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DEPARTMENT OF THE AIR FORCE

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CANNON AIR FORCE BASE, NEW MEXICO

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W. P. Ard, Colonel, USAF
Commander, 27th Support Group
100 S DL Ingram Blvd Suite 200
Cannon AFB NM 88103-5217

RECEIVED
MAR 8 1996

Ms. Barbara Hoditschek
New Mexico Environment Department
Hazardous & Radioactive Materials Bureau
2044 Galisteo Street
Santa Fe NM 87502

Dear Ms. Hoditschek

Enclosed for your review and comments is the draft RCRA Facility Investigation Report for Landfill 5 located on Cannon AFB.

If you have any questions, please contact Mr. Sanford Hutsell at (505) 784-4348 or Mr. John Constantine at (505) 784-6378.

Sincerely

W. P. ARD, Colonel, USAF
Commander, 27th Support Group

Attachment:
Draft RCRA RFI Report Landfill 5

cc:
EPA Region VI (D. Neleigh)
NMED GW Bureau (J. Jacobs)
HQ ACC CES/ESVW (w/o Atch) (M. Calvert)

Woodward-Clyde

Engineering & sciences applied to the earth & its environment

February 12, 1996

Department of the Army
Corps of Engineers, Omaha District
Attn: CEMRO-ED-EC (Douglas Mellema)
215 North 17th Street
Omaha, Nebraska 68102-4978

Subject: Draft Phase I RFI Report for Landfill No. 5
Cannon Air Force Base, New Mexico
Indefinite Delivery Order 0034 Contract DACW45-93-D-0005
Delivery Order No. 0012
WCFS Project No. C3M11M (T008)

Dear Mr. Mellema:

We are pleased to transmit the Draft Phase I RFI report for Landfill No. 5. The Draft RFI report contains revisions that were necessary to address your comments received on 11 January 1996.

If you have questions regarding the Draft Phase I RFI report or the project in general, please do not hesitate to call me.

Sincerely,

Karen Phillips for

Jeffrey Ehrenzeller
Project Manager

JLE:arh
Enclosures (5)
(1 copy sent)

7c w/enclosures:	Mr. John Constantine, Cannon AFB, NM
1c w/enclosures:	U.S. Army Missouri River Division
1c w/enclosures:	Ms. Margaret Calvert, Langley AFB
1c:	File: C3M11M.8A.1

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VOLUME I

PHASE I RCRA FACILITY INVESTIGATION REPORT FOR LANDFILL NO. 5 (SWMU NO. 113/ IRP NO. LF-5)

PROJECT CZQZ 92 7007

CANNON AIR FORCE BASE

CLOVIS, NEW MEXICO

Prepared for
Commander 27 FW
100 South D.L. Ingram Blvd.
Suite 100
Cannon AFB, NM 88103-5214

February 1996

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μg/g	microgram per gram
%D	percent difference
%R	percent recovery
ACC	Air Combat Command
AFB	Air Force Base
ARARs	Applicable or Relevant and Appropriate Requirements
ATV	all-terrain vehicle
bgs	below ground surface
B.P.	Before Present
CCAL	continuing calibration
CCB	continuing calibration blanks
CEC	cation exchange capacity
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CL	inorganic clays
CLP	Contract Laboratory Program
CME	Central Mine Equipment
CMI	Corrective Measures Implementation
CMS	Corrective Measures Study
cm/sec	centimeters per second
COC	Chain of Custody
COI	chemicals of interest
CRQL	contract required quantitation limit
CUZ	Compatible Use Zones
DBC	dibutylchlorendate
DBCP	1,2-dibromo-3-chloropropane
DCB	decachlorobiphenyl
DCQAP	Data Collection Quality Assurance Plan
DCS	duplicate control samples
DMP	Data Management Plan
DOD	(U.S.) Department of Defense
DQCRs	Daily Quality Control Reports
EM	electromagnetic
EPA	Environmental Protection Agency
EPFC	Exposure Pathways Flow Chart
FS	Feasibility Study
FSP	Field Sampling Plan
Fy	fiscal year
gal/ft	gallon per foot
GC	gas chromatography
GFAA	graphic furnace atomic absorption

gpm	gallon per minute
HHRS	human health risk screen
ICP	inductively coupled plasma
IRP	Installation Restoration Program
LCS	laboratory control samples
LOQ	Limit of Quantitation
MCGL	Maximum Contaminant Goals
MCL	maximum contaminant level
MCP	Military Construction Program
MFH	military family housing
mg/kg	milligrams per kilogram
mg/L	milligram per liter
ML	inorganic silts
mph	miles per hour
MRD	Missouri River Division
MS/MSD	Matrix Spike/Matrix Spike Duplicate
msl	mean sea level
NAPL	non-aqueous phase liquids
NCP	National Contingency Plan
NMED	New Mexico Environmental Department
NPL	National Priority List
NWR	National Wildlife Refuge
OD	outside diameter
OPP	organophosphorus pesticides
OSHA	Occupational Safety and Health Administration
PA	Preliminary Assessment
PAHs	polynuclear aromatic hydrocarbons
PCBs	polychlorinated biphenyl hydrocarbons
PCDDs/PCDFs	polychlorinated dibenzodioxins/polychlorinated dibenzofurans
PCE	tetrachloroethylene
PID	photoionization detector
PMP	Project Management Plan
ppm/v	part per million on a volume by volume basis
PRG	preliminary remediation goal
PRP	potentially responsible party
PRT	Post Run Tubing
QA/QC	Quality Assurance/Quality Control
RAS	Relevant and Appropriate Standards
RCRA	Resource Conservation and Recovery Act
RD/RA	Remedial Design/Remedial Action
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RI	Remedial Investigation
ROD	Record of Decision
RPD	relative percent difference

RRF	relative response factors
RRT	relative retention time
RSD	relative standard deviations
RT	retention time
SARA	Superfund Authorization and Responsibility Act
SC	clayey sand
SCS	single control samples
SDWA	Safe Drinking Water Act
SI	Site Investigation
SM	silty sand
SMCLs	secondary maximum contamination levels
SOPs	Standard Operating Procedures
SOS	Scope of Service
SP	poorly graded fine-grained sand
SQL	sample quantitation limit
SSHP	Site Safety and Health Plan
SVOCs	Semi-Volatile Organic Compounds
SW	well-graded sands
SWMU	Solid Waste Management Unit
TAL	Target Analyte List
TBC	to be considered guidance materials
TCE	trichloroethylene
TCL	Target Compound List
TCX	tetrachloro-m-xylene
TFW	Tactical Fighter Wing
TIC	tentatively identified compound
TOC	Total Organic Carbon
TRPH	Total Recoverable Petroleum Hydrocarbons
USACE	United States Army Corps of Engineers
USAF	United States Air Force
USCS	Unified Soil Classification System
USDA-SCS	United States Department of Agriculture-Soil Conservation Service
USFWS	United States Fish and Wildlife Service
UST	underground storage tank
UTL	upper tolerance level
VOC	Volatile Organic Compound
W-C	Woodward-Clyde
WCFS	Woodward-Clyde Federal Services

A Phase I RCRA Facility Investigation (RFI) was conducted to evaluate the nature and extent of potential soil contamination at Landfill No. 5 (SWMU No. 113/IRP No. LF-5) located at the Cannon Air Force Base Installation (Cannon AFB) near Clovis, New Mexico. This SWMU was identified during a RCRA Facility Assessment (RFA) performed by the U.S. Environmental Protection Agency in 1987.

The Phase I RFI was conducted to satisfy requirements of the United States Air Force (USAF) Installation Restoration Program (IRP), as well as the conditions of the Cannon AFB RCRA operating permit. Activities for the Phase I RFI effort at Landfill No. 5 were performed in accordance with the RFI Work Plan documents prepared by Woodward-Clyde (W-C) as specified in the United States Army Corps of Engineers (USACE) Scope of Service (SOS) for the Phase I Investigation dated June 18, 1993. The Work Plan was approved by the New Mexico Environment Department (NMED) on June 14, 1995.

A human health risk screen was performed as part of the RFI to help support risk decisions for Landfill No. 5.

Field Activities

The Phase I RFI field activities were carried out during 1995 and consisted of site topographic surveying and mapping, surface geophysical surveying, a soil gas investigation, and surface and subsurface soil investigation.

The site topographic surveying and mapping were conducted just prior to the start of the geophysical surveys.. A survey grid was established by a local land surveying company (licensed in the state of New Mexico) to provide a detailed topographic base map, establish a survey grid at 50-foot centers across Landfill No. 5, and locate soil borings drilled during the investigation.

Following the site surveying and mapping by the licensed land surveyor W-C conducted electromagnetic (EM) and magnetic surveys across Landfill No. 5. These surveys were

conducted from January 19 through January 27, 1995. The objectives of the geophysical investigation included:

- Delineating the edges of the landfill
- Locating waste-filled pits, trenches or cells within the landfill
- Identifying potential areas of contamination
- Obtaining information for use in performing the soil gas survey

For the investigation at Landfill No. 5, EM data were collected with a Geonics EM-31 and magnetic surveys were performed using as GEM GSM-19 portable magnetometer/gradiometer.

Upon completion of the EM and magnetic surveys, the data were downloaded into a personal computer and geophysical contour maps produced. In interpreting the geophysical results, the likely causative contributors to an anomaly were considered. The geophysical contour maps appeared to be consistent with the reported historical activities known to have taken place at the site. The eastern portion of Landfill No. 5 was dominated by north-south trending linear anomalies indicative of trenching activities. East-west trending or southwest trending anomalies were depicted in the southern portion of Landfill No. 5 also indicative of trenching type activities. In the western portion of the surveyed area of Landfill No. 5, a much more random distribution of geophysical anomalies existed, with few discernible linear trends supporting historical reports that landfill materials may have been deposited in this area using a semi-random landfill disposal operation (i.e., filling of natural depressions) rather than using a trenching disposal method.

A soil gas investigation was then conducted following the completion and interpretation of the surface geophysical surveys. The geophysical data results aided in the soil gas investigation by helping to optimize soil sampling locations across Landfill No. 5.

The purpose of performing the soil gas investigation was to identify areas of elevated concentrations of volatile organic compounds (VOCs) in the soil gas at Landfill No. 5. The soil gas survey was performed as a two-phase investigation. The first phase of the soil gas survey consisted of collecting and field screening soil gas samples at 800 locations using a field photoionization detector (PID). Soil gas samples were collected using a geoprobe. One-

inch diameter soil gas sampling probes were driven into the soil to the targeted depth and a soil gas sample extracted and collected into a syringe. The soil gas was then expelled from the syringe into the orifice of the field PID and a maximum reading noted and recorded.

With few exceptions, the highest PID field screening results occurred within or adjacent to the mapped landfill trench boundaries and or in the area of geophysical anomalies as identified from the magnetic and electromagnetic survey results.

Following review of the PID soil gas results, 78 soil gas samples were collected and analyzed for VOCs using a gas chromatograph (GC). Of these 78 locations analyzed for VOCs, 51 of the locations indicated concentrations below the laboratory reporting limit of 1.2 parts per million on a volume to volume basis (ppm/v). Thirty-seven of the locations detected VOCs above the laboratory reporting limit with sixteen different VOC analytes being reported in the soil gas samples. For the sixteen analytes detected in GC analysis of the soil gas, 74 percent of the reported detections were at concentrations below 5.0 ppm/v.

The 16 VOC analytes tentatively identified can be separated into three analyte classes: (1) petroleum related or fuel additive compounds (i.e., 5 analytes including; benzene, toluene, ethylbenzene, xylenes, and chloroethane); (2) compounds commonly used in refrigerants or as blowing (foam) agents (i.e., 3 analytes including; trichlorofluoromethane, dichlorodifluoromethane, and chloromethane); and (3) compounds typically used as solvents (i.e., 8 analytes; dichloromethane [methylene chloride], tetrachloroethylene [PCE], trichloroethylene [TCE], 1,1,1,2-tetrachloroethane, 1,1,1-trichloroethane, 1,1-dichloroethylene, chlorobenzene, and trans 1,2-dichloroethylene). Results showed that VOCs were present at low concentrations in soil gas at distinct locations within or adjacent to previously mapped landfill trenches.

Following the surface geophysical surveys and the soil gas investigation, a surface and subsurface soil investigation was designed based on the results of these two investigations The geophysical results provided a better estimation of individual trench locations and the soil gas investigation aided in drilling in those areas of suspected VOC contamination within the landfill trenches or cells. Selected boring locations were preapproved by the USACE and NMED.

The surface and subsurface investigation for the Phase I RFI was conducted from July 17 through August 1, 1995. Thirty analytical soil borings and three geotechnical borings were drilled, and surface/subsurface soil samples were collected and submitted for chemical analysis. Borings were drilled to depths of approximately 40 feet below the landfill/native soil interface. At 10 of the 30 analytical boring locations, one surface sample was collected and analyzed for VOCs, SVOCs, pesticides/PCB, metals, cyanide and TRPH. Borings were drilled using a truck-mounted Central Mine Equipment (CME) 75 high-torque auger drill rig using hollow-stem augers. CME 5-foot continuous core barrels with polybutyrate liners were used to collect samples for description of the landfill waste material. Upon retrieval and opening of each core barrel soil, landfill waste was extruded from the polybutyrate lines onto the core barrel and a PID was used to screen the entire sample for the presence of volatile organic vapors.

After sampling through the landfill waste material and identifying the landfill/native soil interface, soil samples were collected for chemical and/or lithologic description at approximate 5-foot intervals to 40 feet below the landfill native soil interface using a 2-foot-long, modified California split spoon with stainless steel liners. Upon retrieval and opening of the split spoon, the PID was used to screen the entire sample for the presence of volatile organic vapors. The stainless steel liner displaying the highest PID reading in the split spoon was selected for VOC analysis; otherwise, the bottom-most liner within the split spoon sampler was selected and submitted to the laboratory for VOC analysis. The remaining soil was then extracted from the stainless steel liners, homogenized and placed into appropriate jars.

Nature and Extent of Contamination

To describe the nature and extent of surface and subsurface soil contamination at Landfill No. 5, surface and subsurface soil that contained metals above background and chemical compounds that do not occur naturally in the environment were identified. Chemicals analyzed during the Phase I RFI included metals, VOCs, semi-volatile organic compounds (SVOCs), pesticides/polychlorinated biphenyls (PCBs), cyanide, herbicides, dioxin and furans, total recoverable petroleum hydrocarbons (TRPH) and volatile and semivolatile tentatively identified (TIC) compounds. The occurrence of these compounds are discussed below:

Metals

Three elements, calcium, potassium and sodium, were considered to be naturally occurring even though there were exceedances of these elements above background concentrations and were not considered to be contaminants at Landfill No. 5.

Nine metals were detected above background in the surface soil samples collected and analyzed during the Phase I RFI. Their frequency of occurrence, the borings where they were found, and the range of reported concentrations are summarized below:

Analyte	Frequency	Boring(s)	Range or Maximum Concentration(s) Reported Above Background (mg/kg)	Established Background Range for Cannon AFB (mg/kg)[1]
Beryllium	1 sample	113-04	0.7	0 - 0.6
Chromium	1 sample	113-16	19.2	0.8 - 12
Cobalt	1 sample	114-04	5	0 - 4
Iron	1 sample	113-04	9,610	0 - 8,654
Lead	2 samples	113-16, 113-22	41.4-78.2	0 - 18.4
Manganese	1 sample	113-04	275	0 - 151.8
Potassium	1 sample	113-04	2,970	0 - 2,531
Sodium	1 sample	113-13	3,920	0 - 834
Zinc	4 samples	113-04, 113-16, 113-22, 113-28	21.8-28.2	0 - 20.7

[1] Source: Woodward-Clyde. 1994. Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater, Cannon AFB, New Mexico.

Of these 9 metals, 5 metals (beryllium, cobalt, lead, manganese, and sodium) were found exclusively in surface samples. However, in all cases, the metals detected above the maximum background value in surface soil samples were not found above background at depth in any of

the borings. The occurrence of some of these metals above the background values (i.e., lead, cobalt, beryllium, chromium, iron and zinc) are likely due to the presence of pieces of scrap metal on the ground surface at Landfill No. 5.

In the subsurface soil collected and analyzed during the Phase I RFI, 8 metals (arsenic, beryllium, cadmium, cobalt, antimony, mercury, selenium and thallium) were not detected at concentrations above background and were, therefore, not further evaluated within the RFI report.

Ten metals were detected in subsurface soil at Landfill No. 5 at concentrations above the established background range for soil at Cannon AFB. The frequency of occurrence in subsurface samples, the range of reported concentrations above background, and the background range of each metal are summarized below:

Analyte	Frequency of Occurrence Above Background	Range or Maximum Concentration(s) Reported Above Background (mg/kg)	Established Background Range for Cannon AFB (mg/kg)[1]
Aluminum	1 sample in one boring	11,100	593 - 10,796
Barium	9 samples in seven borings	595 - 5,050	0 - 548
Chromium	5 samples in four borings	14.1 - 40.7	0.8 - 12.0
Copper	7 samples in five borings	11.6 - 63.6	0 - 10.1
Iron	2 samples in two borings	8,810 - 9,580	0 - 8,654
Magnesium	8 samples in seven borings	10,200 - 16,300	0 - 9,912
Nickel	11 samples in ten borings	10.4 - 68.6	0 - 9.7
Silver	1 sample in one borings	4.8	0 - 1.8
Vanadium	7 samples in five borings	25.5 - 36.7	1.7 - 25.0
Zinc	4 samples in four borings	23.4 - 59	0 - 20.7

[1] Source: Woodward-Clyde. 1994. Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater, Cannon AFB, New Mexico.

These 10 metals were detected in at least one subsurface soil sample above the background range established in an earlier study for Cannon AFB. Out of 1,500 analytical results for these 10 metals, background was exceeded for only 55 results (i.e., a frequency of 4 percent). Given the isolated and random occurrence of these metals above background within individual borings and areally across Landfill No. 5, it appears that site-specific geologic factors probably account for exceedences and these metals are not likely due to contamination from waste in the landfill cells. In a majority of cases, the metals listed above did not exceed background in the sample collected immediately beneath the landfill cell. Typically within the same boring the metal exceeding background was not detected above background in samples collected above or below the interval where the exceedence occurred.

Volatile Organic Compounds

A total of 8 VOCs (i.e., 1,1,2,2-tetrachloroethane, 2-hexanone, 4-methyl-2-pentanone, acetonitrile, carbon disulfide, ethylbenzene, styrene, and toluene) were detected at 16 boring locations scattered across Landfill No. 5. The distribution and occurrence of these VOCs in subsurface soil samples, the borings in which they were found, and the range of concentrations detected are summarized below.

Analyte	Frequency of Detection	Boring(s)	Detected Concentrations (µg/kg)
1,1,2,2 - Tetrachloroethane	4 samples	113-21	2.3J to 8.2
2-Hexanone	6 samples	113-05, 113-10, 113-16, 113-17, 113-24	1.5J-8.3J
4-Methyl-2-pentanone (MIBK)	5 samples	113-10, 113-16, 113-17	2.5J-230
Acetonitrile	4 samples	113-05, 113-07, 13-08, 113-12	16J to 67J
Carbon disulfide	1 sample	113-06	2.9J
Ethylbenzene	1 sample	113-13	300

Analyte	Frequency of Detection	Boring(s)	Detected Concentrations (µg/kg)
Styrene	1 sample	113-13	1400
Toluene	7 samples	113-04, 113-10, 113-18, 113-22, 113-24, and 113-25	1J-4.9J

These 8 VOCs were detected in subsurface soil a total of 29 times out of 1,200 analytical results for these chemicals — a frequency of 3 percent. Concentration of the detected VOCs ranged from 1 "J" µg/kg to 1,400 µg/kg. Twenty-four of the 29 detections were below the laboratory reporting limit and were therefore in the range for which quantitation is considered uncertain and were qualified as estimated. Detection of ethylbenzene and styrene at concentrations of 300 µg/kg and 1,400 µg/kg, respectively, in boring 113-13 and 4-methyl-2-pentanone (MIBK) at 230 µg/kg immediately beneath the landfill cells are the only results indicative of a potential release of VOCs. Two of these compounds (i.e., ethylbenzene and styrene) were not detected in deeper samples collected within boring 113-13, while MIBK was detected in the two deeper intervals collected in boring 113-16 below the interval sampled immediately beneath the landfill cell.

Detections of the 8 VOCs in surface soil samples occurred at values below the laboratory reporting limit except for the detection of styrene (8.2 µg/kg) at location 113-13.

Semivolatile Organic Compounds

Twelve SVOCs were detected in 11 subsurface soil samples. These included 7 PAHs (2-methylnaphthalene, acenaphthene, chrysene, fluoranthene, fluorene, phenanthrene, pyrene), 3 phenols (4-methylphenol, 4-nitrophenol, phenol), and 1 furan (dibenzofuran). There were no occurrences of SVOCs detected in surface soil samples collected. The distribution and occurrence of the SVOCs in subsurface soil samples, the borings they were found in, and the range of concentrations detected are summarized below:

Polynuclear Aromatic Hydrocarbons

Analyte	Frequency of Detection	Boring(s)	Detected Concentrations (µg/kg)
2-Methylnaphthalene	1 sample	113-13	85J
Acenaphthene	3 samples	113-01 and 113-13	37J-82J
Chrysene	1 sample	113-13	38J
Fluoranthene	2 samples	113-01 and 113-13	67J-93J
Fluorene	2 samples	113-01 and 113-13	41J-69J
Phenanthrene	2 samples	113-01 and 113-13	41J-220J
Pyrene	2 samples	113-01 and 113-13	74J-88J

Phenols

Analyte	Frequency of Detection	Boring(s)	Detected Concentrations (µg/kg)
4-Methylphenol	2 samples	113-16 and 113-24	68J-100J
4-Nitrophenol	2 samples	113-15	49J-69J
Phenol	2 samples	113-01, 113-16 and 113-17	40J-88J

Furans

Analyte	Frequency of Detection	Boring(s)	Detected Concentrations (µg/kg)
Dibenzofuran	1 sample	113-13	44J

PAH compounds were restricted to 2 borings (i.e., 113-01 and 113-13). The concentrations were all below the laboratory reporting limit of 360 µg/kg. As such, they were in the range for which quantitation of sample results is uncertain and were qualified as estimated. It should be noted that PAHs in boring 113-01 occurred in the sample collected at 63 feet, but not in

shallower samples. Additionally, the PAHs in boring 113-13 were, for the most part, detected in the sample at 40 feet with significantly fewer detections above or below this sample.

Phenols were detected eight times scattered over 5 borings all at values equal to or below the laboratory reporting limit. In 2 borings, no phenols were detected in the sample collected immediately beneath the landfill cell. However, phenol was detected immediately beneath the landfill cell at 360 µg/kg and 40 "J" µg/kg in borings 113-0 and 113-15, respectively. The SVOC 4-methylphenol (100 "J" µg/kg) and 4-nitrophenol (49 "J" µg/kg) were also detected immediately beneath the landfill cell in borings 113-16 and 113-15, respectively. These data indicate that a minor release of phenols possibly could have occurred at borings 113-0, 113-15, and 113-16.

Dibenzofuran was detected in only one sample (44 "J" µg/kg) collected at Landfill No. 5. This detection occurred in the second interval sampled below the landfill cell in boring 113-13.

PCBs

Only one detection of Aroclor 1254 at a minor concentration of 75 µg/kg occurred during the Phase I RFI and this result does not indicate a significant release has occurred to subsurface soil at Landfill No. 5 for this compound.

Pesticides, herbicides and cyanide, dioxins and furans

No pesticides, herbicides, cyanide or dioxins and furans were detected in surface or subsurface soil samples collected during the Phase I RFI.

TRPH

TRPH was detected in 6 surface soil samples and 4 subsurface soil samples at concentrations ranging from 43.5 mg/kg to 170 mg/kg. These results indicate the presence of only minor contamination.

Volatile and Semivolatile TICs

During the Phase I RFI, volatile and semivolatile organic TICs were reported in several samples by the laboratory. These TICs were categorized based on the nature of the compound and on professional judgment as to their potential toxicity to the environment or human health. The majority of these compounds appeared to be potentially non-toxic and included alcohols, ketones, fatty acids and esters, saturated hydrocarbons and unknowns. TICs with potential toxicity were further evaluated in the human health risk screen.

In summary, it appears that if a release of hazardous constituents has occurred at Landfill No. 5, it has been insignificant. Additionally, based on the fact that free liquids or soil saturated with liquid wastes were not observed within the landfill wastes while drilling, the potential for a release to occur at Landfill No. 5 in the future is minimal.

Chemical Fate and Transport

Chemicals detected at Landfill No. 5 were grouped into SVOCs, VOCs, and metals to evaluate fate and transport. The following conclusions were drawn from the evaluation:

SVOCs

- PAH compounds are likely to be relatively immobile, but could persist for long periods of time in the subsurface soil environment due to low biodegradation rates.

- PCBs are likely to be relatively immobile and may persist in the subsurface soil environment.

- Phenol compounds appear to be highly mobile but would not likely persist for long periods of time in the subsurface soil environment due to high biodegradation rates.

VOCs

As a group, the VOCs are likely to be medium to highly mobile in the subsurface soil environment. However, these chemicals would not likely persist for long periods of time due to high

volatilization potential and very high biodegradation rates (excluding the chlorinated solvent 1,1,2,2-tetrachloroethane). When considering biodegradation, 1,1,2,2-Tetrachloroethane could persist in the environment since biodegradation of this compound occurs very slowly if at all under aerobic conditions with low organic carbon content, as found in the vadose zone at Landfill No. 5.

Metals

Based on general characteristics of subsurface soil at Landfill No. 5 which include moderate clay content and an alkaline soil pH, metals are not likely to be mobile in the subsurface but would likely persist for long periods of time. The potential for precipitation of metals in the subsurface, thus limiting downward migration in the vadose zone, is evidenced by caliche layers encountered in the borings drilled during the Phase I RFI.

Human Health Risk Screen

A Human Health Risk Screen (HHRS) was performed as part of the Phase I evaluation for Landfill No. 5. The purpose of the HHRS was to determine whether chemicals of interest (COIs) were detected in soil at levels that may pose an unacceptable risk to human health. Maximum site concentrations were compared to proposed RCRA Action Levels for residential soil ingestion to evaluate the potential for cumulative hazard/risk. The HHRS did not include estimating reasonable exposure concentrations or assessing current or future site-specific exposure conditions (e.g., future residential land use is considered to be extremely unlikely at this site). Conservative assumptions were used throughout the HHRS; therefore, the results of the assessment overestimate actual hazard/risk at the site.

COIs evaluated during the HHRS included:

Inorganic Compounds	Organic Compounds
Aluminum	1,1,2,2-Tetrachloroethene
Barium	4-Methyl-2-pentanone (MIBK)
Beryllium	4-Methylphenol
Chromium	4-Nitrophenol
Cobalt	Acenaphthene
Copper	Acetonitrile

Inorganic Compounds	Organic Compounds
Lead	Aroclor 1254
Manganese	Carbon disulfide
Nickel	Chrysene
Silver	Ethylbenzene
Tin	Fluoranthene
Vanadium	Fluorene
Zinc	Phenol
	Pyrene
	Styrene
	Toluene

Of the COIs, only one carcinogen, beryllium, had a maximum concentration (0.7 mg/kg) exceeding its proposed RCRA Action Level (0.2 mg/kg). This one maximum value was the only result for this metal that exceeded the upper limit of the background range (0.6 µg/kg) for 160 samples collected and analyzed. The associated cancer risk for beryllium, assuming a 70-year soil ingestion exposure to the maximum concentration, was 4E-06, well within EPA's target cancer risk range of 1E-06 to 1E-04. Estimated cumulative cancer risk from exposure to maximum concentrations of all detected carcinogens was also 4E-06 due to the presence of beryllium. When the 95% UCL of the arithmetic mean is used to represent the exposure concentration of beryllium in soil, the site concentration (0.24 mg/kg) is approximately equal to the proposed RCRA Action Level (0.2 mg/kg) and the chemical-specific and cancer risk is approximately 1E-06 from soil ingestion. Because the use of maximum detected concentrations overestimates cancer risk for each COI, and cancer risk estimates were nevertheless within EPA's target risk range, it was concluded that exposure to COIs at Landfill No. 5 is not likely to pose an unacceptable risk of cancer.

No noncarcinogenic chemical had a maximum concentration exceeding its proposed RCRA Action Level. The cumulative hazard index for noncarcinogenic effects was 1, indicating that maximum concentrations of noncarcinogenic chemicals in soil at Landfill No. 5 do not pose an unacceptable risk to human health.

A proposed RCRA Action Level could be calculated for only two TICs, acetic acid, ethyl ester (ethyl acetate) and acetic acid, methyl ester (methyl acetate) since toxicity factors were

not available for the other reported TICs. The maximum detected concentration of ethyl acetate during the Phase I RFI was 0.11 mg/kg while the proposed RCRA Action Level was 70,000 mg/kg, yielding a hazard quotient of 2E-06. The maximum detected concentration of methyl acetate was 0.0074 mg/kg while the proposed RCRA Action Level was 80,000 mg/kg, yielding a hazard quotient of 9.3E-08. These values were well below 1 indicating that ethyl acetate and methyl acetate at the site will not pose a threat to human health. Remaining TICs were evaluated qualitatively and from that evaluation it was concluded that the TICs would not likely pose an unacceptable risk to human health.

Based on the results of the HHRS, it was concluded that COIs at Landfill No. 5 do not pose an unacceptable risk to human health.

Recommendations

Based on the results and conclusions of the Phase I RFI, **"No Further Action"** is recommended for this SWMU. This recommendation is supported by the lack of a significant release of hazardous constituents into subsurface soil and a human health risk screen that indicated an unacceptable risk to human health was not present from chemicals that were detected during the Phase I RFI for Landfill No. 5. Continued monitoring of groundwater quality from wells installed to assess potential impacts to groundwater from closed RCRA Cell No. 3 should be adequate for this SWMU.

1.0
INTRODUCTION

1.1 PURPOSE AND SCOPE OF REPORT

The purpose of this Phase I Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Report is to present results of activities performed to characterize the nature and extent of contamination (if any) beneath Landfill No. 5, (Solid Waste Management Unit (SWMU) No. 113), at Cannon Air Force Base (AFB), Clovis, New Mexico. The information obtained from the Phase I investigation at Landfill No. 5 including laboratory analytical results was used to evaluate whether a release of hazardous constituents had occurred to subsurface soil beneath the landfill cells and, if so, whether remedial action (i.e., a Corrective Measures Study (CMS) under RCRA or a Feasibility Study (FS) under the Comprehensive Environmental Response, Compensation, and Liability Act [CERCLA]) was necessary. A human health risk screen was also performed to support a decision regarding: (1) additional investigation (2) remedial action, or (3) no further action for this SWMU.

This RFI was conducted to satisfy requirements of the United States Air Force (USAF) Installation Restoration Program (IRP), as well as the conditions of the Cannon AFB RCRA operating permit. Activities for the Phase I RFI effort at Landfill No. 5 were conducted in accordance with the RFI Work Plan documents prepared by Woodward-Clyde (W-C) as specified in the United States Army Corps of Engineers (USACE) Scope of Service (SOS) for the Phase I investigation dated June 18, 1993. The RFI Work Plan (W-C 1995) included a Data Management Plan (DMP), Project Management Plan (PMP), Site Safety and Health Plan (SSHP) and Data Collection Quality Assurance Plan (DCQAP). These plans will hereafter be referred to as the Work Plan. The current Community Relations Plan for Cannon AFB was considered adequate by USACE and Cannon AFB, and therefore was not revised for the Landfill No. 5 investigation. These plans will hereafter be referred to as the Work Plan.

1.2 REGULATORY FRAMEWORK

As a condition of their RCRA Part B permit, Cannon AFB must evaluate SWMUs identified by the EPA during the RCRA Facility Assessment (RFA). Therefore, the Phase I

investigation conducted at Landfill No. 5 by W-C was designed to satisfy RFI guidance for characterizing the SWMU and developing and implementing corrective action measures, if necessary. The New Mexico Environment Department (NMED) is the lead regulatory agency for the RFI conducted at Landfill No. 5. NMED approved the Phase I RFI Work Plan documents for Landfill No. 5 on June 14, 1995.

To satisfy funding requirements under the USAF IRP, the investigation conducted by W-C at Landfill No. 5 must also follow the IRP CERCLA-based environmental restoration program for characterizing the nature and extent of risks posed by uncontrolled hazardous waste sites and for evaluating potential remedial options. The USAF is the lead agency for implementing IRP activities.

The following discussion provides a brief comparison of the RCRA and CERCLA programs. While RCRA authorizes a general regulatory program to manage all hazardous wastes from "cradle-to-grave" (from generation to ultimate disposal), CERCLA provides authority to respond whenever a release or substantial threat of a release that threatens human health or the environment occurs. CERCLA is the more comprehensive statute, as CERCLA "hazardous substances" encompass RCRA "hazardous wastes" as well as other pollutants regulated by the Clean Air Act, and the Toxic Substances Control Act. Thus, all RCRA "hazardous wastes" may trigger CERCLA response actions when released into the environment.

Under the IRP program, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) is the CERCLA-based environmental restoration program response process.

The RCRA and CERCLA Superfund programs use different labels but follow roughly parallel procedures in responding to releases (Table 1-1).

1.3 REPORT ORGANIZATION

The Phase I RFI Report for Landfill No. 5 is organized into nine sections and appendixes described below:

- Section 1.0, Introduction, describes the report organization, states the purpose and scope of the report, discusses the regulatory framework, and provides the general background information for Cannon AFB.

- Section 2.0, Physical Characteristics, presents the landfill setting, history of use, past investigations, land use and demography and regional soil and geologic conditions at Landfill No. 5.

- Section 3.0, Field Investigation, presents the field investigation objectives and methods and describes the specific field investigation activities conducted at Landfill No. 5. In addition, site-specific soil and geologic conditions and the landfill waste characterization at Landfill No. 5 is described.

- Section 4.0, Nature and Extent of Contamination, presents the chemical analytical results along with an assessment of data quality and describes the nature and extent of contamination in the soils, if any, based on the RFI results.

- Section 5.0, Contaminant Fate and Transport, discusses the factors that affect the movement and persistence of the contaminants identified in Section 4.0, describes potential routes of contaminant migration, and provides support for the human health risk screen.

- Section 6.0, Human Health Risk Screen, presents the results of the risk screen performed for human health.

- Section 7.0, Relevant and Appropriate Standards (RASs), presents RASs used for evaluating the nature and extent of potential hazardous waste contamination at Landfill No. 5.

- Section 8.0, Conclusions and Recommendations, provides the conclusions and recommendations based on the results of the field investigation and the human health risk screen for Landfill No. 5.

- Section 9.0, References, lists references for documents used in preparation of the Phase I RFI Report.

- Appendixes

  - Appendix A contains the detailed site topographic surveying and mapping notes.
  - Appendix B contains the Geophysical Survey Technical Report.
  - Appendix C contains the Soil Gas Technical Report.
  - Appendix D contains lithologic boring logs from the Phase I drilling program.
  - Appendix E contains the database printout for the soil analytical data results.
  - Appendix F provides details of the quality assurance procedures implemented for this project including laboratory data validation reports.

1.4 INSTALLATION BACKGROUND INFORMATION

1.4.1 Description and History of Cannon Air Force Base

Cannon AFB is located in Curry County, New Mexico, approximately seven miles west of the City of Clovis. The base is situated on approximately 4,320 acres south of the intersection of U.S. Highway 84/60 and New Mexico Highway 277. The vicinity map of Cannon AFB is shown in Figure 1-1, and the site map of Cannon AFB is shown in Figure 1-2. Base facilities include the airfield area with operation, maintenance, and support facilities located primarily northwest of the airfield area. Base housing is located in the northwest quarter of the base and north of the base, west of New Mexico Highway 277. Additional ancillary base support facilities such as the wastewater lagoons, fire department training area, and munitions storage are located south and east of the airfield.

Additional information on the history of Air Force operations at Cannon AFB are presented in Section 2.0 of the Work Plan (W-C 1995).

1.4.2 Facility Characteristics

The following subsections discuss the geography, land use and demography, climatology, and biological resources for Cannon AFB.

1.4.2.1 Physical Geography

Cannon AFB is situated in the Southern High Plains Physiographic Province in the Llano Estacado subprovince, as shown on Figure 1-3 (Hawley et al. 1976). The Llano Estacado is a nearly flat plain sloping gently (10 to 15 feet per mile) to the east and southeast. Elevations in the eastern New Mexico portion of the Llano Estacado exceed 4,000 feet above mean sea level (msl). In the vicinity of Cannon AFB, elevations range from 4,250 feet to 4,350 feet above msl.

The most prominent geomorphic features in the vicinity of Cannon AFB are blowouts and broad, widely spaced valleys. Less common landforms are relict sand dunes located along the northern side of the Portales Valley south of the base. Relict dunes are not found on or near Cannon AFB.

Blowouts are broad shallow depressions which form as the result of soil erosion by wind. Blowouts commonly collect surface runoff from small to moderate sized drainage areas. During periods of rainfall, runoff collects in blowouts to form ephemeral playa lakes. Playas have no external surface drainage. Water is lost by infiltration to the soil and evaporation; without recharge, playa lakes persist for only a few days or weeks. Three playas are located within the base, and several more are found to the north and east of the base. Stream valleys tend to be fairly broad and widely spaced.

Streams are ephemeral and drainages are poorly developed. No streams exist on or near Cannon AFB. Running Water Draw and Frio Draw, located about 10 and 20 miles, respectively, north of Cannon AFB, are the nearest streams. These are second-order streams. Both streams are very straight, flow southeast, and have rectilinear drainage patterns with short laterals.

1.4.2.2 Land Use Near Cannon AFB and Demography

This section provides a broad overview of site-wide land use and demographics, including the general area surrounding Cannon AFB. A more specific description of the demographics and land use at Landfill No. 5 is given in later sections of this RFI report.

Cannon AFB is located in southern Curry County, approximately seven miles west of the City of Clovis, New Mexico, which is the county seat. Bureau of Census data for 1990 reports the population of Curry County and the City of Clovis as 44,020 and 32,767 respectively. In 1991, Cannon AFB had a resident population of approximately 4,650, including military personnel and their dependents.

Currently, 1,841 housing units are controlled by Cannon AFB. Unaccompanied enlisted personnel reside in 830 dormitory units on-base. Military families live in 1,011 units, 250 of which are located off-base. Typically, military family housing (MFH) is maintained at 95 percent occupancy, while 5 percent are undergoing repairs and renovations.

Major industries by employment in Curry County include the retail trade, government, and services. Cannon AFB is the largest single employer within the county. The total work force on Cannon AFB is approximately 5,940 positions, which includes approximately 5,040 military and 900 civil service personnel.

Medical services are provided for Cannon AFB personnel and their dependents by two general hospitals in the surrounding communities and by the base hospital. Education of student dependents is provided by the Clovis Municipal School District. A total of 1,735 dependents of Cannon AFB personnel enrolled in Clovis schools during the 1989-1990 school year (USAF 1990).

Land use within Curry County is primarily agricultural. The county has a total land area of 897,000 acres with 837,200 acres designated as farmland; 133,700 acres of this are considered prime farmland (USAF 1990). Lands surrounding Cannon AFB are classified as irrigated farmland of statewide importance. Principal crops include corn, grain, sorghum, wheat, barley, oats, alfalfa, cotton, and various vegetables. Cattle ranching occurs throughout the county.

The City of Clovis is the commercial center for eastern New Mexico and western Texas and is one of the primary growth centers in a 17-county area. The Clovis planning area boundary extends for a five-mile area around the city. Currently, no land use or zoning controls restrict the type and amount of construction in the proximity of Cannon AFB.

Within Cannon AFB there are several land uses occurring, including residential, commercial (businesses, offices, commissary, etc.), industrial (facilities associated with base operations), recreational, and vacant land. The USAF has also designated Compatible Use Zones (CUZs) around Cannon AFB. The CUZs provide recommendations for compatible uses in areas subject to noise and accident hazards. The local communities or county governments are responsible for adopting appropriate land use controls to prevent incompatible development. The county has not passed zoning ordinances controlling development around Cannon AFB. Incompatible land use (in regard to the Air Force's CUZs) has occurred to the northeast of the base and includes both commercial and residential development.

1.4.2.3 Climatology

The climate of east-central New Mexico is classified as tropical semi-arid. Average monthly temperatures range from a January low of 39°F to a July high of 78°F. Extreme daily temperatures range from -11°F to 106°F. Average monthly precipitation ranges from 0.4 inches in winter to 2.7 inches in July. The maximum recorded 24-hour rainfall is 4.7 inches, which occurred in August 1985 (Hale 1992). Rainfall occurs on eight or more days per month during the summer precipitation maximum. Mean annual precipitation is approximately 15 inches. The mean annual lake evaporation is 69 inches/year. Prevailing winds are from the west at an average of 8 miles per hour (mph).

The atmosphere around the area of Cannon AFB is generally well mixed. The seasonal and annual average mixing heights can vary from 400 meters in the morning to 4,000 meters in the afternoon. The afternoon mixing heights are typically greater during the spring and fall seasons. The morning mixing heights are usually low, due to nighttime heat loss from the ground, producing surface-based temperature inversions. After sunrise, these inversions generally break up, and solar heating of the earth's surface causes vertical mixing in the atmosphere (USAF 1990).

Dust is frequently entrained into the atmosphere in this region of the country because of gusty winds and the semiarid climate. The Texas Panhandle-eastern New Mexico area is considered the worst area in the United States for windblown dust. Occasionally, this windblown dust is of sufficient quantity to restrict visibility. Most of the seasonal dust storms occur in March and April, when the wind speeds are typically high.

1.4.2.4 Biological Resources

Land adjacent to Cannon AFB is primarily used for agriculture, and little natural vegetation remains in the area. The wildlife species that are common to agricultural areas throughout the region include bobwhite quail and pheasant. The few playa lakes in the area are used by upland game for cover, by waterfowl for resting and feeding, and by wildlife in general for drinking. Nearby riverbeds also provide water sources during rainy seasons. During periods of low rainfall, the riverbeds are dry.

Plant Resources. The climate of the Base area is considered semiarid. The thin layer of topsoil in the vicinity of Cannon AFB is sandy loam, which is highly susceptible to wind erosion. The undisturbed natural vegetation is mostly shortgrass prairie, including blue grama grassland and mixed grama grassland vegetation types, which have moderately fast recovery rates.

Much of the study area has been previously cleared for agricultural crops. The predominant land use of the region is rangeland, primarily for cattle grazing. In general, moderately grazed rangeland areas of the types occurring in the project area are highly productive in terms of both forage quality and quantity. The rangeland in the vicinity may support up to 15 to 20 head of cattle per section, depending on the rainfall. Large trees do not uniformly exist in the vicinity of the range except where planted around buildings and other structures on the Cannon AFB. Woodlands composed of large shrubs and small trees are confined to riparian areas and playa lakes in the vicinity.

The following plants are candidate species for the Federal List of Endangered and Threatened Wildlife and Plants, and are reportedly found within a 50-mile radius of Cannon AFB: chatterbox orchid (*Epipactus gigantea*), spiny aster (*Aster harridus*), Whittmans milkvetch (*Astragalus witmanii*), dune unicornplant (*Proboscidea sabulosa*), and the tall plains spurge (*Euphorbia strictior*). No federally-protected endangered plants are known to be present on Cannon AFB (Lee Wan and Associates 1990).

New Mexico's rare and endangered plant inventory (Sivinski and Lightfoot 1992) lists only tall plain's spurge as occurring within Curry County. Tall plain's spurge is a state rare and protected plant species (List 2), and a federal 3C species. State List 2 species are considered rare and sensitive plant species because of restricted distribution or low numerical density (Sivinski and Lightfoot 1992). They need not be endemic to New Mexico, but must be regionally endemic or rare throughout their range. Since they are rare, these species are sensitive to long-term or cumulative land use impacts and are vulnerable to biological or climatic events that could eventually threaten them with extinction or extirpation. List 2 species are monitored by the State of New Mexico to determine if they should ever be elevated to List 1 endangered status. List 2 species are not protected by state statute or policy. Federal 3C species are taxa which have proven to be more abundant or widespread than previously believed and/or which have no identifiable threats.

Wildlife Resources. The eastern New Mexico area contains many nongame wildlife species that are typical of the High Plains. Most of these species are distributed widely throughout the western United States. Species diversity is low in most habitats because of the low vegetation diversity. Most amphibian species are associated with riparian habitats and playa lakes. Reptiles are found in all terrestrial habitat types but are most abundant in scrub/grasslands. Nocturnal rodents are the most abundant members of the small mammal community.

Grasslands on the High Plains support a variety of seed-eating sparrows and other ground-dwelling birds, both as residents and migrants. Raptors (hawks and owls) are relatively abundant in all habitats in the region. Insectivorous and tree-nesting species are most abundant in riparian areas. Shorebirds and waterbirds and migratory waterfowl in general use the rivers, playa lakes, and reservoirs of the region.

Two National Wildlife Refuges (NWRs) are located on the periphery of the Cannon AFB. The Grulla and Muleshoe NWRs are within 30 miles of Cannon AFB. These areas provide high-quality habitat for migratory and breeding waterfowl.

Big-game species in the area include mule deer, white-tailed deer, pronghorn, and barbary sheep. Pronghorn are the most abundant game animal in the area. Several species of upland game, such as quail, ring-necked pheasant, and turkey are common in the area. Reservoirs (Ute Lake, Conchas

Lake, and Clayton Lake) and playa lakes are important waterfowl habitats in the region. Numerous species of native and introduced fish inhabit the rivers and perennial streams, and the reservoirs support recreational fishing of warm-water species such as walleye, crappie, channel catfish, largemouth bass, and bluegill.

As determined by the regional office of the U.S. Fish and Wildlife Service (USFWS), two federally-listed endangered animal species, the bald eagle (*Haliaeetus leucocephalus*) and the American peregrine falcon (*Falco peregrinus anatum*), are known to inhabit the area within a 50-mile radius of Cannon AFB. The New Mexico Department of Game and Fish (1995) lists the bald eagle as a State threatened species and the peregrine falcon as a State endangered species. Baird's sparrow (*Ammodramus bairdii*) is also listed by the New Mexico Department of Game and Fish as a State threatened species. The Mississippi kite (*Ictinia mississippiensis*), has been removed from the State endangered list. The Department of Game and Fish lists the black-footed ferret (*Mustela nigripes*), a federally endangered species, to be extirpated and no longer occurring in the state (New Mexico Department of Game and Fish 1995). Native wildlife listed by the State as no longer occurring in Curry County include the American bison (*Bos bison*) and the extinct Merriams' elk (*Cervus elaphus merriani*). State and Federal threatened, endangered, and candidate species are listed in Table 1-2.

Baird's sparrow is a migrant species. As a migrant species, Baird's sparrow would occur in mainly in autumn in the eastern plains and southern lowlands of Curry County. Migrants appear as early as the first week of August and move further south by November. The species seems to have declined in abundance throughout its range in the Southwest due to loss of shrubby shortgrass habitat.

The bald eagle and peregrine falcon may occur infrequently in the vicinity of Cannon AFB. The bald eagle migrates and winters from the northern border of New Mexico to the Gila, lower Rio Grande, middle Pecos, and Canadian valleys. It is seen occasionally in summer and as a breeding bird, with nest reported in the extreme northern and western parts of the state. Winter and migrant populations appear to have increased with reservoir construction. The peregrine falcon is widely distributed but population numbers are low. The American subspecies breed statewide in New Mexico, but mainly west of the eastern plains.

TABLE 1-1

COMPARISON OF RCRA AND IRP - CERCLA PROCESS
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

RCRA Process	IRP - CERCLA Process
RCRA Facility Assessment (RFA) (Agency-conducted)	Preliminary Assessment (PA)/Site Investigation (SI)
RCRA Facility Investigation (RFI)	Remedial Investigation (RI)
Corrective Measures Study (CMS)	Feasibility Study (FS)
Statement of Basis/Response to Comments	Record of Decision (ROD)
Corrective Measures Implementation (CMI)	Remedial Design/Remedial Action (RD/RA)

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TABLE 1-2

FEDERAL- AND STATE-PROTECTED ANIMALS POTENTIALLY OCCURRING IN THE VICINITY OF CANNON AFB (CURRY COUNTY)

Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI

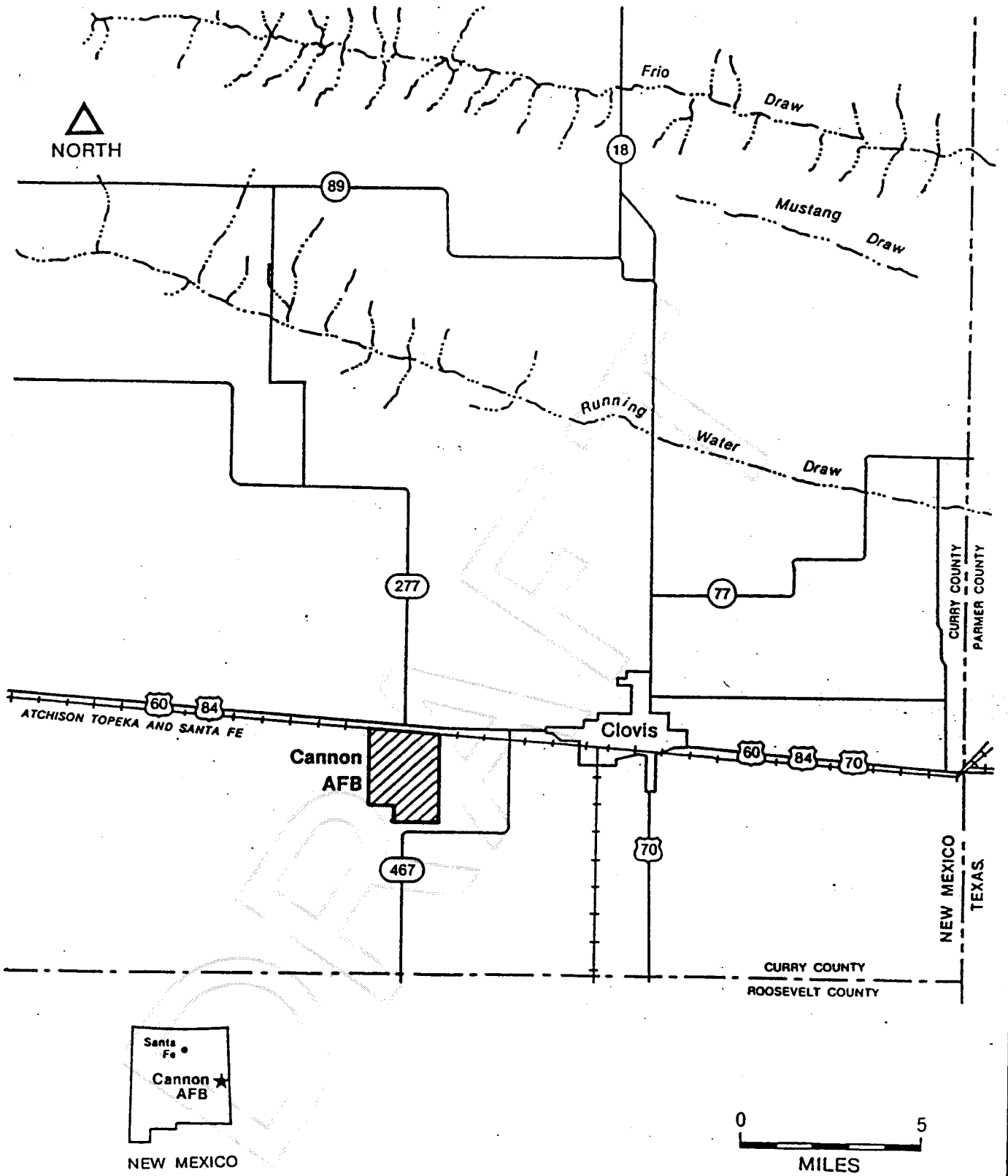
Cannon AFB, New Mexico

	Common Name	Scientific Name	Federal Status	State Status
Birds				
	Baird's Sparrow	*Ammodramus bairdii*	candidate, C2	threatened
	bald eagle	*Haliaeetus leucocephalis*	threatened	threatened
	peregrine falcon	*Falco peregrinus*	endangered	endangered
	ferruginous hawk	*Buteo regalis*	candidate, C2	
	loggerhead shrike	*Lanius ludovicianus*	candidate, C2	
	western burrowing owl	*Athene cunicularia hypugea*	candidate, C2	
Mammals				
	black-footed ferret	*Mustela nigripes*	endangered	extirpated
	plains pocket gopher	*Geomys bursarius*	candidate, C2	
	swift fox	*Vulpes velox*	candidate, C1*	
Reptiles				
	Texas horned lizard	*Phrynosoma cornutum*	candidate, C2	

Federal Candidate, Category 1 -- Taxa for which the USFWS has on file sufficient information on biological vulnerability and threat(s) to support proposals to list them as endangered or threatened species. Proposed rules have not yet been issued because this action is precluded at present by other listing activity. *The swift fox is listed in the November 15, 1994 Federal Register as a C2 candidate species, although the New Mexico State Office of the USFWS lists it as a C1 candidate species.

Federal Candidate, Category 2 -- Taxa for which information now in the possession of the USFWS indicates that proposing to list as endangered or threatened is possibly appropriate, but for which persuasive data on biological vulnerability and threats are not currently available to support proposed rules. USFWS emphasizes that these taxa are not being proposed for listing, and there are no current plans for such proposals until additional supporting information becomes available. Further biological research and field study usually will be necessary to ascertain the status of taxa in this category. It is unlikely that many will be found not to warrant listing, either because they are not threatened or in greater danger of extinction than some taxa already found in Category 1.

Source: New Mexico Dept. of Game and Fish 1995.
USFWS 1995.



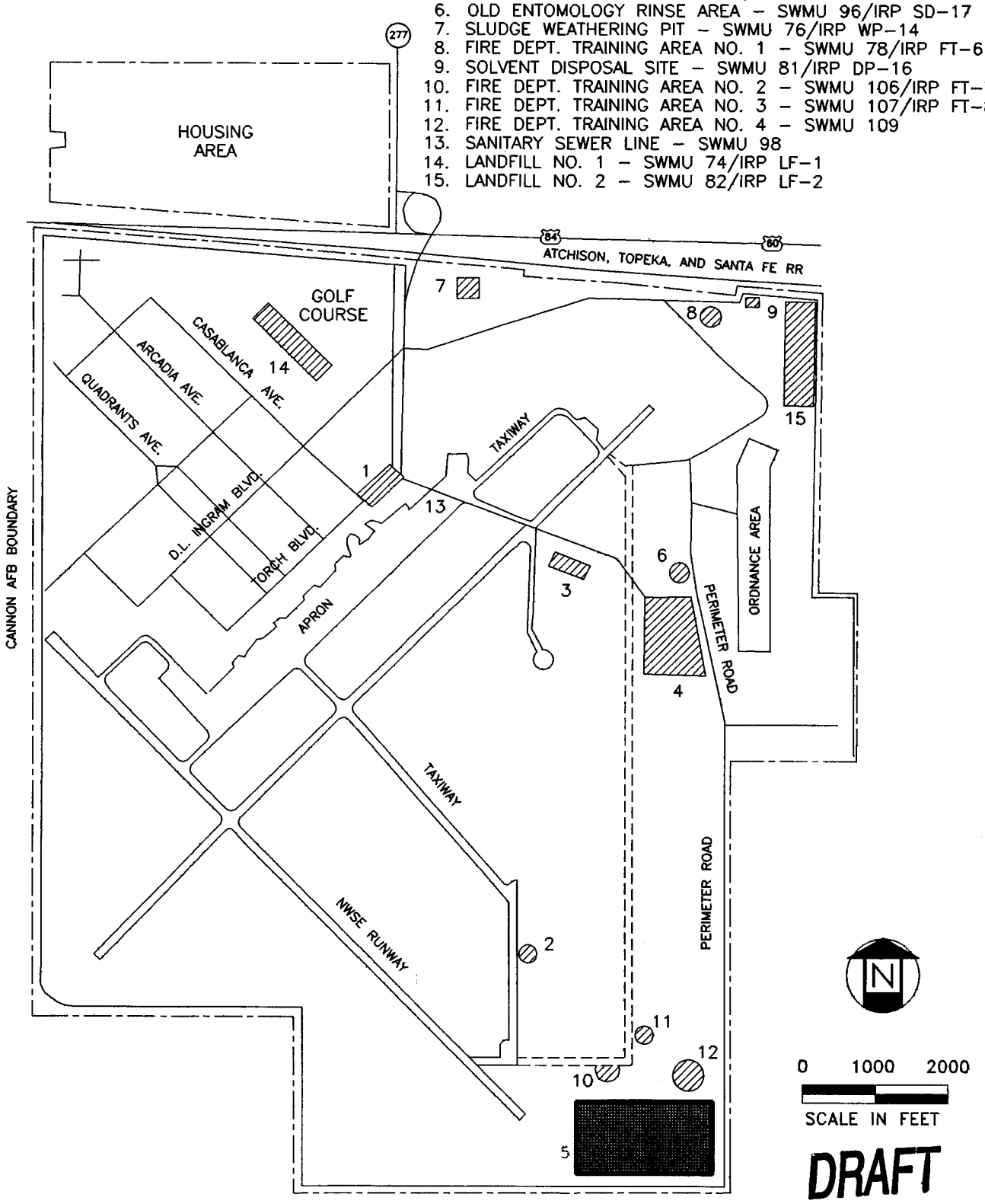
BASE MAP ADAPTED FROM FINAL REPORT, IRP PHASE II, (RADIAN 1986)

Job No. : C3M11M	**VICINITY MAP**
Prepared by : J.T.A.	**CANNON AFB, NM**
Date : 8/13/93	

FIG. 1-1

EXPLANATION

1. AGE DRAINAGE DITCH – SWMU 34/IRP SD-15
2. ENGINE TEST CELL AREA – SWMU 86-90/IRP SD-11
3. NE STORMWATER DRAINAGE AREA – SWMU 95/IRP SD-20
4. WASTEWATER LAGOONS – SWMU 101,102
5. LANDFILL NO. 5 – SWMU 113/IRP LF-5
6. OLD ENTOMOLOGY RINSE AREA – SWMU 96/IRP SD-17
7. SLUDGE WEATHERING PIT – SWMU 76/IRP WP-14
8. FIRE DEPT. TRAINING AREA NO. 1 – SWMU 78/IRP FT-6
9. SOLVENT DISPOSAL SITE – SWMU 81/IRP DP-16
10. FIRE DEPT. TRAINING AREA NO. 2 – SWMU 106/IRP FT-7
11. FIRE DEPT. TRAINING AREA NO. 3 – SWMU 107/IRP FT-8
12. FIRE DEPT. TRAINING AREA NO. 4 – SWMU 109
13. SANITARY SEWER LINE – SWMU 98
14. LANDFILL NO. 1 – SWMU 74/IRP LF-1
15. LANDFILL NO. 2 – SWMU 82/IRP LF-2



Job No. : C3M11M	IRP/SWMU SITE LOCATION MAP
Prepared by : D.A.K.	CANNON AFB, NEW MEXICO
Date : 8/22/93	

3M11FXX

FIG. 1-2

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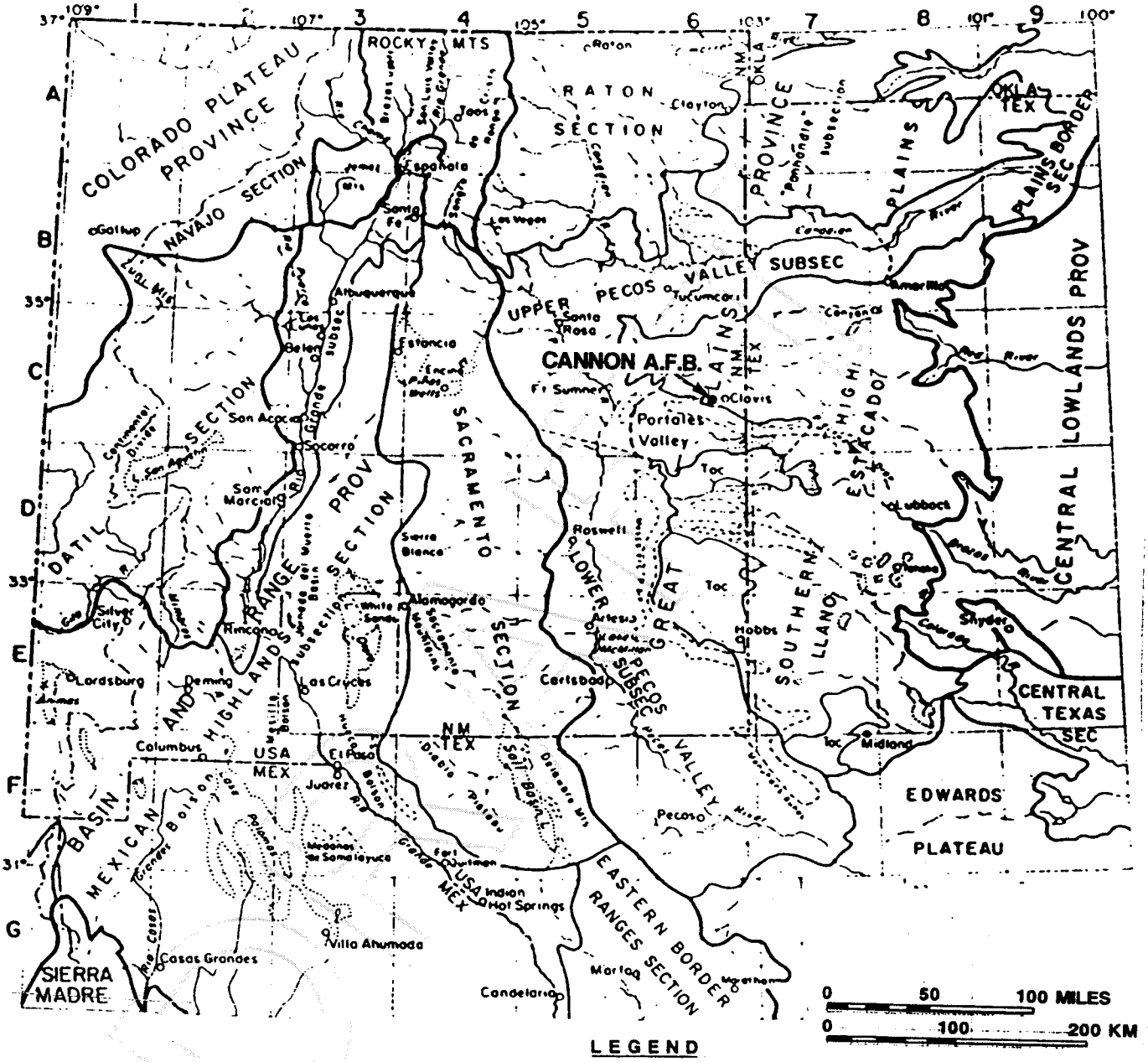


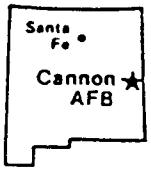
LEGEND

UPPER QUATERNARY EOLION SAND SHEETS WITH DUNE FIELDS

DEPRESSIONS OCUPIED BY UPPER PLEISTOCENE "FLUVIAL" LAKES

Toc — RELICT OGALLA CAPROCK SURFACE

SOURCE: QUATERNARY STRATIGRAPHY IN THE BASIN & RANGE AND GREAT PLAINS PROVINCES NEW MEXICO & WEST TEXAS; HAWLEY, BACKMAN, MANLEY.



NEW MEXICO

Job No. : C3M11M	GEOMORPHIC PROVINCE MAP
Prepared by : D.A.K.	CANNON AFB, NEW MEXICO
Date : 8/20/93	

FIG. 1-3

2.0
PHYSICAL CHARACTERISTICS

2.1 SWMU DESCRIPTION

2.1.1 Setting

Landfill No. 5 (SWMU No. 113/IRP No. LF-5) is a 70-acre, inactive landfill located in the southeastern area of Cannon AFB (Figure 1-2). Past trenching and disposal of waste material occurred over approximately 30 acres in the eastern portion of the landfill. This area is surrounded by a 4 foot high barbed wire fence and has two entrances that remain locked. The remaining 40 acres to the west appear to have received construction debris which was use to backfill natural depressions. The overall landfill site is sparsely vegetated with only a few trees, and the topography is relatively flat except in areas where trenching operations occurred (these areas have slight surface depressions) (Figure 2-1). The general flow of surface water runoff resulting from storms is toward the southeast or local drainage into surface depressions.

No structures (i.e., buildings) are located on the landfill premises; however, a closed RCRA regulated unit known as Cell No. 3 exists within the landfill boundary (Figure 2-1).

2.1.2 History of Use

Landfill No. 5 was active between 1968 and October 1984. Waste materials received at this landfill reportedly included domestic solid waste, waste oils, and solvents; paint, paint remover, and thinners; pesticide containers; and various empty cans and drums. From 1968 to about 1972, the mode of operation at this landfill was burn and bury in trenches. (CH2M Hill, 1983). After 1981, the standard operation was direct burial of the waste in trenches, and tree limbs and construction rubble were the only materials being disposed of at the landfill.

2.1.3 Previous Investigations Pertinent to Landfill No. 5

Prior to the Phase I RFI at Landfill No. 5, previous investigations at Landfill No. 5 had been conducted under both the USAF IRP program and Cannon AFB's RCRA permit requirements

primarily to assess the environmental impact of the RCRA regulated unit, Cell No. 3 within the landfill premises. Cell No. 3, is a RCRA-regulated unit since hazardous waste was reportedly disposed of in this cell through 1981. Until late 1981, an estimated 5 to 10 drums per month of waste oils and solvents were received at the site. The drums ranged from partially to completely full. From the end of 1981 until the cell was permanently closed in 1983, the cell did not receive additional hazardous waste. Closure of the cell consisted of placing an impermeable clay cap over the cell. The cell is fenced for security within Landfill No. 5.

In 1982-83, CH_2M Hill conducted a records search in support of the USAF IRP program for Cannon AFB. This project included a detailed review of pertinent installation records, contact with government agencies, and a site visit. The purpose of this project was to identify and fully evaluate suspected problems associated with past hazardous material disposal sites, control the migration of hazardous contamination from such sites, and control hazards to health and welfare that may have resulted from these past operations. Results of this records search identified several sites including Landfill No. 5 and RCRA Cell No. 3 which warranted further investigation (CH_2M Hill, 1983).

In 1984, monitoring wells currently known as MW-A, MW-B, MW-C, and MW-D located downgradient and upgradient from Landfill No. 5 were installed by Radian Corporation for the USAF Occupational and Environmental Health Laboratory. Groundwater analytical results indicated that groundwater conditions upgradient and downgradient of Landfill No. 5 were very similar. None of the samples collected exceeded drinking water standards for any of the parameters tested. Trichlorofluoromethane was detected at a concentration of 2.1 μg/l in the upgradient well, however, trichlorofluoromethane was not detected in any of the four downgradient wells. No additional volatile aromatic or halocarbon compound was detected in any of the groundwater samples collected (Radian, 1986).

In January 1985, an investigation of Cell No. 3 was performed by Geoscience Consultants (1985). Soil was collected and analyzed from beneath Cell No. 3, however, no volatile organic compounds above the reporting limit of 0.01 micrograms per gram (μg/g) were detected.

A Preliminary Review and Visual Site Inspection of Cannon AFB was performed by A.T. Kearney, Inc. in 1987, to identify and evaluate solid waste management units and other areas of concern. The investigation identified 128 SWMUs, including Landfill No. 5 (Kearney, 1987).

In 1988, two groundwater monitoring wells, MW-I and MW-J were installed by the Tulsa District of the USACE. These wells are located along the southeast boundary of Landfill No. 5.

In 1991, Woodward-Clyde conduced a Remedial Investigation at 18 SWMUs at Cannon AFB, including investigations at Landfill No. 5. During the investigation at Landfill No. 5, groundwater samples were collected from one upgradient well (MW-A) and from four downgradient wells (MW-B, MW-C, MW-D, and MW-I). Groundwater samples were collected and analyzed for Appendix IX constituents listed in 40 CFR 264.

Based on the December 1991 sample event no analytes other than metals were detected above the contract required quantitation limit (CRQL). Metals analysis revealed the presence of barium and vanadium in all five groundwater samples. Both metals had concentrations below their maximum contaminant levels (MCLs) (for barium, 1.0 mg/L; for vanadium, no MCL is established). The concentration of barium was approximately 0.029 mg/L. The concentration of vanadium ranged from 0.023 mg/L to 0.036 mg/L. Lead was detected in one groundwater sample, 113B, at a concentration of 0.016 mg/L, well below its MCL of 0.05 mg/L. Evaluation of the data concluded that the quality of groundwater has not been affected by past landfill activities (W-C 1992).

In 1992, two additional monitoring wells (MW-L and MW-M) were installed along the eastern edge of Landfill No. 5 by the U.S. Geological Survey to meet RCRA release detection monitoring requirements and provide detection of potential contaminant release from Landfill No. 5.

2.1.4 Land Use and Demography

Very few persons enter the Landfill No. 5 area each year since closure of the landfill in 1983. Personnel that now enter the landfill area are primarily persons involved with periodic environmental characterization work at the site (USAF, USACE, environmental consultants, and drilling companies). One person conducts groundwater sampling of the wells located outside the boundary of Landfill No. 5 for about 5 to 10 hours on a semi-annual basis but does not enter the landfill premises (W-C 1992).

2.2 REGIONAL SOILS

Soils in the vicinity of Cannon AFB are classified as silty sand (SM) to clayey sand (SC) under the USCS, and as aridisols (calciorthids) under the United States Department of Agriculture - Soil Conservation Service Comprehensive Soil Classification System (USDA-SCS). The following summary is based on the Curry County Soil Survey (USDA 1958). Figure 2-2 depicts the various soil types mapped at Cannon AFB. Soil characteristics are briefly described in the following paragraphs.

The most common soil type on Cannon AFB is the Amarillo fine sandy loam, 0 to 2 percent slope phase (map symbol Ab). This soil consists of a thin sandy A horizon, well defined clayey B_{1-3} horizons, with a calcic B_3 horizon at depths below 40 inches. The calcic B_3 horizon lies on a calcic C horizon or on caliche. The surface soil is brown (7.5 YR 5/5, dry) and subsurface soils are reddish-brown (5 YR 4/4, dry) to yellowish-red (15 YR 5/6, dry). The calcic C horizon underlying the Amarillo Fine Sandy loam is white. The Amarillo fine sandy loam soil type is present on all relatively flat surfaces at the base but is also found on slopes associated with playas (map symbol Ac). A small area of Amarillo loamy fine sandy 0 to 2 percent slope phase (map symbol Ag) is mapped in the southeast corner of the base.

Clovis fine sandy loams, 0-2 percent slope phase (map symbol Cb) and 2-5 percent slope phase (map symbol Cc), are similar to Amarillo fine sandy loams. Clovis soils are reddish-brown on the surface and in the subsurface, with a white Calcic C horizon. In the Clovis soils, the depth to the calcic C horizon ranges from 28 to 56 inches. The depth to caliche exceeds 56 inches. Clovis and Amarillo fine sandy loams occur in close association.

In a few limited areas, particularly along the steeper slopes around playas, Mausker fine sandy loam, 0 to 2 percent slope phase (map symbol Ma), and 2 to 5 percent phase (map symbol Mb) are found. Mausker fine sandy loams have no B horizons and are very calcareous. Mausker fine sandy loam soils are brown (10 YR 5/3, dry) to light brown (7.15 YR 6/4, dry) at the surface with a pink to reddish-yellow (7.5 YR 7/5, dry) calcic C horizon. Associated with the Mausker fine sandy loam soils around the base Playa Lake are Potter fine sandy loam soils, 0 to 5 percent slope phase (map symbol Pa). This soil typically has a thin A horizon, is grayish brown (10 YR 5/2, dry), with no B horizon; it is similar to Mausker soils. Potter soils are shallow and strongly calcareous, and overlie hard consolidated caliche. The calcic C horizon is within two feet of the surface.

The A and B horizons of Amarillo and Clovis fine sandy loams are rapidly to moderately permeable. Mausker fine sandy loam A and Ac horizons are rapidly permeable. Permeabilities in calcic B and C horizons are moderate (USDA 1958).

2.3 REGIONAL GEOLOGY AND HYDROGEOLOGY

Regional Geology

The near-surface stratigraphic units of interest at Cannon AFB are the Late Miocene-Late Pliocene age Ogallala Formation and the Early Triassic Dockum Group shown in Figures 2-3 and 2-4.

The Dockum Group consists of three formations. The stratigraphically lowest unit is the Santa Rosa Sandstone. Overlying the Santa Rosa Sandstone are the Chinle and Redonda Formations. The Chinle and Redonda Formations are composed mainly of red shales with lesser interbedded sands and are known locally as "redbeds." The top of the Dockum Group is marked by an erosional unconformity having relief of up to several hundred feet (Lee Wan and Associates 1990).

The Ogallala Formation overlies the Dockum Group redbeds. The Ogallala Formation extends from eastern New Mexico and Colorado into Texas, Oklahoma, Kansas, Nebraska, and South Dakota. Drillers' logs from Cannon AFB indicate that the Ogallala Formation varies from 360 to 415 feet in thickness. The incised upper surface of Triassic redbeds strongly influences the Ogallala thickness. Stream valleys in the post-Triassic unconformity are deep and trend dominantly east-west. Thus, Ogallala thickness may thus vary significantly over short north-south distances.

The Ogallala is erosionally truncated to the south along the abandoned Portales Valley, to the west along the Pecos River Valley, and to the north in a series of ephemeral stream valleys. The Ogallala Formation extends more than 125 miles to the east before terminating as an escarpment in Briscoe County, Texas. Springs and seeps are common along the erosional margins of the Ogallala.

The Ogallala dips gently and monoclinally to the southeast in the vicinity of Cannon AFB. As reported in Lee Wan and Associates (1990), data suggest that some Quaternary warping may have

occurred, however most of the structures are well to the northwest and southwest of Cannon AFB. No faults or buried structural lineaments are known to exist in the vicinity of Cannon AFB.

The Ogallala Formation is composed of unconsolidated poorly sorted gravel, sand, silts, and clays. The base of the Ogallala is generally marked by a gravel, cobble, and boulder deposits. This basal member contains sediments derived from igneous and sedimentary rocks transported from the mountains to the west. The Ogallala Formation was laid down by stream and overbank deposits formed within coalescing alluvial fans. These fans form a broad pediment along the eastern flank of the Rocky Mountains. As is typical of alluvial deposits, Ogallala internal stratigraphy varies vertically and horizontally over short distances.

Except where strongly cemented by calcium carbonate (caliche), the sediments of the Ogallala are loose and friable. Authigenic and allogenic clays are found as a trace to abundant matrix mineral (Lee Wan and Associates 1990). Five zones have been identified within the Ogallala of east central New Mexico on the basis of clay minerals. Smectites (montmorillonites) and attapulgite (with sepeolite) are the dominant clays throughout the Ogallala. Illite is a lesser, but persistent clay, as is kaolinite. Smectite is a swelling clay, causing deep cracks to form in dry surface soils. Smectite in particular and, to a lesser extent, attapulgite and illite, are clays with moderate to high cation exchange capacities (CEC). The formation as a whole should therefore have a relatively high CEC, which should inhibit the migration of charged contaminants, and especially ionic forms of metals (Lee Wan and Associates 1990).

Caliche is a major feature of the Ogallala Formation, occurring as nearly continuous to discontinuous layers throughout. A generalized geologic section at Cannon AFB is shown in Figure 2-4. Caliche is hard, white to pale tan on fresh surfaces, weathering to gray, and has a chalky appearance. Caliche forms as calcium carbonate leached from overlying sediments, and precipitates in the pore space of the host sediments. Precipitation is caused by the evaporation of downward percolating water. The caliche may thus mark the position of ancient vadose zones. Radiocarbon dates for the upper "climax" caliche range from approximately 27,000 years Before Present (B.P.) to approximately 42,000 years B.P. (Lee Wan and Associates 1990).

Caliche is relatively soluble in acidic water (pH<7) or in waters containing dissolved carbon dioxide. The top surface of the upper "climax" caliche in fresh outcrop shows solution etching.

The Ogallala has numerous continuous to discontinuous caliche layers throughout its thickness. The upper "climax" caliche is pisolitic (Lee Wan and Associates 1990). The pisolites are thought to have formed as the caliche was repeatedly chemically-weathered and brecciated during Pleistocene pluvials and later recemented during drier intervals. This upper caliche outcrops around playas and the bounding escarpments of the Ogallala and is locally termed "caprock." The "climax" caliche is typically 3 to 5 feet thick. Caliches which occur lower in the Ogallala are platy and harder. Caliche is likely thin or absent below playas.

Regional Hydrogeology

The lower portion of the Ogallala Formation is the primary regional aquifer for both potable and irrigation water. No deeper aquifers are used in the vicinity of Cannon AFB. The Ogallala aquifer is part of the High Plains Aquifer which extends continuously from Wyoming and South Dakota into New Mexico and Texas. In east central New Mexico, the Ogallala aquifer rests on Dockum Group redbeds, which serve as the basal confining layer. The Ogallala is a water table, or unconfined aquifer. The Ogallala aquifer has a southeasterly regional gradient of about 10 to 15 feet/mile (Weeks and Gutentag 1981). Well yields vary from less than one gallon per minute (gpm) in thin silts and sands, and up to 1,600 gpm in thick sands and gravels (Lee Wan and Associates 1990). Water quality is generally good with dissolved solids ranging from 250 to 500 milligrams per liter (mg/L) (Gutentag et al. 1984) and fluorides ranging from 2.2 to 2.7 mg/L (William Matotan and Associates Inc. 1985).

At Cannon AFB, the Ogallala aquifer has an average saturated thickness of 120 feet based on mid-1960's data. Saturated thickness ranges from 93 to 143 feet and is influenced by the configuration of the erosional unconformity surface marking the top of the Dockum Group. The local groundwater gradient is southeasterly at 7 to 15 feet/mile (USAF 1990). Figure 2-5 shows water table elevation contours for 1982. Flow within the saturated zone may be influenced by the configuration of the top of the Dockum Group. Yields in tests of Cannon AFB water wells have ranged from 205 to 1,150 gpm. Specific capacities range from 11.4 to 27.9 gallons per foot (gal/ft) (Lee Wan and Associates 1990).

Very rough estimates of hydraulic conductivity were made from well pump tests conducted by Cannon AFB in water wells 5, 8 and 9 (Figure 2-6) using the Theis equation. The data used in these calculations were obtained to evaluate pump rates, efficiency, and well yield and were not

intended for use in calculating aquifer properties. The results of these calculations should, therefore, be considered as estimates only.

Hydraulic conductivity values for water wells 5 and 9 were approximately 2.0×10^{-3} centimeters per second (cm/sec). Calculations for water well 8 result in a hydraulic conductivity of 2.0×10^{-2} cm/sec. These estimates appear to be low when compared to published hydraulic conductivity data for sands and gravels (Freeze and Cherry 1979). As reported in Kearney (1987), a groundwater flow velocity of about 150 feet per year has been estimated. This calculation suggests a hydraulic conductivity of approximately 1.0×10^{-1} cm/sec.

Hydraulic information specific to Landfill No. 5 (SWMU No. 113/IRP No. LF-5) was obtained during the 18 SWMUs RI conducted by W-C in 1991 (W-C 1992). The hydraulic gradient beneath Landfill No. 5 was approximately 0.0025 feet per foot based on water level elevations measured on November 8, 1991. Using the range of hydraulic conductivity values previously reported and an effective porosity of 28 percent (i.e., based on " clean sand" estimates as stated in Freeze & Cherry 1979), the groundwater velocity is estimated to range from 0.069 feet/day to 0.134 feet/day.

The presence of interstitial clays may account for both the variability and low values of hydraulic conductivities. Boring logs from Cannon AFB IRP projects and published reports (Lee Wan and Associates 1990) indicated that interstitial and interstratified clays are abundant in the Ogallala Formation.

Recharge to the Ogallala is primarily through precipitation. Kearney (1987) indicated that the recharge rate may be as much as 1.0 inch per year. Due to the high evapotranspiration rate and low precipitation, recharge occurs only during heavy rainfall events in which the infiltration capacity of the soil is exceeded and runoff occurs, or during cool months when precipitation exceeds evapotranspiration. Excess runoff flows to playas, and the presence of water in playas may allow deep percolation to the aquifer. It is possible that the caliche may be thin or absent directly below the playas.

Discharge from the Ogallala Formation occurs through well pumping and springs along the eroded margins. Spring discharge does not occur on or near Cannon AFB. Domestic and irrigation water wells are common on and around the base. However, the rate of discharge exceeds local recharge.

Water levels in the Ogallala Formation have declined steadily from the 1930s to the present. From the 1930s to 1980, a decline of 50 to 100 feet has been observed in the area around Clovis, New Mexico. Luckey et al. (1981) states, "the largest area of water level decline exceeding 100 feet occurs south of the Canadian River extending from Curry County, New Mexico to Crosby County, Texas."

The Ogallala Formation will continue to be used as the primary source of potable and irrigation water for eastern New Mexico. The New Mexico State Engineer designated Curry County as a Water Basin in 1989. This designation allows for regulation of water rights, usage, and well drilling.

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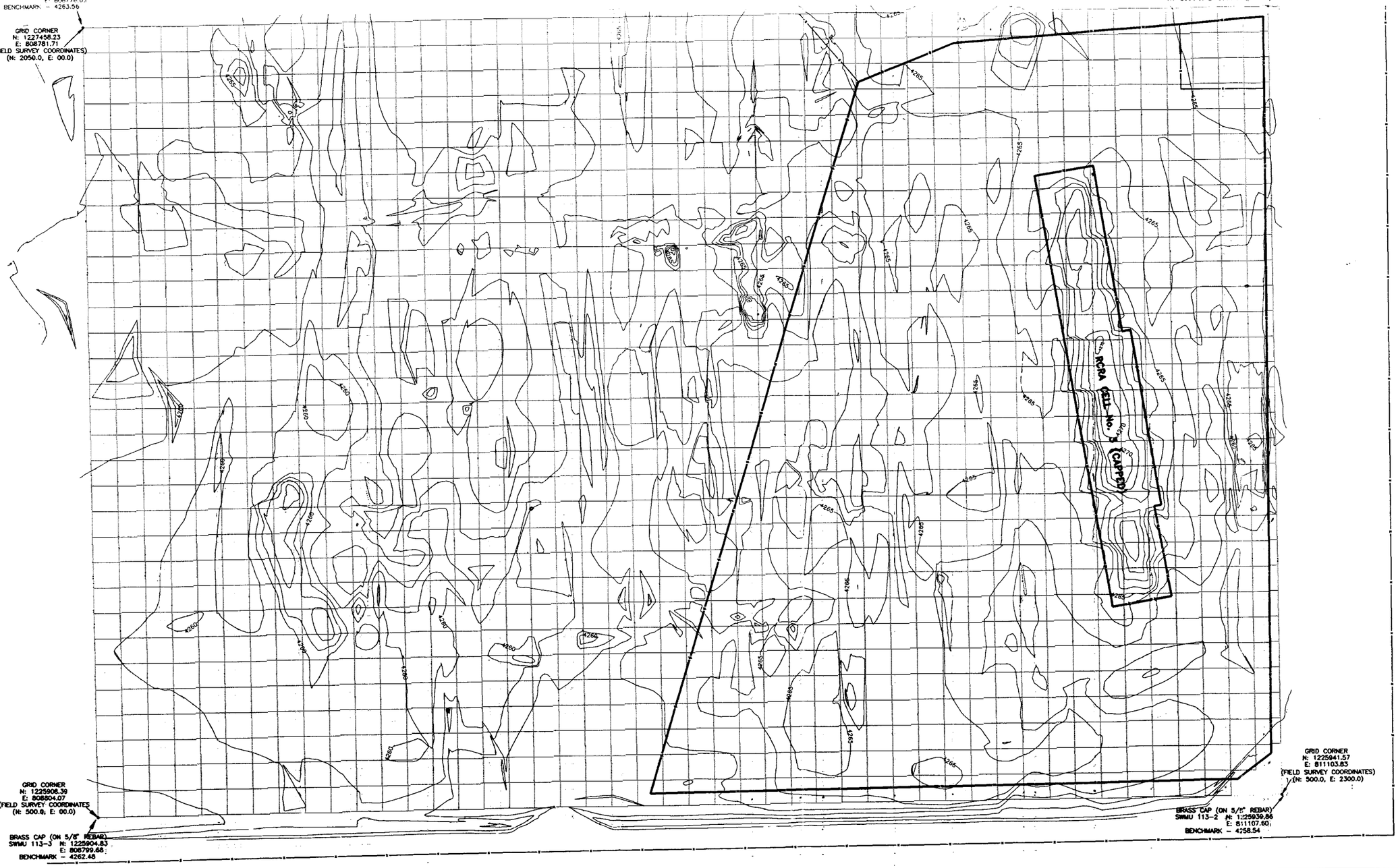

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TASK	2B
LOC.	PROJ. CANNON AFB
SEND TO	
PHONE	
FILE	2M11F087
SCALE	1"=100'

DRAWING NUMBER	REFERENCE DRAWING TITLE	REV	DESCRIPTION OF REVISION	BY	DATE

Woodward-Clyde Consultants
Engineering & sciences applied to the earth & its environment

WARNING
0 1 ½ 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

DESIGNED	GLW/JTA
DRAWN	PFL
CHECKED	
PEER REVIEWED	
PROJECT MANAGER	
DATE	

CANNON AFB NEW MEXICO

TOPOGRAPHIC MAP
LANDFILL NO. 5

REVISION
PROJECT C3M11M
DRAWING 2-1
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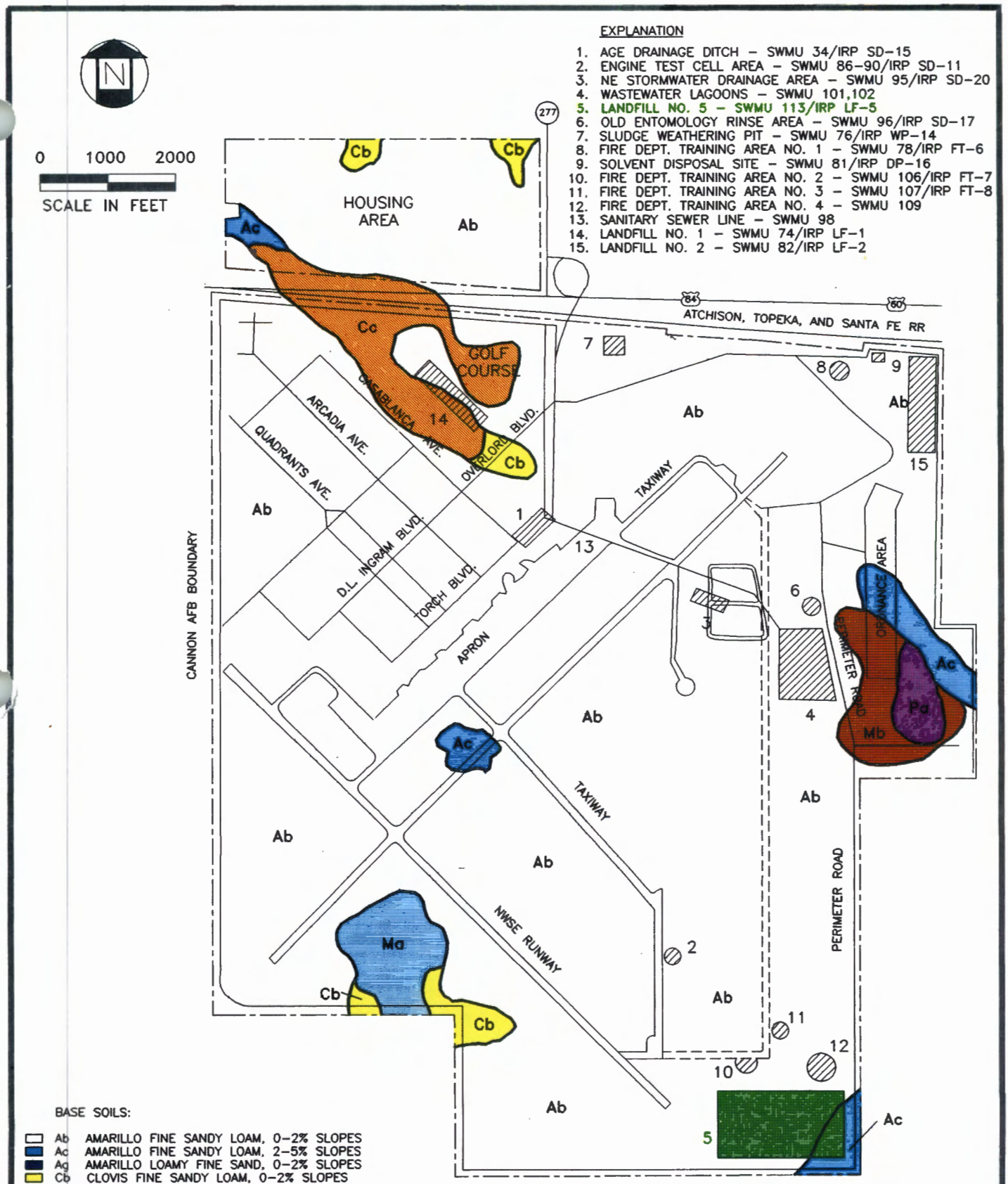

SOURCE: USDA-S.C.S., SOIL SURVEY OF CURRY COUNTY N.M., 1958

DRAFT

Job No. : C3M11M	DISTRIBUTION OF SOILS BY TYPE
Prepared by : D.A.K.	CANNON AFB, NEW MEXICO
Date : 8/22/93	

3M11F28

FIG. 2-2

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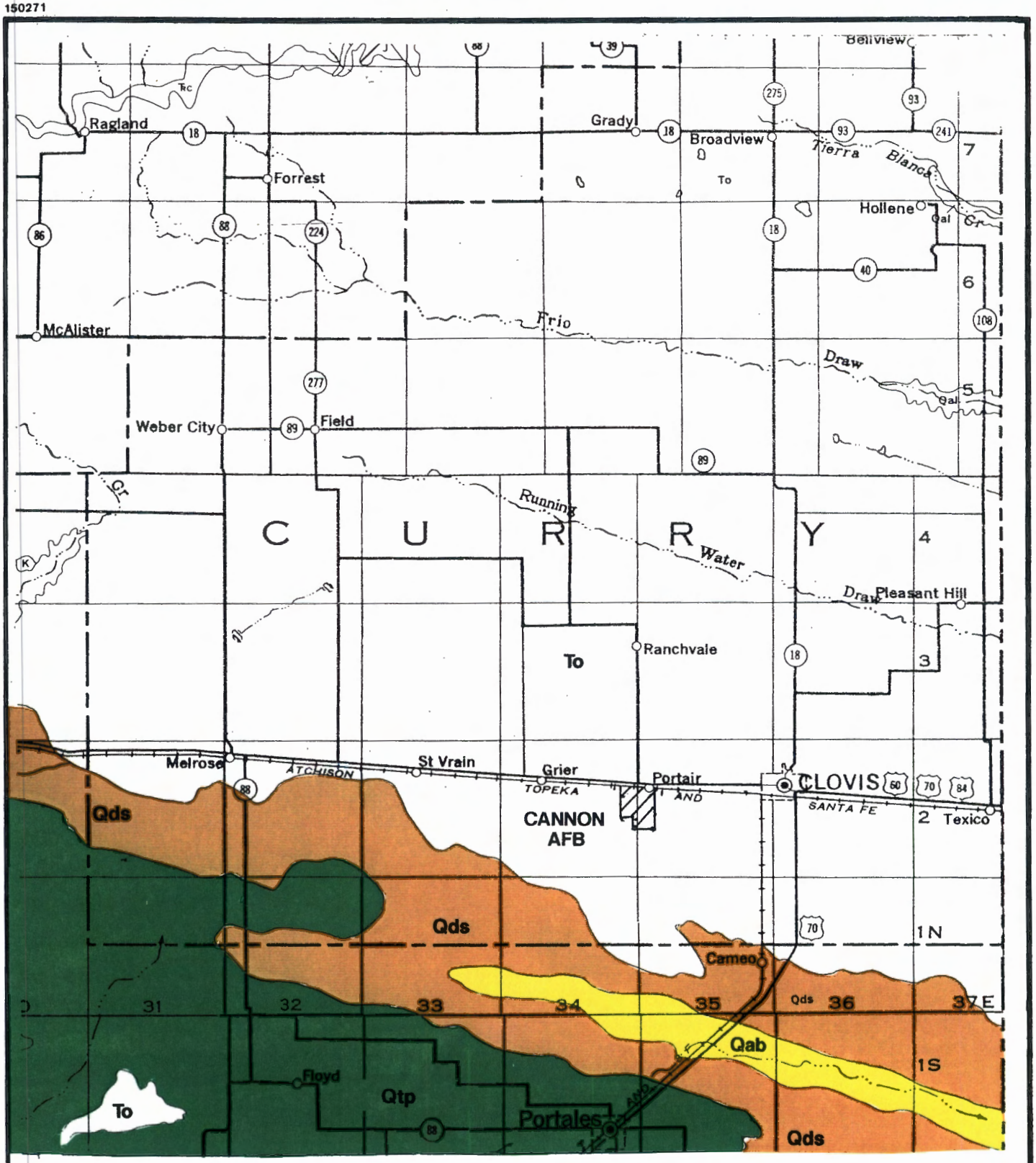


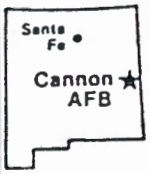
LEGEND

Qtp	GRAVEL, SAND & CALICHE
Qds	DUNE SAND
Qab	ALLUVIUM
To	OGALLALA FORMATION

N

0 2.5 5 10
SCALE IN MILES

SOURCE: U.S.G.S. GEOLOGIC MAP OF NORTHERN N.M., 1962



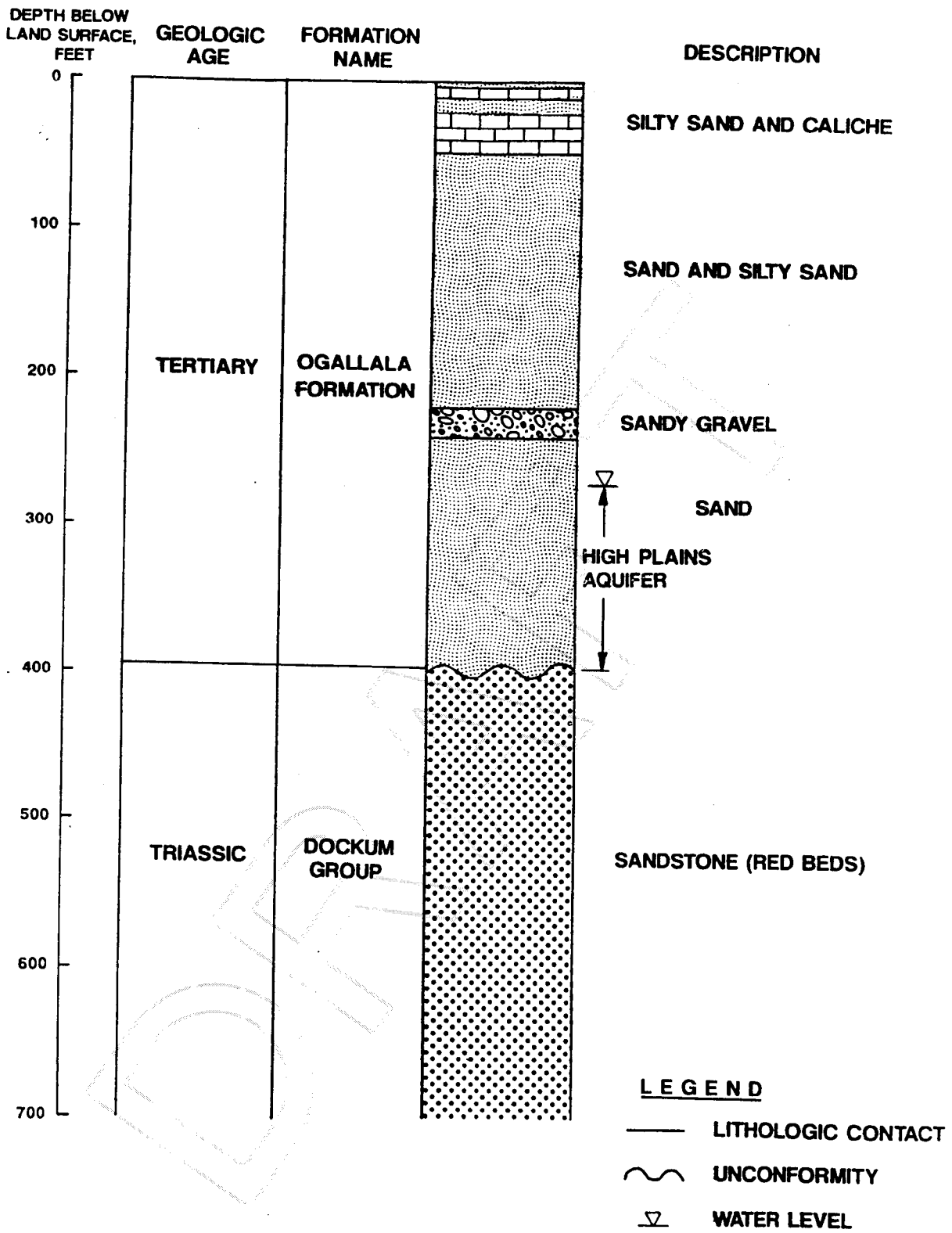
NEW MEXICO

DRAFT

Job No. : C3M11M	GENERALIZED GEOLOGIC MAP
Prepared by : D.A.K.	CANNON AFB, NEW MEXICO
Date : 8/20/93	

FIG. 2-3

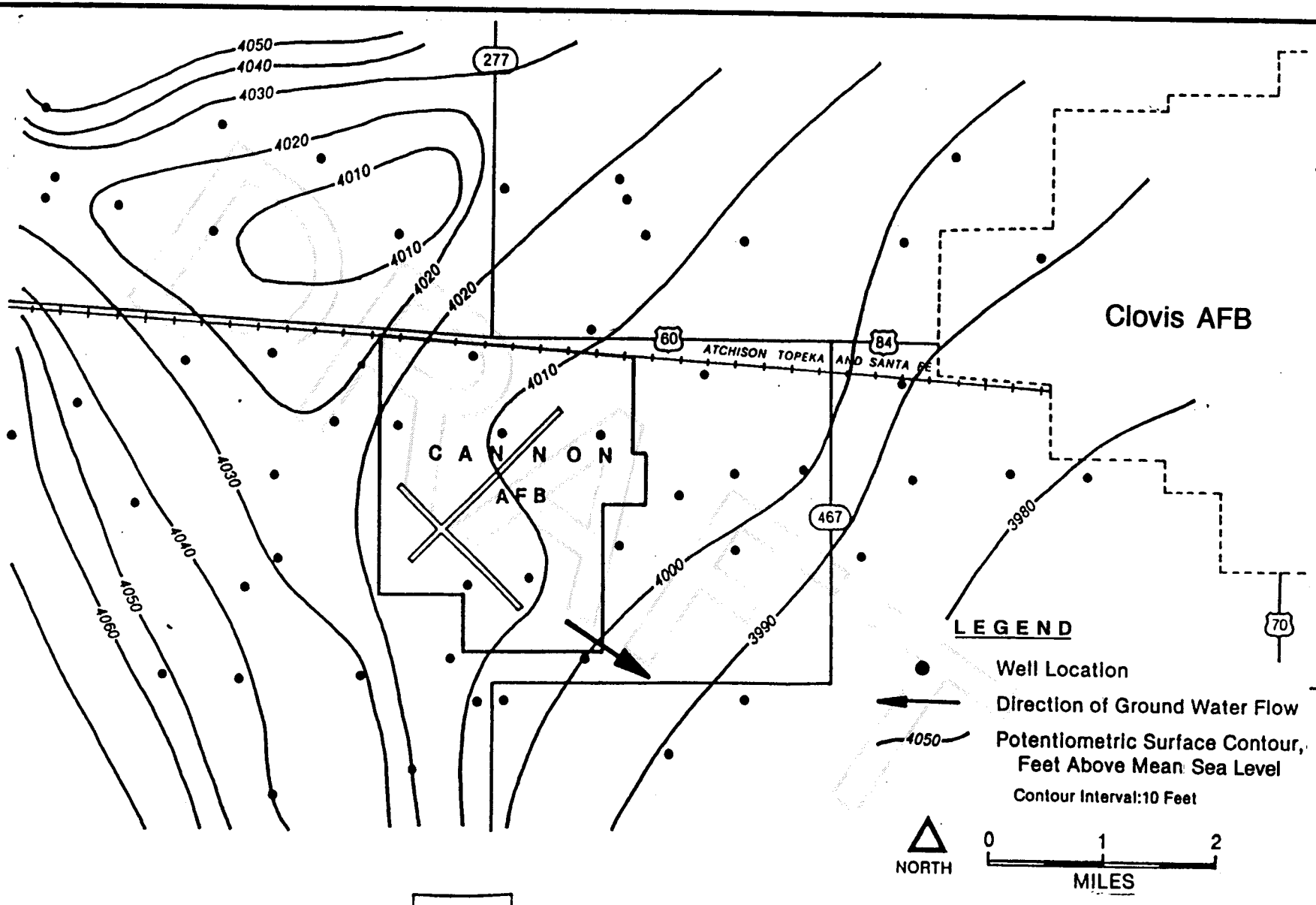
150271



MODIFIED FROM GUTENTAG ET.AL. 1984

Job No. : C3M11M	GENERALIZED GEOLOGIC COLUMN OF CANNON AFB, NEW MEXICO
Prepared by : D.A.K.	
Date : 8/26/93	

FIG. 2-4



GROUNDWATER ELEVATION IN THE VICINITY OF CANNON AFB, NEW MEXICO - JANUARY-FEBRUARY 1982

BASE MAP ADAPTED FROM FINAL REPORT, IRP PHASE II, (RADIAN 1986)

Job No. : C3M11M

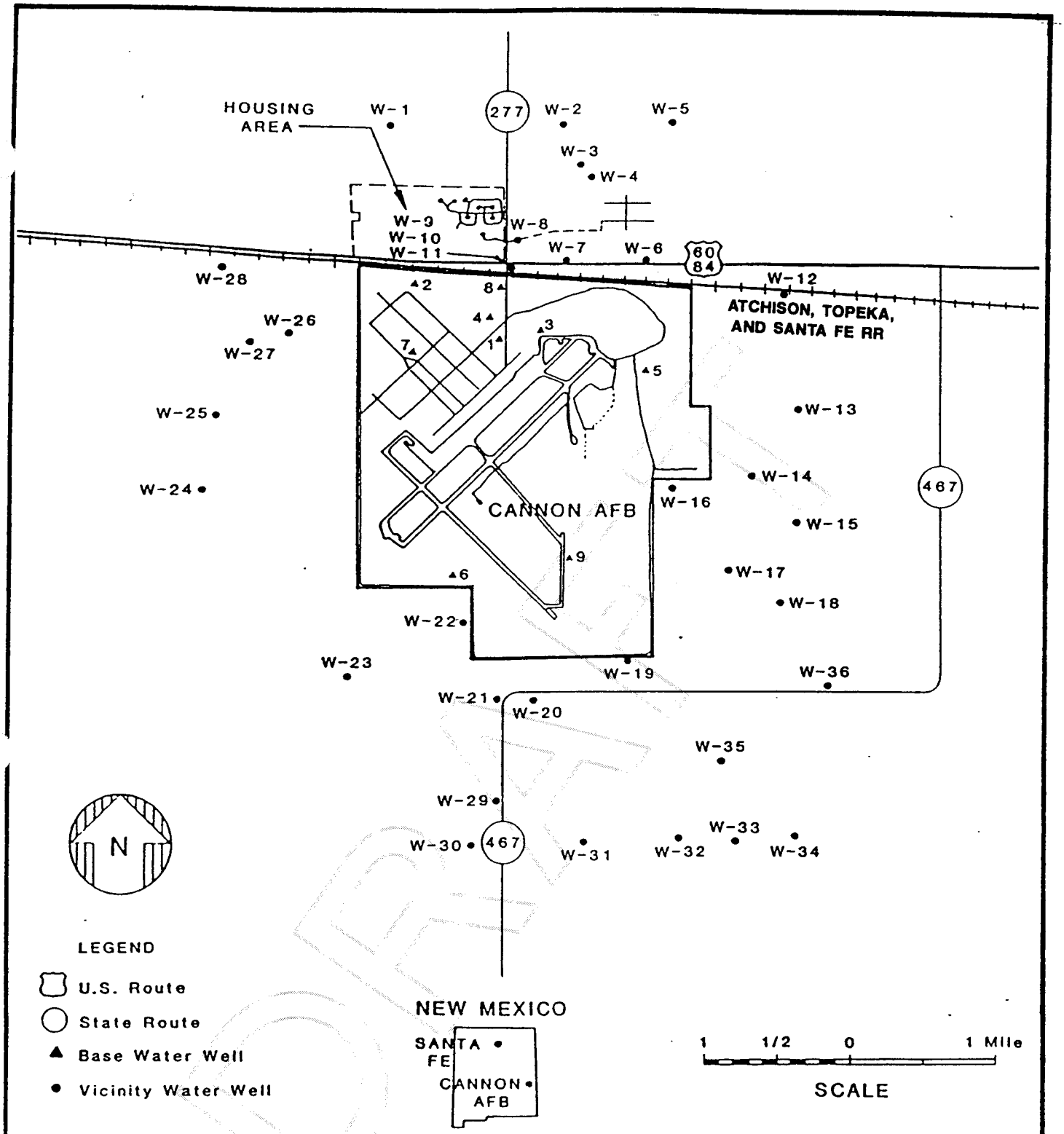
Prepared by: D.A.K.

Date: 8/20/93

ALTITUDE AND CONFIGURATION OF WATER TABLE, VICINITY OF CANNON AFB, NEW MEXICO

136236

FIG. 2-5



SOURCE: FINAL REPORT, IRP PHASE II (RADIAN 1986)

Job No. : C3M11M	WATER WELL LOCATIONS ON AND NEAR CANNON AFB, NM
Prepared by : M.J.A.	
Date : 8/20/93	

FIG. 2-6

3.0
FIELD INVESTIGATION OBJECTIVES, METHODS AND RESULTS

This section provides a discussion of the field investigation objectives, field methods and procedures, and field activities conducted by W-C at Landfill No. 5 between the period of January 19 through August 1, 1995. Site-specific geologic information obtained from the drilling program is also presented.

3.1 LANDFILL NO. 5 FIELD INVESTIGATION OBJECTIVES

The Workplan was prepared to guide the planned RFI investigation to satisfy the Cannon AFB RCRA Part B permit conditions. The following Project Objectives were developed based on the overall objectives and primary purpose of the Phase I RFI.

- Identify suspected source areas within Landfill No. 5 with the potential to release hazardous constituents into the environment
- Collect environmental data of sufficient quality and quantity to define the nature, extent and rate of migration of releases of hazardous constituents to the environment
- Interpret the data collected to determine if additional phases of investigation are needed to address data gaps as well as whether interim corrective measures and/or Corrective Measures Study (Feasibility Study/Remedial Action under CERCLA) may be necessary
- Collect environmental data of sufficient quality and quantity to determine the potential for releases to migrate toward receptors for the significant pathways
- Collect environmental data of sufficient quality to be used in a screening level Health Risk and Environmental Assessment or BRA (to be conducted in the future, if required) and collect data of sufficient quantity to address all significant exposure pathways

- Collect sufficient quality and quantity of environmental data to support a recommendation of "no further action," if warranted, following the evaluation of the findings of the investigation

- Collect data of a quality that can be used as part of any required follow-on study including a Corrective Measures Study

The rationale for the field investigation activities and sampling locations was presented in the Work Plan. Standard operating procedures (SOPs) and sampling protocols for the field investigations at Landfill No. 5 are contained within the Data Collection Quality Assurance Plan (DCQAP) of the Work Plan.

Each of the field activities at Landfill No. 5 was conducted to meet specific task objectives. The objective of the site survey over Landfill No. 5 was to survey the boundary of Landfill No. 5, erect monuments as markers for this SWMU, create a topographic base map, and establish a grid for the geophysical surveys and soil gas investigation. The objective of the geophysical surveys (electromagnetic and magnetic survey) conducted across Landfill No. 5 was to delineate the edges of the landfill, locate waste-filled pits, trenches and cells within the landfill, identify potential areas of contamination, obtain information for use in performing the soil gas survey, and detect buried metallic objects (i.e., drums) for soil boring clearing. The objective of the soil gas survey was to identify areas of elevated volatile organic compound concentrations in soil gas. The objective of the drilling and soil sampling at Landfill No. 5 was to evaluate the presence of hazardous contaminants, if any, in the surface and subsurface soils and obtain site geologic framework information.

3.2 FIELD OBJECTIVES, METHODS AND RESULTS

This section provides a discussion of the site topographic survey and mapping and specific field investigation objectives, methods and results for the geophysical surveys, the soil gas investigation, and the collection of surface and subsurface soil samples for chemical and geotechnical analysis (including sample labeling, sample handling, documentation, and analysis) at Landfill No. 5. Field investigation activities are discussed below in more detail.

3.2.1 Site Topographic Survey and Mapping

A survey grid was established by a local land surveying company (licensed in the state of New Mexico), Lydick Engineer and Surveyors (Lydick) to establish ground control and provide a detailed topographic base map with one foot contours of Landfill No. 5 (Figure 2-1). The grid established at Landfill No. 5 measured 2,300 feet in the east-west direction and 2,050 in the north-south direction. The state plane coordinates and the established site coordinates for the corners around Landfill No. 5 are shown in (Figure 2-1). The grid was established with wooden survey stakes placed at 50-foot centers across Landfill No. 5. In addition to the wooden stakes, survey lathe annotated with field grid coordinates marked with florescent ribbon were placed at 100-foot centers across the site. The field coordinate system was converted to state plane coordinates for final plotting. The survey grid was established using total station optical survey techniques. Soil boring locations were horizontally located and the elevation surveyed following drilling activities. A copy of the surveyor notes, locations, and coordinates are contained in Appendix A.

3.2.2 Geophysical Investigation

The geophysical work (electromagnetic and magnetic surveys) at Landfill No. 5 was conducted to support subsurface remedial investigations at Landfill No. 5. The geophysical field work occurred from January 19 through January 27, 1995 and was documented in the report entitled "Geophysical Survey Technical Report." This report is included as Appendix B of this RFI report. The Geophysical Survey Technical Report included the purpose and scope of the geophysical work, the geophysical methods used, the detailed field program conducted, and the survey results and conclusions. The objectives of the geophysical investigations, the field methods, and the results for both the electromagnetic and magnetic surveys are summarized below.

The objectives of the geophysical investigation included:

- delineating the edges of the landfill
- locating waste-filled pits, trenches or cells within the landfill
- identifying potential areas of contamination
- obtaining information for use in performing the soil gas survey

The surface geophysical techniques used to accomplish these objectives were electromagnetic (EM) and magnetic surveys. Both surveys were conducted in accordance with SOP No. 2, Surface Geophysical Surveys, which is contained in the DCQAP. The geophysical investigations (electromagnetic and magnetic surveys) at Landfill No. 5 were designed to account for site-specific conditions known about the landfill. Historical records indicated that different types of waste disposal activities were conducted at Landfill No. 5. In the eastern half of the site, waste materials were reportedly buried in linear trenches. Records indicate that most of the trenches and cells within this portion of the site were oriented in a general north-south direction. However, the records also indicated that several generally east-west oriented trenches were located in relatively narrow (approximately 100 feet wide) bands across the southern and northern portions of the area. In the western portion of the site, records indicated that waste may have been disposed of in a semi-random manner over a relatively broad area, which is more typical of general landfill disposal practices.

Considering the historical information described above, the geophysical surveys were conducted using an asymmetrical survey grid established by a local land surveyor (Lydick) (see Section 3.2.1). The data station spacing was adjusted in different portions of the site to provide optimal coverage based on the known or suspected types of waste disposal activities in a particular area. In the eastern portion of the site, data station spacings of 50 feet north-south and 15 feet east-west were used to provide resolution of the north-south oriented trenches. However, in portions of the southern and northern areas, the north-south station spacing was reduced to 25 feet to provide better resolution of the suspected east-west trending trenches. In the western portion of the site, station spacings of 50 feet north-south and 20 feet east-west were used. The geophysical station location map is shown in Figure 3-1.

Electromagnetic Survey

EM methods provide a rapid means of measuring the electrical conductivity of subsurface soil and rock. EM data can aid the characterization of:

- Depth and thickness of subsurface units
- Soil and rock units, and lateral variations within the units
- Lateral extent of buried landfill materials

- Lateral extent of paleochannels
- Lateral and, in some instances, vertical extent of contaminants

The EM method involves the induction of an electrical current into the earth. A small alternating current is generated by a transmitter coil that produces a primary, time-varying magnetic field in the ground. Through inductive coupling, the primary magnetic field produces small eddy currents in the subsurface, which in turn, create their own secondary magnetic field. A receiver coil measures both the primary and secondary fields. Changes in magnitude and phase of the individual currents are output as voltages and are related to the subsurface electrical conductivity. Electrical conductivity is a function of the soil or rock type, the porosity and permeability of the rock units, and the fluids and fluid constituents filling pore spaces.

Depth of investigation is related to the separation between the transmitter and receiver coils. For deeper investigations and by using multiple coil spacings, several penetration depths can be achieved, allowing vertical variations of conductivity to be assessed. However, wider coil spacings also reduce the resolution of small shallow features because a larger volume of material is sampled for the terrain conductivity reading. In addition to the coil spacing, the depth of investigation is dependent on the instrument mode of operation. At a given coil spacing, the EM instruments commonly used for near-surface investigations can be operated in two modes or coil orientations. These are the horizontal dipole mode (coils are vertical coplanar) and the vertical dipole mode (coils are horizontal coplanar).

For the investigation at Landfill No. 5, EM data were collected with a Geonics EM-31. Quadrature phase and inphase measurements were obtained using both the horizontal and vertical dipole modes for effective investigation depths of approximately 9 and 18 feet, respectively. Data obtained from the EM survey was recorded using a data logger that allowed the operator to store and record station coordinate information and EM data simultaneously. The data logger recorded both the quadrature and inphase data.

Magnetic Survey

Magnetics methods provide a rapid means for measuring the earth's magnetic field and local variations of the field. Magnetic data can aid in the characterization of the following:

- Detection of buried metallic objects (borehole clearance, landfill or trench mapping)
- Reconnaissance subsurface geologic mapping

A magnetic survey involves the measurement of the earth's magnetic field at various points on the ground surface. Variations in magnetic susceptibility of subsurface material produce anomalies within the earth's magnetic field which can be measured with a magnetometer.

Magnetic surveys can be conducted using a variety of different types of magnetometers. For this project, a proton-precession type magnetometer was used. With this kind of magnetometer, a small alternating current was passed through a current coil within the sensing chamber of the magnetometer, creating a small magnetic field. Protons from the fluid within the chamber aligned themselves with this temporary magnetic field. When the current was turned off, the magnetic field terminated, and the protons attempted to realign themselves, or process, about the earth's magnetic field. A small signal was generated by the precession of the protons, in the same coil used to polarize them. The signal measured was directly proportional to the total magnetic field intensity at that location. This intensity was displayed digitally on the magnetometer, and expressed in gammas or nanoTeslas.

Two types of magnetic measurements were obtained: total field magnetics and vertical gradient magnetics. The total field intensity is simply the magnitude of the earth's magnetic field vector. The magnetic vertical gradient is a measurement of the difference in the total magnetic field between two sensors set at different fixed heights above the ground. Total field measurements are suitable for reconnaissance surveys and vertical gradient measurements allow resolution of composite or more complex magnetic anomalies.

Magnetics measurements are affected by several sources which interfere with the desired magnetic signal. The effects of these sources must be removed, or corrected, from the magnetics data. Diurnal variations, which are dominated by temporal magnetic variations, are primarily caused by particle and electromagnetic radiation from the sun. These variations are often monitored by either reoccupation of a base station at prescribed time intervals, or by a recording magnetic base station.

Magnetics values (or magnetic gradient values) can be plotted on a map and contoured so that variations over the site can be analyzed. Buried subsurface metal can be indicated by high magnetic values or high vertical gradients. Generally, areas with high magnetic anomalies indicate buried

ferromagnetic materials. Low magnetic anomalies can indicate disturbed soils with no ferromagnetic constituents. In many cases, the magnetic anomaly will appear as a dipole characterized by both high and low magnetic values in close proximity to each other. This occurs because the amplitudes of the magnetic measurements are dependent upon the direction the survey traverse approaches the anomalous magnetic field, and upon the subsurface orientation of the anomaly-producing body. The magnetic response and resulting anomaly is proportional to the mass of the subsurface magnetic material. Typically, a single drum can be detected to a depth of 10 to 15 feet. Groups of drums can be detected at depths of 25 feet or more.

For the investigation at Landfill No. 5 magnetic surveys were conducted using an GEM GSM-19 portable magnetometer/gradiometer. Magnetic total field and magnetic vertical gradient data were collected at each station. Base station data used for correcting diurnal variations in the magnetic total field data were collected using a second GEM GSM-19 magnetometer. The magnetic base station was located outside the survey grid (field coordinates North 1890 feet, East 2360 feet) in an apparently undisturbed area.

Geophysical Results

Upon completion of the EM and magnetic surveys, the geophysical data were downloaded to a personal computer. The data were then formatted for input to a contouring program. Data plotting and contouring was accomplished using the computer software GEOSOFT. Data input for the contouring program included the station coordinates and values, a selected spacing for gridding the raw data and a contour interval. Various cultural features were encountered at the site that are readily apparent on the geophysics data contour maps. These features included metal fencing, monitoring wells, buildings, and scrap metal materials.

In interpreting the geophysical results, the likely causative contributors to an anomaly must be considered. The magnetic total field and magnetic gradient respond primarily to buried metallic objects, although some variations in the total magnetic field will exist across the site due to variable magnetic materials within the near surface soils. Anomalies within the inphase mode of the EM measurements are also dominated by buried (or nearby) metallic objects. The EM quadrature anomalies can be due to buried metallic objects, as well as variations in soil constituents due to varying geology or the existence of buried landfill or hardfill debris materials.

The geophysical contour maps appeared to be consistent with the reported historical activities known to have taken place at the site. The eastern portion of the site is dominated by north-south trending linear anomalies indicative of trenching activities. These linear anomalies are usually displayed as conductivity or magnetic highs, or as dipoles. Geophysical results also depict several east-west trending or southwest trending anomalies in the southern portion of the surveyed area. These anomalies, also likely indicative of trenching activities, are most obvious in the total-field magnetics contour map. In many cases there was good agreement between suspected trench locations and mapped geophysical anomalies as illustrated in a map comparing the total magnetic field results to the trench locations previously mapped by Cannon AFB (Figure 3-2).

In the western portion of the survey area, a much more random distribution of geophysical anomalies exists, with few discernible linear trends (Figure 3-2). This finding supports historical reports that landfill materials may have been deposited in this area using a semi-random landfill disposal operation (i.e., filling of natural depressions), rather than using a trenching disposal method.

Geophysical results were used to help optimize soil gas sampling locations across Landfill No. 5. The geophysical information also provided a better estimation of individual trench locations, to facilitate soil boring drilling so that sampling could take place directly below the waste materials.

3.2.3 Soil Gas Investigation

The soil gas survey at Landfill No. 5 was performed by W-C from February 21 through March 9, 1995 and was documented in the report entitled "Soil Gas Survey Technical Report." The complete report is included as Appendix C of this RFI report. The Soil Gas Survey Technical Report includes the purpose and scope of the investigation, sample location rationale, soil gas sample collection procedures (i.e., for the field photoionization detector [PID] soil gas screening survey and for soil gas samples analyzed by the on-site mobile gas chromatography [GC] laboratory), field documentation and decontamination procedures. In addition, the report discusses the quality assurance/quality control measures implemented during the investigation and the PID and mobile laboratory GC sample analysis. Data results, comparison of field PID screening and mobile GC analysis results and conclusions are also discussed. The purpose, field methods, and results and conclusions of the soil gas investigation are summarized below.

The purpose of performing the soil gas investigation was to identify areas of elevated concentrations of volatile organic compounds (VOCs) in the soil gas at Landfill No. 5. The soil gas survey was performed as a two phase investigation following completion of the geophysical survey. The first phase of the soil gas survey consisted of the collection and field screening of soil gas samples at 800 locations using a field PID with a 10.2 eV lamp (Figure 3-3).

Soil gas samples were collected according to SOP No. 1 - "Soil Gas Surveys and Field Gas Chromatograph Operation" contained in the DCQAP. Procedures followed during the investigation are documented in the Soil Gas Investigation Report contained in Appendix C. As detailed below, similar sample collection procedures were used for the field PID soil gas screening survey and the collection of samples for GC analysis. Three Geoprobe hydraulic probe-type sampling systems were used to collect soil gas samples from 5 to 10 feet below ground surface at Landfill No. 5. The Geoprobe units were either all-terrain vehicle (ATV) or truck mounted. The Geoprobe sampling system used the static weight of the carrier vehicle and the rapid hammer action (1,500 blows per minute) to drive one-inch diameter soil gas sampling probes into the soil. Required sampling depths were reached by adding successive three-foot extensions of one-inch diameter, flush-threaded probe rod.

The soil gas sampling probe was driven to a target depth of 10 feet below ground surface, or to probe refusal, at each location. If probe refusal occurred between 5 and 10 feet, the depth was recorded and the soil gas sampling was performed at the depth achieved. At locations where probe refusal occurred between the surface and 5 feet, the probe was removed and a second attempt to achieve greater than 5 feet penetration was made within approximately 5 feet of the original location. The positions of the relocations were recorded in the field log book. If penetration greater than 4 feet could not be achieved in two attempts, the location was abandoned.

Once the sampling depth was achieved, the probe rod was retracted 4 to 8 inches to open the closed end of the soil gas drive point, thereby exposing the interior of the probe to the soil. A stainless steel adapter was attached to the bottom of a 13 foot length of 1/4" outside diameter (OD) polyethylene tubing and a fitted septum was attached to the top. The tubing and adapter were inserted into the probe rod, and threaded into the Post Run Tubing (PRT) soil gas tool at the bottom of the probe rod.

Prior to collection of either the field PID or GC soil gas sample, four 60 cubic centimeter (cc) syringe volumes were withdrawn to flush the system with the in situ soil gases. This volume was equivalent to three times the total dead volume of the probe and disposable tubing (i.e., the entire sampling apparatus).

After flushing the sampling apparatus with in situ soil gas, soil gas samples for the field PID screening analysis were collected in 60 cc plastic syringes. Once the soil gas sample was collected in a syringe, the syringe needle was placed into polyethylene tubing attached to the orifice of the field PID to provide a snug fit. The "Enter" button was then pressed on the field PID to commence the datalogger function, and the plunger on the syringe was evenly pushed to purge the soil gas contents of the syringe over an approximate 6-second period. The maximum reading on the PID was noted and recorded. For the collection of the samples for GC analysis, a surrogate, 1-Chloro-2-fluorobenzene, was injected into the interior of the retractable point, soil gas tool prior to driving the probe. Soil gas samples for the GC analyses were collected in 5 cc glass-teflon, gas-tight syringes. The syringes were used to temporarily store the sample prior to injection into the GC.

The entire PRT soil gas point assembly and adapter was decontaminated and the tubing replaced between soil gas sample locations.

Soil gas sampling equipment which came in contact with soil gas was decontaminated in accordance with SOP No. 4 "Decontamination Procedures" or replaced between each sampling location.

Soil Gas Results

Following review of the PID soil gas results, 78 soil gas samples were collected and analyzed for VOCs using a GC. These 78 soil gas locations were selected based on the concentration of total field PID soil gas results and the proximity of previously mapped landfill trenches and/or geophysical anomalies (Figure 3-3). The soil gas GC analytical results identified specific VOCs present in soil gas at Landfill No. 5.

The majority of the soil gas survey samples for field PID screening were collected in the eastern two-thirds of Landfill No. 5 (i.e., in the area of reported historic landfill trenching operations). The western one-third of the landfill site was investigated using fewer soil gas sample locations, since

this area reportedly received only construction debris and rubble. Soil gas samples were collected at 50-foot grid nodes within the eastern portion of the landfill site and focused in areas where trenching reportedly occurred and/or where anomalies were identified during the geophysical surveys. In areas where the 50-foot grid was not considered dense enough to provide sufficient sample coverage, supplemental soil gas samples were collected. In the western portion of the landfill area, soil gas sample locations focused primarily in the playa lake area and at recorded geophysical survey anomalies. In the playa lake area, soil gas screening samples were collected at 100-foot grid nodes. Supplemental soil gas samples were also collected in this area to evaluate geophysical anomalies.

With few exceptions, the highest PID field screening results occurred within or adjacent to the mapped landfill trench boundaries and/or in the area of geophysical anomalies as identified from the magnetic and electromagnetic survey results. Figure 3-4 shows the results of the field PID soil gas survey in comparison to the total field magnetic survey results and reported landfill cell boundaries.

Several of the mapped landfill trench locations where soil gas samples were collected contained no VOCs based on PID field screening. The lack of VOCs may be consistent with reported information that the land filling operation at some locations at Landfill No. 5 consisted of burning waste before burial and/or may reflect disposal of domestic waste in portions of the landfill.

Of the 78 locations analyzed for VOCs using GC, 51 of the locations indicated concentrations below the laboratory reporting limit of 1.2 parts per million on a volume to volume basis (ppm/v). Thirty-seven of the locations detected volatile organic compounds above the laboratory reporting limit with sixteen different VOC analytes being reported in the soil gas samples. Table 3-1 and Figure 3-5 summarize the GC sample results.

For the sixteen analytes detected in GC analysis of the soil gas, 74 percent of the reported detections were at concentrations below 5.0 ppm/v. The 16 VOC analytes tentatively identified can be separated into three analyte classes: (1) petroleum related or fuel additive compounds (i.e., 5 analytes including; benzene, toluene, ethylbenzene, xylenes, and chloroethane); (2) compounds commonly used in refrigerants or as blowing (foam) agents (i.e., 3 analytes including; trichlorofluoromethane, dichlorodifluoromethane, and chloromethane); and (3) compounds typically used as solvents (i.e., 8 analytes; dichloromethane [methylene chloride],

tetrachloroethylene [PCE], trichloroethylene [TCE], 1,1,1,2 - tetrachloroethane, 1,1,1-trichloroethane, 1,1-dichloroethylene, chlorobenzene, and trans 1,2-dichloroethylene).

Results showed that VOCs were present at low concentrations in soil gas at distinct locations within or adjacent to previously mapped landfill trenches. Soil boring locations were subsequently selected for drilling at Landfill No. 5, based on both the soil gas and geophysical survey results.

3.2.4 Surface and Subsurface Soil Investigation

From July 17 through August 1, 1995 thirty soil borings, 11301 through 11330, were drilled to depths ranging from 51 to 80 feet below ground surface (bgs) and surface and subsurface samples were collected for laboratory analysis (Figure 3-6). The rationale for choosing boring locations along with a boring location map was contained in a letter from W-C to USACE dated May 12, 1995. The rationale for and selection of boring locations shown in Figure 3-6 and discussed in the May 12 letter was approved by NMED during a meeting with Cannon AFB (along with W-C and USACE personnel) held in Santa Fe on June 14, 1995. Table 3-2 from the May 12 letter provides a summary of the location rationale for each boring.

Surface Soil Sample Collection

Surface soil samples were collected for chemical analysis during the field investigations at Landfill No. 5 in accordance with SOP No. 5 - Surface Soil Sampling contained in the DCQAP. Prior to collecting a surface soil sample for chemical analysis, existing vegetation and other foreign matter were cleared from the sampling location using a stainless steel trowel. Using the stainless steel trowel, soil was collected for VOC analysis. Additional soil was then collected and placed into a stainless steel bowl (previously decontaminated) and the sample homogenized and thoroughly mixed with the trowel. The soil was then placed into appropriate sample containers and the samples were immediately labeled and placed in a cooler with ice.

Ten surface soil samples were collected from 0 to 0.5 feet bgs near soil borings 113-01, 113-04, 113-07, 113-10, 113-13, 113-16, 113-19, 113-22, 113-25 and 113-28. These samples were analyzed for VOCs, SVOCs, pesticide/PCB, metals, cyanide, and total recoverable petroleum hydrocarbons (TRPH). In addition, the surface soil sample collected near boring 113-28 was submitted for grain size analysis.

Subsurface Soil Sample Collection

Subsurface soil samples were collected from soil borings which were drilled, sampled, lithologically logged, and grouted in accordance with SOP No. 6 - Subsurface Drilling and Sampling, SOP No. 7 - Lithologic Descriptions of Subsurface Samples, and SOP No. 8 - Borehole Abandonment contained in the DCQAP. Layne Environmental Services, Inc. of Denver, Colorado drilled the soil borings with truck-mounted Central Mine Equipment (CME) 75 high-torque auger drill rigs using hollow-stem augers. A field boring log containing the following information was completed for each boring drilled:

- Boring number, location, and elevation
- Drilling agency, equipment, method, and driller's name
- Geologist's name
- Date started and finished
- Completion depth
- Type of samplers used
- Number and depths of analytical and geotechnical samples
- Number of blows per 6 inches, and sample recoveries
- Sample identification numbers and quality assurance/quality control (QA/QC) samples
- Observations of any contamination or odors
- PID readings for breathing zone, soil boring, and soil samples
- Lithologic descriptions and Unified Soil Classification System (USCS) classifications
- Borehole abandonment information
- Downhole moisture conditions while drilling

CME 5-foot continuous core barrels with polybutyrate liners were used to collect samples for description of the landfill waste material. Upon retrieval and opening of the core barrel soil and waste was extruded from the polybutyrate liners onto the core barrel and a PID was used to screen the entire sample for the presence of volatile organic vapors. In addition, the PID was used to monitor the breathing zone of the on-site personnel. The landfill waste material was described and

evidence of burning of the landfill material, if observed, was recorded on the boring log. In accordance with the Work Plan, no samples for chemical analysis were collected from the landfill waste material during the field investigations.

After sampling through the landfill waste material and identifying the landfill/native soil interface, soil samples were collected for chemical and/or lithologic description at approximate 5-foot intervals to 40 feet below the landfill native soil interface using a 2-foot-long, modified California split spoon sampler with stainless steel liners.

The split spoon was driven 24 inches below the top of a targeted interval or until refusal (100 plus blowcounts) with a pneumatic 140-pound hammer falling 30 inches. The number of hammer blows per 6 inches was recorded on the boring log. Upon retrieval and opening of the split spoon, the PID was used to screen the entire sample for the presence of volatile organic vapors in addition to monitoring the breathing zone of the on-site personnel. If there was a detection of volatile organic vapor on the soil sample using the PID, the stainless steel liner displaying the highest PID reading in the split spoon was selected for VOC analysis. If no PID reading above background was detected when screening the soil sample, the lowermost stainless steel liner within the split spoon sampler was chosen for chemical analysis of VOCs. If a QA/QC sample was designated to be collected for VOC analysis (i.e., field duplicate, matrix spike/matrix spike duplicate [MS/MSD]), either the liner with the second to highest PID reading was chosen if a PID reading was recorded or the second to bottom liner was collected if no PID reading was recorded over the sample. The remainder of the soil sample was then extracted from the stainless steel liners, placed into a decontaminated stainless steel bowl and mixed thoroughly with a decontaminated stainless steel trowel. The soil was then placed into appropriate jars for the following analyses, SVOC, pesticide/polychlorinated biphenyl (PCB), Target Analyte List (TAL) metals, TRPH, total organic carbon (TOC) and herbicides. QA/QC samples and geotechnical samples (for grain size analysis), when collected, were filled at the same time the field samples were collected. Samples collected for chemical analyses were then labeled and placed into a cooler with ice.

All soil cuttings were placed in drums and the drums labeled with the following information, "Contents awaiting testing," Woodward-Clyde Federal Services (WCFS), Landfill No. 5, the boring number, soil interval (depth in feet bgs) placed in each drum, date, and the USAF contact name and phone number. In addition, each drum was given a unique identification number (i.e., LF5-1, LF5-2 etc.). An inventory list of all drums was compiled and is shown in Table 3-3. At the

completion of the project, all drums were placed on wooden pallets in a drum staging area located in the northwest corner of Landfill No. 5.

Upon reaching the total depth, the soil boring was then grouted with a portland/cement and bentonite (5%) mixture subsequent to the removal of the hollow-stem augers. The grout was pumped into the boring though the augers and the augers were then slowly withdrawn. The grout was allowed to settle (at least 24 hours) and each soil boring was later topped off with grout, to ground surface. A ten inch metal spike was placed in the surface grout to indicate the original ground surface.

Soil samples for chemical analysis were collected approximately 5 feet below the landfill/native soil interface and at approximate 10 foot intervals thereafter resulting in five subsurface soil samples from each boring (for a total of 150 field samples, excluding QA/QC samples) being submitted for chemical analysis. Lithologic boring logs for each boring are included in Appendix D. All subsurface soil samples collected for chemical analysis were analyzed for the following SW-846 parameters: VOCs, SVOC, pesticide/PCB, TAL metals, and TRPH. The first analytical sample collected in the native soil immediately below the base of the landfill material at each boring location was also analyzed for herbicides in addition to the above stated parameters. The bottom soil sample collected from each boring for chemical analysis were also analyzed for Appendix IX parameters for VOCs, SVOCs, pesticides/PCB, and TAL metals. Evidence of burned waste within the landfill cell was observed in fourteen soil borings (113-01, 113-06, 113-12, 113-13, 113-18, 113-20, 113-21, 113-22, 113-24, 113-23, 113-25, 113-26, 113-27, 113-30); therefore, in accordance with the Work Plan the bottom soil sample collected for chemical analysis in these borings was also analyzed for dioxins and furans. Twenty-four randomly selected soil samples from various depths in different borings were analyzed for TOC. Sixteen soil samples from various stratigraphic depths were collected from sixteen borings and analyzed for geotechnical parameters (grain size).

In addition to the 30 analytical soil borings drilled (depths ranging from 51 to 80 feet bgs excluding boring 113-31), three geotechnical soil borings 113-32, 113-33, and 113-34 were drilled to depths ranging from 14.5 to 34.0 feet bgs. The total depth of each boring drilled is included in Table 3-2. The three geotechnical soil borings were drilled to delineate the depth of the landfill/native soil interface near boring 113-16 where the base of the landfill was encountered at 40 feet bgs (Figure 3-6).

QA/QC Samples Collected

In accordance with the DCQAP, QA/QC samples (field duplicates, MS/MSD, decontamination water, and split samples) were also collected and submitted to the analytical laboratory to provide a means of assessing the quality of the data obtained during the field sampling program. A total of 8 field duplicates, 10 MS/MSDs, 1 decontamination water, and 16 USACE Missouri River Division (MRD) split samples were collected during the field investigation activities. Blind field duplicate samples were collected to check for sampling and laboratory reproducibility. MS/MSDs were collected to evaluate the precision and bias of a method in a given sample matrix and one decontamination water sample was collected to evaluate the quality of the potable water obtained during the course of the field work at the supply location near the contractor's area at the base. All QA/QC samples, except for MS/MSDs, were submitted blind to the laboratory.

In addition to the QA/QC samples described above, split samples were collected and submitted to the USACE QA laboratory (MRD) in Omaha, Nebraska. These samples were analyzed for the same parameters as the field samples to aid in evaluating interlaboratory precision as well as consistency of field techniques.

Summary information for soil borings drilled during the Phase I investigation is presented in Table 3-4. Table 3-4 includes the boring number, ground elevation, the date the borings were drilled, total depth of each boring, depth bgs to the landfill/native soil interface and evidence of burning in the landfill material. Also included is the number of surface soil samples, subsurface samples QA/QC samples, (field duplicates, MS/MSDs, MRD splits), and geotechnical samples collected during the field program.

A record of the surface, subsurface, and QA/QC samples collected for chemical or geotechnical analysis including boring number, sampling interval, sample identification number, types of QA/QC samples, date and time samples were collected, PID soil sample readings and analytical parameters tested is shown in Table 3-5.

3.2.4.1 Decontamination Procedures

All soil sampling equipment including stainless steel bowls, trowels, stainless steel liners, split spoons, and core barrels were decontaminated between samples. The sampling equipment was

decontaminated using an Alconox wash, a potable water rinse, a hydrochloric acid rinse and a double deionized rinse.

The drill rigs, augers, drill bit, and other larger downhole equipment were decontaminated at the decontamination pad located in the northwest corner of Landfill No 5. Decontamination procedures for the rig and associated downhole equipment (i.e., augers, drill bit) consisted of an Alconox wash using a high pressure steam cleaner, and a potable water rinse. Decontamination procedures were performed in accordance with SOP No. 4 - Equipment Decontamination.

Upon completion of the drilling activities, soil remaining on the decontamination pad from cleaning of the augers was shoveled into drums and waste water remaining on the pad was pumped into drums. Soil and waste water were placed into separate drums, and the drum contents labeled. At the completion of the project, all decontamination pad drums were placed on wooden pallets in the drum staging area, in the northwest corner of Landfill No. 5.

3.2.4.2 Sample Designation

In accordance with the Work Plan, the sample designation system for analytical and geotechnical samples and associated QA/QC samples was a three-letter and eleven-digit/letter unique identification for each sample (CANXXX-YYYY-ZZZZ). CANXXX is the facility identifier with CAN identifying Cannon AFB and XXX identifying the specific SWMU. Since Landfill No. 5 has a three-digit SWMU number and the field investigation required more than 9 boring locations, SWMU #113 was abbreviated as B3. The next four digits/letters (YYYY) identify the specific sampling location, incorporating both the SWMU number and the soil sampling number. All sampling location numbers are SWMU-specific, with the first two numbers or letters corresponding to the SWMU identification number and the last two numbers or letters corresponding to the specific sampling location.

The last four characters (ZZZZ) are the sample identifier. The first digit corresponds to the type of sample (i.e., 1 for soil (analytical), 2 for groundwater, and 4 for soil (geotechnical). The last 3 numbers correspond to the beginning depth of the sample in feet bgs for all soil samples. The following is an example of an identification number for this field investigation.

		SWMU#113		Soil (Analytical)
CAN	113	-	B321	1025
Cannon AFB	SWMU# 113		Boring #21	Approximate Depth of top of Sample in Feet-BGS

The QA/QC samples were identified at the location where they were collected and assigned a unique identification number following the same procedure above except for the last four digit (ZZZZ) identifier. The first two numbers of the QA/QC sample identifier corresponded to SWMU #113. The various SWMUs at Cannon AFB were numbered to aid in the identification of QA/QC samples gathered for each SWMU). Landfill No. 5 sample identification nomenclature followed this convention so that 05 = SWMU No. 113, Landfill No. 5. The third number was either the number 6 denoting a field duplicate, a number 8 denoting a decontamination water sample, or the number 0 denoting the MRD sample split. The last (fourth) digit corresponded to the sequential number of the particular QA/QC sample type. When more than 9 samples for one particular QA/QC type of sample were collected during the field program, the last digit continued with an "a" and proceeded alphabetically thereafter.

The only QA/QC sample type which was not identified above was the MS/MSD sample type. These samples were not discrete samples, but rather an analytical sample which was first analyzed and then spiked by the laboratory and reanalyzed. The samples that were chosen for MS/MSD analyses were labeled in the field as MS/MSD samples and were noted as such on the Chain-of-Custody (COC) forms.

3.2.4.3 Sample Handling, Documentation, and Analysis

All labeling, preservation, handling, shipping, documentation, and tracking for the samples collected for the Landfill No. 5 RCRA Phase I Field Investigation were performed in accordance with SOP No. 9 - Sample Handling, Documentation, and Analysis contained within the DCQAP.

All sample labels were filled out with waterproof ink and numbered. Soil and water sample labels, as well as all sample containers, were supplied by the analytical laboratory. Analytical sample containers were placed in reclosable plastic storage bags and wrapped in protective packing material (i.e., bubble packing). Samples were then placed in trash bags inside a cooler with ice

(double bagged using plastic trash bags) for overnight express carrier shipment to Quanterra Laboratory (Quanterra), Arvada, Colorado. A completed and signed Chain-of-Custody was placed in each cooler being shipped. A numbered custody seal was placed on the outside lid of each cooler and the coolers were taped shut.

The surface and subsurface soil samples were analyzed for the following analytical parameters using SW-846 methods:

- Target Compound List (TCL) VOC Method 8240;
- TCL SVOC Method 8270;
- TAL Metals (M) and Cyanide Methods 6010, 7060, 7471, 7740;,7421, 7841;
- Organochlorine pesticides and PCBs (pesticide/PCB) Method 8080;
- Chlorinated herbicides Method 8150;
- TOC Method 9060; and
- TRPH Method 9071/418.1.

Geotechnical gradation samples were labeled and placed in protective packing material (i.e., bubble packing). At completion of field activities the samples were shipped to Totowa Geotechnical Laboratory in Totowa, New Jersey. Gradation (ASTM D-421) and hydrometer (ASTM D-422) analyses were performed on sixteen soil samples (one surface and fifteen subsurface soil samples) by Totowa Laboratory to evaluate the particle size distribution of the soil sample. The distribution of particles larger than 0.074 millimeters (i.e., retained on the No. 200 sieve) was determined by sieving, while the distribution of particles smaller than 0.074 millimeters was determined by hydrometer analysis.

Documentation of observations and data acquired in the field provided information on the acquisition of samples and also provided a permanent record of field activities. The observations and data were recorded with waterproof ink in permanently bound weatherproof field log books with consecutively numbered pages by each geologist and geologist assistant. In addition, all pertinent sampling information for every sample collected for chemical analyses was recorded on a field sampling data sheet. The field sampling data sheets for all surface and subsurface soil samples along with field log books are filed in the W-C Denver, Colorado office.

To supplement the information recorded in the field book and field sampling data sheets, A-E daily quality control reports (DQCRs) were completed by the site manager each day which included documenting equipment used on site, work performed by each drill rig, QC activities, and problems which occurred during the day. These reports were prepared in accordance with the USACE SOS. The DQCRs are on file in the W-C Denver, Colorado office.

3.3 SITE GEOLOGY AND LANDFILL WASTE CHARACTERIZATION

Site Geology

The near surface stratigraphy (upper 82 feet) beneath Landfill No. 5 consists of Tertiary Miocene to Pliocene fluvial deposits of the Ogallala Formation. The Ogallala Formation consists of stream and overbank deposits formed within coalescing alluvial fans. The total thickness of the Ogallala deposit beneath Landfill No. 5 is not presently known, but based on regional information, may be as thick as 390 feet.

As is typical of alluvial deposits, the stratigraphy from boring to boring beneath Landfill No. 5 varies both vertically and laterally over short distances, in particular, caliche or highly calcareous zones within the units. Five geologic profiles, A-A', B-B', C-C', D-D', and E-E' (Figures 3-7 through 3-11, respectively), were constructed to illustrate the vertical and lateral variation of geologic units observed beneath Landfill No. 5. Geologic profiles A-A', B-B' and C-C' run generally west to east, and geologic profiles D-D' and E-E' run north-south across the landfill. Collection intervals for analytical samples are shown along with waste materials encountered in the cells and depth of the cell (native/soil interface).

From lithologic descriptions of the borings drilled through Landfill No. 5, the Ogallala deposit consists primarily of a calcareous/caliche silty sand unit (referenced as "SM" in accordance with the USCS) and calcareous fine-grained sands with trace amounts of silts (referenced as SP in accordance with the USCS) beneath most of Landfill No. 5. A calcareous silty sandy clay unit (designated as CL) was observed at one boring location (boring 11307). Caliche zones are found at various stratigraphic depths, interbedded with the silty sand or fine-grained sand units, and are generally laterally discontinuous from boring to boring except at a few locations. The caliche is generally described as a buff, tan, pink to pinkish white to white unit, medium dense to very dense, with occasional fine to medium grained quartz grains being present.

The calcareous silty sand (SM) unit is the primary geologic unit encountered by the borings drilled during the Phase I RFI at Landfill No. 5. This unit is described as a very fine to fine-grained sand (only occasionally being medium grained and rarely being coarse-grained) with some silt, and occasional clay. The unit is variable in color and is described as a light reddish tan, buff, tan, dark reddish brown, red orange, and pink orange calcareous silty sand. The unit is variable in its calcium carbonate content/caliche units and therefore its density. Caliche nodules usually tan to chalky white in color occur commonly throughout the rock units beneath the landfill. The geologic units beneath Landfill No. 5 change over short distances from slightly calcareous to highly calcareous, and from loose to very dense.

Occasionally during field logging, sand units were described as having only trace amounts of silt; therefore, the unit was sometimes classified according to the USCS as a poorly-graded fine-grained sand (SP). These rock units were identified in several boring locations and at various stratigraphic depths. Overall the SP units are similar to the SM units (described above) except for the amount of silt observed during borehole logging.

The geologic units encountered beneath Landfill No. 5 during the Phase I RFI drilling program typically showed dry conditions. Occasionally, however, moist or damp conditions were observed over small intervals.

Grain size analyses (hydrometer and sieve analysis) were performed by an off-site laboratory on 16 soil samples. These soil samples were collected at various stratigraphic depths and in different boring locations across the site. Table 3-6 summarizes the USCS results obtained from the laboratory analysis and compares the field USCS designation by the field geologist. Of the 16 soil samples collected and analyzed for grain size analysis, 9 of the samples classified by the laboratory were consistent with field USCS classifications. Five of the 16 soil samples analyzed (soil samples from borings 113-08, 113-14, 113-17, 113-23 and 113-28) were classified by the laboratory with a slightly higher percentage of clay and/or silt fractions then what was observed and logged by the geologists in the field during the Phase I RFI. Two of the 16 soil samples (soil samples from boring 113-03 and 113-09) collected and analyzed for grain size analysis resulted in the laboratory identifying substantial more clay size particles in the soil then what was observed during the field logging activities (Table 3-6).

Landfill Cells

Based on the geophysical surveys and subsequent drilling conducted during the Phase I RFI, approximately 21 landfill cells (exclusive of Cell No. 3) exist at Landfill No. 5 (Figure 3-6). Individual cells were typically 30-50 feet wide and 500 to 1,000 feet long.

The base of landfill cells encountered at Landfill No. 5 ranged in depth from about 7 to 40 feet bgs. Boring 113-29 located near the western boundary of Landfill No. 5 encountered the cell 7 feet bgs (Figure 3-6). Boring 113-16 located in the north central portion of Landfill No. 5 encountered the base of the cell at 40 feet bgs (Figure 3-6). Table 3-4 summarizes the depth of the landfill/native soil interface encountered at each boring location. Material encountered and observed while drilling through the landfill cells included primarily domestic and construction wastes. Domestic waste included plastic, paper, aluminum foil, leaves and twigs and grass clippings, rubber, metal, glass, cardboard, aluminum and tin cans, string, carbonpaper, newspaper, styrofoam, rags, clothing, thread, and bottles. Construction debris included metal fragments and shavings, wood debris, asphalt, bricks, drywall, wire, fiberglass, insulation material, chain link fence, nails, duct tape, screen, steel, plywood, concrete and possible asbestos. In addition, manure was encountered at one boring location. During drilling activities through the landfill cells, waste and soil were found in alternating layers due to intermittent backfilling of native soil over the waste in the cells or trenches. Trash was, therefore, not found continuously throughout the identified cell.

Both the domestic waste and construction debris were found intermixed throughout the entire landfill area. Burned and partially burned wood and paper debris, ash and charcoal were found only in minor amounts while drilling through the landfill material. Fourteen of the 30 analytical borings and 2 of the 3 geotechnical borings drilled showed evidence of burned waste.

Landfill Native Soils

Soils in the vicinity of Landfill No. 5 based on the soil survey of Curry County, New Mexico (USDA 1958) consist of fine sandy loams of the Amarillo Group. The Amarillo Group regionally consists of calcareous sands, silts and clays, is generally dry and is up to 4 feet thick. (Radian 1986). Native soil encountered at Landfill No. 5 during the July and August 1995 field

investigations at Landfill No. 5 were obtained from only two borings drilled (11331 and 11334) (See Appendix D) since these were the only two borings drilled through native soil (i.e., outside of known landfill cells). The soil consisted primarily of fine-grained, well sorted, calcareous, slightly silty, clayey red-brown sands. The sands are comprised predominantly of subangular to subrounded quartz grains. One gradational analysis was performed on a surface sample collected near boring 11328. The results indicated that this soil sample is comprised of approximately 47 percent of sand, and approximately 53 percent silt and clay.

Landfill Backfill

Backfill (soil) over the cells ranged in thickness from about 0.5 feet to 8.0 feet. Backfill consisted primarily of a mixture of silty sand and some clay, with a trace of gravel. The backfilled soil ranged in color from tan white to light brown, pinkish white to red, medium brown to dark brown and red brown. The soil was primarily dry but was moist at some locations and was often calcareous (i.e., caliche nodules). Rootlets were common in the top two to three feet and mottling of the soil was apparent.

DRAFT

.E 3-1
SOIL GAS SURVEY
GC SAMPLE RESULTS SUMMARY

Landfill No. 5 (SWMU No. 113/IRP No. LF-5)
Cannon AFB, New Mexico

Soil Gas Grid Point Location	Grid Coordinates		Detected Analyte (ppm/v)							
	North (ft)	East (ft)	1,1,1,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1-Dichloroethylene	Benzene	Chlorobenzene	Chloroethane	Chloromethane	Dichloro difluoromethane
B36	600	1750	ND	ND	ND	ND	ND	ND	ND	ND
BB39	1900	1900	ND	ND	ND	ND	ND	ND	ND	ND
BB43	1900	2100	ND	ND	ND	3.0	ND	ND	ND	ND
C32	650	1550	ND	ND	ND	ND	ND	ND	ND	45.0
D32	700	1550	ND	ND	ND	5.8	ND	ND	ND	ND
DD37	2000	1800	ND	ND	ND	5.1	ND	ND	ND	ND
F35	800	1700	ND	ND	ND	ND	ND	ND	ND	7.9
G39	850	1900	ND	ND	ND	ND	ND	ND	ND	ND
H25	900	1200	ND	ND	ND	ND	ND	ND	4.2	1.6
H28	900	1350	ND	ND	ND	ND	ND	ND	ND	ND
H31	900	1500	ND	ND	ND	ND	ND	ND	4.7	84.5
I28	950	1350	ND	ND	ND	ND	ND	ND	ND	ND
I31	950	1500	1.7	ND	ND	ND	ND	ND	ND	ND
I34	950	1650	ND	ND	ND	ND	ND	ND	ND	94.2
J40	1000	1950	ND	4.0	ND	ND	ND	ND	ND	19.9
M43	1150	2100	ND	3.0	ND	ND	ND	ND	ND	ND
N44	1200	2150	ND	ND	ND	ND	ND	ND	4.1	3.4
O39	1250	1900	ND	ND	ND	ND	ND	ND	ND	ND
Q39	1350	1900	ND	ND	ND	2.4	ND	ND	ND	3.4
Q45	1350	2200	ND	ND	ND	3.8	ND	ND	8.2	ND
R33	1400	1600	ND	ND	ND	ND	ND	ND	ND	21.2
R46	1050	2250	ND	ND	ND	ND	ND	ND	ND	ND
SB16	575	1350	ND	ND	ND	ND	ND	ND	ND	3.7
SB30	830	1150	ND	ND	ND	ND	ND	ND	ND	ND
SB36	915	1100	ND	ND	ND	ND	ND	ND	ND	ND
SB54	1850	2025	ND	ND	ND	ND	ND	ND	8.2	ND
SB55	1900	2025	ND	ND	ND	1.8	ND	5.2	ND	ND
SB57	1450	1775	ND	ND	ND	ND	ND	ND	4.4	18.8
SB65	1500	1625	ND	ND	1.4	ND	ND	ND	ND	ND
SB73	1650	1420	ND	ND	ND	ND	ND	ND	4.3	2.4
SB86	1450	1125	ND	ND	ND	ND	ND	ND	ND	ND
T46	1500	2250	ND	ND	ND	ND	2.7	ND	ND	ND
U37	1550	1800	ND	ND	ND	ND	ND	ND	4.1	ND
U43	1550	2100	ND	ND	ND	ND	ND	ND	ND	ND
V43	1600	2100	ND	ND	ND	ND	ND	ND	ND	ND
V45	1600	2200	ND	ND	ND	ND	ND	ND	ND	1.8
Z36	1800	1750	ND	ND	ND	ND	ND	ND	4.4	2.3

ND - not detected at 1.2 ppm/v

.E 3-1
SOIL GAS SURVEY
GC SAMPLE RESULTS SUMMARY

Landfill No. 5 (SWMU No. 113/IRP No. LF-5)
Cannon AFB, New Mexico

Soil Gas Grid Point Location	Grid Coordinates		Detected Analyte (ppm/v)								
	North (ft)	East (ft)	Dichloro methane	Ethylbenzene	Tetrachloroethylene	Toluene	trans-1,2-Dichloroethylene	Trichloroethylene	Trichloro fluormethane	Xylenes	Sum of Concentrations
B36	600	1750	ND	ND	ND	ND	ND	ND	ND	1.9	1.9
BB39	1900	1900	ND	ND	ND	ND	ND	ND	2.1	ND	2.1
BB43	1900	2100	ND	ND	ND	ND	ND	ND	ND	ND	3.0
C32	650	1550	ND	ND	ND	ND	ND	ND	ND	ND	45.0
D32	700	1550	ND	1.4	ND	ND	ND	ND	ND	ND	7.2
DD37	2000	1800	ND	ND	ND	ND	ND	ND	1.7	ND	6.8
F35	800	1700	ND	ND	ND	ND	ND	ND	ND	ND	7.9
G39	850	1900	ND	ND	ND	2.8	ND	ND	ND	ND	2.8
H25	900	1200	ND	ND	ND	ND	ND	ND	ND	ND	5.8
H28	900	1350	ND	ND	ND	ND	ND	ND	ND	2.2	2.2
H31	900	1500	5.6	ND	ND	4.2	ND	ND	ND	ND	99.0
I28	950	1350	ND	ND	11.8	3.1	ND	11.8	ND	2.2	28.9
I31	950	1500	ND	2.1	ND	ND	ND	ND	ND	ND	3.8
I34	950	1650	ND	ND	ND	2.8	ND	ND	ND	ND	97.0
J40	1000	1950	5.5	ND	ND	3.4	ND	ND	ND	ND	32.8
M43	1150	2100	3.2	ND	ND	3.7	ND	ND	ND	ND	9.9
N44	1200	2150	ND	ND	ND	2.9	ND	ND	ND	ND	10.4
O39	1250	1900	ND	ND	ND	3.1	ND	ND	ND	ND	3.1
Q39	1350	1900	ND	ND	ND	ND	ND	ND	ND	ND	5.8
Q45	1350	2200	ND	ND	ND	3.1	ND	ND	ND	ND	15.1
R33	1400	1600	2.9	ND	ND	ND	ND	ND	ND	ND	24.1
R46	1050	2250	ND	1.4	ND	ND	ND	ND	ND	ND	1.4
SB16	575	1350	ND	ND	ND	ND	ND	ND	ND	ND	3.7
SB30	830	1150	ND	ND	ND	1.7	ND	ND	ND	ND	1.7
SB36	915	1100	ND	ND	ND	ND	ND	ND	ND	1.4	1.4
SB54	1850	2025	4.1	ND	ND	6.6	ND	ND	ND	ND	18.9
SB55	1900	2025	ND	ND	ND	ND	ND	ND	3.9	ND	10.9
SB57	1450	1775	ND	ND	ND	2.5	ND	ND	ND	ND	25.7
SB65	1500	1625	8.6	ND	ND	4.4	2.6	38.7	ND	ND	55.7
SB73	1650	1420	ND	ND	ND	ND	ND	ND	ND	ND	6.7
SB86	1450	1125	ND	ND	ND	2.5	ND	ND	ND	ND	2.5
T46	1500	2250	ND	ND	ND	ND	ND	ND	ND	ND	2.7
U37	1550	1800	ND	ND	ND	ND	ND	ND	ND	ND	4.1
U43	1550	2100	ND	ND	ND	ND	ND	ND	1.7	ND	1.7
V43	1600	2100	4.0	ND	ND	ND	ND	ND	ND	ND	4.0
V45	1600	2200	ND	ND	ND	3.6	ND	ND	ND	ND	5.4
Z36	1800	1750	ND	ND	ND	2.5	ND	ND	ND	ND	9.2

ND - not detected at 1.2 ppm/v

TABLE 3-2
SOIL BORING LOCATIONS FOR LANDFILL NO. 5
INCLUDING LOCATION RATIONALE
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

Boring Number	Boring Designation	Location Field Coordinates (Grid Point)	Location Rationale[1]
B-1	113-01	N-1400, E-2250 (R46)	1, 2, 3A(1), 3E
B-2	113-02	N-1800, E-2200 (Z45)	1, 2, 3A(2)
B-3	113-03	N-1550, E-2100 (U43)	1, 2, 3A(1), 3E
B-4	113-04	N-1200, E-2150 (N44)	1, 2, 3A(1), 3E
B-5	113-05	N-1150, E-2100 (M43)	1, 2, 3A(1), 3D, 3E
B-6	113-06	N-1850, E-2025 (SB54)	1, 3A(1), 3E
B-7	113-07	N-1750, E-1975 (SB52)	1, 3A(1)
B-8	113-08	N-1450, E-2025 (SB46)	1, 3A(1)
B-9	113-09	N-700, E-1950 (D40)	1, 2, 3A(2)
B-10	113-10	N-1000, E-1950 (J40)	1, 2, 3A(1), 3D, 3E
B-11	113-11	N-1250, E-1900 (O39)	1, 2, 3A(1), 3E
B-12	113-12	N-1450, E-1775 (SB57)	1, 2, 3A(1), 3E
B-13	113-13	N-850, E-1900 (G39)	1, 2, 3A(1), 3E
B-14	113-14	N-1000, E-1800 (J37)	1, 2, 3A(2)
B-15	113-15	N-800, E-1700 (F35)	1, 2, 3A(1), 3E
B-16	113-16	N-1500, E-1500 (T31)	1, 2, 3A(2)
B-17	113-17	N-1250, E-1650 (O34)	1, 2, 3A(1)
B-18	113-18	N-1500, E-1625 (SB65)	1, 2, 3A(1), 3D, 3E
B-19	113-19	N-1850, E-1600 (AA33)	1, 3A(1)
B-20	113-20	N-1650, E-1420 (SB73)	3A(3), 3E
B-21	113-21	N-700, E-1550 (D32)	2, 3A(2), 3C, 3E
B-22	113-22	N-950, E-1350 (I28)	1, 2, 3A(2), 3B, 3D, 3E
B-23	113-23	N-1150, E-1350 (M28)	1, 2, 3A(1), 3E

TABLE 3-2
(Concluded)

Boring Number	Boring Designation	Location Field Coordinates (Grid Point)	Location Rationale[1]
B-24	113-24	N-900, E-1500 (H31)	2, 3, 3E
B-25	113-25	N-900, E-1200 (H25)	1, 2, 3A(2), 3E
B-26	113-26	N-835, E-1000 (SB33)	2, 3A(1)
B-27	113-27	N-1250, E-1175 (SB81)	2, 3A(1)
B-28	113-28	N-1400, E-1075 (SB87)	2, 3A(1)
B-29	113-29	N-1200, E-725 (SG10)	2, 3A(2)
B-30	113-30	N-1550, E-550 (U12)	2, 3A(2)

Notes:

(1) Location rationale designations correspond to the following:

1 - Within trench boundary previously mapped by CAFB.
2 - Mapped geophysical anomaly (total magnetics primary consideration; electromagnetic results secondary).
3 - Soil gas results.

A(1) elevated field PID reading within mapped trench boundary/geophysical anomaly.

A(2) low field PID reading within mapped trench boundary/geophysical anomaly.

A(3) elevated field PID reading outside of mapped trench boundary/geophysical anomaly.

B low field PID, moderate GC concentration of chlorinated solvents.

C low or non-detect field PID readings, detectable petroleum related compounds in GC.

D VOCs in GC samples. VOCs could pose human health risk if found at moderate to low concentrations in soil.

E Compare VOCs identified in soil gas by GC to those identified by GC/MS in soil samples to be collected in Phase I RFI.

TABLE 3-3

DRUM INVENTORY
SOIL BORING PROGRAM
PHASE I RFI, LANDFILL NO. 5
JULY 19 - AUGUST 1, 1995

Drum Inventory No.	Borehole No.	Depth (feet)	Contents	Drum Inventory No.	Borehole No.	Depth (feet)	Contents
Borehole Drill Cuttings							
LF5-1	11304	0-15	Drill Cuttings	LF5-49	11317	0-55[1]	
LF5-2	11304	15-55	(drums No. 1 through 94)	LF5-50	11312	0-23	
LF5-3	11328	0-57[1]		LF5-51	11312	23-55	
LF5-4	11329	0-7		LF5-52	11312	0-66[1]	
LF5-5	11328	0-16		LF5-53	11318	0-28	
LF5-6	11304	55-57		LF5-54	11318	28-50	
LF5-7	11328	16-55		LF5-55	11318	0-63.8[1]	
LF5-8	11327	0-58[1]		LF5-56	11316	0-40	
LF5-9	11327	0-16		LF5-57	11316	40-60	
LF5-10	11327	0-58		LF5-58	11316	0-82[1]	
LF5-11	11329	0-16		LF5-59	11320	0-12	
LF5-12	11307	0-61[1]		LF5-60	11320	12-53	
LF5-13	11307	19-59		LF5-61	11320	0-53[1]	
LF5-14	11307	0-19		LF5-62	11319	0-18	
LF5-15		grout		LF5-63	11319	18-56.5	
LF5-16	11323	0-55[1]		LF5-64	11319	0-56.5[1]	
LF5-17	11323	0-14		LF5-65	11321	0-17	
LF5-18	11323	14-40		LF5-66	11321	17-50	
LF5-19	11322	0-18		LF5-67	11321	0-59[1]	
LF5-20	11322	18-55		LF5-68	11314	0-32	
LF5-21	11322	0-56.5[1]		LF5-69	11314	32-67	
LF5-22	11329	0-52[1]		LF5-70	11314	0-68.5[1]	
LF5-23	11305	19-55		LF5-71	11309	0-18	
LF5-24	11305	55-61		LF5-72	11309	18-54	
LF5-25	11326	16-46		LF5-73	11309	0-54[1]	
LF5-26	11305	0-19		LF5-74	11306	0-16	
LF5-27	11326	0-16		LF5-75	11306	16-45	
LF5-28	11326	0-57[1]		LF5-76	11306	0-58[1]	
LF5-29	11308	-20 + grout		LF5-77	11302	0-14	
LF5-30	11308	20-53		LF5-78	11302	14-51	
LF5-31	11308	53-57		LF5-79	11302	0-51[1]	
LF5-32	11325	0-62[1]		LF5-80	11303	0-23	
LF5-33	11325	24-26		LF5-81	11303	23-55	
LF5-34	11325	-24 + grout		LF5-82	11303	0-60[1]	
LF5-35	11330	0-52[1]		LF5-83	11301	0-23	
LF5-36	11330	9-40		LF5-84	11301	23-55	
LF5-37	11330	40-52		LF5-85	11301	0-65[1]	
LF5-38	11310	58-66		LF5-86	11313	0-22	
LF5-39	11310	0-24		LF5-87	11313	22-50	
LF5-40	11310	24-58		LF5-88	11313	0-65[1]	
LF5-41	11311	0-26		LF5-89	11315	0-20	
LF5-42	11311	26-67		LF5-90	11315	20-56	
LF5-43	11311	0-67[1]		LF5-91	11315	0-56 + grout[1]	
LF5-44	11324	0-18		LF5-92	11334	0-15	
LF5-45	11324	18-50		LF5-93	11333	0-34	
LF5-46	11324	0-60[1]		LF5-94	11332	0-29	
LF5-47	11317	0-19		LF5-95	NA	NA	
LF5-48	11317	19-50					

TABLE 3-3

DRUM INVENTORY
SOIL BORING PROGRAM
PHASE I RFI, LANDFILL NO. 5
JULY 19 - AUGUST 1, 1995

Drum Inventory No.	Contents
Decon Pad Drill Cuttings	
LF5-96	Drill Cuttings from Decon of equipment
LF5-97	at Decon Pad (drums No. 96 through 100)
LF5-98	
LF5-99	
LF5-100	
Decon Water	
LF5-101	Decon water from Decon Pad (drums
LF5-102	No. 101 through 111)
LF5-103	
LF5-104	
LF5-105	
LF5-106	
LF5-107	
LF5-108	
LF5-109	
LF5-110	
LF5-111	
LF5-112	Sampling Equipment Decon water (drums
LF5-113	No. 112 and 113)

Note: (1) Cuttings generated when augers were pulled during grouting

DRAFT

TABLE 3-4

SOIL BORING SUMMARY
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

Boring No.	Elevation	Date(s) Drilled	Total Depth (ft-bgs)	Landfill/Native Soil Interface (ft-bgs)	Evidence of Burned Waste	Field Samples		QA/QC Samples			Geotechnical Samples
						Surface Samples	Subsurface Samples	Field Duplicates	MS/MSD	MRD Splits	
Geotechnical Borings											
11332	4261.13		29.0	23	Yes						
11333	4262.01		34.0	30	Yes						
11334	4262.70		14.5	N.E.							
Analytical Borings											
11301	4264.66	31-Jul-95	65	23	Yes	1	5			1	1
11302	4263.47	31-Jul-95	51	9	No		5				
11303	4264.76	30-Jul-95	59.9	17.5	No		5		1	1	1
11304	4263.93	20-Jul-95	57	15	No	1	5				1
11305	4264.47	20-Jul-95	61	19.5	No		5			2	
11306	4264.85	30-Jul/31-Jul-95	58	16	Yes		5	1			
11307	4264.25	20-Jul/21-Jul-95	61	19	No	1	5	1			
(11331)*	4264.99	Need Date	9.5	N.E.							
11308	4264.85	20-Jul/21-Jul-95	57	15.5	No		5	1	1		1
11309	4261.77	28-Jul/29-Jul-95	54.3	12.5	No		5	1			1
11310	4263.64	19-Jul-95	65	23.5	No	1	5	1			
11311	4264.69	19-Jul-95	66.4	26	No		5		1		1
11312	4264.82	27-Jul-95	66.0	22.5	Yes		5			1	
11313	4262.70	30-Jul-95	65	21.5	Yes	1	5		1	1	1
11314	4262.63	28-Jul-95	68.5	27	No		5				1
11315	4263.43	29-Jul/30-Jul-95	55.8	15	No		5				
11316	4262.70	26-Jul-95	80	40	No	1	5	1			
11317	4263.93	26-Jul-95	55	13	No		5		1	2	1
11318	4264.46	26-Jul/27-Jul-95	63.8	23	Yes		5				
11319	4265.28	27-Jul-95	56.5	12.5	No	1	5				
11320	4263.16	27-Jul-95	53	11.5	Yes		5				
11321	4264.47	28-Jul/29-Jul-95	59	17	Yes		5				1

TABLE 3-4

SOIL BORING SUMMARY
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

						Field Samples		QA/QC Samples			
Boring No.	Elevation	Date(s) Drilled	Total Depth (ft-bgs)	Landfill/Native Soil Interface (ft-bgs)	Evidence of Burned Waste	Surface Samples	Subsurface Samples	Field Duplicates	MS/MSD	MRD Splits	Geotechnical Samples
11322	4263.63	23-Jul/24-Jul-95	58.5	13	Yes	1	5		1		
11323	4263.59	24-Jul-95	55	14	Yes		5			2	1
11324	4265.92	28-Jul-95	60	18	Yes		5				1
11325	4262.81	23-Jul-95	62	18.5	Yes	1	5		1		1
11326	4260.28	23-Jul-95	56.5	16.5	Yes		5	1		2	1
11327	4262.56	22-Jul-95	58	16	Yes		5			2	1
11328	4262.02	22-Jul-95	57	15.5	No	1	5				1
11329	4262.70	21-Jul-95	51.8	7	No		5		1	1	
11330	4262.12	21-Jul/22-Jul-95	52	9	Yes		5	1		1	

Notes:
ft - Feet
ft-bgs - Feet below ground surface
NE - Not Encountered
All boreholes were drilled with a CME-75 drill rig with hollow stem augers. Samples were collected for chemical or geotechnical analyses in split spoons with stainless steel liner.
* Boring 11331 was terminated at 9.5 feet bgs since a landfill cell had not been encountered. The location was moved 4 feet west from Boring 11331 and redrilled as Boring 113

TABLE 3-5

SUMMARY OF SURFACE SOIL, SUBSURFACE SOIL, AND QA/QC SAMPLES COLLECTED FOR CHEMICAL OR GEOTECHNICAL GRAIN SIZE ANALYSIS
Landfill No. 5 (SWMU No. 5/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

BORING NUMBER	DEPTH INTERVAL (FT-BGS)	SAMPLE IDENTIFICATION NUMBER	QA/QC SAMPLES	SAMPLE MATRIX	DATE SAMPLED	TIME SAMPLED	PID ON SAMPLE (ppm)	ANALYTICAL PARAMETERS
11301	0.0 to 0.5	CAN113 B301 0569	FD	Soil	8/1/95		N.R.	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	0.0 to 0.5	CAN113 B301 1001	MS/MSD	Soil	8/1/95		N.R.	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	0.0 to 0.5	CAN113 B301 1000		Soil	7/31/95	0845	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	28.0 to 30.0	CAN113 B301 1028		Soil	7/31/95	1000	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, HERB
	28.0 to 30.0	CAN113 B301 0501	MRD	Soil	7/31/95	1000	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, HERB
	34.0 to 36.0	CAN113 B301 1034		Soil	7/31/95	1021	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	34.0 to 36.0	CAN113 B301 4034		Soil	7/31/95	1021	0	Geotechnical Analyses
		CAN113 B301 0581	DECON	Water	7/31/95		NR	VOC, SVOC, PCB/Pest, Metals, TRPH, HERB, TOC
	45.0 to 47.0	CAN113 B301 1045		Soil	7/31/95	1301	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, TOC
	55.0 to 56.9	CAN113 B301 1055		Soil	7/31/95	1402	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	63.0 to 64.8	CAN113 B301 1063		Soil	7/31/95	1440	0	AIX (VOC, SVOC, PCB/Pest, Metals, PCDD/PCDFs), TRPH
11302	14.0 to 16.0	CAN113 B302 1014		Soil	7/31/95	1051	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, HERB
	20.0 to 22.0	CAN113 B302 1020		Soil	7/31/95	1104	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	30.0 to 31.5	CAN113 B302 1030		Soil	7/31/95	1246	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, TOC
	40.0 to 41.8	CAN113 B302 1040		Soil	7/31/95	1323	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	49.0 to 51.0	CAN113 B302 1050		Soil	7/31/95	1352	0	AIX (VOC, SVOC, PCB/Pest, Metals), TRPH
11303	23.0 to 25.0	CAN113 B303 1023	MS/MSD	Soil	7/30/95	1002	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, HERB
	23.0 to 25.0	CAN113 B303 4023		Soil	7/30/95	1002	0	Geotechnical Analyses
	28.0 to 30.0	CAN113 B303 1028		Soil	7/30/95	1017	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	28.0 to 30.0	CAN113 B303 0502	MRD	Soil	7/30/95	1017	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	40.0 to 42.0	CAN113 B303 1040		Soil	7/30/95	1044	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	50.0 to 51.4	CAN113 B303 1050		Soil	7/30/95	1116	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	58.0 to 59.9	CAN113 B303 1058		Soil	7/30/95	1201	0	AIX (VOC, SVOC, PCB/Pest, Metals), TRPH
11304	0.0 to 0.5	CAN113 B304 1000		Soil	7/20/95	0735	7	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	20.0 to 22.0	CAN113 B304 1020		Soil	7/20/95	0945	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, HERB
	25.0 to 27.0	CAN113 B304 1025		Soil	7/20/95	1009	3.4	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	35.0 to 36.3	CAN113 B304 1035		Soil	7/20/95	1120	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, TOC
	45.0 to 47.0	CAN113 B304 1045		Soil	7/20/95	1158	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	45.0 to 47.0	CAN113 B304 4045		Soil	7/20/95	1158	0	Geotechnical
	55.0 to 57.0	CAN113 B304 1055		Soil	7/20/95	1237	0	AIX (VOC, SVOC, PCB/Pest, Metals), TRPH
11305	24.5 to 26.5	CAN113 B305 1024		Soil	7/20/95	0912	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, HERB
	24.5 to 26.5	CAN113 B305 0503	MRD	Soil	7/20/95	0912	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, HERB
	29.5 to 31.5	CAN113 B305 1029		Soil	7/20/95	0935	40	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	39.5 to 40.3	CAN113 B305 1039		Soil	7/20/95	1018	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, TOC
	49.5 to 51.0	CAN113 B305 1049		Soil	7/20/95	1053	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	59.5 to 60.8	CAN113 B305 1059		Soil	7/20/95	1228	0	AIX (VOC, SVOC, PCB/Pest, Metals), TRPH
	59.5 to 60.8	CAN113 B305 0504	MRD	Soil	7/20/95	1228	0	AIX (VOC, SVOC, PCB/Pest, Metals), TRPH
11306	20.0 to 21.9	CAN113 B306 1020		Soil	7/30/95	1550	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, HERB, TOC
	25.0 to 27.0	CAN113 B306 1025		Soil	7/30/95	1605	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	35.0 to 37.0	CAN113 B306 1035		Soil	7/30/95	1632	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	45.0 to 47.0	CAN113 B306 1045		Soil	7/30/95	1703	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	55.0 to 57.5	CAN113 B306 1055		Soil	7/30/95	1804	0	AIX (VOC, SVOC, PCB/Pest, Metals), TRPH
	55.0 to 57.5	CAN113 B306 0561	FD	Soil	7/30/95	1804	0	AIX (VOC, SVOC, PCB/Pest, Metals, PCDD/PCDFs), TRPH
11307	0.0 to 0.5	CAN113 B307 1000		Soil	7/20/95	1746	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	24.0 to 26.0	CAN113 B307 1024		Soil	7/21/95	0818	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, HERB
	29.0 to 30.8	CAN113 B307 1029		Soil	7/21/95	1115	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	39.0 to 41.0	CAN113 B307 1039		Soil	7/21/95	1156	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, TOC
	49.0 to 51.0	CAN113 B307 1049		Soil	7/21/95	1245	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	59.0 to 60.9	CAN113 B307 1059		Soil	7/21/95	1355	0	AIX (VOC, SVOC, PCB/Pest, Metals), TRPH
	59.0 to 60.9	CAN113 B307 0562	FD	Soil	7/21/95	1355	0	AIX (VOC, SVOC, PCB/Pest, Metals), TRPH
11308	20.0 to 22.0	CAN113 B308 1020		Soil	7/21/95	0749	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, HERB
	20.0 to 22.0	CAN113 B308 4020		Soil	7/21/95	0749	0	Geotechnical
	25.0 to 27.0	CAN113 B308 1025		Soil	7/21/95	0810	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, TOC
	25.7 to 27.0	CAN113 B308 0563	FD	Soil	7/21/95	0810	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, TOC
	35.0 to 35.9	CAN113 B308 1035		Soil	7/21/95	0840	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	45.0 to 47.0	CAN113 B308 1045		Soil	7/21/95	0957	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	55.0 to 57.0	CAN113 B308 1055	MS/MSD	Soil	7/21/95	1035	0	AIX (VOC, SVOC, PCB/Pest, Metals), TRPH
11309	18.0 to 20.0	CAN113 B309 1018		Soil	7/28/95	1528	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, HERB
	25.0 to 26.5	CAN113 B309 1025		Soil	7/28/95	1555	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	25.0 to 26.5	CAN113 B309 4025		Soil	7/28/95	1555	0	Geotechnical Analyses
	35.0 to 36.9	CAN113 B309 1035		Soil	7/28/95	1633	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	35.0 to 36.9	CAN113 B309 0564	FD	Soil	7/28/95	1633	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	45.0 to 47.0	CAN113 B309 1045		Soil	7/28/95	1658	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, TOC
	53.0 to 54.3	CAN113 B309 1053		Soil	7/28/95	1737	0	AIX (VOC, SVOC, PCB/Pest, Metals), TRPH

TABLE 3-5

SUMMARY OF SURFACE SOIL, SUBSURFACE SOIL, AND QA/QC SAMPLES COLLECTED FOR CHEMICAL OR GEOTECHNICAL GRAIN SIZE ANALYSIS
Landfill No. 5 (SWMU No. 5/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

BORING NUMBER	DEPTH INTERVAL (FT-BGS)	SAMPLE IDENTIFICATION NUMBER	QA/QC SAMPLES	SAMPLE MATRIX	DATE SAMPLED	TIME SAMPLED	PID ON SAMPLE (ppm)	ANALYTICAL PARAMETERS
11310	0.0 to 0.5	CAN113 B310 1000		Soil	7/19/95	0814	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	0.0 to 0.5	CAN113 B310 0565	FD	Soil	7/19/95	0814	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	29.5 to 31.0	CAN113 B310 1029		Soil	7/19/95	1007	0	AIX (VOC, SVOC, PCB/Pest, TAL Metals), TRPH
	34.0 to 35.3	CAN113 B310 1034		Soil	7/19/95	1102	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, HERB
	44.0 to 46.0	CAN113 B310 1044		Soil	7/19/95	1140	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, TOC
	54.0 to 55.0	CAN113 B310 1054		Soil	7/19/95	1215	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	64.0 to 65.0	CAN113 B310 1064		Soil	7/19/95	1350	0	AIX (VOC, SVOC, PCB/Pest, Metals), TRPH
11311	31.0 to 33.0	CAN113 B311 1031		Soil	7/19/95	1110	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, Herb
	35.0 to 35.8	CAN113 B311 1035		Soil	7/19/95	1148	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, Herb
	45.0 to 47.0	CAN113 B311 1045		Soil	7/19/95	1244	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, Herb
	45.0 to 47.0	CAN113 B311 4045		Soil	7/19/95	1244	0	Geotechnical sample - Grain Size Analysis
	55.0 to 57.0	CAN113 B311 1055	MS/MSD	Soil	7/19/95	1319	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	65.0 to 66.4	CAN113 B311 1065		Soil	7/19/95	1417	0	AIX (VOC, SVOC, PCB/Pest, Metals), TRPH
11312	27.5 to 29.5	CAN113 B312 1027		Soil	7/27/95	1445		VOC, SVOC, PCB/Pest, TAL Metals, TRPH, HERB
	34.0 to 36.0	CAN113 B312 1034		Soil	7/27/95	1530	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, TOC
	45.0 to 47.0	CAN113 B312 1045		Soil	7/27/95	1602	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	45.0 to 47.0	CAN113 B312 0505	MRD	Soil	7/27/95	1602	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	55.0 to 57.0	CAN113 B312 1055		Soil	7/27/95	1634	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	65.0 to 65.6	CAN113 B312 1065		Soil	7/27/95	1720	0	AIX (VOC, SVOC, PCB/Pest, Metals, PCDD/PCDFs), TRPH
11313	0.0 to 0.5	CAN113 B313 1000		Soil	7/30/95	0735	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	27.0 to 29.0	CAN113 B313 1027		Soil	7/30/95	0935	80	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, HERB
	32.0 to 34.0	CAN113 B313 1032	MS/MSD	Soil	7/30/95	0943	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	40.0 to 42.0	CAN113 B313 1040		Soil	7/30/95	1019	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	40.0 to 42.0	CAN113 B313 4040		Soil	7/30/95	1019	0	Geotechnical Analyses
	50.0 to 51.5	CAN113 B313 1050		Soil	7/30/95	1048	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	50.0 to 51.5	CAN113 B313 0506	MRD	Soil	7/30/95	1048	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	62.0 to 64.5	CAN113 B313 1062		Soil	7/30/95	1153	0	AIX (VOC, SVOC, PCB/Pest, Metals, PCDD/PCDFs), TRPH
11314	32.0 to 33.9	CAN113 B314 1032		Soil	7/28/95	0852	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, HERB
	38.0 to 39.1	CAN113 B314 1038		Soil	7/28/95	0924	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, TOC
	45.0 to 47.0	CAN113 B314 1045		Soil	7/28/95	0950	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	57.0 to 60.5	CAN113 B314 1057		Soil	7/28/95	1110	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	67.0 to 68.5	CAN113 B314 1067		Soil	7/28/95	1146	0	AIX (VOC, SVOC, PCB/Pest, Metals), TRPH
	67.0 to 68.5	CAN113 B314 4067		Soil	7/28/95	1146	0	Geotechnical Analyses
11315	20.0 to 22.0	CAN113 B315 1020		Soil	7/29/95	1055	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, HERB
	25.0 to 27.0	CAN113 B315 1025		Soil	7/29/95	1119	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, TOC
	35.0 to 35.8	CAN113 B315 1035		Soil	7/29/95	1144	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	45.0 to 46.8	CAN113 B315 1045		Soil	7/29/95	1224	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	55.0 to 55.8	CAN113 B315 1055		Soil	7/29/95	1306	0	AIX (VOC, SVOC, PCB/Pest, Metals), TRPH
11316	0.0 to 0.5	CAN113 B316 1000		Soil	7/26/95	0801	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	45.0 to 46.9	CAN113 B316 1045		Soil	7/26/95	1310	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, HERB
	45.0 to 46.9	CAN113 B316 0566	FD	Soil	7/26/95	1310	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, HERB
	50.0 to 50.9	CAN113 B316 1050		Soil	7/26/95	1325	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, TOC
	60.0 to 60.9	CAN113 B316 1060		Soil	7/26/95	1355	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	70.0 to 70.8	CAN113 B316 1070		Soil	7/26/95	1600	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	80.0 to 81.5	CAN113 B316 1080		Soil	7/26/95	1645	0	AIX (VOC, SVOC, PCB/Pest, Metals), TRPH
11317	19.0 to 20.3	CAN113 B317 1019	MRD	Soil	7/26/95	0903	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, HERB
	19.0 to 20.3	CAN113 B317 0507		Soil	7/26/95	0903	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, HERB
	25.0 to 26.5	CAN113 B317 1025		Soil	7/26/95	1002	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, TOC
	25.0 to 26.5	CAN113 B317 0508	MRD	Soil	7/26/95	1002	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, TOC
	35.0 to 36.3	CAN113 B317 1035	MS/MSD	Soil	7/26/95	1040	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	45.0 to 46.9	CAN113 B317 1045		Soil	7/26/95	1139	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	45.0 to 46.9	CAN113 B317 4045		Soil	7/26/95	1139	0	Geotechnical Analyses
	53.0 to 55.0	CAN113 B317 1053		Soil	7/26/95	1211	0	AIX (VOC, SVOC, PCB/Pest, Metals, PCDD/PCDFs), TRPH

TABLE 3-5

SUMMARY OF SURFACE SOIL, SUBSURFACE SOIL, AND QA/QC SAMPLES COLLECTED FOR CHEMICAL OR GEOTECHNICAL GRAIN SIZE ANALYSIS
Landfill No. 5 (SWMU No. 5/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

BORING NUMBER	DEPTH INTERVAL (FT-BGS)	SAMPLE IDENTIFICATION NUMBER	QA/QC SAMPLES	SAMPLE MATRIX	DATE SAMPLED	TIME SAMPLED	PID ON SAMPLE (ppm)	ANALYTICAL PARAMETERS
11318	28.0 to 29.9	CAN113 B318 1028		Soil	7/26/95	1642	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, HERB
	33.0 to 35.0	CAN113 B318 1033		Soil	7/26/95	1656	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	45.0 to 47.0	CAN113 B318 1045		Soil	7/27/95	0738	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, TOC
	55.0 to 56.5	CAN113 B318 1055		Soil	7/27/95	0820	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	63.0 to 63.8	CAN113 B318 1063		Soil	7/27/95	0903	0	AIX (VOC, SVOC, PCB/Pest, Metals, PCDD/PCDFs), TRPH
11319	0.0 to 0.5	CAN113 B319 1000		Soil	7/27/95	1054	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	18.0 to 20.0	CAN113 B319 1018		Soil	7/27/95	1315	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, HERB
	25.0 to 27.0	CAN113 B319 1025		Soil	7/27/95	1340	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	35.0 to 35.9	CAN113 B319 1035		Soil	7/27/95	1411	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	45.0 to 47.0	CAN113 B319 1045	MS/MSD	Soil	7/27/95	1446	0	TAL Metals
	53.0 to 56.5	CAN113 B319 1053		Soil	7/27/95	1528	0	AIX (VOC, SVOC, PCB/Pest, Metals), TRPH
11320	16.0 to 17.5	CAN113 B320 1016		Soil	7/27/95	0851	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, HERB
	20.0 to 22.0	CAN113 B320 1020		Soil	7/27/95	0913	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	30.0 to 32.0	CAN113 B320 1030		Soil	7/27/95	0945	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, TOC
	40.0 to 41.8	CAN113 B320 1040		Soil	7/27/95	1010	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	52.0 to 53.0	CAN113 B320 1052		Soil	7/27/95	1055	0	AIX (VOC, SVOC, PCB/Pest, Metals, PCDD/PCDFs), TRPH
11321	22.0 to 22.9	CAN113 B321 1022		Soil	7/28/95	1549	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, HERB
	27.0 to 29.0	CAN113 B321 1027		Soil	7/28/95	1633	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, TOC
	35.0 to 35.8	CAN113 B321 1035		Soil	7/28/95	1712	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	45.0 to 46.8	CAN113 B321 1045		Soil	7/28/95	1714	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	57.0 to 58.8	CAN113 B321 1057		Soil	7/29/95	0823	0	AIX (VOC, SVOC, PCB/Pest, Metals, PCDD/PCDFs), TRPH
	57.0 to 58.0	CAN113 B321 4057		Soil	7/29/95	0823	0	Geotechnical Analyses
11322	0.0 to 0.5	CAN113 B322 1000		Soil	7/23/95	1356	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	18.0 to 20.0	CAN113 B322 1018		Soil	7/24/95	0729	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, HERB
	25.0 to 25.5	CAN113 B322 1025		Soil	7/24/95	0901	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	35.0 to 36.2	CAN113 B322 1035	MS/MSD	Soil	7/24/95	0934	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	45.0 to 45.9	CAN113 B322 1045		Soil	7/24/95	1003	0.5	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	56.5 to 58.5	CAN113 B322 1056		Soil	7/24/95	1112	0	AIX (VOC, SVOC, PCB/Pest, Metals, PCDD/PCDFs), TRPH
11323	19.0 to 20.5	CAN113 B323 1019		Soil	7/24/95	0908	1.4	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, HERB
	19.0 to 20.5	CAN113 B323 0509	MRD	Soil	7/24/95	0908	1.4	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, HERB
	24.0 to 26.0	CAN113 B323 1024		Soil	7/24/95	0940	1.4	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	24.0 to 26.0	CAN113 B323 4024		Soil	7/24/95	0940	1.4	Geotechnical Analyses
	35.0 to 36.3	CAN113 B323 1035		Soil	7/24/95	1015	1.7	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, TOC
	35.0 to 36.3	CAN113 B323 050A	MRD	Soil	7/24/95	1015	1.7	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, TOC
	45.0 to 47.0	CAN113 B323 1045		Soil	7/24/95	1113	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	54.0 to 55.1	CAN113 B323 1054		Soil	7/24/95	1148	1.7	AIX (VOC, SVOC, PCB/Pest, Metals, PCDD/PCDFs), TRPH
11324	24.0 to 26.0	CAN113 B324 1024		Soil	7/28/95	0855	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, HERB
	29.0 to 29.8	CAN113 B324 1029		Soil	7/28/95	0917	550	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	40.0 to 42.0	CAN113 B324 1040		Soil	7/28/95	0950	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	50.0 to 50.8	CAN113 B324 1050		Soil	7/28/95	1023	3.2	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	58.0 to 58.4	CAN113 B324 4058		Soil	7/28/95	1110	0	Geotechnical Analyses
	59.0 to 60.0	CAN113 B324 1059		Soil	7/28/95	1130	0	AIX (VOC, SVOC, PCB/Pest, TAL Metals, PCDD/PCDFs), TRPH
11325	0.0 to 0.5	CAN113 B325 1000		Soil	7/23/95	0825	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	24.0 to 26.0	CAN113 B325 1024		Soil	7/23/95	1015	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	24.0 to 26.0	CAN113 B325 4024		Soil	7/23/95	1015	0	Geotechnical Analyses
	30.0 to 30.9	CAN113 B325 1030	MS/MSD	Soil	7/23/95	1036	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	40.0 to 42.0	CAN113 B325 1040		Soil	7/23/95	1112	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	50.0 to 50.5	CAN113 B325 1050		Soil	7/23/95	1152	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	60.0 to 62.0	CAN113 B325 1060		Soil	7/23/95	1303	0	AIX (VOC, SVOC, PCB/Pest, Metals, PCDD/PCDFs), TRPH
11326	21.5 to 23.0	CAN113 B326 1021		Soil	7/23/95	1244	1.7	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, HERB
	21.5 to 23.0	CAN113 B326 0567	FD	Soil	7/23/95	1244	1.7	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, HERB
	27.0 to 29.0	CAN113 B326 1027		Soil	7/23/95	1309	1.7	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, TOC
	27.0 to 29.0	CAN113 B326 0508	MRD	Soil	7/23/95	1309	1.7	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, TOC
	37.0 to 39.0	CAN113 B326 1037		Soil	7/23/95	1355	1.3	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	37.0 to 39.0	CAN113 B326 050C	MRD	Soil	7/23/95	1355	1.3	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	47.0 to 47.5	CAN113 B326 1047		Soil	7/23/95	1540	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	55.0 to 56.5	CAN113 B326 4055		Soil	7/23/95	1540	0	Geotechnical Analyses
	55.0 to 56.5	CAN113 B326 1055		Soil	7/23/95	1627	0	AIX (VOC, SVOC, PCB/Pest, Metals, PCDD/PCDFs), TRPH

TABLE 3-5

SUMMARY OF SURFACE SOIL, SUBSURFACE SOIL, AND QA/QC SAMPLES COLLECTED FOR CHEMICAL OR GEOTECHNICAL GRAIN SIZE ANALYSIS
Landfill No. 5 (SWMU No. 5/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

BORING NUMBER	DEPTH INTERVAL (FT-BGS)	SAMPLE IDENTIFICATION NUMBER	QA/QC SAMPLES	SAMPLE MATRIX	DATE SAMPLED	TIME SAMPLED	PID ON SAMPLE (ppm)	ANALYTICAL PARAMETERS
11327	21.0 to 23.0	CAN113 B327 1021		Soil	7/22/95	1459	NR	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, HERB
	21.0 to 23.0	CAN113 B327 050D	MRD	Soil	7/22/95	1459	NR	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, HERB
	24.5 to 26.5	CAN113 B327 1024		Soil	7/22/95	1513	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	24.5 to 26.5	CAN113 B327 050E	MRD	Soil	7/22/95	1315	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	34.5 to 36.5	CAN113 B327 1034		Soil	7/22/95	1612	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	34.5 to 36.5	CAN113 B327 4034		Soil	7/22/95	1612	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	44.5 to 46.0	CAN113 B327 1044		Soil	7/22/95	1642	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	57.5 to 58.1	CAN113 B327 1057		Soil	7/22/95	1832	0	AIX (VOC, SVOC, PCB/Pest, Metals, PCDD/PCDFs), TRPH
11328	0.0 to 0.5	CAN113 B328 1000		Soil	7/22/95	0941	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, TOC
	0.0 to 0.5	CAN113 B328 4000		Soil	7/22/95	0941	0	Geotechnical
	20.0 to 21.5	CAN113 B328 1020		Soil	7/22/95	1146	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, HERB
	25.0 to 27.0	CAN113 B328 1025		Soil	7/22/95	1224	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	35.0 to 37.0	CAN113 B328 1035		Soil	7/22/95	1304	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	45.0 to 47.0	CAN113 B328 1045		Soil	7/22/95	1333	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	55.0 to 57.0	CAN113 B328 1055		Soil	7/22/95	1420	0	AIX (VOC, SVOC, PCB/Pest, Metals), TRPH
11329	14.0 to 16.0	CAN113 B329 1014		Soil	7/21/95	1502	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, HERB, TOC
	20.0 to 22.0	CAN113 B329 1020	MS/MSD	Soil	7/21/95	1518	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	30.0 to 32.0	CAN113 B329 1030		Soil	7/21/95	1541	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	40.0 to 42.0	CAN113 B329 1040		Soil	7/21/95	1605	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	50.0 to 51.8	CAN113 B329 1050		Soil	7/21/95	1638	0	AIX (VOC, SVOC, PCB/Pest, Metals), TRPH
	50.0 to 51.8	CAN113 B329 050F	MRD	Soil	7/21/95	1638	0	AIX (VOC, SVOC, PCB/Pest, Metals), TRPH
11330	14.5 to 16.5	CAN113 B330 1014		Soil	7/21/95	1725	0	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, HERB
	20.0 to 21.3	CAN113 B330 1020		Soil	7/21/95	1749	4	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	30.0 to 32.0	CAN113 B330 0568	FD	Soil	7/22/95	0820	1.3	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	30.0 to 32.0	CAN113 B330 1030		Soil	7/22/95	0820	1.3	VOC, SVOC, PCB/Pest, TAL Metals, TRPH
	40.0 to 42.0	CAN113 B330 1040		Soil	7/22/95	0856	1.3	VOC, SVOC, PCB/Pest, TAL Metals, TRPH, TOC
	50.0 to 52.0	CAN113 B330 1050		Soil	7/22/95	0916	0	AIX (VOC, SVOC, PCB/Pest, Metals), TRPH
	50.0 to 52.0	CAN113 B330 050G	MRD	Soil	7/22/95	0916	0	AIX (VOC, SVOC, PCB/Pest, Metals, PCDD/PCDFs), TRPH

Explanation of Sample Identification Number

* The last four digits of the sample identification number correspond to a certain sample. The first number in the four digit sequence identifies the type of sample collected (i.e. 1 = analytical, etc.), while the last three numbers correspond to the beginning depth of the sample interval.

** The last four digits of the QA/QC sample identification number correspond to a certain QA/QC sample. The first two numbers correspond to a particular SWMU (i.e. B3 = SWMU NO. 113, Landfill No. 5), the third number corresponds to the type of QA/QC sample (i.e. 6 = field duplicate, etc.), while the fourth number corresponds to the sequential number of a particular QA/QC sample type.

Explanation of QA/QC Samples

MS/MSD - Matrix Spike/Matrix Spike Duplicate
FD - Field Duplicate
MRD - QA/QC Sample sent to U.S. Army, Missouri River Division Laboratory
DECON - Sample of the water used for Decontamination

Explanation of PID on Sample (ppm)

Readings reported for volatile organics using an Photo Ionization Detector (PID).
NR - PID measurement was not reported.

Explanation of Analytical Parameters

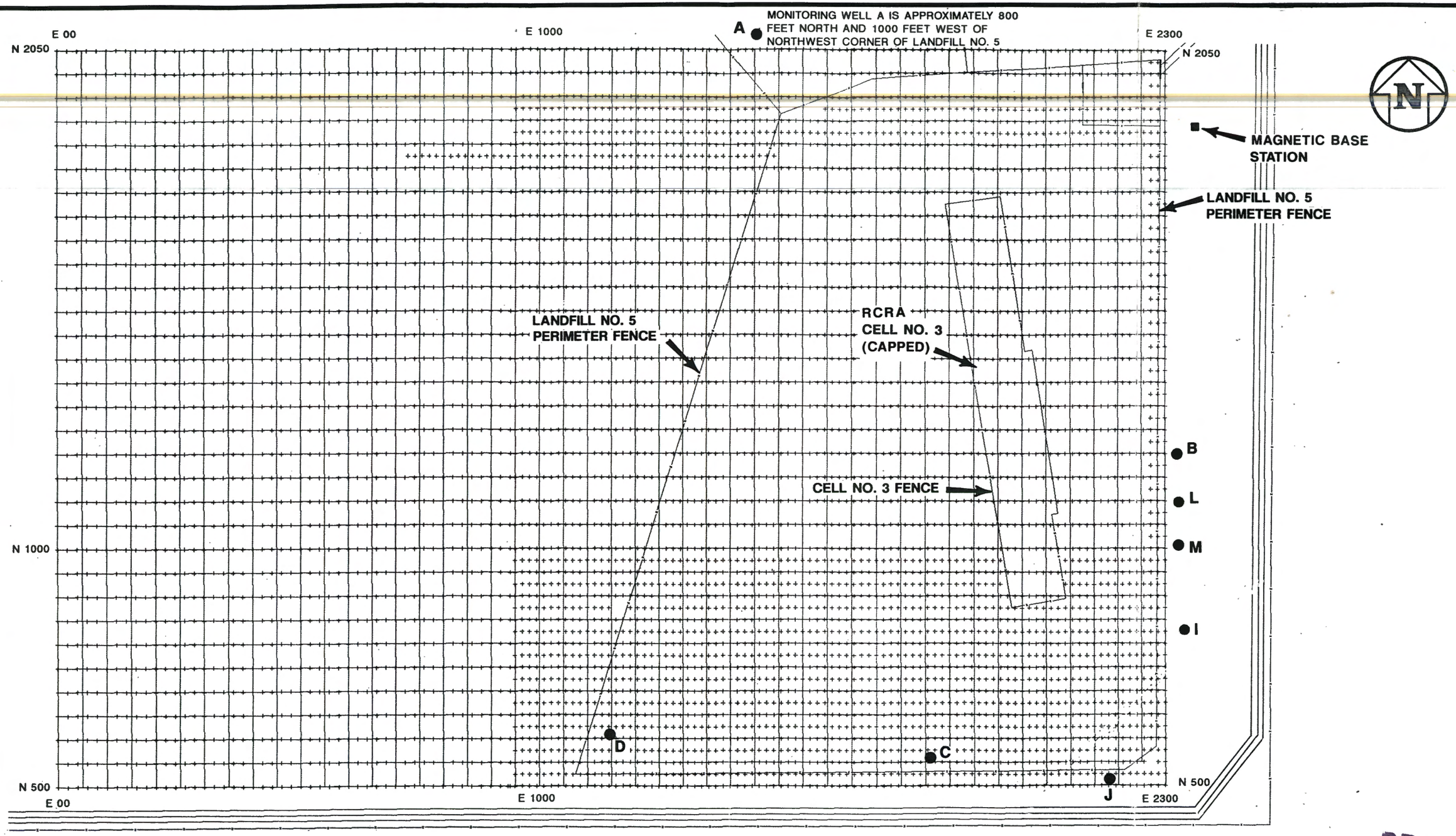
VOC - Volatiles
SVOC - Semi-volatiles
PCB/Pest - Pesticide/PCBs
TAL Metals - Target Analyte List Metals
TRPH - Total Recoverable Petroleum Hydrocarbon
HERB - Herbicides
TOC - Total Organic Carbon
PCDD/PCDFs - Dioxin/Furans

TABLE 3-6

LABORATORY GRADATIONAL ANALYSIS COMPARED TO FIELD USC CLASSIFICATION
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

Boring No.	Sample I.D.	Depth (feet) bgs	Laboratory USC Designation	Field USC Classification Designation
11301	CAN113-B301-4034	34-36	SM	SM
11304	CAN113-B304-4045	45-47	SM	SM
11311	CAN113-B311-4045	45-47	SM	SM
11313	CAN113-B313-4040	40-42	SM	SM
11321	CAN113-B321-4057	57-58.8	SM	SM
11324	CAN113-B324-4058	58-58.4	SM	SM
11325	CAN113-B325-4024	24-26	SM	SM
11326	CAN113-B326-4055	55-56.5	SM	SM
11327	CAN113-B327-4034	34.5-36.5	SC-SM	SM
11308	CAN113-B308-4020	20-22	SC	SM
11314	CAN113-B314-4067	67-68.5	SM	SP
11317	CAN113-B317-4045	45-46.9	SM	SP
11323	CAN113-B323-4024	24-26	SC	SM
11328	CAN113-B328-4000	Surface Sample	CL	ML
11303	CAN113-B303-4023	23-25	CL-SC	SP
11309	CAN113-B309-4025	25-26.5	CL	SW

bgs - below ground surface
SC - Clayey sands
SM - Silty sand
CL - Inorganic clays
ML - Inorganic silts
SP - Poorly graded sands, little to no fines
SW - Well-graded sands, little to no fines



DRAFT

LEGEND

- ● MONITORING WELL
- + GEOPHYSICAL STATION
- APPROXIMATE LOCATION OF ROAD
- FENCE

0 100 200 400
SCALE IN FEET

N 500, E 00 – FIELD GRID COORDINATE

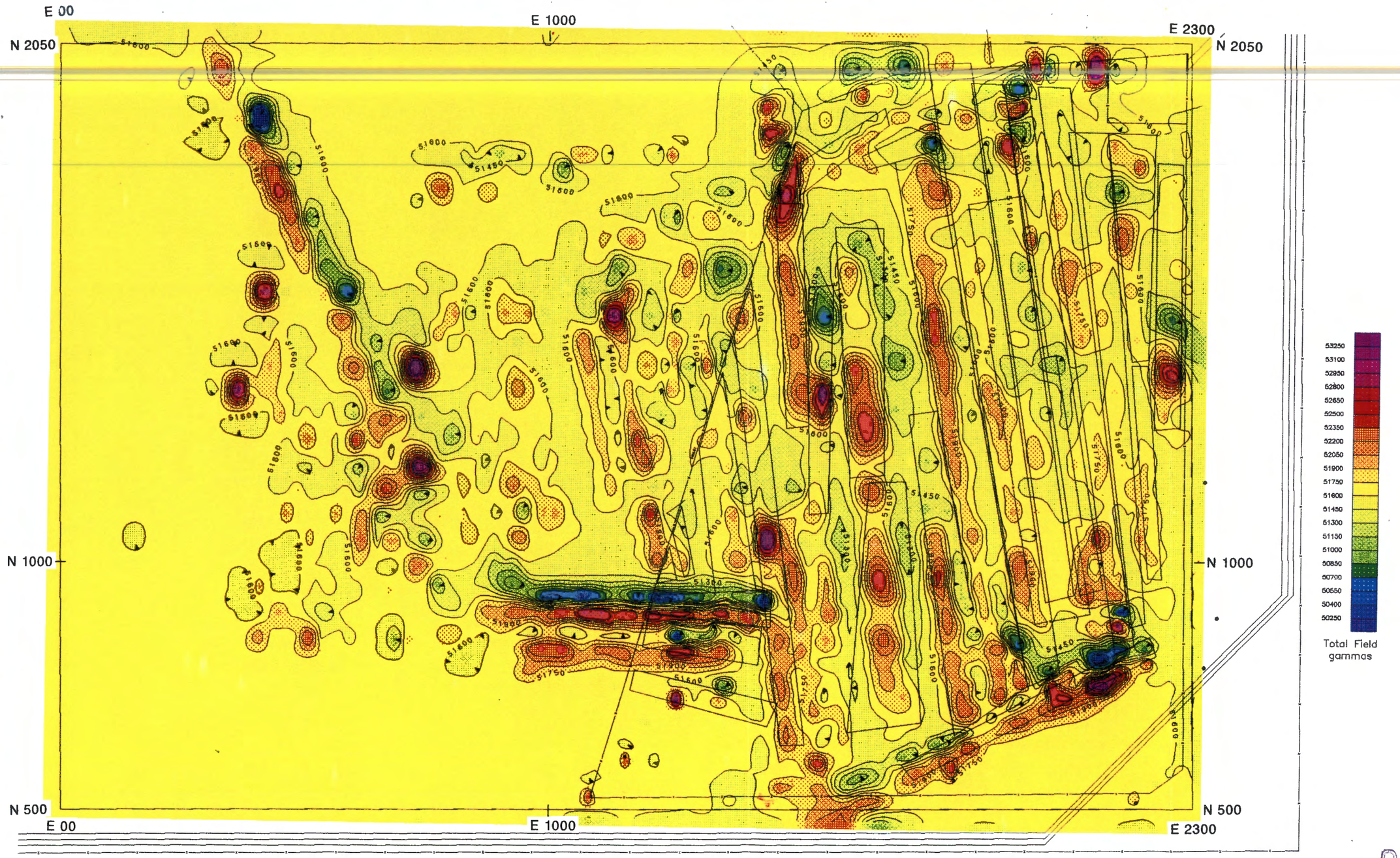
Job No. :	C3M11M
Prepared by :	J.J.N.
Date :	10/25/95

GEOPHYSICAL STATION LOCATION MAP

LANDFILL NO. 5 (SWMU NO. 113/IRP NO. LF-5)
CANNON AFB, NEW MEXICO

T2C9

FIG. 3-1



LEGEND

- MONITORING WELL
- APPROXIMATE LOCATION
- FENCE
- REPORTED LANDFILL CELL BOUNDARIES PREVIOUSLY MAPPED BY CANNON AFB

0 100 200 400

SCALE IN FEET

CONTOUR INTERVAL = 150 gammas

Job No. :	C3M11M
Prepared by :	J.J.N.
Date :	10/25/95

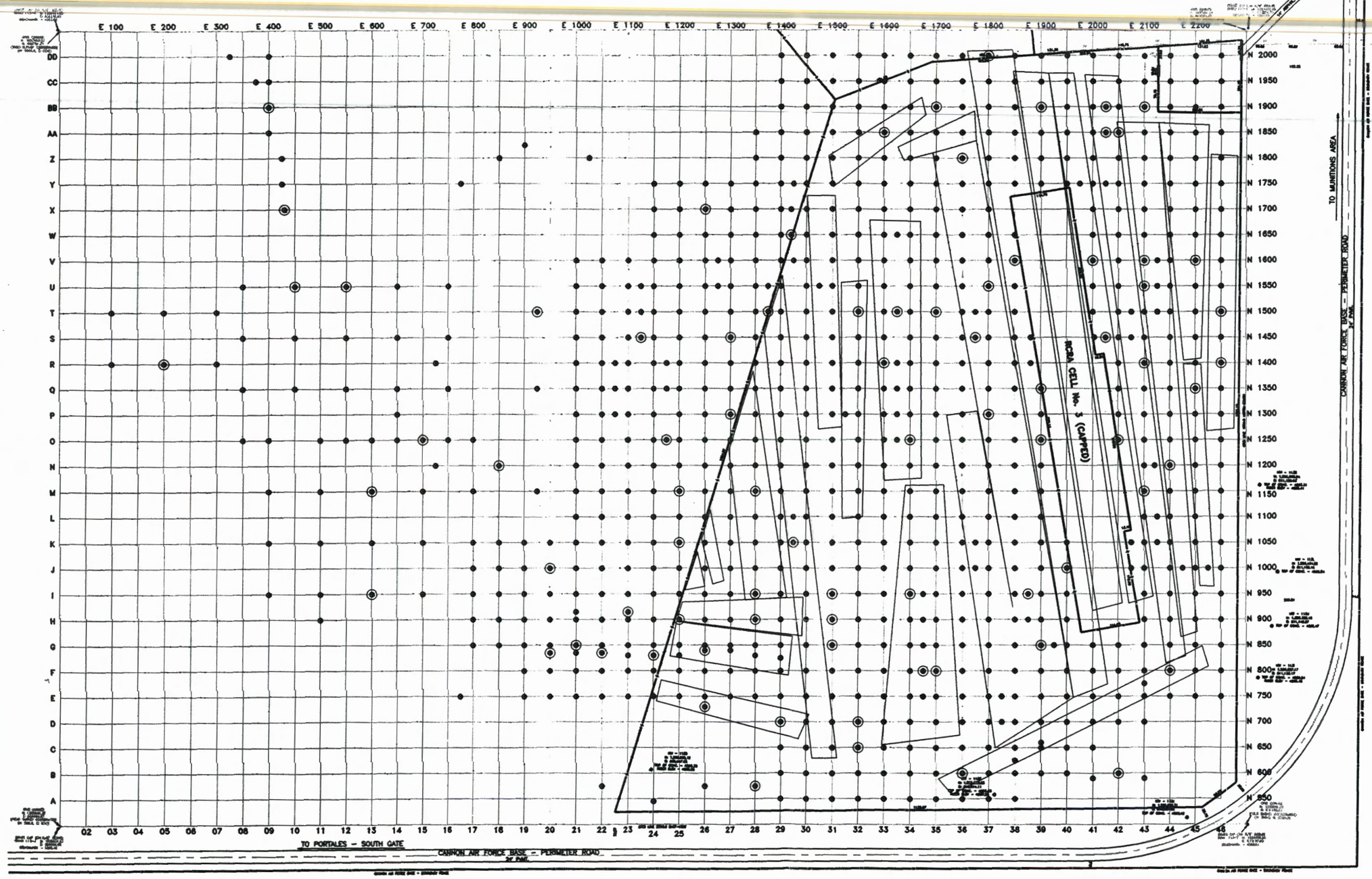
COMPARISON OF TOTAL MAGNETIC FIELD RESULTS TO PREVIOUSLY MAPPED LANDFILL CELL BOUNDARIES

LANDFILL NO. 5 (SWMU NO. 113/IRP NO. LF-5)
CANNON AFB, NEW MEXICO

FIG. 3-2

T2C10

Woodward-Clyde Consultants



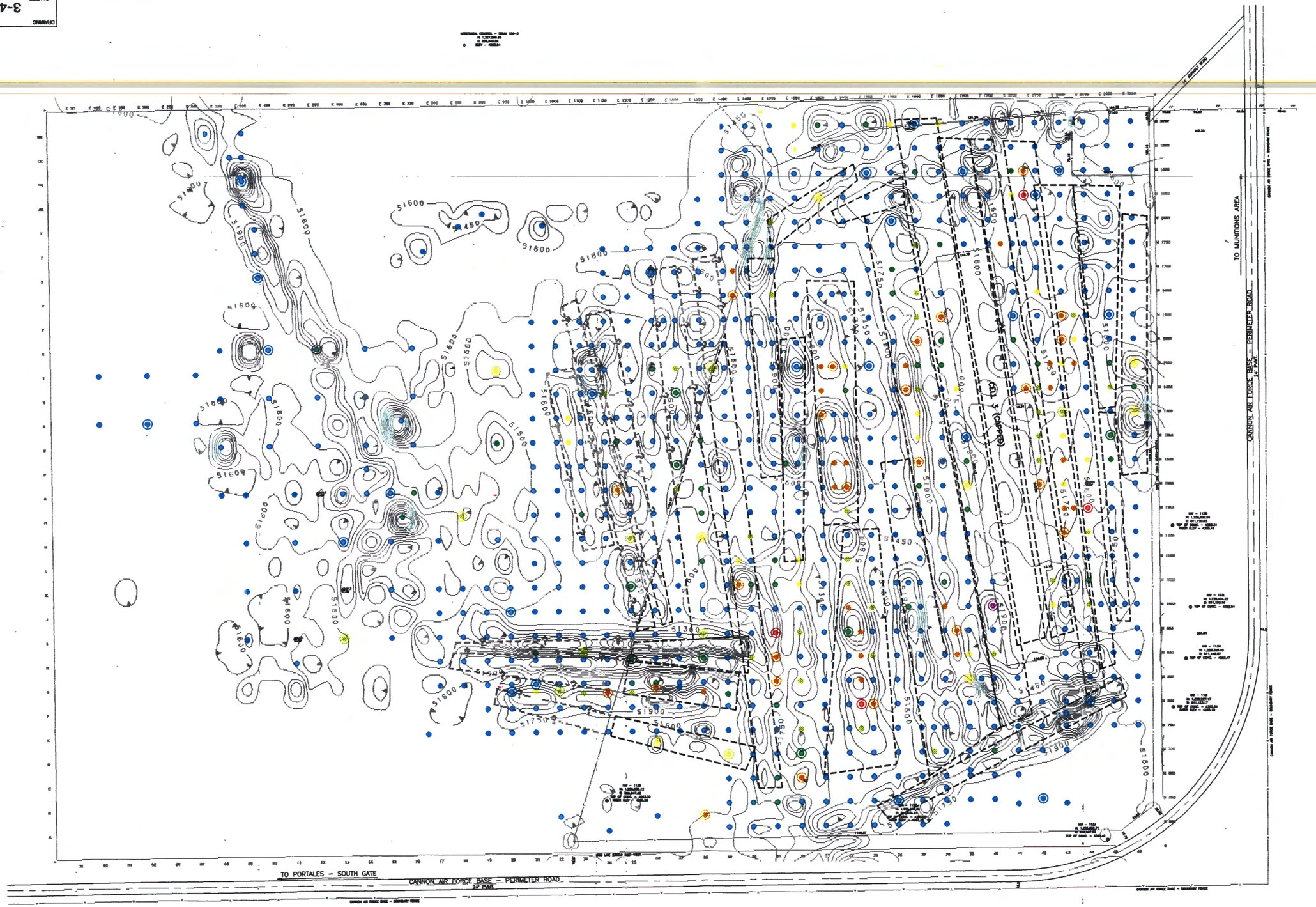
DRAFT

Job No. :	C3M11M
Prepared by :	GLW/JTA
Date :	10/25/95

SOIL GAS SURVEY
SAMPLE LOCATION MAP
LANDFILL NO. 5
(SWMU NO. 113/IRP NO. LF-5)

FIG. 3-3

3M11FGB8


TO MUNITIONS AREA
CANNON AIR FORCE BASE - PERIMETER ROAD
TO PORTALES - SOUTH GATE
CANNON AIR FORCE BASE - PERIMETER ROAD
24' PAVE.
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51900
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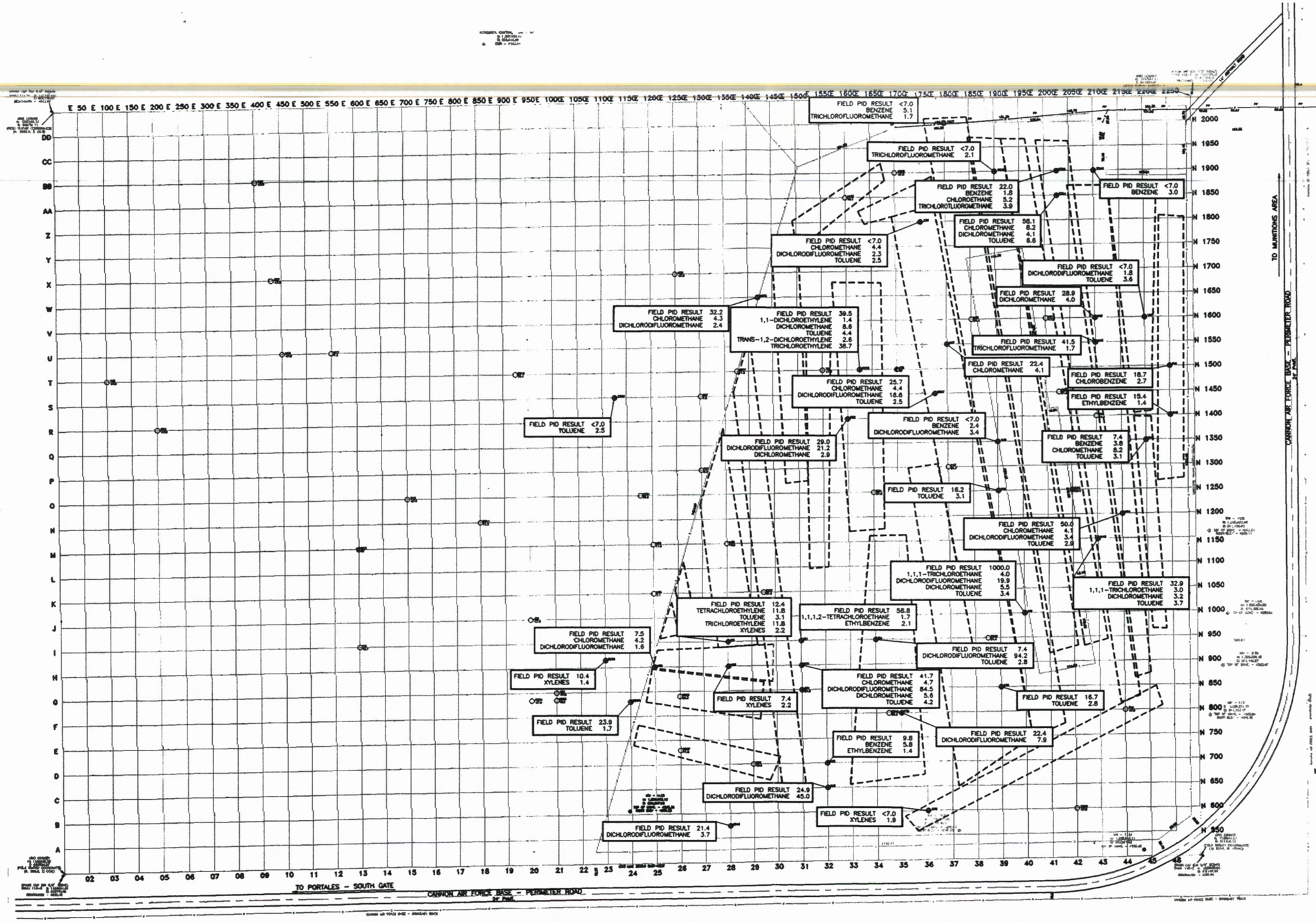


LEGEND

- SG11 / 11.2 — MOBILE LABORATORY GC SAMPLE LOCATION / NO VOCs DETECTED/FIELD PID RESULT
- G39 / NS — MOBILE LABORATORY GC SAMPLE LOCATION / FIELD PID RESULT (ppm/v)
- FIELD PID RESULT 16.7 / TOLUENE 2.8 — DETECTED VOC ANALYTE AND CONCENTRATION (ppm/v)
- 111 / RF — MOBILE LABORATORY GC SAMPLE LOCATION / NO SAMPLE ANALYZED/SAMPLE PROBE REFUSAL
- N 2000, E 50 — FIELD GRID COORDINATES
- A, 02 — SOIL GAS SAMPLE LOCATION GRID
- FENCE
- REPORTED LANDFILL TRENCH BOUNDARY
- MONITORING WELL

DRAFT

WARNING
0 ½ 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

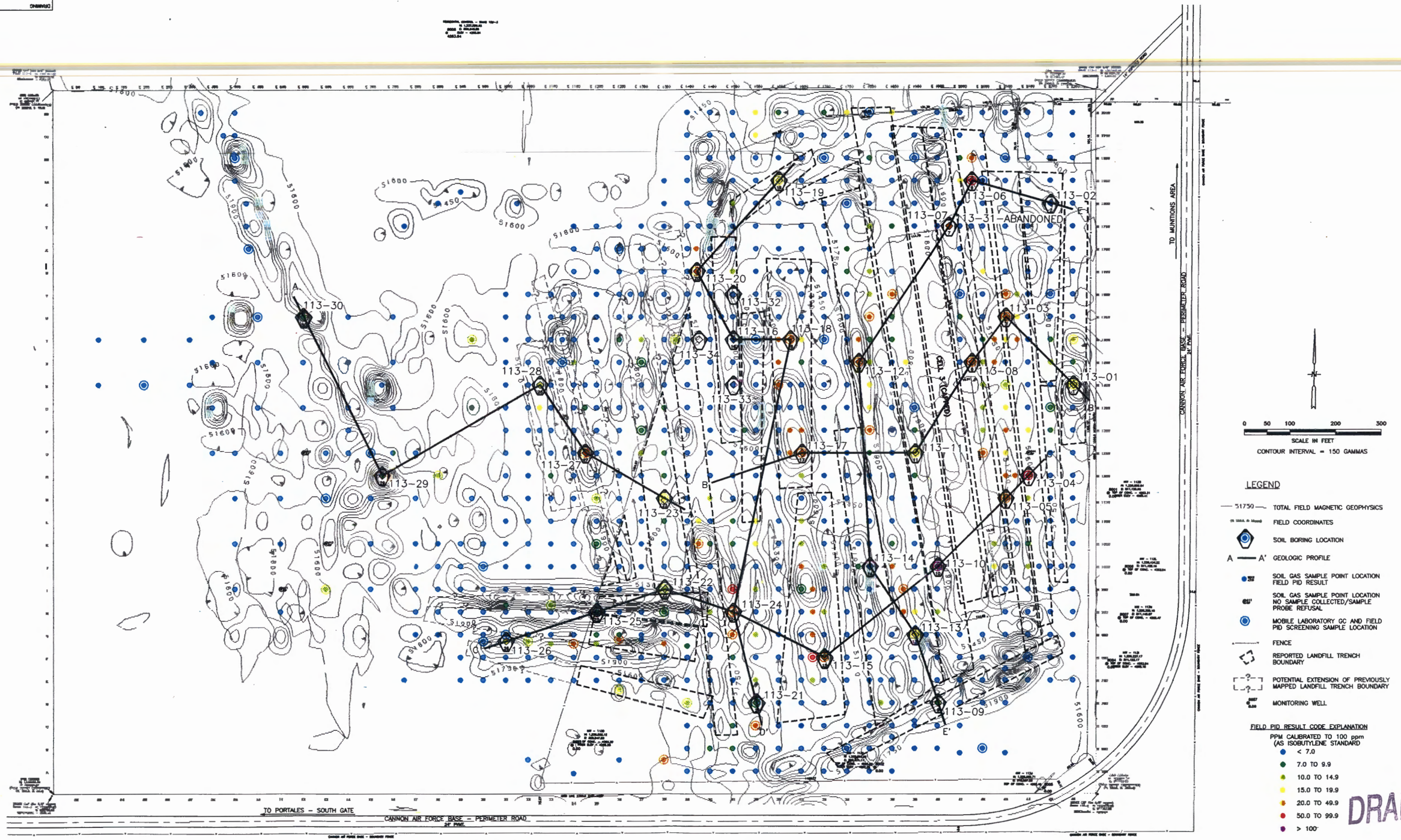
DESIGNED	GLW/JTA
DRAWN	PFL
CHECKED	
PEER REVIEWED	
PROJECT MANAGER	
DATE	4/19/95

CANNON AFB — NEW MEXICO

SOIL GAS SURVEY
MOBILE LABORATORY GC RESULTS
LANDFILL NO. 5
(SWMU NO. 113/IRP NO. LF-5)

REVISION △
PROJECT C3M11M
DRAWING 3-5
SHEET OF

SEND TO / PHONE
LOC. / PROJ. CANNON AFB
PROJ. C3M11M / TASK 23
PFL
FILE 3M11F03 / SCALE 1"=100'


TO MUNITIONS AREA
CANNON AIR FORCE BASE – PERIMETER ROAD
24' PAVE.
TO PORTALES – SOUTH GATE
CANNON AIR FORCE BASE – BOUNDARY FENCE
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113-02
113-03
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4.0
NATURE AND EXTENT OF CONTAMINATION

4.1 INTRODUCTION

This section describes the nature and extent of contamination found in surface and subsurface soil at Landfill No. 5 based on the validated chemical data results obtained from the Phase I RFI. Section 4.2 discusses the quality assurance procedures related to field and laboratory data including specific types of QA/QC activities, required QA/QC activities as presented in the DCQAP and data validation. Section 4.3 discusses the nature and extent of the following: commonly occurring elements (calcium, potassium and sodium) in surface and subsurface soil above regional and site-specific background ranges; metals concentrations detected above the maximum established background at Cannon AFB; SVOCs; VOCs; pesticide/PCBs; TRPH; cyanide; herbicides; dioxin and furan contamination, if any, at Landfill No. 5. In addition, tentatively identified compounds (TICs) identified by the laboratory are also addressed.

4.2 QUALITY ASSURANCE/QUALITY CONTROL OF DATA

This section summarizes quality assurance procedures related to field and laboratory data and the results of quality control samples taken during the Phase I RFI at Landfill No. 5. Appendix E contains the validated analytical results for the samples collected as part of this project. The detailed data validation report is provided as Appendix F.

Details of the data quality objectives are discussed in the DCQAP. The analytical procedures utilized for the samples collected from Landfill No. 5 are summarized in Table 6-1 of the DCQAP. QA/QC measures were followed throughout the analytical program as part of the method and DCQAP requirements, as discussed below in Sections 4.2.1 and 4.2.2.

As set forth in the DCQAP for the Phase I RFI at Landfill No. 5, data quality objectives for quantifiable analytical data are expressed in terms of accuracy, precision, completeness, comparability, and representativeness. Brief definitions of these terms follow:

Accuracy is a measure of the bias in a system. Accuracy is the degree of agreement of a measurement or series of measurements with the accepted reference or true value. The exact bias of a system will never be known since the true values are not accessible; however, inferences can be drawn from the results of blank samples taken in the field, of method blanks, and spiked sample analyses prepared in the laboratory. Control values for accuracy for each type of analytical measurement are defined in the DCQAP.

Precision is a measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Replicate samples are expected to contain identical contaminant concentrations; therefore, any variability in results must be due to variability introduced by sampling (or heterogeneity of sample media), handling, or laboratory procedures. Control values for precision for each type of analytical measurement are defined in the DCQAP.

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that could be obtained under optimum conditions. Amounts of data to be collected are defined in the DCQAP, which sets the analytical completeness goal for the analytical program at 90 percent.

Comparability expresses the confidence with which one data set can be compared with another. Qualitatively, data subjected to the strict QA/QC procedures will be deemed more reliable, and therefore more comparable, than other data. The SOPs describe the sampling and reporting procedures that were followed in order to produce comparable data.

Representativeness is the degree to which a set of data accurately represents the characteristics of a population, a process condition, or an environmental condition. Data are usually considered representative if the sample distribution is within statistically defined bounds of the population mean and variance. Representativeness depends on the sample media and the area being studied.

4.2.1 Specific Types of QA/QC Activities

Specific QA activities required by the DCQAP included the following:

- Laboratory systems and performance audits

- Adherence to required analytical and reporting procedures as described in the DCQAP, and documentation of all laboratory procedures

- Proper storage and archiving of all data

Specific QC samples included the following:

- Laboratory QC samples for soils
  - Matrix spike/matrix spike duplicate (MS/MSD)analyses (matrix spike/duplicate analyses for metals) from field samples, with the exception of polychlorinated dibenzodioxins and polychlorinated dibenzofurans (PCDDs/PCDFs)
  - Method blanks
  - Laboratory control samples

- Field QC samples for soils
  - Decontamination water blank
  - Field Duplicate samples

- Laboratory QC samples for decontamination water blank
  - Method blanks
  - Laboratory control samples

- Sample Splits for soils
  - Ten percent of the soils samples were sent to the USACE Missouri River Division laboratory for confirmation analysis

4.2.1.1 Method or Preparation Blank

Method blanks consisted either of deionized water for water analysis or Ottawa sand for analysis of solids. Method blanks were carried through each step of the analytical method. The method blank data were used to evaluate contamination attributable to laboratory operations during analysis.

4.2.1.2 Surrogate Spikes

Surrogate spikes were compounds added to every blank, sample, MS, MSD, and standard when specified in the analytical methodology. The results were utilized to evaluate the accuracy of analytical measurement on a sample-specific basis. Surrogates are generally brominated, fluorinated, or isotopically labeled compounds not expected to be detected in environmental media. Results were expressed as percent recovery (% R) of the surrogate spike. Recoveries outside of control criteria are evidence of inaccurate results which may be related to matrix interference.

4.2.1.3 Internal Standards

Internal standards were compounds added to every blank, sample (or sample extract), and standard for Methods 8240, 8270, and 8280. For volatile organic analyses and semivolatile analyses by Methods 8240 and 8270, respectively, internal standards are compounds not typically found in the natural environment that are used as the basis to quantitate the target compounds. For PCDDs/PCDFs by Method 8280, internal standards are ^{13}C-isotopically labeled PCDDs/PCDFs used to quantitate sample concentrations, to evaluate extraction efficiency, and to evaluate stability of gas chromatography/mass spectrometry sensitivity and response throughout the analytical run.

4.2.1.4 Matrix Spike/Matrix Spike Duplicate Samples and Matrix Spike/Duplicate Samples

MS/MSD samples were analyzed for VOCs, SVOCs, pesticides/PCBs, organophosphorus pesticides, herbicides, TRPH, TOC and cyanide and sulfide. Matrix Spike/Duplicate (MS/D) samples were reported for the metals analyses.

MS/MSD samples are environmental samples to which known quantities of target analytes are added. The MS/MSD are taken through the entire analytical procedure and the recovery of the analytes is recorded. The sample MS/MSD are processed separately but in an identical fashion. The results are expressed as a percent recovery for analytes added to the MS/MSD, and as relative percent differences (RPD) between the MS/MSD. The results were used to evaluate the effect of the sample matrix on the accuracy and precision of the laboratory analysis.

For the metals analyses results, MS/D analyses were generally reported. The MS analyses are described above, and the percent recoveries provide a measure of the accuracy of the analysis. The

laboratory duplicate is a split of an environmental sample, which is prepared and analyzed in a manner identical to that of the original sample. The results were utilized to evaluate the precision of the laboratory analyses. Results are expressed in RPD between the analytical split and the original sample.

4.2.1.5 Laboratory Control Samples

Laboratory control samples (LCS) were well-characterized, laboratory-generated samples used to monitor the laboratory's day-to-day performance of analytical methods. LCS were used to monitor the precision and accuracy of the analytical process independent of matrix effects.

Two types of LCS were analyzed, duplicate control samples (DCS) and single control samples (SCS). The requirement to analyze one or both of DCS and SCS was specific to each analytical method. For the DCS, known quantities of the MS/MSD spiking analytes were added to a sample of Ottawa sand; and for the SCS, known quantities of surrogate spiking compounds were added to a sample of Ottawa sand.

The results of the LCS were compared to well-defined evaluation criteria to determine whether the laboratory system is "in control." LCS analysis results provides information used to differentiate low recoveries due to procedural errors from those due to matrix effects.

4.2.1.6 Analytical Spike

An analytical spike was performed and utilized in the graphite furnace atomic absorption (GFAA) analyses. Analytical spikes were post-digestion spikes prepared prior to analysis by adding a known quantity of the analyte to an aliquot of the digested sample. Both the unspiked and spiked samples were analyzed in identical fashion. Analytical spike recoveries on each sample were utilized to evaluate accuracy of the analysis on the given sample and to determine whether or not the sample must be reanalyzed at a dilution.

4.2.1.7 Field Duplicates

Field duplicate soil samples were collected at a frequency of 1 per 20 environmental samples. Co-located field duplicates were collected for the volatile organics analyses; homogenized field

duplicate samples were collected for all other analytical methods. The agreement between the sample analytical results for the environmental sample and the field duplicate were expressed as RPD and were evaluated in accordance with the criteria described in SOP No. 10, Data Validation and QC Review of Analytical Laboratory Data Packages, contained in the DCQAP. Evaluation of the environmental sample and field duplicate results provides a means of assessing the precision of field sampling and laboratory analysis.

4.2.1.8 Decontamination Water Blank

A sample of the water used for decontamination procedures was collected and analyzed to verify that no contamination was introduced to the samples by the decontamination water. The decontamination water was analyzed for VOCs, SVOCs, pesticides/PCBs, organophosphorus pesticides, herbicides, metals, and cyanide.

4.2.1.9 Sample Splits

A total of 16 environmental sample splits, equivalent to approximately ten percent of the total samples collected, were sent to the USACE MRD laboratory for confirmation analysis.

4.2.2 Results of DCQAP-Required Activities

4.2.2.1 Field Audits

An audit of field activities was conducted on July 26, 1995 by the site manager. Field activities audited included soil sample collection procedures, equipment decontamination, field documentation, sample handling and labeling, and field screening. No significant problems or deficiencies were observed during the audit that were considered to affect data quality. A field audit checklist was completed as part of this audit, and a memorandum summarizing the audit results was prepared by the Site Manager. Both documents were submitted to the W-C Quality Control Officer and the Project Manager. The field audit was conducted in accordance with requirements in the DCQAP of the Work Plan, and audit checklists and memoranda summarizing these audits are stored in W-C's Cannon AFB Landfill No. 5 project files.

4.2.2.2 Laboratory Audits

No project specific laboratory audits were conducted as part of this investigation. The analytical laboratories used for this project (Quanterra Environmental Services' Denver and West Sacramento laboratories) have been audited by W-C within the last three years and both hold current USACE certifications.

4.2.3 Data Validation

Analytical data quality for soil samples collected during the Phase I RFI at Landfill No. 5, Cannon Air Force Base (July 17, 1995 through to August 1, 1995) is discussed in this section. A total of 150 soil samples from 30 boreholes, 10 surface soil samples and 1 decontamination water sample were submitted to Quanterra Environmental Services, Denver, Colorado (Quanterra) for analysis. The analysis and reporting of the laboratory results follow the requirements described in the DCQAP.

In accordance with Section 6.0 of the DCQAP, a full validation was performed on 10 percent of the analytical data and a QC Review was performed on the remaining 90 percent of the data. The data validation and QC reviews were performed in accordance with SOP No. 10 , "Data Validation and QC Review of Analytical Laboratory Data Packages." QA/QC parameters assessed during the validation process were in accordance with Section 2.0 of the DCQAP "Quality Assurance of Data Quality Objectives and Audit Procedures." Systematic problems identified during the full validation were also evaluated during the QC reviews. The results of the full validation and the QC reviews are summarized in the sections below. The validated analytical results are presented in Appendix E, and complete data validation and QC review reports are presented in Appendix F.

The analytical data were reported by the laboratory in 14 data packages. Three data packages contained results for the PCDD/PCDF analyses and each of the remaining data packages contained analytical results for analyses other than PCDDs/PCDFs. A full validation was performed on greater than 10 percent of the PCDD/PCDF data (package #043634) and on greater than 10 percent of the analytical data for the other parameters (package #043617). A QC Review was performed on the remaining data packages. The sections below present a summary of the data validation and QC reviews for:

- Organics (VOCs, SVOCs, pesticide/PCBs, organophosphorus pesticides, chlorinated herbicides and TRPH)
- Metals
- PCDDs/PCDFs
- Other analytes (total organic carbon, cyanide and sulfide)

The summaries discuss the following items:

- Criteria that were evaluated as part of the data validation and QC review process
- Problems identified by the data validation and QC review
- Data qualification resulting from the data validation and QC review

Precision of the analyses for each sample matrix was evaluated by calculating the RPD from the MS/MSD (environmental sample/laboratory duplicate for metals) results. During the data review process, some minor differences between the RPDs calculated during the data review and those reported by the laboratory were identified. This occurred because the laboratory calculates the RPD before rounding the percent recoveries, but reports the rounded percent recoveries on the hard copy data sheets which were used by the data reviewer to recalculate RPDs. No significant differences were observed, and the minor differences were not considered to affect the quality of the data.

4.2.3.1 Organic Analyses (VOCs, SVOCs, Pesticide/PCBs, OPP, Herbicides, TRPH)

Holding Times

Allowable holding times for extractions and/or analyses for VOCs, SVOCs, pesticide/PCBs, organophosphorus pesticides (OPPs), chlorinated herbicides and TRPH are presented in the DCQAP. The analytical data for all data packages were reviewed to evaluate whether the holding time requirements were met for each method.

Two samples analyzed for SVOCs were re-extracted and re-analyzed due to low surrogate recoveries reported from the initial analysis. For both samples, the re-extractions were conducted outside holding time limits, and all associated sample data for these two samples were qualified as estimated (UJ). For the chlorinate herbicide analyses, the extraction holding time was exceeded by

four days for two samples, and therefore all chlorinated herbicide results for these two samples were qualified as estimated.

All other extractions and analyses were conducted within holding times, and no other data were qualified on the basis of holding times.

GC/MS Instrument Performance

GC/MS instrument performance checks for the VOC and SVOC analyses were evaluated as part of the full validation to ensure mass resolution, identification, and instrument sensitivity. Criteria for instrument performance checks included evaluation of possible transcription or calculation errors, adherence to instrument tuning frequency requirements, mass assignments, and ion abundance criteria. All criteria for the VOC and SVOC analyses were met and no qualification of the data was necessary.

GC Instrument Performance

GC Instrument performance was evaluated as part of the full validation for the pesticide/PCB, OPP, chlorinated herbicide and TRPH analyses and was considered to be satisfactory

Initial and Continuing Calibrations

Initial and continuing calibration criteria were evaluated as part of the full validation to ensure the instrument is capable of producing acceptable qualitative and quantitative data. All initial and continuing calibrations were analyzed at the required frequency. All relative response factors for initial and continuing calibrations and percent relative standard deviations (%RSD) for initial calibrations met the acceptance criteria with the exceptions noted below.

The % RSDs for several analytes were reported above the 30 percent criterion. In accordance with validation protocols the associated data were qualified as estimated (J/UJ). The percent differences (%D) between the initial and continuing calibrations were above the 25 percent criterion for several target compounds and associated sample data were qualified as estimated.

The minimum relative response factors (RRF) criterion of 0.05 was met for all analytes with the exception of 1,4-dioxane, acetonitrile, and isobutanol. The RRF for 1,4-dioxane was less than 0.05 in all of the associated initial and continuing calibrations, and the RRFs for acetonitrile and isobutanol were less than 0.05 in one initial calibration and three continuing calibrations associated with the analysis of samples for the Appendix IX analytes. As the RRF is a measure of instrument sensitivity and not accuracy or bias, a low value for the RRF indicates lower instrument sensitivity and hence an elevated detection limit. The minimum RRF criterion of 0.05 recommended in Functional Guidelines is applicable to the CLP analytes for which a RRF > 0.05 is a reasonable criterion. Several of the Appendix IX analytes (1,4-dioxane, acetonitrile, isobutanol) typically have a lower response than the contract laboratory program (CLP) analytes. In order to take into account the lower sensitivity of the analytical method to these analytes, the laboratory has raised the reporting limits to a concentration at which they can reliably measure these analytes. An evaluation of the response to the low concentration standards for these analytes in the initial calibration indicates that the response per unit area of the peak is consistent with the higher concentration standards. In addition, the analyte peak in the total ion chromatogram is significantly above the instrument noise level and can be adequately detected at concentrations at or below the concentration of the low standard. As such, although the RRFs for 1,4-dioxane, acetonitrile, and isobutanol were less than 0.05, it was the judgment of the data reviewer that the instrument was capable of quantitating 1,4-dioxane, acetonitrile, and isobutanol at the elevated reporting limit and, therefore, no qualification or rejection of the data for these analytes based on the RRF was considered necessary.

In several instances, the instrument sensitivity for 1,4-dioxane, acetonitrile, and isobutanol decreased from the initial to the continuing calibration. In several cases the RRFs for these analytes did not meet the minimum RRF of less than 0.05 and the %D between the initial and continuing calibration exceeded the criterion of 25 percent. It was the judgment of the data reviewer that the reporting limits did not sufficiently reflect the decrease in sensitivity of the analytical method for these analytes and, therefore, the reporting limits were raised proportionately to the decrease in sensitivity and qualified as estimated.

The %RSDs between the initial calibration and continuing calibrations on one of the GC/MS instruments (Instrument N) for the Appendix IX analytes ranged from -16,971 percent (1,2-dibromo-3-chloropropane) to +33 percent (alkyl chloride). The RRFs for the Appendix IX analytes in the initial calibration were significantly lower than those in the continuing calibration

(CCAL) and significantly lower than the RRFs for these analytes from the other instruments used for analysis. It was the judgment of the data reviewer that the low RRFs in the initial calibration were due to an instrument problem on that analysis only and that the RRFs from the continuing calibrations for this instrument are more representative of the sensitivity of the analytical method to these analytes. The extremely low instrument sensitivity exhibited in the initial calibration for 1,2-Dibromo-3-chloropropane (DBCP) for instrument N has resulted in an undetermined bias in the reported results and, therefore, the DBCP results in associated samples were qualified as unusable (R). As the RRFs for the remaining Appendix IX analytes listed above were greater than 0.05, it was the judgment of the data reviewer that the instrument sensitivity was sufficient to quantitate these analytes at the reporting limits and, therefore, no changes in the reporting limits for these analytes were considered necessary. The non-detect results reported for these analytes in sample CAN113-B321-1057 were qualified as estimated (UJ) due to the % difference (%D) exceedances.

Based on the problems noted above for the initial and continuing calibrations for the Appendix IX VOC analyses in the full validation, the calibration data for the Appendix IX VOCs were reviewed in the QC reviews and data qualified as discussed above.

For the SVOC analyses, the initial and continuing calibration data were evaluated as part of the full validation. RRFs and % RSDs for initial calibrations associated with the soils analyses were within acceptance limits and no qualification of data on the basis of initial calibrations was necessary. For the continuing calibration data, all RRFs met the acceptance criterion (RRF greater than 0.05). The %Ds between the initial and continuing calibration were above the 25 percent criterion for ten compounds. In accordance with validation protocols, associated sample data were qualified as estimated.

For the pesticide/PCB analyses, the initial and continuing calibration data were evaluated as part of the full validation. For the single-component analytes, the laboratory analyzed the initial calibration data with a $1/x^2$ weighted linear regression, not forced through the origin. For all analytes tested during the data validation process, the correlation coefficients obtained for linear regressions were greater than 0.995, indicating sufficient linearity of instrument response. For several continuing calibrations, the %Ds between the true concentrations of analytes present and the measured concentrations for one or more analytes exceeded the laboratory's acceptance limit of 15 percent (this control limit is analogous to the Method 8080 requirement that the %D between the average calibration factor determined from the initial calibration and the calibration factor determined from

the continuing calibration be less than 15 percent and was therefore considered to be appropriate). In all cases, the measured concentrations were greater than the true concentrations indicating a potential high bias in the reported sample results. As all associated sample results were reported as nondetect, data qualification was not considered to be necessary. The analytical sequence was found to be satisfactory.

Initial and continuing calibrations for OPP and herbicides were evaluated as part of the full validation. The correlation coefficients were greater than 0.995, indicating sufficient linearity of instrument response. Continuing calibration frequency and results were acceptable. No data qualification was issued on the basis of initial or continuing calibration.

Method Blanks

Method blank contamination was evaluated in all of the data packages. All of the target analytes detected in the method blanks associated with the VOC and SVOC analyses are common laboratory contaminants and, therefore, may potentially be due to laboratory contamination. Methylene chloride was reported as detected in seven method blanks, 2-butanone in three, and acetone in one of the 19 method blanks associated with the VOC analyses in all data packages. Diethyl phthalate was reported as detected in three SVOC method blanks and di-N-butyl phthalate and bis(2-ethylhexyl)phthalate were each reported as detected in one of the 17 method blanks associated with the SVOC analyses. Since these analytes are common laboratory contaminants, sample results were qualified as non-detect if the results were less than 10 times the amount detected in the associated blanks. Where the sample result was greater than the reporting limit but less than 10 times the amount detected in the associated blank, the reporting limit was raised to the sample result and qualified as non-detect.

No target analytes were reported as detected in the method blanks associated with the pesticide/PCB, organophosphorus pesticide, chlorinated herbicides, and TRPH analyses.

Surrogate Recovery

Surrogate recovery data were evaluated for all of the data packages and compared against the QC limits provided in the DCQAP.

VOC surrogate recoveries were within acceptance criteria for all soil samples with the exception of 1,2-dichloroethane-d4 in three samples. The percent recoveries (%Rs) for 1,2-dichloroethane-d4 in these samples were slightly above the upper acceptance limit indicating a potential high bias. However, as the results for these samples were reported as non-detect and as the surrogate recoveries indicate a potential high bias, no qualification of the VOC data for soil was necessary.

The %R for the toluene-d8 surrogate was reported below the lower acceptance limit for the decontamination water sample, indicating a potential low bias. This sample was re-analyzed and a similar %R for the toluene-d8 surrogate was obtained. In accordance with the validation protocols, the results for the decontamination water sample have been qualified on the basis of the low recovery of toluene-d8.

Two soil samples were re-analyzed for SVOCs due to low surrogate recoveries in the initial analyses. Surrogate recoveries for the re-analyses were within acceptance limits and data qualification was not required. Surrogate recoveries for all other soil sample analyses and for the decontamination water analysis were within acceptance limits.

Three pesticide/PCB surrogate compounds were spiked into every field and QC sample prior to extraction. The surrogate compound Dibutylchlorendate (DBC) is the surrogate compound specified by the analytical method (SW-846 Method 8080). The surrogate compounds Decachlorobiphenyl (DCB) and Tetrachloro-m-xylene (TCX) are the surrogate compounds specified by the Contract Laboratory Program methodology.

The surrogate recoveries for DBC were compared to the QC limits contained in the DCQAP. The recoveries of DCB and TCX were compared to the same limits used for DBC limits since the DCQAP contained QC limits for DBC only. Recoveries for all three surrogate compounds in all samples were within the applicable evaluation criteria indicating that satisfactory laboratory performance with respect to the individual samples was attained.

With the exception of the organophosphorus pesticide surrogate recoveries for one soil sample, all surrogate recoveries were within QC limits. The surrogate recoveries for this sample were below the lower QC limits (39 and 41 percent) indicating a potential low bias. Consequently, all results for this sample were qualified as estimated.

All surrogate recoveries for the chlorinated herbicide analyses were within QC limits and no qualification of the chlorinated herbicide results on the basis of surrogates was necessary.

Matrix Spike/Matrix Spike Duplicate

MS/MSD results were evaluated in all of the data packages. All VOC, pesticide/PCB, OPP, chlorinated herbicide, and TRPH MS/MSD percent recoveries and RPDs were within QC limits indicating satisfactory accuracy and precision with respect to the sample matrix.

For the SVOC analyses, two MS/MSD analyses did not meet QC limits for all the target compounds. However, as all surrogate recoveries in the associated samples and the associated SCS and DCS recoveries and RPDs were within QC limits, no qualification of associated data was considered necessary.

Laboratory Control Samples

The laboratory control sample data were evaluated in all of the data packages. The %Rs and RPDs for the DCS and SCS associated with all VOCs, SVOCs, and chlorinated herbicide analyses were within acceptance limits indicating satisfactory accuracy and precision of the analytical methods.

For the pesticide/PCB analyses, the RPDs between the DCS1 and DCS2 results for six analytes for the DCS sample set associated with QC Lot number 10 AUG 95-N3 were outside the acceptance limits (gamma-BHC, 21 percent; heptachlor, 24 percent; aldrin (24 percent); dieldrin (12 percent); endrin (17 percent); and 4,4'-DDT, (14 percent)). Data qualification was not considered necessary, however, because all DCS spike recoveries and all other QC results including MS/MSD precision for samples associated with this DCS set were acceptable, and all associated sample results were nondetect. For the pesticide/PCB DCS sample set associated with QC Lot number 07 AUG 95-S1, the average percent recovery for gamma-BHC (77 percent) was outside the lower acceptance limit indicating a potential low bias. The gamma-BHC results for samples associated with this DCS sample set were qualified as estimated due to the potential low bias.

With the exception of one spike recovery, all SCS and DCS results for the OPP analyses were within acceptance limits indicating satisfactory accuracy and precision with respect to the analytical

method. The recovery of ethyl pirimifos, a surrogate compound, in one of the SCSs was 25 percent, outside the lower acceptance limit. Data qualification was not considered necessary, however, because the surrogate recoveries for all samples associated with this SCS were within acceptance limits.

Field Duplicate Evaluation

Field duplicate results were evaluated in all of the data packages. With the exception of the field duplicates collected for VOCs, all field duplicate samples were homogenized. The field duplicates collected for analysis of VOCs were co-located.

All the field duplicate pairs analyzed for VOCs were within QC limits, with the exception of acetone for the field duplicate pair CAN113-B326-0567/1021. Sample data associated with the field duplicate pair CAN113-B326-0567/1021 have been qualified as estimated (UJ/J). No other qualification of volatile organics data on the basis of field duplicate analyses was necessary.

The results for SVOCs, pesticide/PCBs, OPPs, chlorinated herbicides and TRPH reported for the field duplicate pairs were within the DCQAP QC limits indicating acceptable precision, and no qualification of data for these parameters on the basis of field duplicate analyses was necessary.

Internal Standard Performance

Internal standard performance data for VOCs and SVOCs were evaluated as part of the full data validation. Internal standard areas and retention times for the samples were within the acceptance criteria and no VOC or SVOC results were qualified or rejected on the basis of poor internal standard recoveries.

Target Compound Identification

Target Compound Identification was evaluated as part of the full data validation. For the VOC and SVOC analyses, the relative retention times (RRTs) and mass spectra for the sample compounds were reviewed and met the identification criteria. For the GC analyses of pesticide/PCBs, chlorinated herbicides, OPPs and TRPH, all positively identified compounds (detected only in QC samples for organochlorine pesticides, OPPs and chlorinated herbicides) were

confirmed as present on a chemically dissimilar column. No errors were found in compound identification and no results were qualified on this basis.

Quantitation and Reported Detection Limits

Quantitation and detection limits were evaluated as part of the full validation. Data for one or more detected target analytes for 10 percent of the samples were recalculated from the raw data. Values which were recalculated agreed with the reported values. Reporting limits were properly adjusted for sample dilutions and the soil sample results were reported on a dry weight basis.

Recalculation of a percentage of the reporting limits during the full validation indicated that reporting limits for the soil samples were correctly reported on a dry weight basis and no calculation errors were found.

Data were also checked in both the full validation and the QC reviews to verify that the laboratory qualified results reported as detected below the reporting limits as estimated (J). No errors were found.

System Performance

The overall system performance was evaluated as part of the full validation. System performance was considered satisfactory for all methods.

4.2.3.2 Inorganics (Metals)

Holding Times

Holding time criteria were reviewed as part of both the full validation and the QC reviews. Allowable holding times are presented in the DCQAP. All analyses were conducted within holding times, and no qualification of data was required.

Calibration

Initial and continuing calibration criteria were reviewed as part of the full validation to evaluate whether the instrument is capable of producing acceptable qualitative and quantitative data. All initial and continuing calibrations were analyzed at the required frequency. All initial and continuing calibration criteria were met with the following exception. The correlation coefficient for the linear regression for thallium in the initial calibration was below 0.995. Data qualification was not considered to be necessary, however, because the instrument uses an internal algorithm to calculate results from the calibration curve, not a linear calibration line.

Preparation, Initial Calibration and Continuing Calibration Blanks

Blank data were reviewed as part of both the full validation and the QC reviews. Zinc was reported as detected in one preparation (method) blank associated with the decontamination water sample and calcium was reported as detected in six preparation blanks. The result for zinc in the decontamination water sample was qualified as nondetect at the reported value because the sample concentration was less than 5x the preparation blank result. All results reported for calcium in associated samples were greater than 5 times the respective preparation blank result and no qualification of the calcium data was necessary.

Cadmium was reported as detected in three continuing calibration blanks (CCBs), beryllium in three CCBs and tin and nickel each in one CCB. Associated sample results for these analytes were qualified as nondetect if the sample concentration was less than five times the respective CCB value.

Negative results were reported for chromium in one initial calibration blank and in three CCBs, cadmium in two CCBs and sodium, tin and cobalt each in one CCB. Associated sample results for these analytes reported as detected at concentrations less than three times the absolute value of the respective negative blank result or reported as nondetects with detection limits less than three times the absolute value of the blank result were qualified as estimated (J/UJ) based on a potential low bias.

Interference Check Sample

The interference check sample data were evaluated as part of the full validation. No problems were identified in the reported interference check sample results, indicating that the laboratories interelement and background correction factors were valid.

Laboratory Control Samples

Laboratory control sample data were reviewed as part of both the full validation and the QC reviews. The RPD for tin in one DCS pair exceeded the QC limit for precision and as such, the tin result for the associated sample was qualified as estimated. The percent recoveries for tin in this DCS pair were 158 percent and 11 percent with an average recovery of 135 percent, above the upper QC limit. Detected results reported for tin in samples associated with this DCS pair were qualified as estimated due to the potential inaccuracy. All other DCS percent recoveries and RPDs were within QC limits, and no other qualification on the basis of LCS results were necessary.

Matrix Spike/Laboratory Duplicates

MS recoveries were reviewed as part of both the full validation and the QC reviews. MS and laboratory duplicate sample analyses were the quality control samples requested for assessing accuracy and precision. Due to a laboratory error, MS/MSD analyses were run on two sets of quality control samples instead of matrix spike/laboratory duplicate analyses.

In general, the results for the MS analyses, laboratory duplicate sample analyses, and MS/MSD analyses were within QC limits indicating that, on an overall basis, accuracy and precision were acceptable. The percent recoveries reported for barium and calcium in two MS analyses, lead in three MS analyses, magnesium in two, and manganese in one MS analysis were above the upper QC limit indicating a potential high bias. Detected results for these analytes in associated samples were qualified as estimated ("J"). The percent recoveries reported for antimony and thallium in seven MS and in two MS/D analyses, selenium in nine MS and two MS/D analyses, and for lead, nickel, silver and zinc each in one MS analysis were below the lower QC limit but above 30 percent indicating a potential low bias. Associated sample results for these analytes were qualified as estimated.

The MS percent recoveries for antimony in two MSs, thallium in one MS and selenium in one MS analysis were below 30% indicating unacceptable accuracy. The results for these analytes in associated samples were qualified as unusable (R).

The RPDs between the sample and laboratory duplicate results for aluminum, barium, calcium, chromium, iron, lead, magnesium, manganese, nickel and zinc for one or more laboratory duplicate analyses were outside the QC limit of 20% indicating some imprecision. Associated sample results were qualified as estimated. All other laboratory duplicate results were within QC limits.

For two samples the laboratory analyzed an MS/MSD in place of a laboratory duplicate. In those instances, the RPDs between the MS/MSD results were used to evaluate precision. The RPDs for thallium in one MS/MSD pair and for lead in a second MS/MSD pair were outside the QC limits. Associated sample data were qualified as estimated.

All other percent recoveries and RPDs were within QC limits and no other metals data were qualified on the basis of the matrix spike/laboratory duplicate results.

Furnace Atomic Absorption QC

The graphite furnace atomic absorption QC data were evaluated as part of the full validation. Duplicate injections were not performed with these analyses because they are not a requirement of GFAA methodology in SW-846 nor required by the DCQAP. Post digestion spike recoveries were reported outside the lower QC limits for selenium and thallium in nine samples indicating a potential low bias, and the associated sample results were qualified as estimated.

ICP Serial Dilution

Inductively coupled plasma atomic absorption (ICP) serial dilutions were not performed with the analyses because they are not a requirement of SW-846 on a well characterized matrix and were not specified by the DCQAP for analyses on this project.

Sample Result Verification

Sample results and detection limits were evaluated as part of the full validation. Data for one or more detected target analytes for 10 percent of the samples were recalculated from the raw data. Values which were recalculated agreed with the reported values. Reporting limits were properly adjusted for sample dilutions and the soil sample results were reported on a dry weight basis. In those instances where the post-digestion spike recoveries for selenium and thallium were below 80 percent, the laboratory raised the reporting limits for nondetects by a factor of two to account for the low bias.

Field Duplicate Evaluation

Field duplicate results were evaluated as part of both the full validation and the QC reviews. All field duplicate samples collected for metals analysis were homogenized.

The results for metals reported for the field duplicate pairs were within the DCQAP acceptance limits, indicating acceptable precision, and no qualification of metals data on the basis of field duplicate analyses was necessary.

4.2.3.3 PCDDs/PCDFs

Holding Times

Holding time criteria were reviewed as part of both the full validation and the QC reviews. All PCDD/PCDF analyses were conducted within the required holding time requirements and data qualification was not necessary.

Instrument Performance

Instrument performance was evaluated during the full validation. All instrument performance criteria were met for this analysis, and no qualification was necessary.

Initial and Daily Calibration

Calibration data were evaluated as part of the full validation. All initial and daily calibration requirements specified by Method 8280 were satisfied, and data qualification was not required.

Method Blanks

Two method blanks were associated with the PCDD/PCDF analyses. No target analytes were reported as detected in the method blanks, and consequently, there is no evidence of laboratory contamination.

Recovery Standard

The ion ratios for the recovery standard in all sample analyses was satisfactory, and data qualification was not required.

Internal Standards

The results obtained for internal standard recoveries in all sample analyses were satisfactory, and data qualification was not required.

Laboratory Control Samples

Laboratory control sample data were reviewed as part of both the full validation and the QC reviews. The recoveries obtained for all target analytes present in the laboratory control sample were within the acceptance limits specified in the DCQAP indicating that satisfactory accuracy with respect to the general sample matrix (soils) was attained. The laboratory control sample was not analyzed in duplicate; however, precision was assessed indirectly by calculating the RPDs between the percent recoveries for the target analytes calculated from the continuing calibration analysis and the percent recoveries for the target analytes reported for the laboratory control sample. No instances were found in which the RPD so calculated exceeded the RPD limits for duplicate laboratory control samples. This was considered to be an adequate demonstration of the precision of the sample analysis on laboratory standards. Data qualification was not required.

Field Duplicates

Field duplicate results were reviewed in both the full validation and the QC reviews. The applicable evaluation criteria were satisfied by all analytes for all field duplicate sample pairs and data qualification was not required.

Compound Quantitation and Reported Detection Limits

Compound quantitation and detection limits were evaluated as part of the full validation. More than 10 percent of all sample results were recalculated from the raw data. No errors were found in compound identification and reported analyte concentration (positive results were reported for QC samples only), or detection limit calculations and data qualification was not required.

4.2.3.4 Other Analytes (Total Organic Carbon, Cyanide and Sulfide)

Holding Times

Holding times were reviewed for all sample analyses against the holding time criteria specified in the DCQAP. All analyses were conducted within holding times, and no qualification of data was required.

Calibrations

Calibration data were reviewed as part of the full validation. All calibrations met all validation criteria and no data were qualified based on calibration.

Method Blanks

Method blank data were reviewed as part of both the full validation and QC reviews. TOC, cyanide and sulfide were reported as nondetects in all method blanks associated with the soils analyses and decontamination water analysis. Therefore, there is no evidence of laboratory contamination based on method blank results for these parameters.

Matrix Spike/Matrix Spike Duplicate

MS/MSD data were reviewed as part of both the full validation and QC reviews. All MS/MSD percent recoveries and RPDs were within QC limits indicating satisfactory accuracy and precision.

Laboratory Control Samples

LCS data were reviewed as part of both the full validation and QC reviews. DCSs were the laboratory control samples analyzed for the TOC, cyanide and sulfide analyses. All DCS results were reported within the QC limits indicating satisfactory performance of all steps in the analysis, including preparation.

Field Duplicate Evaluation

Field duplicate results were reviewed as part of both the full validation and the QC reviews. The field duplicate samples collected for analysis of these parameters were homogenized. The results for TOC, cyanide, and sulfide reported for the field duplicate pairs were within the DCQAP QC limits indicating acceptable precision, and no qualification of data for these parameters on the basis of field duplicate analyses was necessary.

Evaluation of Compound Quantitation

Quantitation and detection limits were evaluated as part of the full validation. Data for one or more detected target analytes for 10 percent of the samples were recalculated from the raw data. Values which were recalculated agreed with the reported values. Reporting limits were properly adjusted for sample dilutions and the soil sample results were reported on a dry weight basis.

Data were also checked in both the full validation and the QC reviews to verify that the laboratory qualified results reported as detected below the reporting limits as estimated (J). No errors were found.

4.2.3.5 Tentatively Identified Compounds

All of the reported volatile and semivolatile TICs not present in associated blanks were validated during the full validation using guidance from U.S. Environmental Protection Agency's National Functional Guidelines for Organic Data Review, February 1994. As specified in the DCQAP, reported TICs in all data packages considered potentially to contribute significantly to an unacceptable risk underwent a more detailed validation process than that specified in Functional Guidelines to evaluate with a greater degree of confidence whether the compounds were present or absent in the sample. The additional validation process included a review of such items as the expected chemical fragmentation patterns, compound boiling points versus retention times (RTs), peak shape for a TIC in the total ion chromatogram, comparison of RT with the RTs of other TICs with a good spectral match, and comparison of TIC results for field duplicate pairs. Other reported TICs were reviewed as specified in Functional Guidelines. At least 50 percent of TICs in all data packages that underwent a QC review underwent validation in accordance with Functional Guidelines criteria.

Volatile TICs were reported as detected in 66 samples and semivolatile TICs were reported as detected in 59 samples. The results for TICs identified as reagent contaminants, solvent preservatives, aldol condensation products or other common laboratory artifacts/contaminants such as siloxanes (common laboratory artifact attributed to column bleed), phthalates (common laboratory contaminant) and 1,1,2-trichloro-1,2,2-trifluoroethane (Freon™ - common lab contaminant) were qualified as unusable (R). Six TICs reported by the laboratory were also present in the associated method blanks and were qualified as unusable (R) by the data reviewer. The tentative identifications reported for 12 TICs were rejected during data validation and the identifications revised to "unknown." No other reported TIC identifications were considered unacceptable and results were qualified "NJ," tentatively identified, with approximated concentrations.

A detailed discussion of the TIC validation is presented in the Data Validation report in Appendix F.

4.2.4 Summary

As summarized above and discussed in detail in the full validation and QC review reports in Appendix F, conformance to accuracy and precision criteria were evaluated for all sample results, and qualification or rejection of sample data was performed in accordance with specified guidelines and criteria. The analytical data, as qualified, presented in this report have been found to meet the QA objectives for this project as specified in the validation protocols. QA objectives were satisfied as determined by the quality parameters of accuracy, precision, and completeness as discussed below.

Approximately 3.8 percent of the VOC soils data were qualified as estimated due to calibration problems, poor field duplicate precision, low surrogate recoveries, or detects reported below the reporting limit; and less than 1 percent of the data was rejected due to calibration problems. Results reported as detected below the reporting limit represented 54.2 percent of the data requiring qualification as estimated. All target compound results for the decontamination water sample were reported as not detected and were qualified as estimated due to low surrogate recovery of toluene-d8.

For the SVOC soil data, approximately 1.3 percent were qualified as estimated due to calibration problems or positively identified analytes quantitated below the reporting limit. Results reported as detected below the reporting limit represented 38.5 percent of the data requiring qualification. No qualification of the decontamination water sample results was required.

For the pesticide/PCB data, one result, which represented less than 0.1 percent of the data, was qualified as estimated due to an LCS problem and a reported concentration below the reporting limit. No qualification of the decontamination water sample results was required.

Approximately 3.0 percent of the organophosphorus pesticide data and 3.1 percent of the chlorinated herbicide data were qualified as estimated due to surrogate recoveries and holding time exceedence, respectively. No results for these analytes were reported as detected at values below the reporting limits, and no qualification of the decontamination water sample results was required.

All of the PCDD/PCDF, TRPH, TOC, sulfide and cyanide data were considered valid as reported and no data for these analytes were qualified or rejected.

For the metals analyses, approximately 34 percent of the data were qualified as estimated due to laboratory duplicates, laboratory control sample results, MS recoveries or reported concentration below the reporting limit. Results reported as detected below the reporting limit represented 31.9 percent of the data requiring qualification. No qualification of the decontamination water sample was required.

4.2.4.1 Accuracy

The overall accuracy of the analytical data for this project, as measured by percent recoveries for surrogate compounds, MS/MSD analyses, and LCS analyses were considered acceptable as discussed below.

All surrogate recoveries were within acceptance limits for the SVOCs and chlorinated herbicide analyses, and less than 1 percent of the VOC and pesticide/PCB surrogates and 3 percent of the surrogates for the organophosphorus pesticide analyses were outside of QC limits indicating acceptable matrix-specific accuracy.

The percent recoveries for the MS/MSDs reported for VOCs, SVOCs, organochlorine pesticides, OPPs, chlorinated herbicides and TRPH ranged from 35 to 129 percent, with 98 percent of the percent recoveries in the range of 50 to 129 percent. The percent recoveries for all VOC, pesticide/PCB, OPP, chlorinated herbicide, and TRPH MS/MSD analyses were within QC limits. For the SVOC analyses, the percent recovery for 2,4-dinitrotoluene in one MS and one MSD analysis was out of the QC limits. For the metals analyses, approximately 18 percent of the MS recoveries and 15 percent of the MSD recoveries were outside of the QC limits with less than 2 percent of the MS recoveries less than 30 percent. The percent recoveries for all other MS/MSD analyses were within acceptance limits indicating acceptable accuracy.

With the exception of the spike recovery for gamma-BHC in one of the laboratory control samples, all LCS percent recoveries were within QC limits.

4.2.4.2 Precision

The overall precision of the analytical data for this project, as measured by the RPDs between MS/MSD analyses, laboratory duplicate control sample analyses, laboratory duplicate results and field duplicate results were considered acceptable as discussed below.

All MS/MSD RPDs for organochlorine pesticides, OPP and chlorinated herbicides were within QC limits, and approximately 98 percent of the RPDs for the VOC MS/MSDs and 96 percent of the RPDs for the SVOC MS/MSDs were within QC limits. For the metals analyses, MS/MSD pairs were analyzed rather than laboratory duplicates for two data packages. Approximately 95 percent of the RPDs for metals were within QC limits.

The RPDs reported for the DCSs for all analyses, except metals and organochlorine pesticides, were within QC limits. The RPDs for tin in two of 12 DCSs and all of the RPDs for one of 13 organochlorine pesticide DCS pairs were outside of QC limits.

Approximately 76 percent of the results for the sample/laboratory duplicate pairs and all of the results for the field duplicate sample pairs were within QC limits indicating acceptable precision.

4.2.4.3 Completeness

The percent completeness for analytical methods was greater than 99 percent, thus satisfying the completeness goal of 90 percent specified in the DCQAP. With the exception of the VOC and metals analyses, completeness, which is defined as the percentage of analytical results judged to be valid including estimated values, was 100 percent for all analytical methods

For VOCs, the percent completeness is 99.9 percent due to rejection of the results for DBCP, an Appendix IX analyte, in six samples. The percent completeness for the metals analyses was 98.5 percent due to rejection of results for antimony in 37 samples, selenium in six samples and thallium in 15 samples.

4.2.4.4 Method Blank Contamination

A total of 171 method blanks were analyzed with target analytes reported as detected in 19 of these blanks. Of these method blanks, VOC target analytes were detected in 10 of 19 VOC method blanks, SVOCs were detected in 5 of 17 method blanks, and metals were detected in 4 of 77 method blanks. Target analytes were not reported as detected in any of the method blanks associated with the other analyses. Calcium, zinc, and the common organic laboratory contaminants (methylene chloride, acetone, 2-butanone and phthalates) were the only target analytes reported as detected in the method blanks associated with the sample analyses. All of the analytes reported as detected in the method blanks associated with the VOC and SVOC analyses are common laboratory contaminants. Additionally, samples with detected concentrations of these common laboratory contaminants were randomly distributed throughout the site suggesting that these analytes are likely laboratory artifacts rather than due to a specific source within the site. As such, the presence of low levels of methylene chloride, acetone, 2-butanone and phthalates in environmental samples is likely to be a result of laboratory contamination and should not be considered an indication of the presence of these analytes in the environmental samples.

4.3 SURFACE AND SUBSURFACE SOIL

The purpose of this section is to present the nature and extent of surface and subsurface soil contamination identified at Landfill No. 5 during the Phase I RFI conducted in July and August 1995.

For this discussion, surface or subsurface soil that contains detectable concentrations of chemical compounds that do not occur naturally in the environment (i.e., organic chemical compounds) and metals that were detected at concentrations higher than the background range established for the soil in the area were identified and the nature and extent described. A human health risk screen was performed as part of this RFI (Section 6.0) to assess the potential risk to public health and the environment from contaminants described herein.

Soil was the primary medium of concern for the Phase I RFI at Landfill No. 5 because potential impacts to groundwater, although a concern at Cannon AFB, may not be significant since the Ogallala aquifer beneath Cannon AFB lies at approximately 270 feet bgs.

Inorganic and organic constituents detected in surface and subsurface soil collected for chemical analyses from 30 borings are discussed in detail below by the following chemical groups: commonly occurring elements (calcium, potassium, and sodium), metals, SVOCs, VOCs, PCB/pesticides, TRPH, cyanide and herbicides. TICs identified by the laboratory are also discussed.

Background concentration ranges were previously developed for Cannon AFB and presented in the report entitled "Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater" (W-C 1994). Background ranges for soil were developed in the 1994 study using chemical data from 49 soil samples collected during past investigations in areas believed to represent locations that have not been impacted by past or current activities at Cannon AFB. The background soil locations included: 2 locations in off-base areas, 14 locations near the sanitary sewer line 17 locations west of Landfill No. 2, 4 locations west of Landfill No. 25 and 12 locations along the base perimeter at Cannon AFB. The upper limit of background concentrations in soil for the 1994 study was developed as the mean plus two standard deviations.

4.3.1 Commonly Occurring Elements

Ten surface and 150 subsurface soil samples were analyzed for the major elements (calcium, potassium, and sodium). Minimum, maximum, and mean values for these three elements are listed in Table 4-1 along with background ranges for soil at Cannon AFB (W-C 1994) and concentration ranges for these elements typical of soil of the southwest United States (Lindsay 1979). Calcium, potassium, and sodium concentrations reported in all surface and subsurface samples analyzed are summarized by boring and are presented in Tables 4-2 through 4-31. During the Phase I RFI, sodium was found at a concentration of 3,920 milligrams per kilogram (mg/kg) at the surface location near boring 113-13 which exceeded the maximum background of 834 mg/kg established for Cannon AFB. This was the only occurrence of sodium above background. Potassium was found at a concentration of 2,970 mg/kg at one surface location near boring 113-04 and at a concentration of 2,550 mg/kg in 2 subsurface soil samples collected at depths of 20-22 and 25-27 feet bgs in borings 113-02 and 113-19, respectively which exceeded the maximum background of 2,531 mg/kg established for Cannon AFB. Calcium was found in 20 subsurface samples in 16 borings above the maximum background of 166,199 mg/kg. These 20 samples were collected between approximately 14

and 35 feet bgs. High concentrations of calcium are due to the calcareous nature of the geologic units beneath Landfill No. 5 (i.e., the presence of caliche and calcium carbonate sands). The maximum value of calcium in soil was 284,000 mg/kg found at 20 feet bgs in boring 113-28.

Although calcium, potassium and sodium concentrations were detected above the established background range for Cannon AFB in several soil samples collected during the Phase I RFI, these three elements were all below the maximum literature values for these elements in soil of the Southwest U.S. and are not considered to be contaminants at Landfill No. 5.

4.3.2 Metals

Ten surface and 150 subsurface soil samples were collected and analyzed for a list of 24 metals. The samples collected from the bottom of each boring were also analyzed for tin. Metals concentrations reported in the soil samples collected during the Phase I RFI are summarized by boring (113-01 through 113-30) and are presented in Tables 4-2 through 4-31, respectively. The occurrence and concentrations of metals detected in surface and subsurface soils beneath Landfill No. 5 were compared to statistical background concentrations previously developed for each of the metals (with the exception of tin) at Cannon AFB to describe the nature and extent of metals in soil.

A total of 55 soil samples (surface and subsurface samples) showed concentrations of one or more metals above the background range for the Phase I RFI at Landfill No. 5. Table 4-32 summarizes the results for metals that exceeded the background range listing the soil sampling depths and the boring locations where these metals exceedances were detected. Table 4-33 provides a summary of metals found above the background in subsurface soil samples by boring. These metals and their concentrations are displayed on geologic profiles A-A' through E-E' (Figures 4-1 through 4-5) to illustrate the lateral and vertical occurrence of metals detected above the background range. Figure 3-6 shows the borings and geologic profile line locations.

Subsurface samples were collected at each boring location at designated depths below the base of the landfill cell. The first subsurface sample was collected approximately 5 feet below the base of the landfill and is referred hereafter as the sample collected immediately below the

base of the landfill. The 4 subsequent subsurface samples collected at each boring location were obtained approximately 10, 20, 30, and 40 feet below the base of the landfill and are referred to as the second, third, fourth, and fifth subsurface samples collected for chemical analysis.

The occurrence of metals detected above the maximum background value in surface soil is discussed below first followed by a discussion of metals in subsurface soil.

Surface Soil

A total of 10 surface samples were collected for metals analyses at Landfill No. 5. Metals concentrations above the background range were detected in five of the 10 surface soil samples (i.e., those collected near borings 113-04, 113-13, 113-16, 113-22, and 113-28) with 9 different metals being detected above the background range (Table 4-32). Of these 9 metals, 5 metals (i.e., beryllium, cobalt, lead, manganese, and sodium) were found exclusively in surface samples. The other 4 metals: chromium, iron, potassium and zinc were found at these surface locations as well as in various subsurface samples. However, in all cases, the metals detected above the maximum background value in surface soil samples were not found above background at depth in any of the borings.

The following is a list of the 9 metals detected in surface soil, their frequency of occurrence, the boring locations in which they were found, the range of reported concentrations, and the background range of these metals established for Cannon AFB.

Analyte	Frequency	Boring(s)	Range of Concentrations Reported (mg/kg)	Established Background Range for Cannon AFB (mg/kg)
Beryllium	1 sample	113-04	0.7	0 - 0.6
Chromium	1 sample	113-16	19.2	0.8 - 12
Cobalt	1 sample	114-04	5	0 - 4
Iron	1 sample	113-04	9,610	0 - 8,654
Lead	2 samples	113-16, 113-22	41.4 - 78.2	0 - 18.4
Manganese	1 sample	113-04	275	0 - 151.8
Potassium	1 sample	113-04	2,970	0 - 2,531
Sodium	1 sample	113-13	3,920	0 - 834
Zinc	4 samples	113-04, 113-16, 113-22, 113-28	21.8 - 28.2	0 - 20.7

Concentrations of some of the metals (i.e., lead, cobalt, beryllium, chromium, iron and zinc) above background are likely due to the presence of pieces of scrap metal on the ground surface at Landfill No. 5.

Subsurface Soil

The metals analyses results for the 150 subsurface soil samples collected at Landfill No. 5 showed that 4 metals (arsenic, mercury, selenium and thallium) were not detected at concentrations above background and, therefore, these metals are not further evaluated within this report (Tables 4-2 through 4-31).

Beryllium, cadmium and cobalt were not detected at concentrations above background; however, non-detects with elevated detection limits for these 3 metals (i.e., above the maximum background value) were reported in 5 subsurface samples. Results for antimony reported as non-detects with elevated detection limits above background occurred in 4 of the 5 subsurface samples affected. Table 4-34 summarizes the occurrence of these elevated detection limits above the background range in the 5 subsurface samples. Based on the great number of detections of antimony, beryllium, cadmium, and cobalt within the background range in subsurface soil collected beneath Landfill No. 5 and knowing that the occurrences of elevated detection limits were reported in samples which were analyzed at a dilution in order to quantitate calcium within the calibration ranges, these metals are not considered to be

contaminants and were not further evaluated. The remaining metals detected above background are discussed below. One sample for copper had an elevated detection limit and is included in this table; however, copper was found above background in other subsurface samples collected.

Ten metals were detected in subsurface soil at Landfill No. 5 at concentrations above the established background range. A summary of their frequency of occurrence in subsurface samples, the range of reported concentrations above background and the background range of each metal is shown below followed by a discussion of the occurrence of each of these metals beneath Landfill No. 5.

Analyte	Frequency of Occurrence Above Background[1]	Range of Concentrations Reported Above Background (mg/kg)	Established Background Range for Cannon AFB (mg/kg)
Aluminum	1 sample in one boring	11,100	593 - 10,796
Barium	9 samples in seven borings	595 - 5,050	0 - 548
Chromium	5 samples in four borings	14.1 - 40.7	0.8 - 12.0
Copper	7 samples in five borings	11.6 - 63.6	0 - 10.1
Iron	2 samples in two borings	8,810 - 9,580	0 - 8,654
Magnesium	8 samples in seven borings	10,200 - 16,300	0 - 9,912
Nickel	11 samples in ten borings	10.4 - 68.6	0 - 9.7
Silver	1 sample in one borings	4.8	0 - 1.8
Vanadium	7 samples in five borings	25.5 - 36.7	1.7 - 25.0
Zinc	4 samples in four borings	23.4 - 59	0 - 20.7

[1] Borings where exceedances occurred are listed in Table 4-33.

Aluminum was found above background (10,796 mg/kg maximum background value) in the soil sample collected from a depth of 20 feet bgs (11 feet below the base of the landfill cell) in boring 113-02 located in the northeast corner of Landfill No. 5 (Table 4-32) (Figure 4-5). The concentration reported was 11,100 mg/kg only slightly above the maximum background of 10,796 mg/kg. Since aluminum was not detected in the soil sample (14 feet bgs) collected immediately beneath the landfill cell or in deeper subsurface samples collected below 20 feet bgs it is believed that the aluminum detection likely is due to site specific geologic conditions and not due to the waste within the landfill cell.

Barium was found above background (548 mg/kg maximum background value) in nine soil samples from seven boring locations (Table 4-32) The highest concentration reported was at 5,050 mg/kg in the soil collected from a depth of 45 bgs (22 feet below the base of the landfill cell) at location 113-01 (Figure 4-2). Barium was not detected at concentrations above the maximum background value in the two soil samples collected for chemical analysis above this sample interval or in the two soil samples collected below this sample in boring 113-01. The other eight occurrences of barium were found at 6 borings (113-10, 113-12, 113-17, 113-23, 113-29, and 113-30) in soil samples collected from depths of 14 to 35 feet bgs (depths ranging from 6 to 23 feet below the base of the landfill cells) (Figures 4-1, 4-2, 4-3, and 4-5). Concentrations above background in the 6 borings ranged from 595 mg/kg to 3,470 mg/kg. Only at 2 borings (113-17 and 113-29) did more than one soil sample exhibit concentrations of barium above background. Barium concentrations which exceeded background were found primarily in silty sand units with a high content of calcium and near or within caliche units at boring locations located in the central region of Landfill No. 5. In four of the soil samples where barium exceeded background, calcium was also found above the maximum background concentration. Barium can substitute for calcium in caliche zones and the occurrence of barium concentrations above background in soil at Landfill No. 5 is believed to be due, in part, from this substitution.

Concentrations of chromium above background (12 mg/kg maximum background value) were found in 5 subsurface soil samples collected from 4 borings (113-05, 113-10, 113-25, and 113-26) at depths ranging from 34 to 64 feet bgs (Table 4-32). Borings 113-05 and 113-10 are located near the eastern edge of Landfill No. 5, and borings 113-25 and 113-26 are located in the southwestern area of Landfill No. 5 (Figure 4-3). Chromium was detected at a concentration of 30.7 mg/kg in soil collected from the base of boring 113-10 at a depth of 64 to 65 feet bgs (41.5 feet below the base of the landfill cell). At the same boring location, chromium was detected at a concentration of 40 mg/kg at a depth of 34-35.3 feet bgs (10.5 feet below the base of the landfill cell) and was below the maximum background value in the sample (29.5 feet bgs) collected immediately beneath the landfill cell. Chromium, therefore, showed a decrease in concentration with depth at this location. The other three occurrences of chromium above background were found at depths ranging from 30 to 47 feet bgs (from 11.5 to 30.5 feet below the base of the landfill cells); and were found in only one soil sample collected from borings 113-05, 113-25 and 113-26. Concentrations above

background in these 3 samples ranged from 14.1 mg/kg to 29.4 mg/kg. Since chromium did not occur at concentrations above background in soil collected immediately below the landfill cell at any of the boring locations, it is likely that the chromium concentrations detected above background are due to site specific geologic conditions and not from the waste within the landfill cells.

Concentrations of copper above background (10.1 mg/kg maximum background value) occurred in 7 samples at 5 boring locations (113-01, 113-06, 113-16, 113-20 and 113-24) (Table 4-32). No general trend of the lateral and vertical occurrence of copper above background is apparent from the data collected. The highest reported concentration for copper above the maximum background value was detected in the sample collected from the base of boring 113-01 (the fifth subsurface sample collected in this boring) at a depth of 63-64.8 feet bgs (40 feet below the base of the landfill cell in this boring) (Figure 4-2). However, copper was not detected above background in the 4 shallower subsurface soil samples collected for chemical analyses above this sample in this boring. At borings 113-06, 113-16 and 113-20, soil samples collected immediately below the base of the landfill cell (approximately 5 feet) had copper detected above background (Figures 4-4 and 4-5). At 2 of these 3 borings, 113-06 and 113-20, copper was not detected above background in any of the other 4 samples collected at depth. At boring 113-16, however, copper was found in the second and fourth subsurface soil collected at depths of 50-50.9 and 70-70.9 feet bgs (at 10.9 and 30.9 feet, respectively, below the base of the landfill cell) with copper increasing in concentration with depth. At boring 113-24, copper was detected above background in only the second subsurface soil sample collected below the base of the landfill cell (9 feet below the base of the landfill cell). Copper was not detected in boring 113-24 above background in soil collected for chemical analysis above or below this sample.

Iron was found at concentrations above background (8,654 mg/kg maximum background value) in 2 subsurface samples collected from 2 borings (113-10 and 113-19) (Table 4-32). Iron concentrations above background (9,580 mg/kg and 8,810 mg/kg at borings 113-10 and 113-19, respectively) were found in the second subsurface sample collected at both locations and not in the sample collected immediately beneath the landfill cells (Figures 4-3 and 4-4). These samples were collected from depths of 34 feet bgs (10.5 feet below the base of the landfill cell) and 25 feet bgs (13 feet below the base of the landfill cell) in borings 113-10 and 113-19, respectively. These concentrations are likely due to site-specific geologic conditions

since these concentrations are only slightly above the maximum background of 8,654 mg/kg established for Cannon AFB and iron was not detected at concentrations above background in the soil sample collected immediately beneath the landfill cell at both locations.

Magnesium was found at concentrations above background (9,912 mg/kg maximum background value) in 8 subsurface samples collected from 7 borings (113-04, 113-13, 113-14, 113-15, 113-22, 113-25 and 113-26) (Table 4-32). The range of concentrations detected above background was 10,200 mg/kg to 16,300 mg/kg. These borings are all located in the southern portion of Landfill No. 5. Boring 113-14 was the only location where more than one soil sample had magnesium detected above background (Figure 4-5). Magnesium concentrations reported above background were found in soil collected at depths of 25 to 47 feet bgs (between 5 to 30 feet below the base of the landfill cells) from the 7 borings and occurred primarily in caliche units and sand units with only a trace amount of silt. The highest concentration was detected in a caliche unit found at a depth of 47 feet bgs (approximately 30 feet below the base of the landfill cell) at boring 113-26 (Figure 4-3). In only one of the 8 samples did magnesium occur above background in the sample collected immediately beneath a landfill cell. This sample was collected in a sand unit with little silt at a depth of 32 feet bgs at boring 113-14. At this same boring location, the sample collected at a depth of 38 feet bgs within a caliche unit showed a slight increase in the magnesium concentration. Magnesium concentrations in soil that exceeded background at Landfill No. 5, are believed to be due to site-specific geologic conditions. Magnesium can substitute for calcium and the occurrence of magnesium concentrations above background in soils at Landfill No. 5 is believed to be due, in part, from this substitution.

Nickel was found above background (9.7 mg/kg maximum background value) in 11 subsurface samples from 10 borings at concentrations ranging from 10.4 mg/kg to 392 mg/kg (Table 4-32). At 8 of these 10 borings (113-03, 113-04, 113-05, 113-06, 113-07, 113-10, 113-17, and 113-30), nickel was detected at concentrations above background in the soil samples collected immediately below the base of the landfill cells (Figures 4-1, 4-2, 4-3 and 4-5). Six of these borings are located near the eastern boundary of Landfill No. 5, one in the central area and one near the western edge of Landfill No. 5. At only one of these 8 borings was nickel detected above background in the second subsurface soil sample (boring 113-10 at a depth of 34 feet bgs) collected below the landfill cell (10.5 feet below the base of the cell). The nickel concentration in this second sample (30.2 mg/kg) showed a slight increase in

concentration over the sample (18.4 mg/kg) collected immediately below the landfill cell in boring 113-10 (Figure 4-3). At 2 remaining borings 113-11 and 113-25, only the second soil sample collected below the landfill cell in each boring had nickel detected above background (Figures 4-2 and 4-3). The 2 samples in these borings were collected from a depth between 30 and 35 feet bgs (9 to 11.5 feet below the base of the landfill cells) and had nickel concentrations of 50.7 mg/kg and 68.6 mg/kg, respectively. Nickel concentrations above background were not found at any boring locations below a depth of 35 feet bgs at Landfill No. 5.

Potassium was found above background (2,531 mg/kg maximum background value) in two subsurface soil samples collected from two borings, 113-02 and 113-19 (Table 4-32). Both borings are located in the northernmost area of Landfill No. 5. Both concentrations above background occurred in soil collected between 20 and 25 feet bgs (12.5 and 13 feet below the base of the landfill cells) and both were found at a concentration of 2,550 mg/kg (Figures 4-4 and 4-5). Potassium concentrations in soil samples collected immediately below the landfill cell at these locations as well as in deeper samples collected below a depth of 25 feet bgs in these borings did not exceed background and therefore the occurrence of potassium above background is believed to be due to site geologic conditions.

Silver was found above background (1.8 mg/kg maximum background value) in only 1 subsurface sample collected from a depth of 50-50.9 feet bgs (10 feet below the base of the landfill cell) in boring 113-16 (Table 4-32). The concentration detected was 4.8 mg/kg (Figure 4-4). The sample collected above this sample interval and the 3 soil samples collected below this sample interval in boring 113-16 did not detect silver above background.

Tin was part of the Appendix IX analyte suite which was analyzed only in the bottom sample collected in each boring (i.e., 30 field samples analyzed for tin). Since a background range has not been established for tin in soil at Cannon AFB, the range of detections is presented here, and further evaluation of this metal as a contaminant is deferred to the human health risk screen, Section 6.0 of this report. Tin was detected in 5 samples collected from 5 borings; 113-01, 113-09, 113-17, 113-20 and 113-23. Detected concentrations ranged from 8.7 mg/kg to 56 mg/kg. There was no aerial pattern of occurrence for tin in soil as the borings where tin was detected were randomly located across Landfill No. 5. The geologic unit where tin was primarily detected consisted of a silty sand unit. (Figures 4-1, 4-2, 4-4 and 4-5)

Vanadium was found at concentrations above background (25.0 mg/kg maximum background value) in 7 soil samples at 5 borings (113-06, 113-08, 113-11, 113-19 and 113-27) located in the central and northern area of Landfill No. 5. Concentrations above background ranged from 25.5 mg/kg to 36.7 mg/kg. Vanadium concentrations above background were found in soil collected between 20 and 36.9 feet bgs (Table 4-32). At 3 of the borings (113-06, 113-08 and 113-27) vanadium was found in the soil collected immediately below the base of the landfill cell (Figures 4-1, 4-2 and 4-5). At 2 of these 3 borings (113-08 and 113-27), vanadium was also found at concentrations above background in the second subsurface sample collected below the base of the landfill cell. Vanadium concentrations detected in these samples showed a decrease in concentration with depth. Vanadium was not detected above background in the subsurface soil samples collected below the second sample interval in either boring. At borings 113-11 and 113-19, vanadium concentrations above background were found in only the second subsurface soil sample collected below the base of the landfill. These soil samples were collected at depths of 25-36.9 feet bgs (between 9 and 13 feet below the base of the landfill cells).

Zinc was found above background (20.7 mg/kg maximum background value) in 4 subsurface soil samples collected from 4 borings (113-05, 113-07, 113-17 and 113-25) (Table 4-32). Zinc ranged in concentration above background from 23.4 mg/kg to 59 mg/kg at depths from 24 to 30 feet bgs in the four borings. Zinc concentrations at borings 113-05, 113-07 and 113-17 were found above background in the soil sample collected immediately below the landfill cell but were not found in deeper samples collected at these locations (Figures 4-2, 4-3 and 4-5). At boring 113-25, zinc was only found above background in the second subsurface sample collected at a depth of 30 to 30.9 feet bgs (11 feet below the base of the landfill cell). This sample exhibited the highest zinc concentration (i.e., 59 mg/kg) above background. The sample collected immediately below the landfill cell at this boring did not show zinc above background.

4.3.3 Semivolatile Organic Compounds

Ten surface and 150 subsurface samples were collected from 30 borings and analyzed for SVOCs. Results of the analyses for these samples were used to describe the nature and extent of SVOC contamination at Landfill No. 5. SVOC concentrations detected in these samples

are summarized by boring and are presented in Tables 4-2 through 4-31. Table 4-35 provides a summary of the SVOCs detected, excluding those analytes considered to be common laboratory contaminants (see Section 4.2). The SVOCs considered to be common laboratory contaminants for this investigation are bis(2-ethylhexyl) phthalate, butyl benzyl phthalate, di-n-butyl phthalate, di-n-octyl phthalate and diethyl phthalate.

SVOCs were not detected in any of the surface samples collected and analyzed during the Phase I RFI. SVOCs were detected, however, in 11 subsurface soil samples collected from 6 borings (113-01, 113-13, 113-15, 113-16, 113-17, and 113-24).

Seven of the 12 SVOCs detected at Landfill No. 5 are polynuclear aromatic hydrocarbons (PAHs) including: 2-methylnaphthalene, acenaphthene, chrysene, fluoranthene, fluorene, phenanthrene and pyrene. In addition, three phenols (4-methylphenol, 4-nitrophenol, and phenol) and one furan (dibenzofuran) were detected in the subsurface soil samples.

The distribution and occurrence of the SVOCs in the 11 subsurface soil samples, the borings they were found in, and the range of concentrations detected are summarized below:

Polynuclear Aromatic Hydrocarbons

Analyte	Frequency of Detection	Boring(s)	Detected Concentrations (µg/kg)
2-Methylnaphthalene	1 sample	113-13	85J
Acenaphthene	3 samples	113-01 and 113-13	37J-82J
Chrysene	1 sample	113-13	38J
Fluoranthene	2 samples	113-01 and 113-13	67J-93J
Fluorene	2 samples	113-01 and 113-13	41J-69J
Phenanthrene	5 samples	113-01 and 113-13	41J-220J
Pyrene	2 samples	113-01 and 113-13	74J-88J

Phenols

Analyte	Frequency of Detection	Boring(s)	Detected Concentrations (µg/kg)
4-Methylphenol	2 samples	113-16 and 113-24	68J-100J
4-Nitrophenol	2 samples	113-15	49J-69J
Phenol	3 samples	113-01, 113-16 and 113-17	40J-360

Furans

Analyte	Frequency of Detection	Boring	Detected Concentrations (µg/kg)
Dibenzofuran	1 sample	113-13	44J

The distribution and occurrence of these SVOCs in soil at Landfill No. 5 are described below.

Seven PAHs were detected in 5 subsurface samples collected from 2 borings (113-01 and 113-13) located on the eastern side of Landfill No. 5 (Table 4-35) (Figures 4-2 and 4-5). At boring 113-01, 5 PAHs: acenaphthene, fluoranthene, fluorene, phenanthrene and pyrene were detected in the bottom soil sample collected at a depth of 63 to 64.8 feet bgs (approximately 39 feet below the base of the landfill cell) (Figure 4-2). PAHs were not detected in the 4 subsurface soil samples collected above this sample in boring 113-01; however, phenol was detected at the reporting limit of 360 µg/kg, in the sample collected immediately below the base of the landfill at this location. In all cases the PAH concentrations detected in boring 113-01 were well below the laboratory reporting limit.

At boring 113-13, at least one PAH compound was detected in 4 of the 5 subsurface samples collected (Table 4-35) (Figure 4-5). The first subsurface soil sample collected immediately below the base of the landfill cell at a depth of 27-29 feet bgs at boring 113-13 contained two PAHs: acenaphthene and phenanthrene. The third subsurface soil sample collected in boring 113-13 at a depth of 40-42 feet bgs (approximately 19 feet below the base of the landfill cell) had all 7 PAHs (2-Methylnaphthalene, acenaphthene, chrysene, fluoranthene, fluorene, phenanthrene and pyrene) and dibenzofuran reported as detected. Phenanthrene was the only PAH detected in the 2 bottom-most samples collected in boring 113-13 from depths of 50-

51.5 feet and 62-64.5 feet bgs (between 29 to 43 feet below the base of the landfill cell) with concentrations decreasing with depth. All SVOC detections in this boring were well below the laboratory reporting limit.

At boring 113-16, 2 phenols (4-methylphenol and phenol) were detected in the sample collected immediately below the base of the landfill cell (Table 4-35). This soil sample was collected at a depth of 45-46.9 feet bgs with 4-methylphenol being detected at a concentration of 100J µg/kg and phenol at a concentration of 40J µg/kg. No other SVOCs were found at depth at this boring location (Figure 4-4).

At boring 113-15, 4-nitrophenol was detected in the first and second subsurface samples collected at depths of 20-22 and 25-27 feet bgs (between 5 and 12 feet below the base of the landfill cell) (Table 4-35) (Figure 4-3). The concentration of 4-nitrophenol showed a slight increase in concentration (from 49J µg/kg to 68J µg/kg) with depth. 4-nitrophenol, however, was not detected below 27 feet bgs in the 3 deeper subsurface samples collected from this boring (Figure 4-3). Both concentrations detected were well below the laboratory reporting limit.

At boring 113-17, phenol was detected at a concentration of 47J µg/kg in the second subsurface sample collected at a depth of 25-26.5 feet bgs (approximately 12 feet below the base of the landfill cell) (Table 4-35). Phenol was not detected in the sample collected immediately below the landfill cell or below a depth of 26.5 feet bgs in boring 113-17 (Figure 4-2). The concentration of phenol detected was well below the laboratory reporting limit for phenol.

At boring 113-24, 4-methylphenol was detected at a concentration of 68J µg/kg in the second subsurface sample collected at a depth of 29-29.8 feet bgs (approximately 11 feet below the base of the landfill cell). This was the only SVOC detected at this boring location (Figure 4-4). The concentration of 4-methylphenol detected was well below the laboratory reporting limit.

4.3.4 Volatile Organic Compounds

Ten surface and 150 subsurface soil samples were collected from 30 borings and analyzed for VOCs. Results of the analyses for these samples were used to describe the nature and extent of VOCs detected at Landfill No. 5. VOCs in surface and subsurface soil samples are summarized by boring and are presented in Tables 4-2 through 4-31. Table 4-36 provides a summary of the VOC concentrations detected, excluding those VOC analytes considered to be common laboratory contaminants (i.e., 2-butanone, acetone, and methylene chloride).

A total of 8 VOCs were randomly detected at 16 boring locations across Landfill No. 5. The 8 volatile compounds detected were 1,1,2,2-tetrachloroethane; 2-hexanone; 4-methyl-2-pentanone; acetonitrile; carbon disulfide; ethylbenzene; styrene and toluene.

The distribution and occurrence of these VOCs in the surface and subsurface soil samples, the borings in which they were found, and the range of concentrations detected are summarized below.

Analyte	Frequency of Detection	Boring(s)	Detected Concentrations (µg/kg)
1,1,2,2 - Tetrachloroethane	4 samples	113-21	2.3J to 8.2
2-Hexanone	6 samples	113-05, 113-10, 113-16, 113-17, 113-24	1.5J-8.3J
4-Methyl-2-pentanone (MIBK)	5 samples	113-10, 113-16, 113-17	2.5J-230
Acetonitrile	4 samples	113-05, 113-07, 13-08, 113-12	16J to 67J
Carbon disulfide	1 sample	113-06	2.9J
Ethylbenzene	2 samples	113-13	1.3J-300 (includes one surface sample)
Styrene	2 samples	113-13	8.2 -1400 (includes one surface sample)
Toluene	13 samples	113-01, 113-04, 113-07, 113-10, 113-13, 113-16, 113-18, 113-19, 113-22, 113-24, and 113-25	1J-4.9J

Surface and Subsurface Soil

Ethylbenzene, styrene and toluene were the only 3 VOCs detected in surface soil samples. Ethylbenzene and styrene were both detected in the surface sample collected near boring 113-

13 and were found at concentrations of 1.3J µg/kg and 8.2J µg/kg, respectively (Table 4-36) (Figure 4-5). Both of these VOCs were also detected in the first subsurface sample collected in boring 113-13 at a depth of 27-29 feet bgs (approximately 5 feet below the landfill cell). Concentrations of ethylbenzene and styrene were 300 µg/kg and 1,400 µg/kg, respectively, in the sample 27 to 29 feet bgs. However, ethylbenzene and styrene were not detected in the 4 deeper samples collected at this boring location or any other boring location.

Toluene was detected in 7 of the 10 surface soil samples collected near borings 113-01, 113-04, 113-07, 113-10, 113-13, 113-16 and 113-19 (Table 4-36) (Figures 4-3, 4-4 and 4-5). Concentrations ranged from 1.4J µg/kg to 4.9J µg/kg. All concentrations were below the laboratory reporting limit. Toluene was found at depth at only one of the above surface locations (113-10). Toluene was detected in 6 subsurface soil samples collected from 5 borings (113-10, 113-18, 113-22, 113-24, 113-25). Three of these borings (113-22, 113-24 and 113-25) are located in the southeast corner of landfill No. 5. The other two borings (113-18 and 113-10) are located in the central area of Landfill No. 5. Toluene was detected in only one sample collected immediately below the base of the landfill cell (approximately 5 feet) and this was the sample collected at a depth of 28 feet bgs in boring 113-18. At all other boring locations toluene was detected in soil collected at depths between 45 and 63 feet bgs (between 22 and 41 feet below the base of the landfill cells) with concentrations ranging from 1J µg/kg to 4.8J µg/kg. The maximum concentration (4.8J µg/kg) occurred at a depth of 45 feet bgs in boring 113-22. All detections of toluene in subsurface samples were below the laboratory reporting limit.

At boring 113-06, carbon disulfide was detected at a concentration of 2.9J µg/kg in the second subsurface sample collected at a depth of 25 to 27 feet bgs (approximately 9 feet below the base of the landfill cell) (Table 4-36) (Figure 4-5). This concentration was below the laboratory reporting limit. The sample collected above and the 3 samples collected below this sample in boring 113-06 did not show carbon disulfide to be present, and this VOC was not detected in any other soil samples collected at Landfill No. 5.

At boring 113-21, 1,1,2,2-tetrachloroethane was detected in 4 of the 5 subsurface samples collected from this boring at depths ranging from 22 to 57 feet bgs (between 5 and 40 feet below the base of the landfill cell). Concentrations ranged from 2.3J µg/kg to 8.2 µg/kg (Table 4-36) (Figure 4-4). This was the only boring where soil had detectable concentrations

of this VOC. All concentrations of 1,1,2,2-tetrachloroethane were below the reporting limit except for the maximum concentration of 8.2 µg/kg, found in the second subsurface sample collected (27 feet bgs and 10 feet below the base of the landfill cell).

2-Hexanone was found in 6 subsurface samples collected from depths of 19 to 50.9 feet bgs in 5 borings (113-05, 113-10, 113-16, 113-17 and 113-24) (Table 4-36) (Figures 4-2, 4-3 and 4-4). Concentrations of 2-hexanone ranged from 1.5J µg/kg to 11J µg/kg with the maximum concentration occurring at 50 feet bgs in boring 113-16. 2-Hexanone was detected in one sample from each of the above borings except for boring 113-16. At boring 113-16, 2-Hexanone was detected in two of the subsurface samples collected showing a decrease in concentration with depth (Figure 4-4). In all cases, this compound was detected in either the first or second sample collected below the landfill cell (between 5 and 11 feet below the base of the landfill cells) and was not found in the deeper third, fourth or fifth subsurface soil sample at any of the boring locations.

4-Methyl-2-pentanone was detected in one subsurface sample from boring 113-10, one subsurface sample from boring 113-17 and 3 subsurface soil samples from boring 113-16 (Table 4-36). At borings 113-10 and 113-17 this VOC was detected in the second subsurface sample collected below the base of the landfill cell. These samples were collected at a depth ranging from 25 and 35.3 feet bgs (between 10 to 12 feet below the landfill cells) with concentrations of 6.4J µg/kg to 10J µg/kg (these concentrations were below the laboratory reporting limit). 4-Methyl-2-pentanone was not detected in the samples collected in these two borings above and below these samples (Figures 4-2 and 4-3). At boring 113-16, 4-Methyl-2-pentanone was detected in 3 subsurface samples collected at depths ranging from 45 to 60 feet bgs (between 5 and 20 feet below the base of the landfill cell) at concentrations of 230 µg/kg, 220 µg/kg and 2.5J µg/kg, respectively, showing a significant decrease with depth. The concentration of 2.5J µg/kg was below the laboratory reporting limit. The maximum concentration of 4-methyl-2-pentanone (230µg/kg) was detected in boring 113-16 at a depth of 45 feet bgs.

4.3.5 Pesticide/PCB Compounds

Ten surface and 150 subsurface soil samples were collected and analyzed for pesticides/PCB compounds. Aroclor 1254 was the only PCB detected and was reported in only 2 samples

(one surface and one subsurface sample) from 2 borings (113-19 and 113-16) (Figure 4-4). Aroclor 1254 was detected at a concentration of 75 µg/kg (slightly above the laboratory reporting limit) in a soil sample collected from a depth of 45 to 46.9 feet bgs from boring 113-16. Aroclor 1254 was also detected in the surface soil sample collected near boring 113-19 at a concentration of 25J µg/kg (below the laboratory reporting limit). No other occurrence of PCB compounds were detected in soil from Landfill No. 5. In addition, pesticides were not detected in any soil samples collected from Landfill No. 5.

4.3.6 Total Recoverable Petroleum Hydrocarbons

TRPH was found in 6 surface soil samples collected near borings 113-07, 113-10, 113-16, 113-19, 113-22 and 113-28 (Table 4-36) (Figures 4-6, 4-8, 4-9 and 4-10). Concentrations ranged from 43.5 mg/kg to 85.6 mg/kg. TRPH was not detected in any of the subsurface soil samples collected below these surface locations. TRPH in surface soil occurred randomly across the site and was not found in any one area at Landfill No. 5.

TRPH was detected in 4 subsurface soil samples collected from 4 different borings (113-05, 113-11, 113-17 and 113-24) (Table 4-36) (Figures 4-7 and 4-8). At boring location 113-05 the first subsurface sample collected at a depth of 24.5 to 26.5 feet bgs had TRPH detected at a concentration of 79.1 mg/kg. TRPH was not detected in any other soil samples collected and analyzed for TRPH below 26.5 feet in this boring. At borings 113-11, 113-17 and 113-24 TRPH was detected in only the second subsurface sample collected at each of these boring locations. Concentrations were 59.1 mg/kg, 170 mg/kg and 164 mg/kg, respectively (Table 4-36). These borings occur primarily in the central portion of Landfill No. 5.

4.3.7 Cyanide

Ten surface and 150 subsurface soil samples were analyzed for cyanide. There were no detections of cyanide reported in any of the samples analyzed.

4.3.8 Herbicides

Sixty subsurface samples, two from each boring location with one sample collected immediately below the base of the landfill and the second sample collected at the base of each

boring, were analyzed for herbicides. There were no detections of herbicide compounds in any of the subsurface soil samples analyzed.

4.3.9 Dioxins and Furans

Fourteen subsurface samples, collected from fourteen different borings (113-01, 113-06, 113-12, 113-13, 113-18, 113-20, 113-21, 113-22, 113-23, 113-24, 113-25, 113-26, 113-27, 113-30) were analyzed for dioxin and furans. These samples chosen for dioxin and furan analysis were all collected from the lowermost sample interval (approximately 40 feet below the base of the landfill cell) and in borings where the landfill material showed evidence of burned material. There were no detections of dioxin and furans reported in any of the samples analyzed.

4.4 SEMIVOLATILE AND VOLATILE ORGANICS TENTATIVELY IDENTIFIED COMPOUNDS

During the Phase I RFI, volatile and semivolatile organic TICs were reported in several samples by the laboratory. A total of ten volatile organic TICs and forty-two semivolatile organic TICs were identified during the analyses. In addition, five petroleum related TICs were identified. Tables 4-37 and 4-38 summarize the TICs that were detected and their occurrence in surface and subsurface soil samples analyzed during the Phase I RFI. In order to evaluate the nature and extent of these TICs, they were categorized (based on the nature of the compound and based on professional judgment) into potentially non-toxic chemicals, and potentially toxic chemicals (Table 4-39).

Of the forty-one reported semivolatile TICs identified (excluding the petroleum related TICs), twenty-nine of these compounds were considered to be potentially non-toxic (Table 4-39). Of these twenty-nine compounds, four were alcohol's, one was a ketone, nineteen were fatty acids and esters, and five were categorized as others. Of the ten detected volatile organic TICs (excluding the petroleum related TICs) three were considered to be relatively non-toxic. Of these three compounds one was an alcohol, one was a ketone and one was categorized as other.

A summary of the potentially non-toxic TICs including their occurrence in surface and subsurface soil, the boring locations where these TICs were found and the range of concentrations reported for each of these TICs is shown in Table 4-39. These TICs are discussed below as to their possible origin based on their chemical class, however, no further evaluation of these potentially non-toxic compounds are discussed within this report.

Alcohols, aldehydes, ketones, fatty acids, and fatty acid esters are typically used in household and personal care products and would be expected to be seen in domestic landfills. Alcohols are used as solvents, in paints and lacquers; as plasticizers for PVC resins; in perfumes, cosmetics and pharmaceutical formulations; in lubricants, resins, baking finishes, inks, rubber, paper, photography and dry cleaning products. Aldehydes are used in perfumes and as flavoring agents. Ketones are typically used as solvents, especially for cellulose derivatives, in lacquers, paints, vinyl resins, lacquers, roll-coating inks, stains, paint and varnish removers, insect repellents, moth and mildew proofings, tooth powders, medicines (internal & external) and textile processing. Fatty acids are derived from or contained in animal or vegetable fats or oils and are generally used in lubricants, paints, lacquers, candles, salad oils, shortening, synthetic detergents, and cosmetics. Other TICs that were tentatively identified are considered likely to be from plant material, cooking oils, greases, waxes, cleaners and other miscellaneous household products.

The twelve semivolatile TICs and the seven volatile TICs which were considered potentially toxic or have unknown toxicity values and the petroleum related TICs are discussed in greater detail below. The occurrence of each of these TICs, their frequency of occurrence, the boring locations where these compounds were detected and their range of concentrations are summarized in Table 4-39. These TICs and their concentrations are displayed on five geologic profiles (A-A' through E-E') (Figures 4-6 through 4-10) to illustrate the lateral and vertical distribution of these chemicals in soil at Landfill No. 5. Additionally, the detections of VOC and SVOC compounds are shown on Figures 4-6 through 4-10 to illustrate the vertical distribution of TICs in relation to VOCs and SVOCs.

The semi-volatile compounds which were identified as potentially toxic or have unknown toxicity values were:

- 1-Methylnaphthalene;

- 1,1'-Biphenyl, 4,4'-difluoro-;
- 3-Cyclohexene-1-methanol.,.alpha.,.alpha.4-trim;
- alpha.amyrin;
- Cyclohexane,methyl-;
- Phenol,4,4'-butylidenebis(2-(1,1-dimethylethyl);
- Sulfur, mol. (S8)
- .alpha.-Amyrin
- Cyclopentanecarboxylic acid, 2-amino-, trans-
- Eicosanoic acid,2,3-bis(acetyloxy)propyl ester
- Stigmast-5-en-3-ol-,(3.beta.,24S)
- a'-Neogammacer--22(29)-en-3-ol,(3.beta.,24S)

The seven volatile compounds which were identified were:

- Bicyclo(2.2.1)heptan-2-one, 1,2,2-trimethyl-
- Benzene, 2-butentyl
- Acetic acid, ethyl ester
- Acetic acid, methyl ester
- 2-butene
- 1-pentene,4,4-dimethyl-
- Nonanal

In addition, the semivolatile and volatile petroleum related TICs identified were

- saturated hydrocarbons:<C10;
- saturated hydrocarbons:>C20:
- saturated hydrocarbons: C10-C20
- unsaturated hydrocarbons.

A discussion of the semivolatile TICs, the volatile TICs and the petroleum related TICs is presented below.

Semivolatile TICs of Interest

1-Methylnaphthalene was tentatively identified at a concentration of 76 µg/kg in the subsurface sample collected from a depth of 40 to 42 feet bgs (approximately 19 feet below the base of the landfill cell) at boring 113-13 (Tables 4-37 and 4-39) (Figure 4-10). This TIC was not identified in the two samples collected immediately above or immediately below this sample interval in boring 113-13 or in any other soil sample collected at Landfill No. 5. 1-Methylnaphthalene was detected in the same sample where eight semivolatile PAHs were found (i.e., pyrene, 2-methylnaphthalene, acenaphthene, chrysene, dibenzofuran, fluoranthene, fluorene and phenanthrene) (Figure 4-10).

1,1-Biphenyl, 4,4-difluoro- was found in only one subsurface sample collected at Landfill No. 5 and occurred in boring 113-25. This compound was detected at a concentration of 280 µg/kg in the second subsurface sample collected at a depth of 30-30.9 feet bgs (approximately 11 feet below the base of the landfill cell) (Tables 4-37 and 4-39) (Figure 4-8). This TIC was not detected in the sample collected immediately below the base of the landfill cell or in the three subsurface samples collected below this sample at this boring location. In addition, this compound was not detected in any other soil collected from Landfill No. 5. A saturated hydrocarbon TIC between the range of C10-C20 was also detected at a concentration of 5,370 µg/kg in this soil sample, however, no SVOCs or VOCs were associated with this detection.

3-Cyclohexene-1-methanol.,.alpha.,.alpha.4-trim was found at a concentration of 190 µg/kg in only one surface soil sample collected near boring 113-01 (Tables 4-37 and 4-39) (Figure 4-7). This TIC was not detected in any other of the five subsurface samples collected below the landfill cell at this boring location or in any soil collected from Landfill No. 5. At surface location 113-01 three additional SVOC TICs (.alpha.-amyrin, stigmast-5-en-3-ol-, [3.BETA,.24S), and saturated hydrocarbons greater than C20), one VOC (toluene), and one VOC TIC (bicyclo[2,2,1]heptan-2-one,1,3,3-trimethyl) were also detected.

The compound .alpha.-amyrin was detected at a concentration of 140 µg/kg in only one surface sample collected near boring 113-01. (Tables 4-37 and 4-39) (Figure 4-7). This TIC (possibly a naturally occurring compound) was not detected in the subsurface samples collected at this boring location or in any other soil samples collected from Landfill No. 5.

The occurrence of this compound with other SVOCs and VOCs is described above in the discussion of 3-cyclohexene-1-methanol.,.alpha.,.alpha.4-trim.

Cyclohexane, methyl was detected in 6 subsurface soil samples collected from 3 borings (113-22, 113-23, and 113-27) (Tables 4-37 and 4-39). These borings are all located in the southwest portion of Landfill No. 5. Cyclohexane, methyl was found in the first sample collected immediately below the base of the landfill cell at all three boring locations with concentrations ranging from 140 µg/kg to 180 µg/kg. At only two of these three borings, 113-22 and 113-23, Cyclohexane, methyl was detected in deeper subsurface soil samples (Figures 4-6 and 4-8). At boring 113-22, cyclohexane, methyl was detected at a concentration of 140 µg/kg (the same concentration as detected in the sample collected immediately below the landfill cell at this location) in the fourth subsurface soil sample collected from a depth of 45-45.9 feet bgs (approximately 31 feet below the base of the landfill cell). At boring 113-23, cyclohexane, methyl was detected in the two subsequent soil samples (the second and third sample) collected from depths of 24-26 feet bgs and 35-36.3 feet bgs (between 9 and 20 feet below the base of the landfill cell) at concentrations of 170 µg/kg and 180 µg/kg, respectively (showing only a slight increase in concentration with depth). This TIC, however, was not detected in the fourth or fifth subsurface sample collected at boring 113-23. In only two of the six soil samples where this compound was detected was it found with another compound. In the soil sample collected immediately below the base of the landfill cell at boring 113-27 a SVOC TIC (saturated hydrocarbon greater than C20) was detected at a concentration of 710 µg/kg. In the fourth subsurface soil sample collected from boring 113-22 a VOC (toluene) was also detected at a concentration of 4.8 J µg/kg.

Phenol, 4,4'-butylidenebis(2-(1,1-dimethylethyl) was detected in only one sample, at a concentration of 240 µg/kg the second subsurface soil sample collected at a depth of 27 to 29 feet bgs (approximately 11 to 13 feet below the base of the landfill cell) in boring 113-26 (Tables 4-37 and 4-39) (Figure 4-8). This TIC was not detected in the soil sample collected immediately above nor in the three subsurface samples collected below this sample interval at this boring location and was not detected in any other soil samples collected from Landfill No. 5. In addition, this was the only organic compound detected at this boring location.

Molecular Sulfur was found in the two subsurface soil samples collected immediately below the base of the landfill cell at boring 113-16 (Figure 4-9). The samples were collected at

depths of 45-46.9 and 50-50.9 feet bgs (between approximately 5 and 10 feet below the base of the landfill cell) with detected concentrations of 750 µg/kg and 190 µg/kg, respectively (Tables 4-37 and 4-39). This TIC was not detected below a depth of 50.9 feet bgs at this boring location or in any other soil collected from Landfill No. 5. This TIC was found with two VOC TICs (2-hexanone and 4-methyl-2-pentanone) in both subsurface soil samples. In addition, two semivolatile compounds (4-methylphenol and phenol) were also detected in the soil sample collected immediately below the base of the landfill cell at boring location 113-16.

Alpha.-Amyrin was detected in only one surface soil sample at a concentration of 140 µg/kg near boring 113-01. This TIC was not detected at depth at this location nor was it identified in any other soil at Landfill No. 5 (Tables 4-37 and 4-39) (Figure 4-7). The occurrence of this compound with other SVOCs and VOCs was described earlier in the discussion of 3-cyclohexene-1-methanol.,.alpha.,.alpha.4 trim.

Cyclopentanecarboxylic acid, 2-amino-, trans- was detected at a concentration of 200 µg/kg in only one subsurface soil sample collected at a depth of 55 to 57 feet bgs at boring 113-11 (Tables 4-37 and 4-39). This TIC was detected in the fourth subsurface sample collected below the landfill cell but was not found in the three samples collected above and the one sample collected below this sample interval in this boring (Figure 4-7). This TIC was not detected in any other soil collected from Landfill No. 5 No other organic compounds were detected in this soil sample.

Eicosanoic acid,2,3-bis(acetyloxy)propyl ester was detected at a concentration of 340 µg/kg in only one subsurface soil sample, the third sample) at a depth of 35 to 36.9 feet bgs (approximately 22 feet below the base of the landfill cell) at boring 113-09. (Tables 4-37 and 4-39) (Figure 4-10). This TIC was not identified in the two samples collected above or the two samples collected below this sample interval at this boring and this TIC was not detected in any other soil collected from Landfill No. 5. No other organics were detected in this soil sample or in any of the other soil samples collected from boring 113-09.

Stigmast-5-en-3-ol-, (3.beta.,24S) was detected in four surface samples collected near borings 113-01, 113-04, 113-07 and 113-10 (Figures 4-7, 4-8 and 4-10). Concentrations ranged from 280 to 350 µg/kg (Tables 4-37 and 4-39). At only one of these surface locations (113-04) was this TIC detected (concentration of 260 µg/kg) in the subsurface soil collected at a depth

of 45-47 feet bgs (approximately 30 feet below the base of the landfill cell). This TIC showed a slight decrease in concentration with depth (Figure 4-8). The four borings where stigmast-5-en-3-ol-, (3.beta.24S) was detected are all located on the eastern side of Landfill No. 5. No other occurrence of this TIC in subsurface soil was detected at Landfill No. 5. The two surface samples collected near borings 113-07 and 113-10 also detected toluene, saturated hydrocarbon TICs greater than C20 and TRPH. Toluene was detected in the surface sample collected near boring 113-04 while the subsurface sample collected at 113-04 had a detection of the saturated hydrocarbon TIC greater than C20 at a concentration of 340 µg/kg. The surface sample collected near boring 113-01 had detections of toluene, and saturated hydrocarbon TICs in addition to 2 additional SVOC TICs (3-cyclohexene-1-methanol,.alpha,.alpha,4-trim and .alpha.-amyrin) and one VOC TIC (bicyclo[2.2.1]heptan-2-one,1,3,3-trimethyl).

a'-Neogammacer--22(29)-en-3-ol,(3.beta.,24S) was detected at a concentration of 180 µg/kg in only one subsurface soil sample collected at a depth of 24-26 feet bgs immediately below the landfill cell at boring 113-07 (Tables 4-37 and 4-39) (Figure 4-10). This TIC was not detected in any other subsurface soil samples collected at this boring location or in any other soil collected from Landfill No. 5. No other organic compounds were detected in association with this compound or soil sample.

Volatile TICs

Bicyclo(2.2.1)heptan-2-one,1,3,3-trimethyl- was detected in only one surface sample (concentration of 11 µg/kg) collected near boring location 113-01 (Tables 4-38 and 4-39) (Figure 4-7). This TIC was found with four SVOC TICs, 3-Cyclohexene-1-methanol,.alpha.,.alpha.4-trim, stigmast-5-en-3-ol-,(3.beta,24S), .alpha-amyrin, saturated hydrocarbons greater than C20, and one VOC (toluene). This TIC was not detected in any of the subsurface soil samples collected from boring 113-01 or in any other soil samples collected from Landfill No. 5.

Benzene, 2-butentyl was found in only one subsurface sample (concentration of 570 µg/kg) collected at a depth of 27-29 feet bgs immediately below the base of the landfill cell at boring 113-13 (Tables 4-38 and 4-39) (Figure 4-10). This TIC was not detected in the four subsurface samples collected below this sample interval at this boring location or in any other

soil samples collected from Landfill No. 5. Two VOCs (ethylbenzene and styrene) and two SVOCs (acenaphthene and phenanthrene) were also associated with this TIC.

Acetic acid, ethyl ester was detected in 10 subsurface soil samples at five borings (113-05, 113-07, 113-10, 113-27, and 113-30) (Tables 4-38 and 4-39). This TIC was detected in one subsurface sample collected from borings 113-27 and 113-30 at concentrations of 33 µg/kg and 12 µg/kg, respectively (Figure 4-6). . Both these borings are located in the western portion of Landfill No. 5. Acetic acid, ethyl ester was also detected in three of the five subsurface samples collected (the second, third and fourth subsurface sample) between 10 and 30 feet below the base of the landfill cell at borings 113-05 and 113-10. At both borings (located in the northeast corner of Landfill No. 5) the concentrations detected in these subsurface samples showed an increase with depth from 13 µg/kg to 90 µg/kg (Figure 4-8). This TIC was not detected in the sample collected immediately below the landfill cell or in the bottommost sample collected from borings 113-05 and 113-10. Acetic acid, ethyl ester was also detected in the third and fifth subsurface sample collected (approximately 19 and 37 feet below the base of the landfill cell) at boring 113-07 (located in the northeast corner of Landfill No. 5). Concentrations were found at 110 and 6.5 µg/kg, respectively, showing a decrease in concentration with depth at this boring location (Figure 4-10). No other organic compounds were detected in the samples collected from boring 113-05 and 113-30 that had detections of acetic acid, ethyl ester. In the one sample collected from 113-27, the VOC TIC acetic acid, methyl ester was also detected. In boring 113-10 the second sample collected below the landfill cell had two VOCs (2-hexanone and 4-methyl-2-pentanone) detected and the fourth sample collected in boring 113-10 had a detection of the VOC toluene. The VOC acetonitrile was detected in the 5th sample collected below the landfill cell in boring 113-07.

Acetic acid, methyl ester was detected in only one surface and in only one subsurface sample collected in two borings 113-19 and 113-27, respectively (Figures 4-6 and 4-9). Acetic acid, methyl ester was detected at a concentration of 7.4 µg/kg in the surface soil sample collected near boring 113-19. The saturated hydrocarbon TIC greater than C20, TRPH and toluene were also detected in this surface soil sample. Acetic acid, methyl ester was detected at a concentration of 6.4 µg/kg in the third subsurface soil sample collected beneath the landfill cell (approximately 18 feet below the base of the landfill cell) at boring 113-27 (acetic acid, ethyl ester was also detected in this subsurface sample) (Tables 4-38 and 4-39). Acetic acid, methyl ester was not detected in any other soil collected from Landfill No. 5.

2-butene was detected in only one subsurface sample (the second subsurface sample collected in boring 113-10) at a concentration of 8.6 μg/kg from a depth of 34-35.3 feet bgs (approximately 10 feet below the base of the landfill) (Tables 4-38 and 4-39) (Figure 4-8). This TIC was not detected in the sample collected immediately below the landfill cell or in the three subsurface samples collected below this sample interval. This TIC was also not found in any other soils collected from Landfill No. 5. This TIC was found with two other VOC TICs (acetic acid, ethyl ester and 1-pentene,4,4-dimethyl-) and two VOCs (2-hexanone and 4-methyl-2-pentanone)..

1-pentene, 4,4-dimethyl was detected at a concentration of 6.7 μg/kg in only one subsurface sample (the second subsurface sample collected in boring 113-10) collected at a depth of 34 - 35.3 feet bgs (approximately 10 feet below the base of the landfill cell). This TIC was found with two other VOC TICs (acetic acid, ethyl ester and 2-butene) and two VOCs (2-hexanone and 4-methyl-2-pentanone). This TIC was not detected in the three subsurface samples collected below this sample interval in boring 113-10 nor was it found in any other soils collected from Landfill No. 5.

Nonanal was detected at concentrations of 8.2 μg/kg and 10 μg/kg in two subsurface soil samples collected in borings 113-04 and 113-05, respectively (Tables 4-38 and 4-39) (Figure 4-8). Nonanal was detected in the third subsurface sample collected from boring 113-04 (approximately 20 feet below the base of the landfill cell) and in the fifth sample collected from boring 113-05 (approximately 40 feet below the base of the landfill cell). This TIC was not detected in any other soil collected from these two borings nor was found in any other soil collected at Landfill No. 5. This TIC was found with the VOC, acetonitrile (16 J μg/kg), in the fifth subsurface sample collected from boring 113-05. Both borings are located near the eastern portion of Landfill No. 5.

Petroleum Related TICs

Petroleum related TICs identified in surface and subsurface samples were categorized into four chemical groups. Saturated hydrocarbons >C20, Saturated hydrocarbons in the range of C10-C20, Saturated hydrocarbons <C20 and Unsaturated Hydrocarbons. Concentrations of these TICs in soil at Landfill No. 5 ranged from 0.0078 mg/kg to 6.590 mg/kg. These

petroleum related TICs were commonly associated with TRPH detections in surface and subsurface samples collected during the Phase I RFI. The TIC concentrations were generally 1 to 2 orders of magnitude lower than the TRPH concentrations in samples from the same boring.

Saturated Hydrocarbons >C20 were found in seven surface soil samples collected near borings 113-01, 113-04, 113-07, 113-10, 113-16, 113-19, and 113-28 (Tables 4-37 and 4-38) (Figures 4- through 4-10) TRPH was also detected in 5 of these 7 surface samples (except the surface samples collected near borings 113-01 and 113-04) at concentrations ranging from 43.5 mg/kg to 85.6 mg/kg. Saturated hydrocarbon TIC concentrations were all reported below 1300 µg/kg (1.3 mg/kg) for these seven samples. Saturated hydrocarbon TICs >C20 were found at depth at only two of these surface sample locations.

Saturated hydrocarbon TICs between C10 and C20 were detected at low concentrations (less than 1.4 mg/kg) in two surface samples collected near borings 113-22 and 113-25. These two borings are located in the southwest area of Landfill No. 5. TRPH was also detected at a concentration of 51 mg/kg in the surface sample collected at boring 113-22 (Figure 4-8). At boring 113-25 the first, second, third and fourth samples collected below the landfill cell had reported concentrations of 0.5 mg/kg to 5.3 mg/kg of saturated hydrocarbons between C10 and C20 (Figure 4-8). Concentrations decreased with depth.

Saturated Hydrocarbons >C20 concentrations were detected in six subsurface samples collected from 6 borings (113-04, 113-05 113-08, 113-11, 113-17, 113-24). In borings 113-05, 113-11, 113-17 and 113-24, this TIC was found at concentrations between 4 and 7 mg/kg and was associated with TRPH concentrations ranging from 59.1 mg/kg to 170 mg/kg. These TIC detections were found in the subsurface samples collected either in the first or second subsurface sample beneath the landfill cell at each of the locations. At boring 113-11 saturated hydrocarbons between C10-C20 was also detected.

Saturated hydrocarbon concentrations >C20 and between C10 and C20 were also detected in the fourth subsurface samples collected in borings 113-04 and 113-08, respectively (Figures 4-7 and 4-8). The occurrence of these petroleum related TICs were both below 2 mg/kg and were not associated with detectable concentrations of TRPH.

Saturated hydrocarbon concentrations<C20 were detected in only one sample, the second subsurface sample collected below the base of the landfill cell at boring 113-24 at a concentration of 0.009 mg/kg. No other occurrence of this TIC was found in soil at Landfill No. 5

Unsaturated hydrocarbon TICs were identified in 3 subsurface samples collected from 3 borings (113-03, 113-10 and 113-04). Concentrations were all below 0.2 mg/kg.

4.5 LANDFILL WASTE MATERIAL

Landfill waste found in the cells at Landfill No. 5 included primarily domestic and construction wastes. Domestic waste included plastic, paper, aluminum foil, leaves and twigs and grass clippings, rubber, metal, glass, cardboard, aluminum and tin cans, string, carbonpaper, newspaper, styrofoam, rags, clothing, thread, and bottles. Construction debris included metal fragments and shavings, wood debris, asphalt, bricks, drywall, wire, fiberglass, insulation material, chain link fence, nails, duct tape, screen, steel, plywood, concrete and possible asbestos. It is important to note that liquid wastes or soil saturated with liquid waste were not encountered in the landfill material during the drilling and field logging of the landfill material. In addition, the trash observed was usually found intermixed with soil at each of the landfill cells. The intermixed soil and waste material in the landfill cells was typically dry but was occasionally noted to be moist or damp. Evidence of burned material was observed in 16 of the 34 borings drilled during the Phase I RFI.

Field screening using a photoionization detector (PID) was performed over the soil and waste cores obtained while drilling through the landfill material. Approximately 580 feet of landfill material was described and screened with a PID during the Phase I RFI. PID readings taken of the landfill material in 18 of the 32 borings drilled through landfill cells (113-01, 113-02, 113-07, 113-08, 113-09, 113-10, 113-11, 113-12, 113-15. 113-20, 113-21, 113-23, 113-24, 113-25, 113-26, 113-28, 113-29, and 113-30) (representing over half the footage drilled through landfill material and accounting for approximately 293 feet of material) were at background levels (ambient air). Of the remaining 14 borings (113-03, 113-04, 113-05, 113-06, 113-13, 113-14, 113-16, 113-17, 113-18, 113-19, 113-22, 113-27, 113-32 and 113-33) that encountered landfill material, PID readings were above background (ambient air) over a portion of at least one 5-foot core section of landfill material in the boring. Very seldom were

PID readings above background for the entire length of landfill material screened in a given boring.

Thirty-two PID readings above background were reported for cores of landfill waste material during the Phase I RFI and of these 32 PID readings 28 were below 25 ppm. The four remaining PID readings of landfill waste cores were above 25 ppm at only two boring locations. These locations were borings 113-06 and 113-13. PID readings at these borings ranged from 34 ppm to 102 ppm. Of the twelve borings with PID readings above background in cores of landfill waste material, nine of these borings did have at least one VOC reported as detected for subsurface soil samples collected beneath the landfill cell. Of these nine borings, 4 showed evidence of burned landfill material. It should be noted that VOCs were also detected in subsurface samples collected from 9 borings which did not exhibit PID readings above background in the landfill waste material.

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TABLE 4-1

MINIMUM, MAXIMUM, AND MEAN VALUES OF MAJOR ELEMENTS MEASURED IN SOIL SAMPLES AT LANDFILL NO. 5

Landfill No. 5 (SWMU NO. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

Element	Minimum (mg/kg)	Maximum (mg/kg)	Mean (mg/kg)	Established Background Range for Soils[1] at Cannon AFB (mg/kg)	Common Background Range[2] (mg/kg)
Calcium	6740	284,000	88,802	0 to 166119	7,000 to 500,000
Potassium	428	2,970	1,013	0 to 2,531	400 to 30,000
Sodium	113	3,920	603	0 to 834	750 to 7,500

[1] Source: Woodward-Clyde. 1994. Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater, Cannon AFB, New Mexico.

[2] Source: Lindsay, W.L., 1979. Chemical Equilibria in Soils. John Wily & Sons, N.Y., N.Y.

(mg/kg) = Milligrams per kilogram

TABLE 4-2
METALS RESULTS AND DETECTED CONCENTRATIONS FOR OTHER CHEMICAL COMPOUNDS
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

BORING 113-01

Chemical	Sample Interval (ft bgs)																		Background Range[1]
	0-.5			28-30			34-36			45-47			55-56.9			63-64.8			
	Results	Qual.	R.L.	Results	Qual.	R.L.	Results	Qual.	R.L.	Results	Qual.	R.L.	Results	Qual.	R.L.	Results	Qual.	R.L.	
Aluminum	4430		10.9	2240		21.8	3070		22.1	3220		10.8	2930		10.5	3200		10.8	596 - 10,796
Antimony		R			R			R			R			R			R		0 - 29.6
Arsenic	1.6		0.54	0.99		0.55	1.4		0.55	0.82		0.54	0.44	J	0.53	0.65		0.54	0 - 10.5
Barium	236	J	1.1	74	J	2.2	98.7	J	2.2	**5050**	J	1.1	83.2	J	1.1	119	J	1.1	0 - 548
Beryllium	0.34		0.22		U	0.44		U	0.44	0.15	J	0.22	0.12	J	0.21	0.13	J	0.22	0 - 0.6
Cadmium		U	0.54		UJ	1.1		UJ	1.1		U	0.54		U	0.53		U	0.54	0 - 2.1
Calcium	88300		21.7	**167000**		43.6	150000		44.2	71300		21.5	30900		21.1	75000		21.6	0 - 166,119
Chromium	3.3		1.1	2.6		2.2	1.8	J	2.2	2.2		1.1	3.7		1.1	5		1.1	0.8 - 12.0
Cobalt	2.1		1.1		U	2.2		U	2.2	2.7	J	1.1		UJ	1.1	1.3	J	1.1	0 - 4.0
Copper	3.8		2.2	2.2	J	4.4	2.4	J	4.4	1.1	J	2.2	1.5	J	2.1	**63.6**		2.2	0 - 10.1
Iron	3780		10.9	1410		21.8	1830		22.1	1780		10.8	1840		10.5	2150		10.8	0 - 8,564
Lead	6.1		1.1	2		0.55	2.2		0.55	1.6		0.54	1.3		0.53	1.8		0.54	0 - 18.4
Magnesium	2320		21.7	2300		43.6	4150		44.2	4890		21.5	4550		21.1	6280		21.6	0 - 9,912
Manganese	89.6	J	1.1	21.5	J	2.2	29.3	J	2.2	81.3	J	1.1	27.7	J	1.1	37.7	J	1.1	0 - 151.8
Mercury		U	0.11		U	0.11		U	0.11		U	0.11		U	0.11		U	0.11	0 - 0.2
Nickel	5.2		4.3	2.9	J	8.7	4.9	J	8.8	3.3	J	4.3	3.5	J	4.2	3.7	J	4.3	0 - 9.7
Potassium	1160		543	652	J	1090	686	J	1110	779		538	644		526	580		541	0 - 2,531
Selenium		UJ	1.1		UJ	1.1		UJ	1.1		UJ	1.1		UJ	1.1		UJ	1.1	0 - 36.8
Silver		U	1.1		U	2.2		U	2.2		U	1.1		U	1.1	0.41	J	1.1	0 - 1.8
Sodium		U	543		U	1090		U	1110		U	538		U	526		U	541	0 - 834
Thallium	0.14	J	1.1	0.15	J	1.1	0.15	J	1.1	0.23	J	1.1		U	0.53	0.15	J	1.1	0 - 6.2
Tin	NA			NA			NA			NA			NA			10.7	J	10.8	NA
Vanadium	13.4		1.1	7.9		2.2	18.3		2.2	5.7		1.1	5.7		1.1	10.1		1.1	1.7 - 25.0
Zinc	11.2		2.2	6.6		4.4	7.4		4.4	6		2.2	6		2.1	10.1		2.2	0 - 20.7
Acenaphthene		U	360		U	360		U	370		U	350		U	350	39	J	360	
bis(2-Ethylhexyl)phthalate		U	360		U	360		U	370		U	350		U	350	57	J	360	
Butyl benzyl phthalate		U	360		U	360	38	J	370		U	350		U	350		U	360	
Fluoranthene		U	360		U	360		U	370		U	350		U	350	67	J	360	
Fluorene		U	360		U	360		U	370		U	350		U	350	41	J	360	
Phenanthrene		U	360		U	360		U	370		U	350		U	350	130	J	360	
Phenol		U	360	360		360		U	370		U	350		U	350		U	360	
Pyrene		U	360		U	360		U	370		U	350		U	350	88	J	360	
Acetone		U	11	5.9	J	11		U	11		U	11		U	11	14		11	

(1) Woodward-Clyde 1994 Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater, Cannon AFB, New Mexico.

U = Not Detected J = Estimated Value UJ = Estimated Reporting Limit NA = Not Analyzed

Results that are shaded and in bold are concentrations above the maximum background range.

* Metals concentrations are in milligrams per kilogram (mg/kg), organic concentrations are in micrograms per kilogram (µg/kg)

TABLE 4-3
METALS RESULTS AND DETECTED CONCENTRATIONS FOR OTHER CHEMICAL COMPOUNDS
Landfill No. 5 (SWMU No. 113/IRP NO. LF-5) Phase I RFI
Cannon AFB, New Mexico

BORING 113-02

Chemical	Sample Interval (ft bgs)															Background Range[1]
	14-16			20-22			30-31.5			40-41.8			49-51			
	Results	Qual.	R.L.	Results	Qual.	R.L.	Results	Qual.	R.L.	Results	Qual.	R.L.	Results	Qual.	R.L.	
Aluminum	4630		22.9	**11100**		11.2	5560		22.2	4480		10.8	2480		10.5	596 - 10,796
Antimony		R			R			R			R			R		0 - 29.6
Arsenic	1.4		0.57	1.1		0.56	1		0.55	0.88		0.54	0.48	J	1	0 - 10.5
Barium	180	J	2.3	106	J	1.1	88.2	J	2.2	68.9	J	1.1	22.4	J	1	0 - 548
Beryllium	0.33	J	0.46	0.41		0.22		U	0.44	0.18	J	0.22		U	0.21	0 - 0.6
Cadmium		UJ	1.1		U	0.56		UJ	1.1		U	0.54		U	0.52	0 - 2.1
Calcium	**172000**		45.8	65200		22.3	121000		44.3	50600		21.6	22100		21	0 - 166,119
Chromium	2.8		2.3	7.2		1.1	3.9		2.2	4.9		1.1	1.5		1	0.8 - 12.0
Cobalt		U	2.3	2.3	J	1.1		U	2.2	1.3	J	1.1		UJ	1	0 - 4.0
Copper	3.3	J	4.6	3.7		2.2	2.1	J	4.4	1.8	J	2.2	0.98	J	2.1	0 - 10.1
Iron	3530		22.9	7060		11.2	3430		22.2	2950		10.8	1600		10.5	0 - 8,564
Lead	4.3		0.57	3.5		0.56	1.9		0.55	1.9		0.54	1.5		0.52	0 - 18.4
Magnesium	4970		45.8	4150		22.3	4480		44.3	3980		21.6	2950		21	0 - 9,912
Manganese	46.3	J	2.3	53.8	J	1.1	35.8	J	2.2	34.8	J	1.1	28.8	J	1	0 - 151.8
Mercury		U	0.11		U	0.11		U	0.11		U	0.11		U	0.1	0 - 0.2
Nickel	6	J	9.2	8.5		4.5	6.4	J	8.9	4.8		4.3	2.3	J	4.2	0 - 9.7
Potassium	1530		1140	**2550**		558	977	J	1110	912		539	689		524	0 - 2,531
Selenium		UJ	1.1		UJ	1.1		UJ	1.1		UJ	1.1		UJ	1	0 - 36.8
Silver		U	2.3		U	1.1		U	2.2		U	1.1		U	1	0 - 1.8
Sodium		U	1140		U	558		U	1110		U	539		U	524	0 - 834
Thallium	0.19	J	1.1	0.17	J	1.1	0.12	J	1.1	0.16	J	1.1	0.18	J	0.52	0 - 6.2
Tin	NA			NA			NA			NA			NA	U	10.5	NA
Vanadium	14.3		2.3	13.9		1.1	12		2.2	14.8		1.1	4.8		1	1.7 - 25.0
Zinc	10.4		4.6	18		2.2	10.8		4.4	8.9		2.2	5.6		2.1	0 - 20.7
Acetone		U	11	5.1	J	11		U	11		U	11		U	10	

(1) Woodward-Clyde. 1994. Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater, Cannon AFB, New Mexico.

U = Not Detected J = Estimated Value UJ = Estimated Reporting Limit NA = Not Analyzed

Results that are shaded and in bold are concentrations above the maximum background range.

* Metals concentrations are in milligrams per kilogram (mg/kg), organic concentrations are in micrograms per kilogram (µg/kg)

TABLE 4-4
METALS RESULTS AND DETECTED CONCENTRATIONS FOR OTHER CHEMICAL COMPOUNDS
Landfill No. 5/SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

BORING 113-03

Chemical	Sample Interval (ft bgs)															Background Range[1]
	23-25			28-30			40-42			50-51.4			58-59.9			
	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	
Aluminum	6910		52.5	5430		21.2	3970		10.7	2040		10.3	2340		10.4	596 - 10,796
Antimony		U	31.5		U	12.7		U	6.4		U	6.2		U	6.2	0 - 29.6
Arsenic	1.4		0.52	1.1		0.53	0.9		0.53	0.58		0.52	0.27	J	0.52	0 - 10.5
Barium	167		5.2	104		2.1	45.4		1.1	130		1	25.3		1	0 - 548
Beryllium		U	1		U	0.42		U	0.21		U	0.21		U	0.21	0 - 0.6
Cadmium		U	2.6		U	1.1		U	0.53		U	0.52		U	0.52	0 - 2.1
Calcium	**222000**	J	105	**177000**	J	42.5	63200	J	21.4	68900	J	20.7	31300	J	20.8	0 - 166,119
Chromium	5.5		5.2	2.6		2.1	3.1		1.1	1.7		1	1.8		1	0.8 - 12.0
Cobalt		U	5.2		U	2.1	1.1		1.1	0.73	J	1	0.7	J	1	0 - 4.0
Copper	3.9	J	10.5	2.2	J	4.2	1.1	J	2.1	0.84	J	2.1	0.56	J	2.1	0 - 10.1
Iron	4890		52.5	3330		21.2	2360		10.7	1190		10.3	1430		10.4	0 - 8,564
Lead	2.8		0.52	2.4		0.53	2		0.53	1.3		0.52	1.4		0.52	0 - 18.4
Magnesium	5210	J	105	3860	J	42.5	4200	J	21.4	4050	J	20.7	4120	J	20.8	0 - 9,912
Manganese	52.7		5.2	37.4		2.1	25.1		1.1	21.6		1	25.5		1	0 - 151.8
Mercury		U	0.1		U	0.11		U	0.11		U	0.1		U	0.1	0 - 0.2
Nickel	**22.4**	J	21	5.2	J	8.5	3.9	J	4.3	3.5	J	4.1	2.7	J	4.2	0 - 9.7
Potassium	1460	J	2620	1160		1060	753		534	526		517	518	J	520	0 - 2,531
Selenium		UJ	1		UJ	1.1		UJ	2.1		UJ	1		UJ	1	0 - 36.8
Silver		UJ	5.2		UJ	2.1		UJ	1.1		UJ	1		UJ	1	0 - 1.8
Sodium		U	2620		U	1060		U	534		U	517		U	520	0 - 834
Thallium	0.15	J	1		UJ	1.1	0.16	J	1.1		UJ	1		UJ	0.52	0 - 6.2
Tin	NA			NA			NA			NA			NA	U	10.4	NA
Vanadium	11.9		5.2	14.7		2.1	16.3		1.1	5		1	5.7		1	1.7 - 25.0
Zinc	13.9		10.5	9.9		4.2	6.3		2.1	3.6		2.1	4.2		2.1	0 - 20.7
bis(2-Ethylhexyl)phthalate		U	350		U	350		U	350		U	340	160	J	340	
Acetone		U	10		U	11	4.7	J	11		U	10		U	10	

(1) Woodward-Clyde. 1994. Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater, Cannon AFB, New Mexico.

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* Metals concentrations are in milligrams per kilogram (mg/kg), organic concentrations are in micrograms per kilogram (µg/kg)

TABLE 4-5
METALS RESULTS AND DETECTED CONCENTRATIONS FOR OTHER CHEMICAL COMPOUNDS
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

BORING 113-04

Chemical	Sample Interval (ft bgs)																		Background Range[1]
	0-.5			20-22			25-27			35-36.3			45-47			55-57			
	Result	Qual.	R.L.	Result	Qual	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual	R.L.	
Aluminum	10100		10.7	4960		21.7	4680		21.6	5080		22.9	4460		10.6	3980		10.7	596 - 10,796
Antimony		R		13	J	13	11.8	J	13		UJ	13.7		UJ	6.4		UJ	6.4	0 - 29.6
Arsenic	2.9		1.1	2.1		0.54	1.8		0.54	1.5		0.57	0.78		0.53	0.59		0.54	0 - 10.5
Barium	146	J	1.1	92.4		2.2	134		2.2	258		2.3	175		1.1	48.2		1.1	0 - 548
Beryllium	**0.7**		0.21	0.27	J	0.43	0.23	J	0.43		U	0.46	0.18	J	0.21	0.17	J	0.21	0 - 0.6
Cadmium		U	0.53		U	1.1		U	1.1		U	1.1		U	0.53		U	0.54	0 - 2.1
Calcium	30200		21.4	129000	J	43.4	135000	J	43.3	159000	J	45.8	50100	J	21.3	54700		21.5	0 - 166,119
Chromium	9.8		1.1	6.2		2.2	3.8		2.2	4.9		2.3	2.7		1.1	3		1.1	0.8 - 12.0
Cobalt	**5**		1.1		U	2.2		U	2.2		U	2.3	1.3		1.1		U	1.1	0 - 4.0
Copper	10		2.1	2.8	J	4.3	2.2	J	4.3	3.4	J	4.6	1.7	J	2.1	1.7	J	2.1	0 - 10.1
Iron	**9610**		10.7	4340		21.7	3580		21.6	2830		22.9	2930		10.6	2520		10.7	0 - 8,564
Lead	10		1.1	3	J	0.54	2.9	J	0.54	2.2	J	0.57	2	J	0.53	1.9		0.54	0 - 18.4
Magnesium	2870		21.4	3060	J	43.4	3380	J	43.3	**13800**	**J**	45.8	5580	J	21.3	7430		21.5	0 - 9,912
Manganese	**275**	**J**	1.1	34		2.2	45.3		2.2	32.5		2.3	33.5		1.1	29		1.1	0 - 151.8
Mercury		U	0.11		U	0.11		U	0.11		U	0.11		U	0.11		U	0.11	0 - 0.2
Nickel	9.3		4.3	**10.4**		8.7	7.2	J	8.7	7.8	J	9.2	2.6	J	4.3	3.5	J	4.3	0 - 9.7
Potassium	**2970**		535	1330		1080	970	J	1080	770	J	1140	1030		531	744		537	0 - 2,531
Selenium		UJ	5.3		UJ	2.2		UJ	1.1		UJ	1.1		UJ	1.1		UJ	1.1	0 - 36.8
Silver		U	1.1		U	2.2		U	2.2		U	2.3		U	1.1		U	1.1	0 - 1.8
Sodium		U	535		U	1080	244	J	1080		U	1140		U	531		U	537	0 - 834
Thallium		U	0.53	0.12	J	1.1		U	2.2		U	5.7		U	1.1	0.12	J	1.1	0 - 6.2
Tin	NA			NA			NA			NA			NA			NA	U	10.7	NA
Vanadium	24		1.1	16.4		2.2	16		2.2	17		2.3	6.6		1.1	9.3		1.1	1.7 - 25.0
Zinc	**28.2**		2.1	9.5		4.3	9.3		4.3	7.7		4.6	7.6		2.1	6.9		2.1	0 - 20.7
bis(2-Ethylhexyl)phthalate		U	350		U	360	86	J	360	52	J	380		U	350		U	350	
Diethyl phthalate	45	J	350		U	360		U	360		U	380		U	350		U	350	
Acetone	3.7	J	11	6.3	J	11	6.2	J	11		U	11	5.6	J	11	8.3	J	11	
Methylene chloride		U	5.3		U	5.4	1.2	J	5.4	3.3	J	5.7	1.1	J	5.3		U	5.4	
Toluene	1.3	J	5.3		U	5.4		U	5.4		U	5.7		U	5.3		U	5.4	

(1) Woodward-Clyde. 1994. Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater, Cannon AFB, New Mexico.

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* Metals concentrations are in milligrams per kilogram (mg/kg), organic concentrations are in micrograms per kilogram (µg/kg)

TABLE 4-6
METALS RESULTS AND DETECTED CONCENTRATIONS FOR OTHER CHEMICAL COMPOUNDS
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

BORING 113-05

Chemical	Sample Interval (ft bgs)															Background Range[1]
	24.5-26.5			29.5-31.5			39.5-40.3			49.5-51			59.5-60.8			
	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual	R.L.	Result	Qual.	R.L.	
Aluminum	3400		21.8	3280		21.8	5640		21.6	3530		10.4	3420		10.4	596 - 10,796
Antimony		UJ	13.1		UJ	13.1	11.2	J	12.9		UJ	6.2		UJ	6.2	0 - 29.6
Arsenic	1.6		0.55	1		0.55	1.2		0.54	0.59		0.52	0.67		0.52	0 - 10.5
Barium	194		2.2	501		2.2	520		2.2	47.5		1	103		1	0 - 548
Beryllium	0.22	J	0.44		U	0.44		U	0.43	0.13	J	0.21	0.14	J	0.21	0 - 0.6
Cadmium		U	1.1		U	1.1		U	1.1		U	0.52		U	0.52	0 - 2.1
Calcium	146000	J	43.6	**204000**	J	43.6	144000	J	43.1	42300	J	20.7	51700		20.8	0 - 166,119
Chromium	9.9		2.2	4.8		2.2	**29.4**		2.2	5.1		1	10.7		1	0.8 - 12.0
Cobalt	1.9	J	2.2	1.9	J	2.2	1.8	J	2.2	1.3		1	1.4		1	0 - 4.0
Copper	5.3		4.4	2.7	J	4.4	2.8	J	4.3	1.9	J	2.1	3		2.1	0 - 10.1
Iron	4800		21.8	1930	J	21.8	3650		21.6	2630		10.4	2870		10.4	0 - 8,564
Lead	3.5	J	0.55	1.4	J	0.55	1.8	J	0.54	1.9	J	0.52	2.5		0.52	0 - 18.4
Magnesium	3170	J	43.6	5930	J	43.6	8000	J	43.1	4240	J	20.7	5050		20.8	0 - 9,912
Manganese	57		2.2	18.6		2.2	40.9		2.2	35.4		1	42.9		1	0 - 151.8
Mercury		U	0.11		U	0.11		U	0.11		U	0.1		U	0.1	0 - 0.2
Nickel	**392**		8.7	7.2	J	8.7	5.9	J	8.6	4.1		4.1	4.7		4.2	0 - 9.7
Potassium	824	J	1090	428	J	1090	1030	J	1080	868		518	705		520	0 - 2,531
Selenium		UJ	1.1		UJ	1.1		UJ	2.2		UJ	1		UJ	2.1	0 - 36.8
Silver		U	2.2		U	2.2		U	2.2		U	1	1.1		1	0 - 1.8
Sodium		U	1090		U	1090		U	1080		U	518		U	520	0 - 834
Thallium		U	1.1		U	1.1		U	1.1		U	1		R		0 - 6.2
Tin	NA			NA			NA			NA			NA	U	10.4	NA
Vanadium	13		2.2	16.5		2.2	10.9		2.2	6.6		1	9.2		1	1.7 - 25.0
Zinc	**46.7**		4.4	6.5		4.4	9.4		4.3	6.7		2.1	7.4		2.1	0 - 20.7
bis(2-Ethylhexyl)phthalate	260	J	360	76	J	360	78	J	360		U	340		U	340	
Butyl benzyl phthalate	170	J	360		U	360	36	J	360		U	340		U	340	
Di-n-octyl phthalate	160	J	360		U	360		U	360		U	340		U	340	
2-Butanone (MEK)		U	11	21		11		U	11		U	10		U	10	
2-Hexanone		U	11	1.9	J	11		U	11		U	10		U	10	
Acetone	12		11	98		11	34		11	8.1	J	10	18		10	
Acetonitrile													16	J	210	
Total Petroleum Hydrocarbons	79.1		43.6		U	43.6		U	43.1		U	41.5		U	41.6	

(1) Woodward-Clyde. 1994. Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater, Cannon AFB, New Mexico.

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Results that are shaded and in bold are concentrations above the maximum background range.

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TABLE 4-7
METALS RESULTS AND DETECTED CONCENTRATIONS FOR OTHER CHEMICAL COMPOUNDS
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

BORING 113-06

Chemical	Sample Interval (ft bgs)															Background Range[1]
	2-21.9			25-27			35-37			45-47			55-57.5			
	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	
Aluminum	5310	J	56.6	6210	J	10.9	5190	J	10.8	3640	J	10.5	2310	J	10.5	596 - 10,796
Antimony		UJ	33.9		UJ	6.5		UJ	638		UJ	6.3		UJ	6.3	0 - 29.6
Arsenic	2.8		0.57	2.4		0.54	2.2		0.54	1.8		0.53	0.82		0.53	0 - 10.5
Barium	177	J	5.7	141	J	1.1	15.8	J	1.1	58.4	J	1.1	58.8	J	1.1	0 - 548
Beryllium		U	1.1	0.37		0.22	0.25		0.22	0.14	J	0.21	0.12	J	0.21	0 - 0.6
Cadmium		U	2.8		U	0.54		U	0.54		U	0.53		U	0.53	0 - 2.1
Calcium	**251000**	J	113	33500	J	21.7	37100	J	21.5	53900	J	21.1	47900	J	21	0 - 166,119
Chromium		U	5.7	4.7		1.1	3.6		1.1	6.4		1.1	11.4		1.1	0.8 - 12.0
Cobalt		U	5.7	1.5		1.1	1.1		1.1	0.88	J	1.1		U	1.1	0 - 4.0
Copper	**27.5**		11.3	4.5		2.2	2.3		2.2	2.5		2.1	2.4		2.1	0 - 10.1
Iron	4420	J	56.6	4650	J	10.9	3270	J	10.8	2420	J	10.5	1680	J	10.5	0 - 8,564
Lead	4.8		1.1	3.7		0.54	2.7		0.54	1.8		0.53	1.5		0.53	0 - 18.4
Magnesium	5940	J	113	3070	J	21.7	2710	J	21.5	2540	J	21.1	2520	J	21	0 - 9,912
Manganese	29.5	J	5.7	8	J	1.1	42.2	J	1.1	30.8	J	1.1	26.7	J	1.1	0 - 151.8
Mercury		U	0.11		U	0.11		U	0.11		U	0.11		U	0.11	0 - 0.2
Nickel	**10.7**	J	22.6	6.3		4.3	4.1	J	4.3	4	J	4.2	3.2	J	4.2	0 - 9.7
Potassium	1860	J	2830	1830		543	1210		538	799		526	564		526	0 - 2,531
Selenium		UJ	1.1		UJ	1.1		UJ	1.1		UJ	1.1		UJ	1.1	0 - 36.8
Silver		U	5.7	0.35	J	1.1		U	1.1		U	1.1		U	1.1	0 - 1.8
Sodium		U	2830		U	543		U	538		U	526		U	526	0 - 834
Thallium	0.17	J	1.1	0.17	J	0.54	0.19	J	0.54	0.12	J	0.53	0.23	J	0.53.	0 - 6.2
Tin														U	10.5	NA
Vanadium	**25.5**		5.7	17.8		1.1	13.9		1.1	10		1.1	7.9		1.1	1.7 - 25.0
Zinc	16.4		11.3	13.9		2.2	9		2.2	7.4		2.1	5.4		2.1	0 - 20.7
bis(2-Ethylhexyl)phthalate		U	370		U	360	57	J	350		U	350		U	350	
Di-n-octyl phthalate		U	370		U	360	330	J	350		U	350		U	350	
Acetone		U	11	5.1	J	11		U	11		U	11	7.9	J	11	
Carbon disulfide		U	5.7	2.9	J	5.4		U	5.4		U	5.3		U	5.3	
Methylene chloride		U	5.7		U	5.4	2.1	J	5.4		U	5.3		U	5.3	

(1) Woodward-Clyde. 1994. Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater, Cannon AFB, New Mexico.

U = Not Detected J = Estimated Value UJ = Estimated Reporting Limit NA = Not Analyzed

Results that are shaded and in bold are concentrations above the maximum background range.

* Metals concentrations are in milligrams per kilogram (mg/kg), organic concentrations are in micrograms per kilogram (µg/kg)

TABLE 4-8
METALS RESULTS AND DETECTED CONCENTRATIONS FOR OTHER CHEMICAL COMPOUNDS
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

BORING 113-07

Chemical	Sample Interval (ft bgs)																		Background Range[1]
	0-.5			24-26			29-30.8			39-41			49-51			59-60.9			
	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	
Aluminum	7240		10.3	5110		10.8	4610		22	5440		10.9	3010		10.5	2820		10.6	596 - 10,796
Antimony		R			U	6.5		U	13.2		U	6.5		U	6.3		UJ	6.3	0 - 29.6
Arsenic	2.4		0.51	1.6		0.54	0.41	J	0.55	1.4		0.54	1		0.53	0.49	J	0.53	0 - 10.5
Barium	138	J	1	42.1	J	1.1	134	J	2.2	75.2	J	1.1	75.1	J	1.1	82.9		1.1	0 - 548
Beryllium	0.44		0.21	0.33		0.22	0.24	J	0.44	0.25		0.22	0.16	J	0.21		U	0.21	0 - 0.6
Cadmium		U	0.51		U	0.54		U	1.1		U	0.54		U	0.53		U	0.53	0 - 2.1
Calcium	73200		20.6	22900		21.7	158000		44	83800		21.8	59900		21.1	46000		21.2	0 - 166,119
Chromium	6.4		1	6		1.1	4.7		2.2	7.8		1.1	5.7		1.1	11.7		1.1	0.8 - 12.0
Cobalt	3.5		1	2.3		1.1		U	2.2	1.9		1.1		U	1.1	1.2		1.1	0 - 4.0
Copper	5.7		2.1	3.7		2.2	3.2	J	4.4	2.6		2.2	2	J	2.1	2.1		2.1	0 - 10.1
Iron	6600		10.3	4610		10.8	3360		22	4190		10.9	2630		10.5	2680		10.6	0 - 8,564
Lead	6.9		1	3.9		0.54	3.3		0.55	3		0.54	2.3		0.53	1.7		0.53	0 - 18.4
Magnesium	2070		20.6	2240		21.7	3770		44	4430		21.8	2500		21.1	3510		21.2	0 - 9,912
Manganese	113	J	1	82.3	J	1.1	37.5	J	2.2	53.4	J	1.1	27.6	J	1.1	43.3		1.1	0 - 151.8
Mercury		U	0.1		U	0.11		U	0.11		U	0.11		U	0.11		U	0.11	0 - 0.2
Nickel	7.5		4.1	**46.2**		4.3	6.7	J	8.8	4.9		4.4	3	J	4.2	2.2	J	4.2	0 - 9.7
Potassium	1550		515	1420		542	830	J	1100	980		544	799		527	630		529	0 - 2,531
Selenium		UJ	1		UJ	0.54		UJ	1.1		UJ	0.54		UJ	0.53		UJ	0.53	0 - 36.8
Silver		U	1		U	1.1		U	2.2		U	1.1		U	1.1		U	1.1	0 - 1.8
Sodium		U	515	135	J	542		U	1100		U	544		U	527		U	529	0 - 834
Thallium		U	2.1		UJ	1.1	0.22	J	2.2		UJ	2.2		UJ	2.1	0.11	J	1.1	0 - 6.2
Tin	NA			NA			NA			NA			NA			NA	U	10.6	NA
Vanadium	16		1	12.1		1.1	9.4		2.2	18.8		1.1	6.8		1.1	8.2		1.1	1.7 - 25.0
Zinc	17.7		2.1	**23.4**		2.2	9.1		4.4	9.6		2.2	5.9		2.1	5.9		2.1	0 - 20.7
bis(2-Ethylhexyl)phthalate		U	340	500		360	43	J	360	590		360	430		350		U	350	
Acetone		U	10	4.3	J	11	6.3	J	11		U	11	3.9	J	11		U	11	
Acetonitrile																33	J	210	
Methylene chloride		U	5.1		U	5.4		U	5.5		U	5.4		U	5.3	2.2	J	5.3	
Toluene	3.8	J	5.1		U	5.4		U	5.5		U	5.4		U	5.3		U	5.3	
Sulfide, Total																0.57		0.53	
Total Petroleum Hydrocarbons	66.5		41.2		U	43.3		U	44		U	43.5		U	42.2		U	42.3	

(1) Woodward-Clyde. 1994. Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater, Cannon AFB, New Mexico.

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Results that are shaded and in bold are concentrations above the maximum background range.

* Metals concentrations are in milligrams per kilogram (mg/kg), organic concentrations are in micrograms per kilogram (µg/kg)

TABLE 4-9
METALS RESULTS AND DETECTED CONCENTRATIONS FOR OTHER CHEMICAL COMPOUNDS
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

BORING 113-08

Chemical	Sample Interval (ft bgs)															Background Range(1)
	20-22			25-27			35-35.9			45-47			55-57			
	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	
Aluminum	5070	J	10.9	4630	J	11.7	4520	J	11.1	4250	J	10.8	3070		10.7	596 - 10,796
Antimony	5.8	J	6.5		UJ	7		UJ	6.6		UJ	6.5		UJ	6.4	0 - 29.6
Arsenic	3.7		0.54	3.3		0.59	1.2		0.55	0.83		0.54	0.66		0.53	0 - 10.5
Barium	274	J	1.1	96.3	J	1.2	147	J	1.1	285	J	1.1	38.2		1.1	0 - 548
Beryllium	0.37		0.22	0.28		0.23	0.16	J	0.22	0.13	J	0.22	0.15	J	0.21	0 - 0.6
Cadmium		U	0.54		U	0.59		U	0.55		U	0.54		U	0.53	0 - 2.1
Calcium	71800		21.8	77700		23.4	105000		22.1	43100		21.6	46500		21.3	0 - 166,119
Chromium	5.8		1.1	5.2		1.2	3.6		1.1	4.1		1.1	2.6		1.1	0.8 - 12.0
Cobalt	2.4		1.1	2.2		1.2	1.5		1.1	1.3		1.1	1.5		1.1	0 - 4.0
Copper	3.8		2.2	2.8		2.3	1.8	J	2.2	2.3		2.2	1.3	J	2.1	0 - 10.1
Iron	5050	J	10.9	4070	J	11.7	2770	J	11.1	2530	J	10.8	1940		10.7	0 - 8,564
Lead	4.5		0.54	3.5		0.59	2		1.1	1.6		1.1	2		0.53	0 - 18.4
Magnesium	2810	J	21.8	2710		23.4	7570		22.1	7230		21.6	5510		21.3	0 - 9,912
Manganese	82.3		1.1	54	J	1.2	29.8	J	1.1	30.6	J	1.1	38.2		1.1	0 - 151.8
Mercury		U	0.11		U	0.12		U	0.11		U	0.11		U	0.11	0 - 0.2
Nickel	7.4		4.4	7.1		4.7	4.3	J	4.4	5.4		4.3	3.5	J	4.3	0 - 9.7
Potassium	1510		545	1310		586	759		553	975		539	680		533	0 - 2,531
Selenium		UJ	1.1		UJ	1.2		UJ	1.1		UJ	1.1		UJ	1.1	0 - 36.8
Silver		UJ	1.1		UJ	1.2		UJ	1.1		UJ	1.1		U	1.1	0 - 1.8
Sodium	218	J	545	159	J	586		U	553		U	539		U	533	0 - 834
Thallium	0.22	J	2.2		UJ	2.3		UJ	2.2		UJ	2.2		R		0 - 6.2
Tin	NA			NA			NA			NA			NA	U	10.7	NA
Vanadium	**33.5**		1.1	**27.7**		1.2	21.4		1.1	8		1.1	6		1.1	1.7 - 25.0
Zinc	10.8		2.2	9		2.3	7.2		2.2	6.6		2.2	5		2.1	0 - 20.7
bis(2-Ethylhexyl)phthalate	400		360	410		390	420		370	440		360		U	350	
Acetone	8.5	J	11	8.2	J	12		U	11		U	11	7.4	J	11	
Acetonitrile													67	J	210	

(1) Woodward-Clyde. 1994. Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater, Cannon AFB, New Mexico.

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Results that are shaded and in bold are concentrations above the maximum background range.

* Metals concentrations are in milligrams per kilogram (mg/kg), organic concentrations are in micrograms per kilogram (µg/kg)

TABLE 4-10
METALS RESULTS AND DETECTED CONCENTRATIONS FOR OTHER CHEMICAL COMPOUNDS
Landfill No. 5 (SWMU No. 13/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

BORING 113-09

Chemical	Sample Interval (ft bgs)															Background Range[1]
	18-20			25-26.5			35-36.9			45-47			53-54.3			
	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	
Aluminum	4450		21.8	3490		21.5	3440		21.5	2250		10.5	3620		10.7	596 - 10,796
Antimony		U	13.1		U	12.9		U	12.9		U	6.3		U	6.4	0 - 29.6
Arsenic	1.9		0.55	1.4		0.54	1.5		0.54	0.44	J	0.53	0.57		0.53	0 - 10.5
Barium	128		2.2	87.8		2.1	121		2.2	240		1.1	48.2		1.1	0 - 548
Beryllium	0.32	J	0.44		U	0.43		U	0.43		U	0.21		U	0.21	0 - 0.6
Cadmium		U	1.1		U	1.1		U	1.1		U	0.53		U	0.53	0 - 2.1
Calcium	152000	J	43.7	98400	J	42.9	114000	J	43.1	49000	J	21	96200	J	21.3	0 - 166,119
Chromium	3.8		2.2	3.1		2.1	2.9		2.2	1.7		1.1	6.1		1.1	0.8 - 12.0
Cobalt		U	2.2		U	2.1		U	2.2	0.84	J	1.1	1.5		1.1	0 - 4.0
Copper	2.4	J	4.4	2.2	J	4.3		U	4.3	0.89	J	2.1	1.7	J	2.1	0 - 10.1
Iron	3540		21.8	2530		21.5	2190		21.5	1710		10.5	2360		10.7	0 - 8,564
Lead	2.8		0.55	6		0.54	2.5		0.54	1.5		0.53	1.7		0.53	0 - 18.4
Magnesium	3910	J	43.7	2440	J	42.9	3460	J	43.1	2040	J	21	4680	J	21.3	0 - 9,912
Manganese	30.3		2.2	31.4		2.1	29.1		2.2	22.2		1.1	32.8		1.1	0 - 151.8
Mercury		U	0.11		U	0.11		U	0.11		U	0.11		U	0.11	0 - 0.2
Nickel	4.7	J	8.7	5.7	J	8.6	2.8	J	8.6	3.5	J	4.2	4.2	J	4.3	0 - 9.7
Potassium	1060	J	1090	701	J	1070	541	J	1080	553		526	678		534	0 - 2,531
Selenium		UJ	1.1		UJ	1.1		UJ	1.1		UJ	1.1		UJ	1.1	0 - 36.8
Silver		UJ	2.2	0.61	J	2.1		UJ	2.2		UJ	1.1		UJ	1.1	0 - 1.8
Sodium		U	1090		U	1070		U	1080		U	526		U	534	0 - 834
Thallium		UJ	1.1	0.17	J	0.54	0.15	J	0.54	0.18	J	1.1	0.16	J	1.1	0 - 6.2
Tin	NA			NA			NA			NA			56		10.7	NA
Vanadium	9.9		2.2	8.1		2.1	11		2.2	6.3		1.1	11.7		1.1	1.7 - 25.0
Zinc	8.4		4.4	6.5		4.3	5.6		4.3	4.8		2.1	6.7		2.1	0 - 20.7
bis(2-Ethylhexyl)phthalate	73	J	360	75	J	350	190	J	360		U	350		U	350	
2-Butanone (MEK)		U	11		U	11	3.6	J	11		U	11		U	11	
Acetone		U	11		U	11	5	J	11		U	11		U	11	

(1) Woodward-Clyde. 1994. Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater, Cannon AFB, New Mexico.

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TABLE 4-11
METALS RESULTS AND DETECTED CONCENTRATIONS FOR OTHER CHEMICAL COMPOUNDS
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

BORING 113-10

Chemical	Sample Interval (ft bgs)																		Background Range[1]
	0-.5			29.5-31			34-35.3			44-46			54-55			64-65			
	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	
Aluminum	7260		10.4	4650		22	5350		21	4310		10.4	4030		10.2	3620		10.4	596 - 10,796
Antimony		R			UJ	13.2		UJ	12.6		UJ	6.2		UJ	6.1		UJ	6.3	0 - 29.6
Arsenic	1.9		0.52	0.78		0.55	1.3		0.53	0.78		0.52	0.71		0.51	0.84		0.52	0 - 10.5
Barium	169	J	1	110		2.2	**595**		2.1	59.5		1	81		1	70.3		1	0 - 548
Beryllium	0.49		0.21		U	0.44		U	0.42	0.16	J	0.21	0.14	J	0.2	0.14	J	0.21	0 - 0.6
Cadmium		UJ	0.52		UJ	1.1		UJ	1.1		UJ	0.52		UJ	0.51		UJ	0.52	0 - 2.1
Calcium	44600		20.8	130000	J	44.1	149000	J	42	58200	J	20.7	43200	J	20.4	88500		20.9	0 - 166,119
Chromium	6.4		1	8		2.2	**40.7**		2.1	7		1	6.8		1	**30.7**		1	0.8 - 12.0
Cobalt	3.5		1	2	J	2.2	2.5		2.1	1.1		1	0.9	J	1	1.2		1	0 - 4.0
Copper	6.4		2.1	2.2	J	4.4	6.4		4.2	2	J	2.1	1.9	J	2	3.3		2.1	0 - 10.1
Iron	6550		10.4	3090		22	**9580**		21	3140		10.4	2910		10.2	3240		10.4	0 - 8,564
Lead	7.3		0.52	2	J	0.55	2	J	0.53	1.7	J	0.52	1.7	J	0.51	1.8		0.52	0 - 18.4
Magnesium	2080		20.8	4970	J	44.1	7200	J	42	5370	J	20.7	5570	J	20.4	8060		20.9	0 - 9,912
Manganese	142	J	1	33.1		2.2	69.3		2.1	37.4		1	42.1		1	47.6		1	0 - 151.8
Mercury		U	0.1		U	0.11		U	0.11		U	0.1		U	0.1		U	0.1	0 - 0.2
Nickel	7.4		4.2	**18.4**		8.8	**30.2**		8.4	4.1		4.1	4.5		4.1	5.2		4.2	0 - 9.7
Potassium	1700		520	687	J	1100	957	J	1050	966		518	832		511	600		521	0 - 2,531
Selenium		UJ	2.1		UJ	1.1		UJ	5.3		UJ	1		UJ	1		UJ	1	0 - 36.8
Silver		U	1		U	2.2		U	2.1		U	1		U	1	0.45	J	1	0 - 1.8
Sodium		U	520		U	1100		U	1050		U	518		U	511		U	521	0 - 834
Thallium		U	1		U	1.1		U	2.1	0.1	J	1		U	1		R		0 - 6.2
Tin	NA			NA			NA			NA			NA			NA	U	10.4	NA
Vanadium	16.7		1	17.4		2.2	14.2		2.1	8.8		1	9.7		1	12		1	1.7 - 25.0
Zinc	19.2		2.1	10.1		4.4	14.3		4.2	8.7		2.1	8.6		2	8.1		2.1	0 - 20.7
2-Butanone (MEK)	1.4	J	10		U	11		U	11		U	10		U	10		U	10	
2-Hexanone		U	10		U	11	1.6	J	11		U	10		U	10		U	10	
4-Methyl-2-pentanone (MIBK)		U	10		U	11	6.4	J	11		U	10		U	10		U	10	
Acetone	3.7	J	10		U	11	37		11	7.8	J	10	9.2	J	10	41		10	
Methylene chloride		U	5.2		U	5.5		U	5.3		U	5.2		U	5.1	1.3	J	5.2	
Toluene	4.9	J	5.2		U	5.5		U	5.3		U	5.2	1	J	5.1		U	5.2	
Total Petroleum Hydrocarbons	49		41.6		U	44.1		U	42		U	41.4		U	40.9		U	41.7	

(1) Woodward-Clyde. 1994. Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater, Cannon AFB, New Mexico.

U = Not Detected J = Estimated Value UJ = Estimated Reporting Limit NA = Not Analyzed

Results that are shaded and in bold are concentrations above the maximum background range.

* Metals concentrations are in milligrams per kilogram (mg/kg), organic concentrations are in micrograms per kilogram (µg/kg)

TABLE 4-12
METALS RESULTS AND DETECTED CONCENTRATIONS FOR OTHER CHEMICAL COMPOUNDS
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

BORING 113-11

Chemical	Sample Interval (ft bgs)															Background Range(1)
	31-33			35-35.8			45-47			55-57			65-66.4			
	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	
Aluminum	5940		11	7110		21.8	3520		10.5	3740		10.4	4120		10.6	596 - 10,796
Antimony		UJ	6.6		UJ	13.1		UJ	6.3		UJ	6.2		UJ	6.3	0 - 29.6
Arsenic	1.1		0.55	1.3		0.55	0.88		0.52	0.76		0.52	0.6		0.53	0 - 10.5
Barium	132		1.1	512		2.2	66.4		1	48.1		1	193		1.1	0 - 548
Beryllium	0.25		0.22	0.26	J	0.44	0.12	J	0.21	0.12	J	0.21	0.19	J	0.21	0 - 0.6
Cadmium		UJ	0.55		UJ	1.1		UJ	0.52		UJ	0.52		U	0.53	0 - 2.1
Calcium	81800	J	21.9	120000	J	43.7	55200	J	21	30600	J	20.8	51500		21.1	0 - 166,119
Chromium	5.4		1.1	7.8		2.2	2.8		1	3.1		1	5.1		1.1	0.8 - 12.0
Cobalt	1.2		1.1	2.2		2.2	1.2		1	0.93	J	1	1.4		1.1	0 - 4.0
Copper	2	J	2.2	4.7		4.4	1.4	J	2.1	1.5	J	2.1	2.2		2.1	0 - 10.1
Iron	3600		11	5480		21.8	2460		10.5	2750		10.4	3060		10.6	0 - 8,564
Lead	2.7	J	0.55	2.8	J	0.55	1.8	J	0.52	2.3	J	0.52	1.8		0.53	0 - 18.4
Magnesium	6260	J	21.9	8840	J	43.7	3850	J	21	4730	J	20.8	6370		21.1	0 - 9,912
Manganese	30.9		1.1	56.1		2.2	27.5		1	37		1	43.7		1.1	0 - 151.8
Mercury		U	0.11		U	0.11		U	0.1		U	0.1		U	0.11	0 - 0.2
Nickel	4.1	J	4.4	**50.7**		8.7	3.5	J	4.2	3.2	J	4.2	4.2		4.2	0 - 9.7
Potassium	901		548	1120		1090	877		524	801		520	712		528	0 - 2,531
Selenium		UJ	5.5		UJ	5.5		UJ	1		UJ	1		UJ	0.53	0 - 36.8
Silver		U	1.1		U	2.2		U	1		U	1		U	1.1	0 - 1.8
Sodium		U	548		U	1090		U	524		U	520		U	528	0 - 834
Thallium		U	1.1		U	1.1		U	1		U	1		R		0 - 6.2
Tin	NA			NA			NA			NA			NA	U	10.6	NA
Vanadium	24.5		1.1	**27.2**		2.2	6.9		1	8.3		1	13.2		1.1	1.7 - 25.0
Zinc	10.3		2.2	12.2		4.4	5.9		2.1	6.8		2.1	7.2		2.1	0 - 20.7
2-Butanone (MEK)		U	11	7.9	J	11		U	10		U	10		U	11	
Acetone	12		11	24		11		U	10	3	J	10	11		11	
Methylene chloride		U	5.5		U	5.5		U	5.2		U	5.2	1.2	J	5.3	
Total Petroleum Hydrocarbons		U	43.9	59.1		43.7		U	41.9		U	41.6		U	42.3	

(1) Woodward-Clyde. 1994. Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater, Cannon AFB, New Mexico.

U = Not Detected J = Estimated Value UJ = Estimated Reporting Limit NA = Not Analyzed

Results that are shaded and in bold are concentrations above the maximum background range.

* Metals concentrations are in milligrams per kilogram (mg/kg), organic concentrations are in micrograms per kilogram (µg/kg)

TABLE 4-13
METALS RESULTS AND DETECTED CONCENTRATIONS FOR OTHER CHEMICAL COMPOUNDS
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

BORING 113-12

Chemical	Sample Interval (ft bgs)															Background Range[1]
	27.5-29.5			34-36			45-47			55-57			65-65.6			
	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	
Aluminum	3920		21.5	3940		21.5	3960		10.4	3980		10.4	3530		10.5	596 - 10,796
Antimony		R			R		4.5	J	6.3		R			UJ	6.3	0 - 29.6
Arsenic	0.89		0.54	1.3		0.54	0.71		0.52	0.62		0.52	0.58		0.52	0 - 10.5
Barium	249	J	2.2	**654**	J	2.1	441	J	1	28.4	J	1	56.1		1	0 - 548
Beryllium		U	0.43		U	0.43	0.17	J	0.21	0.2	J	0.21		U	0.21	0 - 0.6
Cadmium		U	1.1		U	1.1		U	0.52		U	0.52		U	0.52	0 - 2.1
Calcium	**190000**		43.1	**179000**		43	65400		20.9	19800		20.9	69500		21	0 - 166,119
Chromium	1.6	J	2.2		U	2.1	2.6		1	4.9		1	7.2		1	0.8 - 12.0
Cobalt		U	2.2		U	2.1	0.8	J	1	1.6		1	1.3		1	0 - 4.0
Copper	1.7	J	4.3	2.1	J	4.3	2.3		2.1	1.2	J	2.1	2.6		2.1	0 - 10.1
Iron	2540		21.5	2560		21.5	2430		10.4	3100		10.4	2960		10.5	0 - 8,564
Lead	2.5		0.54	1.7		0.54	1.8		0.52	2.2		0.52	1.9		0.52	0 - 18.4
Magnesium	4870		43.1	7850		43	5940		20.9	5640		20.9	6170		21	0 - 9,912
Manganese	26.9	J	2.2	29.3	J	2.1	28.6	J	1	46.9	J	1	48.8		1	0 - 151.8
Mercury		U	0.11		U	0.11		U	0.1		U	0.1		U	0.1	0 - 0.2
Nickel	3.8	J	8.6	6	J	8.6	4.8		4.2	8.3		4.2	4.9		4.2	0 - 9.7
Potassium	643	J	1080	668	J	1070	952		522	853		521	652		525	0 - 2,531
Selenium		UJ	1.1		UJ	1.1		UJ	1		UJ	1		UJ	1	0 - 36.8
Silver		U	2.2		U	2.1		U	1		U	1		U	1	0 - 1.8
Sodium		U	1080		U	1070		U	522		U	521		U	525	0 - 834
Thallium		U	1.1		U	1.1	0.13	J	0.52		U	0.52		UJ	0.52	0 - 6.2
Tin	NA			NA			NA			NA			NA	U	10.5	NA
Vanadium	14.9		2.2	18.8		2.1	8.1		1	9.1		1	12.6		1	1.7 - 25.0
Zinc	7.5		4.3	7.7		4.3	6.8		2.1	7.4		2.1	6.3		2.1	0 - 20.7
Acetone		UJ	11		UJ	11	7	J	10		U	10	8.1	J	10	
Acetonitrile													24	J	210	

(1) Woodward-Clyde. 1994. Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater, Cannon AFB, New Mexico.

U = Not Detected J = Estimated Value UJ = Estimated Reporting Limit NA = Not Analyzed

Results that are shaded and in bold are concentrations above the maximum background range.

* Metals concentrations are in milligrams per kilogram (mg/kg), organic concentrations are in micrograms per kilogram (µg/kg)

TABLE 4-14

METALS RESULTS AND DETECTED CONCENTRATIONS FOR OTHER CHEMICAL COMPOUNDS
Landfill No. 5 (SWMU No. 5/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico
BORING 113-13

Chemical	Sample Interval (ft bgs)																		Background Range[1]
	0-.5			27-29			32-34			40-42			50-51.5			62-64.5			
	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	
Aluminum	5310		10.3	3520	J	10.9	3690	J	11	6660	J	10.9	5270	J	10.7	3610	J	10.6	596 - 10,796
Antimony		R			UJ	6.6		UJ	6.6		UJ	6.5		UJ	6.4		UJ	6.4	0 - 29.6
Arsenic	1.8		0.51	0.6		0.55	1.6		0.55	0.97		0.54	0.65		0.53	0.92		0.53	0 - 10.5
Barium	280	J	1	72	J	1.1	20.6	J	1.1	93.2	J	1.1	153	J	1.1	309	J	1.1	0 - 548
Beryllium	0.44		0.21		U	0.22	0.26		0.22	0.21	J	0.22	0.16	J	0.21	0.13	J	0.21	0 - 0.6
Cadmium		U	0.51		U	0.55		U	0.55		U	0.54		U	0.53		U	0.53	0 - 2.1
Calcium	71900		20.6	82100	J	21.8	16100	J	21.9	68100	J	21.7	59200	J	21.4	28100	J	21.3	0 - 166,119
Chromium	4.2		1	2.7		1.1	2.9		1.1	5.4		1.1	9.9		1.1	10.8		1.1	0.8 - 12.0
Cobalt	3		1	1.2		1.1	2		1.1	0.89	J	1.1	0.89	J	1.1	1.1		1.1	0 - 4.0
Copper	4.5		2.1	1.3	J	2.2	2.6		2.2	3.2		2.2	2.7		2.1	2.2		2.1	0 - 10.1
Iron	4190		10.3	2030	J	10.9	2900	J	11	4010	J	10.9	3720	J	10.7	3030	J	10.6	0 - 8,564
Lead	5.3		0.51	2.5		0.55	2.8		0.55	2		0.54	1.9		0.53	1		0.53	0 - 18.4
Magnesium	1890		20.6	3570	J	21.8	2880	J	21.9	**10600**	**J**	21.7	6970	J	21.4	3460	J	21.3	0 - 9,912
Manganese	112		1	31.8	J	1.1	65.4	J	1.1	39.7	J	1.1	40.6	J	1.1	38.9	J	1.1	0 - 151.8
Mercury		U	0.1		U	0.11		U	0.11		U	0.11		U	0.11		U	0.11	0 - 0.2
Nickel	6.2		4.1	3.6	J	4.4	5		4.4	5.2		4.3	6.2		4.3	3	J	4.3	0 - 9.7
Potassium	1220		515	758		546	1240		548	1430		543	1130		534	659		531	0 - 2,531
Selenium		UJ	1		UJ	1.1		UJ	1.1		UJ	1.1		UJ	1.1		UJ	1.1	0 - 36.8
Silver		U	1		U	1.1		U	1.1		U	1.1		U	1.1		U	1.1	0 - 1.8
Sodium	**3920**		515		U	546		U	548		U	543		U	534		U	531	0 - 834
Thallium	0.12	J	1	0.19	J	1.1	0.2	J	0.55	0.14	J	1.1	0.12	J	1.1		U	0.53	0 - 6.2
Tin	NA			NA			NA			NA			NA			NA	U	10.6	NA
Vanadium	13.7		1	10.3		1.1	18.2		1.1	13.8		1.1	12.3		1.1	11.2		1.1	1.7 - 25.0
Zinc	11.6		2.1	6		2.2	7.2		2.2	10.3		2.2	8.8		2.1	6.8		2.1	0 - 20.7
2-Methylnaphthalene		U	340		U	360		U	360	85	J	360		U	350		U	350	
Acenaphthene		U	340	37	J	360		U	360	82	J	360		U	350		U	350	
Chrysene		U	340		U	360		U	360	38	J	360		U	350		U	350	
Dibenzofuran		U	340		U	360		U	360	44	J	360		U	350		U	350	
Fluoranthene		U	340		U	360		U	360	93	J	360		U	350		U	350	
Fluorene		U	340		U	360		U	360	69	J	360		U	350		U	350	
Phenanthrene		U	340	78	J	360		U	360	220	J	360	69	J	350	41	J	350	
Pyrene		U	340		U	360		U	360	74	J	360		U	350		U	350	

TABLE 4-14

METALS RESULTS AND DETECTED CONCENTRATIONS FOR OTHER CHEMICAL COMPOUNDS
Landfill No. 5 (SWMU No. 5/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico
BORING 113-13

Chemical	Sample Interval (ft bgs)																		Background Range[1]
	0-.5			27-29			32-34			40-42			50-51.5			62-64.5			
	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	
1-Methylnaphthalene										76	NJ								
Acetone		U	10	130		110	7.2	J	11	4.9	J	11		U	11		U	11	
Ethylbenzene	1.3	J	5.1	300		55		U	5.5		U	5.4		U	5.3		U	5.3	
Methylene chloride		U	5.1		U	55		U	5.5	1.2	J	5.4	1.8	J	5.3	1.1	J	5.3	
Styrene	8.2		5.1	1400		55		U	5.5		U	5.4		U	5.3		U	5.3	
Toluene	1.9	J	5.1		U	55		U	5.5		U	5.4		U	5.3		U	5.3	

(1) Woodward-Clyde. 1994. Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater, Cannon AFB, New Mexico.

U = Not Detected J = Estimated Value UJ = Estimated Reporting Limit NA = Not Analyzed

Results that are shaded and in bold are concentrations above the maximum background range.

* Metals concentrations are in milligrams per kilogram (mg/kg), organic concentrations are in micrograms per kilogram (µg/kg)

TABLE 4-15

METALS RESULTS AND DETECTED CONCENTRATIONS FOR OTHER CHEMICAL COMPOUNDS
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

BORING 113-14

Chemical	Sample Interval (ft bgs)															Background Range[1]
	32-33.9			38-39.1			45-47			57-60.5			67-68.5			
	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	
Aluminum	4370		22.3	4870		22.4	3270		10.5	3350		10.8	2960		10.6	596 - 10,796
Antimony		R			R			R			R			R		0 - 29.6
Arsenic	0.61		0.56	1.1		0.56	0.82		0.53	0.67		0.54	0.68		0.53	0 - 10.5
Barium	107	J	2.2	121	J	2.2	35.2	J	1.1	55.9	J	1.1	59.4	J	1.1	0 - 548
Beryllium		U	0.45		U	0.45		U	0.21		U	0.22		U	0.21	0 - 0.6
Cadmium		U	1.1		U	1.1		U	0.53		U	0.54		U	0.53	0 - 2.1
Calcium	135000		44.6	124000		44.7	50900		21	95300		21.5	39100		21.2	0 - 166,119
Chromium	6		2.2	4.4		2.2	2.4		1.1	6.9		1.1	4.5		1.1	0.8 - 12.0
Cobalt	1.4	J	2.2	1.4	J	2.2	0.74	J	1.1	1.2		1.1	1.2		1.1	0 - 4.0
Copper	1.6	J	4.5	2.6	J	4.5	0.89	J	2.1	1.8	J	2.2	1.4	J	2.1	0 - 10.1
Iron	2430		22.3	2890		22.4	2370		10.5	2720		10.8	2360		10.6	0 - 8,564
Lead	1.8		1.1	3.1		0.56	2		0.53	2		1.1	1.7		0.53	0 - 18.4
Magnesium	**13200**		44.6	**14500**		44.7	4380		21	8180		21.5	5030		21.2	0 - 9,912
Manganese	25.5	J	2.2	31.6	J	2.2	24.1	J	1.1	34	J	1.1	34.1	J	1.1	0 - 151.8
Mercury		U	0.11		U	0.11		U	0.11		U	0.11		U	0.11	0 - 0.2
Nickel	7.8	J	8.9	8	J	8.9	3.2	J	4.2	5		4.3	4.1	J	4.2	0 - 9.7
Potassium	570	J	1120	745	J	1120	868		525	582		538	529	J	530	0 - 2,531
Selenium		UJ	1.1		UJ	1.1		UJ	1.1		UJ	1.1		UJ	1.1	0 - 36.8
Silver		U	2.2		U	2.2		U	1.1		U	1.1		U	1.1	0 - 1.8
Sodium		U	1120		U	1120		U	525		U	538		U	530	0 - 834
Thallium		U	1.1		U	1.1		U	0.53		U	0.54		U	0.53	0 - 6.2
Tin	NA			NA			NA			NA			NA	U	10.6	NA
Vanadium	18.7		2.2	19.3		2.2	7		1.1	15		1.1	14.6		1.1	1.7 - 25.0
Zinc	5.7		4.5	7		4.5	5.5		2.1	5.5		2.2	6.2		2.1	0 - 20.7
2-Butanone (MEK)		U	11	1.8	J	11	2.6	J	11	4.4	J	11		U	11	
Acetone		U	11	5.8	J	11	4.2	J	11		U	11		U	11	

(1) Woodward-Clyde. 1994. Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater, Cannon AFB, New Mexico.

U = Not Detected J = Estimated Value UJ = Estimated Reporting Limit NA = Not Analyzed

Results that are shaded and in bold are concentrations above the maximum background range.

* Metals concentrations are in milligrams per kilogram (mg/kg), organic concentrations are in micrograms per kilogram (µg/kg)

TABLE 4-16

METALS RESULTS AND DETECTED CONCENTRATIONS FOR OTHER CHEMICAL COMPOUNDS
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

BORING 113-15

Chemical	Sample Interval (ft bgs)															Background Range[1]
	20-22			25-27			35-35.8			45-46.8			55-55.8			
	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	
Aluminum	4290		22.2	4490		22.2	5290		22.2	4250		11.2	4340		10.7	596 - 10,796
Antimony		U	13.3		U	13.3		U	13.3		U	6.7		U	6.4	0 - 29.6
Arsenic	0.9		0.55	1.1		0.56	1.6		0.56	0.82		0.56	0.89		0.54	0 - 10.5
Barium	304		2.2	131		2.2	245		2.2	51.3		1.1	43.2		1.1	0 - 548
Beryllium		U	0.44		U	0.44		U	0.44	0.18	J	0.22	0.12	J	0.21	0 - 0.6
Cadmium		U	1.1		U	1.1		U	1.1		U	0.56		U	0.54	0 - 2.1
Calcium	165000	J	44.4	160000	J	44.4	95900	J	44.5	42100	J	22.4	85800	J	21.4	0 - 166,119
Chromium	2.3		2.2	3.2		2.2	4.5		2.2	5.4		1.1	5.2		1.1	0.8 - 12.0
Cobalt	1.7	J	2.2	1.4	J	2.2	1.5	J	2.2	1	J	1.1	1.6		1.1	0 - 4.0
Copper	1.7	J	4.4	1.9	J	4.4	2.3	J	4.4	1.5	J	2.2	1.7	J	2.1	0 - 10.1
Iron	2610		22.2	2960		22.2	3160		22.2	3140		11.2	2930		10.7	0 - 8,564
Lead	2.4		0.55	2.2		0.56	1.9		0.56	4.7		1.1	1.8		0.54	0 - 18.4
Magnesium	4920	J	44.4	6250	J	44.4	**11100**	**J**	44.5	4690	J	22.4	7950	J	21.4	0 - 9,912
Manganese	29.9		2.2	30.2		2.2	33.9		2.2	38.2		1.1	38.8		1.1	0 - 151.8
Mercury		U	0.11		U	0.11		U	0.11		U	0.11		U	0.11	0 - 0.2
Nickel	5.6	J	8.9	5.4	J	8.9	6.6	J	8.9	4.6	J	4.5	3.9	J	4.3	0 - 9.7
Potassium	823	J	1110	726	J	1110	1040	J	1110	1020		561	812		536	0 - 2,531
Selenium		UJ	1.1		UJ	1.1		UJ	1.1		UJ	1.1		UJ	1.1	0 - 36.8
Silver		UJ	2.2		UJ	2.2		UJ	2.2		UJ	1.1		UJ	1.1	0 - 1.8
Sodium		U	1110		U	1110		U	1110	113	J	561		U	536	0 - 834
Thallium		UJ	1.1	0.12	J	1.1	0.11	J	1.1	0.11	J	0.56	0.16	J	0.54	0 - 6.2
Tin	NA			NA			NA			NA			NA	U	10.7	NA
Vanadium	8.1		2.2	8.2		2.2	14		2.2	10.1		1.1	15		1.1	1.7 - 25.0
Zinc	6.6		4.4	18.9		4.4	7.8		4.4	7.3		2.2	6.7		2.1	0 - 20.7
4-Nitrophenol	49	J	1800	68	J	1800		U	1800		U	1800		U	1700	
bis(2-Ethylhexyl)phthalate	230	J	370	100	J	370	74	J	370	200	J	370		U	350	

(1) Woodward-Clyde. 1994. Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater, Cannon AFB, New Mexico.

U = Not Detected J = Estimated Value UJ = Estimated Reporting Limit NA = Not Analyzed

Results that are shaded and in bold are concentrations above the maximum background range.

* Metals concentrations are in milligrams per kilogram (mg/kg), organic concentrations are in micrograms per kilogram (µg/kg)

TABLE 4-17

METALS RESULTS AND DETECTED CONCENTRATIONS FOR OTHER CHEMICAL COMPOUNDS
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico
BORING 113-16

Chemical	Sample Interval (ft bgs)																		Background Range[1]
	0-.5			45-46.9			50-50.9			60-60.9			70-70.8			80-81.5			
	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	
Aluminum	5830		10.2	4080		10.5	4710		10.5	4500		10.6	3200		10.5	1530		10.4	596 - 10,796
Antimony		R			U	6.3		U	6.3		U	6.4	5.4	J	6.3		UJ	6.2	0 - 29.6
Arsenic	1.8		0.51	0.7		0.52	0.78		0.53	0.66		0.53	0.74		0.53	0.39	J	1	0 - 10.5
Barium	194	J	1	184	J	1	213	J	1.1	125	J	1.1	130	J	1.1	36.9		1	0 - 548
Beryllium	0.38		0.2	0.15	J	0.21	0.19	J	0.21	0.19	J	0.21	0.14	J	0.21		U	0.21	0 - 0.6
Cadmium		U	0.51		U	0.52		U	0.53		U	0.53		U	0.53	0.44	J	0.52	0 - 2.1
Calcium	61200		20.4	46500		21	63000		21.1	46200		21.2	46300		21.1	8830		20.7	0 - 166,119
Chromium	**19.2**		1	6.2		1	7.5		1.1	6.4		1.1	6.7		1.1	6.4		1	0.8 - 12.0
Cobalt	3.3		1	1.4		1	1.5		1.1	1.6		1.1	2		1.1		U	1	0 - 4.0
Copper	6.6		2	**12.6**		2.1	**11.6**		2.1	5.7		2.1	**27.5**		2.1	2.9		2.1	0 - 10.1
Iron	5650		10.2	3240		10.5	3520		10.5	3790		10.6	3730		10.5	2240		10.4	0 - 8,564
Lead	**41.1**		5.1	4.6		0.52	2.8		0.53	1.9		1.1	3.3		0.53	1.2		0.52	0 - 18.4
Magnesium	1990		20.4	4940		21	7370		21.1	5980		21.2	3470		21.1	1370		20.7	0 - 9,912
Manganese	138	J	1	33.2	J	1	48	J	1.1	48.6	J	1.1	57.6	J	1.1	26.2		1	0 - 151.8
Mercury		U	0.1		U	0.1		U	0.11		U	0.11		U	0.11		U	0.1	0 - 0.2
Nickel	6.3		4.1	5.1		4.2	5.4		4.2	5.8		4.2	6.2		4.2	3	J	4.1	0 - 9.7
Potassium	1880		510	938		525	1030		527	906		530	708		526	331	J	519	0 - 2,531
Selenium		UJ	1		UJ	1		UJ	1.1		UJ	1.1		UJ	1.1		UJ	1	0 - 36.8
Silver		U	1	1.5		1	**4.8**		1.1	1.2		1.1	0.98	J	1.1		U	1	0 - 1.8
Sodium		U	510		U	525		U	527		U	530		U	526		U	519	0 - 834
Thallium		U	1		UJ	1		UJ	1.1		UJ	1.1		UJ	1.1		R		0 - 6.2
Tin	NA			NA			NA			NA			NA			NA	U	10.4	NA
Vanadium	13.3		1	8.2		1	10.8		1.1	12.9		1.1	11.6		1.1	5.9		1	1.7 - 25.0
Zinc	**25.3**		2	10.6		2.1	15.6		2.1	9.8		2.1	9.2		2.1	4.5		2.1	0 - 20.7
Aroclor 1254		U	34	75		35		U	35		U	35		U	35		U	34	
4-Methylphenol		U	340	100	J	350		U	350		U	350		U	350				
bis(2-Ethylhexyl)phthalate		U	340	230	J	350		U	350		U	350		U	350		U	340	
Di-n-butyl phthalate		U	340		U	350		U	350		U	350	57	J	350		U	340	
Phenol		U	340	40	J	350		U	350		U	350		U	350		U	340	
2-Butanone (MEK)		U	10	180		21	180		21	3.3	J	11		U	11	3.2	J	10	
2-Hexanone		U	10	8.3	J	21	11	J	21		U	11		U	11		U	10	

TABLE 4-17

METALS RESULTS AND DETECTED CONCENTRATIONS FOR OTHER CHEMICAL COMPOUNDS
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico
BORING 113-16

Chemical	Sample Interval (ft bgs)																		Background Range[1]
	0-.5			45-46.9			50-50.9			60-60.9			70-70.8			80-81.5			
	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	
4-Methyl-2-pentanone (MIBK)		U	10	230		21	220		21	2.5	J	11		U	11		U	10	
Acetone		U	10	370		21	390		21		U	11	5.9	J	11	6	J	10	
Methylene chloride		U	5.1	5.1	J	10	6.3	J	11		U	5.3		U	5.3		U	5.2	
Toluene	1.4	J	5.1		U	10		U	11		U	5.3		U	5.3		U	5.2	
Total Petroleum Hydrocarbons	72.5		40.8		U	42		U	42.2		U	42.4		U	42.1		U	41.5	

(1) Woodward-Clyde. 1994. Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater, Cannon AFB, New Mexico.

U = Not Detected J = Estimated Value UJ = Estimated Reporting Limit NA = Not Analyzed

Results that are shaded and in bold are concentrations above the maximum background range.

* Metals concentrations are in milligrams per kilogram (mg/kg), organic concentrations are in micrograms per kilogram (µg/kg)

TABLE 4-18

METALS RESULTS AND DETECTED CONCENTRATIONS FOR OTHER CHEMICAL COMPOUNDS
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

BORING 113-17

Chemical	Sample Interval (ft bgs)															Background Range[1]
	19-20.3			25-26.5			35-36.3			45-46.9			53-55			
	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	
Aluminum	6020		21.4	6970		21.4	6070		21.3	3560		10.4	3320		10.4	596 - 10,796
Antimony		R			R		12.8	J	12.8		R			R		0 - 29.6
Arsenic	0.92		0.54	1.3		0.53	1.4		0.53	0.79		0.52	0.55		0.52	0 - 10.5
Barium	**1260**	**J**	2.1	238	J	2.1	**736**	**J**	2.1	59.1	J	1	22.9	J	1	0 - 548
Beryllium	0.37	J	0.43	0.29	J	0.43	0.24	J	0.43	0.11	J	0.21	0.14	J	0.21	0 - 0.6
Cadmium		U	1.1		U	1.1		U	1.1		U	0.52		U	0.52	0 - 2.1
Calcium	**168000**		42.8	131000		42.8	117000		42.5	50100		20.8	23600		20.8	0 - 166,119
Chromium	7.1		2.1	5.9		2.1	3.1		2.1	4.8		1	2.8		1	0.8 - 12.0
Cobalt	2	J	2.1	2	J	2.1	2.3		2.1	1.3		1	1.2		1	0 - 4.0
Copper	3.2	J	4.3	3.4	J	4.3	2.4	J	4.3	1.9	J	2.1	1.5	J	2.1	0 - 10.1
Iron	4890		21.4	5630		21.4	3920		21.3	2720		10.4	2700		10.4	0 - 8,564
Lead	3.7		0.54	5.5		1.1	3.1		1.1	1.5		0.52	2.2		0.52	0 - 18.4
Magnesium	5120		42.8	5660		42.8	7880		42.5	4830		20.8	4070		20.8	0 - 9,912
Manganese	50.7	J	2.1	66	J	2.1	41.2	J	2.1	39.6	J	1	37.4	J	1	0 - 151.8
Mercury		U	0.11		U	0.11		U	0.11		U	0.1		U	0.1	0 - 0.2
Nickel	**20.5**		8.6	8.6		8.6	2.5	J	8.5	3.9	J	4.2	3.4	J	4.2	0 - 9.7
Potassium	1810		1070	1590		1070	1270		1060	826		519	749		519	0 - 2,531
Selenium		UJ	1.1		UJ	1.1		UJ	1.1		UJ	1		UJ	1	0 - 36.8
Silver		U	2.1		U	2.1		U	2.1		U	1		U	1	0 - 1.8
Sodium		U	1070		U	1070		U	1060		U	519		U	519	0 - 834
Thallium		U	1.1		U	1.1		U	1.1		U	1		U	1	0 - 6.2
Tin	NA			NA			NA			NA			8.7	J	10.4	NA
Vanadium	11.9		2.1	20.4		2.1	16.9		2.1	7.6		1	8.6		1	1.7 - 25.0
Zinc	14.9		4.3	**24.3**		4.3	13.6		4.3	8.3		2.1	7.4		2.1	0 - 20.7
bis(2-Ethylhexyl)phthalate		U	350	3800		350		U	350		U	340		U	340	
Di-n-butyl phthalate	37	J	350	69	J	350	48	J	350		U	340		U	340	
Di-n-octyl phthalate		U	350		U	350		U	350	39	J	340		U	340	
Phenol		U	350	47	J	350		U	350		U	340		U	340	
2-Butanone (MEK)		U	11		U	11		U	11	1.9	J	10		U	10	
2-Hexanone	1.5	J	11		U	11		U	11		U	10		U	10	

TABLE 4-18

METALS RESULTS AND DETECTED CONCENTRATIONS FOR OTHER CHEMICAL COMPOUNDS
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

BORING 113-17

Chemical	Sample Interval (ft bgs)															Background Range[1]
	19-20.3			25-26.5			35-36.3			45-46.9			53-55			
	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	
4-Methyl-2-pentanone (MIBK)		U	11	10	J	11		U	11		U	10		U	10	
Acetone	8.7	J	11	100		11		U	11	8.3	J	10	7.3	J	10	

(1) Woodward-Clyde. 1994. Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater, Cannon AFB, New Mexico.

U = Not Detected J = Estimated Value UJ = Estimated Reporting Limit NA = Not Analyzed

Results that are shaded and in bold are concentrations above the maximum background range.

* Metals concentrations are in milligrams per kilogram (mg/kg), organic concentrations are in micrograms per kilogram (µg/kg)

TABLE 4-19
METALS RESULTS AND DETECTED CONCENTRATIONS FOR OTHER CHEMICAL COMPOUNDS
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

BORING 113-18

Chemical	Sample Interval (ft bgs)															Background Range[1]
	28-29.9			33-35			45-47			55-56.5			63-63.8			
	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	
Aluminum	4450		21.7	4070		10.8	3120		10.5	3760		10.5	3160		10.6	596 - 10,796
Antimony	14.8	J	13	4.4	J	6.5		R			R			UJ	6.4	0 - 29.6
Arsenic	1.3		0.54	1.6		0.54	0.74		0.53	0.78		0.52	0.71		0.53	0 - 10.5
Barium	104	J	2.2	60.8	J	1.1	106	J	1.1	310	J	1	37.2		1.1	0 - 548
Beryllium	0.25	J	0.43	0.21	J	0.22		U	0.21		U	0.21		U	0.21	0 - 0.6
Cadmium		U	1.1		U	0.54		U	0.53		U	0.52		U	0.53	0 - 2.1
Calcium	144000		43.4	35300		21.6	30700		21.1	32400		21	59700		21.3	0 - 166,119
Chromium	4		2.2	3.2		1.1	2.6		1.1	3.8		1	9.7		1.1	0.8 - 12.0
Cobalt	2.3		2.2	1.8		1.1	1	J	1.1	1.5		1	1.2		1.1	0 - 4.0
Copper	3.2	J	4.3	2.5		2.2	1.2	J	2.1	1.2	J	2.1	1.9	J	2.1	0 - 10.1
Iron	3670		21.7	3460		10.8	2110		10.5	2710		10.5	2990		10.6	0 - 8,564
Lead	3		0.54	3.7		0.54	1.7	J	2.6	2.3		0.52	1.9		0.53	0 - 18.4
Magnesium	3860		43.4	3350		21.6	4170		21.1	4690		21	5830		21.3	0 - 9,912
Manganese	46.3	J	2.2	59.7	J	1.1	26.9	J	1.1	46.1	J	1	37.5		1.1	0 - 151.8
Mercury		U	0.11		U	0.11		U	0.11		U	0.1		U	0.11	0 - 0.2
Nickel	6.3	J	8.7	6.5		4.3	3.7	J	4.2	4.1	J	4.2	4.4		4.3	0 - 9.7
Potassium	1160		1080	1170		540	859		527	881		524	553		532	0 - 2,531
Selenium		UJ	1.1		UJ	1.1		UJ	1.1		UJ	0.52		UJ	1.1	0 - 36.8
Silver		U	2.2		U	1.1		U	1.1		U	1		U	1.1	0 - 1.8
Sodium		U	1080		U	540		U	527		U	524		U	532	0 - 834
Thallium		U	1.1		U	1.1		U	0.53		U	0.52	0.19	J	0.53	0 - 6.2
Tin	NA			NA			NA			NA			NA	U	10.6	NA
Vanadium	14.2		2.2	17.8		1.1	6.6		1.1	9.5		1	11		1.1	1.7 - 25.0
Zinc	9.4		4.3	8.3		2.2	5.1		2.1	6.5		2.1	5.8		2.1	0 - 20.7
2-Butanone (MEK)		U	11		U	11		U	11	3.5	J	10		U	11	
Acetone		U	11		U	11		U	11		U	10	5.5	J	11	
Toluene	1.4	J	5.4		U	5.4		U	5.3		U	5.2	1.1	J	5.3	

(1) Woodward-Clyde. 1994. Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater, Cannon AFB, New Mexico.

U = Not Detected J = Estimated Value UJ = Estimated Reporting Limit NA = Not Analyzed

Results that are shaded and in bold are concentrations above the maximum background range.

* Metals concentrations are in milligrams per kilogram (mg/kg), organic concentrations are in micrograms per kilogram (µg/kg)

TABLE 4-20

METALS RESULTS AND DETECTED CONCENTRATIONS FOR OTHER CHEMICAL COMPOUNDS
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

BORING 113-19

Chemical	Sample Interval (ft bgs)																		Background Range[1]
	0-.5			18-20			25-27			35-35.9			45-47			53-56.5			
	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	
Aluminum	5530		10.1	5760		10.8	8250		11.2	3880		10.7	3170		10.5	4220		10.5	596 - 10,796
Antimony		R			UJ	6.5		UJ	6.7		UJ	6.4		UJ	6.3		UJ	6.3	0 - 29.6
Arsenic	2.7		0.5	2.2		0.54	5.8		0.56	1.1		0.54	0.84	J	2.1	0.86	J	2.1	0 - 10.5
Barium	145	J	1	61.3		1.1	54.2		1.1	207		1.1	37.5		1	72.9		1.1	0 - 548
Beryllium		U	0.39		U	0.23	0.59		0.22		U	0.21		U	0.21		U	0.21	0 - 0.6
Cadmium		U	0.5		U	0.54		U	0.56		U	0.54		U	0.52		U	0.53	0 - 2.1
Calcium	33400		20.2	78800		21.6	6740		22.4	85100		21.4	55900		21	54200		21.1	0 - 166,119
Chromium	6.7		1	5.5		1.1	9.3		1.1	4.1		1.1	2.8		1	4.4		1.1	0.8 - 12.0
Cobalt	2.9		1	2.2		1.1	2.1		1.1	1.3		1.1	1.1		1	1.4		1.1	0 - 4.0
Copper	5.2		2	3.4		2.2	5		2.2	1.5	J	2.1	1.1	J	2.1	1.6	J	2.1	0 - 10.1
Iron	5990		10.1	4840		10.8	**8810**		11.2	2710		10.7	2420		10.5	2890		10.5	0 - 8,564
Lead	9.2		1	5.1		0.54	7.3		0.56	2.1		0.54	1		0.52	1.9		0.53	0 - 18.4
Magnesium	1490		20.2	3710		21.6	2730		22.4	3550		21.4	2880		21	5600		21.1	0 - 9,912
Manganese	108	J	1	65.8		1.1	56.2		1.1	35		1.1	28.7		1	40.1		1.1	0 - 151.8
Mercury		U	0.1		U	0.11		U	0.11		U	0.11		U	0.1		U	0.11	0 - 0.2
Nickel	7.2		4	7.3		4.3	8.9		4.5	4.5		4.3		U	4.2	4.4		4.2	0 - 9.7
Potassium	1260		505	1720		540	**2550**		560	706		536	803		525	889		527	0 - 2,531
Selenium		UJ	1		R			R			R			R			UJ	1.1	0 - 36.8
Silver		U	1		U	1.1		U	1.1		U	1.1		U	1	0.32	J	1.1	0 - 1.8
Sodium		U	505	157	J	540	253	J	560		U	536		U	525		U	527	0 - 834
Thallium	0.13	J	0.5	0.16	J	1.1	0.21	J	0.56	0.19	J	0.54		U	0.52	0.19	J	0.53	0 - 6.2
Tin	NA			NA			NA			NA			NA			NA	U	10.5	NA
Vanadium	15.9		1	15.6		1.1	**35.6**		1.1	12		1.1	6.7		1	8.5		1.1	1.7 - 25.0
Zinc	17		2	10.6		2.2	16.2		2.2	6.9		2.1	5.8		2.1	7.6		2.1	0 - 20.7
Aroclor 1254	25	J	33		U	36		U	37		U	35		U	35		U	35	
2-Butanone (MEK)	2.7	J	10		U	11	1.9	J	11		U	11		U	10		U	11	
Acetone	13		10		U	11		U	11	6.5	J	11	3.3	J	10	3	J	11	
Toluene	4.4	J	5		U	5.4		U	5.6		U	5.4		U	5.2		U	5.3	
Total Petroleum Hydrocarbons	43.5		40.4		U	43.2		U	44.8		U	42.9		U	42		U	42.2	

(1) Woodward-Clyde. 1994. Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater, Cannon AFB, New Mexico.

U = Not Detected J = Estimated Value UJ = Estimated Reporting Limit NA = Not Analyzed

Results that are shaded and in bold are concentrations above the maximum background range.

* Metals concentrations are in milligrams per kilogram (mg/kg), organic concentrations are in micrograms per kilogram (µg/kg)

TABLE 4-21

METALS RESULTS AND DETECTED CONCENTRATIONS FOR OTHER CHEMICAL COMPOUNDS
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

BORING 113-20

Chemical	Sample Interval (ft bgs)															Background Range[1]
	16-17.5			20-22			30-32			40-41.8			52-53			
	Result	Qual.	R.L	Result	Qual.	R.L	Result	Qual.	R.L	Result	Qual.	R.L	Result	Qual.	R.L	
Aluminum	6210		11.2	4140		22.1	3710		11.5	5090		10.8	3740		10.5	596 - 10,796
Antimony		UJ	6.7		UJ	13.2		R			R			UJ	6.3	0 - 29.6
Arsenic	2.3		0.56	1.8		0.55	2		0.58	1.1		0.54	0.5	J	0.52	0 - 10.5
Barium	69.4		1.1	427		2.2	50.7	J	1.2	64.3	J	1.1	88.1		1	0 - 548
Beryllium	0.47		0.22	0.28	J	0.44	0.21	J	0.23	0.14	J	0.22	0.14	J	0.21	0 - 0.6
Cadmium		UJ	0.56		UJ	1.1		UJ	0.58		UJ	0.54		U	0.52	0 - 2.1
Calcium	83400		22.3	**197000**		44.2	44000		23	74600		21.5	31800		20.9	0 - 166,119
Chromium	7.4		1.1	3.8		2.2	4.1		1.2	4		1.1	4.5		1	0.8 - 12.0
Cobalt	2.9		1.1	2	J	2.2	2		1.2	1.2		1.1	1.4		1	0 - 4.0
Copper	**23.5**		2.2	3	J	4.4	2.9		2.3	2.7		2.2	2.6		2.1	0 - 10.1
Iron	6000		11.2	3200		22.1	3120		11.5	3010		10.8	3130		10.5	0 - 8,564
Lead	9.3		1.1	3.9		0.55	3.6		0.58	1.7		0.54	2.1		0.52	0 - 18.4
Magnesium	4080		22.3	5660		44.2	2430		23	9300		21.5	4950		20.9	0 - 9,912
Manganese	40.2		1.1	38.3		2.2	56.7	J	1.2	28.1	J	1.1	42.6		1	0 - 151.8
Mercury		U	0.11		U	0.11		U	0.12		U	0.11		U	0.1	0 - 0.2
Nickel	7.4		4.5	5.6	J	8.8	5.4		4.6	4.3		4.3	4.1	J	4.2	0 - 9.7
Potassium	1920		559	1040	J	1100	964		575	973		538	767		523	0 - 2,531
Selenium		R			R			UJ	1.2		UJ	1.1		UJ	1	0 - 36.8
Silver		U	1.1		U	2.2		U	1.2		U	1.1		U	1	0 - 1.8
Sodium	233	J	559		U	1100		U	575		U	538		U	523	0 - 834
Thallium		U	1.1		U	2.2		U	1.2		U	1.1		R		0 - 6.2
Tin	NA			NA			NA			NA			9.8	J	10.5	NA
Vanadium	21.8		1.1	12.4		2.2	13.3		1.2	12.4		1.1	9		1	1.7 - 25.0
Zinc	12.1		2.2	10.3		4.4	8.1		2.3	7.3		2.2	7.4		2.1	0 - 20.7

(1) Woodward-Clyde. 1994. Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater, Cannon AFB, New Mexico.

U = Not Detected J = Estimated Value UJ = Estimated Reporting Limit NA = Not Analyzed

Results that are shaded and in bold are concentrations above the maximum background range.

* Metals concentrations are in milligrams per kilogram (mg/kg), organic concentrations are in micrograms per kilogram (µg/kg)

TABLE 4-22
METALS RESULTS AND DETECTED CONCENTRATIONS FOR OTHER CHEMICAL COMPOUNDS
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

BORING 113-21

Chemical	Sample Interval (ft bgs)														
	22-22.9			27-29			35-35.8			45-46.8			57-58.8		
	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.
Aluminum	2730	J	10.7	3220		22.6	3870		21.8	4940		10.4	4340		10.7
Antimony		UJ	6.4		U	13.5		U	13.1		U	6.2		U	6.4
Arsenic	0.97		0.54	0.65		0.56	0.91		0.54	0.39	J	0.52	0.34	J	0.53
Barium	377	J	1.1	180		2.3	293		2.2	91.5		1	277		1.1
Beryllium	0.17	J	0.21		U	0.45		U	0.44		U	0.21	0.13	J	0.21
Cadmium	0.69		0.54		U	1.1		U	1.1		U	0.52		U	0.53
Calcium	**254000**	**J**	21.4	**173000**	**J**	45.1	164000		43.5	39200	J	20.8	35800	J	21.4
Chromium	3	J	1.1	2.1	J	2.3	5.4		2.2	10.9		1	6.4		1.1
Cobalt	0.9	J	1.1		U	2.3	1.6	J	2.2	1		1	1.3		1.1
Copper	0.91	J	2.1	1.2	J	4.5	6.4		4.4	1.5	J	2.1	1.6	J	2.1
Iron	2220	J	10.7	1660		22.6	2340		21.8	3740		10.4	3040		10.7
Lead	2.7		0.54	2		0.56	2.6		0.54	1.7		0.52	1.4		0.53
Magnesium	3660	J	21.4	5870	J	45.1	8910	J	43.5	3960	J	20.8	5490	J	21.4
Manganese	20.8	J	1.1	20.3		2.3	26.7		2.2	35.9		1	37.7		1.1
Mercury		U	0.11		U	0.11		U	0.11		U	0.1		U	0.11
Nickel	2.6	J	4.3	5.2	J	9		UJ	8.7		UJ	4.2		UJ	4.3
Potassium	775		535	504	J	1130	615	J	1090	1140		520	764		534
Selenium		UJ	1.1		UJ	1.1		UJ	1.1		UJ	1		UJ	1.1
Silver	1.2		1.1		UJ	2.3		UJ	2.2		UJ	1		UJ	1.1
Sodium		U	535		U	1130		U	1090		U	520		U	534
Thallium	0.12	J	1.1	0.14	J	1.1		UJ	1.1	0.17	J	1	0.17	J	0.53
Tin	NA			NA			NA			NA			NA	U	10.7
Vanadium	10.6		1.1	20.2		2.3	15		2.2	9.2		1	12.8		1.1
Zinc	6.5	J	2.1	5.1		4.5	6.8		4.4	7.4		2.1	6.5		2.1
bis(2-Ethylhexyl)phthalate	110	J	350	240	J	370	100	J	360		U	340		U	350
1,1,2,2-Tetrachloroethane	2.3	J	5.4	8.2		5.6		U	5.4	3.5	J	5.2	3.1	J	5.3
Acetone	5.6	J	11		U	11	16		11	7	J	10		U	11
Methylene chloride		U	5.4		U	5.6		U	5.4		U	5.2	2.8	J	5.3

(1) Woodward-Clyde. 1994. Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater, Cannon AFB, New Mexico.

U = Not Detected J = Estimated Value UJ = Estimated Reporting Limit NA = Not Analyzed

Results that are shaded and in bold are concentrations above the maximum background range.

* Metals concentrations are in milligrams per kilogram (mg/kg), organic concentrations are in micrograms per kilogram (µg/kg)

TABLE 4-23

METALS RESULTS AND DETECTED CONCENTRATIONS FOR OTHER CHEMICAL COMPOUNDS
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

BORING 113-22

Chemical	Sample Interval (ft bgs)																		Background Range[1]
	0-.5			18-20			25-25.5			35-36.2			45-45.9			56.5-58.5			
	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	
Aluminum	6010		10.2	5360		10.3	7190		21.8	5090		21.2	3880		10.4	4380		10.6	596 - 10,796
Antimony	5.2	J	6.1		U	6.2	11	J	13.1		U	12.7		U	6.3		UJ	6.4	0 - 29.6
Arsenic	2.3		0.51	1.1		0.51	0.75		0.55	0.97		0.53	0.68		0.52	0.75		0.53	0 - 10.5
Barium	226	J	1	115	J	1	137	J	2.2	94.3	J	2.1	84.2	J	1	32.7		1.1	0 - 548
Beryllium	0.45		0.2	0.29		0.21	0.33	J	0.44		U	0.42	0.12	J	0.21	0.17	J	0.21	0 - 0.6
Cadmium		U	0.51		U	0.51		U	1.1		U	1.1		U	0.52		U	0.53	0 - 2.1
Calcium	83300		20.5	36900		20.6	**207000**		43.7	150000		42.4	59000		20.9	53300		21.2	0 - 166,119
Chromium	5		1	4.2		1	6.4		2.2	2.2		2.1	2.3		1	3.6		1.1	0.8 - 12.0
Cobalt	3.1		1	2		1	2.4		2.2		U	2.1	0.87	J	1	1.2		1.1	0 - 4.0
Copper	5.5		2	2.3		2.1	3.1	J	4.4	2	J	4.2	1.4	J	2.1	1.5	J	2.1	0 - 10.1
Iron	5510		10.2	4250		10.3	4090		21.8	3180		21.2	2860		10.4	3090		10.6	0 - 8,564
Lead	**78.2**		5.1	3.7		0.51	2.6		0.55	2.3		0.53	1.9		0.52	2.4	J	0.53	0 - 18.4
Magnesium	2270		20.5	3140		20.6	**10200**		43.7	6560		42.4	4430		20.9	6800		21.2	0 - 9,912
Manganese	129	J	1	41.8	J	1	44.1	J	2.2	27.9	J	2.1	31	J	1	39.6		1.1	0 - 151.8
Mercury		U	0.1		U	0.1		U	0.11		U	0.11		U	0.1		U	0.11	0 - 0.2
Nickel	7.1		4.1	8.1		4.1	9		8.7	5.9	J	8.5	3.8	J	4.2	3.7	J	4.2	0 - 9.7
Potassium	1390		512	1540		514	1280		1090	976	J	1060	816		522	760		530	0 - 2,531
Selenium		UJ	1		UJ	1		UJ	1.1		UJ	1.1		UJ	1		UJ	1.1	0 - 36.8
Silver		U	1		U	1		U	2.2		U	2.1		U	1		U	1.1	0 - 1.8
Sodium		U	512		U	514		U	1090		U	1060		U	522		U	530	0 - 834
Thallium		UJ	1	0.13	J	1		UJ	2.2		UJ	2.1		UJ	1		R		0 - 6.2
Tin	NA			NA			NA			NA			NA			NA	U	10.6	NA
Vanadium	15.8		1	11.9		1	16.5		2.2	11		2.1	7.4		1	13.9		1.1	1.7 - 25.0
Zinc	**22.1**		2	10.8		2.1	14.4		4.4	9.9		4.2	7.9		2.1	8		2.1	0 - 20.7
bis(2-Ethylhexyl)phthalate		U	340		U	340		U	360		U	350		U	340	42	J	350	
2-Butanone (MEK)		U	10		U	10	6.6	J	11		U	11		U	10		U	11	
Acetone		U	10	7	J	10	31	J	11	5.7	J	11	7.1	J	10		U	11	
Toluene		U	5.1		U	5.1		U	5.5		U	5.3	4.8	J	5.2		U	5.3	
Total Petroleum Hydrocarbons	51		41		U	41.1		U	43.7		U	42.4		U	41.8		U	42.4	

(1) Woodward-Clyde. 1994. Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater, Cannon AFB, New Mexico.

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Results that are shaded and in bold are concentrations above the maximum background range.

* Metals concentrations are in milligrams per kilogram (mg/kg), organic concentrations are in micrograms per kilogram (µg/kg)

TABLE 4-24

METALS RESULTS AND DETECTED CONCENTRATIONS FOR OTHER CHEMICALS COMPOUNDS
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico
BORING 113-23

Chemical	Sample Interval (ft bgs)															Background Range[1]
	19-20.5			24-26			35-36.3			45-47			54-55.1			
	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	
Aluminum	5530		55.8	6410		22.3	5380		22	5170		10.5	4990		10.5	596 - 10,796
Antimony		U	33.5		U	13.4		U	13.2		U	6.3		UJ	6.3	0 - 29.6
Arsenic	1.3		0.56	1.2		0.56	1.5		0.55	0.76		0.52	0.75		0.53	0 - 10.5
Barium	194	J	5.6	**608**	**J**	2.2	113	J	2.2	41.1	J	1	47.1		1.1	0 - 548
Beryllium		U	1.1	0.31	J	0.45	0.24	J	0.44	0.15	J	0.21	0.15	J	0.21	0 - 0.6
Cadmium		U	2.8		U	1.1		U	1.1		U	0.52		U	0.53	0 - 2.1
Calcium	**251000**		112	129000		44.7	**174000**		44	28400		21	32800		21.1	0 - 166,119
Chromium		U	5.6	5.3		2.2	7.5		2.2	4.2		1	7.9		1.1	0.8 - 12.0
Cobalt		U	5.6	1.8	J	2.2	2	J	2.2	1.4		1	1.7		1.1	0 - 4.0
Copper	6.2	J	11.2	7.4		4.5	3.6	J	4.4	1.7	J	2.1	3		2.1	0 - 10.1
Iron	3430		55.8	4160		22.3	3620		22	3870		10.5	4080		10.5	0 - 8,564
Lead	3.1		0.56	3.7		0.56	2.3		0.55	2.2		0.52	2.4		0.53	0 - 18.4
Magnesium	7100		112	7660		44.7	8950		44	4160		21	4630		21.1	0 - 9,912
Manganese	56.1	J	5.6	32.6	J	2.2	39.9	J	2.2	44.2	J	1	47.4		1.1	0 - 151.8
Mercury		U	0.11		U	0.11		U	0.11		U	0.1		U	0.11	0 - 0.2
Nickel	6.5	J	22.3	7.2	J	8.9	4	J	8.8	3.6	J	4.2	4.2		4.2	0 - 9.7
Potassium	1410	J	2790	1290		1120	906	J	1100	1100		524	1010		526	0 - 2,531
Selenium		UJ	1.1		UJ	1.1		UJ	1.1		UJ	1		UJ	1.1	0 - 36.8
Silver		U	5.6		U	2.2		U	2.2		U	1		U	1.1	0 - 1.8
Sodium		U	2790		U	1120		U	1100		U	524		U	526	0 - 834
Thallium		UJ	2.2		UJ	1.1		UJ	2.2		UJ	0.52		R		0 - 6.2
Tin	NA			NA			NA			NA			8.9	J	10.5	NA
Vanadium	14		5.6	22.3		2.2	20.1		2.2	9.7		1	10.7		1.1	1.7 - 25.0
Zinc	13.3		11.2	13		4.5	9		4.4	8.5		2.1	9.1		2.1	0 - 20.7
Acetone	6.7	J	11		U	11	24		11		U	10		U	11	
Methylene chloride		U	5.6	1.2	J	5.6		U	5.5		U	5.2	1.1	J	5.3	

(1) Woodward-Clyde. 1994. Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater, Cannon AFB, New Mexico.

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Results that are shaded and in bold are concentrations above the maximum background range.

* Metals concentrations are in milligrams per kilogram (mg/kg), organic concentrations are in micrograms per kilogram (µg/kg)

TABLE 4-25

METALS RESULTS AND DETECTED CONCENTRATIONS FOR OTHER CHEMICAL COMPOUNDS
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

BORING 113-24

Chemical	Sample Interval (ft bgs)															Background Range[1]
	24-26			29-29.8			40-42			50-50.8			59-60			
	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	
Aluminum	3310		22.1	4490		21.7	4230		10.8	3500		10.5	3600		10.8	596 - 10,796
Antimony		UJ	13.3		UJ	13		UJ	6.5		UJ	6.3		UJ	6.5	0 - 29.6
Arsenic	0.7		0.55	0.74		0.54	0.12	J	0.54	0.73		0.52	0.68		0.54	0 - 10.5
Barium	103		2.2	367		2.2	56.2		1.1	147		1	251		1.1	0 - 548
Beryllium		U	0.44		U	0.43	0.13	J	0.22		U	0.21		U	0.22	0 - 0.6
Cadmium		U	1.1		U	1.1		U	0.54		U	0.52		U	0.54	0 - 2.1
Calcium	**185000**		44.2	145000		43.4	49200		21.6	69000		21	71800		21.5	0 - 166,119
Chromium	2.2	J	2.2	3.7	J	2.2	3.5	J	1.1	4.6	J	1	6.7	J	1.1	0.8 - 12.0
Cobalt	2	J	2.2	1.8	J	2.2	1.4		1.1	1.1		1	1.5		1.1	0 - 4.0
Copper	2.3	J	4.4	**41.9**		4.3	2.1	J	2.2	2.1		2.1	7.9		2.2	0 - 10.1
Iron	2000	J	22.1	3040	J	21.7	2880	J	10.8	2330	J	10.5	2370	J	10.8	0 - 8,564
Lead	2.2	UJ	1.1	12.2	J	1.1	1.9	J	1.1	2	J	1	2.2	J	0.54	0 - 18.4
Magnesium	3910	J	44.2	4370	J	43.4	5190	J	21.6	5440	J	21	9230	J	21.5	0 - 9,912
Manganese	30.2	J	2.2	32.3	J	2.2	47.7	J	1.1	29.1	J	1	39.7	J	1.1	0 - 151.8
Mercury		U	0.11		U	0.11		U	0.11		U	0.1		U	0.11	0 - 0.2
Nickel	3.4	J	8.8	6.1	J	8.7	4.9	J	4.3	3.4	J	4.2	4	J	4.3	0 - 9.7
Potassium	547	J	1110	631	J	1090	1090		539	788		524	648		538	0 - 2,531
Selenium		UJ	1.1		UJ	1.1		UJ	1.1		UJ	1		UJ	1.1	0 - 36.8
Silver		U	2.2		U	2.2		U	1.1		U	1		U	1.1	0 - 1.8
Sodium		U	1110		U	1090		U	539		U	524		U	538	0 - 834
Thallium		UJ	1.1	0.12	J	1.1		UJ	0.54		UJ	1		UJ	0.54	0 - 6.2
Tin	NA			NA			NA			NA			NA	U	10.8	NA
Vanadium	9.1		2.2	12.8		2.2	11.6		1.1	9.3		1	14.1		1.1	1.7 - 25.0
Zinc	6.9	J	4.4	11.9	J	4.3	8.9	J	2.2	5.8	J	2.1	5.8	J	2.2	0 - 20.7
4-Methylphenol		U	370	68	J	360		U	360		U	350				
bis(2-Ethylhexyl)phthalate		U	370	65	J	360		U	360		U	350		U	360	
Butyl benzyl phthalate		U	370	40	J	360		U	360		U	350		U	360	
2-Butanone (MEK)	2.5	J	11	22		11		U	11	4.7	J	10	5.6	J	11	
2-Hexanone		U	11	3.4	J	11		U	11		U	10		U	11	
4-Methyl-2-pentanone (MIBK)		U	11		U	11		U	11		U	10		U	11	

TABLE 4-25

METALS RESULTS AND DETECTED CONCENTRATIONS FOR OTHER CHEMICAL COMPOUNDS
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

BORING 113-24

Chemical	Sample Interval (ft bgs)															Background Range[1]
	24-26			29-29.8			40-42			50-50.8			59-60			
	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	
Acetone	4.4	J	11	57		11		U	11	9.3	J	10	9.9	J	11	
Toluene		U	5.5		U	5.4	1.8	J	5.4		U	5.2		U	5.4	
Total Petroleum Hydrocarbons		U	44.2	164		43.4		U	43.1		U	41.9		U	43.1	

(1) Woodward-Clyde. 1994. Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater, Cannon AFB, New Mexico.

U = Not Detected J = Estimated Value UJ = Estimated Reporting Limit NA = Not Analyzed

Results that are shaded and in bold are concentrations above the maximum background range.

* Metals concentrations are in milligrams per kilogram (mg/kg), organic concentrations are in micrograms per kilogram (µg/kg)

TABLE 4-26

METALS RESULTS AND DETECTED CONCENTRATIONS FOR OTHER CHEMICAL COMPOUNDS
Landfill No. 5 (SWMU No. 113/ORP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

BORING 113-25

Chemical	Sample Interval (ft bgs)																		Background Range[1]
	0-.5			24-26			30-30.9			40-42			50-50.5			60-62			
	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	
Aluminum	7950		20.6	7690		11.3	7740		24.2	5570		10.8	4880		11.1	4070		10.7	596 - 10,796
Antimony		UJ	12.4	5.2	J	6.8		UJ	14.5		UJ	6.5		UJ	6.6		UJ	6.4	0 - 29.6
Arsenic	1.7		0.52	0.84		0.56	1.1		0.6	0.82		0.54	0.91		0.55	0.79		0.54	0 - 10.5
Barium	281	J	2.1	103		1.1	386		2.4	56.3		1.1	263		1.1	42.1		1.1	0 - 548
Beryllium	0.45		0.41	0.35		0.23	0.28	J	0.48	0.19	J	0.22	0.18	J	0.22	0.16	J	0.21	0 - 0.6
Cadmium		U	1		U	0.56		U	1.2		U	0.54		U	0.55		U	0.54	0 - 2.1
Calcium	118000		41.3	74700		22.5	143000		48.4	48900		21.7	81200		22.2	52500		21.4	0 - 166,119
Chromium	5.2		2.1	5.1	J	1.1	**14.1**	**J**	2.4	3.4	J	1.1	5.8	J	1.1	3		1.1	0.8 - 12.0
Cobalt	3.2		2.1	2.3		1.1	2.4		2.4	1.6		1.1	1.5		1.1	1.2		1.1	0 - 4.0
Copper	4.3		4.1	2.2	J	2.3	4.3	J	4.8	1.7	J	2.2	2.3		2.2	1.5	J	2.1	0 - 10.1
Iron	6140		20.6	5650	J	11.3	6290	J	24.2	3310	J	10.8	3310	J	11.1	2600		10.7	0 - 8,564
Lead	5.2		0.52	3.9	J	0.56	4.4	J	0.6	3.3	J	0.54	2.9	J	0.55	2.1		0.54	0 - 18.4
Magnesium	4090		41.3	5290	J	22.5	**13000**	**J**	48.4	7440	J	21.7	7540	J	22.2	5980		21.4	0 - 9,912
Manganese	81.8	J	2.1	52.2	J	1.1	55.9	J	2.4	33.8	J	1.1	37.4	J	1.1	41		1.1	0 - 151.8
Mercury		U	0.1		U	0.11		U	0.12		U	0.11		U	0.11		U	0.11	0 - 0.2
Nickel	6.6	J	8.3	7.1	J	4.5	**68.6**	**J**	9.7	5.4	J	4.3	5.5	J	4.4	3.7	J	4.3	0 - 9.7
Potassium	2100		1030	1470		563	1300		1210	1160		542	1030		554	758		535	0 - 2,531
Selenium		UJ	1		UJ	1.1		UJ	1.2		UJ	1.1		UJ	1.1		UJ	1.1	0 - 36.8
Silver		U	2.1		U	1.1		U	2.4		U	1.1		U	1.1		U	1.1	0 - 1.8
Sodium		U	1030		U	563		U	1210		U	542		U	554		U	535	0 - 834
Thallium		UJ	1		UJ	1.1		UJ	2.4		UJ	1.1		UJ	1.1		R		0 - 6.2
Tin	NA			NA			NA			NA			NA			NA	U	10.7	NA
Vanadium	17.1		2.1	15.2		1.1	19.4		2.4	11.8		1.1	11.2		1.1	11.9		1.1	1.7 - 25.0
Zinc	17.6		4.1	14	J	2.3	**59**	**J**	4.8	9.2	J	2.2	8.9	J	2.2	7.7		2.1	0 - 20.7
bis(2-Ethylhexyl)phthalate		U	340		U	370		U	400		U	360		U	370	160	J	350	
Acetone		U	10		UJ	11		UJ	12		UJ	11	4.1	J	11	4.9	J	11	
Toluene		U	5.2		U	5.6		U	6		U	5.4		U	5.5	1.7	J	5.4	

(1) Woodward-Clyde. 1994 Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater, Cannon AFB, New Mexico.

U = Not Detected J = Estimated Value UJ = Estimated Reporting Limit NA = Not Analyzed

Results that are shaded and in bold are concentrations above the maximum background range.

* Metals concentrations are in milligrams per kilogram (mg/kg), organic concentrations are in micrograms per kilogram (µg/kg)

TABLE 4-27

METALS RESULTS AND DETECTED CONCENTRATIONS FOR OTHER CHEMICAL COMPOUNDS
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico
BORING 113-26

Chemical	Sample Interval (ft bgs)															Background Range[1]
	21.5-23			27-29			37-39			47-47.5			55-56.5			
	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	
Aluminum	7090		21.9	6720		22.1	3520		10.8	4340		11.1	3210		10.6	596 - 10,796
Antimony		UJ	13.1		UJ	13.2		UJ	6.5		UJ	6.7		UJ	6.3	0 - 29.6
Arsenic	0.95		0.55	1.3		0.55	0.73		0.54	0.49	J	1.1	0.43	J	0.53	0 - 10.5
Barium	187		2.2	342		2.2	43.9		1.1	94.6		1.1	93.6		1.1	0 - 548
Beryllium		U	0.44		U	0.44		U	0.22		U	0.22		U	0.21	0 - 0.6
Cadmium		UJ	1.1		UJ	1.1		UJ	0.54		UJ	0.56		UJ	0.53	0 - 2.1
Calcium	163000		43.8	**167000**		44.1	62600		21.5	99300		22.2	32600		21.1	0 - 166,119
Chromium	11.1	J	2.2	11.6	J	2.2	3.4	J	1.1	**15.6 J**		1.1	10.2		1.1	0.8 - 12.0
Cobalt	2.2		2.2	2.2		2.2	1.5		1.1	2.1		1.1	1.4		1.1	0 - 4.0
Copper	2.4	J	4.4	2.7	J	4.4	1.5	J	2.2	4.3		2.2	2.3		2.1	0 - 10.1
Iron	4560	J	21.9	4600	J	22.1	2560	J	10.8	3370	J	11.1	2640		10.6	0 - 8,564
Lead	3	J	0.55	4.2	J	0.55	1.7	J	0.54	1.6	J	0.56	1.3		0.53	0 - 18.4
Magnesium	5700	J	43.8	5390	J	44.1	4180	J	21.5	**16300 J**		22.2	3980		21.1	0 - 9,912
Manganese	48.5	J	2.2	51.9	J	2.2	24.1	J	1.1	52.8	J	1.1	46.6		1.1	0 - 151.8
Mercury		U	0.11		U	0.11		U	0.11		U	0.11		U	0.11	0 - 0.2
Nickel	7.1	J	8.8	7	J	8.8	4.3	J	4.3	5	J	4.4	3.2	J	4.2	0 - 9.7
Potassium	1090		1090	1160		1100	735		538	679		555	585		528	0 - 2,531
Selenium		UJ	1.1		UJ	1.1		UJ	1.1		UJ	1.1		UJ	1.1	0 - 36.8
Silver		U	2.2		U	2.2		U	1.1		U	1.1		U	1.1	0 - 1.8
Sodium		U	1090		UJ	1100		U	538		U	555		U	528	0 - 834
Thallium		UJ	1.1		UJ	1.1		UJ	1.1		UJ	2.2		R		0 - 6.2
Tin	NA			NA			NA			NA			NA	U	10.6	NA
Vanadium	16.3		2.2	15.7		2.2	10.6		1.1	18.7		1.1	9.4		1.1	1.7 - 25.0
Zinc	11.8	J	4.4	11.8	J	4.4	5.7	J	2.2	6.6	J	2.2	6.1		2.1	0 - 20.7
bis(2-Ethylhexyl)phthalate		U	360	43	J	360		U	360		U	370		U	350	
2-Butanone (MEK)	17		11		U	11		U	11		U	11		U	11	
Acetone	130	J	11	11	J	11		UJ	11	26	J	11		U	11	
Methylene chloride	1.3	J	5.5		U	5.5		U	5.4		U	5.6		U	5.3	

(1) Woodward-Clyde. 1994. Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater, Cannon AFB, New Mexico.

U = Not Detected J = Estimated Value UJ = Estimated Reporting Limit NA = Not Analyzed

Results that are shaded and in bold are concentrations above the maximum background range.

* Metals concentrations are in milligrams per kilogram (mg/kg), organic concentrations are in micrograms per kilogram (µg/kg)

TABLE 4-28

METALS RESULTS AND DETECTED CONCENTRATIONS FOR OTHER CHEMICAL COMPOUNDS
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

BORING 113-27

Chemical	Sample Interval (ft bgs)															Background Range[1]
	21-23			24.5-26.5			34.5-36.5			44.5-46			57.5-58.1			
	Result	Qual	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	
Aluminum	4410		10.8	5030		10.7	6270		10.9	3460		10.6	3060		10.4	596 - 10,796
Antimony		UJ	6.5		UJ	6.4		UJ	6.5		UJ	6.3		UJ	6.3	0 - 29.6
Arsenic	3.9		0.54	4.4		0.53	1.2		0.54	0.32	J	1.1	0.49	J	1	0 - 10.5
Barium	92		1.1	225		1.1	164		1.1	135		1.1	31		1	0 - 548
Beryllium	0.31		0.22	0.3		0.21	0.25		0.22		U	0.21		U	0.21	0 - 0.6
Cadmium		UJ	0.54		UJ	0.53		UJ	0.54		UJ	0.53		UJ	0.52	0 - 2.1
Calcium	43800		21.6	48200		21.4	57900		21.8	51900		21.1	68700		20.9	0 - 166,119
Chromium	7.1	J	1.1	8.5	J	1.1	5.5	J	1.1	3.5	J	1.1	5.2		1	0.8 - 12.0
Cobalt	1.9		1.1	2.3		1.1	0.98	J	1.1	1.5		1.1	1.3		1	0 - 4.0
Copper	3.4		2.2	4.2		2.1	2.6		2.2	1.9	J	2.1	1.8	J	2.1	0 - 10.1
Iron	5230	J	10.8	5230	J	10.7	4150	J	10.9	2340	J	10.6	2180		10.4	0 - 8,564
Lead	4.2	J	0.54	4	J	0.53	2.1	J	0.54	0.63	J	0.53	1.4		1	0 - 18.4
Magnesium	2240	J	21.6	3200	J	21.4	9100	J	21.8	6340	J	21.1	5060		20.9	0 - 9,912
Manganese	40.7	J	1.1	95.6	J	1.1	38	J	1.1	30.5	J	1.1	36.3		1	0 - 151.8
Mercury		U	0.11		U	0.11		U	0.11		U	0.11		U	0.1	0 - 0.2
Nickel	6.3	J	4.3	6.2	J	4.3	4.2	J	4.4	3.6	J	4.2	2.8	J	4.2	0 - 9.7
Potassium	1380		541	1250		534	1100		545	698		528	535		522	0 - 2,531
Selenium		UJ	1.1		UJ	1.1		UJ	1.1		UJ	1.1		UJ	1	0 - 36.8
Silver		U	1.1		U	1.1		U	1.1		U	1.1		U	1	0 - 1.8
Sodium		U	541		U	534		U	545		U	528		U	522	0 - 834
Thallium		UJ	0.54		UJ	1.1		UJ	1.1		UJ	0.53		R		0 - 6.2
Tin	NA			NA			NA			NA			NA	U	10.4	NA
Vanadium	**36.7**		1.1	**31.1**		1.1	17.6		1.1	7.4		1.1	8.7		1	1.7 - 25.0
Zinc	12.7	J	2.2	14.3	J	2.1	10.2	J	2.2	6.6	J	2.1	5.3		2.1	0 - 20.7
Acetone	5	J	11		U	11	17		11	4.2	J	11	11		10	

(1) Woodward-Clyde. 1994. Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater, Cannon AFB, New Mexico.

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Results that are shaded and in bold are concentrations above the maximum background range.

* Metals concentrations are in milligrams per kilogram (mg/kg), organic concentrations are in micrograms per kilogram (µg/kg)

TABLE 4-29

METALS RESULTS AND DETECTED CONCENTRATIONS FOR OTHER CHEMICAL COMPOUNDS
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

BORING 113-28

Chemical	Sample Interval (ft bgs)																		Background Range[1]
	0-.5			20-21.5			25-27			35-37			45-47			55-57			
	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	
Aluminum	9700		10.4	3720	J	55.5	7070	J	22.4	6250	J	10.9	4600	J	10.4	4340		10.5	596 - 10,796
Antimony		R			UJ	33.3		UJ	13.5		UJ	6.5		UJ	6.2		UJ	6.3	0 - 29.6
Arsenic	1.7		0.52	0.93		0.56	0.81		0.56	0.52	J	1.1	0.43	J	0.52	0.36	J	1	0 - 10.5
Barium	281	J	1	201	J	5.6	170	J	2.2	95	J	1.1	49.7	J	1	30.6		1	0 - 548
Beryllium	0.46		0.21		U	1.1	0.29	J	0.45	0.21	J	0.22	0.13	J	0.21	0.13	J	0.21	0 - 0.6
Cadmium		UJ	0.52		U	2.8		U	1.1		UJ	0.54		UJ	0.52		UJ	0.52	0 - 2.1
Calcium	78500		20.7	**284000**		111	131000		44.8	61100		21.8	27000		20.8	17100		21	0 - 166,119
Chromium	7.4		1		U	5.6	4.4		2.2	4.6		1.1	3.9		1	3.9		1	0.8 - 12.0
Cobalt	3.3		1		U	5.6	3		2.2	1.1		1.1	1.6		1	1.3		1	0 - 4.0
Copper	6.3		2.1	3.3	J	11.1	2.4	J	4.5	1.8	J	2.2	1.5	J	2.1	1.6	J	2.1	0 - 10.1
Iron	7520		10.4	2360	J	55.5	4150	J	22.4	4230	J	10.9	3590	J	10.4	3320		10.5	0 - 8,564
Lead	9.6		1	1.8		0.56	2.7		0.56	2.5		0.54	1.8		0.52	1.8		0.52	0 - 18.4
Magnesium	3050		20.7	4610		111	6380		44.8	5860		21.8	3760		20.8	4060		21	0 - 9,912
Manganese	130	J	1	22.1	J	5.6	39.1	J	2.2	38.1	J	1.1	44.3	J	1	42.6		1	0 - 151.8
Mercury		U	0.1		U	0.11		U	0.11		U	0.11		U	0.1		U	0.1	0 - 0.2
Nickel	7.5		4.1		U	22.2	6.9	J	9	3.5	J	4.4	3.7	J	4.2	2.5	J	4.2	0 - 9.7
Potassium	2210		518	855	J	2780	1100	J	1120	1120		544	963		521	853		524	0 - 2,531
Selenium		UJ	1		UJ	1.1		UJ	1.1		UJ	1.1		UJ	1		UJ	0.52	0 - 36.8
Silver		U	1		UJ	5.6		UJ	2.2		UJ	1.1		UJ	1		U	1	0 - 1.8
Sodium		U	518		U	2780		U	1120		U	544		U	521		U	524	0 - 834
Thallium		U	1		UJ	2.2		UJ	1.1		UJ	1.1		UJ	0.52		R		0 - 6.2
Tin	NA			NA			NA			NA			NA			NA	U	10.5	NA
Vanadium	17.3		1	9.4		5.6	13.5		2.2	15.9		1.1	9.1		1	9.7		1	1.7 - 25.0
Zinc	**21.8**		2.1	10.3	J	11.1	10.5		4.5	10		2.2	8		2.1	7.7		2.1	0 - 20.7
Acetone		U	10		U	11	6	J	11	3	J	11	1.9	J	10		U	10	
Total Organic Carbon	0.57		0.2																
Total Petroleum Hydrocarbons	85.6		41.4		U	44.4		U	44.8		U	43.5		U	41.6		U	41.9	

(1) Woodward-Clyde. 1994. Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater, Cannon AFB, New Mexico.

U = Not Detected J = Estimated Value UJ = Estimated Reporting Limit NA = Not Analyzed

Results that are shaded and in bold are concentrations above the maximum background range.

* Metals concentrations are in milligrams per kilogram (mg/kg), organic concentrations are in micrograms per kilogram (µg/kg)

TABLE 4-30

METALS RESULTS AND DETECTED CONCENTRATIONS FOR OTHER CHEMICAL COMPOUNDS
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

BORING 113-29

Chemical	Sample Interval (ft bgs)															Background Range[1]
	14-16			20-22			30-32			40-42			50-51.8			
	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	
Aluminum	7560	J	11.3	6030	J	22.6	5290	J	10.9	4540	J	22	4080		11	596 - 10,796
Antimony		UJ	6.8		UJ	13.5		UJ	6.5		UJ	13.2		UJ	6.6	0 - 29.6
Arsenic	1.7		0.56	0.89		0.56	0.74		0.54	0.84		0.55	0.56		0.55	0 - 10.5
Barium	**1920**	**J**	1.1	**922**	**J**	2.3	130	J	1.1	90.1	J	2.2	50.9		1.1	0 - 548
Beryllium	0.49		0.23	0.31	J	0.45	0.16	J	0.22		U	0.44	0.14	J	0.22	0 - 0.6
Cadmium		U	0.56		U	1.1		UJ	0.54		U	1.1		UJ	0.55	0 - 2.1
Calcium	74700		22.6	**186000**		45.1	78500		21.8	124000		44	62000		21.9	0 - 166,119
Chromium	6.1		1.1	3.6		2.3	4.7		1.1	3.9		2.2	5.3		1.1	0.8 - 12.0
Cobalt	2.2		1.1	1.9	J	2.3	1.4		1.1	2.2		2.2	1	J	1.1	0 - 4.0
Copper	3.8		2.3	2.7	J	4.5	1.7	J	2.2	2.1	J	4.4	1.6	J	2.2	0 - 10.1
Iron	5590	J	11.3	3570	J	22.6	3610	J	10.9	3320	J	22	3440		11	0 - 8,564
Lead	5.8		0.56	2.9		0.56	2.3		0.54	1.8		0.55	2		0.55	0 - 18.4
Magnesium	3650		22.6	5330		45.1	5800		21.8	5150		44	5410		21.9	0 - 9,912
Manganese	74.3	J	1.1	33.7	J	2.3	36.3	J	1.1	41.8	J	2.2	36.7		1.1	0 - 151.8
Mercury		U	0.11		U	0.11		U	0.11		U	0.11		U	0.11	0 - 0.2
Nickel	8.3		4.5	5.6	J	9	4.6		4.4	4.5	J	8.8	4.1	J	4.4	0 - 9.7
Potassium	2040		565	1290		1130	886		544	757	J	1100	679		548	0 - 2,531
Selenium		UJ	1.1		UJ	1.1		UJ	1.1		UJ	1.1		UJ	1.1	0 - 36.8
Silver		UJ	1.1		UJ	2.3		UJ	1.1		UJ	2.2		U	1.1	0 - 1.8
Sodium		U	565		U	1130		U	544		U	1100		U	548	0 - 834
Thallium	0.12	J	1.1		UJ	2.3		UJ	1.1	0.13	J	1.1		R		0 - 6.2
Tin	NA			NA			NA			NA			NA	U	11	NA
Vanadium	16.3		1.1	10.9		2.3	13.7		1.1	9		2.2	9.7		1.1	1.7 - 25.0
Zinc	13.4		2.3	10.2		4.5	8		2.2	8.6		4.4	7.8		2.2	0 - 20.7
Acetone	6.3	J	11		UJ	11		U	11		U	11	4.3	J	11	

(1) Woodward-Clyde. 1994. Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater, Cannon AFB, New Mexico.

U = Not Detected J = Estimated Value UJ = Estimated Reporting Limit NA = Not Analyzed

Results that are shaded and in bold are concentrations above the maximum background range.

* Metals concentrations are in milligrams per kilogram (mg/kg), organic concentrations are in micrograms per kilogram (µg/kg)

TABLE 4-31

METALS RESULTS AND DETECTED CONCENTRATIONS FOR OTHER CHEMICAL COMPOUNDS
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

BORING 113-30

Chemical	Sample Interval (ft bgs)															Background[1] Range
	14.5-16.5			20-21.3			30-32			40-42			50-52			
	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	Result	Qual.	R.L.	
Aluminum	7330	J	11.2	3690	J	54.6	4680	J	11	4240	J	10.7	3450		10.6	596 - 10,796
Antimony		UJ	6.7		UJ	32.8		UJ	6.6		UJ	6.4		UJ	6.3	0 - 29.6
Arsenic	1.6		0.56	0.82		0.55	0.54	J	1.1	0.55		0.54	0.34	J	1.1	0 - 10.5
Barium	279	J	1.1	**3470**	**J**	5.5	168	J	1.1	125	J	1.1	26.8		1.1	0 - 548
Beryllium	0.48		0.22		U	1.1		U	0.22		U	0.21		U	0.21	0 - 0.6
Cadmium		UJ	0.56		UJ	2.7		UJ	0.55		UJ	0.54		UJ	0.53	0 - 2.1
Calcium	69200		22.3	**229000**		109	100000		22	45100		21.4	14900		21.2	0 - 166,119
Chromium	7.6		1.1		U	5.5	4.9		1.1	4.1		1.1	4.1		1.1	0.8 - 12.0
Cobalt	2.9		1.1		U	5.5	1.4		1.1	1.4		1.1	1.3		1.1	0 - 4.0
Copper	4.3		2.2		U	10.9	1.8	J	2.2	2.3		2.1	1.5	J	2.1	0 - 10.1
Iron	6560	J	11.2	2690	J	54.6	2960	J	11	2830	J	10.7	2710		10.6	0 - 8,564
Lead	5.4		2.8	1.9		0.55	2.1		0.55	1.4		0.54	1.2		0.53	0 - 18.4
Magnesium	4500		22.3	4450		109	7580		22	5720		21.4	4400		21.2	0 - 9,912
Manganese	81	J	1.1	22.6	J	5.5	28.3	J	1.1	34.8	J	1.1	33.4		1.1	0 - 151.8
Mercury		U	0.11		U	0.11		U	0.11		U	0.11		U	0.11	0 - 0.2
Nickel	**23.9**		4.5		U	21.8	3.7	J	4.4	3.8	J	4.3	3.1	J	4.2	0 - 9.7
Potassium	2200		559	683	J	2730	729		550	887		535	707		529	0 - 2,531
Selenium		UJ	1.1		UJ	1.1		UJ	11		UJ	1.1		UJ	1.1	0 - 36.8
Silver		UJ	1.1		UJ	5.5		UJ	1.1		UJ	1.1		U	1.1	0 - 1.8
Sodium		U	559		UJ	2730		U	550		U	535		U	529	0 - 834
Thallium		UJ	1.1		UJ	2.2		UJ	1.1		UJ	1.1		R		0 - 6.2
Tin	NA			NA			NA			NA			NA	U	10.6	NA
Vanadium	18.1		1.1	9.9		5.5	17.1		1.1	7.5		1.1	7.9		1.1	1.7 - 25.0
Zinc	13.7		2.2	8.5	J	10.9	7.1		2.2	7.8		2.1	6.1		2.1	0 - 20.7
Acetone		U	11	55		11		U	11	7.2	J	11	5.2	J	11	

(1) Woodward-Clyde. 1994. Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater, Cannon AFB, New Mexico.

U = Not Detected J = Estimated Value UJ = Estimated Reporting Limit NA = Not Analyzed

Results that are shaded and in bold are concentrations above the maximum background range.

* Metals concentrations are in milligrams per kilogram (mg/kg), organic concentrations are in micrograms per kilogram (µg/kg)

TABLE 4-32
METALS CONCENTRATIONS THAT EXCEEDED THE BACKGROUND RANGE IN SURFACE AND SUBSURFACE SOIL
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

CHEMICAL	113-01			113-02		113-03		113-04			113-05			Background Range (mg/kg)
	28 ft.[1]	45 ft.	63 ft.	14 ft.	20 ft.	23 ft.	28 ft.	0 ft.	20 ft.	35 ft.	24 ft.	29 ft.	39 ft.	
Aluminum					11100									593-10,796
Barium		5050 J												0-548
Beryllium								.7						0-0.6
Calcium	167000			172000		222000 J	177000 J					204000 J		0-166,119
Chromium													29.4	0.8-12.0
Cobalt								5						0-4.0
Copper			63.6											0-10.1
Iron								9610						0-8,654
Lead														0-18.4
Magnesium										13800 J				0-9,912
Manganese								275 J						0-151.8
Nickel						22.4 J			10.4		392			0-9.7
Potassium					2550			2970						0-2,531
Silver														0-1.8
Sodium														0-834
Vanadium														1.7-25.0
Zinc								28.2			46.7			0-20.7

TABLE 4-32
METALS CONCENTRATIONS THAT EXCEEDED THE BACKGROUND RANGE IN SURFACE AND SUBSURFACE SOIL
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

	113-06	113-07	113-08		113-10			113-11	113-12		113-13		Background Range (mg/kg)
CHEMICAL	20 ft.	24 ft.	20 ft.	25 ft.	29 ft.	34 ft.	64 ft.	35 ft.	27 ft.	34 ft.	0 ft.	40 ft.	
Aluminum													593-10,796
Barium						595				654 J			0-548
Beryllium													0-0.6
Calcium	251000 J								190000	179000			0-166,119
Chromium						40.7	30.7						0.8-12.0
Cobalt													0-4.0
Copper	27.5												0-10.1
Iron						9580							0-8,654
Lead													0-18.4
Magnesium												10600 J	0-9,912
Manganese													0-151.8
Nickel	10.7 J	46.2			18.4	30.2		50.7					0-9.7
Potassium													0-2,531
Silver													0-1.8
Sodium											3920		0-834
Vanadium	25.5		33.5	27.7				27.2					1.7-25.0
Zinc		23.4											0-20.7

TABLE 4-32
METALS CONCENTRATIONS THAT EXCEEDED THE BACKGROUND RANGE IN SURFACE AND SUBSURFACE SOIL
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

	113-14		113-15	113-16				113-17			113-19	113-20		Background Range (mg/kg)
CHEMICAL	32 ft.	38 ft.	35 ft.	0 ft.	45 ft.	50 ft.	70 ft.	19 ft.	25 ft.	35 ft.	25 ft.	16 ft.	20 ft.	
Aluminum														593-10,796
Barium								1260 J		736 J				0-548
Beryllium														0-0.6
Calcium								168000					197000	0-166,119
Chromium				19.2										0.8-12.0
Cobalt														0-4.0
Copper					12.6	11.6	27.5					23.5		0-10.1
Iron											8810			0-8,654
Lead				41.1										0-18.4
Magnesium	13200	14500	11100 J											0-9,912
Manganese														0-151.8
Nickel								20.5						0-9.7
Potassium											2550			0-2,531
Silver						4.8								0-1.8
Sodium														0-834
Vanadium											35.6			1.7-25.0
Zinc				25.3					24.3					0-20.7

TABLE 4-32
METALS CONCENTRATIONS THAT EXCEEDED THE BACKGROUND RANGE IN SURFACE AND SUBSURFACE SOIL
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

	113-21		113-22		113-23			113-24		113-25	113-26		Background Range (mg/kg)
CHEMICAL	22 ft.	27 ft.	0 ft.	25 ft.	19 ft.	24 ft.	35 ft.	24 ft.	29 ft.	30 ft.	27 ft.	47 ft.	
Aluminum													593-10,796
Barium						608 J							0-548
Beryllium													0-0.6
Calcium	254000 J	173000 J		207000	251000		174000	185000			167000		0-166,119
Chromium										14.1 J		15.6 J	0.8-12.0
Cobalt													0-4.0
Copper									41.9				0-10.1
Iron													0-8,654
Lead			78.2										0-18.4
Magnesium				10200						13000 J		16300 J	0-9,912
Manganese													0-151.8
Nickel										68.6 J			0-9.7
Potassium													0-2,531
Silver													0-1.8
Sodium													0-834
Vanadium													1.7-25.0
Zinc			22.1							59 J			0-20.7

TABLE 4-32
METALS CONCENTRATIONS THAT EXCEEDED THE BACKGROUND RANGE IN SURFACE AND SUBSURFACE SOIL
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

CHEMICAL	113-27		113-28		113-29		113-30		Background Range (mg/kg)
	21 ft.	24 ft.	0 ft.	20 ft.	14 ft.	20 ft.	14 ft.	20 ft.	
Aluminum									593-10,796
Barium					1920 J	922 J		3470 J	0-548
Beryllium									0-0.6
Calcium				284000		186000		229000	0-166,119
Chromium									0.8-12.0
Cobalt									0-4.0
Copper									0-10.1
Iron									0-8,654
Lead									0-18.4
Magnesium									0-9,912
Manganese									0-151.8
Nickel							23.9		0-9.7
Potassium									0-2,531
Silver									0-1.8
Sodium									0-834
Vanadium	36.7	31.1							1.7-25.0
Zinc			21.8						0-20.7

Note: (1) Sample Intervals are based on feet below ground surface.
J = Estimated value
* Metals concentrations are in milligrams per kilogram (mg/kg)
Background ranges of metals not detected above the highest background values in soil at Landfill No. 5

Antimony - 0-29.6 mg/kg
Arsenic - 0-10.5 mg/kg
Cadmium - 0-2.1 mg/kg
Mercury - 0-0.2 mg/kg
Selenium - 0-36.8 mg/kg
Thallium - 0-6.2 mg/kg

TABLE 4-33

METAL CONCENTRATIONS ABOVE THE BACKGROUND RANGE IN SUBSURFACE SAMPLES
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

Boring No.	Metals above the background range
113-01	Ca, Ba, Cu
113-02	Ca, Al, K
113-03	Ca, Ni
113-04	Ni, Mg
113-05	Ni, Zn, Ca, Cr
113-06	Cu, Ca, Ni, Cr
113-07	Ni, Zn
113-08	V
113-09	--
113-10	Ni, Ba, Cr, Fe
113-11	N, V
113-12	Ca, Ba
113-13	Mg
113-14	Mg
113-15	Mg
113-16	Cu, Ag
113-17	Ba, Ni, Ca, Zn
113-18	--
113-19	Fe, K, V
113-20	Cu, Ca
113-21	Ca
113-22	Ca, Mg
113-23	Ca, Ba
113-24	Cu, Ca
113-25	Ni, Cr, Zn, Mg
113-26	Ca, Mg, Cr
113-27	V
113-28	Ca
113-29	Ba, Ca
113-30	Ni, Ba, Ca

Notes:

The following is a summary of the metals detected above the highest estimated range and the borings where these metals were detected.

(Al) Aluminum	113-02
(Ba) Barium	113-01, 113-10, 113-12, 113-17, 113-23, 113-29 and 113-30
(Ca) Calcium	113-01, 113-02, 113-03, 113-05, 113-06, 113-12, 113-17, 113-20 113-21, 113-22, 113-23, 113-24, 113-26, 113-28, 113-29, 113-30
(Cr) Chromium	113-05, 113-10, 113-25, 113-26
(Cu) Copper	113-01, 113-06, 113-16, 113-20, 113-24

TABLE 4-33
(Concluded)

(Fe) Iron	113-10, 113-19
(Mg) Magnesium	113-04, 113-13, 113-14, 113-15, 113-22, 113-25, 113-26
(Ni) Nickel	113-03, 113-04, 113-05, 113-06, 113-07, 113-10, 113-11, 113-17 113-25, 113-30
(K) Potassium	113-02, 113-19
(Ag) Silver	113-16
(V) Vanadium	113-06, 113-08, 113-11, 113-19, 113-27
(Zn) Zinc	113-05, 113-07, 113-17, 113-25

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TABLE 4-34

METALS WITH DETECTION LIMITS ABOVE THE BACKGROUND

Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

Sample I.D.		Boring 113-03 CAN113-B303-1023	Boring 113-06 CAN113-B306-1020	Boring 113-23 CAN113-B323-1019	Boring 113-28 CAN113-B328-1020	Boring 113-30 CAN113-B330-1020	Background Range[1] (mg/kg)
Antimony	(mg/kg)	(31.5)	(33.9)	(33.5)	(33.3)	--	0-29.6
Beryllium	(mg/kg)	(1)	(1.1)	(1.1)	(1.1)	(1.1)	0-0.6
Cadmium	(mg/kg)	(2.6)	(2.8)	(2.8)	(2.8)	(2.7)	0-2.1
Cobalt	(mg/kg)	(5.2)	(5.7)	(5.6)	(5.6)	(5.5)	0-4.0
Copper	(mg/kg)	--	--	--	--	(10.9)	0-10.1

Notes:
(1) Woodward-Clyde. 1994. Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater, Cannon AFB,
( ) denotes the Laboratory Detection Limit
-- denotes analyte detected or reporting limit below maximum background concentration

TABLE 4-35

SUMMARY OF SEMIVOLATILE ANALYTES DETECTED IN SURFACE AND SUBSURFACE SOIL
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

CHEMICAL		113-01		113-13				113-15		113-16	113-17	113-24
		28 ft.[1]	63 ft.	27 ft.	40 ft.	50 ft.	62 ft.	20 ft.	25 ft.	45 ft.	25 ft.	29 ft.
2-Methylnaphthalene	µg/kg				85 J							
Acenaphthene	µg/kg		39 J	37 J	82 J							
Chrysene	µg/kg				38 J							
Fluoranthene	µg/kg		67 J		93 J							
Fluorene	µg/kg		41 J		69 J							
Phenanthrene	µg/kg		130 J	78 J	220 J	69 J	41 J					
Pyrene	µg/kg		88 J		74 J							
4-Methylphenol	µg/kg									100 J		68 J
4-Nitrophenol	µg/kg							49 J	68 J			
Phenol	µg/kg	360								40 J	47 J	
Dibenzofuran	µg/kg				44 J							

Note: The semivolatile compounds presented in this Table are exclusive of the compounds that are considered to be laboratory contaminants. These are bis(2-ethylhexyl)phthalate, butyl benzyl phthalate, di-n-butyl phthalate, di-n-octyl phthalate and diethyl phthalate.

(1) Sample Intervals are based on feet below ground surface.

TABLE 4-36

SUMMARY OF VOLATILE ANALYTES, TRPH, TOTAL SULFIDE AND TOC DETECTED IN SURFACE AND SUBSURFACE SOIL SAMPLES
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

CHEMICAL		113-01	113-04	113-05			113-06	113-07		113-08	113-10			113-11
		0 ft.	0 ft.	24.5 ft.	29.5 ft.	59.5 ft.	25 ft.	0 ft.	59 ft.	55 ft.	0 ft.	34 ft.	54 ft.	35 ft.
1,1,2,2-Tetrachloroethane	µg/kg													
2-Hexanone	µg/kg				1.9 J							1.6 J		
4-Methyl-2-pentanone (MIBK)	µg/kg											6.4 J		
Acetonitrile	µg/kg					16 J			33 J	67 J				
Carbon disulfide	µg/kg						2.9 J							
Ethylbenzene	µg/kg													
Styrene	µg/kg													
Toluene	µg/kg	2.5 J	1.3 J					3.8 J			4.9 J		1 J	
Sulfide, Total	mg/kg								.57					
Total Organic Carbon	(%)													
TRPH	mg/kg			79.1				66.5			49			59.1

TABLE 4-36

SUMMARY OF VOLATILE ANALYTES, TRPH, TOTAL SULFIDE AND TOC DETECTED IN SURFACE AND SUBSURFACE SOIL SAMPLES
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

CHEMICAL		113-12	113-13		113-16				113-17		113-18		113-19
		65 ft.	0 ft.	27 ft.	0 ft.	45 ft.	50 ft.	60 ft.	19 ft.	25 ft.	28 ft.	63 ft.	0 ft.
1,1,2,2-Tetrachloroethane	µg/kg												
2-Hexanone	µg/kg					8.3 J	11 J		1.5 J				
4-Methyl-2-pentanone (MIBK)	µg/kg					230	220	2.5 J		10 J			
Acetonitrile	µg/kg	24 J											
Carbon disulfide	µg/kg												
Ethylbenzene	µg/kg		1.3 J	300									
Styrene	µg/kg		8.2	1400									
Toluene	µg/kg		1.9 J		1.4 J						1.4 J	1.1 J	4.4 J
Sulfide, Total	mg/kg												
Total Organic Carbon	(%)												
TRPH	mg/kg				72.5					170			43.5

TABLE 4-36

SUMMARY OF VOLATILE ANALYTES, TRPH, TOTAL SULFIDE AND TOC DETECTED IN SURFACE AND SUBSURFACE SOIL SAMPLES
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

CHEMICAL		113-21				113-22		113-24		113-25	113-28
		22 ft.[1]	27 ft.	45 ft.	57 ft.	0 ft.	45 ft.	29 ft.	40 ft.	60 ft.	0 ft.
1,1,2,2-Tetrachloroethane	µg/kg	2.3 J	8.2	3.5 J	3.1 J						
2-Hexanone	µg/kg							3.4 J			
4-Methyl-2-pentanone (MIBK)	µg/kg										
Acetonitrile	µg/kg										
Carbon disulfide	µg/kg										
Ethylbenzene	µg/kg										
Styrene	µg/kg										
Toluene	µg/kg						4.8 J		1.8 J	1.7 J	
Sulfide, Total	mg/kg										
Total Organic Carbon	(%)										.57
TRPH	mg/kg					51		164			85.6

Note: The volatile compounds presented in this Table are exclusive of the compounds that are considered to be laboratory contaminants. These are 2-butanone (MEK), acetone, and methylene chloride.

(1) Sample Intervals are based on feet below ground surface.

TABLE 4-37
SUMMARY OF SEMIVOLATILE ORGANIC TENTATIVELY IDENTIFIED COMPOUNDS DETECTED IN SURFACE AND SUBSURFACE SOIL
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

CHEMICAL	113-01	113-03	113-04			113-05		113-07		113-08		
	0 ft.	28 ft.	0 ft.	20 ft.	45 ft.	24.5 ft	59.5 ft.	0 ft.	24 ft.	25 ft.	45 ft.	55 ft.
.alpha.-Amyrin	140 NJ											
.alpha.-Pinene												
1,1'-Biphenyl, 4,4'-difluoro-												
1-Hexanol, 2-ethyl-												
1-Methylnaphthalene												
1-Nonadecanol												
1-Octadecanol												
14-Pentadecenoic acid												
2-Methylheptanoic acid												
3-Cyclohexene-1-methanol, .alpha.,.alpha.4-trim!	190 NJ											
3-Penten-2-one, 4-methyl-												
a'-Neogammacer-22(29)-en-3-ol,(3.beta.,21.beta.)-									180 NJ			
Butanoic acid												
Butanoic acid, 2-methyl-												
Cyclohexane, methyl-												
Cyclopentanecarboxylic acid, 2-amino-, trans-												
Eicosanoic acid, 2,3-bis (acetyloxy)propyl ester												
Hexadecanoic acid												
Hexanedioic acid, bis(2-ethylhexyl)ester				160 NJ			830 NJ					510 NJ
Hexanedioic acid, dioctyl ester												
Hexanoic acid												
Hexanoic acid, 2-ethyl-												
Hexanoic acid, 2-methyl-												
Isomer of Neogammacer-en-ol									1000 NJ			
Nitrogen compound												
Nonanedioic acid, bis(2-ethylhexyl) ester												
Octadecanoic acid, 2-methylpropyl ester									430 NJ			
Octadecanoic acid, butyl ester												
Octanoic acid												
Oleic Acid												
Oxygenated Hydrocarbon										440 NJ		
Pentanoic acid												
Pentanoic acid, 2-methyl-												
Phenol, 4,4'-butylidenebis[2-(1,1-dimethylethyl)!												
Polynuclear Aromatic Hydrocarbon												
Primary amide												
Propanoic acid												
Propanoic acid, 2-methyl-												
Saturated Hydrocarbon: >C20	290 NJ		150 NJ		160 NJ	310 NJ		290 NJ				
Saturated Hydrocarbon: C10-C20											910 NJ	
Stigmast-5-en-3-ol-, (3.beta.,24S)-	280 NJ		350 NJ		260 NJ			340 NJ				
Sulfur, mol. (S8)												
Unknown			360 NJ		150 NJ	850 NJ		520 NJ				
Unsaturated Hydrocarbon		170 NJ										

TABLE 4-37
SUMMARY OF SEMIVOLATILE ORGANIC TENTATIVELY IDENTIFIED COMPOUNDS DETECTED IN SURFACE AND SUBSURFACE SOIL
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

CHEMICAL	113-09	113-10		113-11		113-13				113-14	
	35 ft.	0 ft.	54 ft.	35 ft.	55 ft.	0 ft.	32 ft.	40 ft.	50 ft.	38 ft.	57 ft.
.alpha.-Amyrin											
.alpha.-Pinene		140 NJ									
1,1'-Biphenyl, 4,4'-difluoro-											
1-Hexanol, 2-ethyl-											
1-Methylnaphthalene								76 NJ			
1-Nonadecanol		200 NJ									
1-Octadecanol		240 NJ									
14-Pentadecenoic acid											
2-Methylheptanoic acid											
3-Cyclohexene-1-methanol, .alpha.,.alpha.4-trim!											
3-Penten-2-one, 4-methyl-				180 NJ							
a'-Neogammacer-22(29)-en-3-ol,(3.beta.,21.beta.)-											
Butanoic acid				1200 NJ						530 NJ	
Butanoic acid, 2-methyl-											
Cyclohexane, methyl-											
Cyclopentanecarboxylic acid, 2-amino-, trans-					200 NJ						
Eicosanoic acid, 2,3-bis (acetyloxy)propyl ester	340 NJ										
Hexadecanoic acid											
Hexanedioic acid, bis(2-ethylhexyl)ester							980 NJ				
Hexanedioic acid, dioctyl ester									1000 NJ		
Hexanoic acid										210 NJ	
Hexanoic acid, 2-ethyl-											
Hexanoic acid, 2-methyl-											
Isomer of Neogammacer-en-ol											
Nitrogen compound											
Nonanedioic acid, bis(2-ethylhexyl) ester											
Octadecanoic acid, 2-methylpropyl ester											
Octadecanoic acid, butyl ester					200 NJ						
Octanoic acid											
Oleic Acid											
Oxygenated Hydrocarbon			190 NJ	260 NJ							
Pentanoic acid											
Pentanoic acid, 2-methyl-											
Phenol, 4,4'-butylidenebis[2-(1,1-dimethylethyl)!											
Polynuclear Aromatic Hydrocarbon											
Primary amide											190 NJ
Propanoic acid											
Propanoic acid, 2-methyl-											
Saturated Hydrocarbon: >C20		410 NJ		640 NJ							
Saturated Hydrocarbon: C10-C20				160 NJ							
Stigmast-5-en-3-ol-, (3.beta.,24S)-		350 NJ									
Sulfur, mol. (S8)											
Unknown		460 NJ				270 NJ					
Unsaturated Hydrocarbon											

TABLE 4-37
SUMMARY OF SEMIVOLATILE ORGANIC TENTATIVELY IDENTIFIED COMPOUNDS DETECTED IN SURFACE AND SUBSURFACE SOIL
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

CHEMICAL	113-16			113-17	113-19	113-22			113-23			113-24
	0 ft.	45 ft.	50 ft.	25 ft.	0 ft.	0 ft.	18 ft.	45 ft.	19 ft.	24 ft.	35 ft.	29 ft.
alpha.-Amyrin												
alpha.-Pinene												
1,1'-Biphenyl, 4,4'-difluoro-												
1-Hexanol, 2-ethyl-				340 NJ								
1-Methylnaphthalene												
1-Nonadecanol												
1-Octadecanol												
14-Pentadecenoic acid				910 NJ								
2-Methylheptanoic acid												360 NJ
3-Cyclohexene-1-methanol, .alpha.,.alpha.4-trim!												
3-Penten-2-one, 4-methyl-												
a'-Neogammacer-22(29)-en-3-ol,(3.beta.,21.beta.)-												
Butanoic acid				3700 NJ								3400 NJ
Butanoic acid, 2-methyl-		490 NJ										700 NJ
Cyclohexane, methyl-							140 NJ	140 NJ	170 NJ	170 NJ	180 NJ	
Cyclopentanecarboxylic acid, 2-amino-, trans-												
Eicosanoic acid, 2,3-bis (acetyloxy)propyl ester												
Hexadecanoic acid				480 NJ								1000 NJ
Hexanedioic acid, bis(2-ethylhexyl)ester												
Hexanedioic acid, dioctyl ester												
Hexanoic acid		650 NJ		400 NJ								4900 NJ
Hexanoic acid, 2-ethyl-		400 NJ	150 NJ									
Hexanoic acid, 2-methyl-		320 NJ										2600 NJ
Isomer of Neogammacer-en-ol												
Nitrogen compound		140 NJ										
Nonanedioic acid, bis(2-ethylhexyl) ester		210 NJ										
Octadecanoic acid, 2-methylpropyl ester												
Octadecanoic acid, butyl ester												
Octanoic acid		270 NJ										1100 NJ
Oleic Acid												1700 NJ
Oxygenated Hydrocarbon		180 NJ		570 NJ								
Pentanoic acid		500 NJ		330 NJ								4200 NJ
Pentanoic acid, 2-methyl-		180 NJ										2200 NJ
Phenol, 4,4'-butylidenebis[2-(1,1-dimethylethyl)!												
Polynuclear Aromatic Hydrocarbon												
Primary amide												
Propanoic acid		3000 NJ	780 NJ	370 NJ								
Propanoic acid, 2-methyl-		1300 NJ	440 NJ									340 NJ
Saturated Hydrocarbon: >C20	380 NJ			830 NJ	240 NJ							570 NJ
Saturated Hydrocarbon: C10-C20						260 NJ						
Stigmast-5-en-3-ol-, (3.beta.,24S)-												
Sulfur, mol. (S8)		750 NJ	190 NJ									
Unknown												1200 NJ
Unsaturated Hydrocarbon												

TABLE 4-37
SUMMARY OF SEMIVOLATILE ORGANIC TENTATIVELY IDENTIFIED COMPOUNDS DETECTED IN SURFACE AND SUBSURFACE SOIL
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

CHEMICAL	113-25					113-26	113-27	113-28
	0 ft.	24 ft.	30 ft.	40 ft.	50 ft.	27 ft.	21 ft.	0 ft.
alpha.-Amyrin								
alpha.-Pinene								
1,1'-Biphenyl, 4,4'-difluoro-			280 NJ					
1-Hexanol, 2-ethyl-								
1-Methylnaphthalene								
1-Nonadecanol								
1-Octadecanol								
14-Pentadecenoic acid								
2-Methylheptanoic acid								
3-Cyclohexene-1-methanol, .alpha.,.alpha.4-trim!								
3-Penten-2-one, 4-methyl-								
a'-Neogammacer-22(29)-en-3-ol,(3.beta.,21.beta.)-								
Butanoic acid								
Butanoic acid, 2-methyl-								
Cyclohexane, methyl-							150 NJ	
Cyclopentanecarboxylic acid, 2-amino-, trans-								
Eicosanoic acid, 2,3-bis (acetyloxy)propyl ester								
Hexadecanoic acid								
Hexanedioic acid, bis(2-ethylhexyl)ester								
Hexanedioic acid, dioctyl ester								
Hexanoic acid								
Hexanoic acid, 2-ethyl-								
Hexanoic acid, 2-methyl-								
Isomer of Neogammacer-en-ol								
Nitrogen compound								
Nonanedioic acid, bis(2-ethylhexyl) ester								
Octadecanoic acid, 2-methylpropyl ester								
Octadecanoic acid, butyl ester								
Octanoic acid								
Oleic Acid								
Oxygenated Hydrocarbon							230 NJ	
Pentanoic acid								
Pentanoic acid, 2-methyl-								
Phenol, 4,4'-butylidenebis[2-(1,1-dimethylethyl)!						240 NJ		
Polynuclear Aromatic Hydrocarbon								190 NJ
Primary amide								
Propanoic acid								
Propanoic acid, 2-methyl-								
Saturated Hydrocarbon: >C20							170 NJ	330 NJ
Saturated Hydrocarbon: C10-C20	870 NJ	930 NJ	440 NJ	640 NJ	380 NJ			
Stigmast-5-en-3-ol-, (3.beta.,24S)-								
Sulfur, mol. (S8)								
Unknown								
Unsaturated Hydrocarbon								

Note: All semivolatile organic concentrations in micrograms per kilogram (µg/kg)
NJ = Tentatively identified compound with an estimated concentration.

TABLE 4-38
SUMMARY OF VOLATILE ORGANIC TENTATIVELY IDENTIFIED COMPOUNDS DETECTED IN SURFACE AND SUBSURFACE SOIL
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

CHEMICAL	113-01	113-04			113-05					113-07		113-09
	0 ft.	25 ft.	35 ft.	45 ft.	24.5 ft.	29.5 ft.	39.5 ft.	49.5 ft.	59.5 ft.	39 ft.	59 ft.	53 ft.
1-Pentene, 4,4-dimethyl-												
2-Butene												
2-Hepten-1-ol												
Acetic acid, ethyl ester						13 NJ	21 NJ	27 NJ		110 NJ	6.5 NJ	
Acetic acid, methyl ester												
Benzene, 2-butenyl-												
Bicyclo[2.2.1]heptan-2-one,1,3,3-trimethyl-	11 NJ											
Camphor	5.3 NJ											
Nonanal			8.2 NJ						10 NJ			
None Detected												0 NJ
Oxygenated Hydrocarbon				6.9 NJ		5.9 NJ						
Saturated Hydrocarbon: <C10												
Unknown					5.5 NJ	9.4 NJ		15 NJ				
Unsaturated Hydrocarbon		7.8 NJ										

TABLE 4-38
SUMMARY OF VOLATILE ORGANIC TENTATIVELY IDENTIFIED COMPOUNDS DETECTED IN SURFACE AND SUBSURFACE SOIL
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

CHEMICAL	113-10				113-13	113-14	113-19	113-23			113-24	113-26		113-27	113-30
	34 ft.	44 ft.	54 ft.	64 ft.	27 ft.	57 ft.	0 ft.	24 ft.	45 ft.	54 ft.	29 ft.	37 ft.	55 ft.	34.5 ft.	20 ft.
1-Pentene, 4,4-dimethyl-	6.7 NJ														
2-Butene	8.6 NJ														
2-Hepten-1-ol								7 NJ	12 NJ	5.6 NJ					
Acetic acid, ethyl ester	29 NJ	44 NJ	90 NJ											33 NJ	12 NJ
Acetic acid, methyl ester							7.4 NJ							6.4 NJ	
Benzene, 2-butenyl-					570 NJ										
Bicyclo[2.2.1]heptan-2-one,1,3,3-trimethyl-															
Camphor															
Nonanal															
None Detected															
Oxygenated Hydrocarbon											9.5 NJ				
Saturated Hydrocarbon: <C10											9.4 NJ				
Unknown						5.6 NJ						7.3 NJ	6.7 NJ		11 NJ
Unsaturated Hydrocarbon				11 NJ											

Note: All volatile organic concentrations in micrograms per kilograms (ug/kg)
NJ = Tentatively identified compound with an estimated concentration.

TABLE 4-39
SUMMARY OF VOLATILE AND SEMI-VOLATILE TICs AND THEIR OCCURRENCE IN SURFACE AND SUBSURFACE SOIL AT LANDFILL NO. 5
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

Category	Chemical Group	Occurrence	Boring Locations	Range of Concentrations (NJ) (ug/kg)
POTENTIALLY NON-TOXIC CHEMICALS				
Alcohol				
2-Hepten-1-ol	VOC	3 samples in 1 boring	113-23	5.6 - 12
1-Nonadecanol	SVOC	1 sample in 1 boring (surface sample)	113-10	200
1-Octadecanol	SVOC	1 sample in 1 boring (surface sample)	113-10	240
1-Hexanol, 2-ethyl-	SVOC	1 sample in 1 boring	113-17	340
Isomer of Neogammacer-en-ol	SVOC	1 sample in 1 boring	113-07	340 - 1000
Ketone				
3-Penten-2-one, 4-methyl-	SVOC	1 sample in 1 boring	113-11	180
Camphor	VOC	1 sample in 1 boring (surface sample)	113-01	5.3
Fatty Acids & Esters				
Octadecanoic acid, 2-methylpropyl ester	SVOC	1 sample in 1 boring	113-07	430
Hexanedioic acid, bis(2-ethylhexyl)ester	SVOC	4 samples in 4 borings	113-04, 113-05, 113-08, 113-13	160 - 980
14-Pentadecenoic acid	SVOC	1 sample in 1 boring	113-17	910
2-Methylheptanoic acid	SVOC	1 sample in 1 boring	113-24	360
Butanoic acid	SVOC	4 samples in 4 borings	113-11, 113-14, 113-17, 113-24	530 - 3700
Butanoic acid, 2-methyl-	SVOC	2 samples in 2 borings	113-16, 113-24	490 - 700
Hexadecanoic acid	SVOC	2 samples in 2 borings	113-17, 113-24	480 - 1000
Hexadecanoic acid, dioctyl ester	SVOC	1 sample in 1 boring	113-13	1000
Hexanoic acid	SVOC	4 samples in 4 borings	113-14, 113-16, 113-17, 113-24	210 - 4900
Hexanoic acid, 2-ethyl-	SVOC	2 samples in 1 boring	113-16	150 - 400
Hexanoic acid, 2-methyl-	SVOC	2 samples in 2 borings	113-16, 113-24	320 - 2600
Nonanedioic acid, bis(2-ethylhexyl)ester	SVOC	1 sample in 1 boring	113-16	210
Octadecanoic acid, butyl ester	SVOC	1 sample in 1 boring	113-11	200
Octanoic acid	SVOC	2 samples in 2 borings	113-16, 113-24	270 - 1100
Oleic Acid	SVOC	1 sample in 1 boring	113-24	1700
Pentanoic acid	SVOC	3 samples in 3 borings	113-16, 113-17, 113-24	330 - 4200
Pentanoic acid, 2-methyl-	SVOC	2 samples in 2 borings	113-16, 113-24	180 - 2200

TABLE 4-39
SUMMARY OF VOLATILE AND SEMI-VOLATILE TICs AND THEIR OCCURRENCE IN SURFACE AND SUBSURFACE SOIL AT LANDFILL NO. 5
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

Category	Chemical Group	Occurrence	Boring Locations	Range of Concentrations (NJ) (ug/kg)
Propanoic acid	SVOC	3 samples in 2 borings	113-16, 113-17	370 - 3000
Propanoic acid, 2-methyl-	SVOC	3 samples in 2 borings	113-16, 113-24	340 - 1300
Other				
Nitrogen Compound	SVOC	1 sample in 1 boring	113-16	140
Oxygenated Hydrocarbon	SVOC	9 samples in 9 borings	113-04, 113-05, 113-08, 113-10, 113-11, 113-16, 113-17, 113-24, 113-27	5.9 to 570
Polynuclear Aromatic Hydrocarbon	SVOC	1 sample in 1 boring	113-28	190
Primary amide	SVOC	1 sample in 1 boring	113-14	190
Unknown	SVOC & VOC	13 samples in 9 borings	113-04, 113-05, 113-07, 113-10, 113-13, 113-14, 113-24, 113-26, 113-30	5.5 to 1200
PETROLEUM RELATED				
Saturated Hydrocarbon:<C10	VOC	1 sample in 1 boring	113-24	9.4
Saturated Hydrocarbon:>C20	SVOC	13 samples in 12 borings (6 surface samples)	113-01, 113-04, 113-05, 113-07, 113-10, 113-11, 113-16, 113-17, 113-19, 113-24, 113-27, 113-28	140 - 830
Saturated:C10-C20	SVOC	8 samples in 4 borings (2 surface samples)	113-08, 113-11, 113-22, 113-25	140 - 3200
Unsaturated Hydrocarbon	VOC & SVOC	3 samples in 3 borings	113-03, 113-04, 113-10	6 - 170

TABLE 4-39
SUMMARY OF VOLATILE AND SEMI-VOLATILE TICs AND THEIR OCCURRENCE IN SURFACE AND SUBSURFACE SOIL AT LANDFILL NO. 5
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

Category	Chemical Group	Occurrence	Boring Locations	Range of Concentrations (NJ) (ug/kg)
CHEMICALS OF POTENTIAL OR UNKNOWN TOXICITY				
Bicyclo[2.2.1]heptan-2-one,1,3,3-trimethyl-	VOC	1 sample in 1 boring (surface sample)	113-01	11
Benzene, 2-butenyl-	VOC	1 sample in 1 boring	113-13	570
Acetic acid, ethyl ester	VOC	10 samples in 5 borings	113-05, 113-07, 113-10, 113-27, 113-30	6.5 to 110
Acetic acid, methyl ester	VOC	2 samples in 2 borings	113-19, 113-27	6.4-7.4
2-butene	VOC	1 sample in 1 boring	113-10	8.6
1-pentene, 4,4-dimethyl-	VOC	1 sample in 1 boring	113-10	6.7
Nonanal	VOC	2 samples in 2 borings	113-04, 113-05	8.2-10
Phenol, 4,4'-butylidenebis[2-(1,1-dimethylethyl)	SVOC	1 sample in 1 boring	113-26	240
Cyclohexane, methyl-	SVOC	6 samples in 3 borings	113-22, 113-23, 113-27	140 - 180
3-Cyclohexene-1-methanol, .alpha.,.alpha.4-trim	SVOC	1 sample in 1 boring (surface sample)	113-01	190
1,1'-Biphenyl, 4,4'-difluoro-	SVOC	1 sample in 1 boring	113-25	280
Sulfur, mol. (S8)	SVOC	2 samples in 1 boring	113-16	190 - 750
1-Methylnaphthalene	SVOC	1 sample in 1 boring	113-13	76
.alpha.-Amyrin	SVOC	1 sample in 1 boring (surface sample)	113-01	140
.alpha-Pinene	SVOC	1 sample in 1 boring	113-10	140
Cyclopentanecarboxylic acid, 2-amino-, trans-	SVOC	1 sample in 1 boring	113-11	200
Eicosanoic acid, 2,3-bis(acetyloxy)propyl ester	SVOC	1 sample in 1 boring	113-09	340
Stigmast-5-en-3-ol-,(3.beta.,24S)-	SVOC	5 samples in 4 borings (4 surface samples)	113-01, 113-04, 113-07, 113-10	260 - 350
a'-Neogammacer-22(29)-en-3-ol,(3.beta.,21.beta.)-	SVOC	1 sample in 1 boring	113-07	180

5.0
CONTAMINANT FATE AND TRANSPORT

Potential contaminant migration pathways and the fate and transport of the chemicals of interest (COI) initially identified for the human health risk screen (Section 6.0) at Landfill No. 5 are discussed in this section. The importance of physical and chemical properties of the COIs in relation to transport mechanisms is presented. This generalized discussion provides useful insights on possible transport behavior and likely chemical persistence for Landfill No. 5. Given the limited nature and similarity of the COIs, they are discussed as classes of contaminants (i.e., organics and inorganics) for the entire Landfill No. 5 Site. The COIs for Landfill No. 5 include metals and organic compounds, principally VOCs, SVOCs, (i.e., polynuclear aromatic hydrocarbons - PAHs) and PCBs (Table 5-1).

Potentially important exposure pathways and transport mechanisms are discussed for Landfill No. 5 followed by an assessment of the physical and chemical properties which control fate and transport in soil. The mobility and/or persistence of the COIs in specific media are addressed next, followed by a discussion of exposure assessment for potential receptors.

5.1 EXPOSURE PATHWAYS AND POTENTIAL CONTAMINANT TRANSPORT MECHANISMS

As presented in Section 3.4 of the Work Plan for the Phase I RFI at Landfill No. 5, the initial evaluation of potential risks to human and the environment led to the development of an Exposure Pathways Flow Chart (EPFC) for Landfill No. 5 which is shown in Figure 5-1. The EPFC was initially used to assist in development of the sampling strategy for the Phase I RFI and is used in this report to evaluate the need for future work at Landfill No. 5.

Figure 5-1 shows chemical sources and potential human exposure pathways for Landfill No. 5. The EPFC presents chemical release sources and transport media, potential human receptors, and intake mechanisms for each potential exposure pathway. An exposure pathway describes the means by which release, transport, and intake by receptor populations of chemicals of concern occurs. An exposure pathway consists of five necessary elements:

- A source and mechanism of chemical release to the environment
- An environmental transport medium for the released chemical (e.g., air, groundwater, or surface water)
- A point of potential human exposure to the transported chemicals (e.g., a domestic drinking water well)
- Human receptors located at these points of exposure
- A human intake mechanism (e.g., inhalation or ingestion) at the point of exposure

All five elements must be present for an exposure pathway to be complete and for chemical exposure to occur. In the EPFC, potentially significant pathways are denoted with solid lines, and pathways that are considered to be insignificant relative to other pathways are denoted with dashed lines (Figure 5-1).

The potential sources of chemical emissions from Landfill No. 5 are presented in Figure 5-1. The primary potential source is generally waste (e.g., fuels, oils, and solvents) that have possibly leached into subsurface soils; the secondary potential sources are other media, such as subsurface soil or water, impacted by the primary source.

Chemicals in these media or sources may be transported away from Landfill No. 5, thereby affecting other media that may act as tertiary sources. Percolation and leaching of the wastes to the subsurface soil is shown as a primary chemical release mechanism. Subsurface soils are an important secondary source of potential chemical release. Chemicals released from Landfill No. 5 may infiltrate/percolate through the soil and be released to groundwater.

Exposure pathway 1 shown on Figure 5-1 involves the release of chemicals from the landfill cells to subsurface soil then further percolation to groundwater. Exposure pathway 2 involves release of chemicals from Landfill No. 5 and potential transport to receptors by way of ingestion, inhalation, or dermal contact from air and dust. Exposure pathway 3 consists of a release of chemicals from the landfill cells to the vadose zone (i.e., subsurface soil) leading to potential exposure through direct contact.

COIs at Landfill No. 5 could potentially move into the adjacent environment by several transport mechanisms. These mechanisms include (1) air - volatilization of organics and

movement within soil gas or the atmosphere, and wind transport of metals and/or organics on- or off-site; (2) leaching - through the vadose zone; and (3) groundwater - subsequent movement via groundwater flow. These potential transport mechanisms are discussed below.

5.1.1 Air

The air mechanism includes volatilization from water or soil, and wind transport. Volatilization is a process by which an organic compound is transferred from soil or water into soil gas and/or the atmosphere. Volatilization will influence the migration of VOCs; however, it will have much less, or no, impact on most SVOCs detected and will not influence the metals detected. The focus of this transport mechanism is on the upward migration and dispersion of soil gasses into the atmosphere. The wind component will affect metals adsorbed to dust particles, as well as organics which may also be absorbed to dust particles or dispersed in the atmosphere. Air transport could potentially modify organic concentrations associated with surface soils. The degree to which metal or organic concentrations could be modified during transport will depend on the physio-chemical properties of the specific chemicals of interest.

5.1.2 Leaching (Vadose Zone)

Chemicals potentially released to the subsurface at Landfill No. 5 could migrate, in the dissolved phase or as non-aqueous phase liquids (NAPLs), downward within the vadose zone. This migration could result in residual contamination in the vadose zone. Contamination in the vadose zone may result from adsorption of dissolved-phase contaminants onto subsurface soils as the contaminants migrate downward with infiltrating meteoric water. Contaminants may be left behind in dead end pore spaces of the geological materials as contaminants move downward. Dissolved-phase contaminants not held in the vadose zone could ultimately reach the saturated zone where mixing with groundwater may occur. NAPLs not held as residual contamination in the vadose zone may move downward under the force of gravity until encountering a hydraulic (i.e., capillary fringe) or lithologic (fine-grained geologic layer) barrier.

If present, NAPLs can penetrate the capillary fringe and the water table only if the liquid has sufficient pressure head to overcome the capillary pressure (Anderson et al. 1992). Likewise,

NAPLs can penetrate fine-grained geologic materials only if the liquid has sufficient pressure head to overcome the increased capillary pressure in the fine-grained materials. When capillary pressure cannot be overcome, lateral spreading or pooling of the liquid on top of the water table or fine-grained barrier may occur. In the case of a lens of fine-grained material surrounded by coarse-grained material, spreading may occur on top of the lens until the liquid spills over the edge of the lens, at which point the liquid may continue downward until reaching the water table or another lithologic barrier. It should be noted that NAPLs were not observed during the Phase I RFI.

For extended periods following the initial release of contaminants, infiltrating precipitation moving downward through the vadose zone can leach contaminants from the zone of residual contamination and transport them to the saturated zone. This is an important transport mechanism for contaminants with high aqueous solubility. Contaminants with lower solubilities (e.g., metals) are less likely to be leached from the vadose zone and typically exhibit lower mobility.

5.1.3 Groundwater

As previously discussed, the Ogallala, or Great Plains, aquifer underlies Cannon AFB. It consists of gravels, sands, silts and clays which vary from 360 to 415 feet in thickness at Cannon AFB. Caliche is a major feature of the Ogallala Aquifer in the area and may vary from 5 to 25 feet in thickness. The predominant clays within the Ogallala are smectites and attapulgite. The Ogallala Aquifer has a saturated thickness of about 95 to 145 feet which is strongly influenced by the configuration of the erosional unconformity underlying the Ogallala Aquifer. Based on information collected during the 1991 W-C investigation of 18 SWMUs, the unsaturated thickness ranges from 264 to about 355 feet bgs. The recharge rate for the Ogallala Aquifer has been estimated at 1 inch/year (Kearney 1987) and is attributable to the low annual rainfall coupled with the high annual evapotranspiration rate. The hydraulic gradient is toward the southeast at 7 to 15 feet/mile.

Groundwater from the Ogallala Aquifer is the base's sole source of water which is supplied by nine wells. These wells have capacities of 200 to 765 gpm (gallons per minute) and were installed to total depths ranging from 357 to 415 feet bgs (USAF 1991). In 1984 these wells were producing at an average daily rate of 1.3 million gallons (William Matotan and

Associates 1985). During the peak summer demand, about 25 percent of this water was used for irrigation.

Dissolution of metals and organics through the leaching of contaminated surface, or near surface, soils by infiltrating meteoric water is considered the principal means by which contaminants could enter the site groundwater beneath Landfill No. 5. This infiltrating water will originate from precipitation, probably during storm events. In the near surface, adsorption of chemicals of interest may play a role in retarding downward mobilization. However, facilitated transport of contaminants through dissolution may not be a significant means for contaminants to reach groundwater given the unconsolidated nature and thickness of the vadose zone as well as the potential for adsorption and low annual precipitation at the site. For organics which enter the unsaturated zone via infiltration, volatilization within the thick unsaturated zone may limit the concentrations of any dissolved volatile organics before they reach the water table.

5.2 PHYSICAL AND CHEMICAL PROPERTIES

This section provides a discussion of the physical and chemical properties of the COIs which directly affect their fate and transport. These properties are summarized in Table 5-2.

5.2.1 Volatilization

Volatilization will affect the volatile organic concentrations in the soil. Organics influenced by this process will be transferred into a gaseous phase, soil gas and/or the atmosphere. Assuming that a free non-aqueous phase does not exist, volatilization will principally be controlled by a chemical's solubility, vapor pressure, Henry's Law constant, and adsorption. Water content of a soil, temperature, and atmospheric conditions (i.e., wind and sunlight) may also influence volatilization from a soil (Lyman et al. 1990).

Volatilization is a complex process that is dependent on very site-specific conditions. Nevertheless, some appreciation of an organic chemical's volatility can be made by considering the Henry's Law constant and vapor pressure values. Henry's Law constant is directly proportional to a chemical's vapor pressure and molecular weight and inversely proportional to its water solubility and temperature. Henry's Law constant values > 10^{-3} atm-m^3/mole (cubic meters of atmosphere per

mole) are considered to have a high volatility while those with values < 10^{-7} atm-m^3/mole are less volatile than water and will tend to concentrate in water as it evaporates (Lyman et al. 1990). Dragun (1988) and Olsen and Davis (1990) suggest comparable though slightly different values for high and low volatility. According to Ney (1990), organic vapor pressures of > 10^{-2} mm Hg (millimeters of mercury) are indicative of high volatility while values of < 10^{-6} mm Hg suggests low volatility.

5.2.2 Aqueous Solubility

Solubility is one of the most important factors influencing the fate and transport of metals and organic chemicals. For metals in solution, their solubility will be controlled by the solution Eh-pH relationships; number, concentrations, solubility product, etc. of ion complexes in solution; aqueous major ion chemistry; etc. Dissolved metal fate and transport will depend upon a number of very site-specific factors whose collection and/or calculation were beyond the scope of this investigation. Water solubility of organics is typically considered with respect to the K_{OW} (octanol/water partition coefficient). The K_{OW} value is defined as "... the ratio of a chemical's concentration in the octanol phase to its concentration in the aqueous phase of a two-phase system." (Lyman et al. 1990) Other factors which can affect an organic's solubility include adsorption, volatilization, and presence of organic carbon. According to Lyman et al. (1990), values of log K_{OW} > 4 indicate the organic is very hydrophobic and would have a low water solubility, high soil/sediment adsorption coefficients, lower mobility, and higher potential to bioaccumulate. Conversely, values of log K_{OW} < 1 suggest high solubilities and greater mobility, but small soil/sediment adsorption coefficients and decreased potential for bioaccumulation.

5.2.3 Adsorption

Adsorption is also an important factor which influences the fate and transport of both metals and organics. Typically, adsorption is expressed in terms of an adsorption coefficient, and it can be defined as the ratio to which a metal or organic chemical partitions itself between the solid and solution phases. This can apply to water-saturated or unsaturated soils, storm water, sediment, or aquifer materials. Adsorption is often referred to in terms of the soil-water distribution coefficient - K_d, or distribution coefficient. K_d is defined as the ratio of concentration adsorbed on soil surfaces to the concentration in water. For organics, K_d has been strongly correlated with the fraction of total organic carbon in the solid matrix (f_{OC}) and which has been used to define the organic carbon

partition coefficient - K_{OC} (Olsen and Davis 1990). It is defined as the ratio of K_d to f_{OC} (i.e., chemical adsorbed per unit weight of total organic carbon (TOC) in the soil/sediment/aquifer to the concentration of the chemical in solution at equilibrium). This correlation appears to hold over a wide range of TOC content values (i.e., 0.1 to 2 percent TOC) as reported by Lyman et al. (1990). For organics, a critical fraction of organic carbon can be defined (i.e., < 0.1 percent TOC), below which inorganic clay surface reactions dominate the adsorption process (Olsen and Davis 1990). A qualitative assessment of chemical mobility based on K_d values has been made by Dragun (1988) as follows: > 10 immobile, 2 to 10 low mobility, 0.5 to 2 intermediate mobility, 0.1 to 0.5 mobile, and < 0.1 very mobile. According to Adams (1972), K_{OC} values can range from 1 to 10^7. Chemicals with a log K_{OC} of > 4 will adsorb to soil OC, while chemicals with a low log K_{OC} of < 3 will not readily adsorb to soil OC. Generally, the higher the value, the less mobile the organic. Additional discussion on the importance of TOC and clay mineralogy in adsorption processes is presented below.

Organic Carbon Content

The fraction of TOC in geologic materials is strongly correlated with the potential for adsorption of contaminants in the subsurface, especially for adsorption of organic compounds. The partitioning of organic contaminants from the dissolved phase to the solid phase is usually proportional to the TOC content of the media. TOC content also influences biodegradation. Microorganisms, which are required to catalyze chemical-degradation reactions, are dependent on organic carbon as a food source.

The TOC content measured from 24 samples collected at Landfill No. 5 during the Phase I RFI ranged from non-detect to 0.57 percent with TOC not reported in 23 samples at a laboratory limit of 0.2 percent. The reported TOC content in soil samples collected at Landfill No. 5 is relatively low. Literature (McCarthy and Zachara 1989) reveals that whether chemicals adsorb onto organic or inorganic materials depends on the fraction of TOC relative to a specific critical level of TOC. This critical level is chemical-specific and dependent on site conditions. As the TOC content approaches the critical level, organic adsorbents begin to dominate the adsorption process. However, if the fraction of TOC is small, adsorption of organic chemicals to inorganic adsorbents (mostly clay) is important.

Clay Content and Mineralogy

Clay content and mineralogy are important parameters affecting the adsorption of both organic and inorganic chemicals. A high content of clay in geologic materials provides favorable conditions for adsorption because of the following: (1) clay minerals have negatively charged surfaces and behave as inorganic adsorbents; (2) clays have relatively large surface areas, and adsorption tends to be greater when the surface area of the media is greater (all other factors being equal); and (3) substantial clay content in geologic materials tends to reduce the effective permeability, thereby reducing migration velocities and increasing residence time so that the probability of geochemical processes approaching equilibrium is increased.

Based on the geologic characterization presented in Section 3.0, clay content in much of the geologic materials underlying Landfill No. 5 covers a range from 4 to 27 percent. Grain-size analyses (Table 3.5-2) show that the average clay content in 16 samples collected during the Phase I RFI at Landfill No. 5 is 11 percent with three samples exhibiting clay content above 20 percent.

Clay mineralogy is potentially significant to the adsorption process because the surface area and the CEC of clays varies with the specific mineralogy. The common clay minerals can be divided into five groups: smectites, vermiculites, illites, kaolinites, and chlorites. Their specific surface areas in terms of meters^2/gram (m^2/g) and CEC can vary by orders of magnitude. Limited site-specific information on clay types for surficial soils and subsurface materials is available for Cannon AFB, and specific clay types present at Landfill No. 5 have not been determined.

5.2.4 Biodegradation

Biodegradation, including biotransformation, occurs via microorganisms that may be either attached to the soil, or present in the soil pores, or in solution. Factors affecting biodegradation rates include composition and size of the microbial population, presence of a suitable and available substrate (i.e., energy source), soil acidity and alkalinity, soil temperature and moisture, presence of essential inorganic elements, chemical concentration, oxygen availability, and adsorption (Dragun 1988). Typically, biodegradation rates are measured in half-lives which are defined as the time required for microbial degradation to reduce a chemical concentration by half. Biodegradation is typically associated with organics and not metals. Although for some metals (e.g., iron and sulfur) microorganisms do play a significant role in controlling reaction rates, the effects of such

microbially mediated reactions appears to be less well understood than for organics. Half-lives for organics only in soil are cited in Table 5-2.

Frequently, the half-lives cited for organics can vary greatly. This variation is likely due to reductions below optimum in at least one of the above referenced factors which can thereby control the reaction rate (Dragun 1988).

5.2.5 Other Physical and Chemical Properties

The four processes previously discussed in this section probably represent the most important controls on the fate and transport of COIs at Landfill No. 5. However, it is important to recognize that other properties or processes also exist which could contribute to contaminant mobility and fate. Some of these properties and processes include bioconcentration, complexation, dehydrohalogenation, diffusion, hydrolysis, oxidation, photolysis, precipitation, reduction, and solubility in solvents. These additional factors were not discussed because, individually, they are not considered to be as significant as the volatilization, aqueous solubility, adsorption, and biodegradation processes.

5.3 CONTAMINANT PERSISTENCE

Within a particular medium, physical, chemical, and biological processes will affect the persistence of chemicals. Using the information on potential pathways and physical and chemical properties, together with the nature and extent of contamination information for Landfill No. 5 (Section 4.0), the persistence of metals, VOCs, and SVOCs is discussed in this section for soil only since groundwater was not addressed during the Phase I RFI. Generalizations are drawn from these information sources, as well as site geologic and hydrogeologic features, to provide qualitative information on fate and transport for the classes of chemicals identified.

5.3.1 Semivolatile Organics

The SVOCs detected at Landfill No. 5 have been broadly classified as PAHs, PCBs, and phenols. For the purposes of this discussion, the PCBs are considered SVOCs.

Polynuclear Aromatic Hydrocarbons

The PAH COIs identified in Table 5-1 (i.e., acenaphthene, chrysene, fluoranthene, fluorene, and pyrene) were associated with subsurface soils collected from two soil borings, 113-01 and 113-13, at Landfill No. 5.

Based on information provided earlier in Table 4-35, PAHs were typically detected at low concentrations (i.e., less than 221 μg/kg) below the laboratory reporting limit and were, therefore, qualified as estimated values. Additionally, PAHs were detected in only 5 samples of 160 samples (i.e., a frequency of 3 percent) collected during the Phase I RFI and fewer compounds were generally detected and at lower concentrations with depth as shown in Table 4–35 for boring 113-13.

Based on the above information and following discussion, the PAH compounds could be relatively persistent but their transport potential appears to be limited because:

- Solubility of PAH compounds in water is low (i.e., less than 4 mg/l, Table 5–2)

- Log K_{ow} for the PAH compounds is greater than 4, indicating low mobility (Table 5–2).

- Except for acenaphthene, log K_{oc} values are greater than 3 and in most cases greater than 4, indicating that PAHs will readily adsorb to organic carbon material found in subsurface soil, thus limiting mobility.

Although the PAH compounds may be relatively persistent, biodegradation rates shown in Table 5–2 suggest that short half-lives (i.e., less than 108 days) for acenaphthene and fluorene could lead to significant contaminant concentration reduction within a short time frame for these PAHs. Longer half lives for chrysene, fluoranthene and pyrene (i.e., up to 5 years for pyrene) indicate that these compounds are likely to be persistent for much longer time periods.

Phenols

As presented earlier in Section 4.0 and in Table 4-35, 3 SVOCs in the phenol group (i.e., 4-methylphenol, 4-nitrophenol and phenol) were detected in 6 subsurface soil samples collected at Landfill No. 5 at concentrations ranging from 40J µg/kg to 360 µg/kg. Except for the one detection of phenol at 360 µg/kg at a depth of 28 feet in boring 113-01, all other detections were below the laboratory reporting limit and were, therefore, qualified as estimated. Phenol was detected at concentrations ranging from 40J µg/kg to 360 µg/kg in 3 samples, one from each of 3 borings. 4-Methylphenol was detected twice from samples collected in borings 113–16 and 113–24 at concentrations of 68J µg/kg to 100J µg/kg (Table 4–35). 4-Nitrophenol was detected at concentrations of 49J µg/kg and 68J µg/kg in two samples collected from boring 113-5.

Unlike the PAHs discussed earlier, the phenols have comparatively high mobility because:

- A high solubility in water ranging from 16,000 to 93,000 mg/l (Table 5-2) indicates potential for high mobility.

- Log K_{ow} values near 1 and log K_{oc} values less than 3 indicate that the phenols are highly mobile and will not readily adsorb to organic carbon material found in subsurface soil.

With regard to persistence in soil at Landfill No. 5, the relatively short biodegradation half lives (i.e., less than 30 days) shown in Table 5-2 suggest that chemical concentrations could be significantly reduced in a short time frame, thus lessening the persistence of phenols in subsurface soil at Landfill No. 5.

Polychlorinated Biphenyls

PCB (Aroclor 1254) was detected in only 2 of 160 soil samples collected during the Phase I RFI. PCB was detected at 75 µg/kg at a depth of 45 feet in boring 113–16 and at 25 µg/kg in a surface soil sample collected at boring 113–19. These concentrations are comparatively low.

Given the limited detection of PCB during the Phase I RFI (i.e., detected in approximately 1 percent of samples collected) and the following information it appears that, similar to that discussed for PAHs, PCB has limited migration potential in soil because:

- Solubility in water is less than 0.5μg/l
- Log K_{ow} and log K_{oc} greater than 4 both indicate the chemical is very hydrophobic and readily adsorb to organic carbon material in subsurface soil (Table 5–2).

5.3.2 Volatile Organics

Seven VOCs of interest for Landfill No. 5 are presented in Table 5–1 and include 1,1,2,2-tetrachloroethane, 4-methyl-2-pentanone, acetonitrile, carbon disulfide, ethylbenzene, styrene, and toluene. The nature and extent of these VOCs were addressed previously in Section 4.0 and a summary of detections of these compounds was presented in Table 4–36. Ranges of detected concentrations and the frequency of detection are summarized below:

Chemical	Concentration Range (μg/kg)	Frequency of Detection (% of samples analyzed)
1,1,2,2-Tetrachloroethane	2.3J to 8.2	2.2
4-Methyl-2-pentanone (MIBK)	2.5J to 230	3.0
Acetonitrile	165J to 67J	2.5
Carbon disulfide	2.9J	0.5
Ethylbenzene	1.3J to 300	1.0
Styrene	8.2 to 1400	1.0
Toluene	1J to 4.9J	8.0

Most of the VOCs were detected at low concentrations below the laboratory reporting limit and were therefore qualified as estimated.

The physical and chemical properties of the VOCs of interest detected at Landfill No. 5 presented in Table 5–2 indicate that most of the VOCs are likely to be mobile in a soil environment because:

- The VOCs are medium to highly soluble in water with solubility values ranging from 208 mg/l to 17,000 mg/l (Table 5-2).

- Log K_{ow} values ranging from 1.09 to 3.13 indicate intermediate mobility properties.

- Log K_{oc} values ranging from 0.79 to 2.87 suggest that the VOCs will not readily adsorb to organic carbon material present in soil.

Although the VOCs are likely to be mobile in the soil environment, several factors can limit VOC persistence in soil at Landfill No. 5 as discussed below.

Information provided in Table 5–2 (i.e., Henry's Law Constant) indicates that carbon disulfide, ethylbenzene, styrene and toluene are highly volatile and will likely partition to a vapor phase quite readily. The remaining VOCs (acetonitrile, 1,1,2,2-tetrachloroethane and 4-methyl-2-pentanone) of interest have an intermediate tendency to volatilize. Additionally, the short biodegradation half lives (i.e., 1 to 28 days) in soil for the VOCs of interest (excluding the chlorinated solvent 1,1,2,2-tetrachloroethane) indicate that these chemicals will likely not readily persist in a subsurface environment for long periods of time and the potential for biodegradation to reduce chemical concentrations is quite high. The compound 1,1,2,2-tetrachloroethane will likely persist in the environmental as biodegradation occurs very slowly if at all under aerobic conditions found in the vadose zone at Landfill No. 5.

5.3.3 Metals

The metals which are considered to be COIs for Landfill No. 5 include aluminum, barium, beryllium, chromium, cobalt, copper, lead, manganese, nickel, silver, tin, vanadium and zinc (Table 5–1). The nature and extent of these metals was previously addressed in Section 4.0 and detections above the background range were summarized in Table 4–32.

It is interesting to note from Table 4-32 data that a majority of detections of metals of interest above the background range were isolated instances, meaning that metals were typically detected above background at one sample interval in the vertical sampling profile within a boring and was rarely found above background in other samples collected within the same boring. Exceptions to this include detections of vanadium in boring 113–08, nickel in boring 113–10 and copper in boring 113-16.

With regard to mobility and persistence of metals in subsurface soil at Landfill No. 5, current site data do not allow a quantitative estimate of these properties. However, it is expected that metal complexes in soil or water will form reaction products that get incorporated into soil minerals, precipitate as oxide or hydroxide minerals, or form coating on minerals (Dragun 1988). It is expected that most of the metals will be assimilated into oxide, hydroxide, or oxyhydroxide complexes within soil or water. Based on existing site information, several generalizations can be made:

- Within this area of the Ogallala Formation (i.e., the uppermost geologic unit at Landfill No. 5), the predominant clay minerals are montmorillonites and attapulgite. The CEC for montomorillonite clays are generally quite high and range from 80 to 150 milliequivalents per 100 grams (meq/100 g) (Dragun 1988) while the CEC values for the attapulgite will be probably less than 50 meq/100 g. Based on grain-size information collected during this investigation, the clay content of subsurface soil material averaged 11 percent and was greater than 20 percent in several samples. The relatively high CEC of clays within the Ogallala Formation and a moderate clay content would suggest that the mobility of metals of interest in subsurface soil at Landfill No. 5 would be limited because of adsorption of metals to clay surfaces.

- The pH of soil can also influence mobility of metals. For example, alkaline or near-neutral pH values usually result in negatively charges surfaces on clays and relatively high CEC and action adsorption values (Dragun 1988). The alkaline pH of 7.0 to 8.0 reported in the Curry County Soil Survey (USDA 1958) for soil at Cannon AFB suggests that cation exchange and cation adsorption are probably significant transport processes for metals. Additionally, at soil pH values greater than 5 or 6, most inorganic cations will precipitate as hydroxides or carbonates (i.e., caliche); therefore, their mobility in the vadose zone will be reduced.

Available information indicates that metals in subsurface soil at Landfill No. 5 are probably not very mobile but are likely to be persistent.

In summary, COIs for Landfill No. 5 were grouped into SVOCs, VOCs and metals to evaluate fate and transport. The following conclusions can be drawn from the evaluation:

SVOCs

- PAH compounds are likely to be relatively immobile, but could persist for long periods of time in the subsurface soil environment due to low biodegradation rates.

- PCBs are likely to be relatively immobile and may persist in the subsurface soil environment.

- Phenol compounds appear to be highly mobile but would not likely persist for long periods of time in the subsurface soil environment due to high biodegradation rates.

VOCs

As a group, the VOCs are likely to be medium to highly mobile in the subsurface soil environment. However, these chemicals would not likely persist for long periods of time due to high volatilization potential and very high biodegradation rates (excluding the chlorinated solvent 1,1,2,2-tetrachloroethane). When considering biodegradation, 1,1,2,2-Tetrachloroethane could persist in the environment since biodegradation of this compound occurs very slowly if at all under aerobic conditions with low organic carbon content, as found in the vadose zone at Landfill No. 5.

Metals

Based on general characteristics of subsurface soil at Landfill No. 5 which include moderate clay content and an alkaline soil pH, metals are not likely to be mobile in the subsurface but would likely persist for long periods of time. The potential for precipitation of metals in the subsurface, thus limiting downward migration in the vadose zone, is evidenced by caliche layers encountered in the borings drilled during the Phase I RFI.

5.4 EXPOSURE ASSESSMENT

Exposure assessment evaluates the potential for human beings (receptor populations) to be exposed to chemicals at or released from the site (Landfill No. 5 on Cannon AFB). Steps in this exposure assessment include:

- Identification of current and potential future onset and offset land use scenarios
- Identification of current and potential future receptor populations
- Evaluation of exposure pathways

Land uses, potentially exposed receptors, and potentially complete exposure pathways are discussed below.

5.4.1 Current and Future Land Use

On Site: Landfill No. 5 is located in the southeast corner of Cannon AFB. Cannon AFB is currently an operating military facility and is expected to remain as such for the foreseeable future. In addition to the perimeter fence around the base, there is a fence around Landfill No. 5. Therefore, trespassing at the landfill probably does not occur.

Landfill No. 5 is not currently in operation. The only persons entering the landfill are those involved in periodic environmental characterization work at the site (USAF, USCOE, environmental consultants, and drilling companies). One person conducts groundwater sampling of the wells located outside the boundary of Landfill No. 5 for about 5 to 10 hours on a semi-annual basis but does not enter the landfill premises.

Groundwater occurs in the unconfined Ogallala Aquifer, which is the primary source of potable and irrigation water for eastern New Mexico. The Ogallala Aquifer beneath Landfill No. 5 is located at a depth of approximately 270 feet bgs (Gutentag 1984).

Off Site: Lands surrounding Cannon AFB are primarily irrigated farmland. Landfill No. 5 is locally surrounded to the north and east by a sparsely vegetated field and to the south and west by agricultural property. The nearest residence on the base is approximately 4½ miles to the northwest of Landfill No. 5 and the nearest resident outside of the base is to the southeast within approximately 1 mile from Landfill No. 5. Potable and irrigation water are obtained primarily from the Ogallala aquifer.

5.4.2 Potentially Exposed Populations

Current Receptors: Potentially exposed current receptors identified in the exposure pathway flowchart in Figure 5-1 are base workers who occasionally enter the landfill (visits to the site by current base workers are infrequent).

Current residents were not considered potentially exposed receptors because the only potential route of exposure to constituents from Landfill No. 5 was via groundwater use, and there is no evidence of groundwater contamination nor is it expected in the future.

Future receptors: Future land use at Cannon AFB is expected to remain unchanged (i.e., the base is expected to continue its present operations). Landfill No. 5 is currently inactive and fenced off; and future use at the landfill is expected to be used as aircraft operations and maintenance facilities and/or as an open area. Parts of the landfill are in the clear zone for a nearby runway and cannot be used for construction. However, a hypothetical construction scenario was identified in the exposure pathway flowchart in Figure 5-1 to address exposure to both surface and subsurface soil should future excavation activities occur on the landfill.

5.4.3 Exposure Pathways and Routes

A complete exposure pathway requires a chemical source, chemical release mechanism, environmental transport medium, exposure point, and a human intake route. If one of these elements is lacking, the pathway is incomplete and no human exposure can occur. A preliminary exposure pathway flowchart displaying these elements for Landfill No. 5 is shown in Figure 5-1.

The potential sources of chemical emissions from Landfill No. 5 are presented in Figure 5-1. The primary source is buried waste (e.g., general refuse, fuels, oils, and solvents) that has leached or leaked into subsurface soils; the secondary sources are other media, such as surface and subsurface soil or water impacted by release from the primary source.

Percolating and leaching of wastes to subsurface soil is shown as the primary release mechanism. Subsurface soils are an important secondary source of potential chemical release.

Transport mechanisms with the potential to carry contaminants to human exposure points include storm water runoff, infiltration/percolation to groundwater, release of volatiles from surface and subsurface soil to air, fugitive dust emissions, and direct oral and dermal contact with surface and subsurface soil. These transport mechanisms are evaluated below.

- Pathways associated with stormwater runoff are considered to be incomplete because no drainage ways or surface water bodies are present on or in the vicinity of Landfill No. 5. In addition, limited rainfall occurs in the semi-arid climate.

- Pathways associated with groundwater are considered to be incomplete because no viable transport mechanism currently exists between subsurface soil and groundwater. Although leaching of contaminants from subsurface soil to groundwater by infiltration/percolation could potentially occur, the large distance between the groundwater table and potentially contaminated subsurface soil (over 200 feet) and the low levels of precipitation in the semi-arid environment have apparently prevented transport of contaminants from subsurface or groundwater. In support of the lack of a viable transport mechanism from subsurface soil to groundwater, samples collected at five monitoring locations indicated that groundwater beneath Landfill No. 5 had not been impacted by past activities at the landfill (W-C 1992).

- Transport of VOCs to air, fugitive dust emissions, and direct contact are each viable transport mechanisms for surface soil and for subsurface soil (following construction activities).

Therefore, the following pathways were considered potentially complete.

Current on-site base workers:

- Inhalation of VOCs released from soil into outdoor air
- Inhalation of surface soil constituents in windblown dust
- Ingestion of surface soil
- Dermal contact with surface soil

Future on-site construction workers:

- Inhalation of VOCs released from soil into outdoor air
- Inhalation of surface soil in windblown dust
- Ingestion of surface soil
- Dermal contact with surface soil
- Inhalation of subsurface soil in fugitive dust due to wind and construction activities
- Ingestion of subsurface soil
- Dermal contact with subsurface soil

5.4.4 Exposure Scenarios Evaluated in the Human Health Risk Screen (HHRS)

Section 5.4.3 identified exposure scenarios and potentially complete pathways for Landfill No. 5. In Section 6.0, the human health risk screen (HHRS) evaluates one exposure pathway (soil ingestion for onsite residents). Although the HHRS is not site specific (i.e., residential exposure is not expected and not all potentially complete pathways are evaluated), it is very conservative and is likely protective of the site-specific exposure scenarios identified in Section 5. This conclusion is supported by an evaluation of potentially complete pathways not assessed in the HHRS (Section 6.3.1), which indicated that including the dermal and inhalation routes of exposure for soil in the HHRS would not have significantly increased estimates of hazard/risk.

TABLE 5-1

CHEMICALS OF INTEREST
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

Inorganics	Organics	
Aluminum	1,1,2,2-Tetrachloroethane (VOC)	Chrysene (SVOC)
Barium	4-Methyl-2-pentanone (MIBK) (VOC)	Ethylbenzene (VOC)
Beryllium	4-Methylphenol (SVOC)	Fluoranthene (SVOC)
Chromium	4-Nitrophenol (SVOC)	Fluorene (SVOC)
Cobalt	Acenaphthene (SVOC)	Phenol (SVOC)
Copper	Acetonitrile (VOC)	Pyrene (SVOC)
Lead	Aroclor 1254	Styrene (VOC)
Manganese	Carbon disulfide (VOC)	Toluene (VOC)
Nickel		
Silver		
Tin		
Vanadium		
Zinc		

VOC = volatile organic compound
SVOC = semivolatile organic compound

TABLE 5-2

PHYSICAL AND CHEMICAL PROPERTIES OF ORGANIC CHEMICALS OF INTEREST[(1)]

Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI

Cannon AFB, New Mexico

Chemical	Molecular Formula	Molecular Weight (g/mole)	Water Solubility[1] (mg/L)	Vapor Pressure[1] mmHg	Henry's Law Constant[1] (atm-m^3/mole)	Log K_{ow}[1]	Log K_{oc}[1]	Biodegradation Rate in Soil[2] (half-life in days)
Volatile Organic Compounds								
Acetonitrile	CH_3CN	41	NA	NA	NA	NA	NA	7-28
Carbon disulfide	CS_2	76	2,000-2,940 at 20°C	297.5-300 at 20°C	$1.33x10^{-2}$ (calc)	1.84; 2.16(calc)	2.38-2.55	NA
Ethylbenzene	C_8H_{10}	106	131-208 at 25°C	7.08 at 20°C	$6.44-6.6x10^{-3}$; $8.68x10^{-3}$ at 25°C	3.05-3.15	1.98; 2.41	3-10
Styrene	C_8H_8	104	160-320 at 25°C	5 at 20°C	$2.61x10^{-3}$ (calc)	2.95; 3.16	2.87	14-28
1,1,2,2-Tetrachloroethane	$C_2H_2Cl_4$	168	2,870-2,970 at 25°C; 2,870-3,230 at 25°C	5-8 at 20°C	$3.8x10^{-4}$; $4.56x10^{-4}$ at 25°C	2.56; 2.39	2.07; 1.663	NR[3]
4-Methyl-2-pentanone (MIBK)	$C_6H_{12}O$	100	17,000 at 20°C	6-16 at 20°C	$1.49x10^{-5}$ at 25°C (calc)	1.09	0.79 (calc)	1-7
Toluene	C_7H_7	92	490-627 at 25°C	22 at 20°C	$6.7x10^{-3}$; $6.74x10^{-3}$ at 25°C	2.11-2.80	2.06; 2.18	4-22
Semi-Volatile Organic Compounds								
4-Methylphenol	C_7H_8O	108	22,600-24,000 at 40°C	0.08-0.12 at 25°C	$7.92x10^{-7}$ at 25°C	1.67-3.01	1.69	≤1
4-Nitrophenol	$C_6H_5NO_3$	139	16,000-25,000 at 25°C	$1x10^{-4}$ at 20°C	$3.0x10^{-5}$ at 20°C (calc)	1.85-2.04	1.74; 2.33	≈1.2
Acenaphthene	$C_{12}H_{10}$	154	3.47-3.93 at 25°C	$1x10^{-3}$-$1x10^{-2}$ at 20°C	$1.5-2.41x10^{-4}$; $7.92x10^{-5}$ at 25°C	3.92; 4.33	1.25	12-102
Chrysene	$C_{18}H_{12}$	228	0.0018-0.006 at 25°C	$6.3x10^{-7}$ at 20°C	$7.26x10^{-20}$ (calc)	5.60-5.91	5.39	365-993
Fluoranthene	$C_{16}H_{10}$	202	0.206-0.373	$5.0x10^{-6}$ at 25°C	$1.69x10^{-2}$ at 25°C	5.22	4.62	140-440
Fluorene	$C_{13}H_{10}$	166	1.6622-1.98 at 25°C	$1.95x10^{-4}$ at 35°C	$2.1x10^{-4}$	4.12-4.38	3.70	32-60
Phenol	C_6H_60	94	82,000-84,000 at 20°C	0.2 at 20°C	$3.97x10^{-7}$ at 25°C	1.48; 1.46	1.43; 1.24	1-10
Pyrene	$C_{16}H_{10}$	202	0.132-0.171 at 25°C	$2.5x10^{-6}$ at 25°C; $6.85x10^{-7}$ at 25°C	$1.09x10^{-5}$; $1.87x10^{-5}$	4.88-5.32	4.66-5.13	210-1898
Polychlorinated Biphenyls								
Aroclor 1254	ND	327	0.05 at 20°C	$7.71x10^{-5}$ at 25°C; $6x10^{-5}$ at 20°C	$2.3-2.7x10^{-3}$	5.61-6.47	5.61	NA

TABLE 5-2

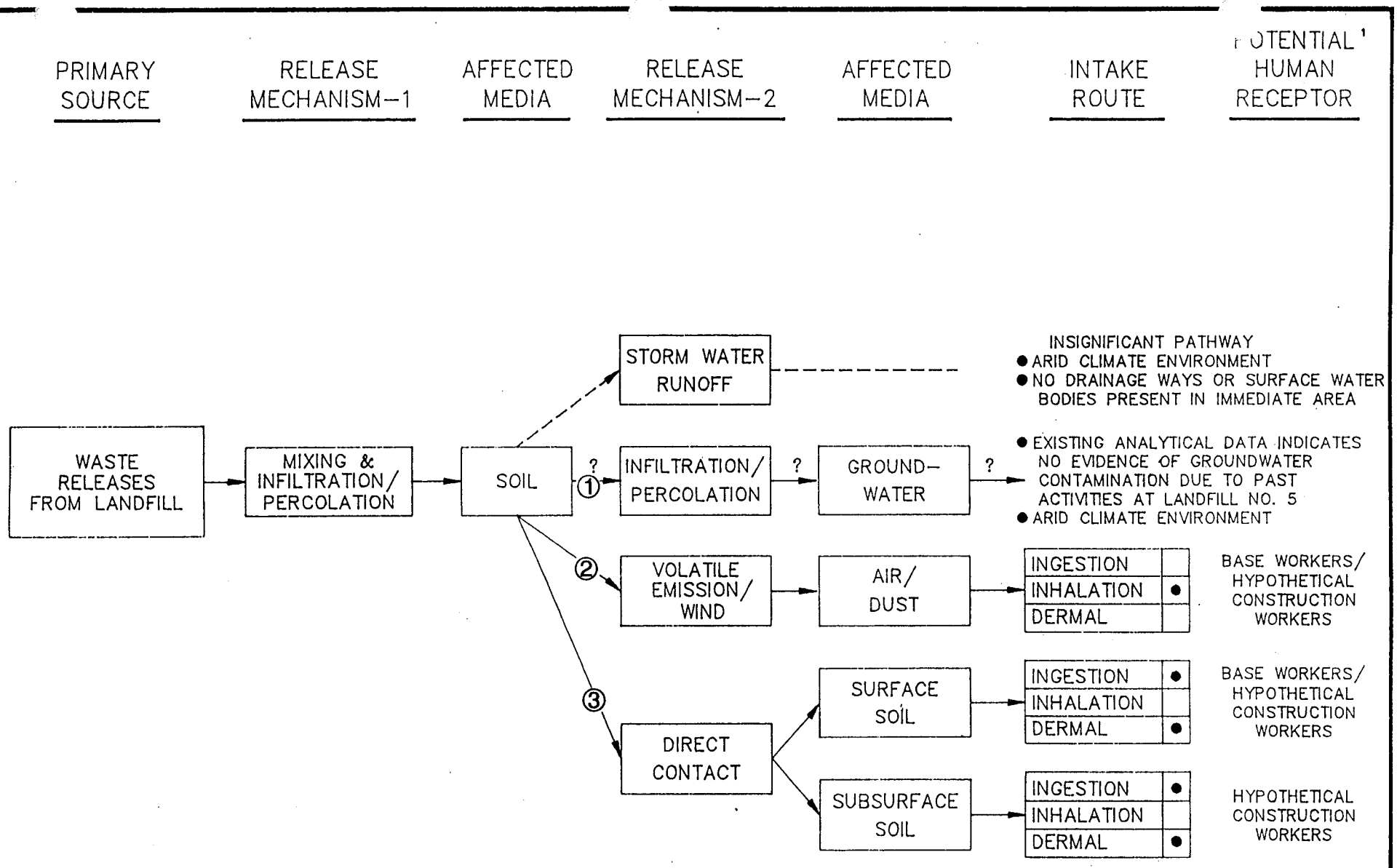
PHYSICAL AND CHEMICAL PROPERTIES OF ORGANIC CHEMICALS OF INTEREST[1]
(Concluded)

Notes:
All values at 25°C where noted in reference and/or unless otherwise specified.
All references from Montgomery and Welkom 1990, except 6, 7, 13, 17, 26, 34 and 35 from Dragun 1988

g	grams	atm-m3/mol	cubic meters of atmosphere per mole
mg/L	milligrams per liter	Kow	octanol water partition coefficient
mmHg	millimeters of mercury	Koc	Organic carbon partition coefficient

(1) Groundwater Chemicals Desk Reference, Montgomery, John H. and L.M. Welkom, 1991.
(2) Handbook of Environmental Degradation Rates, Howard, Phillip H. et al., 1991.
(3) Chlorinated solvents biodegrade very slowly if at all under aerobic conditions as in the vadose zone at Landfill No. 5 and therefore a biodegradation rate for 1,1,2,2-Tetrachloroethane is not relevant.

ND Not definitive. PCB-1254 is a mixture of many biphenyls with varying degrees of chlorination. According to Hutzinger [1], the approximate composition of PCB-1254 by weight is as follows: biphenyls (<0.1%), chlorobiphenyls (<0.1%), dichlorobiphenyls (0.5%), trichlorobiphenyls (1%), tetrachlorobiphenyls (21%), pentachlorobiphenyls (48%), hexachlorobiphenyls (23%), and heptachlorobiphenyls (6%).
NA Not available in references cited



NOTES:

SOLID LINES REPRESENT POTENTIALLY COMPLETE PATHWAYS

DASHED LINES REPRESENT INCOMPLETE PATHWAYS

① EXPOSURE PATHWAY NUMBER

DRAFT

DRN BY JTA	DATE 08/19/93	PRELIMINARY EXPOSURE PATHWAY FLOW CHART LANDFILL NO. 5 (SWMU NO. 113/IRP NO. LF-5) CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO.	FIG. NO.
CHK'D BY .	REVISIONS: 0		C3M11M	5-1

6.0
HUMAN HEALTH RISK SCREEN

The purpose of the HHRS in the Phase I RFI is to determine whether COIs (defined in Section 6.1) were detected in soils at levels that may pose an unacceptable risk to human health. The HHRS was performed according to Step No. 5 identified in the Phase I RFI Work Plan Decision Diagram (W-C 1995) (Figure 6-1).

The evaluation is screening level because it compares maximum detected chemical concentrations regardless of sample depth to risk-based screening concentrations (i.e., proposed RCRA Action Levels for soil ingestion assuming residential use [EPA 1990a]). The HHRS does not include estimating reasonable exposure concentrations or assessing current or future site-specific exposure conditions (e.g., future residential land use is considered to be extremely unlikely at this site). Therefore, the HHRS will overestimate hazard/risk at the site and will be protective of exposure pathways identified in Section 5.4.

As indicated in Figure 6-1, if concentrations of COIs do not exceed proposed RCRA Action Levels then no further action is recommended. If site concentrations exceed proposed RCRA Action Levels, then further evaluation of the site may be warranted.

6.1 METHODOLOGY

Steps in the HHRS, shown in Figure 6-1, included:

- Assessing whether an imminent threat to human health or the environment was present
- Identifying COIs, defined as potentially hazardous constituents (above background for inorganic analytes) for which proposed RCRA Action Levels were available or could be calculated using EPA-approved toxicity values
- Comparing maximum concentrations of chemicals of interest to proposed RCRA Action Levels
- Estimating cumulative risk from exposure to multiple chemicals

The methods used in performing these steps are summarized below.

6.1.1 Imminent Threat Evaluation

Physical and chemical data were reviewed and an evaluation was made to determine whether an imminent threat to human health and the environment was present (Section 6.2.1). If an imminent threat is evident, then the need for interim action will be evaluated. If no threat is apparent, no interim action is necessary and the HHRS proceeds to the next step, identification of chemicals of interest.

6.1.2 Identification of Chemicals of Interest

COIs in soil were defined as chemicals detected in surface or subsurface soil that exceeded background levels and for which either a proposed RCRA Action Level was available or could be calculated using an EPA-approved toxicity value.

Detected Chemicals: Analytical results for detected chemicals in surface and subsurface soil were discussed in Section 4.0, Nature and Extent. Appendix E of this report contains all the validated soil data results for these samples. Detected chemicals included VOCs, herbicides/pesticides/PCBs, SVOCs, inorganics, and TICs. The possible contribution of TICs to hazard/risk at the site is discussed separate from other analytes in Section 6.3.

Background Comparison: Detected inorganic analytes in soil were evaluated to determine whether site concentrations exceeded background levels (Section 6.2.2). The background range for inorganics established for Cannon AFB are shown in Table 4-32. For the background comparison, maximum detected site concentrations were compared to the 95% upper tolerance limit (95% UTL, estimated as the arithmetic mean plus two standard deviations) of background soil concentrations. Analytes whose maximum detected site concentration exceeded the 95% UTL of the background concentrations were retained for further screening for chemicals of interest.

Availability of RCRA Action Levels and EPA Toxicity Values: Inorganic analytes whose site concentration exceeded background levels and all detected organic compounds were evaluated to determine whether proposed RCRA Action Levels were available or could be calculated using

EPA-approved toxicity values (Section 6.2.2). Proposed RCRA Action Levels are based on EPA chronic residential exposure assumptions and are intended as screening levels at RCRA facilities to determine whether a more detailed health risk evaluation (CMS) is warranted (EPA 1990a).

Chemicals without either a proposed RCRA Action Level or an EPA toxicity value were evaluated qualitatively for potential hazard/risk in Section 6.3.

6.1.3 Comparison of Maximum Concentrations to Proposed RCRA Action Levels

Maximum detected concentrations for COIs were compared to chemical-specific proposed RCRA Action Levels derived based on the soil ingestion pathway. Proposed RCRA Action Levels were calculated using current (October 1995) EPA oral toxicity values, and equations and exposure parameters (shown below) from 55 FR 30798, EPA Proposed Corrective Action Rule for Solid Waste Management Units (EPA 1990a).

The equation for calculating proposed RCRA Action Levels for noncarcinogenic compounds is:

$$Cnc = (HI * RfD * BWc)/(IRc * A * CF)$$

where:

Cnc	=	Proposed noncarcinogenic RCRA Action Level in soil		
HI	=	Target hazard index	=	1 (unitless)
RfD	=	EPA oral reference dose	=	chemical specific (mg/kg-day)
BWc	=	Body weight for 5-year-old child	=	16 kg
IRc	=	Soil ingestion rate for a child	=	0.2 g/day
A	=	Absorption Factor	=	1 (unitless)
CF	=	Conversion factor	=	0.001 kg/g

The equation for calculating proposed RCRA Action Levels for carcinogenic compounds is:

$$Cc = (R * BWa * LT)/(IRa * SF* A * CF * ED)$$

where:

Cc	=	Proposed carcinogenic RCRA Action Level in soil		
R	=	Risk target level for class A, B1, and B2 carcinogens	=	1E-06 (unitless)
SF	=	EPA oral slope factor	=	chemical specific $(mg/kg\text{-}day)^{-1}$
BWa	=	Body weight for an adult	=	70 kg
LT	=	Lifespan	=	70 years
IRa	=	Soil ingestion rate for an adult	=	0.1 g/day
A	=	Absorption Factor	=	1 (unitless)
CF	=	Conversion factor	=	0.001 kg/g
ED	=	Exposure duration	=	70 years

The equations and parameters used to calculate proposed RCRA Action Levels are based on conservative assumptions that will overestimate risk at this site. For example:

- Exposure assumptions assume a lifetime residential scenario and include childhood exposure. Current residents on and off the base are not exposed to chemical constituents from the landfill, and future residential land use at Landfill No. 5 is considered extremely unlikely. Instead, potential receptors identified in Section 5.4 are current adult base workers and future construction workers whose exposure would be expected to be lower than that for the residential scenario assumed in calculating proposed RCRA Action Levels

- Proposed RCRA Action Levels are calculated assuming a target cancer risk level of 1E-06, whereas EPA's target cancer risk range for multiple chemical exposure extends two orders of magnitude higher to 1E-04 (EPA 1990b, 1991).

Proposed RCRA Action Levels were derived for the soil ingestion pathway only. Therefore, the HHRS did not evaluate hazard/risk for the dermal and inhalation exposure pathways, each identified as potentially complete pathways in the exposure assessment (Section 5.4). As discussed in Section 6.3.1, excluding the dermal and inhalation routes of exposure in the HHRS probably did not significantly affect estimates of hazard/risk at Landfill No. 5.

Because numerous conservative assumptions were used in calculating proposed RCRA Action Levels, exceedence of RCRA Action Levels by site concentrations does not necessarily indicate the presence of unacceptable risk at the site. For example, estimated cumulative cancer risk in the current assessment at Cannon AFB (4E-06) was well within EPA's target risk range of 1E-06 to 1E-04 for hazardous waste sites, even though the maximum concentration of the carcinogen beryllium exceeded its proposed RCRA Action Level (Section 6.2.4).

6.1.4 Evaluation of Cumulative Health Hazard/Cancer Risk

In addition to comparing maximum site concentrations to proposed RCRA Action Levels, potential cumulative effects of ingestion of multiple chemicals were also addressed. A total hazard index for ingestion of multiple noncarcinogenic chemicals was estimated by:

- determining the ratio of the maximum site concentration to the proposed RCRA Action Level for each chemical of interest

- summing the ratios (hazard quotients) to yield a hazard index

If the total hazard index is less than or equal to 1, exposure to noncarcinogenic chemicals of interest at the site are judged unlikely to result in adverse noncarcinogenic health effects (EPA 1989).

Chemical-specific cancer risk was determined by calculating the ratio of the maximum site concentration to proposed RCRA Action Level for each COI, then multiplying that ratio by 1E-06. Cancer risk estimates for each chemical were then summed to give cumulative cancer risk for the site. EPA's target range for cancer risk is 1E-06 to 1E-04 (EPA 1990b, 1991).

6.2 RESULTS OF THE HHRS

This section shows results for the imminent threat evaluation, identification of COIs, chemical-specific comparison of site concentrations to proposed RCRA Action Levels, and estimation of cumulative health hazards and cancer risk.

6.2.1 Imminent Threat Evaluation

Based on field observations and analytical results, no imminent threat to human health or the environment is present at Landfill No. 5. This conclusion was supported by the results of this HHRS, in which no chemical of interest significantly exceeded its proposed RCRA Action Level.

6.2.2 Chemicals of Interest

Table 6-1 lists the 43 detected inorganic and organic constituents (except for TICs) in soils, compares maximum site concentrations of inorganic analytes to background concentrations, shows the availability of chemical-specific proposed RCRA Action Levels, and identifies COIs for the site. The 29 COIs identified for evaluation in the HHRS are listed in Table 6-2.

Five detected organic compounds (including TRPH) and six inorganic analytes detected above background did not have proposed RCRA Action Levels or EPA-approved toxicity factors (Table 6-1). The potential contribution of these analytes to hazard/risk at the site is discussed qualitatively in Section 6.3.

Detected TICs, shown in Table 6-6, were not quantitatively evaluated in this HHRS. Instead, TICs were evaluated qualitatively for potential hazard/risk in Section 6.3.

6.2.3 Comparison of Site Exposure Concentrations to Proposed RCRA Action Levels

Results of the chemical-specific and cumulative hazard/risk evaluation of chemicals of interest are summarized in Tables 6-3 and 6-4.

Carcinogens: The maximum concentrations of one carcinogenic COI, beryllium, exceeded its proposed RCRA Action Level (Table 6-3), with an associated cancer risk of 4E-06. However, the maximum site value of 0.7 mg/kg for beryllium only slightly exceeded the 95% UTL of the background concentration of 0.6 mg/kg for beryllium, suggesting that beryllium at the site may be naturally occurring rather than site related.

Because the maximum concentration is usually not representative of an average exposure concentration, the 95% UCL of the arithmetic mean was calculated from the Phase I RFI sampling

data for beryllium, using one-half of the sample quantitation limit for soil samples that were nondetect (Table 6-5). The 95% UCL is recommended by EPA as the exposure concentration to be used in estimating site risk (EPA 1989, 1994a). The 95% UCL of 0.24 mg/kg for beryllium slightly exceeds the proposed RCRA Action Level of 0.2 mg/kg, yielding a ratio of 1.2.

Noncarcinogens: No noncarcinogenic COI exceeded its proposed RCRA Action Level, indicating that the hazard quotient for each chemical was less than 1 (Table 6-4).

6.2.4 Evaluation of Cumulative Health Hazards/Cancer Risks

Carcinogens: The cumulative cancer risk for COIs, estimated by multiplying the cumulative ratio by 1E-06, was 4E-06 due primarily to beryllium (maximum concentration of 0.7 mg/kg) (Table 6-3). This cancer risk is well within EPA's target cancer risk range of 1E-06 to 1E-04 (EPA 1990b).

The cancer risk for beryllium using the 95% UCL site exposure concentration of 0.24 mg/kg is 1.2E-06, which is approximately equal to EPA's "point of departure" of 1E-06, indicating negligible cancer risk (EPA 1990b).

Noncarcinogens: The sum of the chemical-specific ratios for noncarcinogenic chemicals of interest was 1 (Table 6-4). The primary contributor to the hazard index was barium at a concentration of 5600 mg/kg (hazard quotient of 0.8), in a sample obtained at a depth of 46 feet where human exposure would not occur. Because of the depth of the sample and the low mobility of most metals, the barium is probably natural occurring. In addition, barium can substitute for calcium in caliche-rich zones that may explain concentrations of barium above the maximum background range. In addition, further evaluation of barium at the site indicates that the maximum detected value of 5600 mg/kg is not representative of site-wide barium concentrations. The 95% UCL of the arithmetic mean of barium is 293 mg/kg (Table 6-5). The hazard quotient using the 95% UCL exposure concentration of 293 mg/kg is 0.04, indicating that the average concentrations of barium at the site will not pose a risk to human health.

6.3 UNCERTAINTY IN THE ASSESSMENT

6.3.1 Uncertainty Associated with Performing a Screening-Level Risk Assessment

Because this was a screening-level risk assessment, conservative assumptions were used throughout the assessment to ensure that risk was not underestimated, including:

- The use of conservative exposure assumptions (e.g., assuming residential exposure overestimates actual exposure at the site) and a target cancer risk level of 1E-06 to calculate proposed RCRA Action Levels for chemicals of interest (Section 6.1.3)

- The use of maximum detected concentrations for chemicals of interest instead of estimating the arithmetic mean

Dermal and inhalation exposure to COIs in soil and to VOCs in outdoor air were potentially complete exposure pathways (Section 5.4). However, these routes of exposure were not evaluated in the HHRS. To evaluate whether excluding these exposure routes has a significant effect on the estimates of risk for Landfill No. 5, maximum site concentrations were compared to EPA Region IX preliminary remediation goals (PRGs) for residential exposure to soil (EPA 1995a). Region IX PRGs are risk-based concentrations similar to RCRA Action Levels, but include residential exposure to soil by the oral, dermal, and inhalation routes. As in the comparison to RCRA Action Levels, only the maximum concentration of beryllium (0.7 mg/kg) exceeded its Region IX PRG of 0.14 mg/kg with an associated cancer risk of 5E-06. No noncarcinogenic COI exceeded its Region IX PRG, indicating that the hazard quotient for each chemical was less than or equal to 1. These results are similar to those using the proposed RCRA Action Levels for soil ingestion (Section 6.2.3), indicating that excluding the dermal and inhalation routes of exposure for soil in the HHRS has not significantly affected estimates of hazard/risk for this site.

Additional uncertainty exists regarding the potential of TICs and other detected compounds without toxicity factors to adversely affect human health under exposure conditions at the landfill. These compounds are evaluated qualitatively in the followings sections.

6.3.2 Tentatively Identified Compounds

Detected TICs, number of detections, and maximum detected concentrations are shown in Table 6-6. A proposed RCRA Action Level was calculated for only two TICs, acetic acid, ethyl ester (ethyl acetate) and acetic acid, methyl ester (methyl acetate). Other TICs did not have either a proposed RCRA Action Level or an EPA-approved toxicity value. The maximum detected concentration of ethyl acetate was 0.11 mg/kg while the proposed RCRA Action Level was 70,000 mg/kg, yielding a hazard quotient of 2E-06. The maximum detected concentration of methyl acetate was 0.0074 mg/kg while the proposed RCRA Action Level was 80,000 mg/kg, yielding a hazard quotient of 9.3E-08. These values are well below 1 indicating that ethyl acetate and methyl acetate at the site will not pose a threat to human health.

The remaining TICs, which do not have either a proposed RCRA Action Level or EPA-approved toxicity value were categorized as (1) probably nontoxic, (2) toxicity unknown, (3) specific chemical form unknown, and (4) probably related to petroleum products (Table 6-7). These categories of TICs are evaluated qualitatively in the following discussion.

TICs With Unknown Toxicity: Seventeen TICs that could not readily be classified as nontoxic were classified as toxicity unknown (Table 6-7). As discussed below, these TICs were detected infrequently and at low concentrations, suggesting a low potential for human exposure.

- A methylated form of the PAH naphthalene, 1-methylnaphthalene, was detected in 1 of 160 samples at a concentration of 0.076 mg/kg and at a depth of 41 feet. This concentration is substantially less than the Region IX PRG for naphthalene of 800 mg/kg (no proposed RCRA Action Level was available for naphthalene) indicating that 1-methylnaphthalene at the site is unlikely to pose excess risk to human health. Furthermore, no human exposure would occur at a depth of 41 feet.

- Methylcyclohexane was detected in 6 of 160 samples, at depths of 19 to 25 feet, with a maximum detected concentration of 0.18 mg/kg. A related compound, cyclohexane, is regulated by Occupational Safety and Health Administration (OSHA) for the inhalation route of exposure. Based on low concentrations, infrequent detections, and the presence at depths below the depth typical of excavations (15 feet), potential for human exposure to methylcyclohexane at the

site is negligible. Therefore, it is unlikely that this TIC would pose a threat to human health.

- 4,4-difluoro-1,1'-biphenyl was detected in 1 of 160 samples at a concentration of 0.28 mg/kg and a depth of 30 feet. Based on chemical structure, this halogenated biphenyl might be expected to have effects similar to those of PCBs (although the relative potency of this TIC to PCBs is unknown). The maximum site concentration of this compound exceeds the proposed RCRA Action Level for PCBs (0.09 mg/kg) by a factor of 3 (comparable to a cancer risk of 3E-06). Because the potential for human exposure to this TIC at the site is negligible, and potential risk is low based on analogy to PCBs, it does not pose a risk to human health.

- Three TICs are considered hazardous under high exposure conditions (however, toxicity at chronic, low exposure conditions is unknown): 2-butene (explosive), alpha-pinene (skin irritant; poisonous by inhalation), and nonanal (skin irritant). However, these compounds were detected in only 1 of 160 samples at very low concentrations. 2-Butene was detected at a concentration of 0.0086 mg/kg at a depth of 35 feet; nonanal was detected at a concentration of 0.01 mg/kg at a depth of 60 feet; alpha-pinene was detected in surface soil at a concentration of 0.14 mg/kg. Because of low detection frequency and low concentrations, human exposure and risk is low.

- For the 11 TICs listed below, no information on the potential toxicity was found. Based on low concentrations (maximum detected concentrations from 0.007 to 0.8 mg/kg) and infrequent detection (out of 160 soil samples, molecular sulfur was detected twice, stigmast-5-en-3-ol-, [3.beta.,24S]- was detected five times, and other TICs were detected only once), it is unlikely that these TICs pose a threat to human health.

  alpha-amyrin
  2-butenylbenzene
  molecular sulfur
  1-pentene, 4,4-dimethyl

phenol, 4,4'-butylidenebis[2-(1,1-dimethylethyl]
bicyclo[2.2.1]heptan-2-one-1,3,3-trimethyl-
3-cyclohexane-1-methanol,.alpha.,.alpha.4-trim
cyclopentane carboxylic acid, 2-amino, trans
eicosanic acid, 2,3-bis[acetyloxy]propyl ester
stigmast -5-en-3-ol-, (3.beta.,24S)-
a'-neogammacer-22(29)-en-3-ol,(3.beta.,21.beta.)-

Relatively Nontoxic TICs: Twenty-six TICs were considered to be relatively nontoxic based on chemical form (Table 6-7). These included alcohols, fatty acids, fatty acid esters, and ketones. In general, these TICs were detected infrequently (from one to four detections out of 160 samples) and at low concentrations (ranging from 0.0053 to 4.9 mg/kg) suggesting a low potential for human exposure. Based on low potential for exposure and low toxicity, these TICs would not be expected to pose a risk to human health at the site.

TICs Whose Specific Chemical Form Is Unknown: Five TICs were identified as a chemical class rather than a compound (Table 6-7). For four of these TICs no qualitative discussion of potential toxicity is possible: nitrogen compound, oxygenated hydrocarbon, primary amide, unsaturated hydrocarbon. One TIC, identified only as a "PAH", was detected in one sample at a concentration of 0.19 mg/kg. Because this concentration is less than the proposed RCRA Action Level of 0.9 mg/kg for the most potent PAH, benzo(a)pyrene, and was detected in only one sample, it is unlikely that this TIC would pose an unacceptable risk to human health.

TICs Related to Petroleum Products: Three TICs were relatively nontoxic, saturated hydrocarbons probably related to petroleum products (Table 6-7). The maximum concentrations of these TICs (0.009 to 3.2 mg/kg) were well below typical levels of concern for TRPH in soil (action levels for the State of New Mexico are 50 to 100 mg/kg). Based on low potential for exposure and toxicity, it is not expected that these compounds would pose a threat to human health.

6.3.3 Compounds Without Toxicity Values

Inorganic Analytes: Six inorganic analytes with maximum detected concentrations exceeding the background range did not have either a proposed RCRA Action Level or an EPA-toxicity value

(Table 6-1). Calcium, iron, magnesium, potassium, and sodium are relatively nontoxic, essential dietary elements which are unlikely to pose a threat to human health at the levels detected in soil at the site. Lead was detected at a maximum concentration of 78.2 mg/kg, which is less than EPA's screening level of 400 mg/kg for residential childhood exposure to lead in soil at RCRA sites (EPA 1994b). Therefore, lead in soil would not be expected to pose a risk to human health.

Organic Compounds: Eight organic chemicals detected at low concentrations (maximum <0.25 mg/kg) did not have proposed RCRA Action Levels or EPA-toxicity values (Table 6-1). Although the toxicity of these compounds is not known, it is unlikely that they would pose a risk to human health at the low concentrations detected at the site (e.g., the proposed RCRA Action Level in soil for the potent carcinogen vinyl chloride [0.33 mg/kg] is higher than the maximum concentrations of these organic compounds).

TRPH was detected in 10 of 160 samples, with a maximum detected value of 170 mg/kg and an 95% UCL of 25 mg/kg (calculated using one-half of the sample quantitation limit for soil samples that were nondetect). TRPH does not have a proposed RCRA Action Level or an EPA-approved toxicity value. However, the State of New Mexico has action levels of 50 mg/kg for TRPH derived from gasoline and 100 mg/kg for TRPH derived from diesel or waste oil. The source of the TRPH at Landfill No. 5 is not known. However, it is likely that TRPH at the site is weathered and therefore less toxic than fresh product (because potentially toxic volatile constituents such as benzene evaporate and are generally absent in weathered fuel). This is supported by the lack of detections or very low concentrations of typical volatile fuel constituents in soils at the site (e.g., toluene was detected at a maximum concentration of 0.0049 mg/kg and benzene, ethylbenzene, and xylene were not detected).

6.4 CONCLUSION

Based on the results of the HHRS, it does not appear that chemicals of interest at Landfill No. 5 pose an unacceptable risk to human health.

A HHRS was performed for Landfill No. 5 to determine whether chemicals detected in soils may pose an unacceptable risk to human health. Maximum site concentrations were compared to proposed RCRA Action Levels for residential soil ingestion to evaluate the potential for cumulative

hazard/risk. Conservative assumptions were used throughout the HHRS; therefore, the results of the assessment probably overestimate actual hazard/risk at the site.

Only one carcinogen, beryllium had a maximum concentration (0.7 mg/kg) exceeding its proposed RCRA Action Level (0.2 mg/kg). The associated cancer risk assuming a 70-year soil ingestion exposure to the maximum concentration is 4E-06, well within EPA's target cancer risk range of 1E-06 to 1E-04. Estimated cumulative cancer risk from exposure to maximum concentrations of all detected carcinogens was also 4E-06 due to the presence of beryllium. When the 95% UCL of the arithmetic mean is used to represent the exposure concentration of beryllium in soil, the site concentration (0.24 mg/kg) is approximately equal to the proposed RCRA Action Level (0.2 mg/kg) and the chemical-specific cancer risk is approximately 1E-06 from soil ingestion, whereas that for cumulative cancer risk is 2E-06. Because the use of maximum detected concentrations overestimates cancer risk for each chemical of interest, and cancer risk estimates were nevertheless within EPA's target risk range, it is concluded that exposure to COIs at Landfill No. 5 probably does not pose an unacceptable risk of cancer.

No noncarcinogenic chemical had a maximum concentration exceeding its proposed RCRA Action Level. The cumulative hazard index for noncarcinogenic effects was 1, indicating that maximum concentrations of noncarcinogenic chemicals in soil at the site do not pose an unacceptable risk to human health.

TICs and other compounds without toxicity values were evaluated qualitatively and were not considered to pose a threat to human health based on low potential for toxicity and human exposure (due to infrequent detection, detection at depths below 15 feet, and low concentrations).

Based on the results of the HHRS, it is concluded that chemicals of interest at Landfill No. 5 do not pose an unacceptable risk to human health.

TABLE 6-1
SELECTION OF CHEMICALS OF INTEREST
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

Detected Constituents (1)	Site Maximum Concentration (mg/kg)	95%UTL of Background Range (mg/kg) (2)	Maximum Concentration Exceeds 95% UTL?	RCRA Action Level or Toxicity Value Available? (3)	Chemical of Interest?(4)
Aluminum	1.11E+04	1.08E+04	Yes	Yes	Yes
Antimony	1.48E+01	2.96E+01	No	Yes	No
Arsenic	5.80E+00	1.05E+01	No	Yes	No
Barium	5.05E+03	5.48E+02	Yes	Yes	Yes
Beryllium	7.00E-01	6.00E-01	Yes	Yes	Yes
Cadmium	6.90E-01	2.10E+00	No	Yes	No
Calcium	2.84E+05	1.66E+05	Yes	No	No
Chromium	4.07E+01	1.20E+01	Yes	Yes	Yes
Cobalt	5.00E+00	4.00E+00	Yes	Yes	Yes
Copper	6.36E+01	1.01E+01	Yes	Yes	Yes
Iron	9.61E+03	8.65E+03	Yes	No	No
Lead	7.82E+01	1.84E+01	Yes	No	No
Magnesium	1.63E+04	9.91E+03	Yes	No	No
Manganese	2.75E+02	1.52E+02	Yes	Yes	Yes
Nickel	3.92E+02	9.70E+00	Yes	Yes	Yes
Potassium	2.97E+03	2.53E+03	Yes	No	No
Silver	4.80E+00	1.80E+00	Yes	Yes	Yes
Sodium	3.92E+03	8.34E+02	Yes	No	No
Thallium	2.30E-01	6.20E+00	No	Yes	No
Tin	5.60E+01	?(5)	?(5)	Yes	Yes(6)
Vanadium	3.67E+01	2.50E+01	Yes	Yes	Yes
Zinc	5.90E+01	2.07E+01	Yes	Yes	Yes
1,1,2,2-Tetrachloroethane	8.20E-03	- (7)	-	Yes	Yes
2-Hexanone	1.10E-02	-	-	No	No
2-Methylnaphthalene	8.50E-02	-	-	No	No
4-Methyl-2-pentanone (MIBK)	2.30E-01	-	-	Yes	Yes
4-Methylphenol	1.00E-01	-	-	Yes	Yes
4-Nitrophenol	6.80E-02	-	-	Yes	Yes

TABLE 6-1
SELECTION OF CHEMICALS OF INTEREST
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

Detected Constituents (1)	Site Maximum Concentration (mg/kg)	95%UTL of Background Range (mg/kg) (2)	Maximum Concentration Exceeds 95% UTL?	RCRA Action Level or Toxicity Value Available? (3)	Chemical of Interest?(4)
Acenaphthene	8.20E-02	-	-	Yes	Yes
Acetonitrile	6.70E-02	-	-	Yes	Yes
Aroclor 1254	7.40E-02	-	-	Yes	Yes
Carbon disulfide	2.90E-03	-	-	Yes	Yes
Chrysene	3.80E-02	-	-	Yes	Yes
Dibenzofuran	4.40E-02	-	-	No	No
Ethylbenzene	3.00E-01	-	-	Yes	Yes
Fluoranthene	9.30E-02	-	-	Yes	Yes
Fluorene	6.90E-02	-	-	Yes	Yes
Phenanthrene	2.20E-01	-	-	No	No
Phenol	3.60E-01	-	-	Yes	Yes
Pyrene	8.80E-02	-	-	Yes	Yes
Styrene	1.40E+00	-	-	Yes	Yes
Toluene	4.90E-03	-	-	Yes	Yes
Total Petroleum Hydrocarbon (TPH)	1.70E+02	-	-	No	No

(1) Does not include tentatively identified compounds (TICs), which were evaluated separately in the assessment (see Table 6-6).
(2) 95% Upper Tolerance Limit (95%UTL) of background concentrations as estimated by the mean plus two standard deviations. Background concentrations of inorganics are discussed in Section 4.0 and shown in Table 4-32.
(3) Proposed action levels from 55 FR 30798 (Subpart S, Corrective Action for SWMUs at Hazardous Waste Management Facilities, 27 July 1990). For potential contaminants that did not have proposed RCRA Action Levels but have EPA toxicity factors, action levels were calculated using methodology from 55 FR 30798.
(4) Chemicals of interest were detected organic compounds not considered to be laboratory contaminants and with proposed RCRA Action Levels or EPA-approved oral toxicity values and detected inorganic analytes whose concentration exceeded the background range and who have proposed RCRA Action Levels or EPA-approved oral toxicity values.
(5) Background samples were not analyzed for tin.
(6) In the absence of information about background concentrations of tin, it was assumed that site concentrations of tin exceeded background and tin was selected as a chemical of interest.
(7) A background comparison was not performed for organic compounds.

TABLE 6-2
CHEMICALS OF INTEREST
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

Inorganic Compounds	Organic Compounds
Aluminum	1,1,2,2-Tetrachloroethane
Barium	4-Methyl-2-pentanone (MIBK)
Beryllium	4-Methylphenol
Chromium	4-Nitrophenol
Cobalt	Acenaphthene
Copper	Acetonitrile
Lead	Aroclor 1254
Manganese	Carbon disulfide
Nickel	Chrysene
Silver	Ethylbenzene
Tin	Fluoranthene
Vanadium	Fluorene
Zinc	Phenol
	Pyrene
	Styrene
	Toluene

TABLE 6-3
RISK-BASED SCREENING OF CARCINOGENIC CHEMICALS OF INTEREST
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

Chemical of Interest	Maximum Concentration (mg/kg)	Proposed RCRA Action Level (mg/kg) (a)	Ratio of Maximum Concentration to Proposed RCRA Action Level	Cancer Risk (b)
1,1,2,2-Tetrachloroethane	8.20E-03	4E+00(c)	2E-03	2E-09
Aroclor 1254	7.50E-02	9E-02(c)	8E-01	8E-07
Chrysene	3.80E-02	1E+01(d)	4E-03	4E-09
Beryllium	7.00E-01	2E-01 (c)	4E+00	4E-06
Cumulative Cancer Risk				4E-06

[ ] = Maximum detected concentration exceeds proposed RCRA Action Level.

(a) Proposed RCRA Action Levels were calculated using guidance in 55 FR 30798 (Subpart S, Corrective Action for SWMUs at Hazardous Waste Management Facilities, 27 July 1990) and current toxicity values from IRIS (EPA 1995b) and HEAST (EPA 1994c). Action Levels are based on residential soil ingestion and 1E-06 (1 in 1,000,000) cancer risk level.

(b) Cancer risk = (Ratio of maximum concentration to Action Level)* 1E-06.

(c) Calculated from toxicity values provided in IRIS (through October 1995) (EPA 1995b).

(d) Calculated from toxicity values provided in USEPA 1993 (Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons, EPA/625/3-89/016).

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TABLE 6-4
RISK-BASED SCREENING OF NONCARCINOGENIC CHEMICALS OF INTEREST
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

Chemical of Interest	Maximum Concentration (mg/kg)	Proposed RCRA Action Level (mg/kg) (a)	Ratio of Maximum Concentration to Proposed RCRA Action Level (Hazard Quotient)
4-Methyl-2-pentanone (MIBK)	2.30E-01	6E+03(b)	4E-05
4-Methylphenol	1.00E-01	4E+02(b)	3E-04
Acenaphthene	8.20E-02	5E+03(c)	2E-05
Acetonitrile	6.70E-02	5E+02(c)	1E-04
Aroclor 1254	7.40E-02	2E+00(c)	4E-02
Carbon disulfide	2.90E-03	8E+03(c)	4E-07
Ethylbenzene	3.00E-01	8E+03(c)	4E-05
Fluoranthene	9.30E-02	3E+03(c)	3E-05
Fluorene	6.90E-02	3E+03(c)	2E-05
Phenol	3.60E-01	5E+04(c)	7E-06
Pyrene	8.80E-02	2E+03(c)	4E-05
Styrene	1.40E+00	2E+04(c)	7E-05
Toluene	4.90E-03	2E+04(c)	2E-07
Aluminum	1.11E+04	2E+05(d)	6E-02
Barium	5.05E+03	6E+03 (c)	8E-01
Beryllium	7.00E-01	4E+02(c)	2E-03
Chromium	4.07E+01(e)	8E+04(c,f)	5E-04
		4E+02 (c,g)	1E-01
Cobalt	5.00E+00	5E+03(d)	1E-03
Copper	6.36E+01	3E+03(b)	2E-02
Manganese	2.75E+02	4E+03(c)	7E-02
Nickel	3.92E+02	2E+03(c)	2E-01
Silver	4.80E+00	4E+02(c)	1E-02
Tin	5.60E+01	5E+03(b)	1E-02
Vanadium	3.67E+01	6E+02(b)	6E-02
Zinc	5.90E+01	2E+04(c)	3E-03
Total Hazard Index			1E+00(h)
			1E+00(i)

(a) Proposed RCRA Action Levels were calculated using guidance in 55 FR 30798 (Subpart S, Corrective Action for SWMUs at Hazardous Waste Management Facilities, 27 July 1990) and updated toxicity values from IRIS (EPA 1995) and HEAST (EPA 1994c). Action Levels are based on residential soil ingestion and hazard index of 1.

(b) Calculated from toxicity values provided in HEAST (EPA 1994c).

(c) Calculated from toxicity values provided in IRIS (through October 1995) (EPA 1995b).

(d) Calculated from provisional toxicity values for aluminum and cobalt provided by ECAO (EPA 1994d).

(e) Total chromium (chromium III plus VI).

(f) Calculated using oral RfD for chromium (III).

(g) Calculated using oral RfD for chromium (VI).

(h) Assuming only chromium (III) is present at the site.

(i) Assuming only chromium (VI) is present at the site.

TABLE 6-5
SAMPLING RESULTS FOR HAZARD/RISK DRIVERS IN SOIL
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

BERYLLIUM			BARIUM		
FIELD ID	RESULT (mg/kg) (1)	WCQ(2)	FIELD ID	RESULT (mg/kg)	WCQ
CAN113-B304-1000	0.7		CAN113-B301-1045	5050	J
CAN113-B319-1025	0.59		CAN113-B330-1020	3470	J
CAN113-B310-1000	0.49		CAN113-B329-1014	1920	J
CAN113-B329-1014	0.49		CAN113-B317-1019	1260	J
CAN113-B330-1014	0.48		CAN113-B329-1020	922	J
CAN113-B320-1016	0.47		CAN113-B317-1035	736	J
CAN113-B328-1000	0.46		CAN113-B312-1034	654	J
CAN113-B322-1000	0.45		CAN113-B323-1024	608	J
CAN113-B325-1000	0.45		CAN113-B310-1034	595	
CAN113-B307-1000	0.44		CAN113-B305-1039	520	
CAN113-B313-1000	0.44		CAN113-B311-1035	512	
CAN113-B302-1020	0.41		CAN113-B305-1029	501	
CAN113-B316-1000	0.38		CAN113-B312-1045	441	J
CAN113-B306-1025	0.37		CAN113-B320-1020	427	
CAN113-B308-1020	0.37		CAN113-B325-1030	386	
CAN113-B317-1019	0.37	J	CAN113-B321-1022	377	J
CAN113-B325-1024	0.35		CAN113-B324-1029	367	
CAN113-B301-1001	0.34		CAN113-B326-1027	342	
CAN113-B302-1014	0.33	J	CAN113-B318-1055	310	J
CAN113-B307-1024	0.33		CAN113-B313-1062	309	J
CAN113-B322-1025	0.33	J	CAN113-B315-1020	304	
CAN113-B309-1018	0.32	J	CAN113-B321-1035	293	
CAN113-B301-1000	0.31		CAN113-B308-1045	285	J
CAN113-B323-1024	0.31	J	CAN113-B325-1000	281	J
CAN113-B327-1021	0.31		CAN113-B328-1000	281	J
CAN113-B329-1020	0.31	J	CAN113-B313-1000	280	J
CAN113-B327-1024	0.3		CAN113-B330-1014	279	J
CAN113-B317-1025	0.29	J	CAN113-B321-1057	277	
CAN113-B322-1018	0.29		CAN113-B308-1020	274	J
CAN113-B328-1025	0.29	J	CAN113-B325-1050	263	
CAN113-B308-1025	0.28		CAN113-B304-1035	258	
CAN113-B320-1020	0.28	J	CAN113-B324-1059	251	
CAN113-B325-1030	0.28	J	CAN113-B312-1027	249	J
CAN113-B304-1020	0.27	J	CAN113-B315-1035	245	
CAN113-B311-1035	0.26	J	CAN113-B309-1045	240	
CAN113-B313-1032	0.26		CAN113-B317-1025	238	J
CAN113-B306-1035	0.25		CAN113-B301-1001	236	J
CAN113-B307-1039	0.25		CAN113-B322-1000	226	J
CAN113-B311-1031	0.25		CAN113-B327-1024	225	
CAN113-B318-1028	0.25	J	CAN113-B316-1050	213	J
CAN113-B327-1034	0.25		CAN113-B319-1035	207	

TABLE 6-5
SAMPLING RESULTS FOR HAZARD/RISK DRIVERS IN SOIL
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

BERYLLIUM			BARIUM		
FIELD ID	RESULT (mg/kg) (1)	WCQ(2)	FIELD ID	RESULT (mg/kg)	WCQ
CAN113-B307-1029	0.24	J	CAN113-B301-1000	205	J
CAN113-B317-1035	0.24	J	CAN113-B328-1020	201	J
CAN113-B323-1035	0.24	J	CAN113-B305-1024	194	
CAN113-B304-1025	0.23	J	CAN113-B316-1000	194	J
CAN113-B305-1024	0.22	J	CAN113-B323-1019	194	J
CAN113-B313-1040	0.21	J	CAN113-B311-1065	193	
CAN113-B318-1033	0.21	J	CAN113-B326-1021	187	
CAN113-B320-1030	0.21	J	CAN113-B316-1045	184	J
CAN113-B328-1035	0.21	J	CAN113-B302-1014	180	J
CAN113-B312-1055	0.2	J	CAN113-B321-1027	180	
CAN113-B311-1065	0.19	J	CAN113-B306-1020	177	J
CAN113-B316-1050	0.19	J	CAN113-B304-1045	175	
CAN113-B316-1060	0.19	J	CAN113-B328-1025	170	J
CAN113-B325-1040	0.19	J	CAN113-B310-1000	169	J
CAN113-B302-1040	0.18	J	CAN113-B330-1030	168	J
CAN113-B304-1045	0.18	J	CAN113-B303-1023	167	
CAN113-B315-1045	0.18	J	CAN113-B327-1034	164	
CAN113-B325-1050	0.18	J	CAN113-B313-1050	153	J
CAN113-B304-1055	0.17	J	CAN113-B308-1035	147	J
CAN113-B312-1045	0.17	J	CAN113-B324-1050	147	
CAN113-B321-1022	0.17	J	CAN113-B304-1000	146	J
CAN113-B322-1056	0.17	J	CAN113-B319-1000	145	J
CAN113-B307-1049	0.16	J	CAN113-B306-1025	141	J
CAN113-B308-1035	0.16	J	CAN113-B307-1000	138	J
CAN113-B310-1044	0.16	J	CAN113-B322-1025	137	J
CAN113-B313-1050	0.16	J	CAN113-B327-1044	135	
CAN113-B325-1060	0.16	J	CAN113-B304-1025	134	
CAN113-B329-1030	0.16	J	CAN113-B307-1029	134	J
CAN113-B301-1045	0.15	J	CAN113-B311-1031	132	
CAN113-B308-1055	0.15	J	CAN113-B315-1025	131	
CAN113-B316-1045	0.15	J	CAN113-B303-1050	130	
CAN113-B323-1045	0.15	J	CAN113-B316-1070	130	J
CAN113-B323-1054	0.15	J	CAN113-B329-1030	130	J
CAN113-B305-1059	0.14	J	CAN113-B309-1018	128	
CAN113-B306-1045	0.14	J	CAN113-B316-1060	125	J
CAN113-B310-1054	0.14	J	CAN113-B330-1040	125	J
CAN113-B310-1064	0.14	J	CAN113-B309-1035	121	
CAN113-B316-1070	0.14	J	CAN113-B314-1038	121	J
CAN113-B317-1053	0.14	J	CAN113-B301-1063	119	J
CAN113-B320-1040	0.14	J	CAN113-B322-1018	115	J
CAN113-B320-1052	0.14	J	CAN113-B323-1035	113	J

TABLE 6-5
SAMPLING RESULTS FOR HAZARD/RISK DRIVERS IN SOIL
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

BERYLLIUM			BARIUM		
FIELD ID	RESULT (mg/kg) (1)	WCQ(2)	FIELD ID	RESULT (mg/kg)	WCQ
CAN113-B329-1050	0.14	J	CAN113-B310-1029	110	
CAN113-B301-1063	0.13	J	CAN113-B314-1032	107	J
CAN113-B305-1049	0.13	J	CAN113-B302-1020	106	J
CAN113-B308-1045	0.13	J	CAN113-B318-1045	106	J
CAN113-B313-1062	0.13	J	CAN113-B303-1028	104	
CAN113-B321-1057	0.13	J	CAN113-B318-1028	104	J
CAN113-B324-1040	0.13	J	CAN113-B305-1059	103	
CAN113-B328-1045	0.13	J	CAN113-B324-1024	103	
CAN113-B328-1055	0.13	J	CAN113-B325-1024	103	
CAN113-B301-1055	0.12	J	CAN113-B301-1034	98.7	J
CAN113-B306-1055	0.12	J	CAN113-B308-1025	96.3	J
CAN113-B311-1045	0.12	J	CAN113-B328-1035	95	J
CAN113-B311-1055	0.12	J	CAN113-B326-1047	94.6	
CAN113-B315-1055	0.12	J	CAN113-B322-1035	94.3	J
CAN113-B322-1045	0.12	J	CAN113-B326-1055	93.6	
CAN113-B317-1045	0.11	J	CAN113-B313-1040	93.2	J
CAN113-B306-1020	0.55	U	CAN113-B304-1020	92.4	
CAN113-B328-1020	0.55	U	CAN113-B327-1021	92	
CAN113-B330-1020	0.55	U	CAN113-B321-1045	91.5	
CAN113-B323-1019	0.55	U	CAN113-B329-1040	90.1	J
CAN113-B303-1023	0.5	U	CAN113-B302-1030	88.2	J
CAN113-B304-1035	0.23	U	CAN113-B320-1052	88.1	
CAN113-B314-1038	0.225	U	CAN113-B309-1025	87.8	
CAN113-B314-1032	0.225	U	CAN113-B322-1045	84.2	J
CAN113-B321-1027	0.225	U	CAN113-B301-1055	83.2	J
CAN113-B315-1035	0.22	U	CAN113-B307-1059	82.9	
CAN113-B315-1025	0.22	U	CAN113-B310-1054	81	
CAN113-B315-1020	0.22	U	CAN113-B307-1039	75.2	J
CAN113-B302-1030	0.22	U	CAN113-B307-1049	75.1	J
CAN113-B301-1034	0.22	U	CAN113-B301-1028	74	J
CAN113-B301-1028	0.22	U	CAN113-B319-1053	72.9	
CAN113-B305-1029	0.22	U	CAN113-B313-1027	72	J
CAN113-B310-1029	0.22	U	CAN113-B310-1064	70.3	
CAN113-B324-1024	0.22	U	CAN113-B320-1016	69.4	
CAN113-B329-1040	0.22	U	CAN113-B302-1040	68.9	J
CAN113-B326-1027	0.22	U	CAN113-B311-1045	66.4	
CAN113-B326-1021	0.22	U	CAN113-B320-1040	64.3	J
CAN113-B330-0568	0.22	U	CAN113-B319-1018	61.3	
CAN113-B321-1035	0.22	U	CAN113-B318-1033	60.8	J
CAN113-B305-1039	0.215	U	CAN113-B310-1044	59.5	
CAN113-B324-1029	0.215	U	CAN113-B314-1067	59.4	J

TABLE 6-5
SAMPLING RESULTS FOR HAZARD/RISK DRIVERS IN SOIL
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

BERYLLIUM			BARIUM		
FIELD ID	RESULT (mg/kg) (1)	WCQ(2)	FIELD ID	RESULT (mg/kg)	WCQ
CAN113-B312-1034	0.215	U	CAN113-B317-1045	59.1	J
CAN113-B312-1027	0.215	U	CAN113-B306-1055	58.8	J
CAN113-B309-1035	0.215	U	CAN113-B306-1045	58.4	J
CAN113-B309-1025	0.215	U	CAN113-B325-1040	56.3	
CAN113-B309-0564	0.215	U	CAN113-B324-1040	56.2	
CAN113-B303-1028	0.21	U	CAN113-B312-1065	56.1	
CAN113-B310-1034	0.21	U	CAN113-B314-1057	55.9	J
CAN113-B322-1035	0.21	U	CAN113-B319-1025	54.2	
CAN113-B319-1000	0.195	U	CAN113-B315-1045	51.3	
CAN113-B319-1018	0.115	U	CAN113-B329-1050	50.9	
CAN113-B313-1027	0.11	U	CAN113-B320-1030	50.7	J
CAN113-B314-1057	0.11	U	CAN113-B328-1045	49.7	J
CAN113-B324-1059	0.11	U	CAN113-B304-1055	48.2	
CAN113-B326-1037	0.11	U	CAN113-B309-1053	48.2	
CAN113-B326-1047	0.11	U	CAN113-B311-1055	48.1	
CAN113-B330-1030	0.11	U	CAN113-B305-1049	47.5	
CAN113-B302-1050	0.105	U	CAN113-B323-1054	47.1	
CAN113-B303-1058	0.105	U	CAN113-B303-1040	45.4	
CAN113-B303-1050	0.105	U	CAN113-B326-1037	43.9	
CAN113-B303-1040	0.105	U	CAN113-B315-1055	43.2	
CAN113-B319-1053	0.105	U	CAN113-B307-1024	42.1	J
CAN113-B316-1080	0.105	U	CAN113-B325-1060	42.1	
CAN113-B319-1035	0.105	U	CAN113-B323-1045	41.1	J
CAN113-B319-1045	0.105	U	CAN113-B308-1055	38.2	
CAN113-B318-1055	0.105	U	CAN113-B319-1045	37.5	
CAN113-B318-1063	0.105	U	CAN113-B318-1063	37.2	
CAN113-B318-1045	0.105	U	CAN113-B316-1080	36.9	
CAN113-B314-1067	0.105	U	CAN113-B314-1045	35.2	J
CAN113-B314-1045	0.105	U	CAN113-B322-1056	32.7	
CAN113-B324-1050	0.105	U	CAN113-B327-1057	31	
CAN113-B312-1065	0.105	U	CAN113-B328-1055	30.6	
CAN113-B309-1053	0.105	U	CAN113-B312-1055	28.4	J
CAN113-B307-1059	0.105	U	CAN113-B330-1050	26.8	
CAN113-B309-1045	0.105	U	CAN113-B303-1058	25.3	
CAN113-B326-1055	0.105	U	CAN113-B317-1053	22.9	J
CAN113-B327-1044	0.105	U	CAN113-B302-1050	22.4	J
CAN113-B327-1057	0.105	U	CAN113-B313-1032	20.6	J
CAN113-B330-1040	0.105	U	CAN113-B306-1035	15.8	J
CAN113-B321-1045	0.105	U			
CAN113-B330-1050	0.105	U			

TABLE 6-5
SAMPLING RESULTS FOR HAZARD/RISK DRIVERS IN SOIL
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

BERYLLIUM			BARIUM		
FIELD ID	RESULT (mg/kg) (1)	WCQ(2)	FIELD ID	RESULT (mg/kg)	WCQ
Number of samples	163		Number of samples	161	
Arithmetic mean (mg/kg)	0.221		Arithmetic mean (mg/kg)	227	
Maximum detected value (mg/kg)	0.700		Maximum detected value (mg/kg)	5050	
95% UCL of the arithmetic mean (mg/kg)	0.236		95% UCL of the arithmetic mean (mg/kg)	293	

(1) WCQ = Woodward-Clyde analytical data qualifiers; "J" indicates that the quantity of the analyzed chemical was estimated. "U" indicates that the analyzed chemical was not detected.

(2) Sample concentration of analyte. For samples in which the analyte was nondetect (U-qualified results), sample concentration shown is one-half of the sample quantitation limit (SQL).

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TABLE 6-6
TENTATIVELY IDENTIFIED COMPOUNDS (TICs)
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

Tentatively Identified Compound (TIC)	Number of Detections (out of 160 samples)	Maximum Concentration (mg/kg)
.alpha.-Amyrin	1	1.4E-01
1,1'-Biphenyl, 4,4'-difluoro-	1	2.8E-01
1-Hexanol, 2-ethyl-	1	3.4E-01
1-Methylnaphthalene	1	7.6E-02
1-Nonadecanol	1	2.0E-01
1-Octadecanol	1	2.4E-01
1-Pentene, 4,4-dimethyl-	1	6.70E-03
14-Pentadecenoic acid	1	9.1E-01
2-Butene	1	8.60E-03
2-Hepten-1-ol	3	1.2E-02
2-Methylheptanoic acid	1	3.6E-01
3-Cyclohexene-1-methanol, .alpha.,.alpha.4-	1	1.9E-01
3-Penten-2-one, 4-methyl-	1	1.8E-01
a'-Neogammacer-22(29)-en-3-ol,(3.beta.,21.l	1	1.8E-01
.alpha.-Pinene	1	1.40E-01
Benzene, 2-butenyl-	1	5.7E-01
Bicyclo[2.2.1]heptan-2-one,1,3,3-trimethyl-	1	1.1E-02
Butanoic acid	4	3.7E+00
Butanoic acid, 2-methyl-	2	7.0E-01
Camphor	1	5.3E-03
Cyclohexane, methyl-	6	1.8E-01
Cyclopentanecarboxylic acid, 2-amino-, tran	1	2.0E-01
Eicosanoic acid, 2,3-bis (acetyloxy)propyl es	1	3.4E-01
Acetic acid, ethyl ester	10	1.1E-01
Hexadecanoic acid	2	1.0E+00
Hexanedioic acid, bis(2-ethylhexyl)ester	4	9.8E-01
Hexanedioic acid, dioctyl ester	1	1.0E+00
Hexanoic acid	4	4.9E+00
Hexanoic acid, 2-ethyl-	2	4.0E-01
Hexanoic acid, 2-methyl-	2	2.6E+00
Isomer of Neogammacer-en-ol	2	1.0E+00
Nitrogen compound	1	1.4E-01
Nonanal	2	1.00E-02
Nonanedioic acid, bis(2-ethylhexyl) ester	1	2.1E-01
Octadecanoic acid, 2-methylpropyl ester	1	4.3E-01
Octadecanoic acid, butyl ester	1	2.0E-01
Octanoic acid	2	1.1E+00
Oleic Acid	1	1.7E+00
Oxygenated Hydrocarbon	11	5.7E-01
Pentanoic acid	3	4.2E+00

TABLE 6-6
TENTATIVELY IDENTIFIED COMPOUNDS (TICs)
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

Tentatively Identified Compound (TIC)	Number of Detections (out of 160 samples)	Maximum Concentration (mg/kg)
Pentanoic acid, 2-methyl-	2	2.2E+00
Phenol, 4,4'-butylidenebis[2-(1,1-dimethylet]	1	2.4E-01
Polynuclear Aromatic Hydrocarbon	1	1.9E-01
Primary amide	1	1.9E-01
Propanoic acid	3	3.0E+00
Propanoic acid, 2-methyl-	3	1.3E+00
Saturated Hydrocarbon: <C10	1	9.4E-03
Saturated Hydrocarbon: >C20	12	8.3E-01
Saturated Hydrocarbon: C10-C20	7	3.2E+00
Stigmast-5-en-3-ol-, (3.beta.,24S)-	5	3.5E-01
Sulfur, mol. (S8)	2	7.5E-01
Unsaturated Hydrocarbon	4	1.7E-01

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TABLE 6-7
CATEGORIES OF TENTATIVELY IDENTIFIED COMPOUNDS (TICs)
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

TICs Considered to Be Relatively Nontoxic Based on Professional Judgment

I. Fatty acids and Fatty Acid Esters

Octadecanoic acid, 2-methylpropyl ester
Hexanedioic acid, bis(2-ethylhexyl)ester
14-Pentadecenoic acid
2-Methylheptanoic acid
Butanoic acid
Butanoic acid, 2-methyl-
Hexadecanoic acid
Hexanedioic acid, dioctyl ester
Hexanoic acid
Hexanoic acid, 2-ethyl-
Hexanoic acid, 2-methyl-
Nonanedioic acid, bis(2-ethylhexyl) ester
Octadecanoic acid, butyl ester
Octanoic acid
Oleic Acid
Pentanoic acid
Pentanoic acid, 2-methyl-
Propanoic acid
Propanoic acid, 2-methyl-

II. Alcohols

1-Nonadecanol
1-Octadecanol
1-Hexanol, 2-ethyl-
2-Hepten-1-ol
Isomer of Neogammacer-en-ol

III. Ketones

3-Penten-2-one, 4-methyl-
Camphor

TICs with Unknown Toxicity

Phenol, 4,4'-butylidenebis[2-(1,1-dimethylethyl)!
Bicyclo[2.2.1]heptan-2-one,1,3,3-trimethyl-
3-Cyclohexene-1-methanol, .alpha.,.alpha.4-trim!
Eicosanoic acid, 2,3-bis (acetyloxy)propyl ester
Cyclopentanecarboxylic acid, 2-amino-, trans-
a'-Neogammacer-22(29)-en-3-ol,(3.beta.,21.beta.)-
Stigmast-5-en-3-ol-, (3.beta.,24S)-
1,1'-Biphenyl, 4,4'-difluoro-
1-Pentene, 4,4-dimethyl-
Benzene, 2-butenyl-
1-Methylnaphthalene
Cyclohexane, methyl-
.alpha.-Amyrin
Sulfur, mol. (S8)
Nonanal
2-Butene
.alpha.-Pinene

TICs Whose Specific Chemical Form is Unknown

Nitrogen compound
Oxygenated Hydrocarbon
Primary amide
Unsaturated Hydrocarbon
Polynuclear Aromatic Hydrocarbon

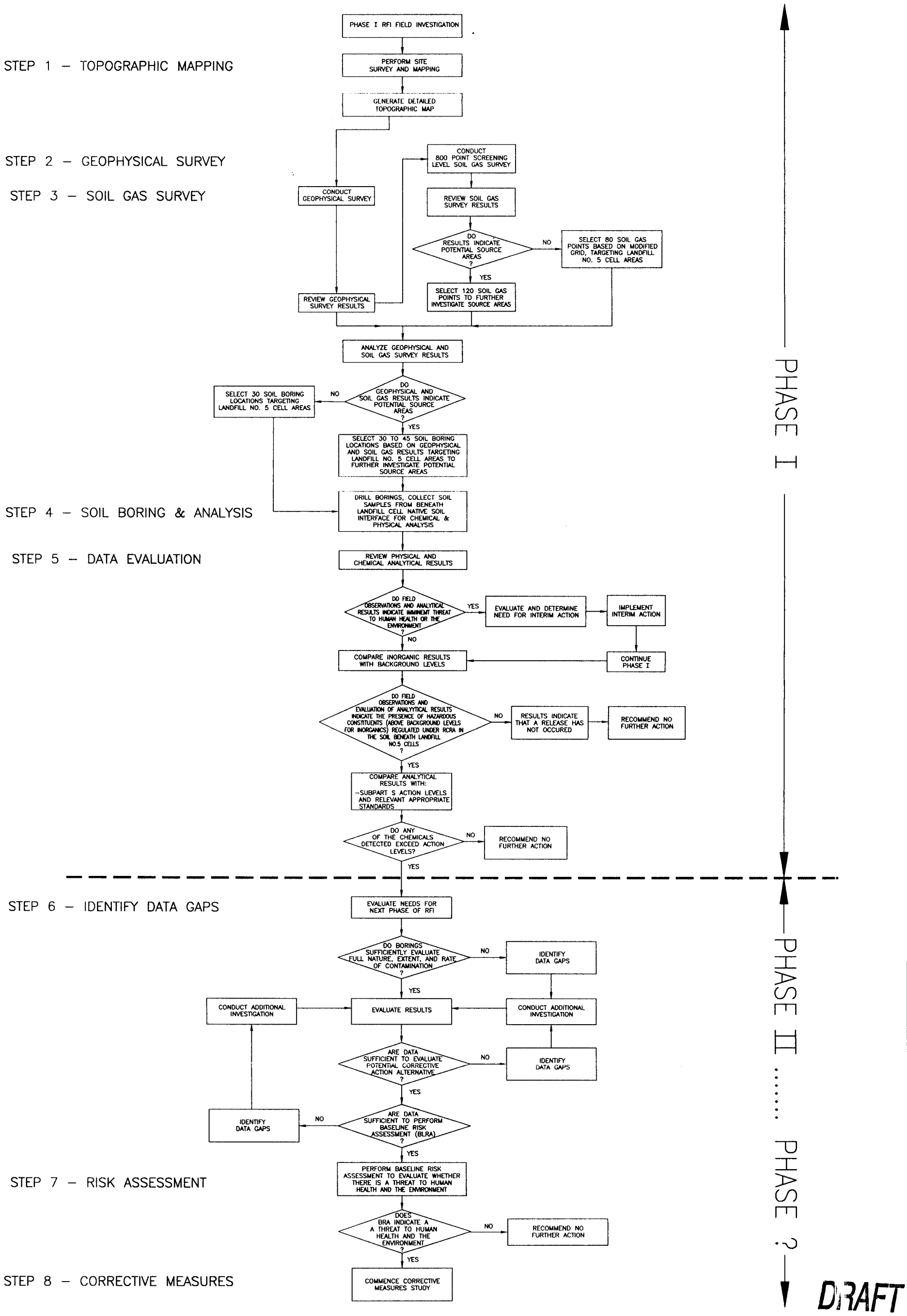
TICs Related to Petroleum Products

Saturated Hydrocarbon: <C10
Saturated Hydrocarbon: >C20
Saturated Hydrocarbon: C10-C20

TICs With EPA-Approved Toxicity Values

Acetic acid, ethyl ester
Acetic acid, methyl ester

PHASE I RFI OBJECTIVE: EVALUATE THE PRESENCE OR ABSENCE OF A RELEASE TO THE ENVIRONMENT FROM LANDFILL NO. 5



Job No. : C3MIIM	DECISION DIAGRAM FOR LANDFILL NO. 5 (SWMU NO. 113/IRP NO. LF-5) CANNON AIR FORCE BASE
Prepared by : J.T.A.	
Date : 8/5/94	

M11001

FIG. 6–1

7.0
RELEVANT AND APPROPRIATE STANDARDS

Both RCRA and CERCLA requirements for evaluating the nature and extent of hazardous wastes potentially occurring at Landfill No. 5 will be addressed in investigations at Cannon AFB. Through discussions with the New Mexico Department of Environmental Protection, RASs would be the basis for meeting the regulatory permit requirements under RCRA.

Cannon AFB must evaluate the SWMUs identified by the USEPA during the RFA as a condition of their RCRA Part B permit. The Phase I RFI was designed to satisfy the RFI guidance for characterizing the SWMUs and developing and implementing corrective action measures, if necessary.

As part of future CERCLA FS, CMS under RCRA, alternative remedial or corrective action measures may be evaluated to assess the degree to which they attain or exceed relevant federal and state public health and environmental standards. A preliminary identification and discussion of RASs applicable to the RFI at Cannon AFB is presented below. Review of these RASs will highlight any site-specific regulatory conditions that might either limit the choice of alternatives or which place limits on contaminant concentrations at the site.

Cannon AFB is also conducting this investigation under the Air Force's IRP. The IRP requires that the investigation follow the regulatory requirements of CERCLA which is the basis for assessment and response actions on USAF installations under its provisions. Additionally, the Superfund Authorization and Responsibility Act (SARA) augmented the scope and requirements of CERCLA and gave specific directives to federal facilities regarding investigation of waste disposal sites. Under SARA, determination of applicable or relevant and appropriate requirements (ARARs), which in this section is synonymous with RASs, is required.

The RASs presented in this section are chemical-specific and location-specific. Identification of action-specific RASs can only be addressed once detailed remedial alternatives are developed.

7.1 DEFINITION OF RASs

Remedial actions must attain a general standard of cleanup that assures protection of human health and the environment, is cost-effective, and uses permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, SARA requires that any hazardous substance or pollutant remaining on site meet levels or specific standards which have been established under federal environmental law, or state environmental statutes which are more stringent than federal.

A requirement may be either applicable or relevant and appropriate to remedial activities at a site, but not necessarily both. Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstances at a site.

If a regulation is not applicable, it may still be relevant and appropriate. The basic considerations are whether the requirement (1) regulates or addresses problems or situations sufficiently similar to those encountered at the subject site (i.e., relevant), and (2) is appropriate to the circumstances of the release or threatened release, such that its use is well suited to the particular site. Determining whether a requirement is relevant and appropriate is site-specific and must be based on best professional judgment. The judgment is based on a number of factors, including the characteristics of the remedial action, the hazardous substances present on site, and the physical circumstances of the site and of the release, as compared to the statutory or regulatory requirement. Compliance with all requirements found to be applicable or relevant and appropriate is mandatory under SARA unless a waiver is obtained from the EPA.

"To be considered" guidance materials (TBCs) are nonpromulgated advisories, proposed rules, criteria, or guidance documents issued by federal or state governments that do not have the status of potential RASs. However, these advisories and guidance documents should be considered when determining protective cleanup levels where no RAS exists, or where RASs are not sufficiently protective of human health and the environment. In these circumstances, TBC values are used to establish cleanup targets.

7.2 CHEMICAL-SPECIFIC RASs

A summary of federal and state regulations, standards, and guidance is presented in Tables 7-1 and 7-2. The chemical-specific RASs are included in Table 7-1. The location-specific RASs are included in Table 7-2 and discussed in Section 7.4. This information is based on standards, guidelines, and criteria found in relevant literature, discussions with appropriate state regulatory agency personnel, and past project experience.

Chemical-specific requirements are based on health or risk-based concentration limits of discharge limitations in environmental media (i.e., water, soil) for specific hazardous chemicals. These requirements may be used to set cleanup levels for the chemicals of concern in the designated media, or to set a safe level of discharge where a discharge occurs as part of the remedial activity.

Sources for potential target cleanup levels included selected standards, criteria, and guidelines that are typically considered as RASs for remedial actions conducted under CERCLA, as well as some guidance and proposed action levels developed under RCRA that should be regarded as TBCs. In addition, New Mexico has developed cleanup levels for underground storage tank-related remediation, as well as standards for groundwater.

For groundwater, maximum contamination levels (MCLs) or non-zero maximum contaminant goals (MCGLs) established under the Safe Drinking Water Act (SDWA) are often accepted by regulatory agencies as cleanup levels for groundwater remedial activities, especially if the groundwater is or could be a drinking water source. Also included are hazardous constituent concentration limits under RCRA Subpart F, which are applicable to releases from RCRA-regulated units. Secondary maximum contamination levels (SMCLs) established under SDWA are also presented in Table 7-3 although they are not federally enforceable and should be regarded as TBCs. If no values are shown for possible contaminants in Table 7-3, there are currently no standards for that contaminant. Under this Phase I investigation, groundwater was not sampled; therefore, no comparative study was conducted; however, the MCLs and MCGLs were updated as appropriate according to standards passed in June, 1995.

State and federal standards and criteria for surface water quality are not considered applicable or relevant and appropriate as long as there is no possibility of remedial activities impacting

surface water bodies. However, should any remediation of the landfill involve discharge of contaminated groundwater to a surface water body, both the state and federal surface water quality standards and criteria would need to be complied with.

7.3 TBCs

In general, very few cleanup standards exist for soil contamination. Often cleanup levels are based on guidance developed from Underground Storage Tank (UST) investigations or, if non-petroleum wastes are involved, levels are based on site-specific risk assessment, hazardous waste definition, or background levels. However, some human health-based criteria for soil and water contaminant levels have been published, including the RFI Guidance and proposed RCRA-related action levels. Although, these criteria were developed specifically for application in RCRA-related activities, it appears they are being used as proposed RASs, where no other standards exist. These proposed RCRA-related action levels and guidelines are presented, therefore, as TBCs rather than as chemical-specific RASs and represent "potential" cleanup levels only. Actual cleanup levels that may be applied to a particular area will depend on site-specific conditions and are subject to final approval by the appropriate regulatory agency or agencies. The RCRA levels are presented and used for the purposes of this RASs evaluation because there are no other sources of standards or guidance for contaminated soil cleanup levels.

7.4 LOCATION-SPECIFIC RASs

Although the universe of location-specific RASs is identified in Table 7-2, only those regulations that are deemed RASs for the Cannon site are discussed below. Potential location-specific RASs for Cannon AFB are presented in Table 7-2 with an explanation as to whether the regulation is relevant and appropriate and why. Location-specific RASs are restrictions placed on the types of activities that may occur in particular locations. The location of a site may be an important characteristic in determining its impact on human health and the environment; thus, individual states may establish location-specific RASs. These RASs may restrict or preclude certain remedial actions or may apply only to certain portions of a site. Examples of location-specific RASs include federal and state requirements for preservation of historic landmarks, endangered species and wetlands protection, and the restrictions on management of hazardous waste in floodplain areas.

Due to the possible presence of both federal and state listed threatened/endangered species at the site, the federal and state Endangered Species Act are both considered potentially relevant and appropriate. If threatened and endangered species are found at the site, these acts would be relevant and appropriate.

Section 106 of the National Historic Preservation Act is also considered "potentially" relevant and appropriate due to a federal agency having authority over any actions that could impact historically significant objects, buildings, or structures at the site. Although no buildings, objects, or structures at Cannon AFB have been placed on the register, the evaluation process is still ongoing at the base. Due to both architectural and archaeological surveys being conducted on-site, the State Cultural Properties Act is also considered "potentially" relevant and appropriate, and negotiations with the State Historic Preservation Office should be renewed prior to any remedial activity.

While there is uncertainty concerning the future definition of wetlands, it is the opinion of the U.S. Fish and Wildlife Service that the playas at the base fall under the current definition of wetland areas under federal wetland delineation guidance (Hagenbuck 1991). The federal regulations governing wetlands, however, are not considered RASs as long as the project does not impact the wetlands areas. If the playa lakes on base continue to be considered wetlands and if the remedial activities should impact these wetland areas, then the regulations would be considered relevant and appropriate and coordination with the U.S. Fish and Wildlife Service would need to be initiated prior to any remedial activity. The State of New Mexico does not have its own wetlands regulations at this time.

7.5 COMPARISON OF LABORATORY RESULTS TO TBCs

The laboratory analytical values presented as "detected" and "estimated" for chemicals at Landfill No. 5 were compared to the applicable chemical-specific TBCs for soil presented in Tables 7-4 and 7-5 to determine which, if any, results exceeded the listed guidelines.

All detected compounds (exclusive of TICs) were evaluated for this report and compared with the TBCs for soil. Background levels for three metals exceeded the action levels for soil. These include arsenic, beryllium, and thallium. In addition, no RCRA action levels or RFI

criteria levels are available for the nonorganics comparison of values for calcium, lead, sodium, iron, potassium, or magnesium in soil. However, each of these is discussed under Section 4.3 and therefore are not analyzed under this section. RCRA action levels and RFI criteria are also not available for the following organic chemicals: Benzo(g,h,i)perylene, dibenzofuran, phenanthrene, 2-methyl naphthalene, and 4-nitrophenol.

Soil sample results were compared against the TBCs for the RFI criteria and proposed RCRA action levels. These levels are not cleanup standards, but are considered screening levels used to assess whether a health risk evaluation is warranted. Only the metals discussed below exceeded RCRA action levels and/or RFI Guidance.

Arsenic

Levels of arsenic in soil samples exceeded the proposed RCRA action level, which is 0.4 mg/kg. Laboratory results indicated arsenic in quantities as high as 5.8 mg/kg. However, the background level of arsenic at Cannon AFB is 10.5 mg/kg; therefore, arsenic should not be considered an additional contaminant at Landfill No. 5.

Barium

One soil sample showed exceedances of barium above the RFI Guidance, which is 4,000 mg/kg, but below the RCRA proposed action level, which is 6,000 mg/kg.

The RFI Guidance human health-based criteria for barium in soil of 4,000 mg/kg was derived using an RfD of 0.07 mg/kg-day (EPA 1989). In August 1990, the RfD for barium was changed from 0.07 to 0.05 mg/kg-day, based on new toxicological data. When the current RfD is used with methodology from the 1989 RFI Guidance, the calculated human health-based criteria for barium in soil is 5,600 mg/kg. The maximum concentration of barium detected at Landfill No. 5 (5,050 mg/kg) is lower than this updated criteria.

Beryllium

The RFI Guidance TBC recommends a soil cleanup of 0.14, while the proposed RCRA action level recommends 0.2 mg/kg. Forty-one samples collected and analyzed during the Phase I

RFI exceeded the RCRA action level of 0.2 mg/kg, and an additional thirty three exceeded 0.14 mg/kg. The background range for beryllium at Cannon AFB is 0 to 0.6 mg/kg. Only one soil sample exhibited an exceedance greater than this level, and this sample was 0.7 mg/kg. It seems, therefore, that for the most part, exceedances are likely caused from naturally occurring levels of beryllium.

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TABLE 7-1

SUMMARY OF
POTENTIAL CHEMICAL-SPECIFIC RASs/TBCs
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

Standard, Requirement, or Criteria	Description	Comment
FEDERAL		
Safe Drinking Water Act (40 USC Sect. 300)		
National Primary Drinking Water Standards [40 CFR Parts 141, 142, (1995)	Establishes maximum contaminant levels (MCLs) for specific contaminants that are health-based standards for public drinking water systems.	MCLs are applicable for drinking water at the tap. MCLs are relevant and appropriate for organic and inorganic contamination of groundwater that is or may be used for drinking.
National Secondary Drinking Water Standards (40 CFR Part 143) (1994)	Establishes secondary maximum contaminant levels (SMCLs) that are nonenforceable guidelines for public drinking water systems to protect the aesthetic quality of the water.	SMCLs may be "to be considered" if groundwater is used as a drinking water source.
Maximum Contaminants Level Goals (MCLGs) [PL No. 99-339, 100 Stat. 642 (1986), (1995); 40 CFR 141,142]	Establishes drinking water quality goals at a level at which no adverse health effects may occur with an adequate margin of safety.	MCLGs set above zero levels are relevant and appropriate for existing or potential sources of drinking water. MCLGs may be relevant and appropriate if the risk posed by multiple contaminants or pathways is in excess of 10^{-4}.
Resource, Conservation, and Recovery Act (RCRA)		
Releases from Solid Waste Management Units (40 CFR Part 264)	Subpart F (264.94) gives concentration limits in groundwater for hazardous constituents from a regulated unit.	Applicable if organic and inorganic contamination of groundwater is found at a RCRA regulated unit.
RCRA Facility Investigation Guidance (EPA 1989a)	Guidance levels for cleanup of contaminated soils based on EPA-derived chronic exposure assumptions; intended as screening levels at RCRA facilities to determine if a more detailed health-risk evaluation is warranted.	To be considered if contaminated soils are found.

TABLE 7-1

SUMMARY OF
POTENTIAL CHEMICAL-SPECIFIC RASs/ TBCs
Landfill No. 5 (SWMU No. 113/IRP No. LF-5)
Cannon AFB, New Mexico

Standard, Requirement, or Criteria	Description	Comment
Proposed RCRA Action Levels (55 FR 30798, 27 July 1990)	Risk-based action levels for contaminants in soil which, if exceeded, would trigger the need for a Corrective Measures Study.	To be considered if contaminated soils are found.
STATE		
New Mexico Water Quality Act, 1978		
New Mexico Drinking Water Regulations (4/16/91)(New Mexico Water Supply Regulations, Sections 202 to 203)	Establishes MCLs and standards for sources of drinking water.	State MCLs are applicable or relevant and appropriate to contaminated water if the state MCL is more stringent than federal requirements.
New Mexico Water Quality Regulations, amended through August 17, 1991 (WQCCR Part 3, Sections 100 through 103)	Establishes human health, domestic water supply, and irrigation use standards for ground water protection.	Applicable if remedial activities include discharges onto or below the surface of the ground.
New Mexico Water Quality Regulations, amended through August, 1991 (WQCCR Part 1, Section 101.UU)	Establishes definition of toxic pollutant based on effects to human health and the environment. Requires a determination of health and environmental risk due to the presence of the contaminant.	Applicable if groundwater related to the source area contains any of the contaminants listed in the definition of toxic pollutants.
New Mexico Hazardous Waste Act 1978		
New Mexico Underground Storage Tank Regulations, amended through July 18, 1991, Section 1209	Sets cleanup levels for soils contaminated with benzene, aromatic hydrocarbons, or petroleum products.	May be "to be considered" if soils are contaminated with benzene, aromatic hydrocarbons, or petroleum products.

TABLE 7-1

SUMMARY OF
POTENTIAL CHEMICAL-SPECIFIC RASs/ TBCs
Landfill No. 5 (SWMU No. 113/IRP No. LF-5)
Cannon AFB, New Mexico

Standard, Requirement, or Criteria	Description	Comment
New Mexico Solid Waste Regulations		
New Mexico Special Waste Requirements Regulations, adopted effective January 30, 1992, Part VII	Sets disposal levels for soils contaminated with BTEX compounds and total petroleum hydrocarbons. Also sets disposal standards for asbestos waste.	May be "to be considered" if soils are contaminated with petroleum hydrocarbons. Asbestos requirements may be applicable if asbestos waste continues to be disposed in Landfill 5 or is removed and placed elsewhere.

TABLE 7-2

SUMMARY OF POTENTIAL LOCATION-SPECIFIC RASs
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

Requirement	Potentially Applicable?	Potentially Relevant and Appropriate?	Comments
Resource Conservation and Recovery Act (RCRA)			
1. New facilities where treatment, storage or disposal of hazardous waste will be conducted is prohibited within 61 meters (200 feet) of a fault displaced in Holocene time [40 CFR 264.18(a)]*	No	No	Treatment, storage, and disposal of waste will not be conducted within 61 meters of a fault displaced in Holocene time.
2. New facilities where treatment, storage or disposal of hazardous waste will be conducted is prohibited within the 100-year floodplain. [40 CFR 264.18(b)]*	No	No	Treatment, storage, and disposal of waste will not be conducted within the 100-year floodplain of adjacent rivers.
3. Prohibits noncontainerized or bulk liquid hazardous waste placement in salt domes, salt bed formations, and underground mines or caves. [40 CFR 264.18(c)]*	No	No	No action that would place waste in a salt dome or salt bed formation, underground mine, or cave is anticipated at this site.
E.O. 11988 Protection of Floodplains			
4. Limits activities in floodplain. Floodplain is defined as "the lowland and relatively flat areas adjoining inland and coastal waters including flood prone areas of off-shore islands, including at a minimum, that area subject to a one percent or greater chance of flooding in any given year." [40 CFR 6, Appendix A and 40 CRF 6.302]	No	No	Remedial activities will not be conducted within any floodplains.

*Adopted by the State of New Mexico and incorporated within Part V of the New Mexico Hazardous Waste Management Regulations.

TABLE 7-2
SUMMARY OF POTENTIAL LOCATION-SPECIFIC RASs
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

Requirement	Potentially Applicable?	Potentially Relevant and Appropriate?	Comments
E.O. 11990 Protection of Wetlands			
5. Minimizes impacts on areas designated as wetlands. [40 CRF 6, Appendix A]	No	No	Although playas are considered wetlands by the U.S. Fish and Wildlife Service, regulations are applicable only if the remedial activities impact the wetland areas. No impacts to the wetland areas are anticipated at this time.
Clean Water Act Section 404			
6. Action to prohibit discharge of dredged or fill material into waters of U.S. without permit. [33 USC 1251; 40 CFR 230; 33 CFR 320-330]	No	No	Dredge and fill permit requirements will not apply because no waters of the U.S. will be impacted by remedial activities on the site.
7. Requires Federal agencies to avoid, to the extent possible, adverse impacts associated with destruction or loss of wetlands	No	No	As described above, although wetlands are considered by the U.S. Fish and Wildlife Service to occur on the base in the form of playas, regulations are applicable only if the remedial activities impact the wetland area.
Endangered Species Act			
8. Protects endangered species and threatened species and preserves their habitat. [16 USC 1531 et seq.; 50 CFR 200, 50 CFR 402]	Yes	---	Although Walk, Haydel & Associates report in their Remedial Investigation that there are no critical habitats in the immediate vicinity of the site (according to the Wildlife Management Plan for the base), two federally listed endangered species are known to inhabit the area within a 50-mile radius of the site (Lee Wan & Associates, Inc. 1990).

TABLE 7-2
SUMMARY OF POTENTIAL LOCATION-SPECIFIC RASs
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

Requirement	Potentially Applicable?	Potentially Relevant and Appropriate?	Comments
Bald Eagle Protection Act			
9. Protects all eagle species and restricts activities that may threaten or adversely affect their habitat (16 USC Section 688 et seq.)	Yes	---	If eagle species are found to occur on the base, special protection provisions will need to be coordinated with US Fish and Wildlife Service. Bald eagles are known to inhabit the area within a 50-mile radius of the site (Lee Wan & Associates, Inc., 1990).
Migratory Bird Treaty Act			
10. Protects migratory, resident, or range habitat of migratory birds including raptors and waterfowl. (16 USC Section 703 et seq.).	Yes	--	Remedial actions cannot threaten or adversely affect the habitats of migratory waterfowl or raptors.
Wilderness Act			
11. Limits activities within an area designed as a wilderness area. [16 USC 1311 et seq.; 50CFR 53.1 et seq.]	No	No	The site is not within a federally owned area designated as a wilderness area.
12. Limits the type of activities permitted in an area designated as a National Wildlife Refuge system [16 USC 668 et seq.; 50 CFR Part 27]	No	No	The site is not in an area designated as part of the National Wildlife Refuge System. (The closest NWRS are over 25 miles from the site.)
Fish and Wildlife Coordination Act			
13. Prohibits activities affecting/modifying streams or bodies of water if the activity has a negative impact on fish or wildlife. [16 USC 661 et seq.; 33 CFR Parts 320-330; 40 CFR 6.302]	No	No	As described above, no streams, rivers, or playas will be impacted by remedial activities.

TABLE 7-2
SUMMARY OF POTENTIAL LOCATION-SPECIFIC RASs
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

Requirement	Potentially Applicable?	Potentially Relevant and Appropriate?	Comments
Wild and Scenic Rivers Act			
14. Protects rivers that are designated as wild, scenic, or recreational. [16 USC 1271; 40 CFR 6.302(e)]	No	No	No rivers designated as wild, scenic or recreational will be affected by remedial activities.
National Historic Preservation Act (NHPA)			
15. Requires the preservation of historic properties included in or eligible for the National Register of Historic Places and to minimize harm to National Historic Landmarks. [16 USC 470 et seq.; 7 CFR 650; 36 CFR Part 65, Part 800]	Yes	---	Pursuant to Section 106 of NHPA, proposed federal undertaking in any state shall take into consideration the effect of the undertaking on any site, building, structure, or object that is included or eligible for inclusion in the National Register; nothing has been placed on the register to date, but surveys are ongoing. Also applicable if historical sites are discovered during a remedial action or if known historical sites exist near a remedial action site.
The Historic and Archaeological Data Preservation Act of 1974			
16. Establishes procedures to provide for preservation of historical and archaeological data which might be destroyed through alteration of terrain as a result of a federal construction project or a federally licensed activity program (16 USC 469, 40 CFR 6.301(c))	Yes	---	May be available if remedial activities affect historical and/or undiscovered archaeological data of the site.
The Archaeological Resource Protection Act of 1979			
17. Requires a permit for any excavation or removal of archaeological resources from public or Indian lands (16 USC 470aa-47011)	Yes	---	May be applicable if any remedial activity involves removal of archaeological resources; substantive requirements need to be met.

TABLE 7-2
SUMMARY OF POTENTIAL LOCATION-SPECIFIC RASs
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

Requirement	Potentially Applicable?	Potentially Relevant and Appropriate?	Comments
Coastal Zone Management Act			
18. Limits activities affecting the coastal zone, including lands thereunder and adjacent shorelands. [16 USC Section 1451 et seq.]	No	No	The site is not located in the coastal zone management area.
State Regulations			
Endangered Species Act (New Mexico Regulation 682)			
19. Requires coordination with the Department of Game and Fish if activities impact on endangered/ threatened species or their habitat.	Yes	---	As stated above, although Walk, Haydel & Associates report in their Remedial Investigation that there are no significant habitats in the immediate vicinity of the site, state listed threatened/endangered species have been identified at or near the base.
1978 New Mexico State Cultural Properties Act (Sections 18-6-1 through 18-6-17 NMSA 1978)			
20. Provides for the preservation, protection, and enhancement of structures, sites, and objects of historical significance within the State.	Yes	--	Although the Cannon AFB site including its properties/buildings are not listed on the State Register of Historic Places, coordination with the State Historic Preservation Office is ongoing with respect to the historical and archaeological surveys that have been conducted at the base; State laws closely follow the federal laws.

TABLE 7-3

POTENTIAL SITE-WIDE CHEMICAL-SPECIFIC RASs/TBCs
GROUNDWATER QUALITY STANDARDS
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

		FEDERAL STANDARDS			STATE STANDARDS NMWQCC Groundwater Quality Standards (g)			
Parameter	Type	SDWA Maximum Contaminant Level (a)	SDWA Maximum Contaminant Level Goal (a) ARARs/TBCs	RCRA Subpart F Concentration Limit (40 CFR 264.94) (b)	Community Water Supply System (h)	Human Health	Other Standards for Domestic Water Supply	Irrigation Use
pH	Field Parameter	6.5-8.5*					6.0-9.0	6.0-9.0
Total Dissolved Solids	Indicator	500,000 µg/L*					1,000,000 µg/L	1,000,000 µg/L
Carbonate	Anion							
Chloride	Anion	250,000 µg/L*					250,000 µg/L	250,000 µg/L
Fluoride	Anion	4,000 µg/L, 2,000 µg/L*	4,000 µg/L		4,000 µg/L	1,600 µg/L		1,600 µg/L
N as Nitrate	Anion	10,000 µg/L	10,000 µg/L(c)		10,000 µg/L	10,000 µg/L		10,000 µg/L
N as Nitrate+Nitrite	Anion	10,000 µg/L(c)	10,000 µg/L(c)					
N as Nitrite	Anion	1,000 µg/L(c)	1,000 µg/L(c)					
Potassium	Anion							
Sulfate	Anion	250,000 µg/L*					600,000 µg/L	600,000 µg/L
Aluminum	Metal	0.5 to 200 µg/L*(c)						5,000 µg/L
Antimony	Metal	6 µg/L(d)	6 µg/L(d)					
Arsenic	Metal	50 µg/L		50 µg/L	50 µg/L	100 µg/L		100 µg/L
Barium	Metal	2,000 µg/L(e)	2,000 µg/L(e)	1,000 µg/L	1,000 µg/L	1,000 µg/L		1,000 µg/L
Beryllium	Metal	4.0 µg/L(d)	4 µg/L(d)					
Boron	Metal							750 µg/L
Cadmium	Metal	5 µg/L(c)	5 µg/L(c)	10 µg/L	10 µg/L	10 µg/L		10 µg/L
Calcium	Metal							
Chromium	Metal	100 µg/L(c)	100 µg/L(c)	50 µg/L	50 µg/L	50 µg/L		50 µg/L
Cobalt	Metal							50 µg/L
Copper	Metal	1,000 µg/L* 1,300 µg/L**	1,300 µg/L(f)				1,000 µg/L	1,000 µg/L
Cyanide	Metal	200 µg/L(d)	200 µg/L(d)			200 µg/L		200 µg/L
Iron	Metal	300 µg/L*					1,000 µg/L	1,000 µg/L
Lead	Metal	15 µg/L***	0(f)	50 µg/L	50 µg/L	50 µg/L		50 µg/L

TABLE 7-3

POTENTIAL SITE-WIDE CHEMICAL-SPECIFIC RASs/TBCs
GROUNDWATER QUALITY STANDARDS
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

		FEDERAL STANDARDS			STATE STANDARDS NMWQCC Groundwater Quality Standards (g)			
Parameter	Type	SDWA Maximum Contaminant Level (a)	SDWA Maximum Contaminant Level Goal (a) ARARs/TBCs	RCRA Subpart F Concentration Limit (40 CFR 264.94) (b)	Community Water Supply System (h)	Human Health	Other Standards for Domestic Water Supply	Irrigation Use
Magnesium	Metal							
Manganese	Metal	50 µg/L*					200 µg/L	200 µg/L
Mercury	Metal	2 µg/L	2 µg/L(c)	2 µg/L	2 µg/L	2 µg/L		2 µg/L
Molybdenum	Metal							1,000 µg/L
Nickel	Metal	100 µg/L(d)	100 µg/L(d)					200 µg/L
Selenium	Metal	50 µg/L(c)	50 µg/L(c)	10 µg/L	10 µg/L	50 µg/L		50 µg/L
Silver	Metal	100 µg/L*(c)		50 µg/L	50 µg/L	50 µg/L		50 µg/L
Sodium	Metal							
Thallium	Metal	2 µg/L(d)	0.5 µg/L(d)					
Tin	Metal							
Titanium	Metal							
Tungsten	Metal							
Vanadium	Metal							
Zinc	Metal	5,000 µg/L*					10,000 µg/L	10,000 µg/L
Gross Alpha	Radionuclide	15 pCi/L			15 pCi/L			
Gross Beta	Radionuclide	4 mrem/yr						
Radium 226+228	Radionuclide	5 pCi/L			5 pCi/L	30 pCi/L		30 pCi/L
Strontium 90	Radionuclide	8 pCi/L			8 pCi/L			
Tritium	Radionuclide	20,000 pCi/L			20,000 pCi/L			
Uranium (total)	Radionuclide					5,000 µg/L		5,000 µg/L
1,1-Dichloroethane	Volatile					25 µg/L		25 µg/L
1,1-Dichloroethene	Volatile	7 µg/L	7 µg/L		7 µg/L	5 µg/L		5 µg/L
1,1,1-Trichloroethane	Volatile	200 µg/L	200 µg/L		200 µg/L	60 µg/L		60 µg/L
1,1,2,2-Tetrachloroethane	Volatile					10 µg/L		10 µg/L

TABLE 7-3

POTENTIAL SITE-WIDE CHEMICAL-SPECIFIC RASs/TBCs
GROUNDWATER QUALITY STANDARDS
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

		FEDERAL STANDARDS			STATE STANDARDS NMWQCC Groundwater Quality Standards (g)			
Parameter	Type	SDWA Maximum Contaminant Level (a)	SDWA Maximum Contaminant Level Goal (a) ARARs/TBCs	RCRA Subpart F Concentration Limit (40 CFR 264.94) (b)	Community Water Supply System (h)	Human Health	Other Standards for Domestic Water Supply	Irrigation Use
1,1,2,2-Tetrachloroethene	Volatile					20 µg/L		20 µg/L
1,1,2-Trichloroethane	Volatile	5 µg/L(d)	3 µg/L(d)			10 µg/L		10 µg/L
1,1,2-Trichloroethene	Volatile					100 µg/L		100 µg/L
1,2-Dichloroethane	Volatile	5 µg/L	0 µg/L		5 µg/L	10 µg/L		10 µg/L
1,2-Dichloroethene	Volatile							
1,2-Dichloropropane	Volatile	5 µg/L(c)	0 µg/L(c)					
4-Methyl-2-pentanone	Volatile							
Acetone	Volatile							
Benzene	Volatile	5 µg/L	0 µg/L	5 µg/L	5 µg/L	10 µg/L		10 µg/L
Bromodichloromethane	Volatile							
Bromoform	Volatile	Tot THM* <100 µg/L						
Bromomethane	Volatile							
Carbon Tetrachloride	Volatile	5 µg/L	0 µg/L		5 µg/L	10 µg/L		10 µg/L
Chlorobenzene (mono)	Volatile	100 µg/L(c)	100 µg/L(c)					
Chlorobenzilate	Volatile							
Chloroethane	Volatile							
Chloroform	Volatile	Tot THM** <100 µg/L			Tot THM** 100 µg/L	100 µg/L		100 µg/L
Chloroprene	Volatile							
Chloromethane	Volatile							
Cis-1,2-Dichloroethene	Volatile	70 µg/L(c)	70 µg/L(c)					
Cis-1,3-Dichloropropene	Volatile							
Dibromochloromethane	Volatile	Tot THM** <100 µg/L						
Ethyl Benzene	Volatile	700 µg/L(c)	700 µg/L(c)			750 µg/L		750 µg/L

TABLE 7-3

POTENTIAL SITE-WIDE CHEMICAL-SPECIFIC RASs/TBCs
GROUNDWATER QUALITY STANDARDS
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

		FEDERAL STANDARDS			STATE STANDARDS NMWQCC Groundwater Quality Standards (g)			
Parameter	Type	SDWA Maximum Contaminant Level (a)	SDWA Maximum Contaminant Level Goal (a) ARARs/TBCs	RCRA Subpart F Concentration Limit (40 CFR 264.94) (b)	Community Water Supply System (h)	Human Health	Other Standards for Domestic Water Supply	Irrigation Use
Methylene Chloride	Volatile	5 µg/L(d)	0 µg/L(d)			100 µg/L		100 µg/L
Styrene	Volatile	100 µg/L(c)	100 µg/L(c)					
Tetrachloroethanes	Volatile							
Tetrachloroethene	Volatile	5 µg/L(c)	0 µg/L(c)					
Toluene	Volatile	1,000 µg/L(c)	1,000 µg/L(c)			750 µg/L		
Total Trihalomethanes	Volatile	100 µg/L						
Total Xylenes	Volatile	10,000 µg/L(c)	10,000 µg/L(c)			620 µg/L		620 µg/L
Trans-1,2-Dichloroethene	Volatile	100 µg/L(c)	100 µg/L(c)					
Trans-1,3-Dichloropropene	Volatile							
Trichloroethanes	Volatile							
Trichloroethene	Volatile	5 µg/L	0 µg/L		5 µg/L			
Vinyl Acetate	Volatile							
Vinyl Chloride	Volatile	2 µg/L	0 µg/L		2 µg/L	1µg/L		1 µg/L
1,2-Dichlorobenzene (ortho)	Semivolatile	600 µg/L(c)	600 µg/L(c)					
1,3-Dichlorobenzene (meta)	Semivolatile	600 µg/L						
1,4-Dichlorobenzene (para)	Semivolatile	75 µg/L			75 µg/L			
1,2,4-Trichlorobenzene	Semivolatile	70 µg/L(d)	70 µg/L(d)					
2-Chloronaphthalene	Semivolatile							
2-Chlorophenol	Semivolatile							
2-Methylnaphthalene	Semivolatile							
2-Nitroaniline	Semivolatile							
2-Nitrophenol	Semivolatile							
2,3,7,8-Tetrachlorodibenzo-p-dioxin	Semivolatile	$3x10^{-8}$(d)	0 µg/L(d)					
2,4-Dichlorophenol	Semivolatile							

TABLE 7-3

POTENTIAL SITE-WIDE CHEMICAL-SPECIFIC RASs/TBCs
GROUNDWATER QUALITY STANDARDS
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

		FEDERAL STANDARDS			STATE STANDARDS NMWQCC Groundwater Quality Standards (g)			
Parameter	Type	SDWA Maximum Contaminant Level (a)	SDWA Maximum Contaminant Level Goal (a) ARARs/TBCs	RCRA Subpart F Concentration Limit (40 CFR 264.94) (b)	Community Water Supply System (h)	Human Health	Other Standards for Domestic Water Supply	Irrigation Use
2,4-Dichlorophenoxyacetic Acid (2,4-D)	Semivolatile (H)	70 µg/L(c)	70 µg/L(c)	100 µg/L	100 µg/L			
2,4-Dimethylphenol	Semivolatile							
2,4-Dinitrophenol	Semivolatile							
2,4-Dinitrotoluene	Semivolatile							
2,4,5-TP Silvex	Semivolatile (H)	50 µg/L(c)	50 µg/L(c)	10 µg/L	10 µg/L			
2,4,6-Trichlorophenol	Semivolatile							
3-Nitroaniline	Semivolatile							
4-Bromophenyl Phenylether	Semivolatile							
4-Chloroaniline	Semivolatile							
4-Chlorophenyl Phenyl Ether	Semivolatile							
4-Chloro-3-methylphenol	Semivolatile							
4-Nitroaniline	Semivolatile							
4,6-Dinitro-2-methylphenol	Semivolatile							
Acenaphthalene	Semivolatile							
Acrylonitrile	Semivolatile							
Alachlor	Semivolatile	2 µg/L	0 µg/L					
Aldicarb	Semivolatile (P)	3 µg/L(e)	1 µg/L(e)					
Aldicarb Sulfone	Semivolatile (P)	2 µg/L	1 µg/L					
Aldicarb Sulfoxide	Semivolatile (P)	4 µg/L	1 µg/L					
Aldrin	Semivolatile (P)							
Aniline	Semivolatile							
Anthracene	Semivolatile							
Atrazine	Semivolatile	3 µg/L(c)	3 µg/L(c)					
Benzo(a)anthracene	Semivolatile							

TABLE 7-3

POTENTIAL SITE-WIDE CHEMICAL-SPECIFIC RASs/TBCs
GROUNDWATER QUALITY STANDARDS
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

		FEDERAL STANDARDS			STATE STANDARDS NMWQCC Groundwater Quality Standards (g)			
Parameter	Type	SDWA Maximum Contaminant Level (a)	SDWA Maximum Contaminant Level Goal (a) ARARs/TBCs	RCRA Subpart F Concentration Limit (40 CFR 264.94) (b)	Community Water Supply System (h)	Human Health	Other Standards for Domestic Water Supply	Irrigation Use
Benzo(a)pyrene	Semivolatile	0.2 µg/L(d)	0 µg/L(d)			0.7 µg/L		0.7 µg/L
Benzo(b)fluoranthene	Semivolatile							
Benzo(g,h,i)perylene	Semivolatile							
Benzo(k)fluoranthene	Semivolatile							
Benzyl Alcohol	Semivolatile							
Bis(2-Chloroethoxy)methane	Semivolatile							
Bis(2-Chloroethyl)ether	Semivolatile							
Bis(2-Chloroisopropyl)ether	Semivolatile							
Bis(2-Ethylhexyl)phthalate	Semivolatile							
Butyl Benzylphthalate	Semivolatile							
Carbofuran	Semivolatile (P)	40 µg/L(c)	40 µg/L(c)					
Carbon Disulfide	Semivolatile							
Chlordane	Semivolatile (P)	2 µg/L(c)	0 µg/L(c)					
Chlorophenol	Semivolatile							
DDT	Semivolatile (P)							
DDT metabolite (DDE)	Semivolatile (P)							
DDT metabolite (DDD)	Semivolatile (P)							
Dalapon	Semivolatile (P)	200 µg/L(d)	200 µg/L(d)					
Diallite	Semivolatile							
Dibenzofuran	Semivolatile							
Dibenz(a,h)anthracene	Semivolatile							
Dibromochloropropane	Semivolatile (P)	0.2 µg/L	0 µg/L					
Dichlorobenzene	Semivolatile							
Dichlorobenzene, o	Semivolatile		600 µg/L					

TABLE 7-3

POTENTIAL SITE-WIDE CHEMICAL-SPECIFIC RASs/TBCs GROUNDWATER QUALITY STANDARDS
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

		FEDERAL STANDARDS			STATE STANDARDS NMWQCC Groundwater Quality Standards (g)			
Parameter	Type	SDWA Maximum Contaminant Level (a)	SDWA Maximum Contaminant Level Goal (a) ARARs/TBCs	RCRA Subpart F Concentration Limit (40 CFR 264.94) (b)	Community Water Supply System (h)	Human Health	Other Standards for Domestic Water Supply	Irrigation Use
Dichlorobenzidine	Semivolatile							
Dieldrin	Semivolatile (P)							
Di(2-ethylhexyl)adipate	Semivolatile (P)	400 µg/L(d)	400 µg/L(d)					
Diethylphthalate	Semivolatile							
Di(2-ethylhexyl)phthalate	Semivolatile	6.0 µg/L(d)	0 µg/L(d)					
Dimethoate	Semivolatile							
Dimethylphthalate	Semivolatile							
Dinitrotoluene	Semivolatile							
Dinoseb	Semivolatile(H)	7 µg/L(d)	7 µg/L(d)					
Di-n-octylphthalate	Semivolatile							
Diquat	Semivolatile(P)	20 µg/L(d)	20 µg/L(d)					
Endosulfan I	Semivolatile (P)							
Endosulfan II	Semivolatile (P)							
Endosulfan Sulfate	Semivolatile (P)							
Endothall	Semivolatile (P)	100 µg/L	100 µg/L(d)					
Endrin	Semivolatile (P)	2.0 µg/L(d)	2.0 µg/L(d)	0.2 µg/L	0.2 µg/L			
Ethylene Dibromide	Semivolatile	0.05 µg/L(c)	0 µg/L(c)			0.1 µg/L		0.1 µg/L
Fluoranthene	Semivolatile							
Fluorene	Semivolatile							
Glyphosate	Semivolatile(P)	700 µg/L(d)	700 µg/L(d)					
Heptachlor	Semivolatile (P)	0.4 µg/L(c)	0 µg/L(c)					
Heptachlor Epoxide	Semivolatile (P)	0.2 µg/L(c)	0 µg/L(c)					
Hexachlorobenzene	Semivolatile	1.0 µg/L(d)	0 µg/L(d)					
Hexachlorobutadiene	Semivolatile							

TABLE 7-3

POTENTIAL SITE-WIDE CHEMICAL-SPECIFIC RASs/TBCs
GROUNDWATER QUALITY STANDARDS
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

		FEDERAL STANDARDS			STATE STANDARDS NMWQCC Groundwater Quality Standards (g)			
Parameter	Type	SDWA Maximum Contaminant Level (a)	SDWA Maximum Contaminant Level Goal (a) ARARs/TBCs	RCRA Subpart F Concentration Limit (40 CFR 264.94) (b)	Community Water Supply System (h)	Human Health	Other Standards for Domestic Water Supply	Irrigation Use
Hexachlorocyclohexane, Alpha	Semivolatile (P)							
Hexachlorocyclohexane, Beta	Semivolatile (P)							
Hexachlorocyclohexane, (Lindane)	Semivolatile (P)	0.2 µg/L(c)	0.2 µg/L(c)	4 µg/L	4 µg/L			
Hexachlorocyclohexane, Technical	Semivolatile (P)							
Hexachlorocyclopentadiene	Semivolatile	50 µg/L(d)	50 µg/L(d)					
Hexachloroethane	Semivolatile							
Indeno(1,2,3-cd)pyrene	Semivolatile							
Methoxychlor	Semivolatile (P)	40 µg/L	40 µg/L(c)	100 µg/L	100 µg/L			
Naphthalene	Semivolatile							
Nitrobenzene	Semivolatile							
Nitrophenols	Semivolatile							
Nitrosodibutylamine	Semivolatile							
Nitrosodiethylamine	Semivolatile							
Nitrosodimethylamine	Semivolatile							
Nitrosopyrrolidine	Semivolatile							
N-Nitrosodiphenylamine	Semivolatile							
N-Nitroso-di-n-dipropylamine	Semivolatile							
Oxamyl	Semivolatile(P)	200 µg/L(d)	200 µg/L(d)					
PCBs	PCBs	0.5 µg/L(c)	0 µg/L(c)			1 µg/L		1 µg/L
Pentachlorinated Ethanes	Semivolatile							
Pentachlorophenol	Semivolatile	1 µg/L(c)	0 µg/L(e)					
Phenanthrene	Semivolatile							
Phenol	Semivolatile				5 µg/L		5 µg/L	5 µg/L

TABLE 7-3

POTENTIAL SITE-WIDE CHEMICAL-SPECIFIC RASs/TBCs
GROUNDWATER QUALITY STANDARDS
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

		FEDERAL STANDARDS			STATE STANDARDS NMWQCC Groundwater Quality Standards (g)			
Parameter	Type	SDWA Maximum Contaminant Level (a)	SDWA Maximum Contaminant Level Goal (a) ARARs/TBCs	RCRA Subpart F Concentration Limit (40 CFR 264.94) (b)	Community Water Supply System (h)	Human Health	Other Standards for Domestic Water Supply	Irrigation Use
Picloram	Semivolatile (H)	500 µg/L	500 µg/L					
Polynuclear Aromatic Hydrocarbons (total PAH)	Semivolatile				30 µg/L	30 µg/L		30 µg/L
Pyrene	Semivolatile							
Simazine	Semivolatile(P)	4 µg/L(d)	4 µg/L(d)					
Trans-1,2-Dichloroethene	Semivolatile	100 µg/L	100 µg/L					
Toxaphene	Semivolatile (P)	3 µg/L(c)	0 µg/L(c)	5 µg/L	5 µg/L			

EXPLANATION OF TABLE

(P) Pesticide (H) Herbicide

* = secondary maximum contaminant level (TBCs)
** = total trihalomethanes: chloroform, bromoform, bromodichloromethane, dibromochloromethane
*** = action levels in no more than 10% of tap samples, 56 FR 26460, 6/7/91, effective 12/7/92

NMWQCC = New Mexico Water Quality Control Commission
RCRA = Resource Conservation and Recovery Act
SDWA = Safe Drinking Water Act
(a) EPA National Primary and Secondary Drinking Water Regulations, 40 CFR 141 and 40 CFR 143 (as of 6/95 and 12/94)
(b) RCRA Subpart F, 40 CFR 264.94 (July, 1992)
(c) EPA National Primary and Secondary Drinking Water Regulations, 40 CFR Parts 141, 142, 143, Final Rule, Effective July 30, 1992 (56 Federal Register 3526; 1/30/91)
(d) EPA National Primary Drinking Water Regulations, 40 CFR 141 and 40 CFR 142, Final Rule (57FR 31776, 7/17/92); Effective date is January 17, 1994, (therefore TBCs) except for endrin, which is effective 8/17/92.
(e) EPA National Primary and Secondary Drinking Water Regulations, 40 CFR Parts 141, 142, 143, Final Rule, Effective January 1, 1993 (56 FR 30266, 7/01/91)
(f) EPA Maximum Contaminant Level Goals and National Primary Drinking Water Regulations for Lead and Copper, 40 CFR 141 and 142; effective December 7, 1992 (56 FR 26460, 6/7/91)
(g) NM Water Quality Control Commission, NM Water Quality Regulations, Part 3, Section 3-103, 11/16/1967 amended through August 17, 1991
(h) New Mexico Drinking Water/Water Supply Regulations, adopted April 16, 1991

If no values are shown for a possible contaminant, there are no standards at this time.

TABLE 7-4

POTENTIAL SCREENING CONCENTRATIONS FOR INORGANIC COMPOUNDS IN SOIL (TO BE CONSIDERED)

Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

Compound	RFI Guidance TBCs[a] (mg/kg)	Proposed RCRA Action Level TBCs[b] (mg/kg)	Other TBCs[c] (mg/kg)
aluminum	-	200,000[f]	-
antimony	30	30[d]	-
arsenic*	-	0.4[d]	-
barium	4,000	600[d]	-
beryllium*	0.14	0.2[d]	-
cadmium	-	40[d]	-
calcium	-	-	-
chromium III	80,000	80,000[d]	-
chromium VI	400	400[d]	-
cobalt	-	5000[f]	-
copper	-	3000[e]	-
cyanide	2,000	2000[d]	-
iron	-	-	-
lead	-	-	500 - 1000
magnesium	-	-	-
manganese	-	4000[d]	-
mercury	-	20[e]	-
nickel	2,000	2000[d]	-
potassium	-	-	-
selenium	-	400[d]	-
silver	200	400[d]	-
sodium	-	-	-
thallium	-	6[e]	-
vanadium	-	600[e]	-
zinc	-	20,000[d]	-

TABLE 7-4

POTENTIAL SCREENING CONCENTRATIONS FOR INORGANIC COMPOUNDS IN SOIL (TO BE CONSIDERED)
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico
(Concluded)

[a] RCRA Facility Investigation Guidance (EPA 1989a); human health-based criteria for systemic toxicants representing an estimate of the daily exposure an individual can experience without appreciable risk of health effects during a lifetime.

[b] Human Health proposed action levels using calculations in 55 FR 30798, Corrective Action for SWMUs at Hazardous Waste Management Facilities (27 July 1990). Sources of toxicity factors used in calculations include: (1) Integrated Risk Information System (IRIS), (2) Health Effects Assessment Summary Tables (HEAST) FY1992, and (3) USEPA Environmental Criteria and Assessment Office in Cincinnati (ECAO-CIN).

[c] Source: OSWER Directive 9355.4-02.

[d] IRIS April, 1994

[e] HEAST 1994

[f] Calculated from provisional toxicity values for aluminum and cobalt provided by USEPA (ECAO) 1994.

* Carcinogen

TABLE 7-5

POTENTIAL SCREENING CONCENTRATIONS FOR ORGANIC COMPOUNDS IN SOIL
(To Be Considered)
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

	RFI Guidance(a) TBCs (mg/kg)	Proposed RCRA Action Level(b) TBCs (mg/kg)	Other TBCs (mg/kg)
Herbicides			
2,4,5-T	200	800 (c)	-
2,4,5-TP (Silvex)	600	600 (c)	-
2,4-D	800	800 (c)	-
2,4-DB	-	600(c)	-
Dalaphon	-	2,000 (c)	-
Dicamba	-	2,000 (c)	-
Dichlorprop	-	-	-
Dinoseb	80	80 (c)	-
MCPA	-	40 (c)	-
MCPP	-	80 (c)	-
Pesticides/PCBs			
4,4'-DDD*	2.9	3.0 (c)	
4,4'-DDT*	2.1	2.0(c)	-
4,4'-DDE*	2.1	2.0(c)	-
Aldrin*	0.04	0.04(c)	-
alpha-BHC*	-	0.1(c)	-
alpha-Chlordane*	0.54	0.5(c)	-
Aroclor-1016*	0.09	0.09(c)	(e)
Aroclor-1221*	0.09	0.09(c)	(e)
Aroclor-1232*	0.09	0.09(c)	(e)
Aroclor-1242*	0.09	0.09(c)	(e)
Aroclor-1248*	0.09	0.09(c)	(e)
Aroclor-1254*	0.09	0.09(c)	(e)
Aroclor-1260*	0.09	0.09(c)	(e)

TABLE 7-5

POTENTIAL SCREENING CONCENTRATIONS FOR ORGANIC COMPOUNDS IN SOIL
(To Be Considered)
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

	RFI Guidance(a) TBCs (mg/kg)	Proposed RCRA Action Level(b) TBCs (mg/kg)	Other TBCs (mg/kg)
Pesticides/PCBs (cont'd)			
beta-BHC*	-	0.4(c)	-
Chlordane*	0.54	0.5(k)	
delta-BHC	-	-	-
Diallate*	-	12(f)	
Dieldrin*	0.04	0.04(c)	-
Dimethoate	2,000	16(c)	
Disulfoton	3	3(c)	
Endosulfan I**	4	500(e,g)	-
Endosulfan II**	-	500(g)	-
Endosulfan sulfate	-	500(g)	
Endrin	20	20(c)	-
Endrin ketone	-	-	-
Famphur	-	-	
gamma-BHC	20	0.5(f)	-
gamma-Chlordane*	0.54	0.5(c)	-
Heptachlor	0.16	0.2(c)	-
Heptachlor epoxide*	0.077	0.08(c)	-
Isodrin	-	-	
Kepone	-	-	
Methoxychlor	-	400(c)	-
Methyl parathion	20	20(c)	
Parathion	20	500(f)	
Phorate	-	20(f)	
Toxaphene*	0.64	0.6(c)	-

TABLE 7-5

POTENTIAL SCREENING CONCENTRATIONS FOR ORGANIC COMPOUNDS IN SOIL
(To Be Considered)
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

	RFI Guidance(a) TBCs (mg/kg)	Proposed RCRA Action Level(b) TBCs (mg/kg)	Other TBCs (mg/kg)
Semivolatiles			
1,2,4,5-tetrachlorobenzene	20	20(c)	
1,2,4-trichlorobenzene	2,000	800(c)	-
1,2-dichlorobenzene	-	7,000(c)	-
1,3,5-trinitrobenzene	-	4(c)	
1,3-dichlorobenzene	-	8(c)	-
1,3-dinitrobenzene	-	8(c)	
1,4-dichlorobenzene*	-	29(f)	
1,4-naphthoquinone	-	-	
1-naphthylamine	-	-	
2,3,4,6-tetrachlorophenol	2,000	2,000(c)	
2,4,5-trichlorophenol	8,000	8,000(c)	-
2,4,6-trichlorophenol*	35	6(c)	-
2,2'-oxybis(1-chloropropane)	-	-	-
2,4-dichlorophenol	200	200(c)	-
2,4-dimethylphenol	-	2,000(c)	-
2,4-dinitrophenol	200	200(c)	-
2,4-dinitrotoluene	2.27	200(c)	-
2,6-dichlorophenol	-	-	
2,6-dinitrotoluene*	-	80(f)	-
2-acetylaminefluorone	-	-	
2-chloronaphthalene	-	6,000(c)	-
2-chlorophenol	-	400(c)	-
2-methylnaphthalene	-	-	0.3-220(i)
2-methylphenol	4,000	4,000(c)	-
2-naphthylamine	-	-	

TABLE 7-5

POTENTIAL SCREENING CONCENTRATIONS FOR ORGANIC COMPOUNDS IN SOIL
(To Be Considered)
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

	RFI Guidance(a) TBCs (mg/kg)	Proposed RCRA Action Level(b) TBCs (mg/kg)	Other TBCs (mg/kg)
Semivolatiles (cont'd)			
2-nitroaniline	-	-	-
2-nitrophenol	-	-	-
2-picoline	-	-	
3-3'-dichlorobenzidine*	-	2(c)	-
3,3'-dimethylbenzidine	-	-	
3-methyl cholanthrene	0.074	-	
3-methylphenol	4,000	4,000(c)	
3-nitroaniline	-	-	-
4,6-dinitro-2-methylphenol	-	-	-
4-aminobiphenyl	-	-	
4-bromophenylphenyl ether	-	-	-
4-chloro-3-methylphenol	-	-	-
4-chloroaniline	-	300(c)	-
4-chlorophenylphenyl ether	-	-	-
4-methylphenol	4,000	400(f)	-
4-nitroaniline	-	-	-
4-nitro-1-oxide-quinoline	-	-	
4-nitrophenol	-	-	-
5-nitro-o-toluidine	-	-	
acenaphthene	-	5,000(c)	-
acenaphthylene	-	-	-
acetophenone	8,000	8,000(c)	
aniline	270	-	
anthracene	-	20,000(c)	-
aramite*	-	30(c)	

TABLE 7-5

POTENTIAL SCREENING CONCENTRATIONS FOR ORGANIC COMPOUNDS IN SOIL
(To Be Considered)
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

	RFI Guidance(a) TBCs (mg/kg)	Proposed RCRA Action Level(b) TBCs (mg/kg)	Other TBCs (mg/kg)
Semivolatiles (cont'd)			
benzo(a)anthracene*	0.22	1.0(j)	0.3-220(i)
benzo(a)pyrene*	0.06	0.1(c)	0.3-220(i)
benzo(b)fluoranthene*	-	1.0(j)	0.3-220(i)
benzo(g,h,i)perylene	-	-	0.3-220(i)
benzo(k)fluoranthene*	-	9.6(j)	0.3-220(i)
benzoic acid	-	300,000(c)	-
benzyl alcohol	-	20,000(f)	-
bis(2-chloroethoxy)methane	-	-	
bis(2-chloroethyl)ether*	0.64	0.6(c)	-
bis(2-ethylhexyl)phthalate*	83	50(c)	0.3-220(i)
butyl benzyl phthalate	-	16,000(c)	0.3-220(i)
carbazole*	-	40(f)	-
chlorobenzilate*	-	2.6(f)	
p-chloro-m-cresol	-	-	
chrysene*	-	9.6(j)	0.3-220(i)
dibenzo(a,h)anthracene	0.0143	0.1(j)	0.3-220(i)
dibenzofuran	-	-	0.3-220(i)
dichlorodifluoromethane	20,000	20,000(c)	
dichlorodiisopropyl ether	-	-	
diethylphthalate	60,000	60,000(c)	-
o,o-diethyl o-pyrazinyl phosphoro-thioate	-	-	
p-dimethylaminoazobenzene	-	-	
7,12-dimethylbenz(a)anthracene	-	-	
alpha,alpha-dimethylphenethylamine	-	-	
dimethylphthalate	-	800,000(f)	-

TABLE 7-5

POTENTIAL SCREENING CONCENTRATIONS FOR ORGANIC COMPOUNDS IN SOIL
(To Be Considered)
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

	RFI Guidance(a) TBCs (mg/kg)	Proposed RCRA Action Level(b) TBCs (mg/kg)	Other TBCs (mg/kg)
Semivolatiles (cont'd)			
di-n-butylphthalate	8,000	8,000(c)	-
di-n-octylphthalate	-	20,000(f)	-
diphenylamine	2,000	2,000(c)	
ethyl methanesulfonate	-	-	
fluoranthene	-	3,000(c)	0.3-220(i)
fluorene	-	3,000(c)	0.3-220(i)
hexachlorobenzene*	0.41	0.4(c)	-
hexachlorobutadiene	90	9(c)	-
hexachlorocyclopentadiene	600	600(c)	-
hexachloroethane*	80	50(c)	-
hexachlorophene	-	20(c)	
hexachloropropene	-	-	
indeno(1,2,3-cd)pyrene*	-	1.0(j)	0.3-220(i)
isosafrole	-	-	
isophorone*	2,000	700(c)	-
methacrylonitrile	8	8(c)	
methapyrilene	-	-	
methyl methane sulfonate	-	-	
n-nitrosodiethylamine*	-	0.005(c)	
n-nitrosodimethylamine*	0.014	0.01(c)	
n-nitrosomethylethylamine*	0.032	0.03(c)	
n-nitrosomorpholine	-	-	
n-nitroso-di-n-butylamine*	-	0.1(c)	
n-nitroso-di-n-propylamine*	0.10	0.1(c)	-
n-nitrosodiphenylamine*	-	100(c)	-

TABLE 7-5

POTENTIAL SCREENING CONCENTRATIONS FOR ORGANIC COMPOUNDS IN SOIL
(To Be Considered)
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

	RFI Guidance(a) TBCs (mg/kg)	Proposed RCRA Action Level(b) TBCs (mg/kg)	Other TBCs (mg/kg)
Semivolatiles (cont'd)			
n-nitrosopiperidine	-	-	
n-nitrosopyrrolidine*	0.33	0.3(c)	
naphthalene	-	-	0.3-220(i)
nitrobenzene	40	40(c)	-
pentachlorobenzene	60	60(c)	
pentachloroethane	-	-	
pentachloronitrobenzene*	27.3	2.7(f)	
pentachlorophenol*	2,000	6(c)	-
phenacetin	-	-	
phenanthrene	-	-	-
phenol	3,000	50,000(c)	-
p-phenylenediamine	-	20,000(f)	
pronamide	6,000	6,000(c)	
pyrene	-	2,000(c)	0.3-220(i)
pyridine	80	80(c)	
safrole	-	-	
tetraethyldithiopyrophosphate	-	40(c)	
trans-1,4-dichloro-2-butene	-	-	
o-toluidine	-	-	
o,o,o-triethyl phosphorothioate	-	-	

TABLE 7-5

POTENTIAL SCREENING CONCENTRATIONS FOR ORGANIC COMPOUNDS IN SOIL
(To Be Considered)
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

	RFI Guidance(a) TBCs (mg/kg)	Proposed RCRA Action Level(b) TBCs (mg/kg)	Other TBCs (mg/kg)
Volatiles			
1,1,1-trichloroethane	7,000	-	-
1,1,1,2-tetrachloroethane*	-	30(c)	
1,1,2,2-tetrachloroethane*	35	3.5(c)	-
1,1,2-trichloroethane	120	1.2(c)	-
1,1-dichlorethane*	-	8,000(f)	-
1,1-dichloroethene	12	1.2(c)	-
1,2-dibromo-3-chloropropane*	0.032	0.5(f)	
1,2-dibromoethane*	-	0.008(c)	
1,2-dichloroethane*	7.7	7.7(c)	
1,2-dichloroethene (total)	-	700(f)	-
1,2-dichloropropane	-	-	
1,2,3-trichloropropane	80	500(c)	
1,4-dioxane*	143	60(c)	
2-butanone (MEK)	4,000	50,000(c)	-
2-hexanone (MnBK)	-	-	-
4-methyl-2-pentanone (MIBK)	4,000	6,000(f)	-
acetone	8,000	8,000(c)	-
acetonitrile	500	500(c)	
acrolein	-	2,000(f)	
acrylonitrile*	1.30	1.3(c)	
allyl chloride	-	-	
benzene*	24	20(c)	<100(k)
bromodichloromethane*	2,000	10(c)	-
bromoform*	2,000	90(c)	-

TABLE 7-5

POTENTIAL SCREENING CONCENTRATIONS FOR ORGANIC COMPOUNDS IN SOIL
(To Be Considered)
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

	RFI Guidance(a) TBCs (mg/kg)	Proposed RCRA Action Level(b) TBCs (mg/kg)	Other TBCs (mg/kg)
Volatiles (cont'd)			
bromomethane	30	100(c)	-
carbon disulfide	8,000	8,000(c)	-
carbon tetrachloride*	5.4	5.4(c)	-
chlorobenzene	2,000	2,000(c)	-
chloroethane	-	-	-
chloroform*	110	100(c)	-
chloromethane	-	50(f)	-
chloroprene	-	-	
cis-1,3-dichloropropene	3.9	3.9(f)	-
dibromochloromethane*	-	8.3(c)	-
ethylbenzene	8,000	8,000(c)	<500 (k)
ethyl cyanide	-	-	
ethyl methacrylate	-	7,000(f)	
isobutyl alcohol	20,000	20,000(c)	
methyl bromide	-	100(c)	
methylene bromide	-	-	
methylene chloride*	93	90(c)	-
methyl iodide	-	-	
methyl methacrylate	-	6,000(f)	
styrene	20,000	20,000(c)	-
tetrachloroethene*	140	800(c)	-
toluene	20,000	20,000(c)	<500 (k)
trans-1,2-dichloroethene	-	2,000(c)	
trans-1,3-dichloropropene	20	3.9(f)	-
trichloroethene*	64	-	-

TABLE 7-5

POTENTIAL SCREENING CONCENTRATIONS FOR ORGANIC COMPOUNDS IN SOIL
(To Be Considered)
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

	RFI Guidance(a) TBCs (mg/kg)	Proposed RCRA Action Level(b) TBCs (mg/kg)	Other TBCs (mg/kg)
Volatiles (cont'd)			
trichlorofluoromethane	20,000	20,000(c)	
vinyl acetate	-	-	
vinyl chloride*	-	0.4(f)	-
xylenes (total)	200,000	200,000(c)	<500 (k)
Hydrocarbons			
Polycyclic Aromatic	-	-	<50 ppm(l)
Hydrocarbons (PAHs)	-	-	-
Total Petroleum Hydrocarbons (TPH)	-	-	<1000 ppm(m)
Dioxins and Furans			
2,3,7,8,(x,y)-hexachlorodibenzodioxin*	1.10E-04	5E-05(n)	
2,3,7,8,(x)-pentachlorodibenzodioxin*	-	9E-06(n)	
2,3,7,8-tetrachlorodibenzodioxin*	-	5E-06(n)	
1,2,3,7,8-pentachlorodibenzofuran*	-	9E-05(n)	
2,3,4,7,8-pentachlorodibenzofuran*	-	9E-06(n)	
2,3,7,8,(x,y)-hexachlorodibenzofuran*	-	5E-05(n)	
2,3,7,8-tetrachlorodibenzofuran*	-	5E-05(n)	

(a) RCRA Facility Investigation Guidance (EPA 1989a); human health-based criteria for systemic toxicants representing an estimate of the daily exposure an individual can experience without appreciable risk of health effects during a lifetime.

(b) Human health proposed action levels calculated using guidance in 55 FR 30798

(c) Calculated from toxicity values provided in IRIS April, 1994.

(d) 55 FR 30798. EPA has already established standards for cleanup of PCBs under TSCA. The agency has determined that the TSCA cleanup standards are relevant to RCRA corrective action.

TABLE 7-5

POTENTIAL SCREENING CONCENTRATIONS FOR ORGANIC COMPOUNDS IN SOIL
(To Be Considered)
Landfill No. 5 (SWMU No. 113/IRP No. LF-5) Phase I RFI
Cannon AFB, New Mexico

	RFI Guidance(a) TBCs (mg/kg)	Proposed RCRA Action Level(b) TBCs (mg/kg)	Other TBCs (mg/kg)

(e) Cleanup levels for PCB spills occuring before May 4, 1987 are at the discretion of the EPA regional administrator. 40 CFR 761 (Subpart G).

(f) Calculated from toxicity values provided in HEAST 1994.

(g) Toxicity values for Endosulfan adopted for Endosulfan I, Endosulfan II, and Endosulfan sulfate

(h) Value for mixture of dinitrotoluene isomers

(i) Range of anthropogenic and naturally occurring PAH concentrations (Blumer et al. 1977)

(j) EPA 1993. Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons. EPA/625/3-89/016. March 1989.

(k) The sum of benzene, toluene, ethylbenzene, and xylene isomer concentrations is less than 500 mg/kg, with benzene individually less than 100 mg/kg. New Mexico Environmental Improvement Board, New Mexico Special Waste Requirement Regulations. Adopted effective January 30, 1992.

(l) New Mexico Department of Environmental Improvement New Mexico UST Regulations, amended through July 18, 1991.

(m) New Mexico Environmental Improvement Board, New Mexico Special Waste Requirement Regulations, Adopted effective January 30, 1992

(n) EPA 1989. Interim Procedures for Estimating risks Associated with Exposures to Mixtures of Chlorinated Dibenzo-p-dioxins and -Dibenzofurans (CDDs and CDFs). EPA/625/3-89/016. March 1989.

* Carcinogens

8.0
CONCLUSIONS AND RECOMMENDATIONS

The Phase I RCRA field investigation and subsequent data reduction and evaluation took place during 1995 for Landfill No. 5 (SWMU No. 113). The work was performed in accordance with the Phase I Work Plan approved by NMED on June 14, 1995.

The primary objective of the Phase I RFI was to determine whether a release of hazardous constituents had occurred to subsurface soil beneath landfill cells. If a release had occurred, a secondary objective was to evaluate the nature and extent of contamination and assess potential risks to human health by performing a screening level risk assessment. The ultimate goal of the work described above was to reach a recommendation of "No Further Action," if appropriate, or performance of additional investigations, if warranted. Important conclusions from the Phase I study are presented below, followed by recommendations for the site.

Geophysical and soil gas surveys were performed in early 1995 to help delineate the extent of individual landfill cells and assist in selecting soil boring locations most likely to intercept contamination (if present) in subsurface soil at Landfill No. 5. The geophysical surveys were successful in delineating the lateral extent of at least 23 landfill cells, exclusive of RCRA Cell No. 3. The majority of the cells located as part of the surveys were in the eastern two-thirds of the SWMU.

Subsequent to completion of the geophysical surveys, a soil gas survey was conducted. This survey consisted of field screening using a photo ionization detector (PID) organic vapor analyzer at 808 locations followed by gas chromatography (GC) analysis using a mobile laboratory at 80 locations.

It is important to note that 631 of 808 (i.e., 74 percent) PID screening samples had results below 7.0 ppm/v, the limit of quantitation, suggesting that a majority of locations sampled were at background readings. Field screening PID readings greater than 7.0 ppm/v occurred primarily in the eastern two-thirds of the SWMU along previously delineated landfill cells, indicating that elevated organic vapors were present in some portions of individual landfill cells, but other portions of the cells did not exhibit elevated levels.

Subsequent GC analyses detected 16 VOCs in soil gas; however, 74 percent of the detections were below 5.0 ppm/v, and the highest detection was 94.2 ppm/v for dichlorodifluoromethane, a historically common refrigerant.

Results of the soil gas survey were used to select 30 soil boring locations which were approved by NMED on June 14, 1995 prior to drilling. Boring locations were selected at sites believed most likely to contain contaminants, based on soil gas results. The 30 soil borings were drilled in July and August 1995 and in accordance with the approved Work Plan, 150 subsurface and 10 surface soil samples were collected and analyzed for the following:

- TCL VOC
- TCL SVOC
- TAL metals
- Pesticides/PCB
- Herbicides (60 samples)
- TOC (24 samples)
- TRPH

Appendix IX analyses were conducted on the bottom sample collected in each boring.

The following conclusions regarding nature and extent of contamination in subsurface soil at Landfill No. 5 are based upon an evaluation of analytical results from 150 field samples, and field observations while drilling. Results for subsurface samples only are discussed below in evaluating potential releases of hazardous constituents beneath landfill cells at Landfill No. 5. However, the Human Health Risk Screen did consider results for both surface and subsurface soil samples.

Metals

Ten metals (i.e., aluminum, barium, chromium, copper, iron, magnesium, nickel, silver, vanadium, and zinc) were detected in at least one subsurface soil sample above the background range established in an earlier study for Cannon AFB (W-C 1994). Out of 1,500 analytical results for these 10 metals, background was exceeded for only 55 results (i.e., a

frequency of 4 percent). Given the isolated and random occurrence of these metals above background within individual borings and areally across Landfill No. 5, it appears that site-specific geologic factors probably account for exceedences and these metals are not likely due to contamination from waste in the landfill cells. In a majority of cases, the metals listed above did not exceed background in the sample collected immediately beneath the landfill cell. Typically within the same boring the metal exceeding background was not detected above background in samples collected above or below the interval where the exceedence occurred.

Semivolatiles

Twelve SVOCs were detected in subsurface soil samples and included seven PAHs (2-methylnaphthalene, acenaphthene, chrysene, fluoranthene, fluorene, phenanthrene, pyrene), three phenols (4-methylphenol, 4-nitrophenol, phenol), and one furan (dibenzofuran).

PAH compounds were restricted to two borings (i.e., 113-01 and 113-13). The concentrations were all below the laboratory reporting limit of 360 µg/kg. As such they were in the range for which quantitation of sample results is uncertain and were qualified as estimated. It should be noted that PAHs in boring 113-01 occurred in the sample collected at 63 feet, but not in shallower samples. Additionally, the PAHs in boring 113-13 were, for the most part, detected in the sample at 40 feet with significantly fewer detections above or below this sample.

Phenols were detected eight times scattered over 5 borings all at values equal to or below the laboratory reporting limit. In two borings, no phenols were detected in the sample collected immediately beneath the landfill cell. However, phenol was detected immediately beneath the landfill cell at 360 µg/kg, and 40 "J" µg/kg in borings 113-01 and 113-16, respectively. The SVOC 4-methylphenol (100 "J" µg/kg) and 4-nitrophenol (49 "J" µg/kg) were also detected immediately beneath the landfill cell in borings 113-16 and 113-15, respectively. These data indicate that a minor release of phenols possibly could have occurred at borings 113-01, 113-15, and 113-16.

Dibenzofuran was detected in only one sample (44 "J" µg/kg) collected at Landfill No. 5. This detection occurred in the second interval sampled below the landfill cell in boring 113-13.

Volatiles

A total of eight VOCs (i.e., 1,1,2,2-tetrachloroethane, 2-hexanone, 4-methyl-2-pentanone, acetonitrile, carbon disulfide, ethylbenzene, styrene, and toluene) were detected at 16 boring locations scattered across Landfill No. 5. These eight VOCs were detected in subsurface soil a total of 29 times out of 1,200 analytical results for these chemicals — a frequency of 3 percent. Concentrations of the detected VOCs ranged from 1 "J" µg/kg to 1,400 µg/kg. Twenty-four of the 29 detections were below the laboratory reporting limit and were therefore in the range for which quantitation is considered uncertain and were qualified as estimated. Detection of ethylbenzene and styrene at concentrations of 300 µg/kg and 1,400 µg/kg, respectively, in boring 113-13 and 4-methyl-2-pentanone (MIBK) at 230 µg/kg immediately beneath the landfill cells are the only results indicative of a potential release of VOCs. Two of these compounds (i.e., ethylbenzene and styrene) were not detected in deeper samples collected within boring 113-13, while MIBK was detected in the two deeper intervals collected in boring 113-16 below the interval sampled immediately beneath the landfill cell.

Other Analytes

Only one detection of Aroclor 1254 at a minor concentration of 75 µg/kg occurred during the Phase I RFI and this result does not indicate a significant release has occurred to subsurface soil at Landfill No. 5 for this compound. No pesticides, herbicides, or cyanide were detected. TRPH was detected in subsurface soil samples at concentrations ranging from 66.5 mg/kg to 170 mg/kg. These results indicate the presence of only minor contamination. A number of VOC and SVOC TICs were reported by the laboratory. However, the majority of these compounds appeared to be potentially non-toxic alcohols, fatty acids and esters, saturated hydrocarbon and unknowns. TICs with potential toxicity were further evaluated in the human health risk screen.

In conclusion, it appears that if a release of hazardous constituents has occurred at Landfill No. 5, it has been insignificant. Additionally, based on the fact that free liquids or soil saturated with liquid wastes were not observed within the landfill wastes while drilling, the potential for a release to occur at Landfill No. 5 in the future is minimal.

Human Health Risk Screen

A Human Health Risk Screen (HHRS) was performed as part of the Phase I evaluation for Landfill No. 5. The purpose of the HHRS was to determine whether chemicals of interest (COIs) were detected in soils at levels that may pose an unacceptable risk to human health. The HHRS was performed according to Step No. 5 identified in the Phase I RFI Work Plan Decision Diagram.

The HHRS evaluation was screening level because it compared maximum detected chemical concentrations regardless of sample depth to risk-based screening concentrations (i.e., proposed RCRA Action Levels for soil ingestion assuming residential use. The HHRS did not include estimating reasonable exposure concentrations or assessing current or future site-specific exposure conditions (e.g., future residential land use is considered to be extremely unlikely at this site). Therefore, the HHRS likely overestimated hazard/risk at Landfill No. 5 and will be protective of human health.

COIs evaluated during the HHRS included:

Inorganic Compounds	Organic Compounds
Aluminum	1,1,2,2-Tetrachloroethene
Barium	4-Methyl-2-pentanone (MIBK)
Beryllium	4-Methylphenol
Chromium	4-Nitrophenol
Cobalt	Acenaphthene
Copper	Acetonitrile
Lead	Aroclor 1254
Manganese	Carbon disulfide
Nickel	Chrysene
Silver	Ethylbenzene
Tin	Fluoranthene
Vanadium	Fluorene
Zinc	Phenol
	Pyrene
	Styrene
	Toluene

Of the COIs, only one carcinogen, beryllium had a maximum concentration (0.7 mg/kg) exceeding its proposed RCRA Action Level (0.2 mg/kg). This one maximum value was the

only result for this metal that exceeded the upper limit of the background range (0.6 mg/kg) for 160 samples collected and analyzed. The associated cancer risk for beryllium assuming a 70-year soil ingestion exposure to the maximum concentration was 4E-06, well within EPA's target cancer risk range of 1E-06 to 1E-04. Estimated cumulative cancer risk from exposure to maximum concentrations of all detected carcinogens was also 4E-06 due to the presence of beryllium. When the 95% UCL of the arithmetic mean is used to represent the exposure concentration of beryllium in soil, the site concentration (0.24 mg/kg) is approximately equal to the proposed RCRA Action Level (0.2 mg/kg) and the chemical-specific and cancer risk is approximately 1E-06 from soil ingestion. Because the use of maximum detected concentrations overestimates cancer risk for each COI, and cancer risk estimates were nevertheless within EPA's target risk range, it was concluded that exposure to COIs at Landfill No. 5 is not likely to pose an unacceptable risk of cancer.

No noncarcinogenic chemical had a maximum concentration exceeding its proposed RCRA Action Level. The cumulative hazard index for noncarcinogenic effects was 1, indicating that maximum concentrations of noncarcinogenic chemicals in soil at Landfill No. 5 do not pose an unacceptable risk to human health.

A proposed RCRA Action Level could be calculated for only two TICs, acetic acid, ethyl ester (ethyl acetate) and acetic acid, methyl ester (methyl acetate) since toxicity factors were not available for the other reported TICs. The maximum detected concentration of ethyl acetate during the Phase I RFI was 0.11 mg/kg while the proposed RCRA Action Level was 70,000 mg/kg, yielding a hazard quotient of 2E-06. The maximum detected concentration of methyl acetate was 0.0074 mg/kg while the proposed RCRA Action Level was 80,000 mg/kg, yielding a hazard quotient of 9.3E-08. These values were well below 1 indicating that ethyl acetate and methyl acetate at the site will not pose a threat to human health. Remaining TICs were evaluated qualitatively and from that evaluation it was concluded that the TICs would not likely pose an unacceptable risk to human health.

Based on the results of the HHRS, it was concluded that COIs at Landfill No. 5 do not pose an unacceptable risk to human health.

Recommendations

Based on the results and conclusions of the Phase I RFI, "**No Further Action**" is recommended for this SWMU. This recommendation is supported by lack of a significant release of hazardous constituents into subsurface soil and a human health risk screen that indicated an unacceptable risk to human health was not present from chemicals that were detected during the Phase I RFI for Landfill No. 5. Continued monitoring of groundwater quality from wells installed to assess potential impacts to groundwater from closed RCRA Cell No. 3 should be adequate for this SWMU.

DRAFT

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