Level	Samples Affected

No Target Analytes were detected

Is concentration in the method blank below the detection limit? Yes ☑ No ☐

Affected samples: _____

_____

_____

Reviewed By: Kevin A Lambert Date: 8/4/98

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

3.3 Field/Rinse/Equipment Blanks

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

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

Collection Date	Blank ID	Analyte	Conc.	Required Detection Limits	Action Level	Samples Affected
			Not submitted on AR COC			

4.0 ICP INTERFERENCE CHECK SAMPLE ANALYSIS

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

Samples affected: _____

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

If no, is the concentration of Al, Ca, Fe, or Mg lower than in ICS? Yes ☐ No ☐ Not Applicable

Reviewed By: Kevin A Lambert Date: Kevin A Lambert 8/4/98
KAL 8/4/98

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

List below any LCS recoveries not within limits.

Preparation Date	Analyte	%R	Action	Samples Affected
			Met Criteria	

6.0 LABORATORY DUPLICATE ANALYSIS

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

Samples affected: _____

_____

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

Samples affected: _____

_____

_____

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

Samples affected: _____

_____

_____

Reviewed By: Kevin A Lambert Date: 8/4/98

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

Samples affected: _____

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

Sample ID	Matrix	Collection Date	RPD	Control Limit	Action	Samples Affected
				Not Submitted on ARCOC		

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

8.0 MATRIX SPIKE ANALYSIS

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

Was a matrix spike prepared and analyzed at the required frequency? Yes ☐ No ☑ Not run on ARCOC group, however MS/MSD from another ARCOC group met acceptance criteria

Reviewed By: Kevin A Lambert Date: 8/4/98

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

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

9.0 FURNACE ATOMIC ABSORPTION ANALYSIS

Not Applicable

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

Samples affected: _____

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

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

Samples affected: _____

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

Samples affected: _____

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

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

Reviewed By: Kevin A Lambert Date: 8/4/98

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

11.0 SAMPLE RESULT VERIFICATION

11.1 Verification of Instrumental Parameters

Are instrument detection limits present and verified on a quarterly basis? Yes ☐ No ☐ Not Applicable

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

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

Samples affected: _____

_____

_____

Are ICP Interelement Correction Factors established and verified annually? Yes ☐ No ☐ Not Applicable

Are ICP Linear Ranges established and verified quarterly? Yes ☐ No ☐ Not Applicable

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

_____

_____

11.2 Reporting Requirements

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

If no, indicate necessary corrections. _____

_____

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

Were sample weights, volumes, and dilutions taken into account when reporting sample results and detection limits? Yes ☑ No ☐

Reviewed By: Kevin A Lambert Date: 8/4/98

SAMPLE FINDINGS SUMMARY

Site: Non-ER Spatz Systems

AR/COC: 60262 Data Classification: Organic

Sample/ Fraction No.	Analysis	DV Qualifiers	Comments
	No qualifications applied		

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: [redacted] Date: 11/2/99

SAMPLE FINDINGS SUMMARY

Site: Non-ER Sparta Systems

AR/COC: 602762 Data Classification: General Chemistry

Sample/ Fraction No.	Analysis	DV Qualifiers	Comments
B6620-SP1-EB-Cr6	hexavalent chromium 18540-29-9	UJB	exceeded hold time

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: 11/2/99

DATA VALIDATION SUMMARY:

SITE/PROJECT: Navy ER Spot CASE #: 7223.230 # OF SAMPLES: 28 MATRIX: Soil
ARCOC #: 002262 LAB SAMPLE IDs: 9908768-01 thru -16
LABORATORY: Enfl -22 thru -28
LABORATORY REPORT #: 9908768

ANALYSIS/ QC ELEMENT	VOC	SVOC	PEST/ PCB	HPLC (UV)	ICP/AES	GFAA/ AA	CVAA (Hg)	GC	RAD	OTHER
1. HOLDING TIMES/ PRESERVATION	✓		✓					✓		✓
2. CALIBRATIONS	✓		✓					✓		✓
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	—		✓					✓		✓

CC 67

CHECK MARK (✓) – ACCEPTABLE
J – ESTIMATED
U – NOT DETECTED
SHADED CELLS – NOT APPLICABLE
UJ – NOT DETECTED, ESTIMATED
R – UNUSABLE

REVIEWED BY: _____ DATE: 11/6/99

DATA VALIDATION SUMMARY:

SITE/PROJECT: Nav. ER Spill CASE #: 7223.230
ARCOC #: 602762
LABORATORY: CEL
LABORATORY REPORT #: 9908768

OF SAMPLES: 5 MATRIX: aqueous
LAB SAMPLE IDs: 9908768 17, -18, -19, -20, -21

ANALYSIS/ QC ELEMENT	VOC	SVOC	PEST/ PCB	HPLC (HE)	ICP/AES	GFAA/ AA	CVAA (Hg)	CN	RAD	Cr+6 OTHER
1. HOLDING TIMES/ PRESERVATION	✓		✓					✓		UJ2
2. CALIBRATIONS	✓		✓					✓		✓
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	—		—					J		✓

CHECK MARK (✓) – ACCEPTABLE
J – ESTIMATED
U – NOT DETECTED
SHADED CELLS – NOT APPLICABLE
UJ – NOT DETECTED, ESTIMATED
R – UNUSABLE

REVIEWED BY: _____ DATE: 11/2/99

HOLDING ..ME/PRESERVATION:

SITE/PROJECT: Non-ER Septic ARCOC #: 602762
LABORATORY: CEL LABORATORY REPORT #: 9908768

Sample ID	Analysis	Holding Time Criteria	Days Holding Time was Exceeded	Preservation Criteria	Preservation Deficiency	Comments
B6620-SP1-EB-Cr6	Cr6+	24hrs	1 day			UB2

Comments:

REVIEWED BY: _____ DATE: ~~10/~~ 11/2/99

Memorandum

Date: 11/02/99

To: File

From: Marcia Hilchey

Subject: Organic Data Review and Validation
Site: Non-ER Septic Systems
AR/COC: 602762
Case: 7223.230
Laboratory: GEL
SDG: 9908768

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 EPA8270, PCB EPA8082). All compounds were successfully analyzed.

No qualifications were applied to VOC sample data.

No qualifications were applied to PCB sample data.

Holding Times

The samples were analyzed within the prescribed holding times, with the exception of the analysis of the re-extracted PCB equipment blank. Since the original sample results were reported, no holding-time qualifications were applied.

Calibration

Initial calibration met acceptance criteria for both methods.

Several VOC analytes failed to meet CCV acceptance criteria. All exhibited less than 40%D, therefore no sample results were qualified.

According to the laboratory case narrative, several PCB analytes failed to meet CCV acceptance criteria. The method states that only Aroclors 1016 and 1260 must be present in the CCV standard. Aroclors 1016 and 1260 met CCV acceptance criteria, therefore no sample results were qualified.

Blanks

No target analytes were detected above the reporting limit in the method blanks, equipment blanks, or VOC *trip blank*.

Surrogates

All VOC surrogate recoveries met acceptance criteria.

Surrogate recovery for the PCB equipment blank (sample B6620-SP1-EB-PCB) was unacceptable. The sample was reextracted and reanalyzed with acceptable surrogate recovery and identical target analyte results (all non-detect). The re-extracted sample analysis exceeded the prescribed holding time. Since all sample results were non-detect, the original results were reported, and no qualifications were applied.

Note: The laboratory stated that the original results were reported for B6620-SP1-EB-PCB (see previous paragraph), however, the reported analysis date and surrogate recovery were incorrect. The reported analysis date and surrogate recovery actually correspond to the reanalysis. Data quality is unaffected

Matrix Spike/Matrix Spike Duplicates (MS/MSD)

Matrix spike sample analysis for soil VOC and PCB samples met acceptance criteria.

No aqueous MS/MSD samples were submitted with this SDG. No sample results were qualified.

Internal Standards

The VOC internal standards met QC acceptance criteria.

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

LCS/LCSD samples met all acceptance criteria.

Other QC

No field duplicate samples were submitted for VOC analysis.

The PCB field duplicate sample analysis met RPD acceptance criteria.

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.

PCBs:
SW846 - Method 8082

SITE/PROJECT: NAEK Septic ARCOC #: 602762
LABORATORY: CEL LABORATORY REPORT #: 9908768

n/a

Name	CAS #	Intercept	Calib RSD / R^2	CCV RPD	Method Blks	LCS	LCSD	LCS RPD	MS	MSD	MS RPD	Field Dup RPD	Eq. Blks	Field Blks			
			<20% / 0.99	<20%				20%			20%						
PCBs																	
Aroclor-1016	12674-11-2	✓	✓	✓	✓							✓	✓				
Aroclor-1221	11104-28-2																
Aroclor-1232	1114-16-5																
Aroclor-1242	53469-21-9																
Aroclor-1248	12672-29-6																
Aroclor-1254	11097-69-1					✓	✓										
Aroclor-1260	11096-82-5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				

Sample	SMC % REC	SMC RT		Sample	SMC % REC	SMC RT
		e/c				

Confirmation

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

Comments:

REVIEWED BY: _____ DATE: 11/2/99

VOLATILE ORGANICS: Page 1 of 2
SW-846 - Method 8260

SITE/PROJECT: Non-ER Septic ARCOC #: 602762
LABORATORY: CEC LABORATORY REPORT #: 9908768

IS	GC/MS		Min RF	Intercept	Calib RF	Calib RSD / R^2	CCV %D	Method Blks	LCS	LCSD	LCS RPD	MS	MSD	MS RPD	Field Dup RPD	Eq. Blks	Trip Blks	TAL	8/25 CC	8/23 CC
	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																	
1	methylene chloride (10xblk)	75-09-2	0.01																	
1	acetone (10xblk)	67-64-1	0.01																	
1	carbon disulfide	75-15-0	0.10																	
1	1,1-dichloroethene	75-35-4	0.20																	
1	1,1-dichloroethane	75-34-3	0.10																	
1	Chloroform	67-66-3	0.20																	
1	1,2-dichloroethane	107-06-2	0.10																	
1	2-butanone (10xblk)	78-93-3	0.01																	
2	1,1,1-trichloroethane	71-55-6	0.10																	
2	carbon tetrachloride	56-23-5	0.10																	
2	Bromodichloromethane	75-27-4	0.20																	
2	1,2-dichloropropane	78-87-5	0.01																	
2	cis-1,3-dichloropropene	10061-01-5	0.20																	
2	Trichloroethene	79-01-6	0.10																	
2	Dibromochloromethane	124-48-1	0.10																	
2	1,1,2-trichloroethane	79-00-5	0.10																	
2	Benzene	71-43-2	0.10																	
2	trans-1,3-dichloropropene	10061-02-6	0.10																	
2	Bromoform	75-25-2	0.10																	
3	4-methyl-2-pentanone	108-10-1	0.10																	
3	2-hexanone	591-78-6	0.01																	
3	Tetrachloroethene	127-18-4	0.20																	
3	1,1,2,2-tetrachloroethane	79-34-5	0.30																	
3	toluene (10xblk)	108-88-3	0.40																	
3	Chlorobenzene	108-90-7	0.10																	
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																		
	Vinyl acetate			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓

Comments:

REVIEWED BY _____ DATE: 11/2/99

VOLATILE ORGANICS: Page 2 of 2
SW-846 - Method 8260

SITE/PROJECT: _____ ARCOC #: 60276
LABORATORY: _____ LABORATORY REPORT #: _____

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:

Memorandum

Date: 11/02/99

To: File

From: Marcia Hilchey

Subject: *General Chemistry Data Review and Validation*
Site: Non-ER Septic Systems
AR/COC: 602762
Case: 7223.230
Laboratory: GEL
SDG: 9908768

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 (total cyanide EPA9012, hexavalent Cr EPA7196). All components were successfully analyzed.

No qualifications were applied to CN sample results.

Qualification was applied to a Cr6+ sample result due to exceeded holding time.

Holding Times

The CN samples were analyzed within the prescribed holding time.

The Cr6+ equipment blank sample was received and analyzed 1 day after the prescribed 24hr. holding time. Sample results were UJ2 qualified.

Calibration

Initial and continuing calibrations met QC acceptance criteria.

Blanks

The method blanks and equipment blanks were free of target analytes above reporting limits.

Matrix Spike Analysis

The matrix spike sample analyses met QC acceptance criteria.

Laboratory Control/Laboratory Control Duplicate Samples

The LCS/LCSD samples met QC acceptance criteria.

Laboratory Replicate Analysis

The replicate sample analyses met QC acceptance criteria.

Other QC

Field duplicate soil sample analyses met RPD acceptance criteria.

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.

GENERAL CHEMISTRY:

SITE/PROJECT: Non-ER Septic ARCOC #: 602762
LABORATORY: CEL LABORATORY REPORT #: 9908768
METHODS: CN, Cr6+

QC/ Analyte	CAS #	ICV	CCV	ICB	CCB	Method Blanks	LCS	LCSD	LCSD RPD	MS	MSD	MSD RPD	REP RPD	Serial Dilution	Field Dup RPD	Equip. Blks	Field Blks			
Total Cyanide		✓	✓	n/a	n/a	✓	✓	✓	✓	✓	n/a	n/a	✓	n/a	✓	✓	n/a			
Cr 6+	18540-29-9	✓	✓	"	"	✓	✓	✓	✓	✓	"	"	✓	" ✓	✓	✓	"			

Comments:

REVIEWED BY: _____ DATE: 10 11/2/99

ORIGINAL

Analysis Request And Chain Of Custody (Continuation)

AR/COC- 602762

Project Name: Non-ER Septic Systems	Project/Task Manager: Mike Sanders				Case No. 72455									
Location	Tech Area				Reference LOV (available at SMO)									Lab use
Building	Room													
Sample No- Fraction	ER Sample ID or Sample Location detail	Depth in Ft	ER Site No.	Date/Time Collected	Sample Matrix	Container Type	Container Volume	Preservative	Sample Collection Methods	Sample Type	Parameter & Method Requested	Lab Sample ID
048373-001	BG620-SPI-BH1-14-5	14 Ft	N/A	081199 0926	S		0926	4C	GR	SA	VOC	
048374-002	BG620-SPI-BH1-14-5	14 Ft	N/A	081199 0955	S	AG	250 ml	4C	GR	SA	PCB, CN, Cr6+	
048375-001	BG620-SPI-BH1-14-5	14 Ft	N/A	081199 1023	S	AG	125 ml	4C	GR	SA	VOC	
048376-002	BG620-SPI-BH1-14-5	14 Ft	N/A	081199 1029	S	AG	250 ml	4C	GR	SA	PCB, CN, Cr6+	
048377-002	BG620-SPI-BH1-14-5	14 Ft	N/A	081199 0956	S	AG	250 ml	4C	GR	SA	PCB, CN, Cr6+	
048378-002	BG620-SPI-BH1-14-5	14 Ft	N/A	081199 0957	S	AG	250 ml	4C	GR	SA	PCB, CN, Cr6+	
048379-003	BG620-SPI-EB-CN	N/A	N/A	081199 1046	DIW	P	4 L	NaOH	GR	EB[1]	total CN	
048380-005	BG620-SPI-EB-Cr6	N/A	N/A	081199 1046	DIW	P	500 ml	4C	GR	EB[1]	Cr6+	
048381-005	BG620-SPI-EB-PCB	N/A	N/A	081199 1047	DIW	AG	1 L	4C	GR[19]	EB	PCB	
048382-005	BG620-SPI-EB	N/A	N/A	081199 1048	DIW	G	3x40 ml	HCl	GR[20]	EB	VOC	
048383-006	BG620-SPI-TB	N/A	N/A	081199 1049	N/A	G	3x40 ml	HCl	GR[21]	TB	VOC	
048384-001	BG621-DPI-BH3-7-5	7 Ft	N/A	081199 1355	S	AG	125 ml	4C	GR[22]	SA	VOC	
048385-002	BG621-DPI-BH3-7-5	7 Ft	N/A	081199 1355	S	AG	250 ml	4C	GR[23]	SA	PCB, CN, Cr6+	
048386-001	BG621-DPI-BH3-12-5	12 Ft	N/A	081199 1405	S	AG	125 ml	4C	GR[24]	SA	VOC	
048387-002	BG621-DPI-BH3-12-5	12 Ft	N/A	081199 1405	S	AG	250 ml	4C	GR[25]	SA	PCB, CN, Cr6+	
048388-001	BG621-DPI-BH2-7-5	7 Ft	N/A	081199 1450	S	AG	125 ml	4C	GR[26]	SA	VOC	
048389-002	BG621-DPI-BH2-7-5	7 Ft	N/A	081199 1450	S	AG	250 ml	4C	GR[27]	SA	PCB CN Cr6+	
048390-001	BG621-DPI-BH2-12-5	12 Ft	N/A	081199 1517	S	AG	125 ml	4C	GR[28]	SA	VOC	
048391-002	BG621-DPI-BH2-12-5	12 Ft	N/A	081199 1517	S	AG	250 ml	4C	GR[29]	SA	PCB CN Cr6+	
048392-001	BG621-DPI-BH1-7-5	7 Ft	N/A	081199 1536	S	AG	125 ml	4C	GR[30]	SA	VOC	

[redacted]

samples 048362

EB samples 048393 > 048389

ORIGINAL

Internal Lab

ANALYSIS REQUEST AND CHAIN OF CUSTODY

Page 1 of 3

AR/COC 602762

Batch No. SAR/WR No. SMO Use

Dept. No./Mail Stop:	8135/1147	[redacted]	Contract No.: AJ-2468A
Project/Task Manager:	NON-ER Septic Syst/M Sanders		Case No.: 7223.230
Project Name:	Non-ER Septic Systems	Lab Contact: E Kent 803 556 8171	SMO Authorization:
Record Center Code:	ER/1295/DAT	Lab Destination: GEL	Bill To: Sandia National Laboratories
Logbook Ref. No.:		SMO Contact/Phone: D Salmi 844-3118	Supplier Services Dept.:
Service Order No.	CF 0888	Send Report to SMO: S Jensen 844-3184	P.O. Box 5800 MS 0154
Location	Tech Area		
Building	Room		

ORIGINAL

9909768 Lab Use

Reference LOV(available at SMO)

Sample No.-Fraction	ER Sample ID or Sample Location Detail	Beginning Depth/ft.	ER Site No.	Date/Time Collected	Sample Matrix	Container Type	Container Volume	Preservative	Collection Method	Sample Type	Parameter & Method Requested	Lab Sample ID
048363-002	B6750-DFI-BH1-5-5	5 Ft	N/A	081799 1105	S	G	500ml	4C	GR 1	SA	PCB CN Cr6+	[redacted]
048364-002	B6750-DFI-BH-10-5	10 Ft	N/A	081799 1107	S	G	500 ml	4C	GR 2	SA	PCB CN Cr6+	
048365-002	B6750-DFI-BH2-5-5	5 Ft	N/A	081799 1125	S	G	500 ml	4C	GR 3	SA	PCB CN Cr6+	
048366-002	B6750-DFI-BH2-10-5	10 Ft	N/A	081799 1129	S	G	500ml	4C	GR 4	SA	PCB CN Cr6+	
048367-002	B6750-DFI-BH3-5-5	5 Ft	N/A	081799 1310	S	AG	250ml	4C	GR 5	SA	PCB, CN Cr6+	
048368-002	B6620-DFI-BH1-10-5	10 Ft	N/A	081799 1327	S	AG	250ml	4C	GR 6	SA	PCB CN Cr6+	
048369-002	B6620-DFI-BH2-5-5	5 Ft	N/A	081799 1338	S	AG	250ml	4C	GR 7	SA	PCB CN Cr6+	
048370-002	B6620-DFI-BH2-10-5	10 Ft	N/A	081799 1430	S	AG	250ml	4C	GR 8	SA	PCB CN Cr6+	
048371-002	B6620-DFI-BH3-5-5	5 Ft	N/A	081799 1503	S	AG	250ml	4C	GR 9	SA	PCB CN Cr6+	
048372-002	B6620-DFI-BH3-10-5	10 Ft	N/A	081799 1520	S	AG	250ml	4C	GR 10	SA	PCB CN Cr6+	

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

Special Instructions/QC Requirements
EDD ☒ Yes ☐ No
Raw Data Package ☒ Yes ☐ No
Send info to Mike Sanders/ VOC (EPA 8260) CN (EPA 9010A) PCB (EPA 8082) Cr6+ (EPA 7196) Please list as separate report
+ VOA TB F... GEL ARRAN... WITH BUSI... INVOICE

	Name	Signature	Init	Company/Organization/Phone
Sample Team Members	Margaret Sanchez			Weston/8118/848-1287
	Gilbert Quintana			IT/8118/238-9417

1. Relinquished by		Org. GEL	Date 8-26-99	Time 0700	4. Relinquished by		Org.	Date	Time
1. Received by	SMO	Org. 7577	Date 8/26/99	Time 0700	4. Received by		Org.	Date	Time
2. Relinquished by		Org. 7577	Date 8/27/99	Time 1130	5. Relinquished by		Org.	Date	Time
2. Received by		Org. GEL	Date 8-28-99	Time 10:30	5. Received by		Org.	Date	Time
3. Relinquished by		Org.	Date	Time	6. Relinquished by		Org.	Date	Time
3. Received by		Org.	Date	Time	6. Received by		Org.	Date	Time

L-11 048363 1327

ORIGINAL

Analysis Request And Chain Of Custody (Continuation)

3 3

Page 1 of 1

AR/COC- 602762

Project Name: Non-ER Bldg & Systems Project/Task Manger: Mike Sanders Case No.

Location Building Sample No- Fraction	Tech Area Room ER Sample ID or Sample Location detail	Depth in Ft.	ER Site No.	Date/Time Collected	Reference LOV (available at SMO) Sample Matrix	Container Type	Container Volume	Preservative	Sample Collection Methods	Sample Type	Parameter & Method Requested	Lab use Lab Sample ID
048338-002	BG741-DR-BH13-5	7 ft	N/A	081399 1537	S	AG	200ml	4C	G-R	SA[1]	PCB CN Cr6+	[redacted]
048338-001	BG741-DR-BH12-5	12 ft	N/A	081799 1542	S	AG	125ml	4C	G-R	SA[1]	VOC	
048338-002	BG741-DR-BH12-25	12 ft	N/A	081799 1552	S	AG	250ml	4C	G-R	SA[1]	PCB CN Cr6+	

[redacted]

ORIGINAL

Contract Verification Review (CVR)

Project Leader A. Roybal | Project Name Non-ER Septic Systems | Case No. 7223.230

AR/COC No. 692762 | Analytical Lab GEL | SDG No. 9908768

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 - date 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				
1.5	Custody records continuous and complete	X				
1.6	Lab sample number(s) provided and SNL sample number(s) cross referenced and correct	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, Replicate)	X				
2.4	Matrix spike/matrix spike duplicate data provided(if requested)	X				
2.5	Detection limits provided; PQL and MDL(or IDL), MDA and L_c	X				
2.6	QC batch numbers provided	X				
2.7	Dilution factors provided and all dilution levels reported	X				
2.8	Data reported in appropriate units and using correct significant figures	X				
2.9	Radiochemistry analysis uncertainty (2 sigma error) and tracer recovery (if applicable) reported	NA				
2.10	Narrative provided	X				
2.11	TAT met		X	Due to hurricane Floyd, GEL was granted several additional days to the TAT.		
2.12	Hold times met	X				
2.13	Contractual qualifiers provided	X				
2.14	All requested result and TIC (if requested) data provided	X				

Contract Verification Review (Continued)

3.0 Data Quality Evaluation

Item	Yes	No	If no, Sample ID No./Fraction(s) and Analysis
3.1 Are reporting units appropriate for the matrix and meet contract specified or project-specific requirements? Inorganics and metals reported as ppm (mg/liter or mg/Kg)? Tritium reported in picocuries per liter with percent moisture for soil samples? Units consistent between QC samples and sample data	X		
3.2 Quantitation limit met for all samples	X		
3.3 Accuracy a) Laboratory control samples accuracy reported and met for all samples	X		
b) Surrogate data reported and met for all organic samples analyzed by a gas chromatography technique	X		
c) Matrix spike recovery data reported and met	X		
3.4 Precision a) Replicate sample precision reported and met for all inorganic and radiochemistry samples	X		
b) Matrix spike duplicate RPD data reported and met for all organic samples	X		
3.5 Blank data a) Method or reagent blank data reported and met for all samples	X		
b) Sampling blank (e.g., field, trip, and equipment) data reported and met	X		
3.6 Contractual qualifiers provided; "J"- estimated quantity; "B"-analyte found in method blank above the MDL for organic or above the PQL for inorganic; "U"- analyte undetected (results are below the MDL, IDL, or MDA (radiochemical)); "H"-analysis done beyond the holding time	X		
3.7 Narrative addresses planchet flaming for gross alpha/beta	NA		
3.8 Narrative included, correct, and complete	X		
3.9 Second column confirmation data provided for methods 8330 (high explosives) and pesticides/PCBs	X		

Contract Verification Review (Continued)

4.0 Calibration and Validation Documentation

Item	Yes	No	Comments
4.1 *GC/MS (8260, 8270, etc.)*			
a) 12-hour tune check provided	X		
b) Initial calibration provided	X		
c) Continuing calibration provided	X		
d) Internal standard performance data provided	X		
e) Instrument run logs provided	X		
4.2 GC/HPLC (8330 and 8010)	NA		
a) Initial calibration provided	NA		
b) Continuing calibration provided	NA		
c) Instrument run logs provided	NA		
4.3 Inorganics (metals)			
a) Initial calibration provided	X		
b) Continuing calibration provided	X		
c) ICP interference check sample data provided	X		
d) ICP serial dilution provided	X		
e) Instrument run logs provided	X		
4.4 *Radiochemistry*			
a) Instrument run logs provided	NA		

Contract Verification Review (Concluded)

6.0 Problem Resolution

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

Sample/Fraction No.	Analysis	Problems/Comments/Resolutions

Were deficiencies unresolved? ☐ 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: _____ Date: 10-6-98 Closed by: _____ Date: _____

April 25, 2000

PAGE DELIBERATELY

NOT SCANNED

Must be viewed at the

Integrated Safety & Security (IS&S)
Records Center

For Assistance Call

844-4688

Contract Verification Review (CVR)

Project Leader A. Roybal | Project Name Non-ER Septic Systems | Case No. 7223.230

AR/COC No. 502762 | Analytical Lab GEL | SDG No. 9908768

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				
1.5	Custody records continuous and complete	X				
1.6	Lab sample number(s) provided and SNL sample number(s) cross referenced and correct	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, Replicate)	X				
2.4	Matrix spike/matrix spike duplicate data provided(if requested)	X				
2.5	Detection limits provided; PQL and MDL(or IDL), MDA and L_c	X				
2.6	QC batch numbers provided	X				
2.7	Dilution factors provided and all dilution levels reported	X				
2.8	Data reported in appropriate units and using correct significant figures	X				
2.9	Radiochemistry analysis uncertainty (2 sigma error) and tracer recovery (if applicable) reported	NA				
2.10	Narrative provided	X				
2.11	TAT met		X	Due to hurricane Floyd, GEL was granted several additional days to the TAT.		
2.12	Hold times met	X				
2.13	Contractual qualifiers provided	X				
2.14	All requested result and TIC (if requested) data provided	X				

Contract Verification Review (Continued)

3.0 Data Quality Evaluation

Item	Yes	No	If no, Sample ID No./Fraction(s) and Analysis
3.1 Are reporting units appropriate for the matrix and meet contract specified or project-specific requirements? Inorganics and metals reported as ppm (mg/liter or mg/Kg)? Tritium reported in picocuries per liter with percent moisture for soil samples? Units consistent between QC samples and sample data	X		
3.2 Quantitation limit met for all samples	X		
3.3 Accuracy a) Laboratory control samples accuracy reported and met for all samples	X		
b) Surrogate data reported and met for all organic samples analyzed by a gas chromatography technique	X		
c) Matrix spike recovery data reported and met	X		
3.4 Precision a) Replicate sample precision reported and met for all inorganic and radiochemistry samples	X		
b) Matrix spike duplicate RPD data reported and met for all organic samples	X		
3.5 Blank data a) Method or reagent blank data reported and met for all samples	X		
b) Sampling blank (e.g., field, trip, and equipment) data reported and met	X		
3.6 Contractual qualifiers provided: "J"- estimated quantity; "B"-analyte found in method blank above the MDL for organic or above the PQL for inorganic; "U"- analyte undetected (results are below the MDL, IDL, or MDA (radiochemical)); "H"-analysis done beyond the holding time	X		
3.7 Narrative addresses planchet flaming for gross alpha/beta	NA		
3.8 Narrative included, correct, and complete	X		
3.9 Second column confirmation data provided for methods 8330 (high explosives) and pesticides/PCBs	X		

Contract Verification Review (Continued)

4.0 Calibration and Validation Documentation

Item	Yes	No	Comments
4.1 GC/MS (8260, 8270, etc.)			
a) 12-hour tune check provided	X		
b) Initial calibration provided	X		
c) Continuing calibration provided	X		
d) Internal standard performance data provided	X		
e) Instrument run logs provided	X		
4.2 GC/HPLC (8330 and 8010)	NA		
a) Initial calibration provided	NA		
b) Continuing calibration provided	NA		
c) Instrument run logs provided	NA		
4.3 Inorganics (metals)			
a) Initial calibration provided	X		
b) Continuing calibration provided	X		
c) ICP interference check sample data provided	X		
d) ICP serial dilution provided	X		
e) Instrument run logs provided	X		
4.4 Radiochemistry			
a) Instrument run logs provided	NA		

Contract Verification Review (Concluded)

5.0 Problem Resolution

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

Sample/Fraction No.	Analysis	Problems/Comments/Resolutions

Were deficiencies unresolved? ☐ 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: _____ Date: 12-6-99 Closed by: _____ Date: _____

ANNEX C
Gore-Sorber™ Passive Soil Vapor Analytical Results

W. L. GORE & ASSOCIATES, INC.

100 CHESAPEAKE BLVD., P.O. BOX 10 • ELKTON, MARYLAND 21922-0010 • PHONE: 410/392-7600
FAX: 410/506-4780

GORE-SORBER® EXPLORATION SURVEY
GORE-SORBER® SCREENING SURVEY

June 6, 2002

Mike Sanders
Sandia National Laboratories
Mail Stop 0719
1515 Eubank, SE
Building 9925, Room 108
Albuquerque, NM 87123

Site Reference: Non-ER Drain & Septic, Kirtland AFB, NM
Gore Production Order Number: 10960025

Dear Mr. Sanders:

Thank you for choosing a GORE-SORBER® Screening Survey.

The attached package consists of the following information (in duplicate):

- **Final report**
- **Chain of custody and analytical data table (included in Appendix A)**
- **Stacked total ion chromatograms (included in Appendix A)**

Please contact our office if you have any questions or comments concerning this report. We appreciate this opportunity to be of service to Sandia National Laboratories, and look forward to working with you again in the future.

Sincerely,
W.L. Gore & Associates, Inc.

Jay W. Hodny, Ph.D.
Associate

Attachments
cc: Andre Brown (W.L. Gore & Associates, Inc.)

I:\MAPPING\PROJECTS\10960025\020606R.DOC

W. L. GORE & ASSOCIATES, INC.

100 CHESAPEAKE BLVD., P.O. BOX 10 • ELKTON, MARYLAND 21922-0010 • PHONE: 410/392-7600
FAX: 410/506-4780

GORE-SORBER® Screening Survey
Final Report

Non-ER Drain & Septic
Kirtland AFB, NM

June 6, 2002

Prepared For:
Sandia National Laboratories
Mail Stop 0719, 1515 Eubank, SE
Albuquerque, NM 87123

W.L. Gore & Associates, Inc.

Written/Submitted by:
Jay W. Hodny, Ph.D., Project Manager

Reviewed/Approved by:
Jim E. Whetzel, Project Manager

Analytical Data Reviewed by:
Jim E. Whetzel, Chemist

I:\MAPPING\PROJECTS\10960025\020606R.DOC

GORE-SORBER® Screening Survey
Final Report

REPORT DATE: June 6, 2002 **AUTHOR:** JWH

SITE INFORMATION

Site Reference: Non-ER Drain & Septic, Kirtland AFB, NM
Customer Purchase Order Number: 28518
Gore Production Order Number: 10960025 **Gore Site Code:** CCT, CCX

FIELD PROCEDURES

 # Modules shipped: 142
Installation Date(s): 4/23,24,25,26,29,30/2002; 5/1,6/2002
 # Modules Installed: 135
Field work performed by: Sandia National Laboratories

Retrieval date(s): 5/8,9,10,14,15,16,21/2002 **Exposure Time:** ~15 **[days]**
 # Modules Retrieved: 131 **# Trip Blanks Returned:** 3
 # Modules Lost in Field: 4 **# Unused Modules Returned:** 3
 # Modules Not Returned: 1

Date/Time Received by Gore: 5/17/2002 @ 2:00 PM; 5/24/2002@1:30PM **By:** MM
Chain of Custody Form attached: √
Chain of Custody discrepancies: None
Comments:
Modules #179227, -228, and -229 were identified as trip blanks.
Modules #179137, -138, -140, and -141 were not retrieved and considered lost from the field.
Module #179231 was not returned.
Modules #179230, 232, and –233 were returned unused.

GORE-SORBER® Screening Survey
Final Report

ANALYTICAL PROCEDURES

W.L. Gore & Associates' Screening Module Laboratory operates under the guidelines of its Quality Assurance Manual, Operating Procedures and Methods. The quality assurance program is consistent with Good Laboratory Practices (GLP) and ISO Guide 25, "General Requirements for the Competence of Calibration and Testing Laboratories", third edition, 1990.

Instrumentation consists of state of the art gas chromatographs equipped with mass selective detectors, coupled with automated thermal desorption units. Sample preparation simply involves cutting the tip off the bottom of the sample module and transferring one or more exposed sorbent containers (sorbers, each containing 40mg of a suitable granular adsorbent) to a thermal desorption tube for analysis. Sorbers remain clean and protected from dirt, soil, and ground water by the insertion/retrieval cord, and require no further sample preparation.

Analytical Method Quality Assurance:
The analytical method employed is a modified EPA method 8260/8270. Before each run sequence, two instrument blanks, a sorber containing 5µg BFB (Bromofluorobenzene), and a method blank are analyzed. The BFB mass spectra must meet the criteria set forth in the method before samples can be analyzed. A method blank and a sorber containing BFB is also analyzed after every 30 samples and/or trip blanks. Standards containing the selected target compounds at three calibration levels of 5, 20, and 50µg are analyzed at the beginning of each run. The criterion for each target compound is less than 35% RSD (relative standard deviation). If this criterion is not met for any target compound, the analyst has the option of generating second- or third-order standard curves, as appropriate. A second-source reference standard, at a level of 10µg per target compound, is analyzed after every ten samples and/or trip blanks, and at the end of the run sequence. Positive identification of target compounds is determined by 1) the presence of the target ion and at least two secondary ions; 2) retention time versus reference standard; and, 3) the analyst's judgment.

NOTE: All data have been archived. Any replicate sorbers not used in the initial analysis will be discarded fifteen (15) days from the date of analysis.

Laboratory analysis: thermal desorption, gas chromatography, mass selective detection
Instrument ID: # 2 **Chemist:** JW
Compounds/mixtures requested: Gore Standard VOC/SVOC Target Compounds (A1)
Deviations from Standard Method: None
Comments: Soil vapor analytes and abbreviations are tabulated in the Data Table Key (page 6).
Module #179091 was returned and noted as damaged, no carbonaceous sorbers; therefore, target compound masses reported in data table cannot be compared to the mass data from the other modules directly.
Module #179101, no identification tag was returned with this module.

GORE-SORBER® Screening Survey
Final Report

DATA TABULATION

 # CONTOUR MAPS ENCLOSED: No contour maps were generated.

NOTE: All data values presented in Appendix A represent masses of compound(s) desorbed from the GORE-SORBER Screening Modules received and analyzed by W.L. Gore & Associates, Inc., as identified in the Chain of Custody (Appendix A). The measurement traceability and instrument performance are reproducible and accurate for the measurement process documented. Semi-quantitation of the compound mass is based on either a single-level (QA Level 1) or three-level (QA Level 2) standard calibration.

General Comments:

- This survey reports soil gas mass levels present in the vapor phase. Vapors are subject to a variety of attenuation factors during migration away from the source concentration to the module. Thus, mass levels reported from the module will often be less than concentrations reported in soil and groundwater matrix data. In most instances, the soil gas masses reported on the modules compare favorably with concentrations reported in the soil or groundwater (e.g., where soil gas levels are reported at greater levels relative to other sampled locations on the site, matrix data should reveal the same pattern, and vice versa). However, due to a variety of factors, a perfect comparison between matrix data and soil gas levels can rarely be achieved.
- Soil gas signals reported by this method cannot be identified specifically to soil adsorbed, groundwater, and/or free-product contamination. The soil gas signal reported from each module can evolve from all of these sources. Differentiation between soil and groundwater contamination can only be achieved with prior knowledge of the site history (i.e., the site is known to have groundwater contamination only).
- QA/QC trip blank modules were provided to document potential exposures that were not part of the soil gas signal of interest (i.e., impact during module shipment, installation and retrieval, and storage). The trip blanks are identically manufactured and packaged soil gas modules to those modules placed in the subsurface. However, the trip blanks remain unopened during all phases of the soil gas survey. Levels reported on the trip blanks may indicate potential impact to modules other than the contaminant source of interest.

GORE-SORBER® Screening Survey
Final Report

- Unresolved peak envelopes (UPEs) are represented as a series of compound peaks clustered together around a central gas chromatograph elution time in the total ion chromatogram. Typically, UPEs are indicative of complex fluid mixtures that are present in the subsurface. UPEs observed early in the chromatogram are considered to indicate the presence of more volatile fluids, while UPEs observed later in the chromatogram may indicate the presence of less volatile fluids. Multiple UPEs may indicate the presence of multiple complex fluids.

Project Specific Comments:

- Stacked total ion chromatograms (TICs) are included in Appendix A. The six-digit serial number of each module is incorporated into the TIC identification (e.g.: 123456S.D represents module #123456).
- No target compounds were detected on the trip blanks and/or the method blanks. Thus, target analyte levels reported for the field-installed modules that exceed trip and method blank levels, and the analyte method detection limit, have a high probability of originating from on-site sources.
- A small subset of modules was placed at each of several site locations; therefore no contour mapping was performed. Larger and more comprehensive soil gas surveys may be warranted at the individual sites where elevated soil gas levels were observed.

GORE-SORBER® Screening Survey
Final Report

KEY TO DATA TABLE
Non-ER Drain & Septic, Kirtland AFB, NM

UNITS

µg	micrograms (per sorber), reported for compounds
MDL	method detection limit
bdl	below detection limit
nd	non-detect

ANALYTES

BTEX	combined masses of benzene, toluene, ethylbenzene and total xylenes (Gasoline Range Aromatics)
BENZ	benzene
TOL	toluene
EtBENZ	ethylbenzene
mpXYL	m-, p-xylene
oXYL	o-xylene
C11,C13&C15	combined masses of undecane, tridecane, and pentadecane (C11+C13+C15) (Diesel Range Alkanes)
UNDEC	undecane
TRIDEC	tridecane
PENTADEC	pentadecane
TMBs	combined masses of 1,3,5-trimethylbenzene and 1,2,4-trimethylbenzene
135TMB	1,3,5-trimethylbenzene
124TMB	1,2,4-trimethylbenzene
ct12DCE	cis- & trans-1,2-dichloroethene
t12DCE	trans-1,2-dichloroethene
c12DCE	cis-1,2-dichloroethene
NAPH&2-MN	combined masses of naphthalene and 2-methyl naphthalene
NAPH	naphthalene
2MeNAPH	2-methyl naphthalene
MTBE	methyl t-butyl ether
11DCA	1,1-dichloroethane
$CHCl_3$	chloroform
111TCA	1,1,1-trichloroethane
12DCA	1,2-dichloroethane
CCl_4	carbon tetrachloride
TCE	trichloroethene
OCT	octane
PCE	tetrachloroethene
ClBENZ	chlorobenzene
14DCB	1,4-dichlorobenzene

BLANKS

TBn	unexposed trip blanks, travels with the exposed modules
method blank	QA/QC module, documents analytical conditions during analysis

APPENDIX A:

1. CHAIN OF CUSTODY
2. DATA TABLE
3. STACKED TOTAL ION CHROMATOGRAMS
4. COLOR CONTOUR MAPS

GORE-SORBER® Screening Survey Chain of Custody

For W.L. Gore & Associates use only
Production Order # 10960025

W. L. Gore & Associates, Inc., Survey Products Group
100 Chesapeake Boulevard • Elkton, Maryland 21921 • Tel: (410) 392-7600 • Fax (410) 506-4780

Instructions: Customer must complete ALL shaded cells

Customer Name: SANDIA NATIONAL LABS	Site Name: NON-ER DRAIN+ SEPTIC
Address: ACCOUNTS PAYABLE MS0154	Site Address: ~~KIVL 2ND~~ AFB, NM KIRTLAND
P.O.BOX 5130	Project Manager: MIKE SANDERS
ALBUQUERQUE NM 87185 U.S.A.	Customer Project No.:
Phone: 505-284-3303	Customer P.O. #: 28518 Quote #: 211946
FAX: 505-284-2616	

Serial # of Modules Shipped				# of Modules for Installation 135 # of Trip Blanks 7		
# 179087 - # 179144	# 179087 - # 179134			Total Modules Shipped: 142 Pieces		
# 179150 - # 179233	# 179135 - # 179136			Total Modules Received: 142 Pieces		
# - #	# 179139 - #			Total Modules Installed: 135 Pieces		
# - #	# 179142 - # 179144			Serial # of Trip Blanks (*Client Decides*)		
- #	# 179150 - # 179151			# 171227	#	#
- #	# - #			#	#	#
- #	# - #			#	#	#
# - #	# - #			#	#	#
# - #	# - #			#	#	#
# - #	# - #			#	#	#
				#	#	#
				#	#	#

Prepared By: Chyrene Tafoya
Verified By: Mary Anne Murphy

Installation Performed By:
Name (*please print*): GILBERT QUINTANA
Company/Affiliation: SNL/NM

Installation Method(s) (*circle those that apply*):
Slide Hammer Hammer Drill Auger
Other: GEOPROBE

Installation Start Date and Time: 4/23/02 1081ST : AM PM
Installation Complete Date and Time: 5/6/02 1094 01 : AM PM

Retrieval Performed By:
Name (*please print*): GILBERT QUINTANA
Company/Affiliation: SNL/NM

Total Modules Retrieved: _____ Pieces
Total Modules Lost in Field: _____ Pieces
Total Unused Modules Returned: _____ Pieces

Retrieval Start Date and Time: 5/8/02 / / : AM PM
Retrieval Complete Date and Time: / / : AM PM

	Date	Time		Date	Time
Relinquished By: [signature] Affiliation: W.L. Gore & Associates, Inc.	5-4-02	12:00	Received By: Mike Sanders Affiliation: Sandia/ER	5-6-02	
Relinquished By: [signature] Affiliation: 6135	5-14-02	12:58	Received By: Affiliation:	Date	Time
Relinquished By: Affiliation	Date	Time	Received By: [signature] Affiliation: W.L. Gore & Associates, Inc.	5/7/02	14:00

GORE-SORBER® Screening Survey Chain of Custody

For W.L. Gore & Associates use only
Production Order # 10960025

W. L. Gore & Associates, Inc., Survey Products Group

100 Chesapeake Boulevard • Elkton, Maryland 21921 • Tel: (410) 392-7600 • Fax (410) 506-4780

Instructions: Customer must complete ALL shaded cells

Customer Name: SANDIA NATIONAL LABS	Site Name: NON-ER DUAIN+ SEPTIC
Address: ACCOUNTS PAYABLE MS0154	Site Address: ~~KTVL 2ND~~ AFB, NM KIRTLAND
P.O.BOX 5130	
ALBUQUERQUE NM 87185 U.S.A.	Project Manager: MIKE SANDERS
Phone: 505-284-3303	Customer Project No.:
FAX: 505-284-2616	Customer P.O. #: 28518 Quote #: 211946

Serial # of Modules Shipped				# of Modules for Installation 135 # of Trip Blanks 7		
# 179087	- # 179144	#179152	- # 179187	Total Modules Shipped: 142 Pieces		
# 179150	- # 179233	#179188	- #179226	Total Modules Received: 142 Pieces		
#	- #	#	- #	Total Modules Installed: 135 Pieces		
#	- #	#	- #	Serial # of Trip Blanks (*Client Decides*)	#	#
	- #	#	- #	#179228	#	#
	- #	#	- #	#179229	#	#
	- #	#	- #	#	#	#
#	- #	#	- #	#	#	#
#	- #	#	- #	#	#	#
#	- #	#	- #	#	#	#
				#	#	#
				#	#	#

Prepared By: Maryanne Mc
Verified By: Mary Anne Meighi

Installation Performed By:	Installation Method(s) (*circle those that apply*):
Name (*please print*): GILBERT QUINTANA	Slide Hammer Hammer Drill Auger
Company/Affiliation: SNL/NM	Other: GEOPROBE
Installation Start Date and Time: 4/23/02 1081ST : AM PM	
Installation Complete Date and Time: 5/6/02 1094O1 : AM PM	
Retrieval Performed By:	Total Modules Retrieved: 79 Pieces
Name (*please print*): GILBERT QUINTANA	Total Modules Lost in Field: 4 Pieces
Company/Affiliation:1 SNL/NM	Total Unused Modules Returned: 53 Pieces
Retrieval Start Date and Time: 5/8/02 / / : AM PM	
Retrieval Complete Date and Time: / / : AM PM	

Relinquished By	Date	Time	Received By: M.Vo. Sanders	Date	Time
Affiliation: W.L. Gore & Associates, Inc.	3-4-02	13:00	Affiliation: Sandia ; 6133	3-7-02	
Relinquished By: William J Zelez	Date	Time	Received By:	Date	Time
Affiliation: Sandia NL ; 6135	5-21-02	0935	Affiliation:		
Relinquished By	Date	Time	Received By: Mary Anne Meighi	Date	Time
Affiliation			Affiliation: W.L. Gore & Associates, Inc.	5-24-02	13:30

GORE-SORBER® Screening Survey
Installation and Retrieval Log

SITE NAME & LOCATION

LINE #	MODULE #	INSTALLATION DATE/TIME	RETRIEVAL DATE/TIME	EVIDENCE OF LIQUID HYDROCARBONS (LPH) or HYDROCARBON ODOR (Check as appropriate)			MODULE IN WATER (check one)		COMMENTS
				LPH	ODOR	NONE	YES	NO	
1.	179087	4/23/02, 0815	05-08-02, 0800					✓	1001/898-GS-5
2.	179088	0822							GS-3
3.	179089	0830							GS-2
4.	179090	0840							GS-1
5.	179091 ✓	0852						✓	GS-4
6.	179092	0952	0830					✓	1052/803-GS-1
7.	179093	1000							-4
8.	179094	1010							-3
9.	179095	1018						✓	-2
10.	179096	1135	0900						1030/6587- -5
11.	179097	1151							-6
12.	179098	1238							-4
13.	179099	1247							-3
14.	179100	1254							-2
15.	179101	1309							-1
16.	179102	1347	0920						1082/6620- -4
17.	179103	1355							-5
18.	179104	1404							-1
19.	179105 ✓	1431							-3
20.	179106	1440							-2
21.	179107	4/24/02, 0848	5-9-02, 0930						1109/6531- -5
22.	179108	0853							-6
23.	179109	0900							-4
24.	179110	0907							-2
25.	179111	0916							-3
26.	179112	0936							-1
27.	179113	4/25/02, 0746	5-10-02, 0812						1027/6530- -5
28.	179114	0754							-2
29.	179115	0800							-3
30.	179116	0810							-4
31.	179117	0818	0917						-1
32.	179118	0915	5-10-02, 0925						1010/6536- 5
33.	179119	0922							6
34.	179120	0931							4
35.	179121	0942							2
36.	179122	0947							1
37.	179123	0956	1002						3
38.	179124	1026	5-10-02, 1013						1028/6560- 1
39.	179125	1043							4
40.	179126	1052							3
41.	179127	1103	1041						2
42.	179128	1420	5-10-02, 1045						1026/6501- 2

GORE-SORBER® Screening Survey Installation and Retrieval Log

SITE NAME & LOCATION

LINE #	MODULE #	INSTALLATION DATE/TIME	RETRIEVAL DATE/TIME	EVIDENCE OF LIQUID HYDROCARBONS (LPH) or HYDROCARBON ODOR (Check as appropriate)			MODULE IN WATER (check one)		COMMENTS	
				LPH	ODOR	NONE	YES	NO		
43.	179129	4/25/02, 1428	5-10-02, 1047						1026/6584-65-	3
44.	179130	1437	5-10-02, 1051						↓	1
45.	179131	1442	5-10-02, 1053						1025/6584-	1
46.	179132	1446	↓							2
47.	179133	↓ 1504	5-10-02, 11:06						↓	3
48.	179134	4/26/02, 0905	5-10-02, 1247						1093/6584-	1
49.	179135	0914	↓ 1254						↓	4
50.	179136	0930	5-10-02, 1305							2
51.	179137	0938	Lost							3
52.	179138	0948	Lost						↓	5
53.	179139	1018	5-10-02, 1322						1031/6600-	2
54.	179140	1026	Lost						↓	3
55.	179141	1030	Lost						↓	4
56.	179142	1038	5-10-02, 1343						↓	1
57.	179143	1136	5-10-02, 11:36						276/829X-	2
[illegible]	179144	1142	↓						↓	3
[illegible]	179150	1150	↓						↓	4
[illegible]0.	179151	↓ 1155	5-10-02, 11:54						↓	1
	179152	4/29/02, 0814	5-14-02, 09:42						1084/6505-	1
62.	179153	0822	↓						↓	5
63.	179154	0829	↓						↓	3
64.	179155	0903	↓						↓	2
65.	179156	0845	5-14-02 ↓ 1032						↓	4
66.	179157	0930	05-14-02 0949						1083/6570-	4
67.	179158	0934	↓						↓	1
68.	179159	0946	↓						↓	2
69.	179160	0948	↓ 0940						↓	3
70.	179161	1050	05-14-02, 1025						1032/6610-	1
71.	179162	1100	↓						↓	2
72.	179163	1110	↓						↓	4
73.	179164	1114	↓						↓	3
74.	179165	1120	↓						↓	5
75.	179166	1126	05-14-02, 11:03						↓	6
76.	179167	1222	05-14-02, 11:06						1120/6643-	2
77.	179168	1230	↓						↓	3
78.	179169	1237	↓						↓	4
79.	179170	1242	05-14-02, 11:32						↓	1
80.	179171	1320	5-14-02 - 0844						1034/6710-	4
[illegible]	179172	1325	↓ 0902						↓	3
82.	179173	1332	↓ 0851						↓	2
83.	179174	1340	↓ 0855						↓	1
[illegible]4.	179175	↓ 1423	5-19-02, 0814						1035/6715- ↓	4

GORE-SORBER® Screening Survey Installation and Retrieval Log

SITE NAME & LOCATION

3. of 4

LINE #	MODULE #	INSTALLATION DATE/TIME	RETRIEVAL DATE/TIME	EVIDENCE OF LIQUID HYDROCARBONS (LPH) or HYDROCARBON ODOR (Check as appropriate)			MODULE IN WATER (check one)		COMMENTS	
				LPH	ODOR	NONE	YES	NO		
85.	179176	4/29/02, 1431							1035/6715-65	-3
86.	179177	1440								2
87.	179178	1445	5-14-02 0837							1
88.	179179	4/30/02, 0910	5-15-02 0842						1003/6715-	3
89.	179180	0919								2
90.	179181	0926								1
91.	179182	0937								4
92.	179183	0943								5
93.	179184	0947	5-15-02, 0917							6
94.	179185	1108	5-15-02, 1146						1007/6730-	4
95.	179186	1113								3
96.	179187	1119								2
97.	179188	1132								5
98.	179189	1140	5-15-02 1213							1
99.	179190	1238	5-15-02 10:09						1029/6584N-	1
100.	179191	1250								-2
	179192	1300								-3
102.	179193	1313								-5
103.	179194	1318	5-15-02, 0932							-4
104.	179195	1445	5-15-02, 1405						1006/6741-	5
105.	179196	1450								3
106.	179197	1455								4
107.	179198	1502								2
108.	179199	1508	5-15-02, 1143							1
109.	179200	1525	5-15-02, 1039						1087/6743-	2
110.	179201	1530								3
111.	179202	1534								4
112.	179203	1540	5-15-02, 1059							1
113.	179204	5/1/02, 0822	5-16-02, 0801						1008/6750	3
114.	179205	0835								4
115.	179206	0843								1
116.	179207	0851	5-16-02, 0832							2
117.	179208	0944	5-16-02, 0841						1004/6568-	2
118.	179209	0952								4
119.	179210	1000								3
120.	179211	1009								5
121.	179212	1016	5-16-02, 0907							1
122.	179213	1110	5-16-02, 1105						1095/9938-	3
123.	179214	1116								2
124.	179215	1122	5-16-02, 1121							1
125.	179216	1205	5-16-02-0931						1094/6582-	2
126.	179217	1218	5-16-02-0935							1

GORE-SORBER® Screening Survey Installation and Retrieval Log

SITE NAME & LOCATION

_____

_____

4 of 4

LINE #	MODULE #	INSTALLATION DATE/TIME	RETRIEVAL DATE/TIME	EVIDENCE OF LIQUID HYDROCARBONS (LPH) or HYDROCARBON ODOR (Check as appropriate)			MODULE IN WATER (check one)		COMMENTS
				LPH	ODOR	NONE	YES	NO	
127.	179218	5/1/02, 1225	5-16-02, 0942						1094/LAR-65-3
128.	179219	1231	5-16-02, 0950						↓ -4
129.	179220	5/6/02, 0850	5-21-01 07:57						1081/6650 -1
130.	179221	0857							-3
131.	179222	0909							-2
132.	179223	0918							-4
133.	179224	0926							-6
134.	179225	0933	↓						-5
135.	179226	↓ 0940	5-21-01, 0851						↓ -7
136.	179227								
137.	179228								
138.	179229								
139.	179230								
140.	179231								
141.	179232								
142.	179233								
143.									
144.									
145.									
146.									
147.									
148.									
149.									
150.									
151.									
152.									
153.									
154.									
155.									
156.									
157.									
158.									
159.									
160.									
161.									
162.									
163.									
164.									
165.									
166.									
167.									
168.									

GORE SORBER SCREE[illegible]RVEY ANALYTICAL RESULTS
SANDIA NATIONAL LABS, ALBUQUERQUE, NM
GORE STANDARD TARGET VOCs/SVOCs (A1)
NON-ER DRAIN AND SEPTIC, KIRTLAND AFB, NM
SITES CCT AND CCX - PRODUCTION ORDER #10960025

DATE ANALYZED	SAMPLE NAME	BTEX, ug	BENZ, ug	TOL, ug	EtBENZ, ug	mpXYL, ug	oXYL, ug	C11, C13, &C15, ug	UNDEC, ug	TRIDEC, ug	PENTADEC, ug	TMBs, ug
	MDL=		0.03	0.02	0.01	0.01	0.01		0.02	0.01	0.02	
5/28/2002	179172	nd	nd	nd	nd	nd	nd	0.05	0.03	0.02	bdl	nd
5/29/2002	179173	0.39	0.09	0.18	nd	0.09	0.03	0.19	0.10	0.04	0.05	0.09
5/29/2002	179174	0.03	nd	nd	nd	0.03	nd	0.00	bdl	bdl	bdl	0.00
5/29/2002	179175	nd	nd	nd	nd	nd	nd	0.05	0.05	bdl	bdl	nd
5/29/2002	179176	0.19	0.08	0.10	nd	0.02	nd	1.20	1.12	0.06	0.03	0.04
5/29/2002	179177	0.34	0.14	0.11	nd	0.07	0.03	0.10	0.08	0.02	bdl	0.14
5/29/2002	179178	0.08	nd	0.05	0.01	0.02	nd	0.14	0.06	0.03	0.05	0.00
5/29/2002	179179	0.03	nd	0.03	nd	nd	nd	0.07	0.03	0.02	0.02	0.04
5/29/2002	179180	nd	nd	nd	nd	nd	nd	0.04	0.02	0.01	bdl	0.00
5/29/2002	179181	0.00	nd	nd	nd	bdl	nd	0.10	0.03	0.02	0.05	0.00
5/29/2002	179182	0.09	nd	0.08	nd	0.01	nd	0.08	0.03	0.02	0.03	0.00
5/29/2002	179183	nd	nd	nd	nd	nd	nd	0.08	0.04	bdl	0.04	0.00
5/29/2002	179184	nd	nd	nd	nd	nd	nd	0.09	0.03	0.02	0.04	0.00
5/29/2002	179185	nd	nd	nd	nd	nd	nd	0.05	bdl	0.01	0.04	nd
5/29/2002	179186	nd	nd	nd	nd	nd	nd	0.05	0.03	bdl	0.03	0.04
5/29/2002	179187	0.60	0.18	0.30	0.03	0.06	0.03	0.15	0.05	0.05	0.05	0.11
5/29/2002	179188	0.02	nd	nd	nd	0.02	nd	0.10	bdl	0.02	0.07	0.00
5/29/2002	179189	0.02	nd	nd	nd	0.02	nd	0.07	0.04	0.03	bdl	0.00
5/29/2002	179190	0.06	nd	0.03	nd	0.03	nd	0.11	0.05	0.03	0.04	0.00
5/29/2002	179191	0.10	nd	0.04	nd	0.05	nd	0.08	0.02	0.01	0.05	0.00
5/29/2002	179192	0.01	nd	nd	nd	0.01	nd	0.11	0.04	0.02	0.05	0.00
5/29/2002	179193	nd	nd	nd	nd	nd	nd	0.07	0.03	0.01	0.02	0.00
5/29/2002	179194	0.04	nd	nd	nd	0.04	nd	0.08	0.04	bdl	0.04	0.00
5/29/2002	179195	0.04	nd	nd	nd	0.04	nd	0.08	0.04	0.02	0.02	0.00
5/29/2002	179196	0.02	nd	nd	nd	0.02	nd	0.09	0.04	0.02	0.03	0.00
5/29/2002	179197	0.03	nd	nd	nd	0.03	nd	0.15	0.05	0.04	0.06	0.04
5/29/2002	179198	0.07	nd	0.04	nd	0.03	nd	0.09	0.04	0.03	0.03	nd
5/29/2002	179199	nd	nd	nd	nd	nd	nd	0.05	0.03	0.01	bdl	0.00
5/29/2002	179200	0.00	nd	nd	nd	bdl	nd	0.08	0.03	0.02	0.03	0.00
5/29/2002	179201	0.02	nd	nd	nd	0.02	nd	0.04	0.04	bdl	bdl	0.00
5/29/2002	179202	0.02	nd	nd	nd	0.02	nd	0.04	0.03	0.01	bdl	0.00
5/29/2002	179203	0.04	nd	0.04	nd	nd	nd	0.06	0.04	0.02	bdl	0.03
5/29/2002	179204	0.27	nd	0.22	nd	0.03	0.02	0.29	0.06	0.14	0.09	0.00
5/29/2002	179205	0.12	nd	0.09	nd	0.03	bdl	1.28	1.13	0.08	0.07	0.03
5/29/2002	179206	nd	nd	nd	nd	nd	nd	0.02	0.02	bdl	bdl	nd
5/29/2002	179207	0.03	nd	nd	nd	0.03	nd	0.04	0.04	bdl	bdl	0.00
5/29/2002	179208	0.06	nd	0.04	nd	0.02	nd	0.09	0.04	0.03	0.03	0.00
5/29/2002	179209	0.07	nd	0.04	nd	0.03	nd	0.01	bdl	0.01	bdl	0.00

No mdl is available for summed combinations of analytes. In summed columns (eg., BTEX), the reported values should be considered ESTIMATED if any of the individual compounds were reported as bdl.

GORE SORBER SCREEI SURVEY ANALYTICAL RESULTS
SANDIA NATIONAL LABS, ALBUQUERQUE, NM
GORE STANDARD TARGET VOCs/SVOCs (A1)
NON-ER DRAIN AND SEPTIC, KIRTLAND AFB, NM
SITES CCT AND CCX - PRODUCTION ORDER #10960025

SAMPLE NAME	124TMB, ug	135TMB, ug	ct12DCE, ug	t12DCE, ug	c12DCE, ug	NAPH&2-MN, ug	NAPH, ug	2MeNAPH, ug	MTBE, ug	11DCA, ug	111TCA, ug	12DCA, ug
MDL=	0.03	0.02		0.14	0.03		0.01	0.02	0.04	0.04	0.02	0.02
179172	nd	nd	nd	nd	nd	0.00	nd	bdl	nd	nd	nd	nd
179173	0.06	0.03	nd	nd	nd	0.09	0.03	0.06	nd	nd	nd	nd
179174	bdl	bdl	nd	nd	nd	0.00	nd	bdl	nd	nd	nd	nd
179175	nd	nd	nd	nd	nd	0.00	nd	bdl	nd	nd	nd	nd
179176	0.04	bdl	nd	nd	nd	0.05	0.02	0.02	nd	nd	nd	nd
179177	0.10	0.04	nd	nd	nd	0.10	0.06	0.04	nd	nd	nd	nd
179178	bdl	bdl	nd	nd	nd	0.06	0.02	0.03	nd	nd	nd	nd
179179	0.04	bdl	nd	nd	nd	0.06	0.02	0.04	nd	nd	nd	nd
179180	bdl	bdl	nd	nd	nd	0.07	0.02	0.05	nd	nd	nd	nd
179181	bdl	bdl	nd	nd	nd	0.00	nd	bdl	nd	nd	nd	nd
179182	bdl	nd	nd	nd	nd	0.00	nd	bdl	nd	nd	nd	nd
179183	bdl	nd	nd	nd	nd	0.00	nd	bdl	nd	nd	nd	nd
179184	bdl	nd	nd	nd	nd	0.00	nd	bdl	nd	nd	nd	nd
179185	nd	nd	nd	nd	nd	0.00	nd	bdl	nd	nd	nd	nd
179186	0.04	nd	nd	nd	nd	0.02	nd	0.02	nd	nd	nd	nd
179187	0.09	0.02	nd	nd	nd	0.05	0.02	0.03	nd	nd	nd	nd
179188	bdl	nd	nd	nd	nd	0.00	nd	bdl	nd	nd	nd	nd
179189	bdl	bdl	nd	nd	nd	0.00	nd	bdl	nd	nd	nd	nd
179190	bdl	bdl	nd	nd	nd	0.07	0.02	0.04	nd	nd	nd	nd
179191	bdl	bdl	nd	nd	nd	0.00	nd	bdl	nd	nd	nd	nd
179192	bdl	nd	nd	nd	nd	0.05	0.02	0.03	nd	nd	nd	nd
179193	bdl	nd	nd	nd	nd	0.00	nd	bdl	nd	nd	nd	nd
179194	bdl	bdl	nd	nd	nd	0.02	0.02	bdl	nd	nd	nd	nd
179195	bdl	bdl	nd	nd	nd	0.10	0.03	0.07	nd	nd	nd	nd
179196	bdl	nd	nd	nd	nd	0.05	0.02	0.02	nd	nd	nd	nd
179197	0.04	bdl	nd	nd	nd	0.11	0.04	0.07	nd	nd	nd	nd
179198	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
179199	bdl	nd	nd	nd	nd	0.00	nd	bdl	nd	nd	nd	nd
179200	bdl	nd	nd	nd	nd	0.02	nd	0.02	nd	nd	nd	nd
179201	bdl	nd	nd	nd	nd	0.00	nd	bdl	nd	nd	nd	nd
179202	bdl	nd	nd	nd	nd	0.00	nd	bdl	nd	nd	nd	nd
179203	0.03	bdl	nd	nd	nd	0.03	0.03	bdl	nd	nd	nd	nd
179204	bdl	nd	nd	nd	nd	0.11	0.04	0.07	nd	nd	bdl	nd
179205	0.03	bdl	nd	nd	nd	0.13	0.05	0.07	nd	nd	0.05	nd
179206	nd	nd	nd	nd	nd	0.03	nd	0.03	nd	nd	0.02	nd
179207	bdl	bdl	nd	nd	nd	0.00	nd	bdl	nd	nd	0.03	nd
179208	bdl	bdl	nd	nd	nd	0.00	nd	bdl	nd	nd	nd	nd
179209	bdl	bdl	nd	nd	nd	0.05	0.02	0.03	nd	nd	nd	nd

5 Site 08

No mdl is available for summed combinations of analytes. In summed columns (eg., BTEX), the reported values should be considered ESTIMATED if any of the individual compounds were reported as bdl.

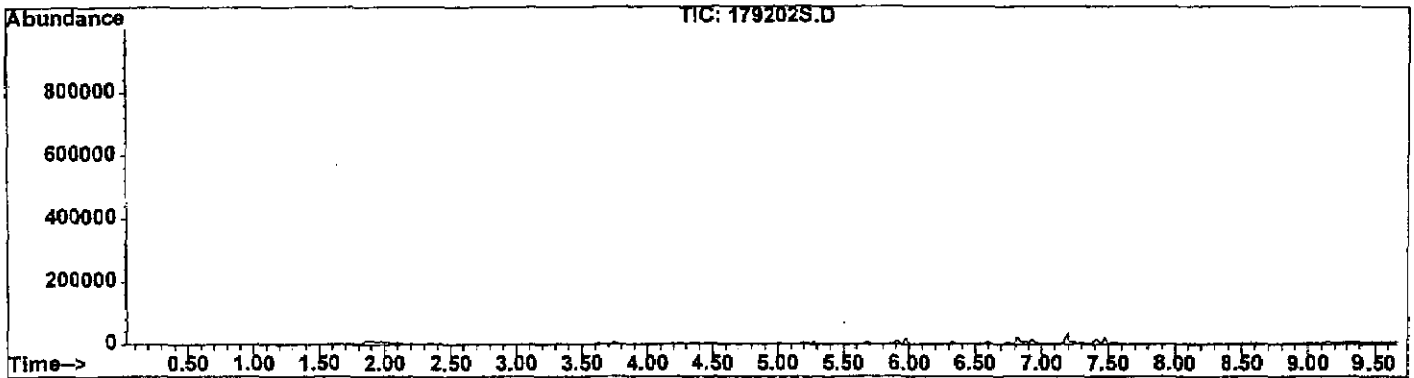
GORE SORBER SCREE[illegible]RVEY ANALYTICAL RESULTS
SANDIA NATIONAL LABS, ALBUQUERQUE, NM
GORE STANDARD TARGET VOCs/SVOCs (A1)
NON-ER DRAIN AND SEPTIC, KIRTLAND AFB, NM
SITES CCT AND CCX - PRODUCTION ORDER #10960025

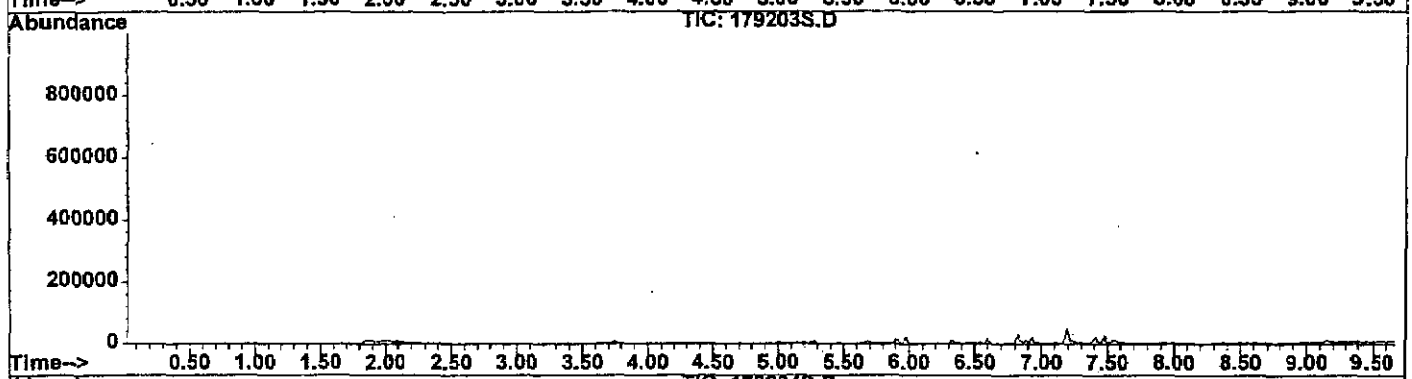
SAMPLE NAME	TCE, ug	OCT, ug	PCE, ug	14DCB, ug	CHCl3, ug	CCl4, ug	ClBENZ, ug
MDL=	0.02	0.02	0.01	0.01	0.03	0.03	0.01
179172	nd	nd	nd	nd	nd	nd	nd
179173	nd	0.14	0.02	nd	nd	nd	nd
179174	nd	nd	nd	nd	nd	nd	nd
179175	nd	nd	0.04	nd	nd	nd	nd
179176	nd	nd	0.03	nd	nd	nd	nd
179177	nd	0.09	0.02	nd	nd	nd	nd
179178	nd	nd	0.01	nd	nd	nd	nd
179179	0.13	nd	0.07	nd	0.05	nd	nd
179180	0.08	nd	0.02	nd	nd	nd	nd
179181	0.11	nd	0.03	nd	nd	nd	nd
179182	0.15	nd	0.04	nd	nd	nd	nd
179183	0.59	nd	0.08	nd	nd	nd	nd
179184	nd	nd	nd	nd	nd	nd	nd
179185	0.06	nd	nd	nd	nd	nd	nd
179186	nd	nd	nd	nd	nd	nd	nd
179187	0.13	nd	0.08	nd	nd	nd	nd
179188	nd	nd	0.11	nd	nd	nd	nd
179189	0.06	nd	0.02	nd	nd	nd	nd
179190	nd	nd	bdl	nd	nd	bdl	nd
179191	nd	nd	0.03	nd	nd	0.03	nd
179192	nd	nd	0.03	nd	nd	nd	nd
179193	nd	nd	0.08	nd	nd	nd	nd
179194	nd	nd	0.04	nd	nd	nd	nd
179195	nd	nd	nd	nd	nd	nd	nd
179196	nd	nd	nd	nd	nd	0.03	nd
179197	nd	nd	nd	nd	nd	bdl	nd
179198	nd	0.09	nd	nd	nd	nd	nd
179199	nd	nd	nd	nd	nd	bdl	nd
179200	nd	nd	0.09	nd	nd	nd	nd
179201	nd	nd	0.12	nd	nd	nd	nd
179202	nd	nd	0.12	nd	nd	nd	nd
179203	nd	nd	0.09	nd	nd	nd	nd
179204	1.49	nd	3.01	nd	nd	nd	nd
179205	4.14	nd	6.74	nd	nd	nd	nd
179206	4.72	nd	2.69	nd	nd	nd	nd
179207	2.89	nd	2.57	nd	nd	nd	nd
179208	nd	nd	nd	nd	0.05	nd	nd
179209	nd	nd	nd	nd	nd	nd	nd

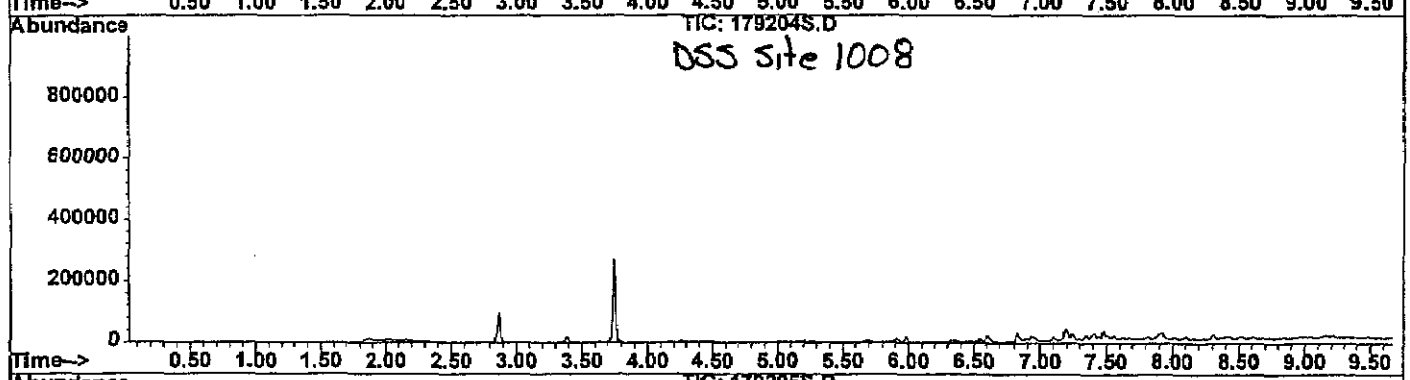
S site
008

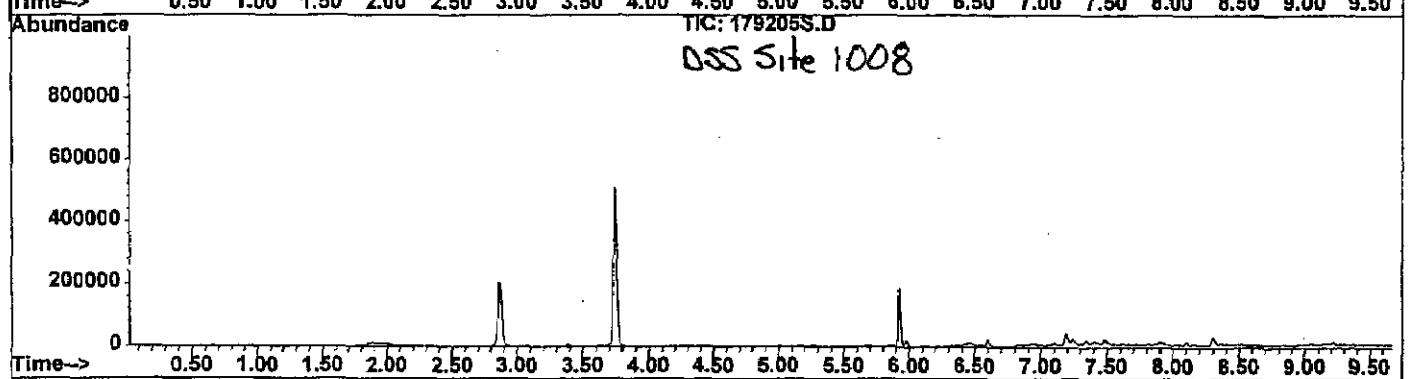
No mdl is available for summed combinations of analytes. In summed columns (eg., BTEX), the reported values should be considered ESTIMATED if any of the individual compounds were reported as bdl.

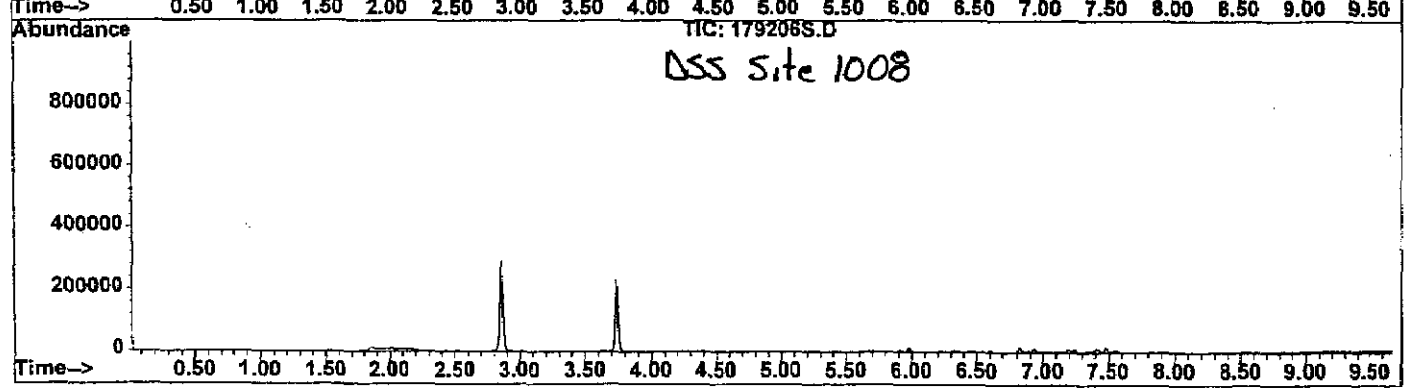
TIC - SITE CCX - PRODUCTION ORDER #10960025
In Numerical Order



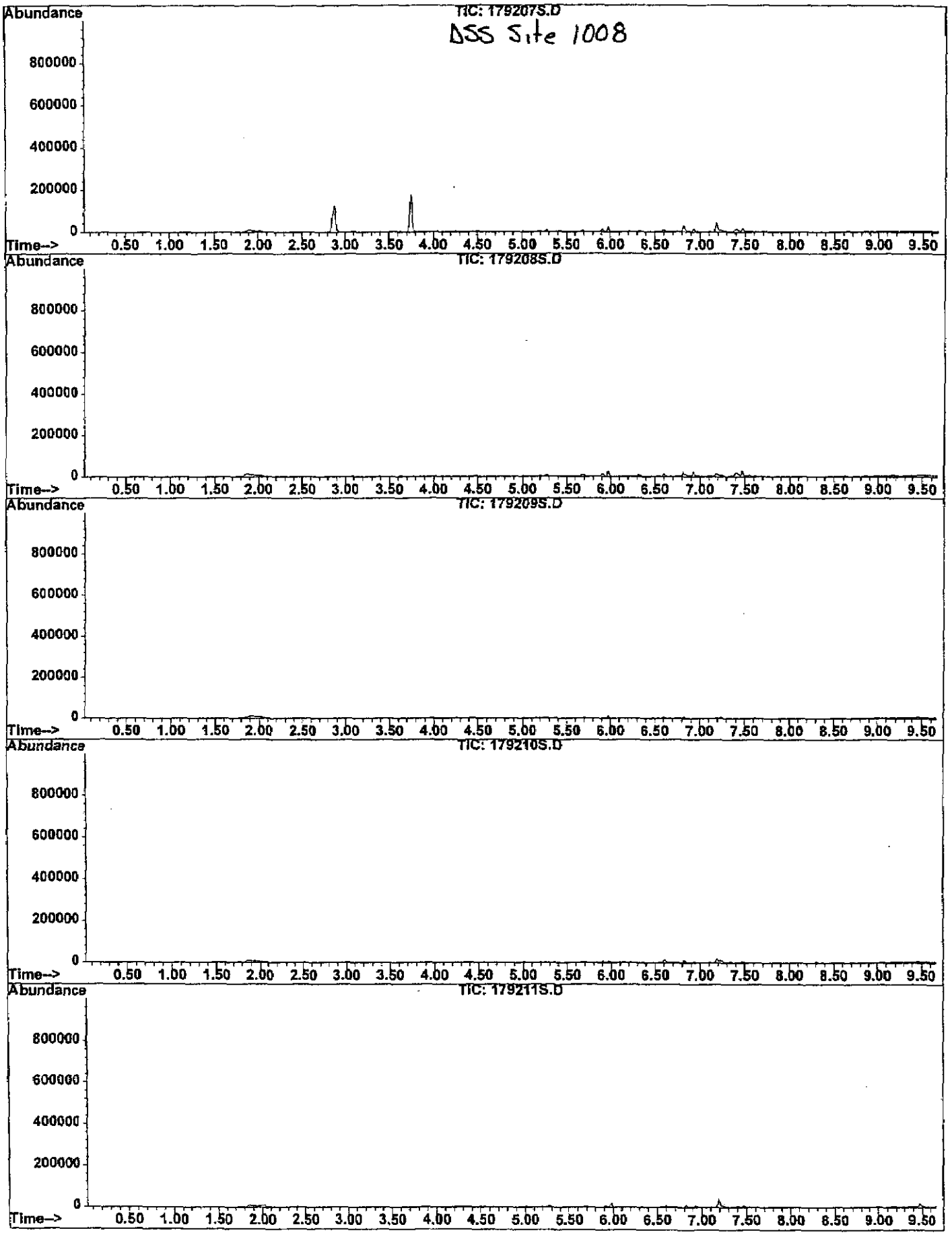








TIC - SITE CCX - PRODUCTION ORDER #10960025
In Numerical Order



ANNEX D
Risk Assessment

TABLE OF CONTENTS

This page intentionally left blank.

LIST OF TABLES

LIST OF TABLES (Concluded)

LIST OF FIGURES

DSS SITE 1008: RISK ASSESSMENT REPORT

I. Site Description and History

Drain and Septic Systems (DSS) Site 1008, Building 6750 Septic System, Operable Unit (OU) 1295, at Sandia National Laboratories/New Mexico (SNL/NM), consists of a 1,000-gallon septic tank flowing to a junction that feeds two drainfield lines approximately 50 feet long. The site is located in the northwestern portion of SNL/NM Technical Area (TA)-III on land that is owned by Kirtland Air Force Base (KAFB) and leased to the U.S. Department of Energy (DOE). Available information indicates that Building 6750 was constructed in 1965 (SNL/NM March 2003); it is assumed that the septic system was also constructed at that time. In January 1994 the septic tank system was disconnected from the building and connected to an extension of the City of Albuquerque (COA) sanitary sewer system.

Environmental concern about DSS Site 1008 is based upon the potential for the release of constituents of concern (COCs) in effluent discharged to the environment via the septic system at this site. Because operational records were not available, the investigation was planned to be consistent with other DSS site investigations and to sample for the most commonly anticipated COCs found at similar test facilities.

No springs or perennial surface water bodies are located within 2 miles of the site. Average annual rainfall in the SNL/NM and KAFB area, as measured at Albuquerque International Sunport is 8.1 inches (NOAA 1990). Surface-water runoff in the vicinity of the site is minor because the surface slope is flat to a gentle incline to the west. During most rainfall events, precipitation quickly infiltrates the soil at DSS Site 1008. However, virtually all the moisture subsequently undergoes evapotranspiration. The estimates of evapotranspiration for the KAFB area range from 95 to 99 percent of the annual rainfall (SNL/NM March 1996). Most of the area immediately surrounding DSS Site 1008 is unpaved with some native vegetation, and no storm sewers are used to direct surface water away from the site.

DSS Site 1008 lies at an average elevation of approximately 5,353 feet above mean sea level. The depth to groundwater is approximately 460 feet below ground surface (bgs). Groundwater flow is believed to be predominantly north-northwest (SNL/NM March 2002). The nearest groundwater monitoring wells are those installed around the Mixed Waste Landfill in the north-northeastern part of TA-III. These wells are located approximately 2,000 feet and 2,285 feet northeast of the site. The nearest production wells are north and northeast of the site and include KAFB-0904 and KAFB-10, which are approximately 2.6 and 1.1 miles away, respectively.

II. Data Quality Objectives

The Data Quality Objectives (DQOs) presented in the "Sampling and Analysis Plan [SAP] for Characterizing and Assessing Potential Releases to the Environment From Septic and Other Miscellaneous Drain Systems at Sandia National Laboratories/New Mexico" (OU 1295 [SAP]) (SNL/NM October 1999) and "Field Implementation Plan [FIP], Characterization of Non-Environmental Restoration Drain and Septic Systems" (OU 1295 FIP) (SNL/NM November 2001) identified the site-specific sample locations, sample depths, sampling procedures, and

analytical requirements for this and many other DSS sites. The DQOs outlined the Quality Assurance (QA)/Quality Control (QC) requirements necessary for producing defensible analytical data suitable for risk-assessment purposes. The baseline sampling conducted at DSS Site 1008 was designed to:

- Determine to the degree possible whether each of the 101 systems included on the 1996 list was still in existence, or had ever actually existed.
- For systems confirmed or believed to exist, determine the exact or apparent locations and components of those systems (septic tanks, drainfields, seepage pits, etc.).
- Identify which systems would, and would not, need initial shallow investigation work as required by NMED.
- For systems requiring characterization, determine the specific types of shallow characterization work (including passive soil-vapor sampling and/or shallow soil borings) that would be required by NMED.

Table 1 summarizes the rationale for determining the sampling locations at this site.

Table 1
Summary of Sampling Performed to Meet DQOs

DSS Site 1008 Sampling Areas	Potential COC Source	Number of Sampling Locations	Sample Density (samples/acre)	Sampling Location Rationale
Soil beneath the septic system drainfield	Effluent discharged to the environment from the drainfield	2	NA	Evaluate potential COC releases to the environment from effluent discharged from the drainfield

COC = Constituent of concern.
DQO = Data quality objective.
DSS = Drain and Septic Systems.
NA = Not applicable.

Soil samples were collected from two depth intervals in each of the two borehole drilled beneath the drainfield at DSS Site 1008. These samples were identified as 6750-DF1-BH-1-5 and -10 and 6750-DF1-BH-2-5 and -10. The samples were collected with a Geoprobe™ drilling rig from two 3-foot-long sampling intervals at each boring location. Drainfield sampling intervals started at 5 and 10 feet bgs in each of the drainfield borings. The soil samples were collected using the same procedures utilized at numerous other OU 1295 sites, and in accordance with procedures described in the OU 1295 SAP and FIP.

Table 2 summarizes the types of confirmatory and QA/QC samples collected at the site, and the laboratories that performed the analyses.

Table 2
Number of Confirmatory Soil and QA/QC Samples Collected from DSS Site 1008

Sample Type	VOCs	SVOCs	PCBs	HE	RCRA Metals	Hexavalent Chromium	Cyanide	Gamma Spectro-scopy Radio-nuclides	Gross Alpha/ Beta Activity
Confirmatory	4	4	4	4	4	4	4	4	4
Duplicates	0	0	0	0	0	0	0	0	0
EBs and TBs (VOCs only)	2	0	0	1	1	0	0	0	0
Total Samples	6	4	4	5	5	4	4	4	4
Analytical Laboratory	ERCL	GEL	GEL	ERCL	ERCL	GEL	GEL	RPSD	GEL

DSS = Drain and Septic Systems.
EB = Equipment blank.
ERCL = Environmental Restoration Chemistry Laboratory.
GEL = General Engineering Laboratories, Inc.
HE = High explosive(s).
PCB = Polychlorinated biphenyl.
RCRA = Resource Conservation and Recovery Act.
RPSD = Radiation Protection Sample Diagnostics Laboratory.
QA = Quality assurance.
QC = Quality control.
SVOC = Semivolatile organic compound.
TB = Trip blank.
VOC = Volatile organic compound.

The DSS Site 1008 baseline soil samples were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), high explosive (HE) compounds, polychlorinated biphenyls (PCBs), Resource Conservation and Recovery Act (RCRA) metals, hexavalent chromium, cyanide, radionuclides, and gross alpha/beta activities. The samples were analyzed by an off-site laboratory (General Engineering Laboratories, Inc. [GEL]), the on-site SNL/NM Environmental Restoration (ER) Chemistry Laboratory, and the SNL/NM Radiation Protection Sample Diagnostics (RPSD) Laboratory. Table 3 summarizes the analytical methods and some of the data quality requirements from the OU 1295 SAP and FIP.

QA/QC samples were collected during the baseline sampling effort according to the ER Project Quality Assurance Project Plan. The QA/QC samples consisted of one trip blank (for VOCs only) and one set of equipment blanks. No significant QA/QC problems were identified in the QA/QC samples.

All of the baseline soil sample results were verified/validated by SNL/NM. The off-site laboratory results from GEL were reviewed 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). The data validation reports are presented in the associated DSS Site 1008 no further action (NFA) proposal. The gamma spectroscopy data from the RPSD Laboratory were reviewed according to "Laboratory Data Review Guidelines," Procedure No. RPSD-02-11, Issue No. 02 (SNL/NM July 1996). The gamma spectroscopy results are presented in the NFA proposal. The reviews confirmed that the analytical data are defensible and acceptable for use in the NFA proposal; therefore, the DQOs have been fulfilled.

Table 3
Summary of Data Quality Requirements

Analytical Requirement[a]	Data Quality Level	GEL	ERCL	RPSD
VOCs EPA Method 8260	Defensible	None	4 samples	None
SVOCs EPA Method 8270	Defensible	4 samples	None	None
PCBs EPA Method 8082	Defensible	4 samples	None	None
HE Compounds EPA Method 8330	Defensible	None	4 samples	None
RCRA metals EPA Method 6020/7000	Defensible	None	4 samples	None
Hexavalent Chromium EPA Method 7196A	Defensible	4 samples	None	None
Total Cyanide EPA Method 9012A	Defensible	4 samples	None	None
Gamma Spectroscopy Radionuclides	Defensible	None	None	4 samples
Gross Alpha/Beta Activity	Defensible	4 samples	None	None

Note: The number of samples does not include QA/QC samples such as duplicates, trip blanks, and equipment blanks
[a]EPA November 1986.
EPA = U.S. Environmental Protection Agency.
ERCL = Environmental Restoration Chemistry Laboratory.
GEL = General Engineering Laboratories, Inc.
HE = High explosive(s).
PCB = Polychlorinated biphenyl.
QA = Quality assurance.
QC = Quality control.
RCRA = Resource Conversation and Recovery Act.
RPSD = Radiation Protection Sample Diagnostics Laboratory.
SVOC = Semivolatile organic compound.
VOC = Volatile organic compound.

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

III.1 Introduction

The determination of the nature, migration rate, and extent of contamination at DSS Site 1008 was based upon an initial conceptual model validated with confirmatory sampling at the site. The initial conceptual model was developed from archival site research, site inspections, soil sampling, and passive soil-vapor sampling. The DQOs contained in the OU 1295 SAP and FIP identified the sample locations, sample density, sample depth, and analytical requirements. The sample data were subsequently used to develop the final conceptual model for DSS Site 1008, which is presented in Section 2.5 of the associated NFA proposal. The quality of the data specifically used to determine the nature, migration rate, and extent of contamination are described below.

III.2 Nature of Contamination

Both the nature of contamination and the potential for the degradation of COCs at DSS Site 1008 were evaluated using laboratory analyses of the soil samples. The analytical requirements included analyses for VOCs, SVOCs, HE compounds, PCBs, RCRA metals, hexavalent chromium, cyanide, radionuclides by gamma spectroscopy, and gross alpha/beta activities. The analytes and methods listed in Tables 2 and 3 are appropriate to characterize the COCs and any potential degradation products at DSS Site 1008.

III.3 Rate of Contaminant Migration

The septic system at DSS Site 1008 was deactivated in January 1994, when Building 6750 was connected to an extension of the COA sanitary sewer system. Therefore, the migration rate of COCs that may have been introduced into the subsurface via the septic system at this site was dependent on the volume of aqueous effluent discharged to the environment from this system when it was operational. Any migration of COCs from this site after use of the septic system was discontinued has been dependent predominantly on precipitation, although it is highly unlikely that sufficient precipitation has fallen on the site to reach the depth at which COCs may have been discharged to the subsurface from this system. Analytical data generated from the soil sampling conducted at the site are adequate to characterize the rate of COC migration at DSS Site 1008.

III.4 Extent of Contamination

Subsurface baseline soil samples were collected from boreholes drilled at two locations beneath the effluent release area (drainfield) at the site to assess whether releases of effluent from the septic system caused any environmental contamination.

The baseline soil samples were collected at sampling depths starting at 5 and 10 feet beneath the drainfield area. Sampling intervals started at the depths at which effluent discharged from the drainfield drain lines would have entered the subsurface environment at the site. This sampling procedure was required by New Mexico Environmental Department (NMED) regulators, and has been used at numerous drain and septic system type of sites at SNL/NM. The baseline soil samples are considered to be representative of the soil potentially contaminated with the COCs at this site, and are sufficient to determine the vertical extent, if any, of COCs.

IV. Comparison of COCs to Background Screening Levels

Site history and characterization activities are used to identify potential COCs. The DSS Site 1008 NFA proposal describes the identification of COCs and the sampling that was conducted in order to determine the concentration levels of those COCs across the site. Generally, COCs that were evaluated in this risk assessment included all detected organic compounds, 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. Nondetected organic compounds 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) was selected to provide the background screen listed in Tables 4 and 5.

Nonradiological inorganic constituents 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 for inclusion in the risk assessment consisted of inorganic and organic compounds. However, only inorganic compounds were included in the risk assessment as all organic compounds were nondetections.

Table 4 lists the nonradiological COCs for the human health and the ecological risk assessments at DSS Site 1008. Table 5 lists radiological COCs for the human health and ecological risk assessments. All tables show the associated SNL/NM maximum background concentration values (Dinwiddie September 1997). Sections VI.4, VII.2 and VII.3 provides discussion of Tables 4 and 5.

V. Fate and Transport

The primary releases of COCs at DSS Site 1008 were to the subsurface soil, resulting from the discharge of waste water from the Building 6750 septic system to the drainfield. Wind, water, and biota are natural mechanisms of COC transport from the primary release point. Because the discharge of waste water was to the subsurface, wind and surface water are considered to be of low significance as transport mechanisms at this site.

Water at DSS Site 1008 is currently received as precipitation (approximately 8.1 inches annually [NOAA 1990]). 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 sandy texture of the soil. However, because it is estimated that 95 to 99 percent of the annual precipitation in this area is lost through evapotranspiration, the depth of percolation of this water into the soil is limited, and the potential for further downward movement of COCs through leaching is low. Because groundwater at this site is approximately 460 feet bgs, the potential for COCs to reach groundwater through the unsaturated zone above the water table is extremely small.

COCs can enter the food chain through uptake by plant roots. COCs taken up by plant roots can be transported to aboveground tissues where they can be consumed by herbivores, which can in turn be eaten by predators. Once in the food web, COCs can be transported from the site by the movements of the organisms that contain them or other surficial transport mechanisms. However, because DSS Site 1008 occupies only a very small area (less than 1 acre) with limited vegetation cover, food chain transport is expected to be of low significance at this site.

All COCs at DSS Site 1008 are inorganic, including both radiological and nonradiological analytes. With the exception of cyanide, the nonradiological COCs are elemental in form, and are not considered to be degradable. Transformations of these inorganic COCs could include

Table 4
Nonradiological COCs for Human Health and Ecological Risk Assessment at DSS Site 1008 with Comparison to the Associated SNL/NM Background Screening Value, BCF, and Log K_{ow}

COC	Maximum Concentration (mg/kg)	SNL/NM Background Concentration (mg/kg)[a]	Is Maximum COC Concentration Less Than or Equal to the Applicable SNL/NM Background Screening Value?	BCF (maximum aquatic)	Log K_{ow} (for organic COCs)	Bioaccumulator?[b] (BCF>40, Log K_{ow}>4)
Arsenic	4.6	4.4	**No**	44[c]	–	**Yes**
Barium	240 J	214	**No**	170[d]	–	**Yes**
Cadmium	0.22	0.9	Yes	64[c]	–	**Yes**
Chromium, total	14	15.9	Yes	16[c]	–	No
Chromium VI	0.116 J	1	Yes	16[c]	–	No
Cyanide	0.0685[e]	NC	**Unknown**	NC	–	**Unknown**
Lead	9.3	11.8	Yes	49[c]	–	**Yes**
Mercury	0.0225[e]	<0.1	**Unknown**	5,500[c]	–	**Yes**
Selenium	0.74 J	<1	**Unknown**	800[f]	–	**Yes**
Silver	0.0225[e]	<1	**Unknown**	0.5[c]	–	No

Note: **Bold** indicates COCs that failed the background screening procedure and/or are bioaccumulators.
[a]Dinwiddie September 1997, Southwest Supergroup.
[b]NMED March 1998.
[c]Parameter was not detected. Concentration is 0.5 detection limit.
[d]Yanicak March 1997.
[e]Neumann 1976.
[f]Callahan et al. 1979.
BCF = Bioconcentration factor.
COC = Constituent of concern.
DSS = Drain and Septic Systems.
J = Estimated concentration.
K_{ow} = Octanol-water partition coefficient.
Log = Logarithm (base 10).
mg/kg = Milligram(s) per kilogram.
NC = Not calculated.
NMED = New Mexico Environment Department.
SNL/NM = Sandia National Laboratories/New Mexico.
– = Information not available.

Table 5
Radiological COCs for Human Health and Ecological Risk Assessment at DSS Site 1008 with Comparison to the Associated SNL/NM Background Screening Value and BCF

COC	Maximum Activity (pCi/g)	SNL/NM Background Activity (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)
Cs-137	ND (0.036)	0.079	Yes	3,000[c]	**Yes**
Th-232	0.726	1.01	Yes	3,000[c]	No
U-235	**ND (0.248)**	0.16	**No**	900[c]	**Yes**
U-238	**ND (3.59)**	1.4	**No**	900[c]	**Yes**

Note: **Bold** indicates COCs that exceed background screening values and/or are bioaccumulators.
[a]Dinwiddie September 1997, Southwest Supergroup.
[b]NMED March 1998.
[c]Baker and Solda: 1992.
BCF = Bioconcentration factor.
COC = Constituent of concern.
DSS = Drain and Septic Systems.
MDA = Minimum detectable activity.
ND ( ) = Not detected above the MDA, shown in parentheses.
NMED = New Mexico Environment Department.
pCi/g = Picocurie(s) per gram.
SNL/NM = Sandia National Laboratories/New Mexico.

changes in valence (oxidation/reduction reactions) or incorporation into organic forms (e.g., the conversion of selenite or selenate from soil to seleno-amino acids in plants). Cyanide was not detected in the soil, but if it is present, it is likely to occur as cyanide salts (i.e., sodium cyanide or potassium cyanide). Free cyanide or hydrogen cyanide are likely to be quickly metabolized by soil biota. Radiological COCs will undergo decay to stable isotopes or radioactive daughter elements. However, because of the long half-lives of the radionuclides, the aridity of the environment at this site, and the lack of potential contact with biota, none of these mechanisms is expected to result in significant losses or transformations of the inorganic COCs.

Table 6 summarizes the fate and transport processes that can occur at DSS Site 1008. COCs at this site include radiological and nonradiological inorganic analytes. For the reasons detailed above, wind, surface water, and biota are considered to be of low significance as potential transport mechanisms at this site. The potential for transformation of nonradiological inorganics is low and loss through decay of radiological COCs is insignificant because of their long half-lives.

Table 6
Summary of Fate and Transport at DSS Site 1008

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

DSS = Drain and Septic Systems.

VI. Human Health Risk Assessment

VI.1 Introduction

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

Step 1.	Site data are described that provide information on the potential COCs, as well as the relevant physical characteristics and properties of the site.
Step 2.	Potential pathways are identified by which a representative population might be exposed to the COCs.
Step 3.	The potential intake of these COCs by the representative population is calculated using a tiered approach. The first component of the tiered approach is a screening procedure. The 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 carried forward in the risk assessment process.
Step 4.	Toxicological parameters are identified and referenced for COCs that were not eliminated during the screening procedure.
Step 5.	Potential toxicity effects (specified as a hazard index [HI]) and estimated excess cancer risks are calculated for nonradiological COCs and background. For radiological COCs, the incremental total effective dose equivalent (TEDE) and incremental estimated cancer risk are calculated by subtracting applicable background concentrations directly from maximum on-site contaminant values. This background subtraction 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), NMED and the DOE to determine whether further evaluation and potential site cleanup, are required. Nonradiological COC risk values also are compared to background risk so that an incremental risk can be calculated.
Step 7.	Uncertainties of the above steps are addressed.

VI.2 Step 1. Site Data

Section I provides the description and history for DSS Site 1008. Section II presents a comparison of results to DQOs. Section III discusses the nature, rate, and extent of contamination.

VI.3 Step 2. Pathway Identification

DSS Site 1008 has been designated a future land use scenario of industrial (DOE et al. September 1995) (see Appendix 1 for default exposure pathways and parameters). However, the residential land use scenario is also considered within the pathway analysis. Because of the location and the characteristics of the potential contaminants, the primary pathway for human exposure is considered to be soil ingestion for the nonradiological COCs and direct gamma exposure for the radiological COCs. The inhalation pathway for both nonradiological and radiological COCs is included because the potential exists to inhale dust. Soil ingestion is included for the radiological COCs as well. The dermal pathway is included for the nonradiological COCs because of the potential exposure of the receptor to contaminated soil. No water pathways to groundwater are considered. Depth to groundwater at DSS Site 1008 is approximately 460 feet bgs. No intake routes through plant, meat, or milk ingestion are considered appropriate for either the industrial or residential land use scenarios. Figure 1 shows the conceptual model flow diagram for DSS Site 1008.

Pathway Identification

Nonradiological Constituents	Radiological Constituents
Soil ingestion	Soil ingestion
Inhalation (dust)	Inhalation (dust)
Dermal contact	Direct gamma

VI.4 Step 3. Background Screening Procedure

Step 3, the background screening procedure, is discussed in this section. The procedure compares the maximum COC concentration to the background screening level. The method and results are described below.

VI.4.1 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 (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 a 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.

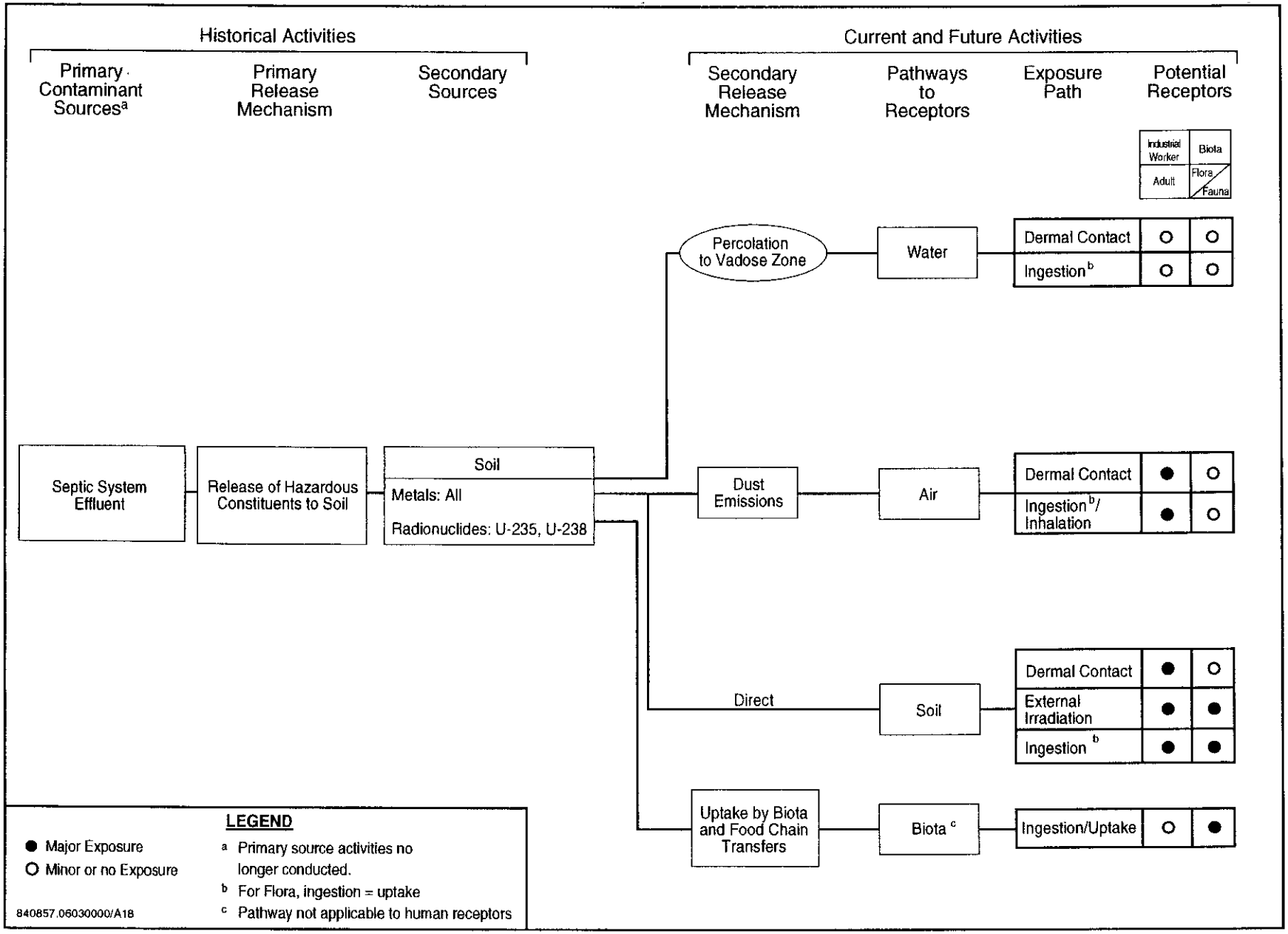


Figure 1

Conceptual Site Model Flow Diagram for Building 6750 Septic System, DSS Site 1008

VI.4.2 Results

Tables 4 and 5 show DSS Site 1008 maximum COC concentrations, which were compared to the SNL/NM maximum background values (Dinwiddie September 1997) for the human health risk assessment. For the nonradiological COCs, two constituents were measured at concentrations greater than their respective background screening values. Four constituents did not have quantified background screening concentrations, therefore it is unknown if these COCs exceeded background.

For the radiological COCs, two constituents had minimum detectable activity values greater than their respective backgrounds (U-235 and U-238). These values were conservatively used in the risk assessment.

VI.5 Step 4. Identification of Toxicological Parameters

Tables 7 and 8 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 2003), the Health Effects Assessment Summary Tables (HEAST) (EPA 1997a), and the Technical Background Document for Development of Soil Screening Levels (NMED December 2000). Dose conversion factors (DCFs) used in determining the excess TEDE values for radiological COCs for the individual pathways 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 were taken from "Federal Guidance Report No. 11, Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion" (EPA 1988).
- DCFs for surface contamination were taken from DOE/EH-0070, "External Dose-Rate Conversion Factors for Calculation of Dose to the Public" (DOE 1988).
- DCFs for volume contamination (exposure to contamination deeper than the immediate surface of the site) were calculated using the methods discussed in "Dose-Rate Conversion Factors for External Exposure to Photon Emitters in Soil" (Kocher 1983) and in ANL/EAIS-8, "Data Collection Handbook to Support Modeling the Impacts of Radioactive Material in Soil" (Yu et al. 1993b).

VI.6 Step 5. Exposure Assessment and Risk Characterization

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

Table 7
Toxicological Parameter Values for DSS Site 1008 Nonradiological COCs

COC	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]	ABS
Arsenic	3E-4[c]	M	–	–	1.5E+0[c]	1.5E+1[c]	A	0.03[d]
Barium	7E-2[c]	M	1.4E-4[e]	–	–	–	D	0.01[d]
Cyanide	2E-2[c]	M	–	–	–	–	D	0.1[d]
Mercury	3E-4[e]	–	8.6E-5[c]	M	–	–	D	0.01[d]
Selenium	5E-3[c]	H	–	–	–	–	D	0.01[d]
Silver	5E-3[c]	L	–	–	–	–	D	0.01[d]

[a]Confidence associated with IRIS (EPA 2003) database values. Confidence: L = low, M = medium, H = high.
[b]EPA weight-of-evidence classification system for carcinogenicity (EPA 1989) taken from IRIS (EPA 2003):
A = Human carcinogen
D = Not classifiable as to human carcinogenicity.
[c]Toxicological parameter values from IRIS electronic database (EPA 2003).
[d]Toxicological parameter values from NMED December 2000.
[e]Toxicological parameter values from HEAST (EPA 1997a).
ABS = Gastrointestinal adsorption coefficient.
COC = Constituent of concern.
DSS = Drain and Septic Systems.
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.
NMED = New Mexico Environmental Department.
RfD_{inh} = Inhalation chronic reference dose.
RfD_o = Oral chronic reference dose.
SF_{inh} = Inhalation slope factor.
SF_o = Oral slope factor.
– = Information not available.

Table 8
Toxicological Parameter Values for DSS Site 1008
Radiological COCs Obtained from RESRAD Risk Coefficients[a]

COC	SF_o (1/pCi)	SF_{inh} (1/pCi)	SF_{ev} (g/pCi-yr)	Cancer Class[b]
U-235	4.70E-11	1.30E-08	2.70E-07	A
U-238	6.20E-11	1.20E-08	6.60E-08	A

[a]From Yu et al. 1993a.
[b]EPA weight-of-evidence classification system for carcinogenicity (EPA 1989): A = Human carcinogen 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.
DSS = Drain and Septic Systems.
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.

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, as well as parameters for both industrial and residential land use scenarios. The equations for nonradiological COCs are based upon the Risk Assessment Guidance for Superfund (RAGS) (EPA 1989). Parameters are based upon information from the RAGS (EPA 1989), the *Technical Background Document for Development of Soil Screening Levels (NMED December* 2000) and other EPA and NMED guidance documents, and reflect the reasonable maximum exposure (RME) approach advocated by the RAGS (EPA 1989). For radiological COCs, the coded equations provided in RESRAD computer code are used to estimate the incremental TEDE and cancer risk for individual exposure pathways. Further discussion of this process is provided in the "Manual for Implementing Residual Radioactive Material Guidelines Using RESRAD" (Yu et al. 1993a).

Although the designated land use scenario is industrial for this site, risk and TEDE values for a residential land use scenario are also presented.

VI.6.2 Risk Characterization

Table 9 shows an HI of 0.02 for the DSS Site 1008 nonradiological COCs and an estimated excess cancer risk of 3E-6 for the designated industrial land use scenario. The numbers presented include exposure from soil ingestion, dermal contact, and dust inhalation for nonradiological COCs. Table 10 shows an HI of 0.02 and an estimated excess cancer risk of 3E-6 for the designated industrial land use scenario.

Table 9
Risk Assessment Values for DSS Site 1008 Nonradiological COCs

COC	Maximum Concentration (mg/kg)	Industrial Land Use Scenario[a]		Residential Land Use Scenario[a]	
		Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Arsenic	4.6	0.02	3E-6	0.21	1E-5
Barium	240 J	0.00	–	0.05	–
Cyanide	0.0685[b]	0.00	–	0.00	–
Mercury	0.0225[b]	0.00	–	0.00	–
Selenium	0.74 J	0.00	–	0.00	–
Silver	0.0225[b]	0.00	–	0.00	–
Total		**0.02**	**3E-6**	**0.3**	**1E-5**

[a]EPA 1989.
[b]Maximum concentration was 0.5 detection limit.
COC = Constituent of concern.
DSS = Drain and Septic Systems.
EPA = U.S. Environmental Protection Agency.
J = Estimated concentration.
mg/kg = Milligram(s) per kilogram.
– = Information not available.

Table 10
Risk Assessment Values for DSS Site 1008 Nonradiological Background Constituents

COC	Background Concentration[a] (mg/kg)	Industrial Land Use Scenario[b]		Residential Land Use Scenario[b]	
		Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Arsenic	4.4	0.02	3E-6	0.20	1E-5
Barium	214	0.00	–	0.04	–
Cyanide	NC	–	–	–	–
Mercury	<0.1	–	–	–	–
Selenium	<1	–	–	–	–
Silver	<1	–	–	–	–
Total		**0.02**	**3E-6**	**0.2**	**1E-5**

[a]Dinwiddie September 1997, Southwest Supergroup.
[b]EPA 1989.
COC = Constituent of concern.
DSS = Drain and Septic Systems.
EPA = U.S. Environmental Protection Agency.
mg/kg = Milligram(s) per kilogram.
NC = Not calculated.
– = Information not available.

For the radiological COCs, contribution from the direct gamma exposure pathway is included. For the industrial land use scenario, a TEDE was calculated for an individual on the site, which resulted in an incremental TEDE of 6.7E-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 (industrial in this case); the calculated dose value for DSS Site 1008 for the industrial land use is well below this guideline. The estimated excess cancer risk is 6.3E-7.

For the residential land use scenario nonradioactive COCs, the HI is 0.3 and the estimated excess cancer risk is 1E-5 (Table 9). The numbers in the table included exposure from soil ingestion, dermal contact, and dust inhalation. Although the EPA (1991) generally recommends that inhalation not be included in a residential land use scenario, this pathway is included because of the potential for soil in Albuquerque, New Mexico, to be eroded and for dust to be subsequently 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 DSS Site 1008 associated background constituents, there was an HI of 0.2 and an estimated excess cancer risk of 1E-5.

For the radiological COCs, the incremental TEDE for the residential land use scenario is 1.7E-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 DSS Site 1008 for the residential land use scenario is well below this guideline. Consequently, DSS Site 1008 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 1.8E-6. The excess cancer risk from the nonradiological COCs and the radiological COCs should be summed to provide risk estimates for persons exposed to both types of carcinogenic contaminants, as noted in OSWER Directive No. 9200.4-18, "Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination" (EPA 1997b). This summation is tabulated in Section VI.9, "Summary."

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

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

For the industrial land use scenario nonradiological COCs, the HI is 0.02, which is less than the numerical guideline of 1 suggested in the RAGS (EPA 1989). The excess cancer risk was 3E-6. NMED Guidance states that cumulative excess lifetime cancer risk must be less than 1E-5 (Bearzi January 2001), thus the excess cancer risk for this site is below the suggested acceptable risk value. This assessment also determined risks considering background concentrations of the potential nonradiological COCs for both the industrial and residential land use scenarios. Assuming the industrial land use scenario, for nonradiological COCs the HI is 0.02 and the estimated excess cancer risk is 3E-6. Incremental risk is determined by subtracting risk associated with background from potential COC risk. These numbers are not rounded before the difference is determined and therefore may appear to be inconsistent with numbers presented in tables and within the text. For conservatism, the background constituents that do not have quantifiable background screening values are assumed to have a

hazard quotient (HQ) of 0.00. The incremental HI is 0.00, and there is no incremental estimated excess cancer risk for the industrial land use scenario. These incremental risk calculations indicate insignificant risk to human health from nonradiological COCs considering an industrial land use scenario.

For radiological COCs in the industrial land use scenario, incremental TEDE is 6.7E-2 mrem/yr, which is significantly less than the EPA's numerical guideline of 15 mrem/yr. Incremental estimated excess cancer risk is 6.3E-7.

The calculated HI for the residential land use scenario nonradiological COCs is 0.3, which is below numerical guidance. The excess cancer risk was 1E-5. NMED Guidance states that cumulative excess lifetime cancer risk must be less than 1E-5 (Bearzi January 2001), thus the excess cancer risk for this site was slightly above the suggested acceptable risk value. For background concentrations of the nonradiological COCs the HI is 0.2 and the estimated excess cancer risk is 1E-5. The incremental HI is 0.02, and the there is no estimated incremental cancer risk for the residential land use scenario. These incremental risk calculations indicate insignificant risk to human health from nonradiological COCs considering a residential land use scenario.

The incremental TEDE for a residential land use scenario from the radiological components is 1.7E-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 1.8E-6.

VI.8 Step 7. Uncertainty Discussion

The determination of the nature, rate, and extent of contamination at DSS Site 1008 was based upon an initial conceptual model that was validated with baseline sampling conducted at the site. The baseline sampling was implemented in accordance with the OU 1295 SAP (SNL/NM October 1999) and FIP (SNL/NM November 2001); the DQOs contained in these two documents are appropriate for use in risk-screening assessments. The data from soil samples collected at effluent release points are representative of potential COC releases to the site. The analytical requirements and results satisfy the DQOs, and data quality was verified/ validated in accordance with SNL/NM procedures. Therefore, there is no uncertainty associated with the data quality used to perform the risk assessment at DSS Site 1008.

Because of the location, history of the site, and future land use (DOE et al. September 1995), there is low uncertainty in the land use scenario and the potentially affected populations that were considered in performing the risk assessment analysis. Because the COCs are found in 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 9 shows the uncertainties (confidence) in nonradiological toxicological parameter values. There is a mixture of estimated values and values from the IRIS (EPA 2003), HEAST (EPA

1997a), and Technical Background Document for Development of Soil Screening Levels (NMED December 2000). Where values are not provided, information is not available from the HEAST (EPA 1997a), IRIS (EPA 2003), Technical Background Document for Development of Soil Screening Levels (NMED December 2000), Risk Assessment Information System (ORNL 2003) or EPA regions (EPA 2002a, EPA 2002b, EPA 2002c). Because of the conservative nature of the RME approach, uncertainties in toxicological values are not expected to change the conclusion from the risk assessment analysis.

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

The HI for the nonradiological COCs is within the human health acceptable range for the residential land use scenario in established numerical guidance. Though the estimated excess cancer risk was slightly above the NMED guideline for the residential land use scenario, a comparison of the maximum arsenic COC concentration (4.6 milligrams [mg]/kilogram [kg]) to the background screening value (4.4 mg/kg) and the range of arsenic background concentrations (0.033 to 17 mg/kg), indicates that the maximum concentration is most likely part of the background population. In addition, the calculated incremental excess cancer risk is zero. Thus, considering the background screening value, the range of background concentrations, and the incremental estimated excess cancer risk, the maximum arsenic concentration is not indicative of contamination.

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

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

VI.9 Summary

DSS Site 1008 has identified COCs consisting of some inorganic and radiological compounds. Because of the location of the site, the designated industrial land use scenario, and the nature of contamination, potential exposure pathways identified for this site included soil ingestion, dermal contact, and dust inhalation for chemical COCs and soil ingestion, dust inhalation, and direct gamma exposure for radionuclides. The same exposure pathways were applied to the residential land use scenario.

Using conservative assumptions and an RME approach to risk assessment, calculations for nonradiological COCs show that the HI for the industrial land use scenario (0.02) is significantly less than the accepted numerical guidance from the EPA. The estimated excess cancer risk was 3E-6; thus, excess cancer risk is also below the acceptable risk value provided by the NMED for an industrial land use scenario (Bearzi January 2001). The incremental HI was 0.00, and there was no incremental excess cancer risk for the industrial land use scenario. Incremental risk calculations indicate insignificant risk to human health for the industrial land use scenario.

Using conservative assumptions and an RME approach to risk assessment, calculations for nonradiological COCs show that the HI for the residential land use scenario (0.3) is also below the accepted numerical guidance from the EPA. The estimated excess cancer risk was 1E-5; thus, excess cancer risk was slightly above the acceptable risk value provided by the NMED for a residential land use scenario (Bearzi January 2001). The incremental HI is 0.02, and there was no incremental excess cancer risk for the residential land use scenario. Incremental risk calculations indicate insignificant risk to human health for the residential land use scenario.

Though the total estimated excess cancer risk was slightly above the NMED guideline for the residential land use scenario, a comparison of the maximum arsenic COC concentration (4.6 mg/kg) to the background screening value (4.4 mg/kg) and the range of arsenic background concentrations (0.033 to 17 mg/kg) indicates that the maximum concentration is most likely part of the background population. In addition, the calculated incremental excess cancer risk is zero. Thus, considering the background screening value, the range of background concentrations and the incremental estimated excess cancer risk, the maximum arsenic concentration is not indicative of contamination.

Incremental TEDE and corresponding estimated cancer risk from radiological COCs are much lower than EPA guidance values; the estimated TEDE is 6.7E-2 mrem/yr for the industrial land use scenario. This value is much lower than the EPA's numerical guidance of 15 mrem/yr in EPA guidance (EPA 1997b). The corresponding incremental estimated cancer risk value is 6.3E-7 for the industrial land use scenario. Furthermore, the incremental TEDE for the residential land use scenario that results from a complete loss of institutional control is 1.7E-1 mrem/yr with an associated risk of 1.8E-6. The guideline for this scenario is 75 mrem/yr (SNL/NM February 1998). Therefore, DSS Site 1008 is eligible for unrestricted radiological release.

The summation of the nonradiological and radiological carcinogenic risks are tabulated in Table 11 below:

Table 11
Summation of Radiological and Nonradiological Risks from Site Carcinogens

Scenario	Nonradiological Risk	Radiological Risk	Total Risk
Industrial	3E-6	6.3E-7	3.6E-6
Residential	1E-5	1.8E-6	1.2E-5

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 either the industrial or residential land use scenarios.

VII. Ecological Risk Assessment

VII.1 Introduction

This section addresses the ecological risks associated with exposure to constituents of potential ecological concern (COPECs) in soils at DSS Site 1008. A component of the NMED Risk-

Based Decision Tree is an ecological assessment that corresponds with that presented in the EPA's "Ecological Risk Assessment Guidance for Superfund" (EPA 1997c). The current methodology is tiered and contains an initial scoping assessment followed by a more detailed risk assessment. Initial components of the NMED's decision tree (a discussion of DQOs, a data assessment, and evaluations of bioaccumulation and fate-and-transport potential) are addressed in previous sections of this report. Following the completion of the scoping assessment, a determination is made as to whether a more detailed examination of potential ecological risk is necessary. If deemed necessary, the scoping assessment proceeds to a risk 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 constituents associated with site activities. Included in this section are an evaluation of existing data, a comparison of maximum detected concentrations to background concentrations, and an examination of bioaccumulation, 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 4 and 5), constituents in soil within the 0- to 5-foot depth interval that were identified as COCs for this site were as follows:

- Arsenic
- Barium
- Cyanide
- Mercury
- Selenium
- Silver
- U-235
- U-238

VII.2.2 Bioaccumulation

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

- Arsenic
- Barium
- Mercury
- Selenium

- U-235
- U-238

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 (BCFs) for aquatic species. Because only aquatic BCFs are used to evaluate the bioaccumulation potential for metals, bioaccumulation in terrestrial species is likely to be overpredicted.

VII.2.3 Fate and Transport Potential

The potential for 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, surface water, and biota (food chain uptake) are expected to be of low significance as transport mechanisms for COPECs at this site. Degradation, transformation, and radiological decay of the COPECs are also expected to be of low significance.

VII.2.4 Scoping Risk-Management Decision

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

VII.3 Risk Assessment

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

Components within the risk assessment include the following:

- Problem formulation sets the stage for the evaluation of potential exposure and risk.
- Exposure estimation provides a quantitative estimate of potential exposure.
- Ecological effects evaluation presents benchmarks used to gauge the toxicity of COPECs to specific receptors.
- Risk characterization characterizes the ecological risk associated with exposure of the receptors to environmental media at the site.

- Uncertainty assessment discusses uncertainties associated with the estimation of exposure and risk.
- Risk interpretation evaluates ecological risk in terms of HQs and ecological significance.
- Risk assessment scientific/management decision point presents the decision to risk managers based upon the results of the risk assessment.

VII.3.1 Problem Formulation

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

VII.3.1.1 Ecological Pathways and Setting

DSS Site 1008 is less than 1 acre in size. The site is located in an area dominated by grassland habitat. The site is unpaved, and is open to use by wildlife. No threatened or endangered species are known to occur at this site (IT February 1995) and no surface water bodies, seeps, or springs are associated with the site.

Complete ecological pathways may exist at this site through the exposure of plants and wildlife to COPECs in surface soil at this site. 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 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

Discharges of waste water from the septic system of Building 6750 is the primary source of COPECs at DSS Site 1008. COPECs identified for this site are listed in Section VII.2.1 and are all inorganic, including both radiological and nonradiological analytes. The 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. 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). In order to provide conservatism, this ecological risk assessment was based upon

the maximum soil concentrations of the COPECs measured in the upper 5 feet of soil at this site. Tables 4 and 5 present maximum concentrations for the COPECs.

VII.3.1.3 Ecological Receptors

A nonspecific perennial plant was selected as the receptor to represent plant species at the site (IT July 1998). Vascular plants are the principal primary producers at the site and are key to the diversity and productivity of the wildlife community associated with the site. The deer mouse (*Peromyscus maniculatus*) and the burrowing owl (*Speotyto cunicularia*) 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. 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 of 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 12 presents the species-specific factors used in modeling exposures in the wildlife receptors. Justification for use of the factors presented in this table is described in the ecological risk assessment methodology document (IT July 1998).

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

For the radiological dose rate calculations, the deer mouse was modeled as an herbivore (100 percent of its diet as plants), and the burrowing owl was modeled as a strict predator on small mammals (100 percent of its diet as deer mice). Both were modeled with soil ingestion comprising 2 percent of the total dietary intake. Receptors are exposed to radiation both internally and externally from U-235 and U-238. Internal and external dose rates to the deer mouse and the burrowing owl are approximated using modified dose rate models from the 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

Table 12
Exposure Factors for Ecological Receptors at DSS Site 1008

Receptor Species	Class/Order	Trophic Level	Body Weight (kg)[a]	Food Intake Rate (kg/day)[b]	Dietary Composition[c]	Home Range (acres)
Deer Mouse (*Peromyscus maniculatus*)	Mammalia/ Rodentia	Herbivore	2.39E-2[d]	3.72E-3	Plants: 100% (+ Soil at 2% of intake)	2.7E-1[e]
Deer Mouse (*Peromyscus maniculatus*)	Mammalia/ Rodentia	Omnivore	2.39E-2[d]	3.72E-3	Plants: 50% Invertebrates: 50% (+ Soil at 2% of intake)	2.7E-1[e]
Deer Mouse (*Peromyscus maniculatus*)	Mammalia/ Rodentia	Insectivore	2.39E-2[d]	3.72E-3	Invertebrates: 100% (+ Soil at 2% of intake)	2.7E-1[e]
Burrowing owl (*Speotyto cunicularia*)	Aves/ Strigiformes	Carnivore	1.55E-1[f]	1.73E-2	Rodents: 100% (+ Soil at 2% of intake)	3.5E+1[g]

[a]Body weights are in kg wet weight.
[b]Food intake rates are estimated from the allometric equations presented in Nagy (1987). Units are kg dry weight per day.
[c]Dietary compositions are generalized for modeling purposes. Default soil intake value of 2% of food intake.
[d]Silva and Downing 1995.
[e]EPA 1993, based upon the average home range measured in semiarid shrubland in Idaho.
[f]Dunning 1993.
[g]Haug et al. 1993.
DSS = Drain and Septic Systems.
EPA = U.S. Environmental Protection Agency.
kg = Kilogram(s).

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 soil 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 the 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 U-235 and U-238 in soil.

Table 13 presents the transfer factors used in modeling the concentrations of COPECs through the food chain. Table 14 presents maximum concentrations in soil and derived concentrations in tissues of the various food chain elements that are used to model dietary exposures for each of the wildlife receptors.

VII.3.3 Ecological Effects Evaluation

Table 15 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.

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 DSS Site 1008.

VII.3.4 Risk Characterization

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

HQs for the omnivorous and insectivorous deer mice exceeded unity for both arsenic and barium. Because of a lack of sufficient toxicity information, an HQ for plants could not be determined for cyanide and HQs for the burrowing owl could not be determined for cyanide and silver. 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 HIs except that for the burrowing owl exceeded unity; the maximum HI was 9.4 for the insectivorous deer mouse.

Table 13
Transfer Factors Used in Exposure Models for COPECs at DSS Site 1008

COPEC	Soil-to-Plant Transfer Factor	Soil-to-Invertebrate Transfer Factor	Food-to-Muscle Transfer Factor
Arsenic	4.0E-2[a]	1.0E+0[b]	2.0E-3[a]
Barium	1.5E-1[a]	1.0E+0[b]	2.0E-4[c]
Cyanide	0.0E+0[d]	0.0E+0[d]	0.0E+0[d]
Mercury	1.0E+0[c]	1.0E+0[b]	2.5E-1[a]
Selenium	5.0E-1[c]	1.0E+0[b]	1.0E-1[c]
Silver	1.0E+0[c]	2.5E-1[e]	5.0E-3[c]

[a]Baes et al. 1984.
[b]Default value.
[c]NCRP January 1989.
[d]No data found for food chain transfers of cyanide; however, because of its high metabolic activity, cyanide is assumed not to transfer in the food chain.
[e]Stafford et al. 1991.
COPEC = Constituent of potential ecological concern.
DSS = Drain and Septic Systems.
NCRP = National Council on Radiation Protection and Measurements.

Table 14
Media Concentrations[a] for COPECs at DSS Site 1008

COPEC	Soil (maximum)[a]	Plant Foliage[b]	Soil Invertebrate[b]	Deer Mouse Tissues[c]
Arsenic	4.6E+0	1.8E-1	4.6E+0	1.6E-2
Barium	2.4E+2[d]	3.6E+1	2.4E+2	8.9E-2
Cyanide	6.9E-2[e]	0.0E+0	0.0E+0	0.0E+0
Mercury	2.3E-2[e]	2.3E-2	2.3E-2	1.8E-2
Selenium	7.4E-1[d]	3.7E-1	7.4E-1	1.8E-1
Silver	2.3E-2[e]	2.3E-2	5.6E-3	2.3E-4

[a]In milligrams per kilogram. All biotic media are based upon dry weight of the media. Soil concentration measurements are assumed to have been based upon dry weight. Values have been rounded to two significant digits after calculation.
[b]Product of the soil concentration and the corresponding transfer factor.
[c]Based upon the deer mouse with an omnivorous diet. Product of the average concentration ingested in food and soil times the food-to-muscle transfer factor times a wet weight-dry weight conversion factor of 3.125 (EPA 1993).
[d]Estimated value.
[e]Analyte not detected. Maximum concentration is 0.5 of the detection limit.
COPEC = Constituent of potential ecological concern.
DSS = Drain and Septic Systems.
EPA = U.S. Environmental Protection Agency.

Table 15
Toxicity Benchmarks for Ecological Receptors at DSS Site 1008

COPEC	Plant Benchmark[a,b]	Mammalian NOAELs			Avian NOAELs		
		Mammalian Test Species[c,d]	Test Species NOAEL[d,e]	Deer Mouse NOAEL[e,f]	Avian Test Species[d]	Test Species NOAEL[d,e]	Burrowing Owl NOAEL[e,g]
Arsenic	10	mouse	0.126	0.133	mallard	5.14	5.14
Barium	500	rat[h]	5.1	10.5	chicken	20.8	20.8
Cyanide	–	rat[i]	68.7	126	–	–	–
Mercury (organic)	0.3	rat	0.03	0.06	mallard	0.0064	0.0064
Mercury (inorganic)	0.3	mouse	13.2	14.0	Japanese quail	0.45	0.45
Selenium	1	rat	0.2	0.391	screech owl	0.44	0.44
Silver	2	rat	17.8[j]	34.8	–	–	–

[a]In mg/kg soil dry weight.
[b]Efroymson et al. 1997.
[c]Body weights (in kg) for the NOAEL conversion are as follows: lab mouse, 0.030; lab rat, 0.350, (except where noted).
[d]Sample et al. 1996, except where noted.
[e]In mg/kg body weight per day.
[f]Based upon NOAEL conversion methodology presented in Sample et al. (1996), using a deer mouse body weight of 0.0239 kg and a mammalian scaling factor of 0.25.
[g]Based upon NOAEL conversion methodology presented in Sample et al. (1996). The avian scaling factor of 0.0 was used, making the NOAEL independent of body weight.
[h]Body weight: 0.435 kg.
[i]Body weight: 0.273 kg.
[j]Based upon a rat lowest-observed-adverse-effect level of 89 mg/kg/d (EPA 2003) and an uncertainty factor of 0.2.
COPEC = Constituent of potential ecological concern.
DSS = Drain and Septic Systems.
kg = Kilogram(s)
mg/kg = Milligram(s) per kilogram.
mg/kg/d = Milligram(s) per kilogram per day.
NOAEL = No observed adverse effect level.
– = Insufficient toxicity data.

Table 16
HQs for Ecological Receptors at DSS Site 1008

COPEC	Plant HQ[a]	Deer Mouse HQ (Herbivorous)[a]	Deer Mouse HQ (Omnivorous)[a]	Deer Mouse HQ (Insectivorous)[a]	Burrowing Owl HQ[a]
Arsenic	4.6E-1	3.2E-1	**2.9E+0**	5.5E+0	2.3E-3
Barium	4.8E-1	6.0E-1	**2.1E+0**	**3.6E+0**	2.6E-2
Cyanide	–	1.7E-6	1.7E-6	1.7E-6	–
Mercury (organic)	7.5E-2	5.7E-2	5.7E-2	5.7E-2	3.2E-1
Mercury (inorganic)	7.5E-2	2.6E-4	2.6E-4	2.6E-4	4.6E-3
Selenium	7.4E-1	1.5E-1	2.3E-1	3.0E-1	4.9E-2
Silver	1.1E-2	1.0E-4	6.5E-5	2.7E-5	–
HI[b]	**1.8E+0**	**1.1E+0**	**5.3E+0**	**9.4E+0**	4.0E-1

[a]**Bold** text indicates HQ or HI exceeds unity.
[b]The HI is the sum of individual HQs.
COPEC = Constituent of potential ecological concern.
DSS = Drain and Septic Systems.
HI = Hazard index.
HQ = Hazard quotient.
– = Insufficient toxicity data available for risk estimation purposes.

Tables 17 and 18 summarize the internal and external dose rate model results for U-235 and U-238 for the deer mouse and burrowing owl, respectively. The total radiation dose rate to the deer mouse was predicted to be 5.9E-4 rad/day and that for the burrowing owl was 5.7E-4 rad/day; both are 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 DSS Site 1008. 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, and the incorporation of strict herbivorous and strict insectivorous diets for predicting the extreme HQ values for the deer mouse. Each of these uncertainties, which are consistent among each of the site-specific ecological risk assessments, is discussed in greater detail in the uncertainty section of the ecological risk assessment methodology document for the SNL/NM ER Project (IT July 1998). It should further be noted that of the six COPECs, three (cyanide, mercury, and silver) were not detected; the exposure estimates were conservatively based upon one half of the detection limit. Two (barium and selenium) had estimated values representing the maximum concentration.

Uncertainties associated with the estimation of risk to ecological receptors following exposure to U-235 and U-238 are primarily related to those inherent in the radionuclide-specific data. Radionuclide-dependent data are measured values that have their associated errors. The dose rate models used for these calculations are based upon conservative estimates on receptor shape, radiation absorption by body tissues, and intake parameters. The goal is to provide a realistic but conservative estimate of a receptor's internal and external exposure to radionuclides in soil. It should be noted that these dose estimates are conservatively based upon detection limits of the two radionuclides, and that neither was detected at the site.

In the estimation of ecological risk, background concentrations are included as a component of maximum on-site concentrations. Conservatisms in the modeling of exposure and risk can result in the prediction of risk to ecological receptors when exposed at background concentrations. As shown in Table 19, the background concentrations of arsenic and barium resulted in HQs greater than 1 for both the omnivorous and insectivorous deer mice. In the case of arsenic, background may account for approximately 96 percent of the maximum HQ values shown in Table 16, while for barium, background may account for approximately 89 percent of the maximum HQ values. It is therefore likely that the actual risks to the omnivorous and insectivorous deer mice from exposure to arsenic and barium at DSS Site 1008 are overestimated by the HQs calculated in this risk 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 further source of uncertainty associated with the prediction of ecological risks at this site is the use of the maximum measured concentrations to evaluate exposure and risk. This results

Table 17
Total Dose Rates for Deer Mice Exposed
to Radionuclides at DSS Site 1008

Radionuclide	Maximum Activity (pCi/g)	Total Dose (rad/day)
U-235	ND (0.25)	6.73E-6
U-238	ND (3.6)	5.81E-4
Total Dose		5.88E-4

DSS = Drain and Septic Systems.
MDA = Minimum detectable activity.
ND ( ) = Not detected above the MDA, shown in parentheses.
pCi/g = Picocurie(s) per gram.

Table 18
Total Dose Rates for Burrowing Owls Exposed
to Radionuclides at DSS Site 1008

Radionuclide	Maximum Activity (pCi/g)	Total Dose (rad/day)
U-235	ND (0.25)	5.13E-6
U-238	ND (3.6)	5.60E-4
Total Dose		5.65E-4

DSS = Drain and Septic Systems.
MDA = Minimum detectable activity.
ND ( ) = Not detected above the MDA, shown in parentheses.
pCi/g = Picocurie(s) per gram.

Table 19
HQs for Ecological Receptors Exposed to Background Concentrations at DSS Site 1008

COPEC	Plant HQ[a]	Deer Mouse HQ (Herbivorous)[a]	Deer Mouse HQ (Omnivorous)[a]	Deer Mouse HQ (Insectivorous)[a]	Burrowing Owl HQ[a]
Inorganic					
Arsenic	4.4E-1	3.1E-1	**2.8E+0**	**5.2E+0**	2.2E-3
Barium	4.0E-1	5.4E-1	**1.9E+0**	**3.2E+0**	2.3E-2
Cyanide	NC	NC	NC	NC	NC
Mercury (organic)	1.7E-1	1.3E-1	1.3E-1	1.3E-1	7.1E-1
Selenium	5.0E-1	1.0E-1	1.5E-1	2.0E-1	3.3E-2
Silver	2.5E-1	2.3E-3	1.4E-3	6.0E-4	–
HI[b]	**1.8E+1**	**1.1E+0**	**4.9E+0**	**8.8E+0**	7.7E-1

[a]**Bold** text indicates HQ or HI exceeds unity.
[b]The HI is the sum of individual HQs.
COPEC = Constituent of potential ecological concern.
DSS = Drain and Septic Systems.
HI = Hazard index.
HQ = Hazard quotient.
NC = Background value not calculated.
– = Insufficient toxicity data available for risk estimation purposes.

in a conservative exposure scenario that does not necessarily reflect actual site conditions. For example, the 95% upper confidence limit of the mean soil concentration for barium is 216 mg/kg, which is only slightly higher than the background screening value for this element (214 mg/kg). Therefore, it is likely that the actual exposures to this element at DSS Site 1008 is very close to, if not within, background levels, and risks from exposures to this COPEC at DSS Site 1008 is likely to be within the background levels as shown in Table 17.

Based upon this uncertainty analysis, the potential for ecological risks at DSS Site 1008 is expected to be low. Some HQs greater than unity were predicted; however, closer examination of the exposure assumptions revealed an overestimation of risk primarily attributed to conservative toxicity benchmarks, the use of maximum concentrations, and the contribution of background risk.

VII.3.6 Risk Interpretation

Ecological risks associated with DSS Site 1008 were estimated through a risk assessment that incorporated site-specific information when available. Initial predictions of potential risk to omnivorous and insectivorous deer mice from exposures to arsenic and barium are attributable to conservative toxicity benchmarks, the use of maximum detected values to estimate exposure, and the contribution of background risk. Both of these COPECs showed HQs greater than 1 when exposure was based upon background values, with background accounting for 96 and 89 percent (respectively) of the maximum concentrations for these two metals. Based upon this final analysis, the potential for ecological risks associated with DSS Site 1008 is expected to be low.

VII.3.7 Risk 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.

VIII. References

Baes, III, C.F., R.D. Sharp, A.L. Sjoreen, and R.W. Shor, 1984. "A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides through Agriculture," ORNL-5786, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Baker, D.A., and J.K. Soldat, 1992. "Methods for Estimating Doses to Organisms from Radioactive Materials Released into the Aquatic Environment," PNL-8150, Pacific Northwest Laboratory, Richland, Washington.

Bearzi, J.P. (New Mexico Environment Department), January 2001. Memorandum to RCRA-Regulated Facilities, "Risk-Based Screening Levels for RCRA Corrective Action Sites in New Mexico," Hazardous Waste Bureau, New Mexico Environment Department, Santa Fe, New Mexico. January 23, 2001.

Callahan, M.A., M.W. Slimak, N.W. Gabel, I.P. May, C.F. Fowler, J.R. Freed, P. Jennings, R.L. Durfee, F.C. Whitmore, B. Maestri, W.R. Mabey, B.R. Holt, and C. Gould, 1979. "Water-Related Environmental Fate of 129 Priority Pollutants," EPA-440/4-79-029, Office of Water and Waste Management, Office of Water Planning and Standards, U.S. Environmental Protection Agency, Washington, D.C.

Dinwiddie, R.S. (New Mexico Environment Department) September 1997. *Letter to* M.J. Zamorski (U.S. Department of Energy), "Request for Supplemental Information: Background Concentrations Report, SNL/KAFB." September 24, 1997.

DOE, see U.S. Department of Energy.

Dunning, J.B., 1993. *CRC Handbook of Avian Body Masses*, CRC Press, Boca Raton, Florida.

Efroymson, R.A., M.E. Will, G.W. Suter II, and A.C. Wooten, 1997. "Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Terrestrial Plants: 1997 Revision," ES/ER/TM-85/R3, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

EPA, see U.S. Environmental Protection Agency.

Haug, E.A., B.A. Millsap, and M.S. Martell, 1993. "*Speotyto cunicularia* Burrowing Owl," *in* A. Poole and F. Gill (eds.), *The Birds of North America*, No. 61, The Academy of Natural Sciences of Philadelphia.

IAEA, see International Atomic Energy Agency.

International Atomic Energy Agency (IAEA), 1992. "Effects of Ionizing Radiation on Plants and Animals at Levels Implied by Current Radiation Protection Standards," *Technical Report Series* No. 332, International Atomic Energy Agency, Vienna, Austria.

IT, see IT Corporation.

IT Corporation (IT), February 1995. "Sensitive Species Survey Results, Environmental Restoration Project, Sandia National Laboratories/New Mexico," IT Corporation, Albuquerque, New Mexico.

IT Corporation (IT), July 1998. "Predictive Ecological Risk Assessment Methodology, Environmental Restoration Program, Sandia National Laboratories, New Mexico," IT Corporation, Albuquerque, New Mexico.

Kocher, D.C. 1983. "Dose-Rate Conversion Factors for External Exposure to Photon Emitters in Soil," *Health Physics*, Vol. 28, pp. 193–205.

Nagy, K.A., 1987. "Field Metabolic Rate and Food Requirement Scaling in Mammals and Birds," *Ecological Monographs*, Vol. 57, No. 2, pp. 111–128.

National Council on Radiation Protection and Measurements (NCRP), 1987. "Exposure of the Population in the United States and Canada from Natural Background Radiation," *NCRP Report* No. 94, National Council on Radiation Protection and Measurements, Bethesda, Maryland.

National Council on Radiation Protection and Measurements (NCRP), January 1989. "Screening Techniques for Determining Compliance with Environmental Standards: Releases of Radionuclides to the Atmosphere," *NCRP Commentary* No. 3, Rev., National Council on Radiation Protection and Measurements, Bethesda, Maryland.

National Oceanic and Atmospheric Administration (NOAA), 1990. Local Climatological Data, Annual Summary with Comparative Data, Albuquerque, New Mexico.

NCRP, see National Council on Radiation Protection and Measurements.

Neumann, G., 1976. "Concentration Factors for Stable Metals and Radionuclides in Fish, Mussels and Crustaceans—A Literature Survey," Report 85-04-24, National Swedish Environmental Protection Board.

New Mexico Environment Department (NMED), March 1998. "Risk-Based Decision Tree Description," *in* New Mexico Environment Department, "RPMP Document Requirement Guide," RCRA Permits Management Program, Hazardous and Radioactive Materials Bureau, New Mexico Environment Department, Santa Fe, New Mexico.

New Mexico Environment Department (NMED), December 2000. Technical Background Document for Development of Soil Screening Levels,", Hazardous Waste Bureau and Ground Water Quality Bureau Voluntary Remediation Program, New Mexico Environment Department, Santa Fe, New Mexico.

NMED, see New Mexico Environment Department.

NOAA, see National Oceanographic and Atmospheric Administration.

Oak Ridge National Laboratories (ORNL), 2003. "Risk Assessment Information System", electronic database maintained by Oak Ridge National Laboratory, Oak Ridge, Tennessee.

ORNL, see Oak Ridge National Laboratory.

Sample, B.E., and G.W. Suter II, 1994. "Estimating Exposure of Terrestrial Wildlife to Contaminants," ES/ER/TM-125, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Sample, B.E., D.M. Opresko, and G.W. Suter II, 1996. "Toxicological Benchmarks for Wildlife: 1996 Revision," ES/ER/TM-86/R3, Risk Assessment Program, Health Sciences Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Sandia National Laboratories/New Mexico (SNL/NM), March 1996. "Site-Wide Hydrogeologic Characterization Project, Calendar Year 1995 Annual Report," Environmental Restoration Project, Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories/New Mexico (SNL/NM), February 1998. "RESRAD Input Parameter Assumptions and Justification," Environmental Restoration Project, Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories/New Mexico (SNL/NM), October 1999. "Sampling and Analysis Plan for Characterizing and Assessing Potential Releases to the Environment From Septic and Other Miscellaneous Drain Systems at Sandia National Laboratories/New Mexico", Sandia National Laboratories, Albuquerque, New Mexico, October 19, 1999.

Sandia National Laboratories/New Mexico (SNL/NM), December 1999. "Data Validation Procedure for Chemical and Radiochemical Data (AOP 00-003)," Environmental Restoration Project, Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories/New Mexico (SNL/NM), November 2001. "Field Implementation Plan, Characterization of Non-Environmental Restoration Drain and Septic Systems," Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories/New Mexico (SNL/NM), March 2002. "Annual Groundwater Monitoring Report, Fiscal Year 2000–2001," Sandia National Laboratories, Albuquerque, New Mexico.

Sandia National Laboratories/New Mexico (SNL/NM), March 2003. Database printout provided by SNL/NM Facilities Engineering showing the years that numerous SNL/NM buildings were constructed, Sandia National Laboratories, Albuquerque, New Mexico.

Silva, M., and J.A. Downing, 1995. *CRC Handbook of Mammalian Body Masses*, CRC Press, Boca Raton, Florida.

SNL/NM, See Sandia National Laboratories, New Mexico.

Stafford, E.A., J.W. Simmers, R.G. Rhett, and C.P. Brown, 1991. "Interim Report: Collation and Interpretation of Data for Times Beach Confined Disposal Facility, Buffalo, New York," *Miscellaneous Paper* D-91-17, U.S. Army Corps of Engineers, Buffalo, New York.

U.S. Department of Energy (DOE), 1988. "External Dose-Rate Conversion Factors for Calculation of Dose to the Public," DOE/EH-0070, Assistant Secretary for Environment, Safety and Health, U.S. Department of Energy, Washington, D.C.

U.S. Department of Energy (DOE), 1993. "Radiation Protection of the Public and the Environment," DOE Order 5400.5, U.S. Department of Energy, Washington, D.C.

U.S. Department of Energy (DOE), 1995. "Hanford Site Risk Assessment Methodology," DOE/RL-91-45 (Rev. 3), U.S. Department of Energy, Richland, Washington.

U.S. Department of Energy (DOE), U.S. Air Force, and U.S. Forest Service, September 1995. "Workbook: Future Use Management Area 2," prepared by the Future Use Logistics and Support Working Group in cooperation with U.S. Department of Energy Affiliates, the U.S. Air Force, and the U.S. Forest Service.

U.S. Environmental Protection Agency (EPA), November 1986. "Test Methods for Evaluating Solid Waste," 3rd ed., Update 3, SW-846, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C.

U.S. Environmental Protection Agency (EPA), 1988. "Federal Guidance Report No. 11, Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion," Office of Radiation Programs, U.S. Environmental Protection Agency, Washington, D.C.

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

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

U.S. Environmental Protection Agency (EPA), 1993. "Wildlife Exposure Factors Handbook, Volume I of II," EPA/600/R-93/187a, Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C.

U.S. Environmental Protection Agency (EPA), 1997a. "Health Effects Assessment Summary Tables (HEAST), FY 1997 Update," EPA-540-R-97-036, Office of Research and Development and Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C..

U.S. Environmental Protection Agency (EPA), 1997b. "Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination," OSWER Directive No. 9200-4-18, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C.

U.S. Environmental Protection Agency (EPA), 1997c. "Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risks," Interim Final, U.S. Environmental Protection Agency, Washington, D.C.

U.S. Environmental Protection Agency (EPA), 1998b. "Guidelines for Ecological Risk Assessment," EPA/630/R-95/002F, Risk Assessment Forum, U.S. Environmental Protection Agency, Washington, D.C.

U.S. Environmental Protection Agency (EPA), 2002a. "Region 6 Preliminary Remediation Goals (PRGs) 1996," electronic database maintained by Region 6, U.S. Environmental Protection Agency, Dallas, Texas.

U.S. Environmental Protection Agency (EPA), 2002b. "Region 9 Preliminary Remediation Goals (PRGs) 1996," electronic database maintained by Region 9, U.S. Environmental Protection Agency, San Francisco, California.

U.S. Environmental Protection Agency (EPA), 2002c. "Risk-Based Concentration Table," electronic database maintained by Region 3, U.S. Environmental Protection Agency, Philadelphia, Pennsylvania.

U.S. Environmental Protection Agency (EPA), 2003. Integrated Risk Information System (IRIS) electronic database, maintained by the U.S. Environmental Protection Agency, Washington D.C.

U.S. Fish and Wildlife Service (USFWS), September 1995. "Migratory Nongame Birds of Management Concern in the United States: The 1995 List," Office of Migratory Bird Management, U.S. Fish and Wildlife Service, Washington, D.C.

USFWS, see U.S. Fish and Wildlife Service.

Whicker, F.W., and V. Schultz, 1982. *Radioecology: Nuclear Energy and the Environment*, Vol. 2, CRC Press, Boca Raton, Florida.

Yanicak, S. (Oversight Bureau, Department of Energy, New Mexico Environment Department), March 1997. Letter to M. Johansen (DOE/AIP/POC Los Alamos National Laboratory), "(Tentative) list of constituents of potential ecological concern (COPECs) which are considered to be bioconcentrators and/or biomagnifiers." March 3, 1997.

Yu, C., A.J. Zielen, J.-J. Cheng, Y.C. Yuan, L.G. Jones, D.J. LePoire, Y.Y. Wang, C.O. Loureiro, E. Gnanapragasam, E. Faillace, A. Wallo III, W.A. Williams, and H. Peterson, 1993a. "Manual for Implementing Residual Radioactive Material Guidelines Using RESRAD," Version 5.0. Environmental Assessment Division, Argonne National Laboratory, Argonne, Illinois.

Yu, C., C. Loureiro, J.-J. Cheng, L.G. Jones, Y.Y. Wang, Y.P. Chia, and E. Faillace, 1993b. "Data Collection Handbook to Support Modeling the Impacts of Radioactive Material in Soil," ANL/EAIS-8, Argonne National Laboratory, Argonne, Illinois.

APPENDIX 1
EXPOSURE PATHWAY DISCUSSION FOR CHEMICAL AND RADIONUCLIDE CONTAMINATION

Introduction

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

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

At SNL/NM, all SWMUs exist within the boundaries of the Kirtland Air Force Base. Approximately 240 potential waste and release sites have been identified where hazardous, radiological, or mixed materials may have been released to the environment. Evaluation and characterization activities have occurred at all of these sites to varying degrees. Among other documents, the SNL/NM ER draft Environmental Assessment (DOE 1996) presents a summary of the hydrogeology of the sites and the biological resources present. When evaluating potential human health risk the current or reasonably foreseeable land use negotiated and approved for the specific SWMU/AOC, aggregate, or watershed will be used. The following references generally document these land uses: *Workbook: Future Use Management Area 2 (September 1995); Workbook: Future Use Management Area 1 (October 1995); Workbook: Future Use Management Areas 3, 4, 5, and 6 (January 1996); Workbook: Future Use Management Area 7 (March 1996)*. At this time, all SNL/NM SWMUs have been tentatively designated for either industrial or recreational future land use. The NMED has also requested that risk calculations be performed based upon a residential land use scenario. Therefore, all three land use scenarios will be addressed in this document.

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

- Ingestion of contaminated drinking water
- Ingestion of contaminated soil

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

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

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

- Ingestion of contaminated fish and shellfish
- Ingestion of contaminated fruits and vegetables
- Ingestion of contaminated meat, eggs, and dairy products
- Ingestion of contaminated surface water while swimming
- Dermal contact with chemicals in water

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

Based upon this evaluation, for future risk assessments the exposure routes that will be considered are shown in Table 1.

Table 1
Exposure Pathways Considered for Various Land Use Scenarios

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

Equations and Default Parameter Values for Identified Exposure Routes

In general, SNL/NM expects that ingestion of compounds in drinking water and soil will be the more significant exposure routes for chemicals; external exposure to radiation may also be significant for radionuclides. All of the above routes will, however, be considered for their appropriate land use scenarios. The general equation for calculating potential intakes via these routes is shown below. The equations are taken from "Assessing Human Health Risks Posed by Chemicals: Screening-Level Risk Assessment" (NMED March 6, 2000) and "Technical Background Document for Development of Soil Screening Levels" (NMED December 18, 2000). Equations from both documents are based upon the "Risk Assessment Guidance for Superfund" (RAGS): Volume 1 (EPA 1989, 1991). These general equations also apply to calculating potential intakes for radionuclides. A more in-depth discussion of the equations used in performing radiological pathway analyses with the RESRAD code may be found in the RESRAD Manual (ANL 1993). RESRAD is the only code designated by the U.S. Department of Energy (DOE) in DOE Order 5400.5 for the evaluation of radioactively contaminated sites (DOE 1993). The Nuclear Regulatory Commission (NRC) has approved the use of RESRAD for dose evaluation by licensees involved in decommissioning, NRC staff evaluation of waste disposal requests, and dose evaluation of sites being reviewed by NRC staff. EPA Science Advisory Board reviewed the RESRAD model. EPA used RESRAD in their rulemaking on radiation site cleanup regulations. RESRAD code has been verified, undergone several benchmarking analyses, and been included in the International Atomic Energy Agency's VAMP and BIOMOVS II projects to compare environmental transport models.

Also shown are the default values SNL/NM ER will use in RME risk assessment calculations for industrial, recreational, and residential land use scenarios, based upon EPA and other governmental agency guidance. The pathways and values for chemical contaminants are discussed first, followed by those for radionuclide contaminants. RESRAD input parameters that are left as the default values provided with the code are not discussed. Further information relating to these parameters may be found in the RESRAD Manual (ANL 1993) or by directly accessing the RESRAD websites at: http://web.ead.anl.gov/resrad/home2/ or http://web.ead.anl.gov/resrad/documents/.

Generic Equation for Calculation of Risk Parameter Values

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

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

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

where;

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

For nonradiological constituents of concern (COCs), the total risk/dose (either cancer risk or HI) is the sum of the risks/doses for all of the site-specific exposure pathways and contaminants. For radionuclides, the calculated radiation exposure, expressed as TEDE is compared directly to the exposure guidelines of 15 millirem per year (mrem/year) for industrial and recreational future use and 75 mrem/year for the unlikely event that institutional control of the site is lost and the site is used for residential purposes (EPA 1997).

The evaluation of the carcinogenic health hazard produces a quantitative estimate for excess cancer risk resulting from the COCs present at the site. This estimate is evaluated for determination of further action by comparison of the quantitative estimate with the potentially acceptable risk of 1E-5 for nonradiological carcinogens. The evaluation of the noncarcinogenic health hazard produces a quantitative estimate (i.e., the HI) for the toxicity resulting from the COCs present at the site. This estimate is evaluated for determination of further action by comparison of this quantitative estimate with the EPA standard HI of unity (1). The evaluation of the health hazard from radioactive compounds produces a quantitative estimate of doses resulting from the COCs present at the site. This estimated dose is used to calculate an assumed risk. However, this calculated risk is presented for illustration purposes only, not to determine compliance with regulations.

The specific equations used for the individual exposure pathways can be found in RAGS (EPA 1989) and are outlined below. The RESRAD Manual (ANL 1993) describes similar equations for the calculation of radiological exposures.

Soil Ingestion

A receptor can ingest soil or dust directly by working in the contaminated soil. Indirect ingestion can occur from sources such as unwashed hands introducing contaminated soil to food that is then eaten. An estimate of intake from ingesting soil will be calculated as follows:

$$I_s = \frac{C_s * IR * CF * EF * ED}{BW * AT}$$

where:

I_s = Intake of contaminant from soil ingestion (milligrams [mg]/kilogram [kg]-day)
C_s = Chemical concentration in soil (mg/kg)
IR = Ingestion rate (mg soil/day)
CF = Conversion factor (1E-6 kg/mg)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
BW = Body weight (kg)
AT = Averaging time (period over which exposure is averaged) (days)

It should be noted that it is conservatively assumed that the receptor only ingests soil from the contaminated source.

Soil Inhalation

A receptor can inhale soil or dust directly by working in the contaminated soil. An estimate of intake from inhaling soil will be calculated as follows (EPA August 1997):

$$I_s = \frac{C_s * IR * EF * ED * \left(1/VF \text{ or } 1/PEF\right)}{BW * AT}$$

where:

I_s = Intake of contaminant from soil inhalation (mg/kg-day)
C_s = Chemical concentration in soil (mg/kg)
IR = Inhalation rate (cubic meters [m^3]/day)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
VF = soil-to-air volatilization factor (m^3/kg)
PEF = particulate emission factor (m^3/kg)
BW = Body weight (kg)
AT = Averaging time (period over which exposure is averaged) (days)

Soil Dermal Contact

$$D_a = \frac{C_s * CF * SA * AF * ABS * EF * ED}{BW * AT}$$

where:

D_a = Absorbed dose (mg/kg-day)
C_s = Chemical concentration in soil (mg/kg)
CF = Conversion factor (1E-6 kg/mg)
SA = Skin surface area available for contact (cm^2/event)
AF = Soil to skin adherence factor (mg/cm^2)
ABS = Absorption factor (unitless)
EF = Exposure frequency (events/year)

ED = Exposure duration (years)
BW = Body weight (kg)
AT = Averaging time (period over which exposure is averaged) (days)

Groundwater Ingestion

A receptor can ingest water by drinking it or through using household water for cooking. An estimate of intake from ingesting water will be calculated as follows (EPA August 1997):

$$I_w = \frac{C_w * IR * EF * ED}{BW * AT}$$

where:

I_w = Intake of contaminant from water ingestion (mg/kg/day)
C_w = Chemical concentration in water (mg/liter [L])
IR = Ingestion rate (L/day)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
BW = Body weight (kg)
AT = Averaging time (period over which exposure is averaged) (days)

Groundwater Inhalation

The amount of a constituent taken into the body via exposure to volatilization from showering or other household water uses will be evaluated using the concentration of the constituent in the water source (EPA 1991 and 1992). An estimate of intake from volatile inhalation from groundwater will be calculated as follows (EPA 1991):

$$I_w = \frac{C_w * K * IR_i * EF * ED}{BW * AT}$$

where:

I_w = Intake of volatile in water from inhalation (mg/kg/day)
C_w = Chemical concentration in water (mg/L)
K = volatilization factor (0.5 L/m^3)
IR_i = Inhalation rate (m^3/day)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
BW = Body weight (kg)
AT = Averaging time (period over which exposure is averaged—days)

For volatile compounds, volatilization from groundwater can be an important exposure pathway from showering and other household uses of groundwater. This exposure pathway will only be evaluated for organic chemicals with a Henry's Law constant greater than 1 X 10^{-5} and with a molecular weight of 200 grams/mole or less (EPA 1991).

Tables 2 and 3 show the default parameter values suggested for use by SNL/NM at SWMUs, based upon the selected land use scenarios for nonradiological and radiological COCs, respectively. References are given at the end of the table indicating the source for the chosen parameter values. SNL/NM uses default values that are consistent with both regulatory guidance and the RME approach. Therefore, the values chosen will, in general, provide a conservative estimate of the actual risk parameter. These parameter values are suggested for use for the various exposure pathways, based upon the assumption that a particular site has no unusual characteristics that contradict the default assumptions. For sites for which the assumptions are not valid, the parameter values will be modified and documented.

Summary

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

Table 2
Default Nonradiological Exposure Parameter Values for Various Land Use Scenarios

Parameter	Industrial	Recreational	Residential
General Exposure Parameters			
Exposure Frequency (day/yr)	250[a,b]	8.7 (4 hr/wk for 52 wk/yr)[a,b]	350[a,b]
Exposure Duration (yr)	25[a,b,c]	30[a,b,c]	30[a,b,c]
Body Weight (kg)	70[a,b,c]	70 Adult[a,b,c] 15 Child[a,b,c]	70 Adult[a,b,c] 15 Child[a,b,c]
Averaging Time (days) for Carcinogenic Compounds (= 70 yr x 365 day/yr) for Noncarcinogenic Compounds (= ED x 365 day/yr)	25,550[a,b] 9,125[a,b]	25,550[a,b] 10,950[a,b]	25,550[a,b] 10,950[a,b]
Soil Ingestion Pathway			
Ingestion Rate (mg/day)	100[a,b]	200 Child[a,b] 100 Adult[a,b]	200 Child[a,b] 100 Adult[a,b]
Inhalation Pathway			
Inhalation Rate (m^3/day)	20[a,b]	15 Child[a] 30 Adult[a]	10 Child[a] 20 Adult[a]
Volatilization Factor (m^3/kg)	Chemical Specific	Chemical Specific	Chemical Specific
Particulate Emission Factor (m^3/kg)	1.36E9[a]	1.36E9[a]	1.36E9[a]
Water Ingestion Pathway			
Ingestion Rate (liter/day)	2.4[a]	2.4[a]	2.4[a]
Dermal Pathway			
Skin Adherence Factor (mg/cm^2)	0.2[a]	0.2 Child[a] 0.07 Adult[a]	0.2 Child[a] 0.07 Adult[a]
Exposed Surface Area for Soil/Dust (cm^2/day)	3,300[a]	2,800 Child[a] 5,700 Adult[a]	2,800 Child[a] 5,700 Adult[a]
Skin Adsorption Factor	Chemical Specific	Chemical Specific	Chemical Specific

[a]Technical Background Document for Development of Soil Screening Levels (NMED 2000).
[b]Risk Assessment Guidance for Superfund, Vol. 1, Part B (EPA 1991).
[c]Exposure Factors Handbook (EPA August 1997).
ED = Exposure duration.
EPA = U.S. Environmental Protection Agency.
hr = Hour(s).
kg = Kilogram(s).
m = Meter(s).
mg = Milligram(s).
NA = Not available.
wk = Week(s).
yr = Year(s).

Table 3
Default Radiological Exposure Parameter Values for Various Land Use Scenarios

Parameter	Industrial	Recreational	Residential
General Exposure Parameters			
Exposure Frequency	8 hr/day for 250 day/yr	4 hr/wk for 52 wk/yr	365 day/yr
Exposure Duration (yr)	25[a,b]	30[a,b]	30[a,b]
Body Weight (kg)	70 Adult[a,b]	70 Adult[a,b]	70 Adult[a,b]
Soil Ingestion Pathway			
Ingestion Rate	100 mg/day[c]	100 mg/day[c]	100 mg/day[c]
Averaging Time (days) (= 30 yr x 365 day/yr)	10,950[d]	10,950[d]	10,950[d]
Inhalation Pathway			
Inhalation Rate (m^3/yr)	7,300[d,e]	10,950[e]	7,300[d,e]
Mass Loading for Inhalation g/m^3	1.36 E-5[d]	1.36 E-5[d]	1.36 E-5[d]
Food Ingestion Pathway			
Ingestion Rate, Leafy Vegetables (kg/yr)	NA	NA	16.5[c]
Ingestion Rate, Fruits, Non-Leafy Vegetables & Grain (kg/yr)	NA	NA	101.8[b]
Fraction Ingested	NA	NA	0.25[b,d]

[a]Risk Assessment Guidance for Superfund, Vol. 1, Part B (EPA 1991).
[b]Exposure Factors Handbook (EPA August 1997).
[c]EPA Region VI guidance (EPA 1996).
[d]For radionuclides, RESRAD (ANL 1993).
[e]SNL/NM (February 1998).
EPA = U.S. Environmental Protection Agency.
g = Gram(s)
hr = Hour(s).
kg = Kilogram(s).
m = Meter(s).
mg = Milligram(s).
NA = Not applicable.
wk = Week(s).
yr = Year(s).

References

ANL, see Argonne National Laboratory.

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

DOE, see U.S. Department of Energy.

EPA, see U.S. Environmental Protection Agency.

New Mexico Environment Department (NMED), March 2000. "Assessing Human Health Risks Posed by Chemical: Screening-level Risk Assessment", Hazardous and Radioactive Materials Bureau, NMED, March 6, 2000.

New Mexico Environment Department (NMED), December 2000. "Technical Background Document for Development of Soil Screening Levels", Hazardous Waste Bureau and Ground Water Quality Bureau Voluntary Remediation Program, December 18, 2000.

Sandia National Laboratories/New Mexico (SNL/NM), February 1998. "RESRAD Input Parameter Assumptions and Justification," Sandia National Laboratories/New Mexico Environmental Restoration Project, Albuquerque, New Mexico.

U.S. Department of Energy (DOE), 1993. DOE Order 5400.5, "Radiation Protection of the Public and the Environment," U.S. Department of Energy, Washington, D.C.

U.S. Department of Energy, U.S. Air Force, and U.S. Forest Service, October 1995. "Workbook: Future Use Management Area 1," prepared by the Future Use Logistics and Support Working Group in cooperation with U.S. Department of Energy Affiliates, the U.S. Air Force, and the U.S. Forest Service.

U.S. Department of Energy, U.S. Air Force, and U.S. Forest Service, September 1995. "Workbook: Future Use Management Area 2," prepared by the Future Use Logistics and Support Working Group in cooperation with U.S. Department of Energy Affiliates, the U.S. Air Force, and the U.S. Forest Service.

U.S. Department of Energy and U.S. Air Force (DOE and USAF), January 1996. "Workbook: Future Use Management Areas 3,4,5,and 6," prepared by the Future Use Logistics and Support Working Group in cooperation with U.S. Department of Energy Affiliates, and the U.S. Air Force.

U.S. Department of Energy and U.S. Air Force (DOE and USAF), March 1996. "Workbook: Future Use Management Area 7," prepared by the Future Use Logistics and Support Working Group in cooperation with U.S. Department of Energy Affiliates and the U.S. Air Force.

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

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

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

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

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

U.S. Environmental Protection Agency (EPA), August 1997. *Exposure Factors Handbook*, EPA/600/8-89/043, U.S. Environmental Protection Agency, Office of Health and Environmental Assessment, Washington, D.C.

U.S. Environmental Protection Agency (EPA), 1997. (OSWER No. 9200.4-18) *Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination*, U.S. EPA Office of Radiation and Indoor Air, Washington D.C, August 1997.