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RCRA FACILITY INVESTIGATION (RFI)
SWMU NO. 105
LANDFILL NO. 3
IRP SITE LF-3

FINAL REPORT

AIR FORCE PROJECT NO. CZQZ 91 7006

CANNON AFB, NEW MEXICO

2-1-1994

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SWMU NO. 105
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CANNON AIR FORCE BASE, NEW MEXICO

Prepared for:

U.S. Army Corps of Engineers

Omaha District

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February 1994

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LIST OF ACRONYMS

ACC	Air Combat Command
A-E SQCSR	Architect-Engineer Sampling and Quality Control Summary Report
AFB	Air Force Base
AICUZ	Air Installation Compatible Use Zone
AQCR	New Mexico Air Quality Control Regulation
ARARs	Applicable, Relevant and Appropriate Requirements
ASTM	American Society for Testing and Materials
AWQC	Ambient Water Quality Criteria
BA	Biological Assessment
BDAT	Best Demonstrated Available Treatment Technologies
BGL	Below Ground Level
BHC	Benzene Hexachloride
BP	Before The Present
BTEX	Benzene, Toluene, Ethyl Benzene, Xylene
CAA	Clean Air Act
CAFB	Cannon Air Force Base
CDAP	Chemical Data Acquisition Plan
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act (also known as Superfund)
CEC	Cation Exchange Capacities

LIST OF ACRONYMS (Continued)

CFR	Code of Federal Regulations
CLP	Contract Laboratory Program (USEPA)
CMS	Corrective Measures Study
CNS	Central Nervous System
CWA	Clean Water Act
DL	Detection Limit
DOD	Department of Defense
DOE	Department of Energy
DOT	Department of Transportation
DQOs	Data Quality Objectives
DRMO	Defense Reutilization and Marketing Office
EM	Electromagnetic
EOD	Explosive Ordnance Disposal
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ES&E	Environmental Science and Engineering
FAMSL	Feet Above Mean Sea Level
FS	Feasibility Study
FWS	U.S. Fish and Wildlife Service
HA	Hand Auger

LIST OF ACRONYMS (Continued)

HARM	Hazard Assessment Rating Methodology
HEAST	Health Effects Assessment Summary Table
HHS	Human Health Standards
HSWA	Hazardous and Solid Waste Amendments
HQ	Hazard Quotient (=Exposure/RfD)
ID	Identification
IRFNA	Inhibited Red Fuming Nitric Acid
IRIS	Integrated Risk Information System
IRP	Installation Restoration Program
IWFNA	Inhibited White Fuming Nitric Acid
LCSs	Laboratory Control Samples
LEL	Lowest Effect Level
LOAEL	Lowest Observed Adverse Effect Level
LOX	Liquid Oxygen
MCLs	Maximum Contaminant Levels
MCLG	Maximum Contaminant Level Goals
MRD	Missouri River Division (USACE)
MS/MSD	Matrix Spike/Matrix Spike Duplicate
MTV	Mobility, Toxicity, or Volume
MW	Monitor Wells
NCP	National Oil and Hazardous Substances Pollution Contingency Plan

LIST OF ACRONYMS (Continued)

NMWQCC	New Mexico Water Quality Control Commission
NMWQCCR	New Mexico Water Quality Control Commission Regulations
NOAEL	No Observed Adverse Effect Level
O&M	Operation and Maintenance
OSHA	Occupational Safety and Health Administration
PCBs	Polychlorinated Biphenyls
PID	Photoionization Detector
POL	Petroleum, Oils, and Lubricants
QA/QC	Quality Assurance/Quality Control
QL	Quantitation Limits
RAPs	Remedial Action Plans
RAS	Radian Analytical Services
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facilities Assessment
RfDs	Reference Doses
RfCs	Reference Concentration For Noncarcinoginic Toxicity
RFI	RCRA Facilities Investigation
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision

LIST OF ACRONYMS (Continued)

SARA	Superfund Amendments and Reauthorization Act
SB	Soil Boring
SFs	Carcinogenic Slope Factors
SMCLs	Secondary Drinking Water Maximum Contaminant Levels
SSHP	Site Safety and Health Plan
SVOCs	Semi-volatile Organic Compounds
SWQC	Surface Water Quality Criteria
SWMUs	Solid Waste Management Units
TAC	Tactical Air Command
TAL	Total Analyte List
TBC	To Be Considered
TDS	Total Dissolved Solids
TEL	Tetraethyl Lead
TFW	Tactical Fighter Wing
TIC	Tentatively Identified Compound
TPH	Total Petroleum Hydrocarbons
TRPH	Total Recoverable Petroleum Hydrocarbons
TSCA	Toxic Substances Control Act
TSDFS	Treatment, Storage or Disposal Facilities

LIST OF ACRONYMS (Continued)

UDMH	Unsymmetrical Dimethyl Hydrazine
USACE	U.S. Army Corps of Engineers
USAF	U.S. Air Force
USDA	U.S. Department of Agriculture
USGS	United States Geological Survey
UST	Underground Storage Tank
UTL	Upper Tolerance Limit
VOC	Volatile Organic Compounds

EXECUTIVE SUMMARY

This document is the RCRA Facility Investigation (RFI) report for Landfill No. 3 at Cannon Air Force Base, New Mexico (CAFB) and includes the risk assessment report for the RFI.

This Executive Summary contains an overview of the investigation for Landfill No. 3, a discussion of the nature and extent of contamination, and an assesment of the risk associated with the contaminants at Landfill No. 3.

The objectives of this RFI work effort were to investigate the extent of contamination at CAFB Landfill No. 3 and to make recommendations regarding site remediation for contaminants found to exceed the accepted safe level for humans and/or the environment.

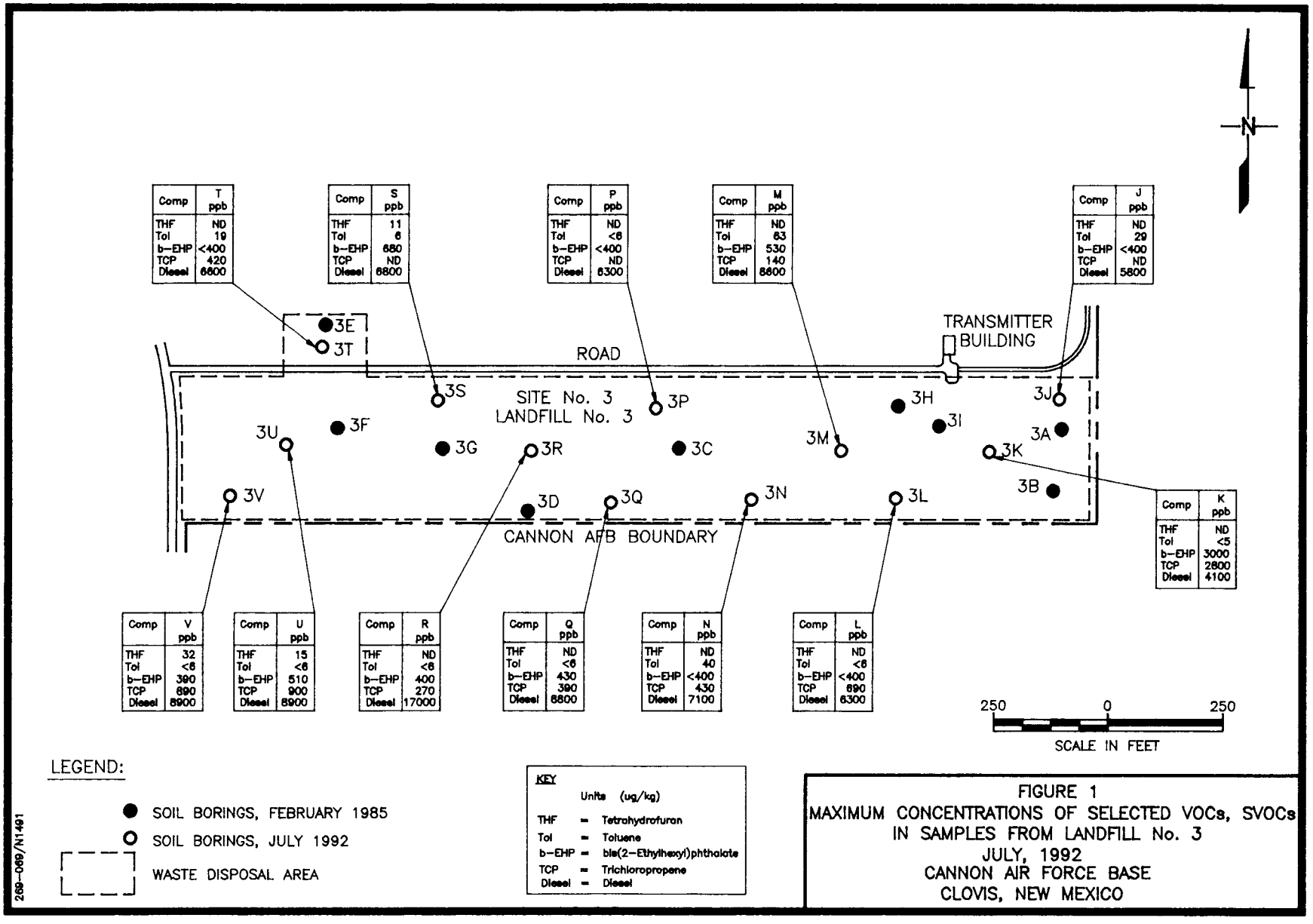
The investigation of Landfill No. 3 involved excavating an exploration trench to find the bottom of the landfill and collecting soil samples from 12 soil borings drilled through the landfill. The soil sampling effort during July 1992 collected soil samples from between 20 feet and 60 feet depth, the interval that was not sampled in 1985, so as to confirm whether or not contaminant migration is a problem at Landfill No. 3. These activities were guided by the Lee Wan work plans (Lee Wan and Associates, 1990) and by the Quality Assurance Project Plan (QAPP), the Field Sampling Plan supplement (FSP) and the Site Specific Health Plan (SSHP). These plans provided technical guidelines for performing the field investigations, procedures for the quality execution of field tasks, criteria for data collection, quality assurance/quality control (QA/QC) procedures, and guidelines to ensure the health and safety of field personnel. The field investigation commenced 5 July 1992 and was completed 25 July 1992.

Following the field investigation and prior to preparation of the RFI report (including the risk assessment), a QA/QC review of the analytical data was completed.

QC data associated with this investigation indicate that chemical data are acceptable and defensible. Data show that quality control mechanisms were effective in ensuring measurement data reliability within expected limits of sampling and analytical error.

Primary activities required by both the RFI and IRP RI include: 1) site characterization to identify and confirm the presence or absence of contamination and the degree of contamination; and 2) development of recommendations for the next phase of the IRP and RCRA corrective action program. The nature and extent of contamination were assessed using results of field measurements and observations, and analytical samples collected from the vadose zone during the field investigation. The maximum concentrations of selected organic compounds found at each borehole location drilled in 1992 are presented in Figures 1 and 2. The compounds shown are those used for the risk assessment. The concentrations of contaminants found were compared to soil action levels (RCRA Proposed Subpart S Media Actions Levels), and the concentrations of all target analytes in the Landfill No. 3 samples, including those that exceeded background soil metals concentrations, were found to be less than the proposed noncarcinogenic action levels. Conclusions regarding the subsurface distribution of contaminant sources in soil were developed for Landfill No. 3. Analytical results and statistical comparisons were used to assess the degree to which the soil, and potentially the groundwater, were affected.

Recommendations for Landfill No. 3 were based on the results of the risk assessment. The risk assessment under both the IRP and RCRA corrective action programs provides an evaluation of the potential threat to human health and the environment for a particular site. At any time during the respective processes, the risk assessment can provide the basis for concluding that site closeout under the IRP, or no further action under the RCRA corrective action program, is warranted if the risk is acceptable to human health and the environment. In addition, the risk assessment



Comp	T ppb
THF	ND
Tol	19
b-EHP	<400
TCP	420
Diesel	6600

Comp	S ppb
THF	11
Tol	6
b-EHP	680
TCP	ND
Diesel	6800

Comp	P ppb
THF	ND
Tol	<6
b-EHP	<400
TCP	ND
Diesel	6300

Comp	M ppb
THF	ND
Tol	63
b-EHP	530
TCP	140
Diesel	8600

Comp	J ppb
THF	ND
Tol	29
b-EHP	<400
TCP	ND
Diesel	5800

Comp	K ppb
THF	ND
Tol	<5
b-EHP	3000
TCP	2800
Diesel	4100

Comp	V ppb
THF	32
Tol	<6
b-EHP	390
TCP	890
Diesel	8900

Comp	U ppb
THF	15
Tol	<6
b-EHP	510
TCP	900
Diesel	8900

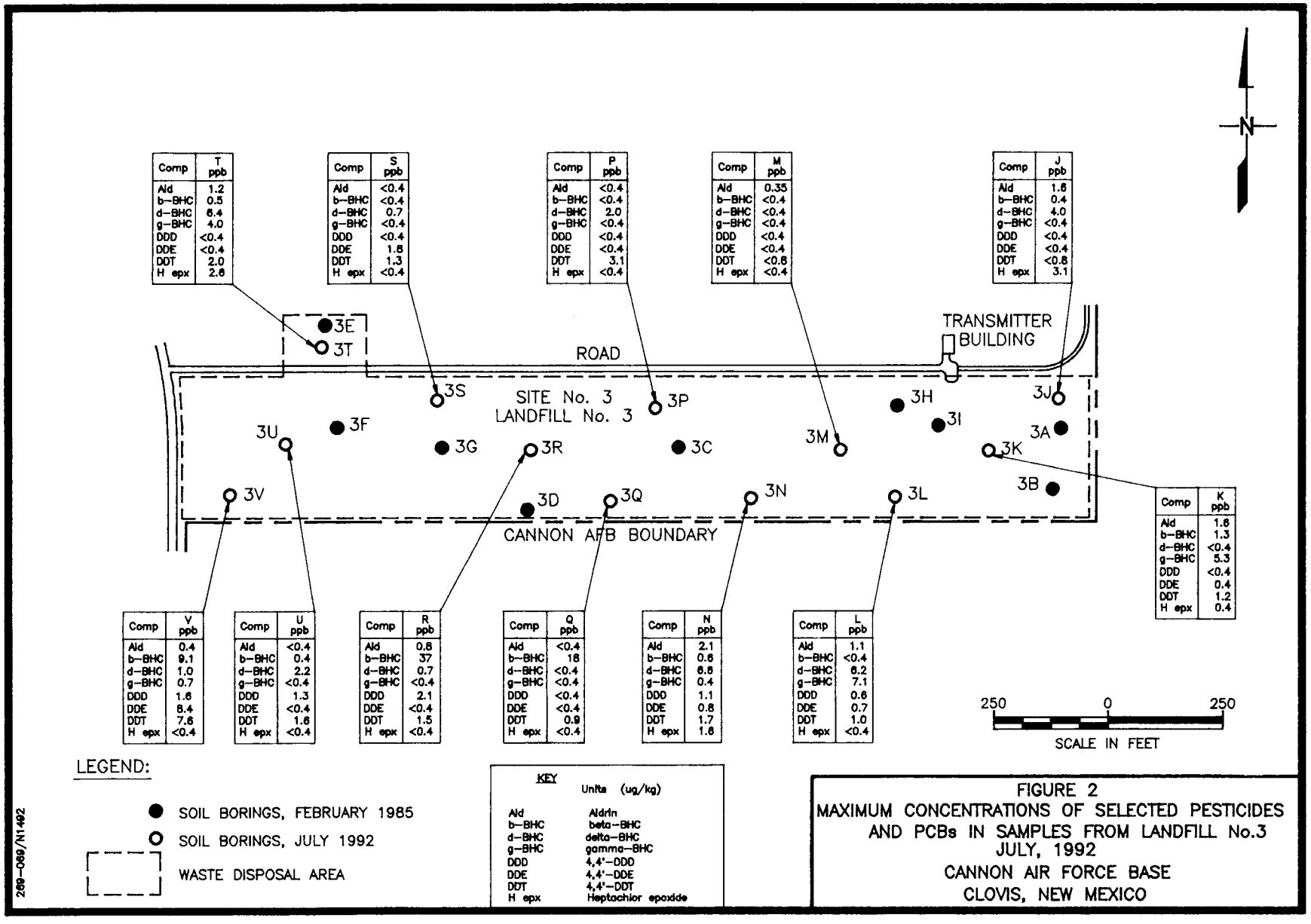
Comp	R ppb
THF	ND
Tol	<6
b-EHP	400
TCP	270
Diesel	17000

Comp	Q ppb
THF	ND
Tol	<6
b-EHP	430
TCP	390
Diesel	6800

Comp	N ppb
THF	ND
Tol	40
b-EHP	<400
TCP	430
Diesel	7100

Comp	L ppb
THF	ND
Tol	<6
b-EHP	<400
TCP	890
Diesel	6300

FIGURE 1
MAXIMUM CONCENTRATIONS OF SELECTED VOCs, SVOCs
IN SAMPLES FROM LANDFILL No. 3
JULY, 1992
CANNON AIR FORCE BASE
CLOVIS, NEW MEXICO



Comp	T ppb
Ald	1.2
b-BHC	0.5
d-BHC	6.4
g-BHC	4.0
DDD	<0.4
DDE	<0.4
DDT	2.0
H epx	2.6

Comp	S ppb
Ald	<0.4
b-BHC	<0.4
d-BHC	0.7
g-BHC	<0.4
DDD	<0.4
DDE	1.6
DDT	1.3
H epx	<0.4

Comp	P ppb
Ald	<0.4
b-BHC	<0.4
d-BHC	2.0
g-BHC	<0.4
DDD	<0.4
DDE	<0.4
DDT	3.1
H epx	<0.4

Comp	M ppb
Ald	0.35
b-BHC	<0.4
d-BHC	<0.4
g-BHC	<0.4
DDD	<0.4
DDE	<0.4
DDT	<0.8
H epx	<0.4

Comp	J ppb
Ald	1.6
b-BHC	0.4
d-BHC	4.0
g-BHC	<0.4
DDD	<0.4
DDE	<0.4
DDT	<0.8
H epx	3.1

Comp	K ppb
Ald	1.6
b-BHC	1.3
d-BHC	<0.4
g-BHC	5.3
DDD	<0.4
DDE	0.4
DDT	1.2
H epx	0.4

Comp	V ppb
Ald	0.4
b-BHC	9.1
d-BHC	1.0
g-BHC	0.7
DDD	1.6
DDE	8.4
DDT	7.6
H epx	<0.4

Comp	U ppb
Ald	<0.4
b-BHC	0.4
d-BHC	2.2
g-BHC	<0.4
DDD	1.3
DDE	<0.4
DDT	1.6
H epx	<0.4

Comp	R ppb
Ald	0.8
b-BHC	37
d-BHC	0.7
g-BHC	<0.4
DDD	2.1
DDE	<0.4
DDT	1.5
H epx	<0.4

Comp	Q ppb
Ald	<0.4
b-BHC	18
d-BHC	<0.4
g-BHC	<0.4
DDD	<0.4
DDE	<0.4
DDT	0.9
H epx	<0.4

Comp	N ppb
Ald	2.1
b-BHC	0.6
d-BHC	6.8
g-BHC	0.4
DDD	1.1
DDE	0.8
DDT	1.7
H epx	1.6

Comp	L ppb
Ald	1.1
b-BHC	<0.4
d-BHC	6.2
g-BHC	7.1
DDD	0.6
DDE	0.7
DDT	1.0
H epx	<0.4

FIGURE 2
MAXIMUM CONCENTRATIONS OF SELECTED PESTICIDES AND PCBs IN SAMPLES FROM LANDFILL No.3
JULY, 1992
CANNON AIR FORCE BASE
CLOVIS, NEW MEXICO

provides the basis for determining that a site should proceed beyond the RI/RFI stages into the Feasibility Study/Corrective Measures Study (FS/CMS), and if necessary, to implementation of an IRP remedial action/RCRA corrective action remedy.

Following the guidelines of the USEPA (EPA, 1989a), a list of chemicals of potential concern were identified based on analytical results from analysis of soil samples collected at Landfill No. 3.

An exposure assessment was made to determine or estimate the magnitude, frequency, duration, and route of human exposure to the chemicals of potential concern. A conceptual site model was developed to provide an understanding of the sources of contaminants, potential migration pathways of contaminants, and potential receptors considering geologic and hydrologic information gathered about the site. This model is shown in Figure 3. The potential pathways and subsequent exposure of receptors were assessed using available modeling techniques, and a toxicity assessment was made based on the estimated exposure of the receptors to identified contaminants.

Toluene was the only chemical detected in surficial soil samples at Landfill No. 3 and is, therefore, the only contaminant estimated to exist in significant quantities in the playa lake water resulting from surface runoff from Landfill No. 3. Toluene has not been classified as to its carcinogenicity by the USEPA and this precluded evaluation of toluene for carcinogenic risks. The noncarcinogenic risks, however, were evaluated and the average and reasonable maximum non-cancer risks estimated. The total hazard indices calculated for both the average and reasonable maximum exposure suggest that contaminants migrating off-site are not likely to cause adverse noncarcinogenic health effects in on-site adult workers, off-site residential adults, and off-site residential children. The risks to wildlife resulting from exposure to contaminants were also evaluated and the level of exposure and resulting risks were found to be low.

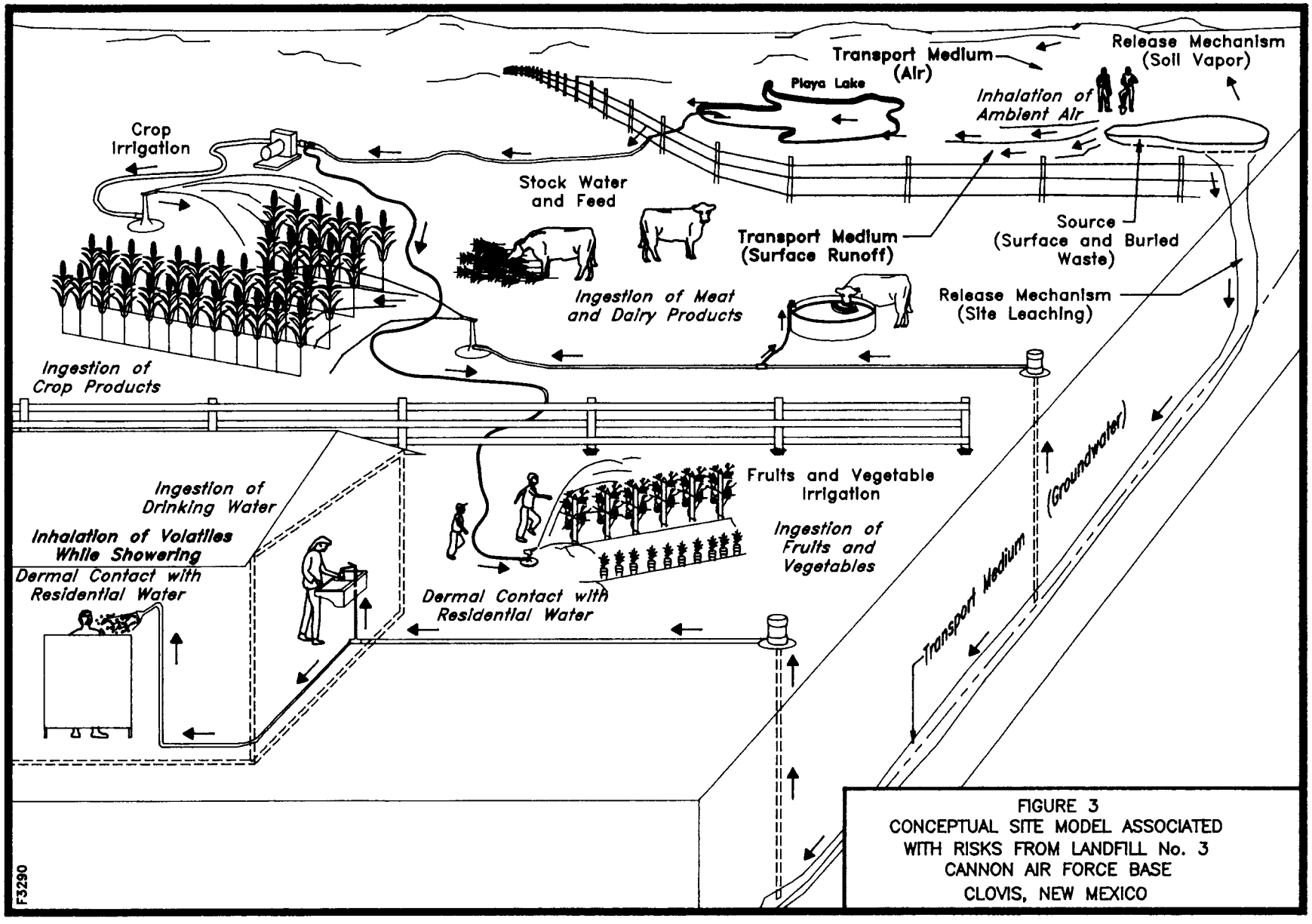


FIGURE 3
CONCEPTUAL SITE MODEL ASSOCIATED
WITH RISKS FROM LANDFILL No. 3
CANNON AIR FORCE BASE
CLOVIS, NEW MEXICO

In summary, the analytical data and the resulting risk assessment performed for Landfill No. 3 demonstrate that the risk to human health and the environment is considered acceptable. No further action is recommended.

1.0 INTRODUCTION

Radian Corporation (Radian) was contracted by the U.S. Army Corps of Engineers (USACE) Omaha District to provide a CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act) type Remedial Investigation (RI), including RCRA (Resource Conservation and Recovery Act) Facility Investigation (RFI) requirements, of Landfill No. 3 at Cannon Air Force Base (CAFB), New Mexico. The work performed under this contract supplements work performed by Radian between 1984 and 1986 at CAFB (Phase II, Stage 1 of the Installation Restoration Program Investigation). Work was conducted based on the RFI Work Plan written by Lee Wan and Associates in June 1990, and on the Work Plan supplements written by Radian Corporation in June 1992. USACE personnel provided project management and technical support for the work at CAFB Landfill No. 3. This document is the RFI report for Landfill No. 3 and includes the Risk Assessment Report.

This section (Section 1.0) contains information regarding the history of the Installation Restoration Program (IRP), the background and objectives of the CAFB Landfill No. 3 RFI, and an overview of the report organization.

1.1 U.S. Air Force Installation Restoration Program

The Department of Defense (DOD) is conducting a nationwide program, the Installation Restoration Program (IRP), to evaluate waste disposal practices on DOD property, to control hazards that may result from these waste disposal practices, and to control the migration of hazardous contaminants. The United States Air Force (USAF) initiated an IRP investigation at CAFB New Mexico in 1983.

1.1.1 IRP Program Overview

Because of the aircraft maintenance activities associated with its primary mission, the USAF has long been engaged in operations in which toxic and hazardous materials are used and industrial wastes are generated. There are a number of federal and state regulatory programs designed to ensure that routinely generated wastes are properly characterized and managed, and that past disposal sites are identified and remediated, as necessary, to eliminate hazards to human health or the environment.

The IRP began in 1975 as a pilot program conducted by the U.S. Army to investigate past hazardous waste disposal sites at DOD installations. Initial guidelines for conducting the IRP were provided to the services in a 23 July 1976 directive from the Assistant Secretary of Defense for Installations and Logistics. In these early stages of the program, DOD components were required to identify their inactive hazardous waste disposal sites and to establish a prioritized program for conducting records searches at their installations. Subsequent legislative enactments have resulted in changes to the scope and procedures of the IRP.

The Resource Conservation and Recovery Act (RCRA), 42 *United States Code* Section 6901 *et seq.*, was enacted in 1976. This law required the EPA to adopt regulations governing the current generation; transportation; and treatment, storage, or disposal of hazardous wastes. Subsequent amendments to the law required EPA to develop a "corrective action" program which, like the IRP, focuses on past waste management practices. These amendments, called the Hazardous and Solid Waste Amendments (HSWA) of 1984, require facilities that seek a RCRA operating permit to investigate and remediate the release of any hazardous wastes or constituents from active and inactive solid waste management units (SWMUs) under the corrective action program. Section 6961 of RCRA, as amended, makes clear that the law and EPA's implementing regulations apply to federal, as well as private, facilities.

In 1980, the U.S. Congress enacted the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 *United States Code* Section 9601 *et seq.*, as amended, which is primarily known for establishing the federal Superfund program. Under the Superfund program, inactive or abandoned waste disposal sites are investigated and remediated by the potentially responsible private or public parties (PRPs), or if no PRPs are identified at a site, the EPA can undertake the investigation and cleanup with monies from the Superfund. The regulations that implement this program are referred to as the National Contingency Plan (NCP), found at 40 *Code of Federal Regulations* (CFR) Part 300. The NCP, in particular, details the requirements for the heart of the Superfund process--the Remedial Investigation (RI)/Feasibility Study (FS).

The 1986 statutory amendments to CERCLA [the Superfund Amendments and Reauthorization Act (SARA) Section 9620] made clear that the provisions of the NCP apply to federal facilities in their implementation of the IRP. In addition, SARA enacted a policy shift toward the Superfund cleanup goals and processes that affect the IRP.

Under SARA, technologies that permanently remove or destroy a contaminant are preferable to actions that only contain or isolate the contaminant. Also, the law specifies that remedial actions must achieve a degree of cleanup that meets legally applicable or relevant and appropriate (ARAR) requirements in light of the hazardous substances that are present. ARARs are quantitative standards, standards of control, and other substantive criteria or limitations promulgated by federal or state agencies; "to be considered" standards are non-promulgated federal and state guidelines, proposed rules, criteria, and advisories that may be useful to apply to the particular substances or units at a Superfund site. Early identification of ARARs (including "to be considered" standards) is required, and potential remediation alternatives should be considered at the initiation of an RI/FS. SARA also provides for greater interaction

with the public and state agencies, and extends EPA's role in evaluating the health risks associated with the contamination.

In November 1986, in response to SARA and in consideration of various EPA interim guidance documents, the USAF modified the IRP to provide for a Superfund-like RI/FS program. The intent was to conduct the RI and FS in parallel instead of serial fashion. The program is now oriented to include ARAR determinations, the identification and screening of technologies, and the development of alternative remedial actions for consideration.

1.1.2 General Overview of IRP and RCRA Corrective Action Program Integration

Both the IRP and RCRA corrective action programs are ultimately intended to ensure remediation of contaminated sites that pose an actual or potential threat to public health, welfare, or the environment. Both programs are implemented through phased approaches to identify, investigate, and remediate these sites. However, there are differences in the two: for example, the IRP is solely a federal facility program, yet RCRA corrective action also applies to private facilities; the IRP preceded the RCRA corrective action program in time by almost 10 years; the IRP does not contain substantive cleanup standards itself--other federal and state laws serve as the basis for identifying cleanup standards through the ARAR process, yet the proposed RCRA corrective action rules (*55 Federal Register*, 27 July 1990) contain ranges of media-specific cleanup standards; and the terminology and scope of the two programs' phases are somewhat different.

Figure 1-1 presents a side-by-side comparison of the primary phases of implementation of the IRP and RCRA corrective action processes. Generally, the scope of each of these phases is described below:

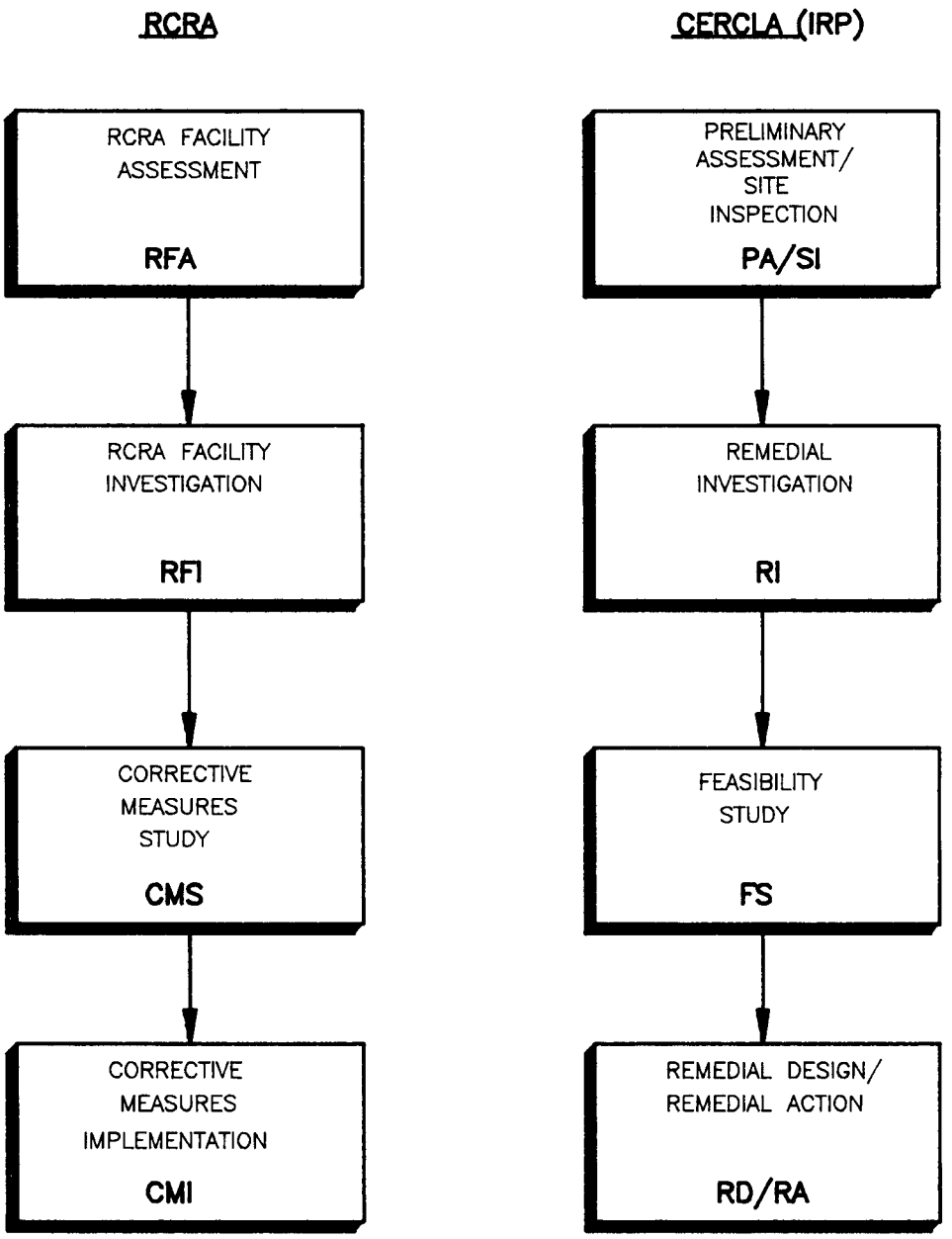


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FIGURE 1-1
COMPARISON OF RCRA
CORRECTIVE ACTION AND IRP PHASES,
CANNON AIR FORCE BASE
CLOVIS, NEW MEXICO

RCRA Facility Assessment (RFA) and CERCLA Preliminary Assessment/Site Inspection (PA/SI)--the first steps in the process to screen and identify what specific sites at the installation need further investigation. The screening is usually based on a visual site inspection and records review at the installation.

RCRA Facility Investigation (RFI) and CERCLA Remedial Investigation (RI)--the stages during which data about site and waste characteristics, their hazards, and routes of exposure are collected and analyzed, and the need for further action developed.

RCRA Corrective Measures Study (CMS) and CERCLA Feasibility Study (FS)--the stages during which a number of potential remedial action alternatives are developed and screened, and a remediation technology is selected that meets the statutory objectives and is based on an established set of cleanup standards.

RCRA Corrective Measures Implementation (CMI) and CERCLA Remedial Design (RD)/Remedial Action (RA)--the stages during which the chosen remedy is designed and implemented.

The EPA, in the preamble to the proposed RCRA corrective action rules, confirmed that because the IRP and RCRA corrective action programs are independent environmental requirements, federal facilities must comply with the requirements of both programs (*55 Federal Register* 30798, 30858). The agency further states that, to the extent possible, it will try to ensure the coordination of activities required under the programs so that duplicative information and work effort are minimized.

This report is CAFB's RI Report for Landfill No. 3. It is also intended to address all of the elements required under the Base's RCRA permit for implementing an RFI for Landfill No. 3, which was designated as SWMU 105 in the RFA performed by

A.T. Kearney, Inc., in 1986 and 1987. Section 1.3.2 provides a detailed reference table to help the reader of this report locate RCRA RFI information requirements in this IRP document.

1.2 Project Setting, Background, and Objectives

1.2.1 Project Setting

CAFB is one of 25 Air Combat Command (ACC) bases. The base is located about seven miles west of Clovis (Curry County), New Mexico in the Southern High Plains section of the Great Plains physiographic province (Figure 1-2). The base is home of the 27th Fighter Wing (FW). CAFB dates to 1929, when Portair Field was established on the site. Portair Field was a civilian passenger terminal for early commercial transcontinental flights. In 1942 the Army Air Corps took control of the civilian airfield and it became known as the Clovis Army Air Base. In 1945, the base was renamed Clovis Army Air Field and was used to teach flying, bombing, and gunnery classes until the end of World War II. After World War II, flying activities at the base decreased until the base was deactivated in May 1947.

The base was reassigned to the Tactical Air Command (TAC) in July 1951, and formally reactivated in November 1951 as Clovis Air Force Base. In 1957, the base was renamed Cannon Air Force Base in honor of the late General John K. Cannon, a former commander of the Tactical Air Command. The TAC and Strategic Air Command were combined in June 1992. Since 1965, the primary mission of CAFB has been to develop and maintain an F-111 tactical fighter wing capable of day, night, and all-weather combat operations and to provide replacement training of combat aircrews for tactical organizations worldwide. Off-base facilities include the Melrose Bombing Range and the Conchas Lake Recreation Annex.

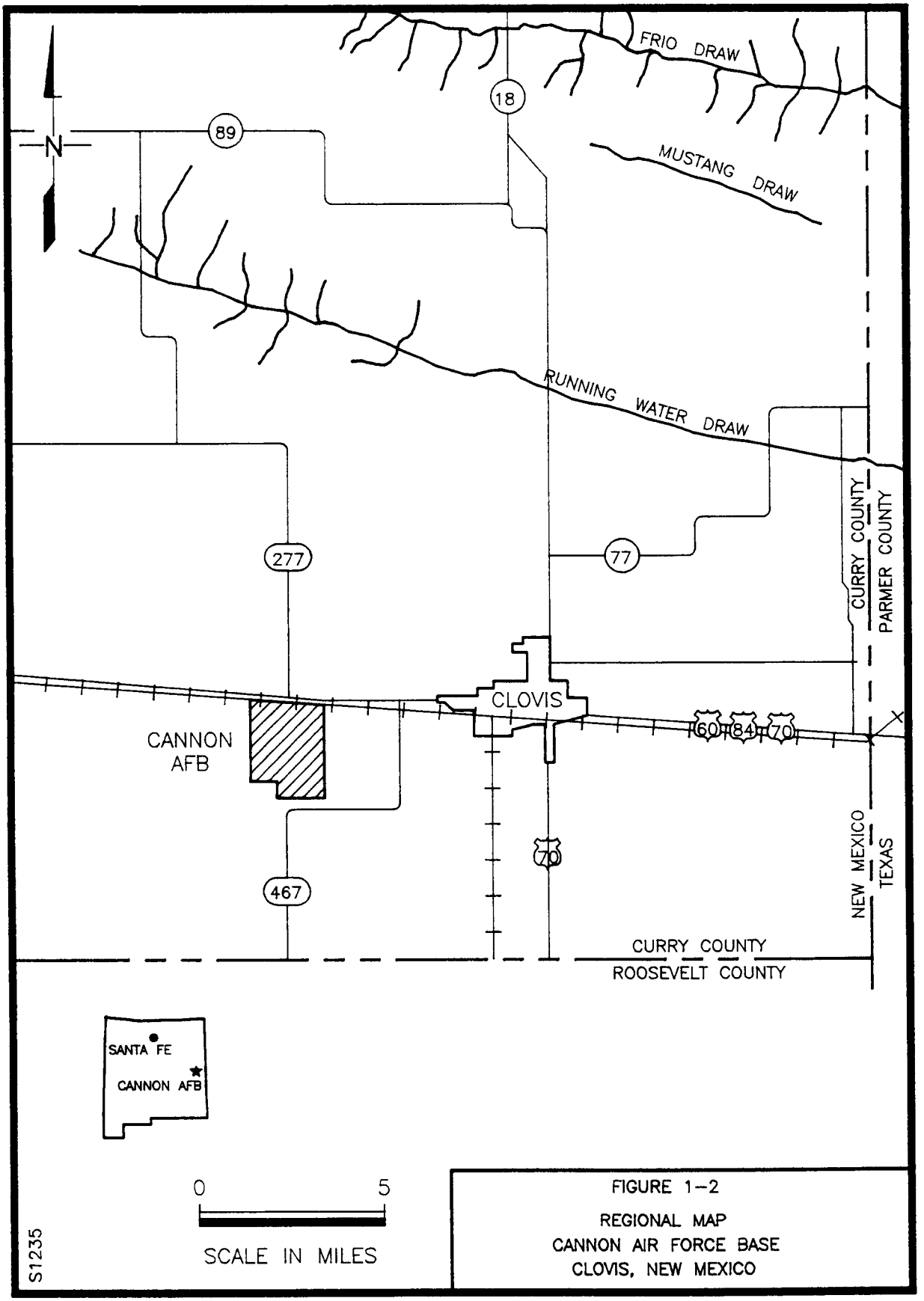


FIGURE 1–2
REGIONAL MAP
CANNON AIR FORCE BASE
CLOVIS, NEW MEXICO

1.2.2 Project Background

Landfill No. 3 (Figure 1-3) received wastes between the years of 1959 and 1967. While active, this unlined, 13.5-acre cut-and-fill area received domestic and industrial solid wastes including waste oil and solvents, paints, paint thinners, pesticide containers, and empty cans and drums. These wastes were burned in trenches and buried the following day. After being abandoned in 1967, the site was not investigated until the U.S. Air Force (USAF) Installation Restoration Program (IRP), Phase I, was conducted at CAFB in 1982 and 1983.

Phase I of the four-phase IRP consisted of an Initial Assessment/Record Search. CH_2M Hill performed the work and produced a report titled *Installation Restoration Program Records Search for CAFB, New Mexico*. In September 1984, Radian Corporation was given the authorization to proceed with the Phase II (Stage I) Field Investigation. Phase II of the IRP consists of Problem Confirmation/Quantification, and the purpose of the Phase II (Stage I) investigation was to determine if environmental contamination has resulted from past disposal practices, fuel spills, and fire training activities at CAFB. In addition, the Phase II (Stage I) investigation was designed to estimate the extent of contamination if found, identify potential environmental consequences of migrating pollutants, and recommend any additional investigations necessary to identify the magnitude, extent, and direction of movement of any contaminants found. In September 1986, Radian produced a report of their findings titled *Installation Restoration Program Phase II-Confirmation/Quantification Stage I.*

As part of their study, Radian in February 1985 drilled nine borings at Landfill No. 3 and collected 27 soil samples (Figure 1-4). All of the samples were collected from either the upper 12 feet or the bottom 5 feet of the 60-foot borings. The conclusions stated in the 1986 Radian report were that at Landfill No. 3, the metals concentrations in the soil were not above background levels found in the area and that the small oil and grease concentrations detected were probably from natural sources.

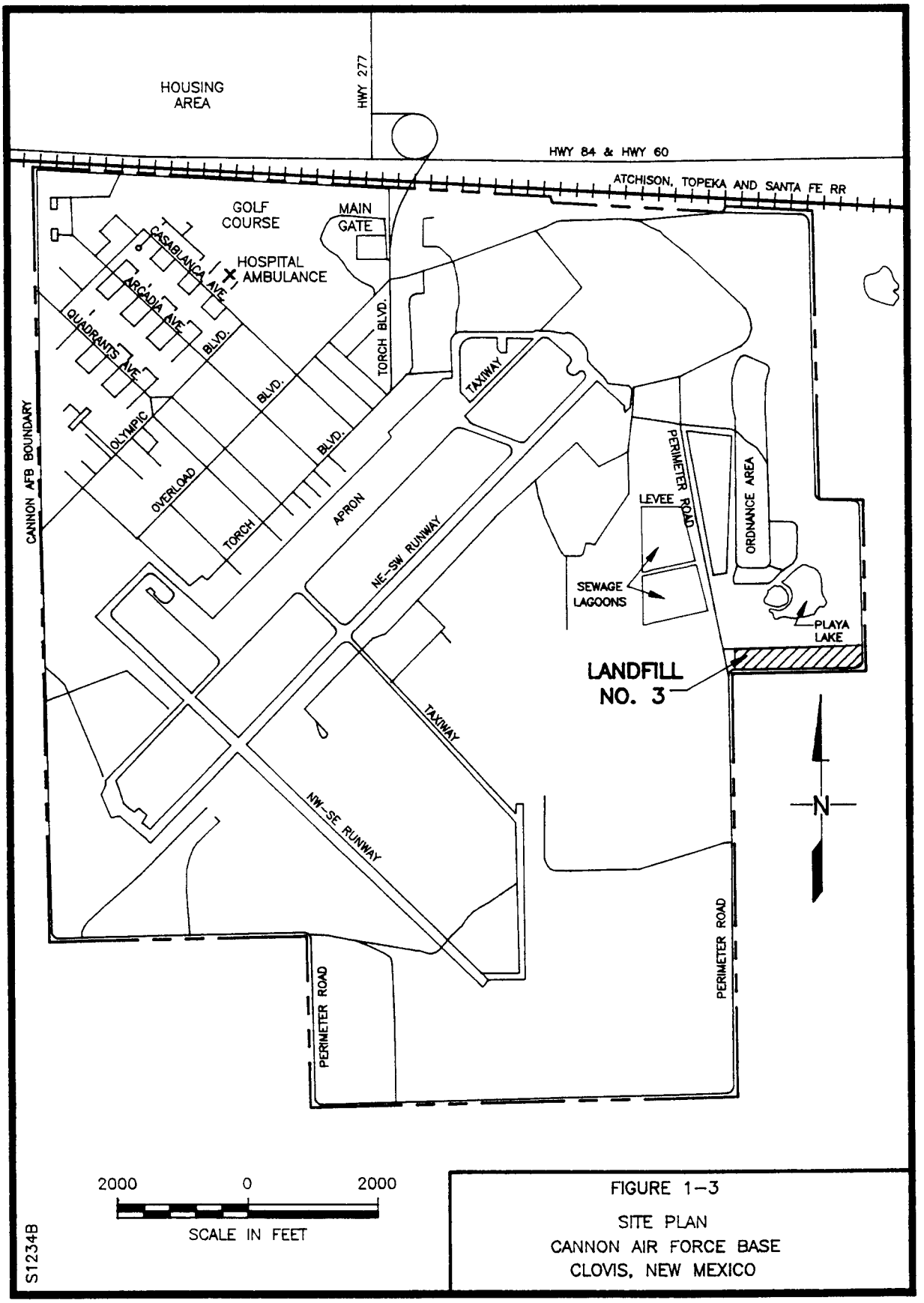


FIGURE 1–3

SITE PLAN
CANNON AIR FORCE BASE
CLOVIS, NEW MEXICO

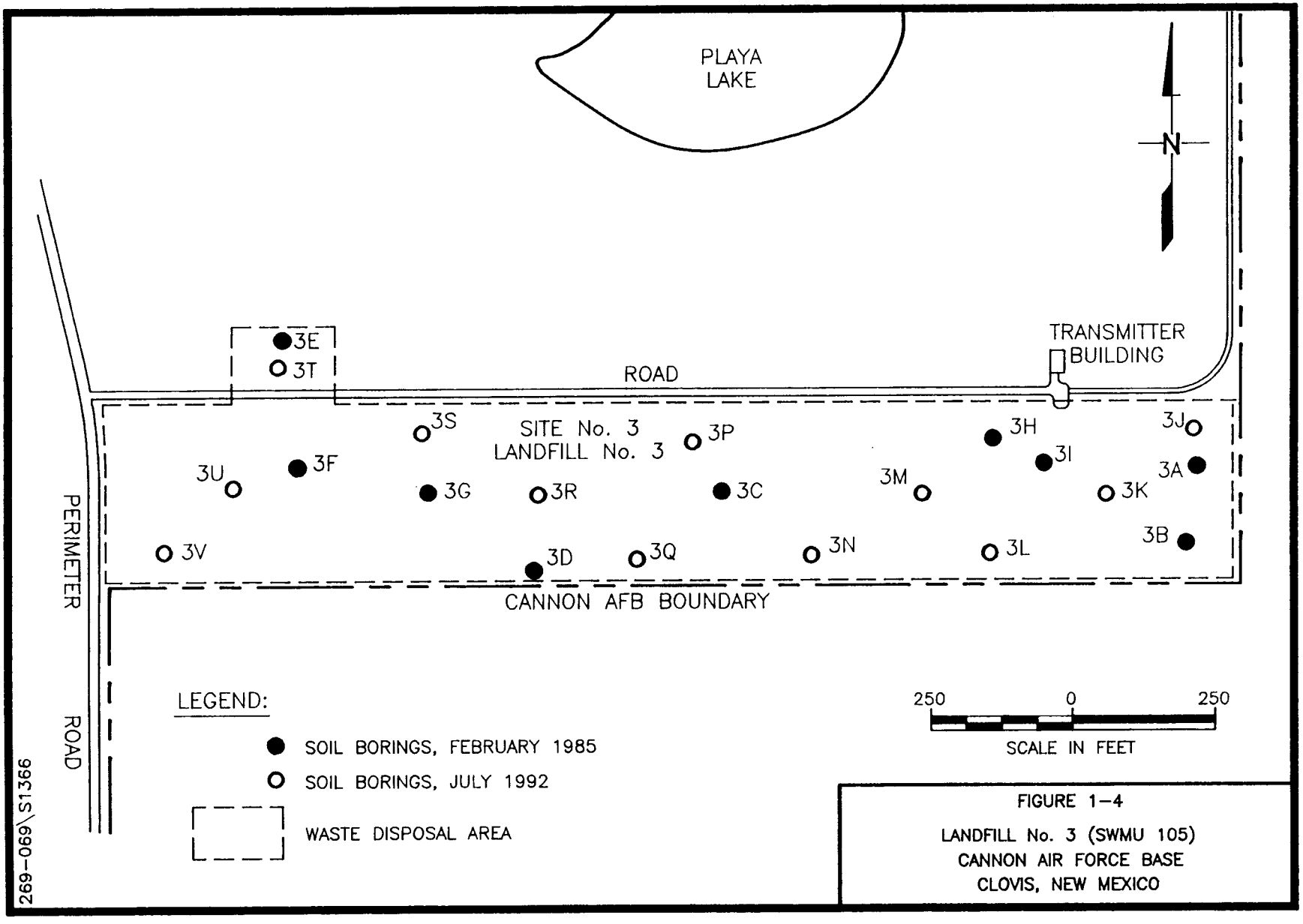


FIGURE 1-4

LANDFILL No. 3 (SWMU 105)
CANNON AIR FORCE BASE
CLOVIS, NEW MEXICO

The soil sampling conducted at Landfill No. 3 during July 1992 collected soil samples from between 20 feet and 60 feet depth, the interval that was not sampled in 1985, so as to confirm whether or not contaminant migration is a problem at Landfill No. 3.

The Hazardous and Solid Waste Amendments (HSWA) to the Resource Conservation and Recovery Act (RCRA) were enacted into law 8 November 1984 and they require corrective action for releases of hazardous wastes or constituents from solid waste management units (SWMUs) at hazardous waste treatment, storage, and disposal facilities. Section 3004(u) of HSWA states that any facility applying for a RCRA hazardous waste management facility permit will be subject to a RCRA Facility Assessment (RFA). The RFA is conducted by the regulatory agency granting the permit and is designed to identify SWMUs that are suspected to be the source of releases to the environment. If any such SWMUs are identified during the RFA, the owner/operator of the facility will be directed to perform a RCRA Facility Investigation (RFI) to assess the nature and extent of the release.

A.T. Kearney, Inc., of Chicago performed a RFA of CAFB under contract to EPA Region VI. Kearney evaluated past operational activities and waste management practices at CAFB and in their 1987 report, they identified 76 SWMUs that could possibly have adverse impacts on the environment. Landfill No. 3 was designated as SWMU 105 in the Kearney report. As a result of the Kearney report, Lee Wan & Associates of Alexandria, Virginia was contracted by CAFB to write RFI work plans for the base.

In June 1990, Lee Wan & Associates submitted the *RCRA Facility Investigation Work Plan, CAFB, New Mexico*. In May 1992, Radian was contracted by the USACE Omaha District to produce work plan supplements specific to CAFB Landfill No. 3 and to perform soil sampling work to fill the data gap left by the soil sampling conducted in February 1985 at Landfill No. 3. These work plan supplements were

submitted by Radian in June 1992, and field work was performed during the month of July 1992.

Landfill No. 3 is a 13.5-acre inactive landfill located on the east side of CAFB just south of the Ordinance Area and east of Perimeter Road (Figure 1-4). The locations sampled in February 1985 are shown on Figure 1-4 (3A through 3I), as are the sampling locations for the July 1992 sampling event.

1.2.3 Objectives

The RFI of CAFB Landfill No. 3 was designed and conducted to characterize the nature and extent of risks posed by uncontrolled hazardous waste sites and for evaluating potential remedial options. The objective of the RFI at Landfill No. 3 was to gather information sufficient to allow an informed decision to be made as to whether downward migration of contaminants is a problem at this site. If contamination migration was found to be a problem, then recommendations are to be made for mitigating risks posed by the site.

1.3 Integration of CAFB IRP and RCRA Corrective Action Program

1.3.1 Background

CAFB applied for a RCRA hazardous waste management permit to authorize the operation of an on-site storage facility for currently generated hazardous wastes. These wastes are stored on-site prior to off-site treatment, recycling, or disposal. As a result, the facility became subject to the RCRA corrective action program.

Concurrent with the IRP, CAFB initiated the RCRA corrective action process by conducting a RCRA Facility Assessment (RFA) in 1987. Similar to the IRP Phase I Records Search, the RFA process involved identifying releases or potential

releases at Solid Waste Management Units (SWMUs). A total of 76 potential release sites were identified and described in the RCRA Facility Assessment Preliminary Review/VSI Report (A.T. Kearney, Inc., 1987).

EPA Region VI issued CAFB the HSWA component of its RCRA operating permit, effective 16 October 1989. The HSWA portions of the permit require CAFB to investigate some of the SWMUs identified in the RFA. EPA selected these SWMUs for investigation based on the results of the RFA and Landfill No. 3 is among those SWMUs chosen for investigation.

1.3.2 Incorporation of RFI Requirements in this Report

The IRP designation for Landfill No. 3 is LF-3 and the RCRA corrective action program designation (RFA, RFI designation) for Landfill No. 3 is SWMU 105. CAFB will meet the requirements of both the IRP and RCRA corrective action program, but wants to ensure that resources are not expended on duplicative efforts.

This site investigation report is presented in the CERCLA RI format but includes a reference table that outlines applicable RCRA corrective action RFI requirements and where they are addressed within this report (Table 1-1). Recommendations for further action or no action at Landfill No. 3 will be provided and will be based on the results of the baseline risk assessment.

1.3.3 Development of Conclusions and Recommendations

As described in Section 1.1.2, the IRP and RCRA corrective action program are similarly phased programs for site investigation and remediation. For IRP sites that are also RCRA corrective action SWMUs, the IRP and RCRA phases are implemented in parallel fashion. During the IRP RI and RCRA RFI (which this report

Table 1-1

Directory of Responses to HSWA Permit Requirements for an RFI

Section	Permit Requirement *	Location in RI Report
A. ENVIRONMENTAL SETTING		
1. Hydrogeology		
a.	Regional and SWMU-specific geologic and hydrogeologic conditions affecting groundwater flow	Sections 2.2 and 2.3; Figures 2-1, 2-2, and 2-5
b.	Topographic features influencing groundwater flow	Sections 2.2 and 2.3; Figures 2-1 and 2-5
c.	Hydrogeologic units in migration pathways	Sections 2.2 and 2.3
d.	Extent and characteristics of hydrogeologic units in migration pathways	Sections 2.2 and 2.3
e.	Water level monitoring	Section 2.3
f.	Man-made influences on hydrogeology	Section 2.3
2. Soils		
a.	Surface soil distribution	Section 2.2; Figures 2-3 and 2-4
b.	Soil profile and classification	Sections 2.2 and 2.3; Figures 2-3 and 2-4
c.	Soil stratigraphy	Sections 2.3; Figures 2-2 and 2-3
d.	Saturated hydraulic conductivity	Section 2.3
e.	Porosity	Appendix G-2
f.	Cation exchange capacity	NA
g.	Soil pH	NA
h.	Particle size distribution	Appendix B
i.	Depth to water table	Section 2.3; Appendix G-2
j.	Moisture	Appendix G-2
k.	Effect of stratigraphy on unsaturated flow	Section 2.3
l.	Infiltration	Section 2.3
m.	Evapotranspiration	Section 2.1

Table 1-1

(Continued)

Section	Permit Requirement *	Location in RI Report
n.	Contaminant concentrations in soils	Sections 5.1 through 5.5, 6.2, 6.3, 6.4; Appendix G-2; Figures 5-1 and 5-2
o.	Metals concentrations in soils	Sections 5.2, 5.4, 6.2, 6.3, and 6.4; Table 5-3
B. SOURCE CHARACTERIZATION		
1. Unit/Disposal Area Characteristics		
a.	Location	Sections 1.2, 2.4, and 6.1
b.	Type	Section 2.4
c.	Design features	Section 2.4
d.	Operating practices	Section 2.4
e.	Period of operation	Section 2.4
f.	Age	Section 2.4
g.	Physical conditions	Section 2.4
h.	Closure method	Section 2.4
2. Waste Characteristics		
a.	Type	Section 2.4
b.	Physical and chemical characteristics	Section 2.4
c.	Migration and dispersal characteristics	Sections 2.1, 2.4, and 6.3; Appendices G-1 and G-2
C. CONTAMINATION CHARACTERISTICS		
1. Groundwater Contamination		
a.	Horizontal and vertical extent of contamination	Section 6.3; Appendix G-2
b.	Horizontal and vertical direction of movement	Section 6.3; Appendix G-2; Figure 6-3

Table 1-1

(Continued)

Section	Permit Requirement [a]	Location in RI Report
c.	Velocity	Sections 2.3 and 6.3; Appendix G-2
d.	Horizontal and vertical concentration profiles of any Appendix IX or radiochemical constituents	N/A
e.	Factors influencing plume movement	Sections 2.2, 2.3, and 6.3; Appendix G-2; Figure 6-3
f.	Extrapolation of future movement	Section 6.3; Appendix G-2; Figure 6-3
2. Soil Contamination		
a.	Vertical and horizontal extent	Sections 5.1 through 5.5; Figures 5-1 and 5-2
b.	Contaminant and soil chemical properties	Section 6.3; Appendix D
c.	Contaminant concentrations	Section 5.0, Appendix C; Figures 5-1 and 5-2
d.	Velocity and direction of contaminant movement	Sections 2.2, 2.3, and 6.3; Figure 6-3
e.	Extrapolation of future contaminant movement	Section 6.3; Appendices G-1 and G-2
3. Surface Water Contamination		
a.	Horizontal and vertical extent of any immiscible or dissolved plumes originating from the facility, and the extent of contamination in the underlying sediments	NA
b.	Horizontal and vertical direction and velocity of contaminant movement	Section 6.3; Appendices G-1 and G-2
c.	Physical, biological, chemical, and radiochemical factors influencing contaminant movement	Section 6.3
d.	Extrapolation of future contaminant movement	Section 6.3; Appendix G-2
e.	Chemistry and radiochemistry of contaminated surface waters and sediments	NA

Table 1-1

(Continued)

Section	Permit Requirement [a]	Location in RI Report
4. Air Contamination		
a.	Horizontal and vertical direction and velocity	Sections 2.1 and 6.3; Appendix G-1
b.	Rate and amount of release	Section 6.3; Appendix G-1
c.	Chemical, radiochemical, and physical composition of contaminants, including horizontal and vertical concentration profiles	Section 6.3; Appendix G-1
D. POTENTIAL RECEPTORS		Sections 6.3, 6.4, 6.5, and 6.6

[a] - Reference HSWA Permit (Section B, Task III) issued 22 August 1991 by EPA Region VI.
NA - Not available.

addresses) the two major activities are, generally: 1) site characterization to identify and confirm the presence or absence of contamination and the degree of contamination; and 2) development of recommendations for the next phase of the IRP and RCRA corrective action program. Thus, this report presents the conclusions of the site characterizations and recommendations for no further work. This section describes how the IRP and RCRA corrective action guidance were used to develop recommendations for no additional work.

In the IRP, a risk assessment is the primary mechanism or basis for the installation to use in the RI to determine whether or not remedial action is necessary for a particular site (*Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA*, pg. 3-20). The results of the risk assessment may indicate that the site poses little or no threat to human health and the environment and therefore, the FS for that site should be eliminated (Id., pg. 3-23).

RCRA corrective action "action levels" are quantitative standards for a variety of pollutants, established by media (air, water, soil). In the specific context of the RCRA corrective action program, these action levels are used to determine the need for a Corrective Measures Study (CMS) (the FS under the IRP). In addition, under the IRP, these action levels are "to be considered" standards for assessing the significance of site contamination. The RCRA proposed corrective action "action levels" were used in the CAFB RI as "to be considered" material against which to compare actual data collected at Landfill No. 3. This is a conservative approach because the RCRA levels are based on a residential/30 year exposure scenario that is not appropriate for the Landfill No. 3 site. The comparisons of data collected at Landfill No. 3 are made as a first "rough" screening of the site. If the RCRA residential/30 year exposure levels are not exceeded, then it is unlikely that the site will pose significant risk for a nonresidential exposure scenario.

The risk assessment is the primary basis for the RI recommendations contained in this report. This approach is consistent with both the IRP guidance referenced above and RCRA corrective action guidance. In the preamble to the proposed RCRA corrective action rule, the EPA recognizes that the RFI stage (the IRP RI stage) may uncover evidence that suspected releases are nonexistent or of such a nature that they pose minimal to no threat to human health and the environment. The agency further states that a "no further action" scenario at the end of the RFI may be appropriate, even when there is a release above the "action levels," where there are site-specific conditions that minimize the risk to affected populations (*55 Federal Register* 30798, 30813). The triggering of a CMS (IRP FS) based on an exceedance of an action level can, therefore, be rebutted by risk-based information.

In summary, the risk assessment under both the IRP and RCRA corrective action program provides an evaluation of the potential threat to human health and the environment for a particular site. At any time during the respective processes, the risk assessment can provide the basis for concluding that a site closeout under the IRP is warranted because of the absence of unacceptable risks to human health and the environment from the site. For site closeout, appropriate documentation in the form of a Decision Document will be prepared to record and summarize the data and risk assessment conclusions. Site closeout is equivalent to the RCRA corrective action term "no further action". Under the proposed corrective action rules (40 CFR Section 264.514), the corrective action process can be terminated for a SWMU if it can be demonstrated that the unit does not pose a threat to human health and the environment. If this is determined to be the case for Landfill No. 3, CAFB will submit a request to EPA for a Class III permit modification, with appropriate supporting documentation, to terminate the corrective action compliance schedule for this unit based on the RFI findings. The risk assessment can also indicate that a site should proceed beyond the RI/RFI stages into the FS/CMS and, if necessary, implementation of an IRP remedial action/RCRA corrective action remedy.

1.4 Report Organization

Following this introduction, this report contains seven sections: Section 2.0 - Environmental Setting; Section 3.0 - Field Investigation Program; 4.0 - Applicable or Relevant and Appropriate Requirements (ARARs); Section 5.0 - Analytical Results; 6.0 - Risk Assessment; 7.0 - Conclusions and Recommendations; and 8.0 - References. The Environmental Setting (Section 2.0) presents information obtained from the literature review and data from this investigation regarding geographic setting, land use, soil, geology, hydrogeology, water use, and surface water. This information is critical to the technical development of the RI and the risk assessment, and provides background information that is referred to throughout the report. Section 3.0, Field Investigation Program, summarizes the methods and procedures used to collect data for this report.

Section 4.0 discusses the standards, requirements, criteria or limitations under any federal environmental law, or any more stringent standard or limitation promulgated under state statutes. Section 5.0 contains the analytical results from the Landfill No. 3 investigation. Topics covered in Section 5.0 include data validation, statistical analyses for background determination, and presentation of risk-based action levels. The conclusions and recommendations in Section 7.0 are based largely on the risk assessment presented in Section 6.0.

2.0 ENVIRONMENTAL SETTING

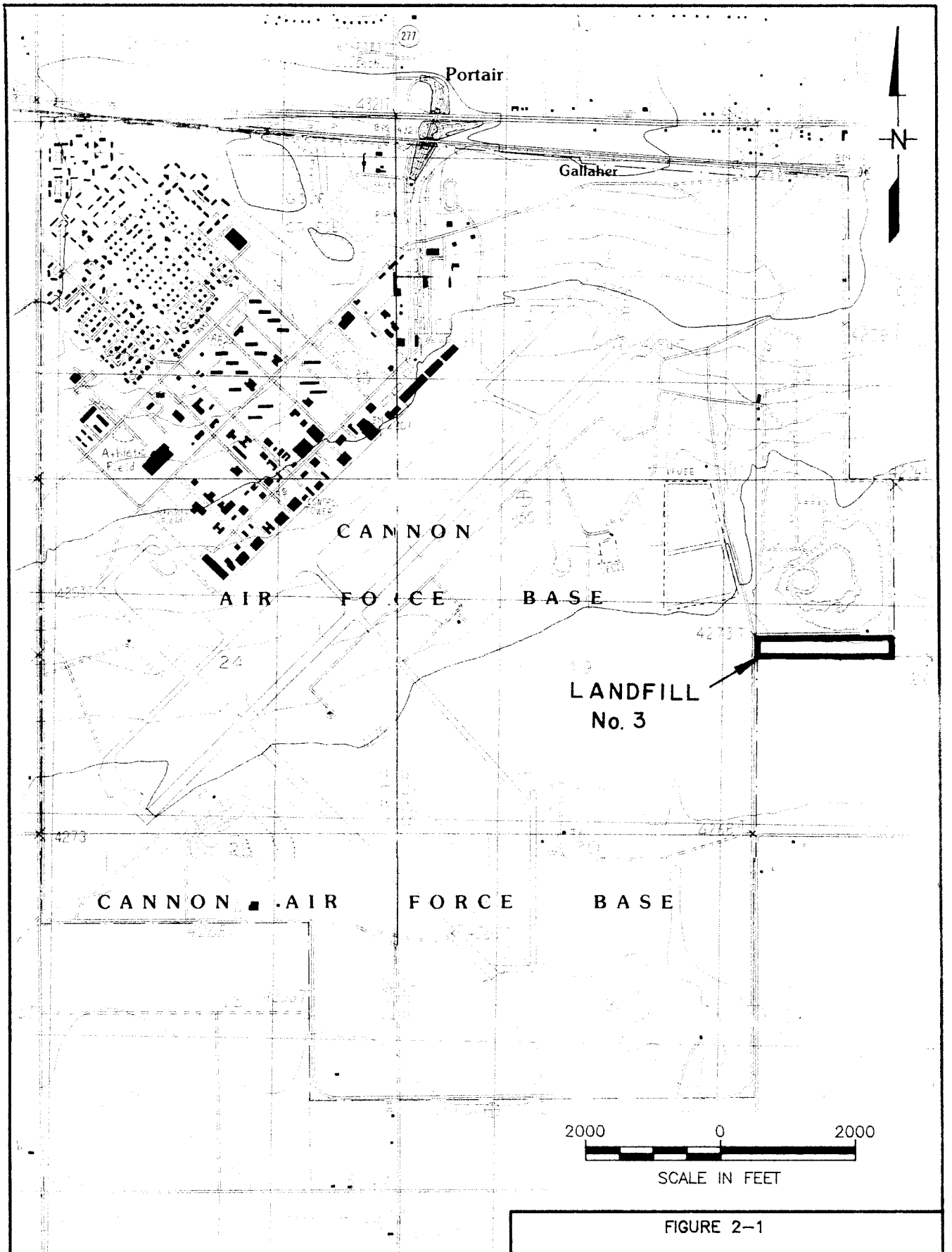
The following subsections describe the environmental setting of CAFB, New Mexico. Included in this section are geographic, geologic, and hydrogeologic data compiled from published literature, previous reports, and the field investigation.

2.1 Geographic Setting

2.1.1 Cultural Geography

As shown in Figure 2-1, CAFB is situated in eastern New Mexico, in the south-central part of Curry County. The base occupies about 4,320 acres in Sections 13, 24 and 25 in T2N, R34E and Sections 17, 18, 19, 20 and 30 of T2N, R35E. Additional land at Melrose (to the west) is occupied by the Bombing Range.

The base is located about 110 miles northwest of Lubbock, Texas and about 7 miles west of Clovis, New Mexico. The major highway serving the base is U.S. Highway 60/84, which runs west from Clovis and forms the northern boundary of the base. The Atchison, Topeka and Santa Fe Railway tracks run parallel and just south of U.S. 60/84. With a population in excess of 33,000 people, Clovis is the largest city close to the base and is the county seat of Curry County. The economy of Clovis depends largely on CAFB, but also is based on irrigated farming and cattle grazing for both beef and dairy production. The majority of the land surrounding CAFB is productive irrigated farmland or grassland. The major crops grown in the Clovis area are wheat, sorghum, sugar beets, corn, cotton, alfalfa, barley and peanuts. Approximately 12,340 people work at CAFB (projected for December 1992). The base is presently undergoing expansion to absorb personnel relocated from Air Force bases scheduled to be closed or downsized.



REFERENCE:
USGS QUAD SHEETS "PORTAIR, NEW MEXICO"
AND "OASIS STATE PARK, NEW MEXICO"

FIGURE 2–1

TOPOGRAPHIC MAP
CANNON AIR FORCE BASE
CLOVIS, NEW MEXICO

2.1.2 Physiography

The Southern High Plains consist of an isolated plateau composed of Cretaceous, Tertiary, Pleistocene, and Holocene age sediments. The regional slope of the Southern High Plains is about 6 to 10 feet per mile and the area around CAFB slopes about 10 to 15 feet per mile to the east and southeast, except in areas adjacent to playa lakes. Most of the plateau consists of sands, clays and gravels deposited by flowing water. All of these units comprise the Ogallala Formation. There are also minor amounts of wind blown and lake bottom sediments present. The surface of the plateau is formed by a resistant "caprock" of Pliocene age caliche. The caliche is composed of calcium carbonate and is a soil weathering product. The caliche is overlain in most places by Pleistocene age sands and thin, fine-grained lake deposits (Reeves, 1970).

The Southern High Plains are bounded on the north by the Canadian River which lies 60 miles to the north of Clovis. The eastern and western sides of the Southern High Plains are bounded by escarpments that rise as much as 300 feet above the surrounding area (CH_2M Hill, 1983). CAFB is located near the center of this plateau where the topography is typified by flat, featureless terrain having almost no relief (Figure 2-1). The High Plains surface is composed of flat, gently sloping surfaces that surround major drainage features and playa lakes. The land surface elevations at CAFB range from 4,327 feet above mean sea level (MSL) at the northwest corner of the Base to about 4,260 feet above mean sea level at the southeast corner (CH_2M Hill, 1983). The land surface of the Base generally slopes to the east and south-east, consistent with the regional slope, except in areas adjacent to playa lakes.

2.1.3 Climate

The climate of east-central New Mexico is classified as tropical semi-arid, with summer temperature and precipitation maxima. Average monthly temperatures range from a January low of 12° C (39° F) to a July high of 26° C (78° F). Extreme daily

temperatures range from -24° C (-11° F) to 41° C (106° F) (NWS Climatic Brief, 1986). Average monthly precipitation ranges from 1 cm (0.4 in) in winter to 6.9 cm (2.7 in) in July (NWS, 1986). The maximum recorded 24 hour rainfall is 12.2 cm (4.8 in), which occurred in August. Rainfall occurs on eight or more days per month during the summer precipitation maximum. Mean annual precipitation is approximately 41 cm (15 in) with most of this resulting from thunderstorm activity from May through October. The mean annual evapotranspiration rate is 181.4 cm/yr (71.4 in/yr) Therefore, the net annual precipitation (mean annual precipitation minus mean annual evapotranspiration) for the CAFB area is approximately minus 55.4 inches per year, representing a net loss in groundwater caused by evapotranspiration. Prevailing winds are from the west at an average of 5 km/hr (8 mph) during fall, winter, and spring. During the summer, winds are from the south at an average of 3.7 km/hr (6 mph).

The atmosphere around the area of CAFB is generally well mixed. The seasonal and annual average mixing heights can vary from 400 meters in the morning to 4000 meters in the afternoon. The afternoon mixing heights are typically greater during the spring and fall seasons. The morning mixing heights are usually low, because of nighttime heat loss from the ground producing surface-based temperature inversions. After sunrise these inversions break up, and solar heating of the earth's surface causes vertical mixing in the atmosphere.

Dust is frequently entrained into the atmosphere in this region of the country because of gusty winds and the semi-arid 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 (average 5 km/hr).

2.2 Geology

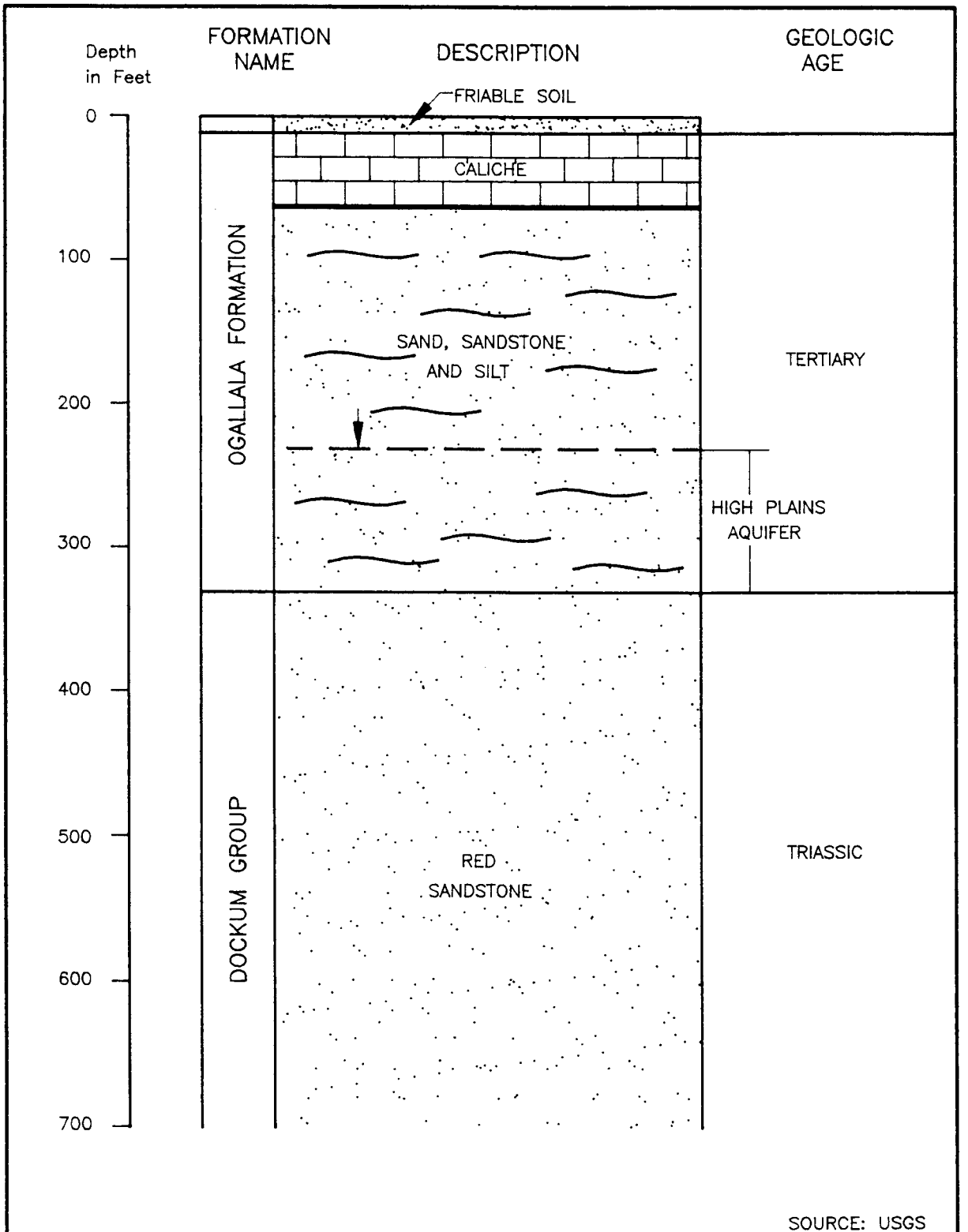
This subsection describes the regional geologic history and present day features of the Southern High Plains in relation to CAFB. This information was gathered from existing reports about the geology of the Southern High Plains. A discussion of the near surface geology on the base is also included.

2.2.1 Geologic Setting

The near-surface stratigraphic units of interest at CAFB are the Late Miocene-Late Pliocene age Ogallala Formation and the Early Triassic Dockum Group.

The Dockum Group consists of three formations (Figure 2-2). 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.

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



269-069/N1450

FIGURE 2-2

GEOLOGIC COLUMN
AT CANNON AIR FORCE BASE
CLOVIS, NEW MEXICO

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 monoclinically to the southeast in the vicinity of CAFB. Frye and Leonard (1972) suggest that some Quaternary warping may have occurred. Most of the structures recognized by Frye and Leonard (1972) are well to the northwest and southwest of CAFB. No faults or buried structural lineaments are known in the vicinity of CAFB.

The Ogallala Formation is composed of unconsolidated, poorly sorted gravel, sand, silt, and clay. The base of the Ogallala is generally marked by a gravel, cobble, and boulder deposit. This basal member contains sediments derived from igneous and sedimentary rocks transported from 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 (Glass, et al., 1973 and Frye, et al., 1974). Frye, et al., (1974) distinguished five zones within the Ogallala of east-central New Mexico on the basis of clay minerals. These zones are illustrated in Figure 2-2. Smectites (montmorillonites) and attapulgite (with sepeotite) 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

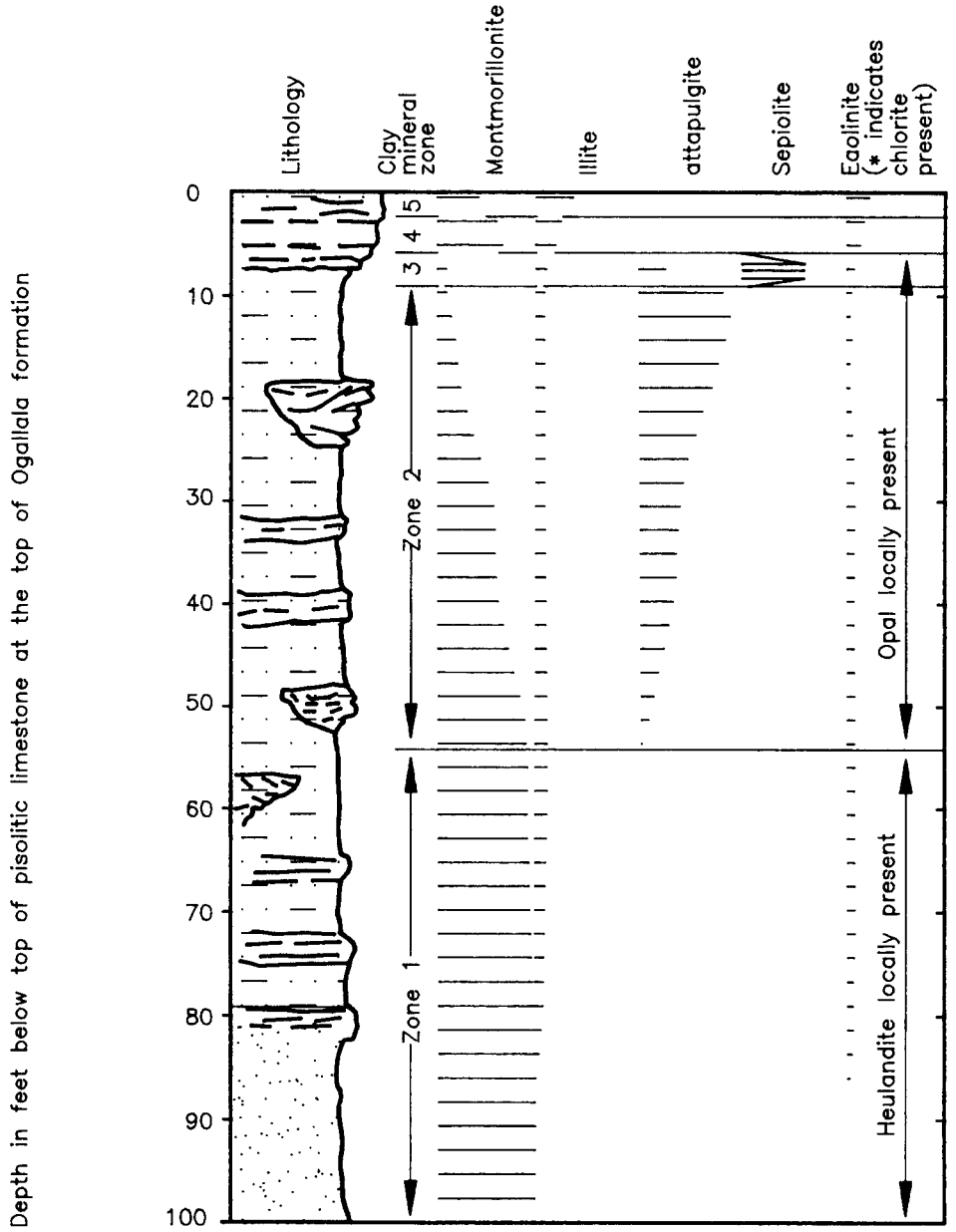
exchange capacities (CEC). The formation as a whole should therefore have a relatively high CEC, which should inhibit the migration of charged contaminants, and especially ionic forms of metals.

Caliche is a major feature of the Ogallala Formation, occurring as nearly continuous layers throughout (Figure 2-3). Caliche is hard, white to pale tan on fresh surfaces, weathering to gray, and has a chalky appearance. Caliche precipitates as calcium carbonate, leached from overlying sediments, 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. Frye, et al., (1974) gives radiocarbon dates for the upper "climax" caliche ranging from -27,000 yrs before the present (B.P.) to -42,000 yrs. B.P. Caliche is relatively soluble in acidic water ($pH<7$) or in waters containing dissolved CO_2. The top surface of the upper "climax" caliche in fresh outdrop shows solution etching.

The Ogallala has numerous continuous to discontinuous caliche layers throughout its thickness. The uppermost caliche, termed the "climax" caliche by Frye and Leonard (1972), is pisolitic. 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 that occur lower in the Ogallala are platy and harder.

2.2.2 Soils

Soils in the vicinity of CAFB are classified as SM to SC under the Unified Classification Systems, and as aridisols (calciorthids) under the Soil Conservation Service Comprehensive Soil Classification System. The following summary is based on the Soil Conservation Service Curry County Soil Survey (1953).



SOURCE: FRYE ET AL, 1974

FIGURE 2–3
GENERALIZED LITHOLOGY
OF THE OGALLALA GROUP
CANNON AIR FORCE BASE
CLOVIS, NEW MEXICO

269–069/N1449

The most common soil type on the base is the Amarillo fine sandy loam, 0 to 2% slope phase (map symbol Ab, Figure 2-4). This soil consists of a thin sandy A horizon and 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 Amarillo fine sandy loam is present on all relatively flat surfaces at the base, but is also found on slopes associated with playas (Map symbol Ac). The Amarillo sandy loam and loamy sand are brown to yellowish red when exposed at the surface. The Amarillo series soil type is derived from stream erosion coupled with extensive reworking of the sediments by wind action (Radian, 1986).

There are several other soil associations at CAFB that are not as extensive or important as the Amarillo series. These soils are commonly found near the playas and draws. The Clovis soils occur in small areas within the broader areas of the Amarillo soils. They usually occupy the upper margins of draws and playas. The Clovis soils are similar to the Amarillo soils but have a shallower caliche zone (16 to 36 inches) and often have a poorly developed soil profile. The Clovis soils consist of three types of soil: the Clovis Loam, the Clovis Fine Sandy Loam, and the Clovis Loamy Fine Sand (CH_2M Hill, 1983).

Two other soil groups are present in very limited areas at CAFB. The Mansker soils are strongly calcareous and occupy the slopes and draws and playas. The Mansker soils form where the higher horizons have been removed by erosion.

Clovis fine sandy loams, 0 to 2% slope phase (Map symbol Cb) and 2 to 5% slope phase (Map symbol Cc), are very similar to Amarillo fine sandy loams. 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.

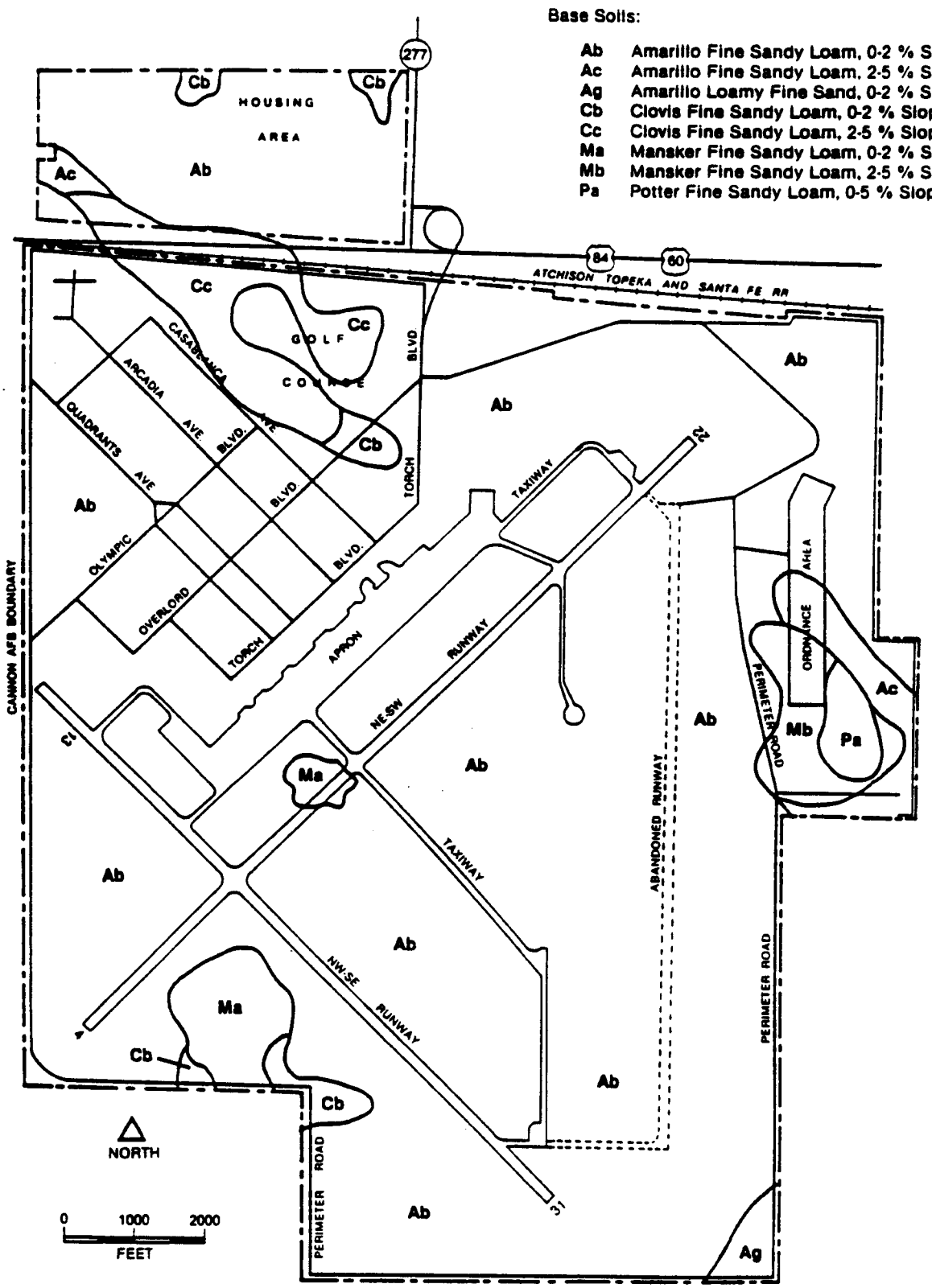


FIGURE 2–4

DISTRIBUTION OF SOILS, BY TYPE
CANNON AIR FORCE BASE
CLOVIS, NEW MEXICO (FROM CH_2M–HILL, 1983)

In a few limited areas, particularly along the steeper slopes around playas, Mansker fine sandy loam, 0 to 2% slope phase (Map symbol Ma), and 2 to 5% phase (Map symbol M6), are found. Mansker fine sandy loams have no B horizons and are very calcareous. The calcic C horizon is within 2 feet of the surface. The Potter soils are shallow and very calcareous soils which overlie hard, consolidated caliche. The areal distribution of these soils is shown in Figure 2-4.

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

2.3 Hydrogeology

This subsection summarizes the regional hydrogeology, including surface water and groundwater in the vicinity of CAFB. This information was gathered from Base records and existing reports about CAFB.

2.3.1 Surface Water

The dominant surface features in the area around CAFB are small temporary lake basins known as playas. Playas are believed to result from soil erosion by wind. Playas have no external surface drainage so water is lost by infiltration to the soil and evaporation. Without recharge playa lakes persist for only a few days or weeks. A large example of these temporary lakes is located on CAFB and is known as Playa Lake. Playa Lake is used as a holding basin for treated effluent from the Base sewage treatment lagoons. Another large playa lake located near the intersection of the primary and the northwest-southeast runways is used as a storm water retention pond.

Regional drainage in Curry County is predominantly to the southeast and the east. Stream drainage is poorly developed and ephemeral because of the low annual

rainfall and the minimal relief. The drainage patterns consist of long shallow valleys and locally termed draws that extend almost from the western edge of the Southern High Plains to the eastern boundary of the plateau. Running Water Draw and Patrick Draw, located about 10 and 20 miles, respectively, north of CAFB, are the nearest streams. Both of these streams are very straight, flow southeast, and have rectilinear drainage patterns with short laterals (second order streams). The valleys or draws eventually drain into one of three major river valleys; the Red, the Brazos or the Colorado. Although the draws extend to the river valleys as drainage systems, they seldom contribute actual flow to the rivers except during periods of unusually high rainfall. The bulk of the precipitation is lost to evapotranspiration and shallow infiltration before it has a chance to run off. In areas not drained by the draws, the playa lakes serve as low point collection areas for surface runoff. The playas have no surface outlet and any water that collects in the lakes is eventually lost to evapotranspiration or infiltration.

2.3.2 Groundwater

The lower portion of the Ogallala Formation is the primary regional aquifer for both potable and irrigation water. No deeper aquifers are utilized in the vicinity of CAFB. The Ogallala aquifer is part of the High Plains Aquifer that 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 (aquiclude). The Ogallala is a water table, or unconfined, aquifer (Weeks and Gutentag 1981; Berkstresser and Mourant, 1966) that has a southeasterly regional gradient of about 13 ft/mile. Well yields vary from less than 1 gallon per minute (gpm) in thin silts and sands up to 1600 gpm in thick sands and gravels (Berkstresser and Mourant, 1966). Water quality is generally good, with hardness and fluorides being somewhat high (ibid 1966).

At CAFB the Ogallala aquifer has an average saturated thickness of 120 feet (mid-1960's). 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 7.5 feet/mile. Figure 2-5 shows water table elevation contours for 1984. Flow within the saturated zone may be influenced by the configuration of the top of the Dockum Group. Yields in tests of CAFB water wells have ranged from 776 L/min (205 gpm) to 4353 L/min (1150 gpm). Specific capacities range from 0.14 m^3/m (11.4 gal/ft.) to 0.35 m^3m (27.9 gal/ft.).

Figure 2-6 shows the locations of water wells located within the boundaries of CAFB. Table 2-1 contains well information such as total depth and location of screened intervals for the CAFB wells. Water well number 5 is the closest well to Landfill No. 3. This well was drilled in 1977 and was recently reworked and fitted with a new submersible pump. The static water level in Well No. 5 is 273 feet below ground level, and the red beds (lower aquifer limit) is at 410 feet below ground surface. This well is expected to be capable of producing 550 gpm with the new pump. CAFB water plant personnel measure and record static water levels, pumping water levels and flow rates monthly.

Figure 2-7 shows the locations of all known off-base water wells within 1 mile distance of Landfill No. 3. The well location information was obtained from the well records of the New Mexico State Engineer's Office. Table 2-2 contains well information such as total depth and location of screened intervals for the off-base wells.

Estimates of hydraulic conductivity were made from well pump tests in water well nos. 5 and 9 using the Theis equation (Lee Wan, 1990). An estimate of hydraulic conductivity for water well number 8 was based on water level recovery data using the Bouwer and Rice (1976) approach. 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 first approximations (Lee Wan, 1990).

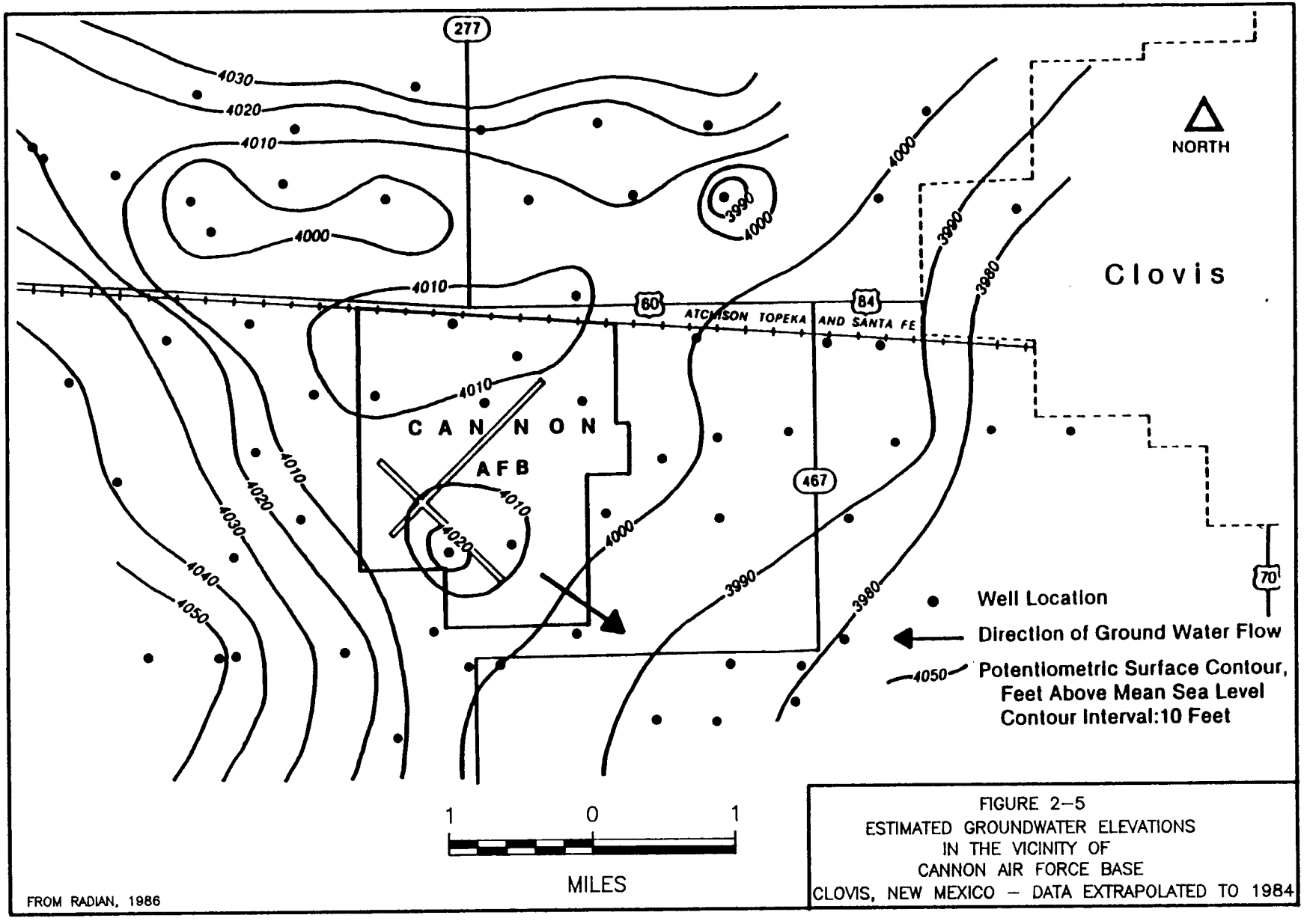


FIGURE 2–5
ESTIMATED GROUNDWATER ELEVATIONS
IN THE VICINITY OF
CANNON AIR FORCE BASE
CLOVIS, NEW MEXICO – DATA EXTRAPOLATED TO 1984

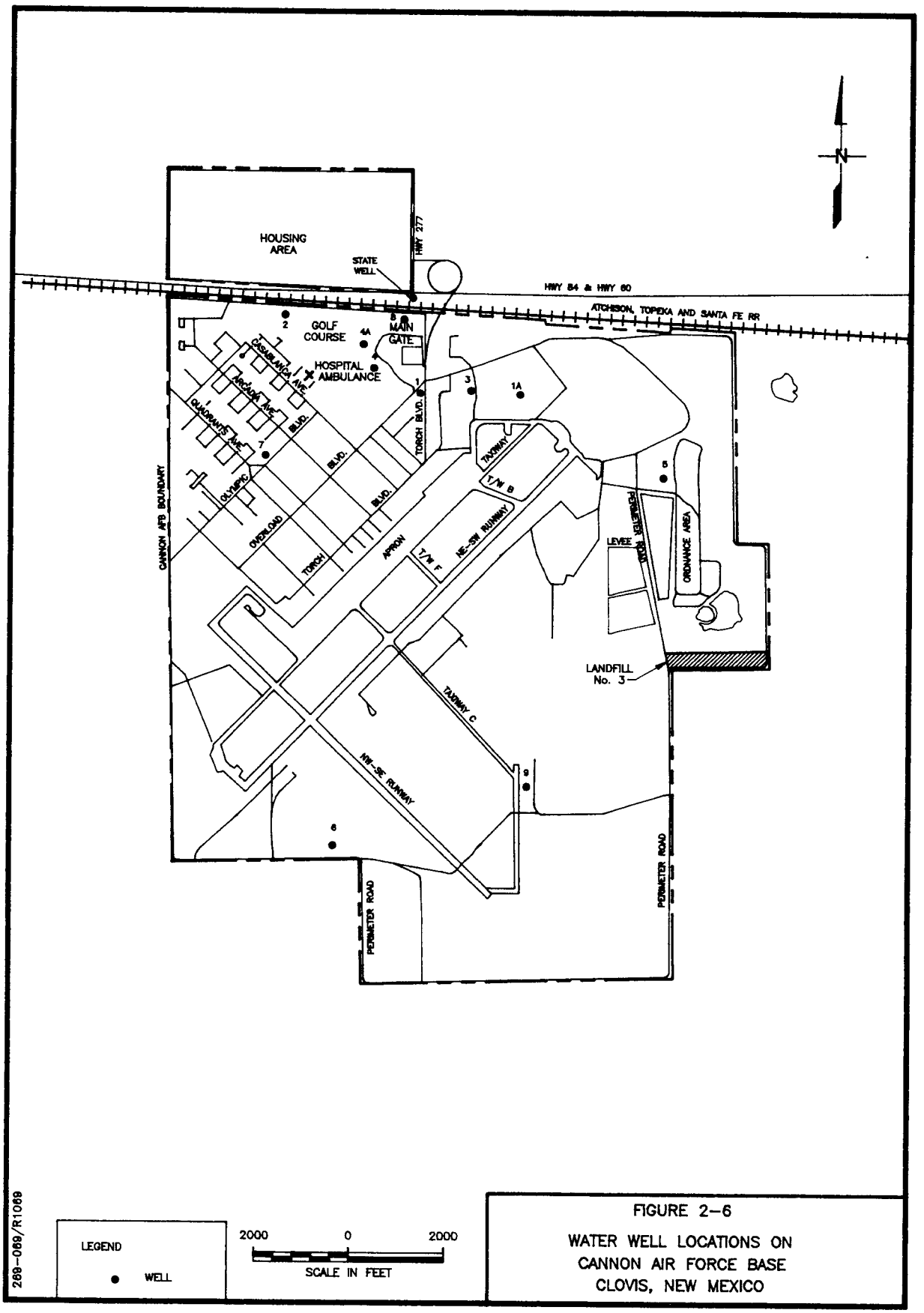


FIGURE 2-6

WATER WELL LOCATIONS ON CANNON AIR FORCE BASE CLOVIS, NEW MEXICO

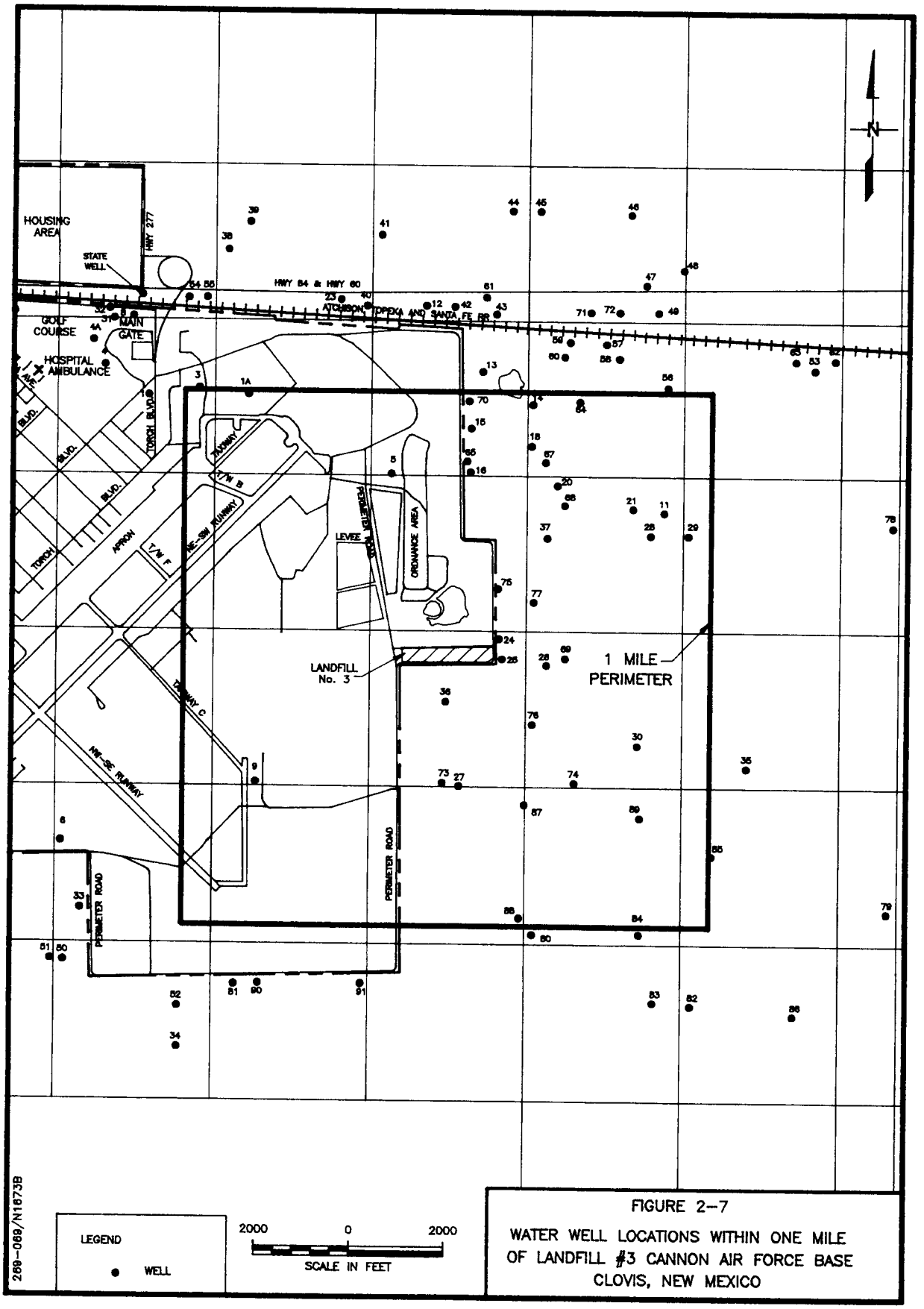


FIGURE 2-7

WATER WELL LOCATIONS WITHIN ONE MILE OF LANDFILL #3 CANNON AIR FORCE BASE CLOVIS, NEW MEXICO

Table 2-1

Water Wells Located on Cannon AFB, New Mexico

Well No.	TD	Screen (feet bgs)	Pump Depth (feet bgs)	Date	Status
1	377	258 - 377	380	8-87	Probably Inactive
1A	407	347 - 397	NA	NA	Active
2	382	287 - 370	NA	NA	Active
3	402	310 - 397	NA	NA	Active
4	357	303 - 354	NA	NA	Active
4A	420	351 - 411	400	9-87	Active
5	400	282 - 342, 346 - 388	NA	NA	Active
6	365	310 - 365 estimated	300	2-64	Active
7	382	280 - 370	NA	NA	Active
8	415	301 - 401	NA	NA	Active
9	385	320 - 370	340	8-69	Active

bgs - below ground surface.
NA - Not available.

Table 2-2

Water Wells Located Off-Base and Within One Mile of Landfill No. 3
Cannon Air Force Base, New Mexico

Well Number	Location (Township & Range)	Total Depth (ft. bgs)	Screen Interval (ft. bgs)	Date	Owner	Status
11	2N.35.16.3330	380			SW Public Service Company	
14	2N.35.17.23332	335			L. Merrill	Active
15	2N.35.17.3211	350	300 - 325 estimated	3-64	L. Merrill	
16	2N.35.17.32311	350	290 - 350	3-64	L. Merrill	
18	2N.35.17.41123	324		4-66	L. Merrill	
20	2N.35.17.43212	341		4-66	L. Merrill	
21	2N.35.17.444444	337			L. Merrill	
24	2N.35.20.14231	357	297 - 357	5-78	L. Merrill	
25	2N.35.20.14433	360	278 - 360	9-81	L. Merrill	Active
26	2N.35.20.2343	340		7-64	L. Merrill	
27	2N.35.20.3343	385	294 - 374		H. House	
28	2N.35.21.1111	335			M. Blackburn	Active
29	2N.35.21.112112	420		1-72		
30	2N.35.21.3313	323		1-55	M. Blackburn	Active
36	2N.35.20.3124	365			O. William	Active
37	2N.35.20.2121	347		4-63	L. Merrill	

Table 2-2

(Continued)

Well Number	Location (Township & Range)	Total Depth (ft. bgs)	Screen Interval (ft. bgs)	Date	Owner	Status
64	2N.35.17.2			3-62	L. Merrill	Active
65	2N.35.17.3			9-62	L. Merrill	Active
67	2N.35.17.4			4-88	L. Merrill	Active
68	2N.35.17.4			4-88	L. Merrill	Active
69	2N.35.20.2			3-62	L. Merrill	Active
70	2N.35.17.1			4-83	L. Merrill	Active
73	2N.35.20.334			1954	W. Willman	Active
74	2N.35.20.4			1965	L. Merrill	Active
75	2N.35.20.1			2-81	L. Merrill	Active
76	2N.35.20.4			3-90	W. Willman	Active
77	2N.35.20.2			1965	L. Merrill	Active
87	2N.35.29.21313	350	290 - 350 estimated	10-52	C. Willman	Active
89	2N.35.29.242443	346	308 - 348	3-65	C. Willman	Active

ft. bgs - feet below ground surface.
Source: Water well files of the New Mexico State Engineer's Office.

Hydraulic conductivity values for water well nos. 5 and 9 were found to be approximately 2.0×10^3 cm/sec. Calculations for water well number 8 results in a hydraulic conductivity of 2.0×10^2 cm/sec. These estimates appear to be too low when compared to published hydraulic conductivity data for sands and gravels. Kearney (1987) indicates a groundwater flow velocity of about 45 m/yr (150 ft/yr). This calculates out to a hydraulic conductivity of approximately 1.0×10^1 cm/sec. Again, this appears to be low when compared with published data. The presence of interstitial clays may account for both the variability and low values of hydraulic conductivities. Boring logs from CAFB IRP projects and published reports (Frye, et al., 1974; Glass, et al., 1973) indicate that interstitial and interstratified clays are abundant in the Ogallala Formation. Additional aquifer testing will be required to accurately determine hydraulic conductivity.

Recharge to the Ogallala is primarily through precipitation. Berkstresser and Mourant (1966) report a recharge rate of 0.5 in/yr as calculated by Theis (1936). Kearney (1987) indicates that the recharge rate may be as much as 1.0 in/yr. Because of the high evapotranspiration rate and low precipitation, recharge will occur only during heavy rainfall events during which the infiltration capacity of the soil is exceeded and runoff occurs, or during cool months when precipitation may exceed evapotranspiration. Table 2-3 shows that in an average year, the evaporation rate exceeds the precipitation rate for all 12 months. Any runoff that does occur will flow to playas.

Discharge from the Ogallala occurs through well pumping and springs along the eroded margins. Spring flow discharge does not occur on or near CAFB; however, domestic and irrigation water wells are common on and around the base. The rate of pumping water from the aquifer exceeds recharge, and consequently, water levels in the Ogallala have declined steadily since the 1930's. A decline of 50 to 100 feet has been observed in the area around Clovis, New Mexico for the period from the 1930's to 1980. Luckey, et al. (1981) states that "the largest area of water-level decline exceeding 100 feet occurs south of the Canadian River extending from Curry Co., New Mexico to Crosby Co., Texas."

Table 2-3

Precipitation Data Based on Average Monthly Values For Clovis, New Mexico [a]

Month	Average Precipitation (ft)	Pan Evaporation (ft)	Net Precipitation (ft)
January	0.0325	0.0333	-0.0008
February	0.0325	0.2833	-0.2508
March	0.0492	0.4167	-0.3675
April	0.1067	0.6167	-0.5100
May	0.1967	0.7083	-0.5116
June	0.2183	0.7750	-0.5567
July	0.2075	0.9833	-0.7758
August	0.2417	0.7583	-0.5606
September	0.1875	0.4583	-0.2708
October	0.1542	0.4167	-0.2625
November	0.0408	0.2917	-0.2509
December	0.0483	0.1833	-0.1350

[a] - From Pan Evaporation Data collected by the Agricultural Science Station north of Clovis, New Mexico.

The dominant use of groundwater in the CAFB area is for potable and irrigation water. Numerous wells are located around CAFB, most of which provide only irrigation water (Figure 2-7). The Ogallala 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 regulations of water rights, usage, and well drilling.

2.4 Site Description

Figure 1-3 shows the location of the Landfill No. 3 site at CAFB and Figure 1-4 shows the layout of the borings for Landfill No. 3, as well as all sampling locations. Landfill No. 3 is a rectangular plot that is approximately 1,960 feet by 300 feet (13.5 acres), and located on the east perimeter of the base. The site is bounded on the north side by the road leading to the transmitter tower, on the south and east sides by barbed wire fences and agricultural fields, and on the west side by Perimeter Road. Landfill No. 3 now appears as an open field covered with native vegetation. The site slopes vary slightly to the north and there are remnant depressions where disposal trenches were excavated and backfilled in the past.

Landfill No. 3 was used to dispose of a variety of wastes between 1959 and 1967. During operation, domestic solid wastes, waste oils, solvents, paints, paint thinners and strippers, pesticide containers and various empty cans and drums were burned in trenches and buried each following day. As trenches became filled, other trenches were excavated nearby and likewise filled.

During excavation of an exploratory trench prior to drilling in July 1992, Radian numerous soda pop and beer bottles were observed among the debris. In addition, there were several sheets of plastic, a synthetic rubber machinery belt and a piece of styrofoam that were unburned. A 5-gallon can was found, but it was crushed and without a lid. Dark organic matter was observed in the trench cut face, showing the

levels at which burning of refuse was done in the former disposal trenches. The unburned material found indicates that either the burning was not done thoroughly or some material was buried without being burned.

3.0 FIELD INVESTIGATION PROGRAM

The RFI was undertaken to investigate Landfill No. 3 for possible contamination and to provide recommendations for continued remedial action. The investigation involved excavating a trench to find the bottom of the landfill and collecting soil samples from soil borings. These activities were guided by the Lee Wan work plans (Lee Wan and Associates, 1990), and by the Quality Assurance Project Plan (QAPP), the Field Sampling Plan supplement (FSP), and the Site Specific Health Plan (SSHP) (Radian, 1992). These plans provided technical guidelines for performing the field investigations, procedures for the quality execution of field tasks, criteria for data collection, quality assurance/quality control procedures (QA/QC), and guidelines to ensure the health and safety of field personnel. Detailed discussions of field procedures can be found in these plans. The following section highlights the procedures outlined in the QAPP and FSP.

3.1 Organization and Development of the Field Program

In June 1992, Radian visited CAFB to meet with USACE and Base personnel, and to tour the site. Before the meeting, Radian had reviewed the 1986 Radian report titled *Installation Restoration Program Phase II - Confirmation/Quantification Stage 1* as well as the 1990 Lee Wan and Associates, Inc. work plans for conducting the RFIs at 27 of the Solid Waste Management Units (SWMUs) identified at CAFB. Landfill No. 3 (SWMU 105) was one of the 27 SWMUs discussed in the Lee Wan work plans. Radian wrote work plan supplements for the Landfill No. 3 investigation proposed in the Lee Wan work plans. The Radian work plan supplements elaborated on the brief work plan for Landfill No. 3 contained in the Lee Wan work plans, and included discussions of the sampling rationale, sample locations, and chemical analyses.

3.2 Data Quality Objectives

The overall objectives of this work effort were to gather information sufficient to determine if downward migration of contaminants is a problem at this site and whether there are any contaminants present that could pose a health risk to humans or the environment. The presence or absence of chemical contamination was determined by detection or non-detection of chemicals in subsurface soil samples. Previous sampling performed at Landfill No. 3 left a data gap between the depths of between 15 and 50 feet, and this work effort was designed to fill the data gap. Data quality objectives (DQOs) were to:

- Collect the samples specified in the QAPP to adequately determine the presence or absence of contamination in Landfill No. 3;
- Ensure data comparability through the use of standard analytical methods and controlled systems to collect and analyze samples;
- Provide analytical results of known and acceptable precision and accuracy; and
- Gather data that could support an evaluation of the risks posed to human health and the environment.

A QA/QC program was used to ensure that data quality objectives were met for the CAFB Landfill No. 3 investigation. The QA/QC efforts were twofold. First, they provided the mechanism for ongoing control and evaluation of measurement data quality throughout the course of the project (i.e., system capability). Second, they specified QC data to be used to define natural-matrix data quality, in terms of precision and accuracy, for various measurement parameters.

3.3 Summary of Field Activities

3.3.1 Sequence of Field Activities

After the work plan supplements, QAPP, and SSHP were approved, the field investigation commenced 5 July 1992. Before drilling began, an exploratory trench was excavated on 7 July 1992 to find the contact between the native soil and the landfill. Sampling was conducted in the interval between this contact and 60 feet below grade. On 8 July, drilling and sampling of the 12 boring locations shown in Figure 1-4 began. After all of the borings had been drilled, the drums of soil cuttings and decon water were moved to temporary storage at Landfill 5 on the southeast side of CAFB. Field activities were completed 25 July 1992.

3.3.2 Identification and Role of Subcontractors

Geotechnical Laboratory - Lydick Engineers and Surveyors, Inc., of Clovis, New Mexico performed sieve analyses of all geotechnical samples collected.

Analytical Laboratory - Radian Analytical Services (RAS) of Austin, Texas was subcontracted to provide analytical services for all chemical analyses performed.

Drilling Subcontractor - Sergent, Hauskins, and Beckwith of Albuquerque, New Mexico, was subcontracted to provide all drilling services.

Surveying - Lydick Engineers and Surveyors Inc., of Clovis, New Mexico was subcontracted to provide surveying services.

3.4 General Information and Definitions

3.4.1 Utility Clearance

Digging permits were required for all activities that involved the disturbance of soils at CAFB. The dig permit for Landfill No. 3 was only valid during the period of 6 July 1992 to 14 August 1992 and was issued by the Base Civil Engineering Division. A scaled map showing the locations of the proposed drilling and trenching locations was sent to the Base Environmental Coordinator's office and circulated with the dig permit application to the Base utility groups. U.S. West (phone company) conducted a field check and marked several buried communication cables on the site. Sampling site locations were adjusted if the marked cables were too close to a proposed sampling site. Base Safety, Fire, Security, and Environmental also signed the digging permits. Copies of the digging permits were kept on-site during completion of the field tasks.

3.4.2 Sample Locations

Figure 1-4 shows the 12 locations sampled in July 1992 as well as the nine locations that were sampled in February 1985 for Landfill No. 3. The July 1992 sampling points were chosen by dividing the 300-foot by 1,960-foot landfill into four equally sized segments of 300-feet by 490-feet and then further subdividing each segment into three equally-sized zones of 490-feet by 100-feet. A sampling point was placed in each of the zones. A more or less diagonal pattern was laid out in three out of four of the 300-foot by 490-foot segments. The distribution of the points was made so as to not sample in the same places that were sampled in 1985, and to still collect a dispersed set of samples across each segment. These locations were changed slightly in the field so as to preferentially sample beneath the former trenches where wastes were dumped and burned before being buried. The locations of these former trenches were evident from subsidence patterns seen in the field. All July 1992 borings were drilled into waste

disposal trenches as evidenced by the surface subsidence patterns. Refuse was identified in 7 of the 15 borings. Borings encountering refuse include: 3L, 3M, 3MM, 3N, 3Q, 3R, and 3U. (Borings were redrilled and sampled at three locations (3MM, 3NN, and 3VV) due to auger refusal in the primary boring or because samples arrived at the laboratory at above the allowable temperature.) Only backfill/cover soil was encountered in eight of the borings.

Sampling in each borehole was conducted so as to fill the data gap that exists in the data obtained from the February 1985 sampling event. Soil sampling was done systematically and began at the interface between the bottom of the landfill and the undisturbed soil below. The depth of this interface was found by digging an exploratory trench prior to sampling. Samples were collected at 5-foot intervals from the base of the landfill to a depth of 60 feet below grade. Up to three additional samples per borehole were collected at points of major lithology changes as indicated by changes in the response of the drill rig while drilling.

3.4.3 Decontamination Procedures

This section describes the procedures used to decontaminate field sampling equipment and associated equipment potentially contaminated during field activities. Decontamination was performed to prevent cross contamination of the samples and to help maintain a clean working environment for the safety of all field personnel.

The following procedures were used to decontaminate:

- Wash with Liquinox® detergent;
- Rinse with potable water;
- Rinse with reagent grade isopropanol;
- Rinse twice with laboratory reagent grade water;

- Allow to air dry; and
- Wrap in foil or visqueen, if equipment not used immediately.

The drilling augers were decontaminated after each boring using a high pressure, high temperature steam cleaner. The back face of the rig was decontaminated between each boring using the steam cleaner. Rinse water was contained in pump sprayers to prevent used rinse water from contaminating subsequent samples. All decontamination water was considered to be potentially contaminated, so it was captured in a trough and subsequently pumped into a drum for storage.

Sample jars were pre-cleaned to EPA specifications and certified to be contaminant-free by the jar manufacturer. The jar lids remained on the jars until just before samples were placed into the jars so as to prevent contamination of the pre-cleaned jars. To prevent possible exposure of laboratory personnel to soil contaminants, the outside surfaces of the filled jars were cleaned as per Standard Operating Procedure (SOP) 13 (Appendix A of the Field Sampling Plan).

During field work at Landfill No. 3, a farmer plowed the field to the south (upwind) of Landfill No. 3 and much dust was blown over to the sampling locations. Efforts were made to keep all sampling equipment covered and the equipment was rinsed with deionized water just prior to use if it had been sitting for any time after being decontaminated as described above.

3.4.4 Description of Calibration Procedures

Field health and safety monitoring instruments were calibrated every morning before use and the batteries were recharged every evening for the following day. The instruments used were a photoionization detector (PID) with a 10.2 eV probe and an explosimeter (LEL). The PID was zeroed, then calibrated to a 100 ppm isobutylene

gas mixture. The LEL was zeroed, then calibrated to a 50% methane gas mixture. All calibration records were recorded in the field logbook.

3.4.5 Management and Disposal of Soil Cuttings and Decontamination Water

All drill cuttings and water from decontamination activities were considered to be potentially contaminated. The cuttings were drummed, labeled, and stored on pallets at each drilling location until all borings were drilled. When all drilling and trenching activities were completed, the drums were collected, transported, and stored on pallets at Landfill 5. Using a "Paint Pen", drums were labeled to identify the type of material contained, the site number, the boring number, the depth interval from which soil cuttings were collected, the date of collection, and the extension of the Base Environmental Coordinator.

If a drum contains any soil from an interval found to be contaminated, the entire contents of the drum will be considered totally contaminated. The laboratory analysis results will be used to prepare a cost estimate and plan for disposing of the contaminated waste soil and water generated during sampling of Landfill No. 3. Upon approval of the disposal plan by the USACE and the Base Environmental Coordinator, Radian will begin disposing of the waste off-site at an approved disposal facility. Cuttings from drums whose contents are found to be clean will be evenly distributed and leveled near the boring from which the cuttings were taken. Alternatively, uncontaminated cuttings may be disposed of at a site chosen by the Base Environmental Coordinator.

3.4.6 Site Restoration

The site was restored to its original state at the completion of field activities. These efforts met the approval of the Base Environmental Coordinator, who toured the site after all field activities were complete.

3.4.7 Survey of Borings

A registered professional land surveyor was retained to survey the vertical elevations and horizontal coordinates of boreholes. The survey requirements for boreholes were as follows:

- Determine ground elevations to the closest 0.1 foot;
- Determine elevation of the center-point of the grouted borehole to the closest 0.01 foot; and
- Determine coordinates of the well to 1.0 foot.

Elevations were referenced to the National Geodetic Vertical Datum of 1929 or to an existing local vertical datum. Coordinates were referenced to the State Plane Coordinate System. The enclosed map (Appendix J) shows the locations of the borings and the above information.

3.5 Sampling and Preservation Procedures

Sampling and analytical efforts were completed for the CAFB RFI to characterize soil at Landfill No. 3. This section discusses sampling methodologies, field documentation, and QA/QC requirements.

3.5.1 Soil Boring and Geotechnical Samples

Soil samples were collected for chemical analysis and for geotechnical analysis from soil borings at 12 locations. Figure 1-4 shows where the samples were collected at Landfill No. 3.

Analytical Samples

SOP 4 - Drilling Operations and 8 - Soil Sampling (Appendix F of the Field Sampling Plan) were followed for drilling and sampling procedures. An overview of the specific procedures followed for Landfill No. 3 is presented here.

Before drilling began, a preliminary examination hole was excavated with a trackhoe to determine the depth of the landfill. The trench was backfilled with the excavated material after the depth of the base of the landfill had been measured. The soil sampling interval began at the interface between the landfill and the undisturbed soil (20 feet below grade).

Soil samples for chemical analyses and for geotechnical analysis were recovered using a CME-75 drill rig and 3-inch diameter stainless steel split-spoon samplers. The split spoon sampler was driven through 6 ⅝-inch OD hollow stem augers according to ASTM Methods D-1586-84 and D-3550. Copies of these standards are found in Appendix B of the Field Sampling Plan. A 140-pound drop hammer was used to drive the split-spoon a maximum of 2 feet. Blow counts were counted every 6 inches and recorded on the drilling log. After removal, one side of the split-spoon was opened lengthwise slightly and screened for volatile organic emissions with a photoionization detector (PID).

Immediately after the split spoon was opened following screening, two 60-mL soil samples for volatile organics (SW-846:8240) and purgeable TPH (SW-

846:8015MP) constituents analyses were collected and packed into 60-mL short wide-mouth glass jars. Volatile constituents samples were collected first to minimize the loss of target compounds by volatilization.

The volatile constituents samples were collected from the portion of the split spoon soil sample that showed the highest volatile organic content based on PID screening. The site geologist then described the physical characteristics of the soil recovered in the split spoon, following the guidelines of Section 2.5 of the Scope of Services (Appendix C of the Field Sampling Plan). The resulting drilling logs are found in Appendix B-1. The soil remaining in the split spoon was homogenized and composited in a decontaminated stainless steel bowl, and all sample collection was done with decontaminated stainless steel equipment and minimum contact with decontaminated gloves.

The composited soil was gently packed into three 250-mL (8 ounce) wide-mouth clear glass sample jars leaving some headspace. If the volume of soil recovered in the split spoon was inadequate to fill the 250-mL jars, the driller was instructed to auger out the interval just sampled and then push the split spoon to collect more soil. The recovered soil was composited with the previously recovered soil and packed into the three 250-mL jars, and the sampling interval was recorded on the chain-of-custody form, on the sample label, and in the field log book.

Upon completion of the boring, the boring was backfilled with cement grout. The cement grout consisted of a mixture of one bag of Portland cement (ASTM C150), seven gallons of water, and three to five pounds of bentonite powder. Grout was pumped through a tremie pipe that extended to within 10 feet of the bottom of the boring. Pumping continued until grout flowed from the top of the boring. The hole was topped off with grout after the initial pour settled.

Geotechnical Samples

Two soil samples were collected for geotechnical analysis from each soil boring. Geotechnical samples were selected at the discretion of the on-site geologist using the following criteria:

- Collect a variety of soil types across the site; and
- Collect samples from a range of depths.

The geotechnical samples were collected by the site geologist and put into heavy-duty Ziploc® freezer bags. The bags were marked with indelible ink showing the boring number, date and time of sample collection, and the depth from which the sample was collected. The geotechnical samples were then stored in a sealed drum on-site with the rest of the samples until lab results indicated which of the geotechnical samples may have been contaminated. No geotechnical samples were found to be contaminated, so all were sent to the geotechnical lab for sieve analysis. The results of the sieve analyses are found in Appendix B-2 of this report.

3.5.2 Field QA/QC Samples

The following paragraphs discuss the field QA/QC samples for analytical soil samples and their collection frequency and procedures. The collection frequency for QA/QC samples is listed in Table 3-1.

QA and QC Split Samples

QA and QC split samples (duplicates) were collected for all analyses at a rate of 10% for each analyte. The soil was homogenized and divided equally among all containers for both standard and duplicate samples, with the exception of samples

Table 3-1

Analytical Sample Counts - Landfill No. 3, Cannon AFB, New Mexico

Chemical Analyses (Method [a] No.)	Base Samples	Field Dups	Equip Rinse	Trip Blank	Amb Blank	MS/ MSD	Analyt Dups	Radian Sample Count	QA Splits	QA Rinse	QA Trip Blanks	Total QA Sample Count [b]	Total Sample Count
Matrix	Soil	Soil	Water	Water	Water	Soil	Soil	--	Soil	Water	Water	--	--
Volatile Organics (8240)	144	14	0	14	0	24	0	196	14	0	14	28	224
Top 10 TIC's	144	14	0	14	0	0	0	172	0	0	0	0	172
SVOC's - soils - (8270)	144	14	8	0	0	24	0	190	14	8	0	22	212
SVOC Top 20 TIC's	144	14	8	0	0	0	0	166	0	0	0	0	166
Herbicides (8150)	36	5	3	0	0	8	0	52	5	3	0	8	60
Pesticides and PCBs - soils- (8080)	144	14	8	0	0	24	0	190	14	8	0	22	212
TPH by modified 8015	36	5	3	0	0	8	0	52	5	3	0	8	60
TRPH (EPA 418.1)	144	14	8	0	0	24	0	190	14	8	0	22	212
Metals [c] (6010, 7060, 7421, 7471, 7740)	144	14	8	0	0	24	0	190	14	8	0	22	212
% Moisture (SW-846) for corr. to dry weight	144	14	0	0	0	0	0	158	0	0	0	0	158
pH (9045)	144	14	0	0	0	0	2	160	0	0	0	0	160

TIC - Tentatively Identified Compounds.
SVOC - Semi-volatile Organic Compounds.
PCB - Polychlorinated Biphenols.
TPH - Total Petroleum Hydrocarbons.
TRPH - Total Recoverable Petroleum Hydrocarbons.
ICPES - Inductively Coupled Plasma Emission Spectroscopy.
[a] - Reference Methods from SW-846 Test Methods For Evaluating Solid Wastes. Physical/Chemical Methods. November 1986, third edition.
[b] - All QA samples will be submitted to USACE Missouri River Division (MRD) Laboratory for analysis.
[c] - ICPES metals: aluminum, antimony, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, magnesium, manganese, nickel, potassium, silver, sodium, thallium, tin, vanadium and zinc. Other metals: arsenic, lead and mercury.

collected for volatile organics or purgeable (light) TPH analyses. To minimize volatilization, samples collected for either volatile organics or purgeable-TPH analyses were split but not homogenized. QA splits were sent to the USACE Missouri River Division (MRD) Laboratory as described in Section 4.0 of the Field Sampling Plan supplement for Landfill No. 3. QC samples were analyzed by Radian Analytical Services (RAS).

Matrix Spike and Matrix Spike Duplicate (MS/MSD)

Matrix spike and matrix spike duplicate samples were collected on a 5% frequency for each chemical analysis. For all analyses except volatile organics and purgeable TPH, soil was homogenized as described for QA and QC split samples. The matrix spike/matrix spike duplicate (MS/MSD) samples were not collected as separate samples in the field. The field personnel marked the labels of the samples chosen to be MS/MSDs with the letters "MS/MSD" in indelible ink and likewise marked the chain-of-custody in the left margin adjacent to the Sample ID. A note was also made in the remarks section of the chain-of-custody designating all MS/MSD samples included. Table 3-1 shows that for all analyses except herbicides and TPH, 24 MS/MSD analyses were performed by the Radian laboratory. This means that 12 samples were MS samples and 12 were MSD samples. Because each pair of MS and MSD analyses were run on soil collected from one soil sample, only 12 soil samples rather than 24 were designated as MS/MSD samples. The 12 MS/MSD samples were chosen to include the full diversity of soil types found at the site. The laboratory had the option of designating additional MS/MSD samples, if required, to ensure that MS/MSD analyses were performed for each sample batch.

Trip Blanks

Trip blanks consisted of 40-mL VOA vials filled by the laboratory with organic free water and preserved with dilute hydrochloric acid. Trip blanks accompanied

all ice chests that contained volatile organic or purgeable-TPH (SW-846-8015MP) samples during both the sampling activities and shipping.

Equipment Rinse Samples

Equipment blanks were collected by pouring reagent-grade deionized water over decontaminated split-spoon sampling tubes and compositing equipment, and then catching the rinsate in 1-liter bottles. The equipment that was rinsed was noted in the field log book. Each metals rinsate sample was collected in a polyethylene 1-liter bottle. The rinsate samples for TRPH (EPA 418.1), semi-volatile organic compounds (SW-846:8270), TPH-extractables (SW-846:8015M), Pesticides/PCBs (SW-846:8080) and herbicides (SW-846:8150) were each collected in 1-liter glass bottles fitted with Teflon-lined caps (Table 3-2).

3.5.3 Analyses

All soil samples and equipment rinse samples except QA samples were sent to RAS in Austin, Texas. QA samples were sent to the USACE MRD Laboratory in Omaha, Nebraska. The MRD laboratory identification number (LIN) for CAFB Landfill No. 3 samples was 1288, and this number was marked on the chain-of-custody forms accompanying all sample shipments to the MRD laboratory.

3.5.4 Sample Containers, Preservation, and Holding Times

To preserve the integrity of the soil and QA/QC liquid samples before analysis, proper sample containment, preservation methods, holding times, chain-of-custody and shipping procedures outlined in the QAPP and the Field Sampling Plan supplement were followed. All sample bottles and containers were pre-cleaned and

Table 3-2

Summary of Rinse Sample Containers, Preservation, and Holding Times

Reference Method	Parameter	Container Type, No., and Volume	Preservation and Storage Requirements	Maximum Holding Time (Preparation)	Maximum Holding Time (Analysis)
SW-846:6010	Al, Ag, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Na, Ni; Sb, Sn, Tl, V, Zn	(1) 1-L polyethylene	Refrigerated at 4°C HNO_3 pH <2	N/A	6 months [a]
SW-846:7060	As				
SW-846:7421	Pb				
SW-846:7471	Hg				
SW-846:7740	Se				
EPA 418.1	TRPH	(1) 1-L glass, Teflon-lined cap	Refrigerated at 4°C HCl pH <2	N/A	28 days
SW-846:8270	Semi-volatile Organic Compounds	(1) 1-L glass, Teflon-lined cap	Refrigerated at 4°C	7 days	40 days
SW-846:8015M	TPH (extractables)	(1) 1-L glass, Teflon-lined cap	Refrigerated at 4°C	14 days	40 days
SW-846:8080	Organochlorine Pesticides/PCBs	(1) 1-L glass, Teflon-lined cap	Refrigerated at 4°C	7 days	40 days
SW-846:8150	Chlorinated Herbicides	(1) 1-L glass, Teflon-lined cap	Refrigerated at 4°C	7 days	40 days

[a] - Hold time for Mercury is 28 days.

checked according to EPA protocols by the sample bottle supplier, IChem. Samples were kept cool during collection and shipment with regular ice in Ziploc® plastic bags. The samples were stored upright in a durable ice chest and sufficient packing material (e.g., styrofoam peanuts) was used to separate and protect the bottles.

4.0 ARARs EVALUATION

In 1980, Congress enacted the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. Section 9601 *et seq.,* establishing the Superfund program. The regulations, adopted by The U.S. Environmental Protection Agency (USEPA), that implement this program are found in 40 *Code of Federal Regulations* (CFR) Part 300, also known as the National Contingency Plan (NCP). CERCLA was amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986 which mandated that the level or standard of control specified in a remedial action for the site-specific pollutants be "at least that of any applicable or relevant and appropriate (ARAR) standard, requirement, criteria, or limitation under any federal environmental law, or any more stringent standard, requirement, criteria, or limitation promulgated pursuant to a state environmental statute." SARA established that the requirements of the NCP apply to federal facilities in their implementation of the IRP.

CERCLA, as amended by SARA, requires that federal facility remedial actions (for NPL as well as IRP sites) comply with requirements or standards under federal and state environmental laws. The 1990 National Contingency Plan (NCP) incorporates the new statutory requirement that remedies at such sites must comply not only with ARARs under federal laws, but also with promulgated standards, requirements, criteria, or limitations under state environmental or facility siting laws that are more stringent than corresponding federal standards. "Promulgated" state requirements are those laws or regulations that are of general applicability and are legally enforceable. In terms of state ARARs, only those promulgated standards that are: 1) identified by the state in a timely manner; and 2) more stringent than federal requirements may be ARARs.

The terms "applicable" and "relevant and appropriate" are defined as follows:

"Applicable" requirements, as defined at 40 CFR Section 300.4, are cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Applicable requirements are those that would be legally applicable if the remedial action had not been taken under CERCLA; the concept requires that all jurisdictional prerequisites and criteria of the particular statute have been met.

"Relevant and Appropriate" requirements are cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting law that, while not applicable (as defined above), address problems or situations sufficiently similar to those encountered at a CERCLA site that their use is well-suited to the particular site.

4.1 To Be Considered

Criteria, advisories or guidance documents that do not meet the definition of ARARs but may assist in determining what is necessary to be protective or otherwise be useful in developing Superfund remedies are described as information "to-be-considered" (TBCs). Three general categories of TBCs are: 1) health effects information with a high degree of credibility, i.e., reference doses; 2) technical information on how to perform or evaluate site investigations or response actions; and 3) policy, e.g., USEPA's groundwater policy. The 1990 amendments to the NCP emphasize that TBCs are to be used on an "as appropriate" basis and are intended to complement the use of ARARs, not be in competition with ARARs.

The preliminary ARARs for CAFB described below were identified in accordance with *CERCLA Compliance with Other Laws Manual* (EPA/540/G-89/006

and EPA/540/G-89/009) and *Guidance for Conducting Remedial Investigations Under CERCLA, Interim Final* (EPA/540/G-89/004). These ARARs will be reassessed in subsequent stages of the remediation at Landfill No. 3 and expanded or refined as needed. Ultimately, the preferred remedial action alternative will be assessed against the CERCLA and IRP cleanup criteria, including attainment of, or compliance with, ARARs.

The following preliminary ARAR identification is divided into three categories of ARARs: 1) ambient or "chemical-specific" requirements; 2) locational standards; and 3) performance, design, or other "action-specific" requirements.

4.2 Chemical-Specific ARARs

Chemical-specific ARARs are typically health-based or risk-based numerical values or methodologies which, when applied to site-specific conditions, result in the establishment of numerical values. These values, in turn, establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the environment (soil, groundwater, surface water or air) as a result of the remedial action. Potential federal and state chemical-specific ARARs for CAFB are summarized in the following subsections.

4.2.1 Drinking Water Standards

40 CFR Part 141
57 Fed. Reg. 31778, 17 July 1992
N.M. Water Quality Control Commission Regulations (NMWQCCR)
N.M. Drinking Water Regulations

As explained below, current drinking water standards may be an ARAR for the purpose of establishing cleanup levels for contaminated groundwater. The National Primary Drinking Water Regulations establish Maximum Contaminant Levels (MCLs)

that are enforceable standards under the Safe Drinking Water Act for specific contaminants in public water supplies. Maximum Contaminant Level Goals (MCLGs) are non-enforceable goals on which MCLs are based. MCLs are applicable in the selection of groundwater restoration levels. MCLGs are TBC information only.

Table 4-1 presents a side-by-side comparison of the federal MCLs, secondary drinking water standards, MCLGs, and New Mexico Human Health Standards. As noted in the footnotes to the table, the federal MCL and MCLG list includes a number of revisions adopted by the USEPA in 1991 and 1992, but which will not become effective until 1993 and 1994. The New Mexico Human Health Standards are found in Section 3-103 of the *New Mexico Water Quality Control Commission Regulations* (NMWQCCR) which specifies concentrations of pollutants that must not be exceeded in groundwater. These promulgated standards are applicable requirements that regulate discharges onto or below the surface of the ground. In addition to the NMWQCCR (regulating discharges onto or below the ground) the New Mexico Drinking Water Standards (a.k.a., "Water Supply Regulations") apply to each public water system supply in New Mexico.

4.2.2 Surface Water Quality Standards

USEPA Quality Criteria for Water 1986
N.M. Water Quality Control Commission Regulations (NMWQCCR)

Surface water quality standards may be an ARAR if the ultimate remedial action selected involves the discharge of pollutants to surface waters, (i.e., discharge of treated groundwater). The USEPA has developed ambient surface water quality criteria (SWQC) for protection of aquatic life, which are found in *Quality Criteria for Water 1986*, EPA 440/5-86-001 (1 May 1986). These federal water quality criteria are not an ARAR because they have not been promulgated by USEPA, but are TBC information. As discussed in Section 4.1, TBC information includes criteria, advisories or guidance

Table 4-1

National Drinking Water Standards and New Mexico Human Health Standards

Contaminants	National Primary MCLs [a] (mg/l)	New Mexico HHS [b] (mg/l)	National Secondary MCLs [c] (mg/l)	National MCLGs [d] (mg/l)
Organics				
Acrylamide	–	–	–	zero
Alachlor	0.002	–	–	zero
Aldicarb Sulfone	0.003 [e]	–	–	0.001 [e]
Aldicarb Sulfoxide	0.004 [e]	–	–	0.001 [e]
Aldicarb	0.003 [e]	–	–	0.001 [e]
Atrazine	0.003	–	–	0.003
Benzene	0.005	0.01	–	zero
Benzo(a)pyrene	0.0002 [f]	–	–	zero [f]
Carbofuran	0.04	–	–	0.04
Carbon Tetrachloride	0.005	0.01	–	zero
Chlordane	0.002	–	–	zero
2,4,-D	0.07	–	–	0.07
Dalapon	0.2 [f]	–	–	0.2 [f]
Di(2-ethylhexyl)adipate	0.4 [f]	–	–	0.4 [f]
Di(2-ethylhexyl)phthalate	0.006 [f]	–	–	zero [f]
Dibromochloropropane	0.0002	–	–	zero
Para-Dichlorobenzene	0.075	–	–	0.075
o-Dichlorobenzene	0.6	–	–	0.6
Dichloromethane	0.005 [f]	–	–	zero [f]
1,2-Dichloroethane	0.005	0.01	–	–
1,2-Dichloropropane	0.005	–	–	zero
1,1-Dichloroethylene	0.007	–	–	0.007
cis-1,2-Dichloroethylene	0.07	–	–	0.07
trans-1,2-Dichloroethylene	0.1	–	–	0.1
Dinoseb	0.007 [f]	–	–	0.007 [f]
Diquat	0.02 [f]	–	–	0.02 [f]
Endothall	0.1 [f]	–	–	0.1 [f]
Endrin	0.0002 [h], 0.002 [g]	–	–	0.002 [g]
Epichlorohydrin	–	–	–	zero
Ethylbenzene	0.7	0.75	–	0.7
Ethylene Dibromide	0.00005	–	–	zero
Glyphosate	0.7 [f]	–	–	0.7 [f]
Heptachlor Epoxide	0.0002	–	–	zero

Table 4-1

(Continued)

Contaminants	National Primary MCLs [a] (mg/l)	New Mexico HHS [b] (mg/l)	National Secondary MCLs [c] (mg/l)	National MCLGs [d] (mg/l)
Heptachlor	0.0004	–	–	zero
Hexachlorobenzene	0.001 [f]	–	–	zero [f]
Hexachlorocyclopentadiene	0.05 [f]	–	–	0.05 [f]
Lindane	0.0002	–	–	0.0002
Methoxychlor	0.04	–	–	0.04
Monochlorobenzene	0.1	–	–	0.1
Oxamyl (Vydate)	0.2 [f]	–	–	0.2 [f]
Pentachlorophenol	0.001 [e]	0.005	–	zero [e]
Picloram	0.5 [f]	–	–	0.5 [f]
Polychlorinated biphenyls (PCBs as decachloro-biphenyl)	0.0005	–	–	zero
Simazine	0.004 [f]	–	–	0.004 [f]
Styrene	0.1	–	–	0.1
2,3,7,8-TCDD (dioxin)	3×10^{-8}	–	–	zero [f]
Tetrachloroethylene	0.005	–	–	zero
Toluene	1	–	–	1
2,4,5-TP (Silvex)	0.05	0.005	–	0.05
Total Trihalomethanes	0.10 [h,i]	–	–	–
Toxaphene	0.003	–	–	zero
1,2,4-Trichlorobenzene	0.07 [f]	–	–	0.07 [f]
1,1,1-Trichloroethane	0.2	–	–	0.20
1,1,2-Trichloroethane	0.005 [f]	–	–	0.003 [f]
Trichloroethylene	0.005	–	–	zero
Vinyl Chloride	0.002	–	–	zero
Xylenes (total)	10	–	–	10
Inorganics				
Aluminum	–	–	0.05 to 0.2	–
Antimony	0.006 [f]	–	–	0.006 [f]
Arsenic	0.05 [h]	0.1	–	–
Asbestos	7 million fibers/liter (longer than 10 μm)	–	–	7 million fibers/liter (longer than 10 μm)
Barium	1 [h], 2 [e]	1	–	2 [e]
Beryllium	0.004 [f]	–	–	0.004 [f]
Cadmium	0.005	0.01	–	0.005
Chloride	–	–	250	–
Chromium	0.1	0.05	–	0.1

Table 4-1

(Continued)

Contaminants	National Primary MCLs [a] (mg/l)	New Mexico HHS [b] (mg/l)	National Secondary MCLs [c] (mg/l)	National MCLGs [d] (mg/l)
Copper	1.3 [h]	1	1.0	1.3
Cyanide (as free Cyanide)	0.2 [f]	--	--	0.2 [f]
Fluoride	4.0	--	2.0	4.0
Iron	--	--	0.3	--
Lead	0.015 [h]	0.05	--	zero
Manganese	--	--	0.05	--
Mercury	0.002	0.002	--	0.002
Nickel	0.1 [f]	--	--	0.1 [f]
Nitrate (as Nitrogen)	10	--	--	10
Nitrite (as Nitrogen)	1	--	--	1
Total Nitrate and Nitrile (as Nitrogen)	10	--	--	10
Selenium	0.05	0.05	--	0.05
Silver	0.05 [h]	0.05	0.1	--
Sulfate	--	--	250	--
TDS (total dissolved solids)	--	--	500	--
Thallium	0.002 [f]	--	--	0.0005 [f]
Zinc	--	10	5	--
Physical Properties				
Color	--	--	15 color units	--
Corrosivity	--	--	non-corrosive	--
Foaming Agents	--	--	0.5	--
Odor	--	--	3 threshold odor number	--
pH	--	--	6.5 - 8.5 S.U.	--

[a] - From 40 CFR, Section 141.61 for organics and Section 141.62 for inorganics (effective 30 July 1992, unless otherwise noted).
[b] - New Mexico Human Health Standards from N.M. Water Quality Control Commission Regulations as Amended through 18 August 1991.
[c] - From 40 CFR Section 143.3 (effective 30 July 1992, unless otherwise noted).
[d] - From 40 CFR Section 141.50 for organics and Section 141.51 for inorganics (effective 30 July 1992, unless otherwise noted).
[e] - Effective 1 January 1993.
[f] - Effective 17 January 1994.
[g] - Effective 17 August 1992.
[h] - From 40 CFR, Section 141.11 for inorganics and Section 141.12 for organics (effective 1 July 1991; however, the lead level is effective only until 7 December 1992). There is no longer an MCL for lead or copper (Federal Register, 7 June 1991); however, there is an action level of 0.015 mg/L for lead and 1.3 mg/L for copper.
[i] - Applies only to community water systems which serve a population of 10,000 or more that have a disinfectant added to the water.
-- MCL or MCLG not specified.

documents that do not meet the definition of ARARs but may assist in determining what is necessary to be protective or otherwise useful in developing Superfund remedies. The SWQC establish acceptable in-stream concentration of pollutants, for the protection of aquatic life, as set forth in Table 4-2.

4.2.3 USEPA RCRA Proposed Corrective Action Media Action Levels

40 CFR Part 264, Subpart S, Section 264.521 (proposed 27 July 1990, 55 Fed. Reg. 30798 et seq.)

The proposed Corrective Action Subpart S regulations contain methodology and criteria for calculating action levels for contaminants in soil, water, and air. Action levels are not cleanup standards; rather, an exceedence of a media action level potentially triggers the need for a corrective measures study (CMS) of a solid waste management unit (SWMU). RCRA Subpart S action levels are presented in Table 4-3. The USEPA health-based criteria used to calculate these action levels are presented in Table 4-4. The action levels in Table 4-3 were calculated using: 1) the recommended exposure assumptions in Appendix D of the proposed Subpart S Corrective Action Rule; 2) the governing equations for calculating action levels presented in Appendix E of the Subpart S rule; and 3) the risk assessment values presented in Table 4-4 of this report. Appendix A of the Subpart S rule presents example action levels which are to be updated as new data on hazardous constituents are developed (preamble, 55 *Federal Register* 30798 at Section VI.E.2.b). Table 4-4 presents the risk assessment values (i.e., RfDs and CSFs) used in the calculation of the action levels presented in Table 4-3. Action levels under the proposed Subpart S are to be considered as points of departure for setting cleanup standards. RCRA corrective action cleanup standards (media protection standards) (discussed in Subsection 4.2.4) are established at the CMS stage and may be less stringent than the action levels depending on the site conditions.

Table 4-2

Federal Surface Water Quality Criteria

Chemical	Freshwater SWQC	
	Acute (µg/L)	Chronic (µg/L)
METALS		
Antimony	88 [a]	30 [a]
Barium	ND [a]	ND [a]
Beryllium	130 [a,b]	5.3 [a,b]
Cadmium	3.9+ [a]	1.1+ [a]
Chromium (total)	1,700+ [c]	210+ [c]
Cobalt	ND [a]	ND [a]
Copper	9.2+ [a]	6.5+ [a]
Nickel	1,400+ [a]	160+ [c]
Silver	0.92 [a]	0.12 [a]
Tin	--	--
Vanadium	ND [a]	ND [a]
Zinc	120+ [a]	110+ [a]
Arsenic	360 [a,d]	190 [a,d]
Lead	82+ [a]	3.2+ [a]
Mercury	2.4 [a]	0.012 [a]
Selenium	20 [a]	5 [a]
Thallium	1,400 [b,c]	40 [b,c]
ORGANOCHLORINE PESTICIDES AND PCBs		
Aldrin	3 [a]	ND [a]
alpha-BHC	100 [a]	ND [a]
beta-BHC	100 [a]	ND [a]
delta-BHC	100 [a]	ND [a]
gamma-BHC (Lindane)	2 [a]	0.08 [a]
Chlordane (technical)	2.4 [a]	0.0043 [a]
4,4'-DDD	ND [a]	ND [a]
4,4'-DDE	1,500 [a,b]	ND [a]
4,4'-DDT	1.1 [a]	0.001 [a]
Dieldrin	1 [a]	0.0019 [a]
Endosulfan I	0.22 [c]	0.056 [c]
Endosulfan II	0.22 [c]	0.056 [c]

Table 4-2

(Continued)

Chemical	Freshwater SWQC	
	Acute (µg/L)	Chronic (µg/L)
Endosulfan sulfate	--	--
Endrin	0.18 [a]	0.0023 [a]
Endrin aldehyde	--	--
Heptachlor	0.52 [a]	0.0038 [a]
Heptachlor epoxide	0.52 [a]	0.0038 [a]
Isodrin	ND [a]	ND [a]
Kepone	--	--
Methoxychlor	ND [a]	0.03 [a]
Toxaphene	0.73 [a]	0.0002 [a]
PCB-1016	2 [a]	0.014 [a]
PCB-1221	2 [a]	0.014 [a]
PCB-1323	2 [a]	0.014 [a]
PCB-1242	2 [a]	0.014 [a]
PCB-1248	2 [a]	0.014 [a]
PCB-1254	2 [a]	0.014 [a]
PCB-1260	2 [a]	0.014 [a]
ORGANOPHOSPHORUS PESTICIDES		
Dimethoate	ND [a]	ND [a]
Disulfoton	ND [a]	ND [a]
Ethyl parathion (parathion)	0.065 [a]	0.013 [a]
Famphur	ND [a]	ND [a]
Parathion methyl	ND [a]	ND [a]
Phorate	ND [a]	ND [a]
Sulfotepp	ND [a]	ND [a]
Thionazin	--	--
o,o,o-Triethylphosphorthioate	--	--
CHLORINATED HERBICIDES		
2,4-D	ND [a]	ND [a]
2,4,5-T	ND [a]	ND [a]

Table 4-2

(Continued)

Chemical	Freshwater SWQC	
	Acute (µg/L)	Chronic (µg/L)
2,4,5-TP (Silvex)	ND [a]	ND [a]
Dinoseb	ND [a]	ND [a]
VOLATILE ORGANICS		
Acetone	ND [a]	ND [a]
Acetonitrile	ND [a]	ND [a]
Acrolein	68 [a,b]	21 [a,b]
Acrylonitrile	7550 [a,b]	2600 [a,b]
Benzene	5300 [a,b]	ND [a]
Bromodichloromethane	11000 [a,b]	ND [a]
Bromomethane	11000 [a,b]	ND [a]
Carbon disulfide	ND [a]	2 [a]
Carbon tetrachloride	35200 [a,b]	ND [a]
2-Chloro-1,3-butadiene	ND [a]	ND [a]
Chlorobenzene	250 [a,b]	50 [a,b]
Chloroethane	860000 [a]	230000 [a]
Chloroform	28900 [a,b]	1240 [a,b]
Chloromethane	ND [a]	ND [a]
3-Chloropropene (allyl chloride)	860000 [a]	230000 [a]
Dibromochloromethane	11000 [a,b]	ND [a]
1,2-Dibromo-3-chloropropane	ND [a]	ND [a]
1,2-Dibromoethane	ND [a]	ND [a]
Dibromomethane	ND [a]	ND [a]
trans-1,4-Dichloro-2-butene	--	--
Dichlorodifluoromethane	11000 [a,b]	ND [a]
1,2-Dichloroethane	118000 [a,b]	20000 [a,b]
trans-1,2-Dichloroethene	11600 [a,b]	ND [a]
1,1-Dichloroethane	ND [a]	ND [a]
1,1-Dichloroethene	11600 [a,b]	ND [a]
1,2-Dichloropropane	ND [a]	ND [a]

Table 4-2

(Continued)

Chemical	Freshwater SWQC	
	Acute (µg/L)	Chronic (µg/L)
cis-1,3-Dichloropropene	6060 [c,b]	244 [b,c]
trans-1,3-Dichloropropene	6060 [c,b]	244 [b,c]
Ethyl benzene	32000 [a,b]	ND [a]
Ethyl methacrylate	ND [a]	ND [a]
2-Hexanone	ND [a]	ND [a]
Iodomethane	--	--
Methylene chloride	11000 [a,b]	ND [a]
2-Butanone (MEK)	ND [a]	ND [a]
Methyl methacrylate	ND [a]	ND [a]
4-Methyl-2-pentanone (MIBK)	ND [a]	ND [a]
Propanenitrile (propionitrile)	--	--
Styrene	ND [a]	ND [a]
1,1,1,2-Tetrachloroethane	9.32e+03 [a]	ND [a]
1,1,2,2-Tetrachloroethane	9.32e+03 [a]	2400 [a,b]
Tetrachloroethene	ND [a]	ND [a]
Toluene	17500 [a,b]	ND [a]
Tribromomethane	11000 [a,b]	ND [a]
1,1,1-Trichloroethane	18000 [a,b]	ND [a]
1,1,2-Trichloroethane	18000 [a,b]	9400 [a,b]
Trichloroethene	45000 [a,b]	21900 [a,b]
Trichlorofluoromethane	11000 [a,b]	ND [a]
1,2,3-Trichloropropane	ND [a]	ND [a]
Vinyl Acetate	ND [a]	ND [a]
Vinyl Chloride	ND [a]	ND [a]
Xylenes (total)	ND [a]	ND [a]
VOLATILE ORGANICS (Direct Injection)		
1,4-Dioxane	ND [a]	ND [a]
Isobutanol	ND [a]	ND [a]
Methacrylonitrile	ND [a]	ND [a]

Table 4-2

(Continued)

Chemical	Freshwater SWQC	
	Acute (µg/L)	Chronic (µg/L)
SEMIVOLATILE ORGANICS		
Acenaphthene	[a,c]	[a,c]
Acenaphthylene	ND [a]	ND [a]
Acetophenone	ND [a]	ND [a]
2-Acetylaminofluorene	--	--
4-Aminobiphenyl	--	--
Aniline	ND [a]	ND [a]
Anthracene	ND [a]	ND [a]
Aramite	ND [a]	ND [a]
Benzo(a)anthracene	ND [a]	ND [a]
Benzo(a)pyrene	ND [a]	ND [a]
Benzo(b)fluoranthene	ND [a]	ND [a]
Benzo(g,h,i)perylene	ND [a]	ND [a]
Benzo(k)fluoranthene	ND [a]	ND [a]
Benzyl alcohol	--	--
4-Bromophenyl phenyl ether	360 [a,b]	120 [a,b]
Butylbenzylphthalate	940 [a,b]	3 [a,b]
4-Chloro-3-methylphenol	ND [a]	ND [a]
4-Chloroaniline	ND [a]	ND [a]
Chlorobenzilate	ND [a]	ND [a]
bis(2-Chloroethoxy)methane	11000 [a,b]	ND [a]
bis(2-Chloroethyl)ether	238000 [a,b]	ND [a]
bis(2-Chloroisopropyl)ether	--	--
2-Chloronaphthalene	2300 [a]	620 [a]
2-Chlorophenol	4380 [a,b]	ND [a]
4-Chlorophenyl phenyl ether	--	--
Chrysene	ND [a]	ND [a]
Diallate	--	--
Dibenz(a,h)anthracene	ND [a]	ND [a]

Table 4-2

(Continued)

Chemical	Freshwater SWQC	
	Acute (µg/L)	Chronic (µg/L)
Dibenzofuran	ND [a]	ND [a]
1,2-Dichlorobenzene	1120 [a,b]	763 [a,b]
1,3-Dichlorobenzene	1120 [a,b]	763 [a,b]
1,4-Dichlorobenzene	ND [a]	ND [a]
3,3'-Dichlorobenzidine	ND [a]	ND [a]
2,4-Dichlorophenol	2020 [a,b]	365 [a,b]
2,6-Dichlorophenol	--	--
Diethylphthalate	940 [a,b]	3 [a,b]
p-Dimethylaminoazobenzene	--	--
7,12-Dimethylbenz(a)anthracene	--	--
3,3'-Dimethylbenzidine	ND [a]	ND [a]
Dimethylphenethylamine	--	--
2,4-Dimethylphenol	2120 [a]	ND [a]
Dimethylphthalate	940 [a,b]	3 [a,b]
4,6-Dinitro-2-methylphenol	--	--
Di-n-butylphthalate	940 [a,b]	3 [a,b]
Di-n-octylphthalate	ND [a]	ND [a]
1,3-Dinitrobenzene	ND [a]	ND [a]
2,4-Dinitrophenol	230 [a,b]	150 [a,b]
2,4-Dinitrotoluene	330 [a]	230 [a]
2,6-Dinitrotoluene	ND [a]	ND [a]
Diphenylamine	ND [a]	ND [a]
bis(2-Ethylhexyl)phthalate	400 [a]	360 [a]
Ethylmethane sulfonate	--	--
Fluoranthene	3980 [a]	ND [a]
Fluorene	ND [a]	ND [a]
Hexachlorobenzene	0.61 [a]	3.68 [a]
Hexachlorobutadiene	90 [a,b]	9.3 [a,b]
Hexachlorocyclopentadiene	7 [a,b]	5.2 [a,b]

Table 4-2

(Continued)

Chemical	Freshwater SWQC	
	Acute (µg/L)	Chronic (µg/L)
Hexachloroethane	980 [a,b]	540 [a,b]
Hexachlorophene	ND [a]	ND [a]
Hexachloropropene	--	--
Ideno(1,2,3-c,d)pyrene	ND [a]	ND [a]
Isophorone	117000 [a,b]	ND [a]
Isosafrole	--	--
Methapyrilene	--	--
3-Methylchloanthrene	--	--
Methyl methanesulfonate	--	--
2-Methyl naphthalene	--	--
2-Methylphenol	ND [a]	ND [a]
3-Methylphenol	ND [a]	ND [a]
4-Methylphenol	ND [a]	ND [a]
Naphthalene	2300 [a]	620 [a]
1,4-Naphthoquinone	ND [a]	ND [a]
1-Naphthylamine	--	--
2-Naphthylamine	ND [a]	ND [a]
2-Nitroaniline	--	--
3-Nitroaniline	--	--
4-Nitroaniline	--	--
Nitrobenzene	27000 [a,b]	ND [a]
2-Nitrophenol	--	--
4-Nitrophenol	ND [a]	ND [a]
4-Nitroquinoline-N-oxide	--	--
N-Nitroso-di-n-butylamine	5850 [a,b]	ND [a]
N-Nitrosodiethylamine	5850 [a,b]	ND [a]
N-Nitrosodiphenylamine	5850 [a,b]	ND [a]
N-Nitrosodipropylamine	5850 [a,b]	ND [a]
N-Nitrosodimethylamine	5850 [a,b]	ND [a]

Table 4-2

(Continued)

Chemical	Freshwater SWQC	
	Acute (µg/L)	Chronic (µg/L)
N-Nitrosomethylethylamine	5850 [a,b]	ND [a]
N-Nitrosomorpholine	--	--
N-Nitrosopiperidine	--	--
N-Nitrosopyrrolidine	5850 [a,b]	ND [a]
5-Nitro-o-toluidine	--	--
Pentachlorobenzene	250 [a,b]	50 [a,b]
Pentachloroethane	--	--
Pentachloronitrobenzene	250 [a,b]	50 [a,b]
Pentachlorophenol	22 pH [a]	13 pH [a]
Phenacetin	--	--
Phenanthrene	30 [a]	6.3 [a]
Phenol	10200 [a,b]	2560 [a,b]
p-Phenylenediamine	--	--
2-Picoline	--	--
Pronamide	ND [a]	ND [a]
Pyrene	ND [a]	ND [a]
Pyridine	ND [a]	ND [a]
Safrole	--	--
1,2,4,5-Tetrachlorobenzene	250 [a,b]	50 [a,b]
2,3,4,6-Tetrachlorophenol	ND [a]	ND [a]
o-Toluidine	--	--
1,2,4-Trichlorobenzene	250 [a,b]	50 [a,b]
2,4,5-Trichlorophenol	100 [a]	63 [a]
2,4,6-Trichlorophenol	ND [a]	970 [a,b]
DIOXINS AND FURANS		
2,3,7,8-Tetrachlorodibenzo-p-dioxin	.01 [b,c]	.00001 [b,c]
Tetrachlorodibenzo-p-dioxins	--	--
Tetrachlorodibenzo-p-furans	--	--
Pentachlorodibenzo-p-dioxins	--	--

Table 4-2

(Continued)

Chemical	Freshwater SWQC	
	Acute (µg/L)	Chronic (µg/L)
Pentachlorodibenzo-p-furans	--	--
Hexachlorodibenzo-p-dioxins	--	--
Hexachlorodibenzo-p-furans	--	--
GENERAL		
Cyanide	22 [a]	5.2 [a]
Sulfide	--	2 [c]
Total Organic Carbon	--	--

Source: USEPA Quality Criteria for Water, 1986, unless otherwise noted.

NOTES:
[a] - U.S. Environmental Protection Agency (EPA), 1992b. Integrated Risk Information System (IRIS). May 28, 1992.
[b] - Lowest effect concentration, criteria not available.
[c] - U.S. Environmental Protection Agency (EPA), 1991c. "Amendments to The Water Quality Standards Regulation to Establish the Numeric Criteria for Priority Toxic Pollutants Necessary to Bring All States into Compliance with Section 303(c)(2)(B); Proposed Rule. Federal Register 56223, Tuesday, November 19, 1991.
[d] - Proposed criteria.
[e] - (Total NH_3) pH and temperature dependant.
HBL - Health-Based Level
ND - No data available.
U - Under review.
– Not available.
+ - Hardness dependent criteria (100 mg/l used).

Table 4-3

RCRA Proposed Subpart S Media Action Levels [a]

Chemical	Soil Action Levels		Air Action Level		Water Action Level	
	(noncarc) (mg/kg)	(carc) (mg/kg)	(noncarc) (μg/m3)	(carc) (μg/m3)	(noncarc) (mg/L)	(carc) (mg/L)
METALS						
Antimony	3.20e+01	–	–	–	1.40e-02	–
Barium	5.60e+03	–	–	–	2.45e+00	–
Beryllium	4.00e+02	1.63e-01	–	4.17e-04	1.75e-01	8.14e-06
Cadmium	8.00e+01	–	–	5.56e-04	1.75e-02	–
Chromium (III)	8.00e+04	–	–	–	3.50e+01	–
Chromium (VI)	4.00e+02	–	–	8.33-05	1.80e-01	–
Cobalt	–	–	–	–	–	–
Copper	3.20e+03	–	–	–	1.40e+00	–
Nickel	1.60e+03	–	–	–	7.00e-01	–
Silver	4.00e+02	–	–	–	1.75e-01	–
Tin	4.80e+04	–	–	–	2.10e+01	–
Vanadium	5.60e+02	–	–	–	2.45e-01	–
Zinc	1.60e+04	–	–	–	7.00e+00	–
Arsenic	2.40e+01	–	–	2.33e-04	1.05e-02	–
Lead	1.14e+02	–	–	–	1.50e-02 [b]	–
Mercury	–	–	–	–	–	–
Selenium	4.00e+02	–	–	–	1.75e-01	–
Thallium	0.4e+01	–	–	–	2.45e-03	–
ORGANOCHLORINE PESTICIDES AND PCBs						
Aldrin	2.40e+00	4.12e-02	–	2.04e-04	1.05e-03	2.06e-06
alpha-BHC	–	1.11e-01	–	5.56e-04	–	5.56e-06
beta-BHC	–	3.89e+00	–	1.89e-02	–	1.94e-04
delta-BHC	–	–	–	–	–	–
gamma-BHC (Lindane)	2.40e+01	5.38e-01	–	–	1.05e-02	2.69e-05
Chlordane (technical)	4.80e+00	5.38e-01	–	2.70e-03	2.10e-03	2.69e-05
4,4'-DDD	–	2.92e+00	–	–	–	1.46e-04
4,4'-DDE	–	2.06e+00	–	–	–	1.03e-04
4,4'-DDT	4.00e+01	2.06e+00	–	1.03e-02	1.75e-02	1.03e-04
Dieldrin	4.00e+00	4.38e-02	–	2.17e-04	1.75e-03	2.19e-06
Endosulfan I	4.00e+00	–	–	–	1.75e-03	–
Endosulfan II	4.00e+00	–	–	–	1.75e-03	–
Endosulfan sulfate	4.00e+00	–	–	–	1.75e-03	–
Endrin	2.40e+01	–	–	–	1.05e-02	–
Endrin aldehyde	–	–	–	–	–	–
Heptachlor	4.00e+01	1.56e-01	–	7.69e-04	1.75e-02	7.78e-06

Table 4-3

(Continued)

Chemical	Soil Action Levels		Air Action Level		Water Action Level	
	(noncarc) (mg/kg)	(carc) (mg/kg)	(noncarc) (μg/m3)	(carc) (μg/m3)	(noncarc) (mg/L)	(carc) (mg/L)
Heptachlor epoxide	1.04e+00	7.69e-02	–	3.85e-04	4.55e-04	3.85e-06
Isodrin	–	–	–	–	–	–
Kepone	–	1.00e+00 [c]	–	–	–	–
Methoxychlor	4.00e+02	–	–	–	1.75e-01	–
Toxaphene	–	6.36e-01	–	3.13e-03	–	3.18e-05
PCB-1016	–	9.09e-02	–	–	–	4.55e-06
PCB-1221	–	9.09e-02	–	–	–	4.55e-06
PCB-1323	–	9.09e-02	–	–	–	4.55e-06
PCB-1242	–	9.09e-02	–	–	–	4.55e-06
PCB-1248	–	9.09e-02	–	–	–	4.55e-06
PCB-1254	–	9.09e-02	–	–	–	4.55e-06
PCB-1260	–	9.09e-02	–	–	–	4.55e-06
ORGANOPHOSPHORUS PESTICIDES						
Dimethoate	1.60e+01	–	–	–	7.00e-03	–
Disulfoton	3.20e+00	–	–	–	1.40e-03	–
Ethyl parathion (parathion)	4.80e+02	–	–	–	2.10e-01	–
Famphur	–	–	–	–	–	–
Parathion methyl	2.00e+01	–	–	–	8.75e-03	–
Phorate	–	–	–	–	–	–
Sulfotepp	4.00e+01	–	–	–	1.75e-02	–
Thionazin	–	–	–	–	–	–
o,o,o-Triethylphosphorthioate	–	–	–	–	–	–
CHLORINATED HERBICIDES						
2,4-D	8.00e+02	–	–	–	3.50e-01	–
2,4,5-T	8.00e+02	–	–	–	3.50e-01	–
2,4,5-TP (Silvex)	6.40e+02	–	–	–	2.80e-01	–
Dinoseb	8.00e+01	–	–	–	3.50e-02	–
VOLATILE ORGANICS						
Acetone	8.00e+03	–	–	–	3.50e+00	–
Acetonitrile	4.80e+02	–	–	–	2.10e-01	–
Acrolein	8.00e+03	–	2.00e-02	–	3.50e+00	–
Acrylonitrile	–	1.30e+00	2.00e+00	1.47e-02	–	6.48e-05
Benzene	–	2.41e+01	–	1.20e-01	–	1.21e-03
Bromodichloromethane	1.60e+03	5.38e+00	–	–	7.00e-01	2.69e-04
Bromomethane	1.12e+02	–	5.00e-02	–	4.90e-02	–
Carbon disulfide	8.00e+03	–	–	–	3.50e+00	–

Table 4-3

(Continued)

Chemical	Soil Action Levels		Air Action Level		Water Action Level	
	(noncarc) (mg/kg)	(carc) (mg/kg)	(noncarc) (μg/m3)	(carc) (μg/m3)	(noncarc) (mg/L)	(carc) (mg/L)
Carbon tetrachloride	5.60e+01	5.38e+00	–	6.67e-02	2.45e-02	2.69e-04
2-Chloro-1,3-butadiene	1.60e+03	–	–	–	7.00e+00	–
Chlorobenzene	1.60e+03	–	–	7.00e+02	7.00e-01	–
Chloroethane	–	–	1.00e+04	–	–	–
Chloroform	8.00e+02	1.15e+02	–	4.35e-02	3.50e-01	5.74e-03
Chloromethane	–	–	–	–	–	–
3-Chloropropene (allyl chloride)	–	–	1.00e+00	–	–	–
Dibromochloromethane	1.60e+03	8.33e+01	–	–	7.00e-01	4.17e-03
1,2-Dibromo-3-chloropropane	–	–	2.00e-01	4.2e-04	–	–
1,2-Dibromoethane	–	–	–	4.55e-03	–	–
Dibromomethane	–	8.24e-03	–	–	–	4.12e-07
trans-1,4-Dichloro-2-butene	–	–	–	3.85e-04	–	–
Dichlorodifluoromethane	1.60e+04	–	–	–	7.00e+00	–
1,2-Dichloroethane	–	7.69e+00	–	3.85e-02	–	3.85e-04
trans-1,2-Dichloroethene	1.60e+03	–	–	–	7.00e-01	–
1,1-Dichloroethane	8.00e+03	–	–	–	3.50e+00	–
1,1-Dichloroethene	7.20e+02	1.17e+01	–	2.00e-01	3.15e-01	5.83e-04
1,2-Dichloropropane	–	1.03e+01	4.00e+00	–	–	5.15e-04
cis-1,3-Dichloropropene	2.40e+01	3.89e+00	2.00e+01	2.70e-02	1.05e-02	1.94e-04
trans-1,3-Dichloropropene	2.40e+01	3.89e+00	2.00e+01	2.70e-02	1.05e-02	1.94e-04
Ethyl benzene	8.00e+03	–	1.00e+03	–	3.50e+00	–
Ethyl methacrylate	7.20e+03	–	–	–	3.15e+00	–
2-Hexanone	–	–	–	–	–	–
Iodomethane	–	–	–	–	–	–
Methylene chloride	4.80e+03	9.33e+01	–	2.13e+00	2.10e+00	4.67e-03
2-Butanone (MEK)	4.00e+03	–	–	–	1.75e+00	–
Methyl methacrylate	6.40e+03	–	–	–	2.80e+00	–
4-Methyl-2-pentanone (MIBK)	4.00e+03	–	–	–	1.75e+00	–
Propanenitrile (propionitrile)	–	–	–	–	–	–
Styrene	1.60e+04	–	1.00+03	–	7.00e+00	1.17e-03
1,1,1,2-Tetrachloroethane	2.40e+03	2.69e+01	–	–	1.05e+00	1.35e-02
1,1,2,2-Tetrachloroethane	–	3.50e+01	–	1.72e-02	–	1.75e-03
Tetrachloroethene	8.00e+02	1.37e+01	–	–	3.50e-01	6.86e-04
Toluene	1.60e+04	–	–	–	7.00e+00	–
Tribromomethane	1.60e+03	8.86e+01	–	9.09e-01	7.00e-01	4.43e-03
1,1,1-Trichloroethane	7.20e+03	–	–	–	3.15e+00	–

Table 4-3

(Continued)

Chemical	Soil Action Levels		Air Action Level		Water Action Level	
	(noncarc) (mg/kg)	(carc) (mg/kg)	(noncarc) (μg/m3)	(carc) (μg/m3)	(noncarc) (mg/L)	(carc) (mg/L)
1,1,2-Trichloroethane	3.20e+02	1.23e+02	–	6.06e-01	1.40e-01	6.14e-03
Trichloroethene	–	–	–	–	–	3.18e-03
Trichlorofluoromethane	2.40e+04	–	–	–	1.05e+01	–
1,2,3-Trichloropropane	4.80e+02	–	–	–	2.10e-01	–
Vinyl Acetate	8.00e+04	–	2.00e+02	–	3.50e+01	–
Vinyl Chloride	–	3.68e-01	–	–	–	1.84e-05
Xylenes (total)	1.60e+05	–	–	–	7.00e+01	–
VOLATILE ORGANICS (Direct Injection)						
1,4-Dioxane	8.00e+03	6.40e+01	–	–	3.50e+00	3.18e-03
Isobutanol	2.40e+04	–	–	–	1.05e+01	–
Methacrylonitrile	8.00e+00	–	–	–	3.50e-03	–
SEMIVOLATILE ORGANICS						
Acenaphthene	4.80e+03	–	–	–	2.10e+00	–
Acenaphthylene	–	–	–	–	–	–
Acetophenone	8.00e+03	–	–	–	3.50e+00	–
2-Acetylaminofluorene	–	–	–	–	–	–
4-Aminobiphenyl	–	–	–	–	–	–
Aniline	–	1.23e+02	1.00e+00	–	–	6.14e-03
Anthracene	2.40e+04	–	–	–	1.05e+01	–
Aramite	–	2.80e+01	–	1.40e-01	–	1.40e-03
Benzo(a)anthracene	–	8.33e-01	–	–	–	4.17e-05
Benzo(a)pyrene	–	1.21e-01	–	–	–	6.04e-06
Benzo(b)fluoranthene	–	8.64e-01	–	–	–	4.32e-05
Benzo(g,h,i)perylene	–	5.38e+00	–	–	–	2.69e-04
Benzo(k)fluoranthene	–	1.84e+00	–	–	–	9.21e-05
Benzyl alcohol	2.40e+04	–	–	–	1.05e+01	–
4-Bromophenyl phenyl ether	1.60e+03	–	–	–	7.00e-01	–
Butylbenzylphthalate	1.60e+04	–	–	–	7.00e+00	–
4-Chloro-3-methylphenol	–	–	–	–	–	–
4-Chloroaniline	3.20e+02	–	–	–	1.40e-01	–
Chlorobenzilate	1.60e+03	–	–	–	7.00e-01	–
bis(2-Chloroethoxy)methane	–	–	–	–	–	–
bis(2-Chloroethyl)ether	–	6.36e-01	–	3.03e-03	–	3.18e-05
bis(2-Chloroisopropyl)ether	–	–	–	–	–	–
2-Chloronaphthalene	6.40e+03	–	–	–	2.80e+00	–
2-Chlorophenol	4.00e+02	–	–	–	1.75e-01	–

Table 4-3

(Continued)

Chemical	Soil Action Levels		Air Action Level		Water Action Level	
	(noncarc) (mg/kg)	(carc) (mg/kg)	(noncarc) (μg/m3)	(carc) (μg/m3)	(noncarc) (mg/L)	(carc) (mg/L)
4-Chlorophenyl phenyl ether	–	–	–	–	–	–
Chrysene	–	2.80e+01	–	–	–	1.40e-03
Diallate	–	1.15e+01	–	–	–	5.74e-04
Dibenz(a,h)anthracene	–	1.09e-01	–	–	–	5.47e-06
Dibenzofuran	–	–	–	–	–	–
1,2-Dichlorobenzene	7.20e+03	–	–	–	3.15e+00	–
1,3-Dichlorobenzene	–	–	–	–	–	–
1,4-Dichlorobenzene	–	2.92e+01	–	–	–	1.46e-02
3,3'-Dichlorobenzidine	–	1.56e+00	–	–	–	7.78e-05
2,4-Dichlorophenol	2.40e+02	–	–	–	1.05e-01	–
2,6-Dichlorophenol	–	–	–	–	–	–
Diethylphthalate	6.40e+04	–	–	–	2.80e+01	–
p-Dimethylaminoazobenzene	–	–	–	–	–	–
7,12-Dimethylbenz(a)anthracene	–	–	–	–	–	–
3,3'-Dimethylbenzidine	–	7.61e-02	–	–	–	3.80e-06
Dimethylphenethylamine	–	–	–	–	–	–
2,4-Dimethylphenol	1.60e+03	–	–	–	7.00e-01	–
Dimethylphthalate	–	–	–	–	–	–
4,6-Dinitro-2-methylphenol	–	–	–	–	–	–
Di-n-butylphthalate	8.00e+03	–	–	–	3.50e+00	–
Di-n-octylphthalate	1.60e+03	–	–	–	7.00e-01	–
1,3-Dinitrobenzene	8.00e+00	–	–	–	3.50e-03	–
2,4-Dinitrophenol	1.60e+02	–	–	–	7.00e-02	–
2,4-Dinitrotoluene	1.60e+02	–	–	–	7.00e-02	–
2,6-Dinitrotoluene	–	–	–	–	–	5.15e-05
Diphenylamine	2.00e+03	–	–	–	8.75e-01	–
bis(2-Ethylhexyl)phthalate	1.60e+03	5.00e+01	–	–	7.00e-01	2.50e-03
Ethylmethane sulfonate	–	–	–	–	–	–
Fluoranthene	3.20e+03	–	–	–	1.40e+00	–
Fluorene	3.20e+03	–	–	–	1.40e+00	–
Hexachlorobenzene	6.40e+01	4.38e-01	–	2.17e-03	2.80e-02	2.19e-05
Hexachlorobutadiene	1.60e+02	8.97e+01	–	4.55e-01	7.00e-02	4.49e-03
Hexachlorocyclopentadiene	5.60e+02	–	–	–	2.45e-01	–
Hexachloroethane	8.00e+01	5.00e+02	–	2.50e+00	3.50e-02	2.50e-02
Hexachlorophene	2.40e+01	–	–	–	1.05e-02	–
Hexachloropropene	–	–	–	–	–	–

Table 4-3

(Continued)

Chemical	Soil Action Levels		Air Action Level		Water Action Level	
	(noncarc) (mg/kg)	(carc) (mg/kg)	(noncarc) (μg/m3)	(carc) (μg/m3)	(noncarc) (mg/L)	(carc) (mg/L)
Ideno(1,2,3-c,d)pyrene	–	5.38e-01	–	–	–	2.69e-05
Isophorone	1.60e+04	1.71e+03	–	–	7.00e+00	8.54e-02
Isosafrole	–	–	–	–	–	–
Methapyrilene	–	–	–	–	–	–
3-Methylchloanthrene	–	–	–	–	–	–
Methyl methanesulfonate	–	–	–	–	–	–
2-Methyl naphthalene	–	–	–	–	–	–
2-Methylphenol	4.00e+03	–	–	–	1.75e+00	–
3-Methylphenol	4.00e+03	–	–	–	1.75e+00	–
4-Methylphenol	4.00e+03	–	–	–	1.75e+00	–
Naphthalene	3.20e+03	–	–	–	1.40e-01	–
1,4-Naphthoquinone	–	–	–	–	–	–
1-Naphthylamine	–	–	–	–	–	–
2-Naphthylamine	–	–	–	–	–	–
2-Nitroaniline	–	–	–	–	–	–
3-Nitroaniline	–	–	–	–	–	–
4-Nitroaniline	–	–	–	–	–	–
Nitrobenzene	4.00e+01	–	–	–	1.75e-02	–
2-Nitrophenol	–	–	–	–	–	–
4-Nitrophenol	–	–	–	–	–	–
4-Nitroquinoline-N-oxide	–	–	–	–	–	–
N-Nitroso-di-n-butylamine	–	1.30e-01	–	6.25e-04	–	6.48e-06
N-Nitrosodiethylamine	–	4.67e-03	–	2.33e-05	–	2.33e-07
N-Nitrosodiphenylamine	–	1.43e+02	–	–	–	7.14e-03
N-Nitrosodipropylamine	–	1.00e-01	–	–	–	5.00e-06
N-Nitrosodimethylamine	–	1.37e-02	–	7.14e-05	–	6.86e-07
N-Nitrosomethylethylamine	–	3.18e-02	–	–	–	1.59e-06
N-Nitrosomorpholine	–	–	–	–	–	–
N-Nitrosopiperidine	–	–	–	–	–	–
N-Nitrosopyrrolidine	–	3.33e-01	–	1.64e-03	–	1.67e-05
5-Nitro-o-toluidine	–	–	–	–	–	–
Pentachlorobenzene	6.40e+01	–	–	–	2.80e-02	–
Pentachloroethane	–	–	–	–	–	–
Pentachloronitrobenzene	2.40e+02	–	–	–	1.05e-01	–
Pentachlorophenol	2.40e+03	5.83e+00	–	–	1.05e+00	2.92e-04
Phenacetin	–	–	–	–	–	–

Table 4-3

(Continued)

Chemical	Soil Action Levels		Air Action Level		Water Action Level	
	(noncarc) (mg/kg)	(carc) (mg/kg)	(noncarc) (μg/m3)	(carc) (μg/m3)	(noncarc) (mg/L)	(carc) (mg/L)
Phenanthrene	4.80e+00	–	–	–	2.10e-03	–
Phenol	4.80e+04	–	–	–	2.10e+01	–
p-Phenylenediamine	–	–	–	–	–	–
2-Picoline	–	–	–	–	–	–
Pronamide	6.00e+03	–	–	–	2.63e+00	–
Pyrene	2.40e+03	–	–	–	1.05e+00	–
Pyridine	8.00e+01	–	–	–	3.50e-02	–
Safrole	–	–	–	–	–	–
1,2,4,5-Tetrachlorobenzene	2.40e+01	–	–	–	1.05e-02	–
2,3,4,6-Tetrachlorophenol	2.40e+03	–	–	–	1.05e+00	–
o-Toluidine	–	2.92e+00	–	–	–	1.46e-04
1,2,4-Trichlorobenzene	8.00e+02	–	–	–	4.59e-02	–
2,4,5-Trichlorophenol	8.00e+03	–	–	–	3.50e+00	–
2,4,6-Trichlorophenol	–	6.36e+01	–	3.23e-01	–	3.18e-03
DIOXINS AND FURANS						
2,3,7,8-Tetrachlorodibenzo-p-dioxin	–	4.67e-06	–	3.3e-08	–	2.33e-10
Tetrachlorodibenzo-p-furans [c]	–	4.67e-05	–	–	–	2.33e-09
Pentachlorodibenzo-p-dioxins [c]	–	9.33e-06	–	–	–	4.67e-10
Pentachlorodibenzo-p-furans [c]	–	9.33e-06	–	–	–	4.67e-10
Hexachlorodibenzo-p-dioxins [c]	–	4.67e-05	–	–	–	2.33e-09
Hexachlorodibenzo-p-furans [c]	–	4.67e-05	–	–	–	2.33e-09
GENERAL						
Cyanide	1.60e+03	–	–	–	7.00e-01	–
Sulfide	–	–	–	–	–	–
Total Organic Carbon	–	–	–	–	–	–

Source: Proposed 40 CFR Section 264.521

NOTES:

[a] - Action levels are based on criteria outlined in Table 2-5.

[b] - Maximum Contaminant Level Goals and National Primary Drinking Water Regulations for Lead and Copper. Final rule. Federal Register 56110, Friday, June 7, 1991.

[c] - Value given for 2,3,7,8-isomers; other isomers considered non-carcinogenic and have no health-based action levels.

Table 4-4

USEPA Health-Based Criteria for the Calculation of Proposed Subpart S Action Levels

Chemical	EPA Carc. Class [b]	Oral RfD (mg/kg/d)	Oral SF 1/(kg/kg/d)	Inhalation RfC (mg/m³)	Inhalation Unit Risk 1/(µg/m³)
METALS					
Barium	D	7.00e-02 [a]	ND [a]	U [b]	ND [b]
Beryllium	B2	5.00e-03 [a]	4.30e+00 [a]	ND [b]	2.40e-03 [b]
Cadmium	B1	1.00e-03 [a]	ND [a]	U [b]	1.80e-03 [b]
Chromium (III)	D	1.00e+00 [c]	–	ND [c]	U [c]
Chromium (VI)	A	5.00e-03 [c]	–	U [c]	1.20e-02 [c]
Cobalt		U [a]	ND [a]	ND [b]	ND [b]
Copper	D	4.00e-02 [d]	ND [a]	ND [b]	ND
Nickel	D	2.00e-02 [a]	ND [a]	–	–
Silver	D	5.00e-03 [a]	ND [a]	ND [b]	ND [b]
Tin		6.00e-01 [e]	–	–	–
Vanadium		7.00e-03 [e]	ND [a]	ND [b]	ND [b]
Zinc	D	2.00e-01 [e]	ND [a]	ND [b]	ND [b]
Arsenic	A	3.00e-04 [a]	ND [a]	ND [b]	4.30e-03 [b]
Lead	B2	1.40e-03 [k]	ND [a]	ND [b]	ND [b]
Mercury	D	U [a]	ND [a]	U [b]	ND [b]
Selenium	D	5.00e-03 [a]	ND [a]	ND [b]	ND [b]
Thallium		8.00e-04	–	–	–
ORGANOCHLORINE PESTICIDES AND PCBs					
Aldrin	B2	3.00e-05 [a]	1.70e+01 [a]	ND [b]	4.90e-03 [b]
alpha-BHC	B2	ND [a]	6.30e+00 [a]	ND [b]	1.80e-03 [b]
beta-BHC	C	ND [a]	1.80e+00 [a]	ND [b]	5.30e-04 [b]
delta-BHC	D	ND [a]	–	ND [b]	ND [b]
gamma-BHC (Lindane)	B2/C	3.00e-04 [a]	1.30e+00 [e]	ND [b]	ND [b]
Chlordane (technical)	B2	6.00e-05 [a]	1.30e+00 [a]	ND [b]	3.70e-04 [b]
4,4'-DDD	B2	ND [a]	2.40e-01 [a]	ND [b]	ND [b]
4,4'-DDE	B2	ND [a]	3.40e-01 [a]	ND [b]	ND [b]
4,4'-DDT	B2	5.00e-04 [a]	3.40e-01 [a]	ND [b]	9.70e-05 [b]
Dieldrin	B2	5.00e-05 [a]	1.60e+01 [a]	ND [b]	4.60e-03 [b]
Endosulfan I	D	5.00e-05 [f]	–	–	–

Table 4-4

(Continued)

Chemical	EPA Carc. Class[b]	Oral RfD (mg/kg/d)	Oral SF 1/(kg/kg/d)	Inhalation RfC (mg/m^3)	Inhalation Unit Risk 1/(μg/m^3)
Endosulfan II	D	5.00e-05[f]	–	–	–
Endosulfan sulfate		5.00e-05[f]	–	–	–
Endrin	D	3.00e-04[a]	ND[a]	ND[b]	ND[b]
Endrin aldehyde		–	–	–	–
Heptachlor	B2	5.00e-04[a]	4.50e+00[a]	ND[b]	1.30e-03[b]
Heptachlor epoxide	B2	1.30e-05[a]	9.10e+00[a]	ND[b]	2.60e-03[b]
Isodrin		U[a]	ND[a]	ND[b]	ND[b]
Kepone		–	–	–	–
Methoxychlor		5.00e-03[a]	ND[a]	U[b]	ND[b]
Toxaphene	B2	ND[a]	1.10e+00[a]	ND[b]	3.20e-04[b]
PCB-1016	B2	ND[a]	7.70e+00[a]	ND[b]	ND[b]
PCB-1221	B2	ND[a]	7.70e+00[a]	ND[b]	ND[b]
PCB-1323	B2	ND[a]	7.70e+00[a]	ND[b]	ND[b]
PCB-1242	B2	ND[a]	7.70e+00[a]	ND[b]	ND[b]
PCB-1248	B2	ND[a]	7.70e+00[a]	ND[b]	ND[b]
PCB-1254	B2	ND[a]	7.70e+00[a]	ND[b]	ND[b]
PCB-1260	B2	ND[a]	7.70e+00[a]	ND[b]	ND[b]
ORGANOPHOSPHORUS PESTICIDES					
Dimethoate	D	2.00e-04[a]	ND[a]	ND[b]	ND[b]
Disulfoton	D	4.00e-05[a]	ND[a]	ND[b]	ND[b]
Ethyl parathion (parathion)	C	6.00e-03	ND[a]	ND[b]	ND[b]
Famphur		U[a]	ND[a]	ND[b]	ND[b]
Parathion methyl	D	2.50e-04[a]	ND[a]	ND[b]	ND[b]
Phorate		ND[a]	ND[a]	ND[b]	ND[b]
Sulfotepp		5.00e-04[a]	ND[b]	ND[b]	ND[b]
Thionazin		–	–	–	–
o,o,o-Triethylphosphorthioate		–	–	–	–
CHLORINATED HERBICIDES					
2,4-D		1.00e-02[a]	ND[a]	ND[b]	ND[b]
2,4,5-T		1.00e-02[a]	ND[a]	ND[b]	ND[b]
2,4,5-TP (Silvex)		8.00e-03[a]	ND[a]	ND[b]	ND[b]

Table 4-4

(Continued)

Chemical	EPA Carc. Class [b]	Oral RfD (mg/kg/d)	Oral SF 1/(kg/kg/d)	Inhalation RfC (mg/m^3)	Inhalation Unit Risk 1/(μg/m^3)
Dinoseb		1.00e-03 [a]	ND [a]	ND [b]	ND [b]
VOLATILE ORGANICS					
Acetone	D	1.00e-01 [a]	ND [a]	ND [b]	ND [b]
Acetonitrile	D	6.00e-03 [a]	ND [a]	U [b]	ND [b]
Acrolein		1.00e-01 [a]	ND [a]	2.00e-05 [b]	ND [b]
Acrylonitrile	B1	ND [a]	5.40e-01 [a]	2.00e-03 [b]	6.80e-05 [b]
Benzene	A	–	2.90e-02 [a]	U [b]	8.30e-06 [b]
Bromodichloromethane	B2	2.00e-02 [b]	1.30e-01 [a]	ND [b]	ND [b]
Bromomethane	D	1.40e-03 [a]	ND [a]	5.00e-05 [b]	ND [b]
Carbon disulfide	D	1.00e-01 [a]	ND [a]	U [b]	ND [b]
Carbon tetrachloride	B2	7.00e-04 [a]	1.30e-01 [a]	ND [b]	1.50e-05 [b]
2-Chloro-1,3-butadiene		2.00e-02 [c]	–	7.00e-03	ND [b]
Chlorobenzene	D	2.00e-02 [a]	ND [a]	U [b]	ND [b]
Chloroethane		ND [a]	ND [a]	1.00e+01 [b]	ND [b]
Chloroform	B2	1.00e-02 [a]	6.10e-03 [a]	U [b]	2.30e-05 [b]
Chloromethane	C	U [a]	ND [a]	U [b]	ND [b]
3-Chloropropene (allyl chloride)		ND [a]	ND [a]	1.00e-03 [b]	ND [b]
Dibromochloromethane	C	2.00e-02 [a]	8.40e-02 [a]	ND [b]	ND [b]
1,2-Dibromo-3-chloropropane	B2	ND [a]	ND [a]	2.00e-04 [b]	2.4e-03
1,2-Dibromoethane	B2	U [a]	8.50e+01 [a]	U [b]	2.20e-04 [b]
Dibromomethane	B2	ND [a]	8.50e+01 [a]	U [b]	ND [b]
trans-1,4-Dichloro-2-butene		–	–	–	2.60e-03 [b]
Dichlorodifluoromethane	D	2.00e-01 [a]	ND [a]	ND [b]	ND [b]
1,2-Dichloroethane	B2	ND [a]	9.10e-02 [a]	ND [b]	2.60e-05 [b]
trans-1,2-Dichloroethene		2.00e-02 [a]	ND [a]	ND [b]	ND [b]
1,1-Dichloroethane	C	1.00e-01 [c]	ND [a]	U	ND [b]
1,1-Dichloroethene	C	9.00e-03 [a]	6.00e-01 [a]	U [b]	5.00e-05 [b]
1,2-Dichloropropane	B2	ND [a]	6.80e-02 [c]	4.00e-03 [b]	ND [b]
cis-1,3-Dichloropropene	B2	3.00e-04 [g]	1.80e-01 [g]	2.00e-02 [g]	3.70e-05 [g]
trans-1,3-Dichloropropene	B2	3.00e-04 [g]	1.80e-01 [g]	2.00e-02 [g]	3.70e-05 [g]
Ethyl benzene	D	1.00e-01 [a]	–	1.00e+00 [b]	ND [b]

Table 4-4

(Continued)

Chemical	EPA Carc. Class[b]	Oral RfD (mg/kg/d)	Oral SF 1/(kg/kg/d)	Inhalation RfC (mg/m^3)	Inhalation Unit Risk 1/(μg/m^3)
Ethyl methacrylate		9.00e-02[e]	ND[a]	ND[b]	ND[b]
2-Hexanone		–	ND[a]	ND[b]	ND[b]
Iodomethane		–	–	–	–
Methylene chloride	B2	6.00e-02[a]	7.50e-03[a]	U[b]	4.70e-07[b]
2-Butanone (MEK)	D	5.00e-02[e]	ND[a]	U[b]	ND[b]
Methyl methacrylate		8.00e-02[e]	ND[a]	ND[b]	ND[b]
4-Methyl-2-pentanone (MIBK)		5.00e-02[e]	–	U[b]	ND[b]
Propanenitrile (propionitrile)		–	–	–	–
Styrene	B2	2.00e-01[a]	–	1[e]	ND[b]
1,1,1,2-Tetrachloroethane	C	3.00e-02[a]	2.60e-02[a]	ND[b]	ND[b]
1,1,2,2-Tetrachloroethane	C	U[a]	2.00e-01[a]	ND[b]	5.80e-05[b]
Tetrachloroethene	B2	1.00e-02[a]	5.10e-02[e]	ND[b]	ND[b]
Toluene	D	2.00e-01[a]	ND[a]	U[b]	ND[b]
Tribromomethane	B2	2.00e-02[a]	7.90e-03[a]	ND[b]	1.10e-06[b]
1,1,1-Trichloroethane	D	9.00e-02[e]	ND[a]	U[b]	ND[b]
1,1,2-Trichloroethane	C	4.00e-03[a]	5.70e-02[a]	U[b]	1.65e-05[b]
Trichloroethene	B2	U[a]	–	U[b]	ND[b]
Trichlorofluoromethane	D	3.00e-01[a]	ND[a]	ND[b]	ND[b]
1,2,3-Trichloropropane		6.00e-03[a]	ND[a]	ND[b]	ND[b]
Vinyl Acetate		1.00e+00[e]	ND[a]	2.00e-01[b]	ND[b]
Vinyl Chloride	A	ND[a]	1.90e+00[c]	ND[b]	ND[b]
Xylenes (total)	D	2.00e+00[a]	ND[a]	U[b]	ND[b]
VOLATILE ORGANICS (Direct Injection)					
1,4-Dioxane	B2	1.00e-01[a]	1.10e-02[a]	ND[b]	ND[b]
Isobutanol		3.00e-01[a]	ND[a]	ND[b]	ND[b]
Methacrylonitrile		1.00e-04[a]	ND[a]	ND[b]	ND[b]
SEMIVOLATILE ORGANICS					
Acenaphthene		6.00e-02[a]	ND[a]	ND[b]	ND[b]
Acenaphthylene		U[a]	ND[a]	ND[b]	ND[b]
Acetophenone	D	1.00e-01[c]	–	U[b]	ND[b]
2-Acetylaminofluorene		–	–	–	–

Table 4-4

(Continued)

Chemical	EPA Carc. Class[b]	Oral RfD (mg/kg/d)	Oral SF 1/(kg/kg/d)	Inhalation RfC (mg/m^3)	Inhalation Unit Risk 1/(μg/m^3)
4-Aminobiphenyl		–	–	–	–
Aniline	B2	ND[a]	5.70e-03[c]	1.00e-03[b]	ND[b]
Anthracene	D	3.00e-01[a]	ND[a]	ND[b]	ND[b]
Aramite	B2	U[a]	2.50e-02[a]	ND[b]	7.16e-06[b]
Benzo(a)anthracene	B2	ND[a]	8.40e-01[h]	ND[b]	ND[b]
Benzo(a)pyrene	B2	ND[a]	5.79e+00[a]	ND[b]	ND[b]
Benzo(b)fluoranthene	B2	ND[a]	8.10e-01[h]	ND[b]	ND[b]
Benzo(g,h,i)perylene		ND[a]	1.30e-01[h]	ND[b]	ND[b]
Benzo(k)fluoranthene	B2	–	3.80e-01[h]	ND[b]	ND[b]
Benzyl alcohol		3.00e-01[c]	–	–	–
4-Bromophenyl phenyl ether		2.00e-02[a]	ND[a]	ND[b]	ND[b]
Butylbenzylphthalate	C	2.00e-01[a]	ND[a]	ND[b]	ND[b]
4-Chloro-3-methylphenol		–	–	ND[b]	ND[b]
4-Chloroaniline		4.00e-03[a]	ND[a]	ND[b]	ND[b]
Chlorobenzilate		2.00e-02[a]	ND[a]	ND[b]	ND[b]
bis(2-Chloroethoxy)methane		ND[a]	ND[a]	ND[b]	ND[b]
bis(2-Chloroethyl)ether	B2	ND[a]	1.10e+00[a]	U[b]	3.30e-04[b]
bis(2-Chloroisopropyl)ether		–	–	–	–
2-Chloronaphthalene		8.00e-02[a]	ND[a]	ND[b]	ND[b]
2-Chlorophenol	D	5.00e-03[a]	ND[a]	ND[b]	ND[b]
4-Chlorophenyl phenyl ether		–	–	–	–
Chrysene		ND[a]	2.50e-02[h]	ND[b]	ND[b]
Diallate	B2	–	6.10e-02[c]	–	–
Dibenz(a,h)anthracene	B2	ND[a]	6.40e+00[h]	ND[b]	ND[b]
Dibenzofuran		ND[a]	ND[a]	U[b]	ND[b]
1,2-Dichlorobenzene		9.00e-02[a]	ND[a]	ND[b]	ND[b]
1,3-Dichlorobenzene		ND[a]	ND[a]	ND[b]	ND[b]
1,4-Dichlorobenzene	C	ND[a]	2.40e-02[a]	ND[b]	ND[b]
3,3'-Dichlorobenzidine	B2	ND[a]	4.50e-01[a]	U[b]	ND[b]
2,4-Dichlorophenol	D	3.00e-03[a]	ND[a]	ND[b]	ND[b]
2,6-Dichlorophenol		–	–	–	–

Table 4-4

(Continued)

Chemical	EPA Carc. Class[b]	Oral RfD (mg/kg/d)	Oral SF 1/(kg/kg/d)	Inhalation RfC (mg/m^3)	Inhalation Unit Risk 1/(μg/m^3)
Diethylphthalate	D	8.00e-01[a]	ND[a]	ND[b]	ND[b]
p-Dimethylaminoazobenzene		–	–	–	–
7,12-Dimethylbenz(a)anthracene		–	–	–	–
3,3'-Dimethylbenzidine	B2	ND[a]	9.20e+00[e]	U[b]	ND[b]
Dimethylphenethylamine		–	–	–	–
2,4-Dimethylphenol		2.00e-02[a]	ND[a]	ND[b]	ND[b]
Dimethylphthalate		U[a]	ND[a]	U[b]	ND[b]
4,6-Dinitro-2-methylphenol		–	–	–	–
Di-n-butylphthalate	D	1.00e-01[a]	ND[a]	U[b]	ND[b]
Di-n-octylphthalate		2.00e-02[e]	ND[a]	ND[b]	ND[b]
1,3-Dinitrobenzene	D	1.00e-04[a]	ND[a]	ND[b]	ND[b]
2,4-Dinitrophenol	D	2.00e-03[a]	ND[a]	U[b]	ND[b]
2,4-Dinitrotoluene		2.00-03[c]	ND[a]	U[b]	ND[b]
2,6-Dinitrotoluene	B2	U[a]	ND[c]	ND[b]	ND[b]
Diphenylamine	D	2.50e-02[a]	ND[a]	ND[b]	ND[b]
bis(2-Ethylhexyl)phthalate	B2	2.00e-02[a]	1.40e-02[a]	ND[b]	ND[b]
Ethylmethane sulfonate		–	–	–	–
Fluoranthene		4.00e-02[a]	ND[a]	ND[b]	ND[b]
Fluorene		4.00e-02[a]	ND[a]	ND[b]	ND[b]
Hexachlorobenzene	B2	8.00e-04[a]	1.60e+00[a]	U[b]	4.60e-04[b]
Hexachlorobutadiene	C	2.00e-03[a]	7.80e-02[a]	U[b]	2.20e-05[b]
Hexachlorocyclopentadiene	D	7.00e-03[a]	ND[a]	ND[b]	ND[b]
Hexachloroethane	C	1.00e-03[a]	1.40e-02[a]	U[b]	4.00e-06[b]
Hexachlorophene	D	3.00e-04[a]	ND[a]	ND[b]	ND[b]
Hexachloropropene		–	–	–	–
Ideno(1,2,3-c,d)pyrene	B2	ND[a]	1.30e+00[h]	ND[b]	ND[b]
Isophorone	C	2.00e-01[a]	4.10e-03[a]	U[b]	ND[b]
Isosafrole		–	–	–	–
Methapyrilene		–	–	–	–
3-Methylchloanthrene		–	–	–	–
Methyl methanesulfonate		–	–	–	–

Table 4-4

(Continued)

Chemical	EPA Carc. Class[h]	Oral RfD (mg/kg/d)	Oral SF 1/(kg/kg/d)	Inhalation RfC (mg/m³)	Inhalation Unit Risk 1/(µg/m³)
2-Methyl naphthalene		–	–	–	–
2-Methylphenol	D	5.00e-02[a]	ND[a]	U[b]	ND[b]
3-Methylphenol	D	5.00e-02[a]	ND[a]	U[b]	ND[b]
4-Methylphenol	C	5.00e-02[e]	ND[a]	U[b]	ND[b]
Naphthalene	D	4.00e-02[e]	ND[a]	ND[b]	ND[b]
1,4-Naphthoquinone		U[a]	ND[a]	ND[b]	ND[b]
1-Naphthylamine		–	–	–	–
2-Naphthylamine		ND[a]	ND[a]	ND[b]	ND[b]
2-Nitroaniline		–	–	–	–
3-Nitroaniline		–	–	–	–
4-Nitroaniline		–	–	–	–
Nitrobenzene		5.00e-04[a]	ND[a]	U[b]	ND[b]
2-Nitrophenol		–	–	–	–
4-Nitrophenol		U[a]	ND[a]	U[b]	ND[b]
4-Nitroquinoline-N-oxide		–	–	–	–
N-Nitroso-di-n-butylamine	B2	ND[a]	5.40e+00[a]	U[b]	1.60e-03[b]
N-Nitrosodiethylamine	B2	ND[a]	1.50e+02[a]	ND[b]	4.30e-02[b]
N-Nitrosodiphenylamine	B2	ND[a]	4.90e-03[a]	ND[b]	ND[b]
N-Nitrosodipropylamine	B2	ND[a]	7.00e+00[a]	ND[b]	ND[b]
N-Nitrosodimethylamine	B2	ND[a]	5.10e+01[a]	ND[b]	1.40e-02[b]
N-Nitrosomethylethylamine	B2	ND[a]	2.20e+01[a]	ND[b]	ND[b]
N-Nitrosomorpholine		–	–	–	–
N-Nitrosopiperidine		–	–	–	–
N-Nitrosopyrrolidine	B2	ND[a]	2.10e+00[a]	ND[b]	6.10e-04[b]
5-Nitro-o-toluidine		–	–	–	–
Pentachlorobenzene	D	8.00e-04[a]	ND[a]	ND[b]	ND[b]
Pentachloroethane		–	–	–	–
Pentachloronitrobenzene	C	3.00e-03[a]	ND[a]	ND[b]	ND[b]
Pentachlorophenol	B2	3.00e-02[a]	1.20e-01[a]	U[b]	ND[b]
Phenacetin		–	–	–	–
Phenanthrene	D	6.00e-05[i]	ND[a]	ND[b]	ND[b]

Table 4-4

(Continued)

Chemical	EPA Carc. Class [b]	Oral RfD (mg/kg/d)	Oral SF 1/(kg/kg/d)	Inhalation RfC (mg/m³)	Inhalation Unit Risk 1/(µg/m³)
Phenol	D	6.00e-01[a]	ND[e]	U[b]	ND[b]
p-Phenylenediamine		–	–	–	–
2-Picoline		–	–	–	–
Pronamide	D	7.50e-02[a]	ND[a]	ND[b]	ND[b]
Pyrene	D	3.00e-02[a]	ND[a]	ND[b]	ND[b]
Pyridine	D	1.00e-03[a]	ND[a]	ND[b]	ND[b]
Safrole		–	–	–	–
1,2,4,5-Tetrachlorobenzene	D	3.00e-04[a]	ND[a]	ND[b]	ND[b]
2,3,4,6-Tetrachlorophenol	D	3.00e-02[a]	ND[a]	ND[b]	ND[b]
o-Toluidine	B2	–	2.40e-01[e]	–	–
1,2,4-Trichlorobenzene	D	1.00e-02[e]	ND[a]	ND[b]	ND[b]
2,4,5-Trichlorophenol	D	1.00e-01[a]	ND[a]	ND[b]	ND[b]
2,4,6-Trichlorophenol	B2	ND[a]	1.10e-02[a]	U[b]	3.10e-06[b]
DIOXINS AND FURANS					
2,3,7,8-Tetrachlorodibenzo-p-dioxin	B2	–	1.50e+05[e]	–	3.30e-11[e]
Tetrachlorodibenzo-p-furans[c]		–	1.5e+04[j]	–	–
Pentachlorodibenzo-p-dioxins		–	7.5e+04[j]	–	–
Pentachlorodibenzo-p-furans		–	7.5e+04[j]	–	–
Hexachlorodibenzo-p-dioxins	B	–	1.5e+04[j]	–	–
Hexachlorodibenzo-p-furans		–	1.5e+04[j]	–	–
GENERAL					
Cyanide	D	2.00e-02[a]	ND[a]	ND[b]	ND[b]
Sulfide		–	–	–	–
Total Organic Carbon		–	–	–	–

NOTES:

[a] - U.S. Environmental Protection Agency (EPA), 1992b. Integrated Risk Information System (IRIS). May 12, 1992.

[b] - U.S. Environmental Protection Agency (EPA), 1992b. Integrated Risk Information System (IRIS). May 28, 1992.

[c] - IRIS, September 15, 1992.

[d] - Calculated based on drinking water MCL from: U.S. Environmental Protection Agency (EPA), 1991a. Drinking Water Regulations and Health Advisories. Office of Water, Washington, D.C. April, 1991.

[e] - U.S. Environmental Protection Agency (EPA), 1992a. Health Effects Assessment Summary Tables (HEAST). Annual FY-1992. NTIS No. PB92-921199. March, 1992.

[f] - RFD for endosulfan used (HEAST FY1992).

[g] - Calculated based on HBLs for 1,3-dichloropropene from IRIS, May 12 and 28 1992.

Table 4-4

(Continued)

[h] - Calculated using comparative potency approach in: Clement Associates, Inc., 1988. Comparative Potency Approach for Estimating the Cancer Risk Associated with the Exposure to Mixtures of Polycyclic Aromatic Hydrocarbons. ICF-Clements Associates, Inc., Fairfax, Virginia. April 1, 1988.

[i] - Calculated based on HBL from: U.S. Environmental Protection Agency (EPA), 1990. Docket Report on Health-Based Levels and Solubilities Used in the Evaluation of Delisting Petitions Submitted Under 40 CFR Parts 260.20 and 260.22. EPA 68-W9-0091, 1990.

[j] - Calculated based on toxicity equivalency factor (TEF) approach in: U.S. Environmental Protection Agency (EPA), 1989. "1989 Update to the Interim Procedures for Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzo-p-Dioxins and - Dibenzofurans (CDDs and CDFs)." EPA Risk Assessment Forum, Washington D.C. March, 1989. Value given is for 2,3,7,8-isomer, other isomers are considered non-carcinogenic and have no HBLs or action levels.

[k] - Calculated based on action level for lead in water at the tap in: U.S. Environmental Protection Agency (EPA), 1991b. "Maximum Contaminant Level Goals and National Primary Drinking Water Regulations for Lead and Copper; Final Rule." Federal Register 56110, Friday, June 7, 1991.

ND - No data available.

U - Under review.

– Not listed on IRIS or HEAST.

Because the RCRA Subpart S rules have not been promulgated, the media action levels are TBC information only.

4.2.4 USEPA RCRA Proposed Corrective Action Media Protection (Cleanup) Standards

40 CFR Part 264, Subpart S, Section 264.521 (proposed 27 July 1990, 55 Fed. Reg. 30798 et seq.)

Media cleanup standards are contaminant concentrations that must be achieved by the remedial action under the proposed RCRA corrective action program. Media cleanup standards must 1) ensure protection of human health and the environment; 2) be set for each medium of concern during the remedy selection process; and 3) be met at the "point of compliance" specified in Section 264.525(e) of Subpart S. The USEPA is proposing to set media cleanup standards within the overall context of the remedy selection process. Because media cleanup standards are still in the proposed stage, they are TBC information for Landfill No. 3 and, if used, would be based on action levels in conjunction with site-specific risk assessments.

4.2.5 Polychlorinated Biphenyls (PCBs)

In 1987, USEPA adopted amendments to the PCB regulations establishing spill cleanup requirements ("PCB cleanup policy"). These requirements apply to PCB spills which occur after 4 May 1987 (effective date). Spills that occurred before the effective date are excluded from the scope of the PCB cleanup policy. The cleanup requirements for those "historic" spills are established on a discretionary basis through the USEPA regional offices.

4.2.6 Total Petroleum Hydrocarbons (TPH) Standards

New Mexico Underground Storage Tank Regulations

New Mexico Underground Storage Tank (UST) Regulations are the only standards available for remediation of soils contaminated with petroleum hydrocarbons. The New Mexico UST regulations, which are to be considered during remediation, state that decontamination of soil will be complete when:

1. Soil contamination has been reduced to a level which will not contaminate groundwater;

2. No highly contaminated soils remain in the ground; and

3. An analysis of what appears to be the most contaminated soil reveals, for soils contaminated by jet aviation fuel or other heavy petroleum product, that the total petroleum hydrocarbon value is less than 100 ppm, total aromatic hydrocarbon value is less than 50 ppm, and the benzene concentration is less than 10 ppm using an appropriate laboratory test in areas where the underlying groundwater contains 10,000 milligrams per liter or less total dissolved solids and the contaminated soil is 50 feet or less above the seasonal high static groundwater level.

4.3 Location-Specific ARARs

Location-specific ARARs are requirements that affect the management of hazardous constituents, or the units in which they are managed, due to the location of the units. Location-specific ARARs might be triggered, for example, if groundwater remediation were selected as a remedial action which required the construction of new surface wastewater treatment units. Examples of sensitive locations for such units include wetlands, floodplains, historic areas, and wildlife refuges. Federal and state location-specific ARARs are set forth in Table 4-5.

Table 4-5

Potential Location-Specific ARARs

Statutory, Regulatory Basis	Citation	Description
Resource Conservation and Recovery Act	40 CFR Sec. 264.18 18 AAC Sec. 63.040	Prohibits or restricts siting of hazardous waste management units in certain sensitive areas (100-year floodplain, active seismic area, wetlands).
Migratory Bird Treaty Act of 1972	16 USC Sec. 703-712 50 CFR Parts 10, 20, 21	If migratory birds are present, provides protection of almost all species of native birds in the U.S. from unregulated activities. Unregulated activities can include poisoning at hazardous waste sites.
Fish and Wildlife Conservation Act of 1980	16 USC Sec. 2901 50 CFR Part 83	Requires the submittal of conservation plans outlining provisions to conserve non-game fish and wildlife. Approved conservation plans are enforced by state agencies.
Federal Land Policy and Management Act	13 USC Sec. 1700 et seq.	Establishes requirements concerning utilization of public lands, particularly rights-of-way regulation, land use planning and land acquisition and appropriation of waters on public lands.
Fish and Wildlife Improvement Act	16 USC Sec. 661-666c	Provides for development, protection, rearing, and stocking of all species of wildlife, wildlife resources, and their habitat.
Endangered Species Act	16 USC 1531 et seq. 50 CFR Part 200 50 CFR Part 402	Provides for protection and conservation of various species of fish, wildlife, and plants.
New Mexico Wildlife Conservation Act	NMSA, Sections 17-2-37 through 17-2-46	Includes an amended listing of endangered wildlife in New Mexico.
Clean Water Act, Section 404	33 USC 1251 et seq. Sec. 404 40 CFR Part 230	Prohibits discharge of dredged or fill material into wetlands without a permit.
Fish and Wildlife Improvement Act	33 CFR 320-330	Provides for management of dredged material; establish requirements for structures affecting navigable waterways; and provides for certain permitting requirements.
Archaeological and Historic Preservation Act	16 USC Sec. 469 40 CFR 6.301(c)	Establishes procedures for preservation of historical and archaeological resources when terrain is altered as a result of a federal or federally licensed construction activity.
National Historic Preservation Act	16 USC Sec. 470 40 CFR Sec. 6.301(b) 36 CFR Part 800	Provides for the protection of historic places.
Historic Sites, Buildings, and Antiquities Act	16 USC Sec. 461-467	Provides for the protection of natural landmarks.

4.4 Action-Specific ARARs

Action-specific ARARs are technology-based or activity-based requirements that may be triggered by the particular remedial activities chosen. The action-specific requirements do not in themselves determine the remedial alternatives, rather they place restrictions on the manner in which a selected alternative may be achieved. Table 4-6 lists potential action-specific requirements pursuant to each federal and state environmental law. Because this landfill does not fall strictly under the RCRA requirements for closure, a risk-based "no further action" under CERCLA is an option.

Table 4-6

Potential Action-Specific Federal ARARs
Landfill No. 3, Cannon AFB, New Mexico

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comments/ Applicability
Solid Waste Disposal Act	42 USC Sec. 6901-6987	Resource Conservation and Recovery	
Criteria for Classification of Solid Waste Disposal Facilities and Practices	40 CFR Part 257	Establishes criteria for use in determining which solid waste disposal facilities and practices pose a reasonable probability of adverse effects on health or the environment and thereby prohibit open dumps.	Landfilling
Criteria for Municipal Solid Waste Disposal Facilities	40 CFR Part 258	Establishes minimum federal criteria for design, construction, operation, and permitting of municipal solid waste landfills.	
Identification and Listing of Hazardous Waste	40 CFR Part 261	Defines those solid wastes which are subject to regulation as hazardous waste.	
Standards Applicable to Generators of Hazardous Waste	40 CFR Part 262	Establishes standards for generators of hazardous waste	Remedial action causes hazardous waste to be generated
Standards Applicable to Transporters of Hazardous Waste	40 CFR Part 263	Establishes standards which apply to persons transporting hazardous waste within the U.S.	Transport of wastes offsite
Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities	40 CFR Part 264	Establishes minimum national standards which define the acceptable management of hazardous waste for owners and operators of facilities which treat, store, or dispose of hazardous waste.	

Table 4-6

(Continued)

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comments/ Applicability
Interim Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities	40 CFR Part 265	Establishes minimum national standards that define the acceptable management of hazardous waste during the period of interim status and until certification of final closure or, if the facility is subject to post-closure requirements, until post-closure responsibilities are fulfilled.	
Standards for Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities	40 CFR Part 266	Establishes requirements which apply to recyclable materials used in a manner constituting disposal or hazardous waste burned for energy recovery.	Hazardous wastes are recycled on or offsite
Interim Standards for Owners and Operators of New Hazardous Waste Land Disposal Facilities	40 CFR Part 267	Establishes minimum national standards that define acceptable management of hazardous waste land disposal facilities.	Landfilling onsite
Land Disposal Restrictions Program	40 CFR Part 268	Sets treatment standards for hazardous wastes based on the levels achievable by current technology; sets two-year national variances from the statutory effective dates due to insufficient treatment capacity.	Off-site land disposal of liquid wastes
Hazardous Waste Permit Program	40 CFR Part 270	Establishes provisions covering basic EPA permitting requirements.	
Technical Standards and Corrective Action Requirements for Owners and Operators of Underground Storage Tanks (USTs)	40 CFR Part 280	Provides regulations pertaining to underground storage tanks.	Operation or removal of an UST
Clean Water Act	33 USC Sec. 1251-1376		
EPA-Administered Permit Programs: The National Pollutant Discharge Elimination System	40 CFR Part 122	Requirements for the discharge of pollutants from any point source into waters of the U.S.	Applicable if remedial action requires outfall discharge

Table 4-6

(Continued)

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comments/ Applicability
Criteria and Standards for the National Pollutant Discharge Elimination System	40 CFR Part 125	Provides discharge criteria, chemical standards, and permit forms for existing industrial operations.	Applicable to remedial actions which cause discharge to waters of the U.S.
Occupational Safety and Health Act of 1970	29 USC Sec. 657 and 667		
Occupational Safety and Health Standards	29 CFR Part 1910	Sets standards for safety in the work environment.	Applicable to all remedial actions
Safety and Health Regulations for Construction	29 CFR Part 1926	Sets standards for safety in the construction work environment.	
Safety and Health Standards for Federal Service Contracts	29 CFR Part 1925	States that safety and health standards are applicable to work performed under Federal Service Contracts.	
Clean Air Act			
National Emissions Standards for Hazardous Air Pollutants	40 CFR Part 61	Establishes emissions standards for hazardous air pollutants that may reasonably be anticipated to result in an increase in mortality or an increase in serious irreversible, or incapacitating illness.	Incineration, storage of petroleum liquids; air stripping
National Primary and Secondary Ambient Air Quality Standards	40 CFR Part 50	Establishes standards for ambient air quality to protect public health and welfare.	
Safe Drinking Water Act	40 USC Sec. 300G		
Underground Injection Control Program	40 CFR Part 144	Provides for protection of underground sources of drinking water.	Underground injection of wastes/ contaminated water
Underground Injection Control Program: Criteria and Standards	46 CFR Part 146	Provides technical requirements for UIC programs.	

Table 4-6

(Continued)

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comments/ Applicability
Department of Transportation - Hazardous Materials Regulations			
Shipping and Manifesting Requirements for Hazardous Waste	49 CFR Parts 171-179	Provides requirements for packaging, manifesting, and transportation of hazardous waste.	Applicable to all Remedial Actions

Table C-1

(Continued)

Sample Number	Depth	Metals (mg/kg)													Purgeable Organics[a] (EPA 8010/8020) (µg/kg)
		Ag	As	Ba	Cd	Cr	Cu	Fe	Hg	Ni	O/G	Pb	Se	Zn	
3H-3	57.5-58.0'	0.40	<0.20	51	<0.20	<0.50	<0.50	600	<0.05	<0.30	25	0.78	<0.18	0.31	<1.0
3I-1	0-2'	0.87	<0.20	47	0.35	4.9	1.0	4500	<0.05	3.8	45	4.2	<0.18	6.1	<1.0
3I-2	7-9'	0.25	<0.20	54	<0.20	2.2	<0.50	2400	<0.05	1.6	35	2.9	<0.18	3.7	<1.0
3I-3	57.5-59.5'	<0.20	<0.20	18	<0.20	<0.50	<0.50	1100	<0.05	<0.30	<10	0.81	<0.18	<0.30	<1.0

[a] - 8010 analyte list:

Chloromethane
Bromomethane
Vinyl Chloride
Chloroethane
Methylene Chloride
Trichlorofluoromethane
1,1-Dichloroethene
1,1-Dichloroethane
trans-1,2-Dichloroethene
Chloroform
1,2-Dichloroethane
1,1,1-Trichloroethane
Carbon Tetrachloride
Bromodichloromethane
1,2-Dichloropropane
trans-1,3-Dichloropropene
Trichloroethene
Dibromochloromethane
1,1,2-Trichloroethane
cis-1,3-Dichloropropene
2-Chloroethylvinyl Ether
Bromoform
1,1,2,2-Tetrachloroethane
Tetrachloroethylene
Chlorobenzene
1,3-Dichlorobenzene
1,2-Dichlorobenzene
1,4-Dichlorobenzene

8020 analyte list:

Benzene
Toluene
Ethyl Benzene
1,3-Dichlorobenzene
1,2-Dichlorobenzene
1,4-Dichlorobenzene

[b] - Duplicate sample.

5.0 ANALYTICAL RESULTS

This section contains the field data from the 1985 (Radian, 1986) and 1992 sampling events at Landfill No. 3 and relevant conclusions made from these data. The following subsections present:

- Overview of the 1985 and 1992 sampling events and the tabulation of the detailed analytical results;
- Comparison of the field metals data to background soil metals data;
- Description of organic contaminants founds at the site;
- Comparison of the field data to the recommended soil action levels listed in the RCRA proposed Subpart S Media Action Levels (40 CFR, Section 264.521); and
- Conclusions and recommendations.

5.1 Analytical Results

In 1985, nine boreholes were drilled at the Landfill No. 3 site. Three samples from each borehole were generated, one corresponding to a 0 to 4 foot depth interval, one at about 7 to 11.5 feet, and one at about 55.5 to 59.5 feet. The 1985 sampling effort resulted in 28 field samples which were analyzed for halogenated volatile organics, aromatic volatile organics, metals, and oil and grease. Table 5-1 lists the analytical methods used to determine each of the parameters used to characterize the Landfill No. 3 samples. The results for these analyses are given in Appendix C, Table C-1 and will be discussed in following subsections.

The 1985 results indicated that there was no evidence of past waste disposal activities associated with Landfill No. 3 which would result in a threat to human health or the environment. However, further review of the Decision Document based on

Table 5-1

Analytical Methods Used to Characterize Landfill No. 3, Cannon AFB, New Mexico

Parameter	Method
1985 Analytical Methods	
Halogenated Volatile Organics	SW 8010
Aromatic Volatile Organics	SW 8020
Metals - ICPES Hg by CVAAS As by GFAAS Pb by GFAAS Se by GFAAS	SW 6010 SW 7471 SW 7060 SW 7421 SW 7740
Oil and Grease	E418.1 Modified
1992 Analytical Methods	
Organochlorine Pesticides and PCBs	SW 8080
Volatile Organic Compounds	SW 8240
Semivolatile Organic Compounds	SW 8270
Total Recoverable Petroleum Hydrocarbons	SW 9071/EPA 418.1 [a]
TAL Metals - ICPES Hg by CVAAS As by GFAAS Pb by GFAAS Se by GFAAS Sb by GFAAS Tl by GFAAS	SW 6010 SW 7471 SW 7060 SW 7421 SW 7740 SW 7041 SW 7841
Total Extractable Hydrocarbons	SW 8015 ME [b]
Total Purgeable Hydrocarbons	SW 8015 MP [b]
Chlorinated Herbicides	SW 8150

[a] - EPA 418.1 was used to analyze the extract generated using SW 9071.
[b] - SW 8015 was modified according to California LUFT.

the 1985 data (EA Engineering, 1990), resulted in a request to perform additional sampling and analyses of the soils in the 20 to 60 foot depth interval at Landfill No. 3.

Twelve additional boreholes were drilled in 1992. Six to twelve samples were generated at depth intervals ranging from 20 to 61 feet for each borehole. Three surface soils were also sampled. This effort resulted in one hundred and forty-four field samples which were analyzed for organochlorine pesticides, polychlorinated biphenyls (PCBs), volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), total recoverable petroleum hydrocarbons (TRPH), and total analyte list (TAL) metals. In addition, 41 of these samples were also analyzed for total extractable hydrocarbons (diesel, jet fuel, and kerosene), total purgeable hydrocarbons (gasoline and its components), and chlorinated herbicides. Table 5-1 lists the analytical methods used to analyze these samples. The results of these analyses are presented in Appendix C, Tables C-2 and C-3 and will be discussed in the following subsections. Please note that Appendix C does not contain "J-flagged" data, which are data greater than the instrument detection limit, but less than the reporting limit. All results less than the reporting limit are given as "(reporting limit)". The J-flagged data was used in the risk assessment and are presented in Appendix D.

5.2 Comparison of Field and Site Specific Background Metals Data

Site specific background metals data were determined from background soil boring samples taken in areas adjacent to Landfill No. 2 at depths ranging from 0 to 74 feet (Woodward-Clyde, 1992). These data were used to calculate an upper tolerance limit (UTL) for the background data. The UTL was calculated based on a 95% confidence level, where the UTL (95%) defines a limit such that 95% of the background results should be less than the UTL 95% of the time. For metals not detected in more than one of the background soil samples (i.e., antimony, cadmium, copper, mercury, selenium, silver, sodium, thallium, and zinc), the maximum detection limit is used as the

UTL. The UTLs for the background soil are listed in Table 5-2. The calculations and data used to determine the UTLs are provided in Appendix F.

The metals data for the 1985 and 1992 field samples were then compared to the UTLs. Those samples containing metals concentrations greater than the UTLs are listed in Table 5-3. Approximately 30% of the Landfill No. 3 samples exceeded the background concentration for barium (230 mg/kg). Aluminum, beryllium, calcium, chromium, cobalt, copper, iron, magnesium, nickel, potassium, selenium, vanadium, and zinc concentrations also exceeded the background concentrations in one to eleven of the 167 field samples.

Atomic absorption data were used to compare arsenic, lead, and selenium data (1992) to the background soil UTLs. The remainder of the metals were analyzed by inductively coupled plasma emission spectroscopy (ICPES). The field samples contained high concentrations of calcium which interfered with the antimony analyses. In addition, the ICPES thallium reporting limits were not low enough to adequately evaluate the data. Therefore, 15 field samples, selected based on high reporting limits or apparent hits when analyzed by ICPES, were submitted for analyses by graphite furnace atomic absorption (GFAAS). These results for "worst case" samples are given in Table C-2 in Appendix C. Thallium and antimony were not detected in these samples.

Matrix spike recoveries indicate that the GFAAS results may have been biased low. In order to provide the most conservative assessment of site contamination, the field data were corrected for these biases; thallium - 30% low; antimony - 80% low; and selenium - 30% low. None of the corrected selenium, antimony, or thallium data concentrations in the field samples exceeded the background UTLs. A detailed listing of the analytical results for all target metals are given in Appendix C, Tables C-1 and C-2. These tables list the original field data which were not corrected for the apparent GFAAS bias.

Table 5-2

Upper Tolerance Limits for Background Soil Cores
Confidence Level = 95%, Tolerance Level = 95%

Analyte	Number Detected	Percent Detected	Total Number of Results	Mean (mg/kg)	Standard Deviation (mg/kg)	Upper Tolerance Limit (mg/kg) [a]	Minimum Detection Limit (mg/kg)	Maximum Detection Limit (mg/kg)
Aluminum	17	100	17	4900	2600	12,250	-- [c]	-- [c]
Antimony	0	0	17	--	--	-- [b]	<6.1	<13
Arsenic	17	100	17	1.9	1.3	5.6	-- [c]	-- [c]
Barium	17	100	17	78	53	230	-- [c]	-- [c]
Beryllium	13	76.5	17	0.3	0.18	0.81	<0.17	<0.21
Cadmium	0	0	17	--	--	-- [b]	<0.51	<1.1
Calcium	17	100	17	56,000	65,000	241,000	-- [c]	-- [c]
Chromium	17	100	17	6.9	2.9	15	-- [c]	-- [c]
Cobalt	14	82.4	17	2.1	1.3	5.7	<1.0	<2.2
Copper	1	5.9	17	--	--	-- [b]	<2.0	<4.4
Iron	17	100	17	4,100	2,100	10,000	-- [c]	-- [c]
Lead	17	100	17	3.4	3.5	13	-- [c]	-- [c]
Magnesium	17	100	17	4900	3,300	14,500	-- [c]	-- [c]
Manganese	17	100	17	56	46	190	-- [c]	-- [c]
Mercury	0	0	17	--	--	-- [b]	<0.10	<0.12

Table 5-2

(Continued)

Analyte	Number Detected	Percent Detected	Total Number of Results	Mean (mg/kg)	Standard Deviation (mg/kg)	Upper Tolerance Limit (mg/kg) [a]	Minimum Detection Limit (mg/kg)	Maximum Detection Limit (mg/kg)
Nickel	16	94.1	17	4.0	2.3	10	<4.1	<4.1
Potassium	17	100	17	1100	590	2,800	-- [c]	-- [c]
Selenium	0	0	17	--	--	-- [b]	<0.51	<2.2
Silver	0	0	17	--	--	-- [b]	<0.51	<2.2
Sodium	1	5.9	17	--	--	-- [b]	<510	<1090
Thallium	1	5.9	17	--	--	-- [b]	<0.51	<1.1
Vanadium	17	100	17	12	4.1	24	-- [c]	-- [c]
Zinc	1	5.9	17	--	--	-- [b]	<4.3	<15

[a] - Upper tolerance limit calculated as [mean + (std x K-factor)].
[b] - Insufficient detected results to calculate upper tolerance limit.
[c] - All the data detected. Detection limit not reported.

Table 5-3

Metals Found at Concentrations Greater Than the Background Soil UTLs in Field Samples From Landfill No. 3, Cannon AFB, New Mexico, 1992

Sample ID	Metals (mg/Kg)													
	Al	Ba	Be	Ca	Cr	Co	Cu	Fe	Mg	Ni	K	Se	V	Zn
Background Soil UTLs	12240	228	0.81	241000	15	5.7	<4.4	10000	14500	10	2790	<2.2	24	<15
1985 Samples [a]														
3A-1 (4.5)	--	--	--	--	--	--	--	--	--	--	--	--	--	19
3A-2 (11.0)	--	310	--	--	--	--	--	--	--	--	--	--	--	--
3C-1 (4.0)	--	--	--	--	--	--	--	--	--	--	--	--	--	17
3C-2 (10.0)	--	--	--	--	--	--	--	--	--	--	--	--	--	23
3D-2 (11.0)	--	260	--	--	--	--	--	--	--	--	--	--	--	--
3E-1 (4.0)	--	240	--	--	--	--	--	--	--	--	--	--	--	--
3G-1 (4.5)	--	--	--	--	--	--	--	--	--	--	--	--	--	110
3G-2 (10.5)	--	--	--	--	--	--	--	--	--	--	--	--	--	43
3H-2 (11.0)	--	540	--	--	--	--	--	--	--	--	--	--	--	--
1992 Samples														
CAN-105-3J-21	--	250	--	--	--	--	--	--	--	--	--	--	--	--
CAN-105-3J-30DUP	--	250	--	--	--	--	--	--	--	--	--	--	--	--
CAN-105-3K-20	--	490	--	--	--	--	--	--	--	--	--	--	--	--
CAN-105-3K-25	--	390	--	--	--	--	--	--	20000	--	--	--	--	--
CAN-105-3K-30	--	270	--	--	--	--	--	--	--	--	--	--	--	--
CAN-105-3K-56	--	580	--	--	--	--	--	--	--	--	--	--	--	--
CAN-105-3L-23.5	--	270	--	--	--	--	--	--	--	--	--	--	--	--
CAN-105-3L-25	--	250	--	--	--	--	--	--	--	--	--	--	--	--

Table 5-3

(Continued)

Sample ID	Metals (mg/Kg)													
	Al	Ba	Be	Ca	Cr	Co	Cu	Fe	Mg	Ni	K	Se	V	Zn
Background Soil UTLs	12240	228	0.81	241000	15	5.7	<4.4	10000	14500	10	2790	<2.2	24	<15
CAN-105-3L-30	--	980	--	--	--	--	--	--	--	--	3100	--	--	22
CAN-105-3M-SFC	--	--	--	--	--	--	--	--	--	--	--	--	--	17
CAN-105-3M-23.5	22000	340	1.1	460000	--	8.3	9.8	15000	18000	30	4400	--	49	39
CAN-105-3MM-30.5	--	1500	--	--	--	--	--	--	--	--	--	--	--	17
CAN-105-3M-40	--	--	--	--	--	--	--	--	3500	--	--	--	--	--
CAN-105-3N-27	--	310	--	--	--	--	--	--	--	--	--	--	--	--
CAN-105-3N-30	25000	910	--	300000	26	--	--	16000	22000	21	4900	--	44	28
CAN-105-3NN-20	--	320	--	--	--	--	--	--	--	--	--	--	--	--
CAN-105-3P-21	--	320	--	--	--	--	--	--	--	--	--	--	--	--
CAN-105-3P-26	--	620	--	--	16	--	--	--	--	--	--	--	--	--
CAN-105-3Q-SFC	--	--	--	--	--	--	6.4	--	--	--	--	--	--	21
CAN-105-3Q-21	--	390	--	--	--	--	--	--	--	--	--	--	--	17
CAN-105-3Q-26	--	550	--	--	--	--	8.7	--	21000	--	--	--	--	--
CAN-105-3Q-30	--	460	--	--	--	--	8.1	--	19000	--	--	--	--	--
CAN-105-3R-25	--	280	--	--	--	--	10	--	--	--	--	--	--	--
CAN-105-3R-36	--	--	--	--	--	--	4.4	--	--	--	--	--	--	--
CAN-105-3R-41	--	--	--	--	--	--	--	--	15000	--	--	--	--	--
CAN-105-3R-51	--	230	--	--	--	--	--	--	--	--	--	--	--	--
CAN-105-3S-21	--	410	--	--	--	--	--	--	18000	--	--	3.3	--	--
CAN-105-3S-25	--	270	--	--	--	--	--	--	--	--	--	2.2	--	--

Table 5-3

(Continued)

Sample ID	Metals (mg/Kg)													
	Al	Ba	Be	Ca	Cr	Co	Cu	Fe	Mg	Ni	K	Se	V	Zn
Background Soil UTLs	12240	228	0.81	241000	15	5.7	<4.4	10000	14500	10	2790	<2.2	24	<15
CAN-105-3S-31	–	2400	–	–	–	–	–	–	–	–	–	–	–	–
CAN-105-3S-31DUP	–	2200	–	–	–	–	–	–	–	–	–	–	–	–
CAN-105-3S-36	–	240	–	–	–	–	–	–	–	–	–	–	–	–
CAN-105-3S-43	–	–	–	–	–	–	–	–	15000	–	–	–	–	–
CAN-105-3S-45	–	–	–	–	18	–	–	–	–	–	–	–	–	–
CAN-105-3T-20	–	510	–	–	–	–	–	–	–	–	–	–	–	–
CAN-105-3U-20	13000	–	–	–	–	–	–	–	–	–	–	–	–	17
CAN-105-3U-25	14000	–	–	–	17	–	–	–	–	–	2800	–	–	26
CAN-105-3U-30	–	–	–	–	–	–	–	–	–	–	–	–	–	17
CAN-105-3U-32.5	–	–	–	–	–	–	–	–	–	–	–	2.3	–	–
CAN-105-3U-33.5	–	–	–	–	–	–	–	–	–	–	–	2.3	–	–
CAN-105-3U-35	–	–	–	–	20	–	–	–	–	–	–	–	–	–
CAN-105-3V-20.5	–	470	–	–	–	–	–	–	–	–	–	2.6	–	–
CAN-105-3V-25.5	–	–	–	–	–	–	–	–	–	–	–	2.6	–	–
CAN-105-3VV-30	–	–	–	–	–	–	–	–	–	–	–	2.6	–	46
CAN-105-3VV-35	–	560	–	–	–	–	–	–	–	–	–	2.5	–	–

[a] - Radian, 1986

NOTE: Atomic absorption data were used to compare arsenic, lead, antimony, selenium, and thallium data to the UTLs. All field samples were analyzed for antimony and thallium by ICPES. Due to the high concentrations of calcium in these samples, the antimony and thallium results were biased high. Ten percent of the field samples (those exhibiting the highest apparent concentrations or detection limits for Sb and Tl) were submitted for analyses by graphite atomic absorption spectroscopy (GFAAS). All results were corrected for analytical biases at this site. All corrected GFAAS results are below the Cannon AFB background UTLs.

5.3 Organic Compounds Detected at Landfill No. 3

Landfill No. 3 1985 soil samples were analyzed for halogenated volatile organics and aromatic volatile organics. None of the target compounds were detected in the 1985 samples (where the reporting limit was 1 μg/kg for all target compounds). A list of the 1985 target organic compounds is give in Appendix C, Table C-1.

Several organochlorine pesticides and PCBs were detected in one or more of the samples from the 1992 Landfill No. 3 effort. These include 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, aldrin, dieldrin, endrin, endrin aldehyde, heptachlor expoxide, methoxychlor, beta-BHC, delta-BHC, gamma-BHC, PCB-1254, and PCB-1260. Table 5-4 lists only the samples found to contain one or more of the organochlorine pesticides or PCBs detected at the Cannon Landfill No. 3 site. Organochlorine pesticide and PCB data with a G flag denotes that the second column confirmation analyses confirms the presence of the compound but that the concentration was estimated due to matrix interferences.

Low levels of organochlorine pesticides were found distributed throughout the site. The most prevalent pesticides were aldrin, beta-BHC, delta-BHC, gamma-BHC, and 4,4'-DDT. Sample CAN-105-3L-23.5 contained 5.1 μg/kg 4,4'-DDT and sample CAN-105-3W-30 contained 8.4 μg/kg 4,4'-DDE and 7.6 μg/kg 4,4'-DDT. In addition, PCB-1254 and PCB-1260 were each detected in one field sample. Sample CAN-105-3MM-21 was found to contain 110 μg/kg PCB-1254 and sample CAN-105-3S-21 contained 160 μg/kg PCB-1260. The remaining 138 field samples from the site did not contain detectable concentrations of PCB-1254 or PCB-1260 (the method reporting limit was about 7 μg/kg for both PCB-1254 and PCB-1260). All other pesticides or PCBs detected in these samples were flagged with an "@" (indicating a result less than five times the reporting limit) and/or a "G" (indicating an estimated value due to matrix interferences).

Table 5-4

Organochlorine Pesticides and PCBs Found in Soil Samples From Landfill No. 3, Cannon AFB, New Mexico, 1992

Sample ID	Organochlorine Pesticides and PCBs (8080), µg/kg[a]													
	4,4'-DDD	4,4'-DDE	4,4'-DDT	Aldrin	Dieldrin	Endrin	Endrin Aldehyde	Heptachlor Epoxide	Methoxychlor	PCB-1254	PCB-1260	beta-BHC	delta-BHC	gamma-BHC
CAN-105-3J-21	<0.36	<0.36	<0.72	0.72 G@	<0.36	<0.36	<0.72	3.1 G	<1.8	<7.2	<7.2	<0.36	4 G	<0.36
CAN-105-3J-30	<0.36	<0.36	<0.73	0.51 G@	<0.36	<0.36	<0.73	<0.36	<1.8	<7.3	<7.3	<0.36	3.8 G	<0.36
CAN-105-3J-35	<0.35	<0.35	<0.70	0.75 G@	<0.35	<0.35	<0.70	<0.35	<1.7	<7.0	<7.0	<0.35	<0.35	<0.35
CAN-105-3J-52.5	<0.35	<0.35	<0.69	1.6 G@	<0.35	<0.35	<0.69	<0.35	<1.7	<6.9	<6.9	<0.35	<0.35	<0.35
CAN-105-3J-61	<0.34	<0.34	<0.68	0.6 G@	<0.34	<0.34	<0.68	<0.34	<1.7	<6.8	<6.8	<0.34	3.8 G	<0.34
CAN-105-3K-20	<0.36	<0.36	<0.71	<0.36	<0.36	<0.36	<0.71	<0.36	<1.8	<7.1	<7.1	1.3 G@	<0.36	2.8 G
CAN-105-3K-25	<0.38	<0.38	1.2 G@	<0.38	<0.3	<0.38	<0.75	<0.38	<1.9	<7.5	<7.5	<0.38	<0.38	<0.38
CAN-105-3K-30	<0.36	<0.36	<0.72	<0.36	<0.36	<0.36	<0.72	<0.36	<1.8	<7.2	<7.2	<0.36	<0.36	5.3 G
CAN-105-3K-36	<0.35	<0.35	1 G@	1.2 G@	<0.35	<0.35	<0.70	<0.35	<1.8	<7.0	<7.0	<0.35	<0.35	<0.35
CAN-105-3K-DUP10 (3K-40)	<0.35	<0.35	<0.70	<0.35	<0.35	<0.35	<0.70	<0.35	<1.8	<7.0	<7.0	<0.35	<0.35	0.65 @
CAN-105-3K-45	<0.35	<0.35	<0.71	<0.35	<0.35	<0.35	<0.71	<0.35	<1.8	<7.1	<7.1	<0.35	<0.35	0.75 @
CAN-105-3K-51	<0.36	<0.36	<0.72	0.65 G@	<0.36	<0.36	<0.72	0.42 G@	<1.8	<7.2	<7.2	<0.36	<0.36	<0.36
CAN-105-3K-59	<0.34	<0.34	<0.69	0.54 G@	<0.34	<0.34	<0.69	<0.34	<1.7	<6.9	<6.9	<0.34	<0.34	<0.34
CAN-105-3L-23.5	0.6 G@	0.71 @	5.1	<0.37	<0.37	<0.37	<0.74	<0.37	<1.9	<7.4	<7.4	<0.37	<0.37	<0.37

Table 5-4

(Continued)

Sample ID	Organochlorine Pesticides and PCBs (8080), µg/kg*													
	4,4'-DDD	4,4'-DDE	4,4'-DDT	Aldrin	Dieldrin	Endrin	Endrin Aldehyde	Heptachlor Epoxide	Methoxychlor	PCB-1254	PCB-1260	beta-BHC	delta-BHC	gamma-BHC
CAN-105-3L-25	<0.39	<0.39	<0.77	0.42 G@	<0.39	<0.39	<0.77	<0.39	<1.9	<7.7	<7.7	<0.39	3.2 G	<0.39
CAN-105-3L-56	<0.35	<0.35	<0.69	<0.35	<0.35	<0.35	<0.69	<0.35	<1.7	<6.9	<6.9	<0.35	5.9 G	7.1 G
CAN-105-3L-61	<0.35	<0.35	0.97 @	1.1 G@	<0.35	<0.35	<0.70	<0.35	<1.7	<7.0	<7.0	<0.35	6.2 G	1.5 @
CAN-105-3M-40	<0.35	<0.35	<0.69	0.35 G@	<0.35	<0.35	<0.69	<0.35	<1.7	<6.9	<6.9	<0.35	<0.35	<0.35
CAN-105-3MM-21	<0.36	<0.36	<0.72	<0.36	<0.36	<0.36	<0.72	<0.36	<1.8	110	<7.2	<0.36	<0.36	<0.36
CAN-105-3N-27	1.1 G@	0.61 G@	1.7 @	2.1 G	<0.36	<0.36	0.81 @	<0.36	<1.8	<7.1	<7.1	<0.36	<0.36	<0.36
CAN-105-3N-30	<0.36	<0.36	<0.72	<0.36	<0.36	<0.36	0.86 @	<0.36	<1.8	<7.2	<7.2	<0.36	<0.36	<0.36
CAN-105-3NN-20	<0.36	<0.36	<0.72	<0.36	<0.36	<0.36	<0.72	<0.36	<1.8	<7.2	<7.2	0.64 G@	<0.36	0.36 @
CAN-105-3NN-45	<0.37	<0.37	<0.73	<0.37	<0.37	<0.37	<0.73	<0.37	<1.8	<7.3	<7.3	<0.37	1.3 @	<0.37
CAN-105-3NN-61	<0.35	<0.35	0.83 @	<0.35	<0.35	<0.35	<0.70	1.6 G@	<1.7	<7.0	<7.0	<0.35	6.6 G	<0.35
CAN-105-3P-40	<0.36	<0.36	3.1 G@	<0.36	0.89 G@	<0.36	<0.71	<0.36	<1.8	<7.1	<7.1	<0.36	<0.36	<0.36
CAN-105-3P-45	<0.35	<0.35	0.88 G@	<0.35	<0.35	<0.35	<0.71	<0.35	<1.8	<7.1	<7.1	<0.35	<0.35	<0.35
CAN-105-3P-51	<0.35	<0.35	<0.69	<0.35	<0.35	<0.35	<0.69	<0.35	<1.7	<6.9	<6.9	<0.35	2 G	<0.35
CAN-105-3P-DUP7 (3P-56)	<0.34	<0.34	1.2 G@	<0.34	<0.34	<0.34	<0.69	<0.34	<1.7	<6.9	<6.9	<0.34	<0.34	<0.34
CAN-105-3Q-26	<0.39	<0.39	0.88 G@	<0.39	<0.39	<0.39	<0.77	<0.39	<1.9	<7.7	<7.7	<0.39	<0.39	<0.39
CAN-105-3Q-36	<0.35	<0.35	0.76 G@	<0.35	<0.35	<0.35	<0.70	<0.35	<1.7	<7.0	<7.0	<0.35	<0.35	<0.35
CAN-105-3Q-41	<0.35	<0.35	0.78 G@	<0.35	<0.35	<0.35	<0.70	<0.35	<1.7	<7.0	<7.0	15 G	<0.35	<0.35
CAN-105-3Q-46	<0.36	<0.36	0.8 @	<0.36	<0.36	<0.36	<0.72	<0.36	<1.8	<7.2	<7.2	18 G	<0.36	<0.36

Table 5-4

(Continued)

Sample ID	Organochlorine Pesticides and PCBs (8080), µg/kg*													
	4,4'-DDD	4,4'-DDE	4,4'-DDT	Aldrin	Dieldrin	Endrin	Endrin Aldehyde	Heptachlor Epoxide	Methoxychlor	PCB-1254	PCB-1260	beta-BHC	delta-BHC	gamma-BHC
CAN-105-3Q-53.5	<0.35	<0.35	0.8 G@	<0.35	<0.35	<0.35	<0.69	<0.35	<1.7	<6.9	<6.9	<0.35	<0.35	<0.35
CAN-105-3R-25	0.75 G@	<0.36	<0.72	0.75 G@	<0.36	<0.36	<0.72	<0.36	2.2 @	<7.2	<7.2	37 G	0.72 @	<0.36
CAN-105-3R-31	<0.36	<0.36	<0.71	<0.36	<0.36	<0.36	<0.71	<0.36	<1.8	<7.1	<7.1	<0.36	0.6 G@	<0.36
CAN-105-3R-32.5	2.1 G	<0.39	1.5 @	<0.39	<0.39	<0.39	<0.78	<0.39	<1.9	<7.8	<7.8	<0.39	0.71 G@	<0.39
CAN-105-3R-35	<0.38	<0.38	1 G@	<0.38	<0.38	<0.38	<0.76	<0.38	<1.9	<7.6	<7.6	<0.38	<0.38	<0.38
CAN-105-3R-41	<0.38	<0.38	1 G@	<0.38	<0.38	<0.38	<0.76	<0.38	<1.9	<7.6	<7.6	<0.38	<0.38	<0.38
CAN-105-3R-DUP5 (3R-52.5)	<0.35	<0.35	1 @	<0.35	<0.35	<0.35	<0.69	<0.35	<1.7	<6.9	<6.9	<0.35	0.57 G@	<0.35
CAN-105-3R-61	<0.35	<0.35	0.93 G@	<0.35	<0.35	<0.35	<0.70	<0.35	<1.7	<7.0	<7.0	<0.35	0.58 G@	<0.35
CAN-105-3S-21	<0.37	1.8 @	<0.74	<0.37	2.6 G	<0.37	<0.74	<0.37	<1.8	<7.4	160	<0.37	0.6 @	<0.37
CAN-105-3S-25	<0.38	<0.38	1 G@	<0.38	<0.38	<0.38	<0.76	<0.38	<1.9	<7.6	<7.6	<0.38	<0.38	<0.38
CAN-105-3S-36	<0.36	<0.36	0.94 G@	<0.36	<0.36	<0.36	<0.71	<0.36	<1.8	<7.1	<7.1	<0.36	0.59 G@	<0.36
CAN-105-3S-43	<0.38	<0.38	1.3 @	<0.38	<0.38	<0.38	<0.77	<0.38	<1.9	<7.7	<7.7	<0.38	0.69 G@	<0.38
CAN-105-3S-51	<0.35	<0.35	0.9 G@	<0.35	<0.35	<0.35	<0.69	<0.35	<1.7	<6.9	<6.9	<0.35	0.56 G@	<0.35
CAN-105-3T-20	<0.36	<0.36	0.94 @	<0.36	<0.36	<0.36	<0.72	2.6 G	<1.8	<7.2	<7.2	<0.36	6.4 G	<0.36
CAN-105-3T-28.5	<0.35	<0.35	<0.70	0.9 G@	<0.35	<0.35	<0.70	<0.35	<1.8	<7.0	<7.0	<0.35	5.5 G	<0.35
CAN-105-3T-31	<0.36	<0.36	<0.71	<0.36	<0.36	<0.36	<0.71	<0.36	<1.8	<7.1	<7.1	<0.36	<0.36	0.81 @
CAN-105-3T-35	<0.36	<0.36	<0.72	<0.36	<0.36	<0.36	<0.72	<0.36	<1.8	<7.2	<7.2	<0.36	<0.36	0.69 @
CAN-105-3T-40	<0.36	<0.36	0.75 @	<0.36	<0.36	<0.36	<0.72	<0.36	<1.8	<7.2	<7.2	0.37 G@	<0.36	1.3 G@
CAN-105-3T-46	<0.35	<0.35	0.75 @	1.2 G@	<0.35	<0.35	<0.70	<0.35	<1.8	<7.0	<7.0	<0.35	<0.35	1.5 G@

Table 5-4

(Continued)

Sample ID	Organochlorine Pesticides and PCBs (8080), µg/kg*													
	4,4'-DDD	4,4'-DDE	4,4'-DDT	Aldrin	Dieldrin	Endrin	Endrin Aldehyde	Heptachlor Epoxide	Methoxychlor	PCB-1254	PCB-1260	beta-BHC	delta-BHC	gamma-BHC
CAN-105-3T-48	<0.35	<0.35	<0.69	<0.35	<0.35	<0.35	<0.69	<0.35	<1.7	<6.9	<6.9	<0.35	<0.35	3.8 G
CAN-105-3T-52	<0.39	<0.39	1.5 G@	<0.39	<0.39	<0.39	<0.77	<0.39	<1.9	<7.7	<7.7	0.41 G@	<0.39	2.7 G
CAN-105-3T-56	<0.36	<0.36	2 G@	<0.36	<0.36	<0.36	<0.73	<0.36	<1.8	<7.3	<7.3	0.52 G@	5.5 G	4 G
CAN-105-3T-DUP13 (3T-60)	<0.35	<0.35	0.81 @	1.2 G@	<0.35	<0.35	<0.70	<0.35	<1.7	<7.0	<7.0	0.49 G@	6.2 G	2 G
CAN-105-3T-60	<0.35	<0.35	<0.70	<0.35	<0.35	<0.35	<0.70	<0.35	<1.7	<7.0	<7.0	<0.35	<0.35	3.4 G
CAN-105-3U-20	1.3 G@	<0.37	1.2 @	<0.37	<0.37	<0.37	<0.73	<0.37	<1.8	<7.3	<7.3	<0.37	0.61 G@	<0.37
CAN-105-3U-25	<0.36	<0.36	1.6 @	<0.36	<0.36	<0.36	<0.72	<0.36	<1.8	<7.2	<7.2	<0.36	0.74 G@	<0.36
CAN-105-3U-DUP2 (3U-30)	<0.36	<0.36	1.6 @	<0.36	<0.36	<0.36	<0.72	<0.36	<1.8	<7.2	<7.2	<0.36	0.7 G@	<0.36
CAN-105-3U-30	<0.38	<0.38	1.1 G@	<0.38	<0.38	<0.38	<0.75	<0.38	<1.9	<7.5	<7.5	<0.38	0.62 G@	<0.38
CAN-105-3U-32.5	<0.36	<0.36	1 G@	<0.36	<0.36	<0.36	<0.72	<0.36	<1.8	<7.2	<7.2	<0.36	0.59 G@	<0.36
CAN-105-3U-35	<0.37	<0.37	<0.73	<0.37	<0.37	<0.37	<0.73	<0.37	<1.8	<7.3	<7.3	<0.37	2.2 G	<0.37
CAN-105-3U-43.5	<0.39	<0.39	<0.77	<0.39	<0.39	<0.39	<0.77	<0.39	<1.9	<7.7	<7.7	0.42 G@	<0.39	<0.39
CAN-105-3U-55	<0.35	<0.35	<0.70	<0.35	<0.35	<0.35	<0.70	<0.35	<1.7	<7.0	<7.0	0.41 G@	<0.35	<0.35
CAN-105-3V-25.5	<0.37	<0.37	1 @	<0.37	<0.37	<0.37	<0.73	<0.37	<1.8	<7.3	<7.3	<0.37	0.62 @	<0.37
CAN-105-3V-45	<0.36	<0.36	1.2 @	<0.36	<0.36	<0.36	<0.71	<0.36	<1.8	<7.1	<7.1	<0.36	0.59 G@	<0.36
CAN-105-3V-52	<0.35	<0.35	1.1 G@	<0.35	<0.35	<0.35	<0.70	<0.35	<1.8	<7.0	<7.0	<0.35	0.65 @	<0.35

Table 5-4

(Continued)

Sample ID	Organochlorine Pesticides and PCBs (8080), µg/kg[a]													
	4,4'-DDD	4,4'-DDE	4,4'-DDT	Aldrin	Dieldrin	Endrin	Endrin Aldehyde	Heptachlor Epoxide	Methoxychlor	PCB-1254	PCB-1260	beta-BHC	delta-BHC	gamma-BHC
CAN-105-3V-50	<0.35	<0.35	1.4 G@	<0.35	<0.35	<0.35	<0.71	<0.35	<1.8	<7.1	<7.1	<0.35	0.74 G@	<0.35
CAN-105-3V-55	<0.35	<0.35	1.6 @	<0.35	<0.35	<0.35	<0.69	<0.35	<1.8	<6.9	<6.9	<0.35	<0.35	<0.35
CAN-105-3V-61	1.6 G@	<0.34	1.2 @	<0.34	<0.34	<0.34	<0.69	<0.34	<1.7	<6.9	<6.9	<0.34	0.62 G@	<0.34
CAN-105-3VV-30	<0.35	8.4	7.6	0.41 G@	<0.35	6.1 G	<0.70	<0.35	4.2 G@	<7.0	<7.0	9.1 G	1 @	0.68 @
CAN-105-3VV-35	1.5 G@	0.54 G@	1.4 @	<0.35	<0.35	<0.35	<0.71	<0.35	<1.8	<7.1	<7.1	<0.35	0.61 @	<0.35
CAN-105-3VV-41	<0.35	<0.35	<0.70	<0.35	<0.35	<0.35	<0.35	<0.35	<1.8	<7.0	<7.0	<0.35	0.7 G@	<0.35

[a] - Heptachlor and alpha-BHC were not detected above the reporting level in the field samples, and are therefore not included in this table. These compounds were included in the risk assessment based on J-flagged data. J-flagged data are given in Appendix D.

@ - Reported value is within a factor of five of the detection limit.

G - Second column confirmation denotes the presence of this compound but the result is estimated due to matrix interferences.

Diesel, total recoverable petroleum hydrocarbons (TRPH), acetone, methylene chloride, toluene, xylenes, bis(2-ethylhexyl)phthalate, were detected in one or more of the samples from this site. In addition, several tentatively identified compounds (TIC) were also found in a several of the field samples including; acetonitrile, ethyl acetate, tetrahydrofuran, cyclohexanone, and trichloropropene(s).

The mass spectral analyses of samples for VOCs and SVOCs result in the identification and quantitation of compounds given in the Target Compound List (TCL). Sometimes the mass spectra indicate the presence of additional organic compounds that are not on the TCL. These spectra are compared to spectra in the mass spectral data library, and the compounds are tentatively identified based on similarities to the library spectra. These compounds are called tentatively identified compounds (TICs), and the assigned identity of the compound is, in most cases, highly uncertain. SW-846 provides procedures to estimate the concentration of TICs. These estimates, however, are highly uncertain and could be orders of magnitude higher or lower than the actual concentration. When evaluating TIC data, it is important to note that the assigned identity may be incorrect and that the quantitation is likely to be inaccurate.

Table 5-5 lists only the results for samples containing one or more of the TRPH, diesel, VOC or SVOC compounds found in the Cannon Landfill No. 3 samples. Results for TICs are semi-quantitative and are listed only when that compound was detected in a sample. Reporting limits are not available for TICs.

Acetone, diesel, and TRPH reported in these samples appear to be due to contamination (Radian, October 1992). Acetone was detected in 16 of the 22 trip blanks at levels up to two times the reporting limit indicating that low levels of acetone in the field samples may be due to reagent contamination, bottles, field conditions, or sampling and storage conditions. Acetone was detected in 2 of the 141 field samples at about 2.5 times the reporting limit. TRPH was detected in three of eight equipment blanks collected with the field samples at concentrations up to two times the method reporting

Table 5-5

TRPH, Diesel, VOCs and SVOCs Concentrations Found in Soil Samples From Landfill No. 3, Cannon AFB, New Mexico, 1992

Sample ID	TRPH (9071/418.1) mg/kg	Diesel (8015ME) ug/kg	Volatile Organic Compounds (8240), ug/kg							SVOCs (8270), ug/kg		
			Acetone	Acetonitrile *	Ethyl acetate *	Methylene chloride	Tetra-hydrofuran *	Toluene	Xylenes	bis(2-Ethylhexyl) phthalate	Cyclohexanone *	Trichloropropene(s) *
CAN-105-3J-21	31 B@	5300 GB@	<110		240	<5.4		<5.4	<5.4	<360		
CAN-105-3J-25.5	31 B@		<110		87	<5.5		29	<5.5	<370	220	
CAN-105-3J-DUP11 (3J-30)	46 B@		<110		82	5.8 @		10 @	<5.5	<370		
CAN-105-3J-30	<27		<110		150	5.6 @		<5.5	<5.5	<370		
CAN-105-3J-35	33 B@	4400 GB@	<100		110	<5.2		<5.2	<5.2	<350		
CAN-105-3J-40	27 B@	5800 GB@	240 @		180	5.3 @		<5.2	<5.2	<350		
CAN-105-3J-45	<26		<100		220	<5.2		<5.2	<5.2	<350		
CAN-105-3J-50	31 B@		<110		81	<5.4		<5.4	<5.4	<360		
CAN-105-3J-52.5	<26		<100		71	<5.2		<5.2	<5.2	<350		
CAN-105-3J-55	<26		<100		60	<5.2		<5.2	<5.2	<350		
CAN-105-3J-61	<26		<100		170	<5.1		<5.1	<5.1	<340		
CAN-105-3K-20	50 B@		<110		6.4	<5.4		<5.4	<5.4	<360	360	
CAN-105-3K-22.5	38 B@	3700 GB@	<110		28	<5.7		<5.7	<5.7	<380	150	230
CAN-105-3K-25	<28	2900 GB@	<110		64	<5.7		<5.7	<5.7	<380	260	150
CAN-105-3K-30	53 B@		<110		73	<5.4		<5.4	<5.4	<360	180	1400
CAN-105-3K-36	30 @		<110		120	<5.3		<5.3	<5.3	<350	240	1970
CAN-105-3K-DUP10 (3K-40)	<26	3300 GB@	<110		82	<5.3		<5.3	<5.3	<350	770	170
CAN-105-3K-40	<26	3100 GB@	<110		73	<5.3		<5.3	<5.3	<350	240	2840
CAN-105-3K-45	36 B@	4100 GB@	<110		160	<5.3		<5.3	<5.3	300	280	1400
CAN-105-3K-51	36 B@		<110		54	<5.4		<5.4	<5.4	<360		
CAN-105-3K-56	38 B@		<100		140	<5.2		<5.2	<5.2	<350		
CAN-105-3K-59	27 B@		<100		77	<5.2		<5.2	<5.2	<340		

Table 5-5

(Continued)

Sample ID	TRPH (9071/418.1) mg/kg	Diesel (8015ME) ug/kg	Volatile Organic Compounds (8240), ug/kg							SVOCs (8270), ug/kg		
			Acetone	Acetonitrile *	Ethyl acetate *	Methylene chloride	Tetra-hydrofuran *	Toluene	Xylenes	bis(2-Ethylhexyl) phthalate	Cyclohexanone *	Trichloropropane(s) *
CAN-105-3K-61	<26		<100		14	<5.2		<5.2	<5.2	<350	280	2170
CAN-105-3L-21	34 @	3300 GB@	<110		110	<5.5		<5.5	<5.5	<370	150	
CAN-105-3L-23.5	35 @		<110		92	<5.6		<5.6	<5.6	<370		
CAN-105-3L-25	39 @	6300 GB@	<120		180	<5.8		<5.8	<5.8	<390	150	
CAN-105-3L-30	<28		<110		260	<5.6		<5.6	<5.6	<370	190	
CAN-105-3L-DUP9 (3L-38)	41 @		<110		190	<5.3		<5.3	<5.3	<360		
CAN-105-3L-38	31 @		<110		99	<5.4		<5.4	<5.4	<360		
CAN-105-3L-41	34 @	<2700	<110		180	<5.4		<5.4	<5.4	<360	220	
CAN-105-3L-43	28 @		<110		300	<5.4		<5.4	<5.4	<360		570
CAN-105-3L-48.5	34 @		<110		330	<5.4		<5.4	<5.4	<360	140	690
CAN-105-3L-52.5	61 @		<110		180	<5.3		<5.3	<5.3	<350		
CAN-105-3L-56	43 B@		<100		140	<5.2		<5.2	<5.2	<340	210	170
CAN-105-3L-61	38 B@		<100		190	<5.2		<5.2	<5.2	<350	280	2170
CAN-105-3M-23.5	<27		<110		190	7.3 B@		<5.4	<5.4	<360		
CAN-105-3M-40	33 @		<100		180	<5.2		<5.2	<5.2	<350		
CAN-105-3M-50	31 @		<110		110	<5.4		11@	<5.4	530B@		140
CAN-105-3M-52.5	39 @		<110		240	<5.3		<5.3	<5.3	<360		
CAN-105-3M-56	45 @		<100		230	<5.1		<5.1	<5.1	<340		
CAN-105-3M-61	54 @		<100		190	<5.2		<5.2	<5.2	<350		140
CAN-105-3M-SFC			<100			<5.1		63	<5.1	<340	200	
CAN-105-3MM-21	<27	8000 GB@	<110			<5.4		<5.4	<5.4	<360		
CAN-105-3MM-25	<27		<110			7.2 B@		<5.5	<5.5	<360	180	
CAN-105-3MM-30.5	<27		<110		24	<5.5		<5.5	<5.5	<360	140	
CAN-105-3MM-35	<27	8600 GB@	<110		130	<5.4		23@	<5.4	<360		

Table 5-5

(Continued)

Sample ID	TRPH (9071/418.1) mg/kg	Diesel (8015ME) ug/kg	Volatile Organic Compounds (8240), ug/kg							SVOCs (8270), ug/kg		
			Acetone	Acetonitrile *	Ethyl acetate *	Methylene chloride	Tetra-hydrofuran *	Toluene	Xylenes	bis(2-Ethylhexyl) phthalate	Cyclohexanone *	Trichloropropene(s) *
CAN-105-3MM-37.5	<26		<110		99	<5.3		<5.3	<5.3	<350		
CAN-105-3MM-DUP 8 (3M-37.5)	<26		<110		130	<5.3		<5.3	<5.3	<350		
CAN-105-3N-27	<26		<110		78	<5.3		<5.3	<5.3	<350	140	
CAN-105-3N-30	<27	6100 GB@	<110		160	<5.4		<5.4	<5.4	<360	250	
CAN-105-3N-36	<26		<100		89	5.5 B@		<5.2	<5.2	<350	240	240
CAN-105-3N-SFC			<100			<5.1		26	<5.1	<340	170	
CAN-105-3NN-20	<27		<110		54	<5.4		<5.4	<5.4	<360		250
CAN-105-3NN-41	<27		<110		180	<5.4		<5.4	<5.4	<360		280
CAN-105-3NN-DUP1 4 (3NN-45)	<27	5500 GB@	<110		92	<5.5		6.2@	<5.5	<370	150	150
CAN-105-3NN-45	<27	7100 GB@	<110		200	<5.5		40	<5.5	<370		
CAN-105-3NN-50	<26	5600 GB@	<100			<5.3		<5.3	<5.3	<360		430
CAN-105-3NN-53	<26		<110		370	<5.3		<5.3	<5.3	<350	180	320
CAN-105-3NN-55	<26		<110		250	<5.3		<5.3	<5.3	<350	170	
CAN-105-3NN-61	<26		<110		33	<5.2		<5.2	<5.2	<350		
CAN-105-3P-21	35 B@		<110		41	<5.4		<5.4	<5.4	<360	140	
CAN-105-3P-26	43 B@		<110			5.5 B@		<5.5	<5.5	<370		
CAN-105-3P-31	<26	6300 GB@	<110		31	<5.4		<5.4	<5.4	<360	180	
CAN-105-3P-36	<26		<100		130	<5.2		<5.2	<5.2	<350		
CAN-105-3P-40	29 B@		<110		110	<5.3		<5.3	<5.3	<360		
CAN-105-3P-45	<26		<110		60	<5.3		<5.3	<5.3	<350	170	
CAN-105-3P-51	<25	5200 GB@	<100		84	<5.2		<5.2	<5.2	<350		
CAN-105-3P-53	<25		<100		31	<5.1		<5.1	<5.1	<340	240	
CAN-105-3P-56	<26		<100		7.2	<5.2		<5.2	<5.2	<340	240	

Table 5-5

(Continued)

Sample ID	TRPH (9071/418.1) mg/kg	Diesel (8015ME) ug/kg	Volatile Organic Compounds (8240), ug/kg							SVOCs (8270), ug/kg		
			Acetone	Acetonitrile *	Ethyl acetate *	Methylene chloride	Tetra-hydrofuran *	Toluene	Xylenes	bis(2-Ethylhexyl) phthalate	Cyclohexanone *	Trichloropropene(s) *
LAN-105-3P-DUP7 (3P-56)	<25	<100				<5.2		<5.2	<5.2	<340		410
CAN-105-3P-61	26 B@	<5200	<100		43	<5.1		<5.1	<5.1	<340	200	
CAN-105-3Q-21	<27	5900 G@	<110		21	36 B		<5.3	<5.3	<360	320	
CAN-105-3Q-26	41 B@		<120		88	15 B@		<5.8	<5.8	430@		
CAN-105-3Q-30	32 B@		<130		84	19 B@		<6.4	<6.4	<430	260	
CAN-105-3Q-36	<26		<100		8.4	<5.2		<5.2	<5.2	<350		
CAN-105-3Q-41	34 B@		<100			<5.2		<5.2	<5.2	<350		
CAN-105-3Q-46	<27	8800 GB@	<110		91	<5.4		<5.4	<5.4	<360		
CAN-105-3Q-DUP6 (3Q-51)	<27		<110		84	<5.3		<5.3	<5.3	<350	180	
CAN-105-3Q-51	<27		<100		32	<5.3		<5.3	<5.3	<360	180	390
CAN-105-3Q-53.5	<27		<110		9.4	<5.2		<5.2	<5.2	<350	140	
CAN-105-3Q-55	<26	7300 GB@	<100		87	<5.2		<5.2	<5.2	<350		
CAN-105-3Q-60	<26		<100		57	<5.2		<5.2	<5.2	<350		
CAN-105-3Q-SFC			<100			22 B@		<5.2	<5.2	<350	240	
CAN-105-3R-21	<27		<110			<5.4		<5.4	<5.4	<360	220	
CAN-105-3R-25	<27	17000 G@	<110			<5.4		<5.4	<5.4	<360		
CAN-105-3R-31	<27		<110	4.9		<5.3		<5.3	<5.3	<360		
CAN-105-3R-35	<28		<110			<5.7		<5.7	<5.7	<380	190	260
CAN-105-3R-41	<28	10000 G@	<110	5.2		<5.7		<5.7	<5.7	<380		
CAN-105-3R-45	<27		<120	6.2		10 B@		<6.1	<6.1	<410		
CAN-105-3R-51	<26		<100			<5.2		<5.2	<5.2	<350	170	
CAN-105-3R-DUP5 (3R-52.5)	<26	11000 G@	<100			<5.2		<5.2	<5.2	<350		
CAN-105-3R-52.5	<25	8300 G@	<100	2.9		<5.2		<5.2	<5.2	<340	440	270

Table 5-5

(Continued)

Sample ID	TRPH (9071/418.1) mg/kg	Diesel (8015ME) ug/kg	Volatile Organic Compounds (8240), ug/kg							SVOCs (8270), ug/kg		
			Acetone	Acetonitrile *	Ethyl acetate *	Methylene chloride	Tetra-hydrofuran *	Toluene	Xylenes	bis(2-Ethylhexyl) phthalate	Cyclohexanone *	Trichloropropene(s) *
CAN-105-3R-56	<26		<100			<5.2		<5.2	<5.2	400@		
CAN-105-3R-61	<26		<100			37 B		<5.2	<5.2	<350		
CAN-105-3S-21	320		<110			<5.5		<5.5	<5.5	680@		
CAN-105-3S-25	<28		<110			5.9 B@	5.7	<5.7	<5.7	<380		
CAN-105-3S-DUP4 (3S-31)	<26		<110			<5.3		<5.3	<5.3	<350	320	
CAN-105-3S-31	<26		<110			<5.3		<5.3	<5.3	<350	210	
CAN-105-3S-36	<26		<110	21		<5.3		<5.3	<5.3	<360	280	
CAN-105-3S-40	<26	6400 G@	<110	480		5.5 B@	11	<5.3	<5.3	<350		
CAN-105-3S-43	<29		<110	16		15 B@	5.7	<5.7	<5.7	<380	270	
CAN-105-3S-45	<27	5500 G@	<110	20		13 B@		<5.4	<5.4	<360	220	
CAN-105-3S-51	<26		<100			<5.2		<5.2	<5.2	<350	340	
CAN-105-3S-55	<26	6800 G@	<100			<5.2		<5.2	<5.2	<350	310	
CAN-105-3S-60	<26		<100	6.4		<5.2		<5.2	<5.2	<340	340	
CAN-105-3T-20	<27	4100 GB@	<110		320	<5.4		<5.4	<5.4	<360		
CAN-105-3T-DUP12 (3T-25)	<27	4700 GB@	<110		110	<5.4		<5.4	<5.4	<360		
CAN-105-3T-25	<27	4100 GB@	<110		130	<5.4		<5.4	<5.4	<360		
CAN-105-3T-28.5	<26		<110		260	<5.3		<5.3	<5.3	<350	210	
CAN-105-3T-31	<27		<110			<5.4		<5.4	<5.4	<360		210
CAN-105-3T-35	<27		230@			<5.4		<5.4	<5.4	<360		
CAN-105-3T-40	<27		<110			<5.4		17@	<5.4	<360	140	320
CAN-105-3T-46	<26	6600 GB@	<110			<5.3		19@	<5.3	<350		420
CAN-105-3T-48	<26		<100			<5.2		9.2@	<5.2	<350		350
CAN-105-3T-52	<29		<120		75	<5.8		<5.8	<5.8	<390		270

Table 5-5

(Continued)

Sample ID	TRPH (9071/418.1) mg/kg	Diesel (8015ME) ug/kg	Volatile Organic Compounds (8240), ug/kg							SVOCs (8270), ug/kg		
			Acetone	Acetonitrile *	Ethyl acetate *	Methylene chloride	Tetra-hydrofuran *	Toluene	Xylenes	bis(2-Ethylhexyl) phthalate	Cyclohexanone *	Trichloropropane(s) *
CAN-105-3T-56	<27		<110			<5.4		7.6@	<5.4	<360		
CAN-105-3T-DUP13 (3T-60)	<26		<100			<5.2		<5.2	<5.2	<350		
CAN-105-3T-60	<26		<100			<5.2		8.5@	<5.2	<350		
CAN-105-3U-20	<27	5900 G@	<110		8.8	5.9 B@	14	<5.5	<5.5	<370	330	
CAN-105-3U-25	<27		<110		13	<5.4	15	<5.4	<5.4	<360	180	
CAN-105-3U-30	<28		<110		6.8	<5.7	7.9	<5.7	<5.7	<380	190	
CAN-105-3U-DUP2 (3U-30)	<26		<110		16	<5.4	8.6	<5.4	<5.4	<360	220	900
CAN-105-3U-32.5	<27		<110		20	<5.4	9.8	<5.4	<5.4	510 B@	250	760
CAN-105-3U-33.5	<27		<110		20	<5.5	6.5	<5.5	<5.5	<360	220	
CAN-105-3U-35	<27	7800 G@	<110			<5.5		<5.5	32	<370	400	
CAN-105-3U-41	<27		<110			<5.4		<5.4	<5.4	<360	180	540
CAN-105-3U-43.5	<29	8900 G@	<120			6.5 B@	13	<5.8	<5.8	<390		580
CAN-105-3U-46	<30		<120	640		8.6 B@	11	<6.0	<6.0	<400	240	
CAN-105-3U-51	<27		<110	33		5.5 B@	5.5	<5.5	<5.5	<360	510	
CAN-105-3U-55	<26		<100			<5.2		<5.2	<5.2	<350	280	
CAN-105-3U-DUP3 (3U-55)	<26		<100			<5.2		<5.2	<5.2	<350	350	
CAN-105-3U-61	<26		<100			<5.1		<5.1	<5.1	<340	270	
CAN-105-3V-20.5	<27	8200 GB@	<110		19	<5.6	28	<5.6	<5.6	<370	330	
CAN-105-3V-25.5	<27		<110		79	<5.5	23	<5.5	<5.5	<370	220	890
CAN-105-3V-45	<26		<110		67	<5.3	16	<5.3	<5.3	<360	210	
CAN-105-3V-52	<26	7200 GB@	<110		51	5.4 B@	14	<5.3	<5.3	<350	320	
CAN-105-3V-50	<27	8900 GB@	<110		68	<5.3	14	<5.3	<5.3	<360	1000	
CAN-105-3V-55	<26		<100		23	<5.2	14	<5.2	<5.2	390 B@	240	

Table 5-5

(Continued)

Sample ID	TRPH (9071/418.1) mg/kg	Diesel (8015ME) ug/kg	Volatile Organic Compounds (8240), ug/kg							SVOCs (8270), ug/kg		
			Acetone	Acetonitrile *	Ethyl acetate *	Methylene chloride	Tetra-hydrofuran *	Toluene	Xylenes	bis(2-Ethylhexyl) phthalate	Cyclohexanone *	Trichloropropene(s) *
CAN-105-3V-61	<26	<5200	<100		13	<5.2	16	<5.2	<5.2	<340	210	
CAN-105-3VV-30	72@		<110			5.7 B@	24	<5.3	<5.3	<350		250
CAN-105-3VV-35	<26		<110			<5.3	21	<5.3	<5.3	<350	210	
CAN-105-3VV-41	<26		<110		83	<5.3	32	<5.3	<5.3	<350	490	210

* - Compound is a tentatively identified compound (TIC).
@ - Reported value is within a factor of five of the detection limit.
B - Presence may be due to laboratory contamination. Flag indicates that the analyte was found in the associated blanks. The sample results were not corrected for the concentration in the blank.
G - Result does not match the characteristic diesel pattern but elutes in the retention time window, so is quantitated as diesel (See Appendix L).

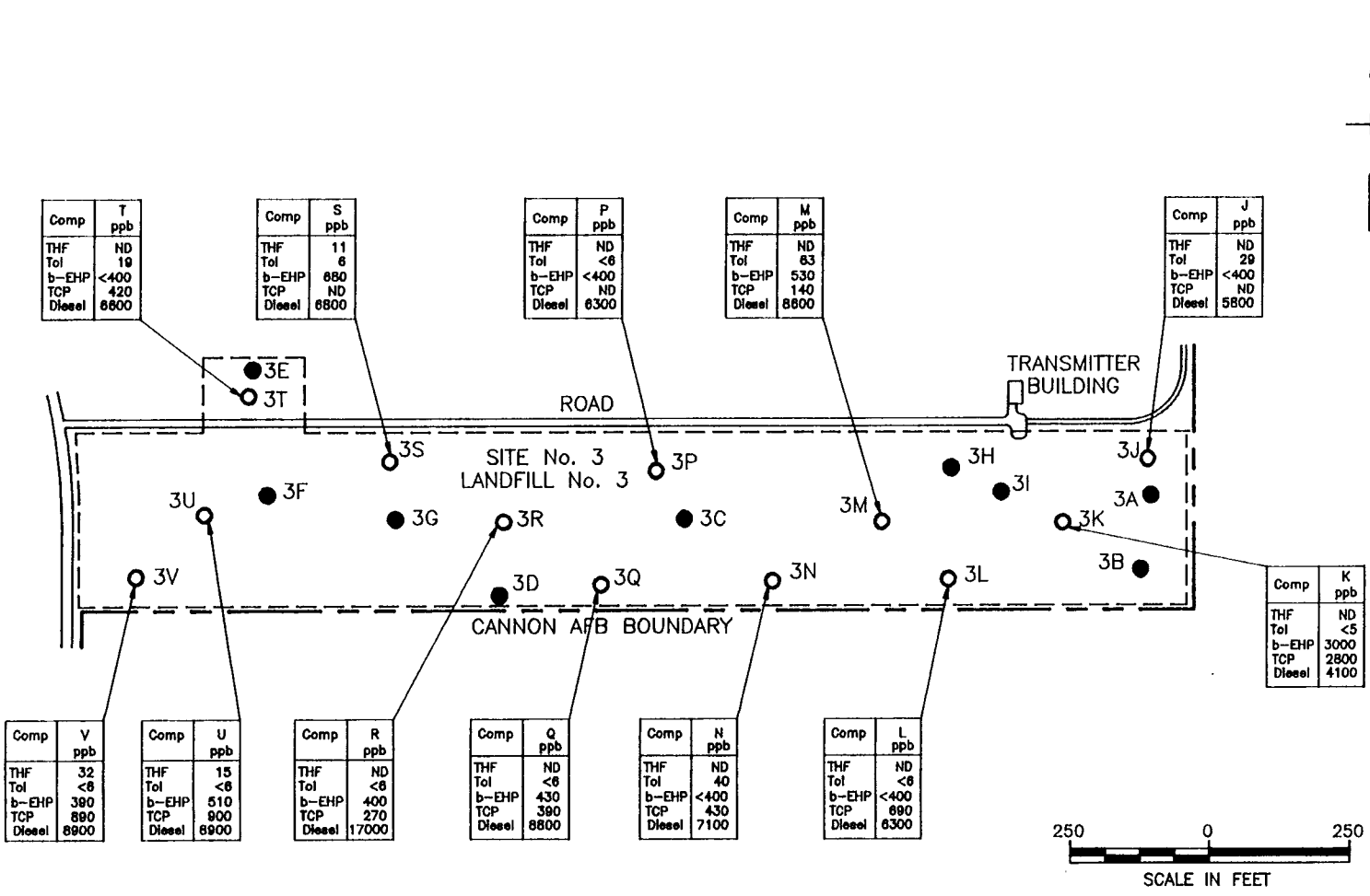
Note: Blank space indicates that the sample was not analyzed for TRPH or diesel, or that the listed compound is a TIC and was not found in all the samples. TIC results are semi-quantitative, therefore a reporting limit is not available.

The remaining target organic compounds were not detected above the reporting levels in these field samples and are therefore not included in this table. J-flagged data was also used to evaluate the chemicals of concern for the risk assessment. The J-flagged data are presented in Appendix D.

limit. TRPH was also detected at these levels in 4 of 14 soil method blanks. These results suggest that low concentrations, up to 50 mg/kg, in the field samples may have been due to laboratory contamination. Diesel was detected in all but 2 of the 12 blanks (3 equipment and 9 method blanks) analyzed with these samples. Although the laboratory reported this compound as diesel based on its retention time, the chromatograph did not match the characteristic diesel pattern in the blanks or field samples. Therefore, field results up to 15,000 μg/kg (three times the reporting limit) are attributed to laboratory contamination. Appendix L contains a supplemental report which addresses this compound reported as "diesel" in detail.

Toluene, methylene chloride, xylenes, and bis(2-ethylhexyl)phthalate were detected at low (sub-ppm) concentrations in 15% or less of the Landfill No. 3 1992 field samples. Ethyl acetate (TIC) is present in most of the field samples. This compound has been used as a solvent for coatings and plastics, in varnishes, lacquers, and airplane dope. Tetrahydrofuran is a solvent for polyvinylchlorides (PVC), vinyl chloride copolymers and vinyldiene chloride copolymers. Cyclohexanone and trichloropropene(s) are solvents used in various pesticides. Tetrahydrofuran, acetonitrile, cyclohexanone, and trichloropropene(s) are also solvents used in paint and varnish, or tar and grease removers.

The maximum concentrations of selected organic compounds found at each borehole location drilled in 1992 are presented in Figures 5-1 and 5-2. The compound list is based on compounds used for the risk assessment which is presented in Section 6. Detailed listings of the analytical results for all target compounds and reported TICs are given in Appendix C, Tables C-1 and C-3.



Comp	T ppb
THF	ND
Tol	19
b-EHP	<400
TCP	420
Diesel	6600

Comp	S ppb
THF	11
Tol	6
b-EHP	660
TCP	ND
Diesel	6800

Comp	P ppb
THF	ND
Tol	<6
b-EHP	<400
TCP	ND
Diesel	6300

Comp	M ppb
THF	ND
Tol	63
b-EHP	530
TCP	140
Diesel	8600

Comp	J ppb
THF	ND
Tol	29
b-EHP	<400
TCP	ND
Diesel	5800

Comp	K ppb
THF	ND
Tol	<5
b-EHP	3000
TCP	2800
Diesel	4100

Comp	V ppb
THF	32
Tol	<6
b-EHP	390
TCP	890
Diesel	8900

Comp	U ppb
THF	15
Tol	<6
b-EHP	510
TCP	900
Diesel	8900

Comp	R ppb
THF	ND
Tol	<6
b-EHP	400
TCP	270
Diesel	17000

Comp	Q ppb
THF	ND
Tol	<6
b-EHP	430
TCP	390
Diesel	8800

Comp	N ppb
THF	ND
Tol	40
b-EHP	<400
TCP	430
Diesel	7100

Comp	L ppb
THF	ND
Tol	<6
b-EHP	<400
TCP	690
Diesel	6300

LEGEND:

- ● SOIL BORINGS, FEBRUARY 1985
- ○ SOIL BORINGS, JULY 1992
- WASTE DISPOSAL AREA

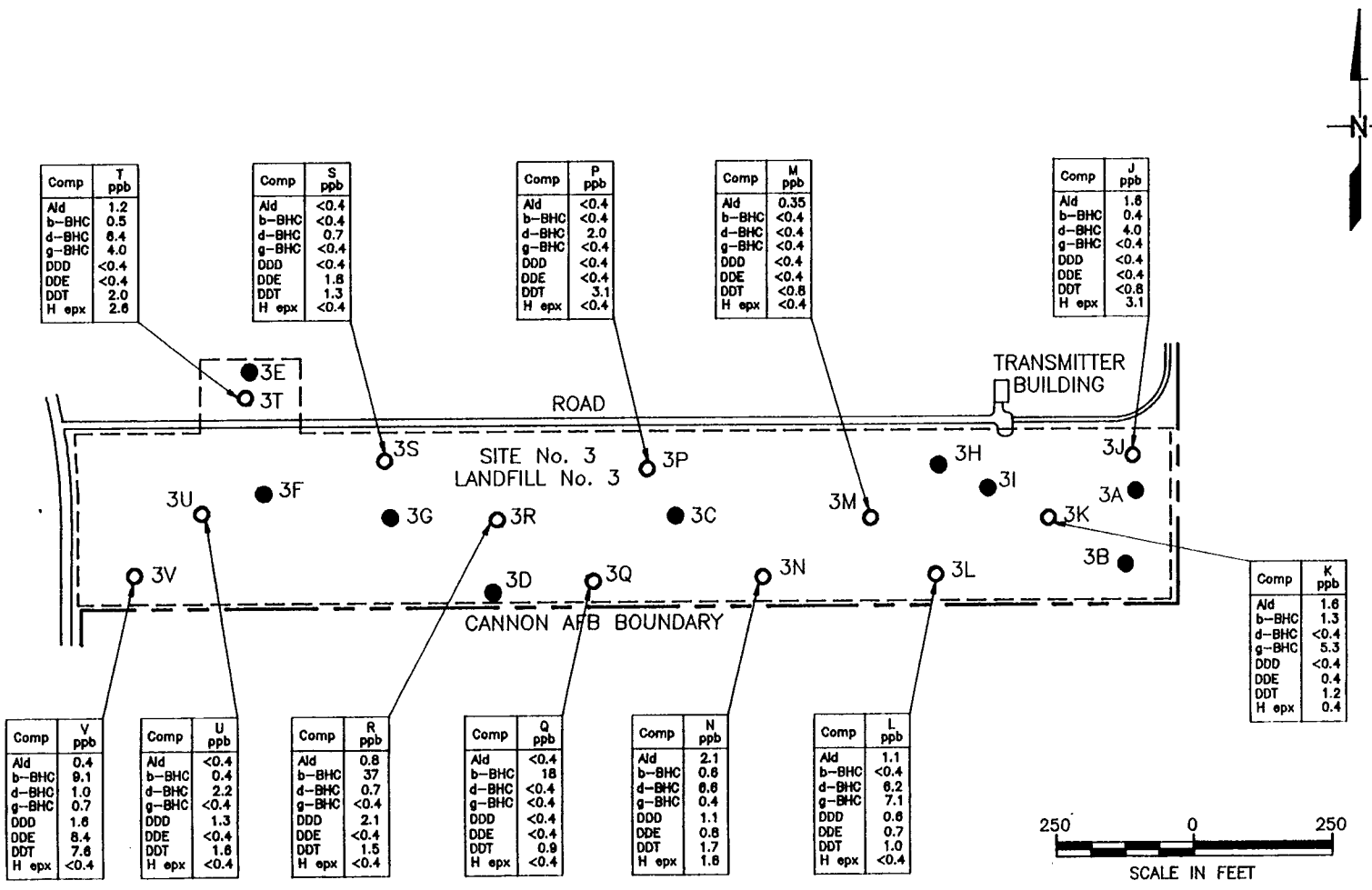
KEY

Units (ug/kg)

THF = Tetrahydrofuran
Tol = Toluene
b-EHP = bis(2-Ethylhexyl)phthalate
TCP = Trichloropropene
Diesel = Diesel

FIGURE 5-1
MAXIMUM CONCENTRATIONS OF SELECTED VOCs, SVOCs
IN SAMPLES FROM LANDFILL No. 3
JULY, 1992
CANNON AIR FORCE BASE
CLOVIS, NEW MEXICO

269-069/N1491



Comp	T ppb
Ald	1.2
b-BHC	0.5
d-BHC	6.4
g-BHC	4.0
DDD	<0.4
DDE	<0.4
DDT	2.0
H epx	2.6

Comp	S ppb
Ald	<0.4
b-BHC	<0.4
d-BHC	0.7
g-BHC	<0.4
DDD	<0.4
DDE	1.8
DDT	1.3
H epx	<0.4

Comp	P ppb
Ald	<0.4
b-BHC	<0.4
d-BHC	2.0
g-BHC	<0.4
DDD	<0.4
DDE	<0.4
DDT	3.1
H epx	<0.4

Comp	M ppb
Ald	0.35
b-BHC	<0.4
d-BHC	<0.4
g-BHC	<0.4
DDD	<0.4
DDE	<0.4
DDT	<0.8
H epx	<0.4

Comp	J ppb
Ald	1.6
b-BHC	0.4
d-BHC	4.0
g-BHC	<0.4
DDD	<0.4
DDE	<0.4
DDT	<0.8
H epx	3.1

Comp	K ppb
Ald	1.6
b-BHC	1.3
d-BHC	<0.4
g-BHC	5.3
DDD	<0.4
DDE	0.4
DDT	1.2
H epx	0.4

Comp	V ppb
Ald	0.4
b-BHC	9.1
d-BHC	1.0
g-BHC	0.7
DDD	1.6
DDE	8.4
DDT	7.6
H epx	<0.4

Comp	U ppb
Ald	<0.4
b-BHC	0.4
d-BHC	2.2
g-BHC	<0.4
DDD	1.3
DDE	<0.4
DDT	1.6
H epx	<0.4

Comp	R ppb
Ald	0.8
b-BHC	37
d-BHC	0.7
g-BHC	<0.4
DDD	2.1
DDE	<0.4
DDT	1.5
H epx	<0.4

Comp	Q ppb
Ald	<0.4
b-BHC	18
d-BHC	<0.4
g-BHC	<0.4
DDD	<0.4
DDE	<0.4
DDT	0.9
H epx	<0.4

Comp	N ppb
Ald	2.1
b-BHC	0.6
d-BHC	6.6
g-BHC	0.4
DDD	1.1
DDE	0.8
DDT	1.7
H epx	1.6

Comp	L ppb
Ald	1.1
b-BHC	<0.4
d-BHC	6.2
g-BHC	7.1
DDD	0.6
DDE	0.7
DDT	1.0
H epx	<0.4

LEGEND:

- ● SOIL BORINGS, FEBRUARY 1985
- ○ SOIL BORINGS, JULY 1992
- WASTE DISPOSAL AREA

KEY

Units (ug/kg)

Ald	Aldrin
b-BHC	beta-BHC
d-BHC	delta-BHC
g-BHC	gamma-BHC
DDD	4,4'-DDD
DDE	4,4'-DDE
DDT	4,4'-DDT
H epx	Heptachlor epoxide

FIGURE 5-2
MAXIMUM CONCENTRATIONS OF SELECTED PESTICIDES AND PCBs IN SAMPLES FROM LANDFILL No.3
JULY, 1992
CANNON AIR FORCE BASE
CLOVIS, NEW MEXICO

269-069/N1482

5.4 Comparison of Field Data to Soil Action Levels

The field data from the 1992 and 1985 sampling efforts were compared to the soil action levels given in Section 4, Table 4-3; RCRA Proposed Subpart S Media Action Levels. The concentrations of all target analytes in the Landfill No. 3 samples, including those which exceeded background soil metals concentrations, were less than the proposed noncarcinogenic actions levels.

CAN-105-3MM-21 contained 110 μg/kg PCB-1254 and CAN-105-3S-21 contained 160 μg/kg PCB-1260. Both these results exceeded the carcinogenic soil action level of 91 μg/kg per PCB aroclor. These compounds were not detected in any of the remaining 138 field samples from the site, at a reporting limit of about 7 μg/kg per aroclor.

The background soil concentration for beryllium exceeds the carcinogenic soil action level listed in RCRA Subpart S, indicating that this criteria is not appropriate for the site. Only sample CAN-105-3M-23.5, containing 1.1 mg/kg beryllium, exceeds the background soil beryllium concentration (0.81 mg/kg) established for Cannon AFB.

Twelve of the samples had reporting limits or sample concentrations for antimony determined by ICPES exceeded the soil action level of 32 mg/kg. These samples were submitted for reanalyses by atomic absorption, which does not experience the strong interelemental effect of calcium on antimony as experienced by the ICPES method. All of these samples were determined to contain less than 3 mg/kg antimony, which is well below the soil action level.

Thallium was not detected in any of the field samples, but the reporting limit for thallium by ICPES was about 10 mg/kg and exceeded the soil action criteria of 4 mg/kg. The USACE instructed Radian to submit about 10% (or 15) of these samples for analyses by atomic absorption. These samples were selected to provide information

across the site at each depth interval. These samples all contained less than 1 mg/kg of thallium when measured by atomic absorption, which was well below the soil action level. All other metals concentrations were below all listed soil action levels.

6.0 RISK ASSESSMENT

The primary mission of CAFB to develop and maintain an F-111 Tactical Fighter Wing has resulted in operations dealing with toxic and hazardous materials. Hazardous wastes are stored on-site prior to off-site treatment, recycling, or disposal. The IRP was established in 1982 to evaluate waste disposal practices, to control migration of hazardous contaminants, and to control hazards that may result from these prior waste practices. Radian was contracted by the USACE in 1984 to perform a Phase II (Stage 1) field investigation. The investigation was conducted in 1985 and consisted of drilling nine borings at Landfill No. 3 and collecting samples from either the upper 12 feet or the lower 5 feet of the 60-foot borings. In 1986, Radian produced a report describing the findings and concluded that there was no evidence that past disposal practices at Landfill No. 3 have resulted in a threat to human health or the environment. Radian was requested to perform a second field investigation at Landfill No. 3 during 1992 to fill in the data gap for samples collected between 20 and 55 feet below the surface.

This section presents the risk assessment including receptor and pathway identification conducted in support of conclusions drawn by the RFI.

Section 6.1 presents a brief narrative description of Landfill No 3. Section 6.2 describes the process used to identify the chemicals of potential concern and presents those chemicals that are quantified for risk in this report. Section 6.3 presents an assessment of the exposure to these chemicals of potential concern, including a conceptual site model. A toxicity assessment of the chemicals of potential concern is presented in Section 6.4. Potential health risks are described in the risk characterization presented in Section 6.5. Section 6.6 presents a qualitative environmental evaluation. Section 6.7 presents conclusions of the baseline risk assessment.

6.1 Characterization of Exposure Setting

Landfill No. 3 is an inactive waste disposal site. The landfill is located on the east side of the base, south of the playa lake, and covers approximately 13.5 acres as shown in Figure 6-1. The landfill was operated from 1959 to 1967 during which time domestic solid wastes, waste oils, solvents, paints, paint thinners and strippers, pesticide containers, and various empty cans and drums were burned in trenches, and the ash and remaining debris were buried. The maximum excavated depth of the landfill during its operation was 20 feet. The inactive site currently appears as a rectangular open field covered by prairie grasses.

The topography at Landfill No. 3 is fairly flat and drainage in the area is generally to the north toward the playa lake. Landfill No. 3 is underlain by approximately 55 feet of caliche. The caliche may serve as a barrier between the landfill base and the underlying Ogallala aquifer. The potential for production of leachate to contaminate groundwater is low, because the amount of precipitation in the arid environment is not sufficient to saturate the vadose zone or recharge the Ogallala aquifer located 320 feet below ground level (BGL).

6.1.1 Population Demographics

CAFB had a resident population of approximately 3,800, including military personnel and their dependents in 1990. Currently, there are 1,841 housing units at CAFB. Base housing is located in the northwest quarter of the base and north of the base, west of New Mexico Highway 277. Base-related employment at CAFB includes approximately 4,900 positions (Woodward-Clyde, 1992). Clovis is located approximately seven miles to the east of the base. In 1990, the population of Clovis was 30,954 persons. Currently, the population potentially exposed to contaminants originating from Landfill No. 3 includes on-base residents and workers, off-base residents, and consumers of locally produced agricultural crops and beef and dairy products. Future on-base land

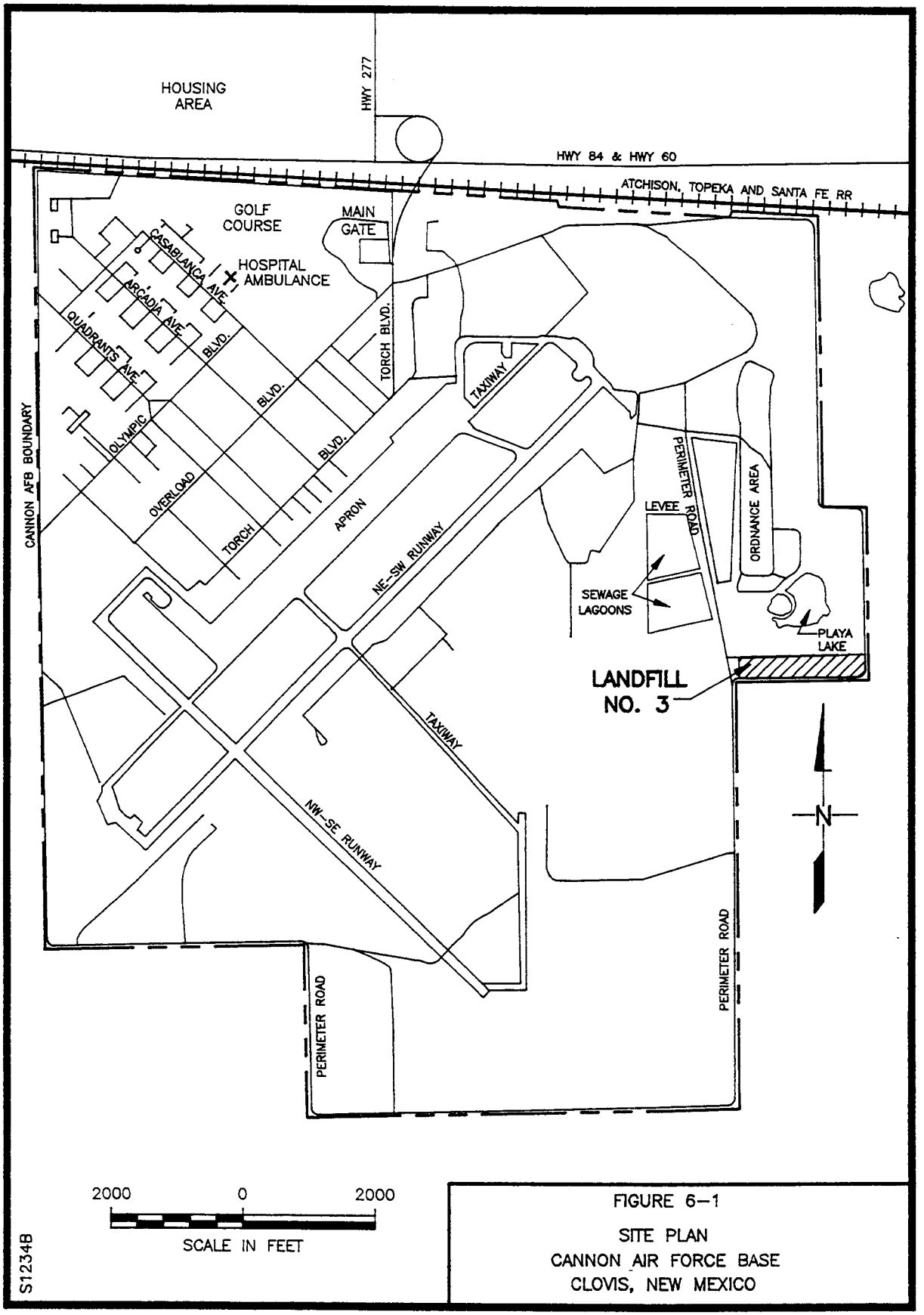


FIGURE 6-1

SITE PLAN
CANNON AIR FORCE BASE
CLOVIS, NEW MEXICO

use is not expected to change. The results of groundwater modeling indicate that future contamination of the groundwater is likely to be insignificant. Therefore, future scenarios were not evaluated in this risk assessment.

6.1.2 Current and Future Land Use

Land use is primarily agricultural within Curry County. As of 1992, total land area in the county is 897,000 acres with 837,200 acres designated as farm land. Lands surrounding CAFB are classified as irrigated farm land with principal crops including: corn, grain, sorghum, wheat, barley, oats, alfalfa, cotton and various vegetables. Cattle ranching and dairy farming occur throughout the county. Currently, no land use or zoning controls restrict the type and amount of construction in the proximity of CAFB. However, the U.S. Air Force has designated Air Installation Compatible Use Zones (AICUZs) around CAFB and provides recommendations for compatible uses in areas subject to noise and accident hazards (Woodward-Clyde, 1992).

CAFB is an active military installation and the home of the 27th Fighter Wing. There are no plans for closure of the facility in the foreseeable future. The use of CAFB as a military installation is highly specialized and land use cannot be significantly altered (i.e., converted to private, commercial, or residential use) without the approval of the U.S. Congress and the Secretary of Defense. For security and safety reasons, ingress and egress to the base is restricted (Landfill No. 3 is fenced on the South and East sides). Future land use is not expected to differ significantly from current land use practices.

6.1.3 Current Water Use

The lower portion of the Ogallala Formation is the primary regional aquifer in the vicinity of CAFB for potable and irrigation water. The dissolved solids in the aquifer range from 250 to 500 mg/L (Woodward-Clyde, 1992). The Ogallala aquifer

extends continuously from Wyoming and South Dakota into New Mexico and Texas. The Ogallala aquifer rests on Dockum Group redbeds, which serve as the basal confining layer in east central New Mexico. The aquifer has a southeasterly regional gradient of about 10 to 15 feet/mile. CAFB presently obtains water from a system of nine on-base water wells. All of the wells located on the base are completed in the Ogallala aquifer and range from 357 to 415 feet deep and have yields ranging from 50 to 820 gallons per minute (gpm). The wells incorporate multiple screens deriving water from interbedded sands of the Ogallala Formation (Radian, 1992).

The location and construction of all on-site wells and all off-site wells located within one mile of the landfill are presented in Section 2.3.2.

6.2 Identification of Chemicals of Potential Concern

Contaminants of potential concern for Landfill No. 3 were identified following guidance in Chapter 5 (Data Evaluation) of the *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A)* (USEPA, 1989a). USEPA guidance stipulates the following nine steps to evaluate analytical data for a comprehensive risk assessment:

1. Gather all data available from the site investigation and sort by medium;
2. Evaluate the analytical methods used;
3. Evaluate the quality of data with respect to sample quantitation limits;
4. Evaluate the quality of data with respect to qualifiers and codes;
5. Evaluate the data with respect to blanks;
6. Evaluate tentatively identified compounds;

7. Compare potential site-related contamination with background;

8. Develop a set of data for use in the risk assessment; and

9. If appropriate, further limit the number of chemicals to be carried through the risk assessment.

This subsection summarizes the data review process and its results.

6.2.1 Step 1: Data Available from Site Investigation

Analytical data from two remedial investigations (RI) performed at Landfill No. 3 have been used in this risk assessment. The first RI was performed in February 1985 under the Installation Restoration Program (IRP) with results reported in September 1986 in a document titled *Installation Restoration Program, Phase II - Confirmation/Quantification Stage 1*. The second RI was performed between July and August 1992 and results are reported in this report which complies with both CERCLA and RCRA requirements.

During the 1986 RI, nine borings were drilled 60 feet deep. Soil samples were collected and analyzed for organic and inorganic constituents. All samples were collected between 0 and 15 feet BGL, which was within the landfill confines, and below the landfill between 55 and 60 feet BGL. Metal concentrations were within background levels, oil and grease detections were considered to be from natural sources, and no organic constituents were detected (Radian, 1986). Analytical methods used to determine metal concentrations in soil samples in 1986 were the same as the analytical methods performed in 1992. The 1986 organic analysis reported all concentrations as non-detects; however, the detection limit for the 1986 data was higher than for the 1992 data. Because the data were not comparable and QA/QC were not available, the 1986 organic analyses were not used in this risk assessment.

The purpose of the 1992 RFI was to supplement the 1986 RI data. In the 1992 investigation, 12 borings were drilled 62 feet deep and soil samples were collected from below the bottom of the landfill between 20 and 62 feet BGL. In addition, surface soil samples were collected at three boring locations. Both organic and inorganic data from the 1992 RFI were included in this risk assessment.

Appendix D presents analytical data used in the risk assessment.

6.2.2 Step 2: Analytical Methods

A detailed evaluation of the analytical methods used and a QA/QC evaluation of the data are presented under separate cover in the *Quality Control Summary Report* (QCSR) (Radian, October 1992). The QA/QC evaluation of the data was a factor in choosing the list of chemicals of potential concern. A summary of the QA/QC concerns and resolutions that pertain to this risk assessment are discussed below.

Total Recoverable Petroleum Hydrocarbons (TRPH)

- The low concentrations of TRPH (up to two times the detection limit of 25 mg/kg) in the field samples may be caused by laboratory contamination because TRPH was detected in the method blanks.

Metals

- Six antimony laboratory control samples (LCSs) and 40 matrix spike/matrix spike duplicate (MS/MSD) pairs were outside acceptance criteria. However, calcium may have interfered with the analysis. Low recovery for antimony across the landfill may not indicate a low bias. Ten percent of the samples were reanalyzed for antimony by graphite furnace atomic absorption (AA). Antimony was not detected in these samples at 0.50 mg/kg; however, matrix spikes associated with these samples indicate that the results may be

biased low by about 80% which could result in an actual detection limit of 2.5 mg/kg. Sample results corrected for this bias were not different from background.

- Ten percent of the samples were analyzed for thallium by graphite furnace AA to achieve a low detection limit. No thallium was detected in these samples at 0.4 mg/kg; however, matrix spikes associated with these samples indicate that the results may be biased low by about 30% which could result in an actual detection limit of 0.5 mg. Sample results corrected for this bias were not significantly different from background.

- At the time of sample analysis LCS recovery demonstrated that laboratory systems were in control. MS/MSD recoveries suggest that these soil matrices may bias selenium measurements low in field samples by about 30 %. Sample results corrected for this bias were not significantly different from background.

Method 8015 (Diesel and gasoline)

- A compound eluting within the diesel retention time, and reported as diesel, was detected in three of three equipment blanks and seven of nine method blanks. All reported blank results were within three times the reporting limit. The reporting limit ranged from 48 to 50 μg/L and 2,500 to 5,000 μg/kg. Although reported as diesel, the chromatographic pattern for the compound does not match the characteristic pattern for diesel. Since the chromatographic pattern for the field results match the pattern for the blank results, the contaminant listed as diesel in the report is probably due to laboratory contamination (See Appendix L for further detail). To provide the most conservative estimate of risk, the contaminant was included as diesel in this risk assessment.

Volatiles

- Tetrahydrofuran was tentatively identified in three method blanks analyzed during 20 through 23 July at concentrations of 5, 12, and 21 μg/kg. Tetrahydrofuran was tentatively identified in 19 field samples analyzed during 20 through 23 July at concentrations ranging from 5.5 to 32 μg/kg. Tetrahydrofuran is a solvent for

polyvinylchlorides (PVC), vinyl chloride copolymers and vinyldiene copolymers. Tetrahydrofuran has also been used in paints, varnishes, and oil and grease removers. These materials may have been used at CAFB. However, due to the presence of tetrahydrofuran in the method blanks, the detected tetrahydrofuran is probably due to laboratory contamination.

Method 8150 (Chlorinated Herbicides)

- Dinoseb control spikes and matrix spikes analyzed on 8 August 1992 had 0 to 18% recovery (8 of 12 spike samples had 0% recovery). Dinoseb appears to have not been extracted from these samples. Field samples from boring sites 3J, 3K, 3L, 3M, 3N, 3P, 3Q, and 3T were extracted with these spike samples. Therefore, dinoseb may have been present in the field samples from these eight sites and not extracted for analysis. Spike samples associated with samples from boring sites 3R, 3S, 3U, and 3V displayed acceptable recovery. Dinoseb was not detected in any field samples from the site. A review of historical records indicate dinoseb has not been used at the base. Dinoseb was not detected in duplicate split samples analyzed by USACE Missouri River Division for quality assurance.

6.2.3 Step 3: Quantitation Limits

RI data reports provide reporting limits (RLs) specific to each sample. The sample RLs take into account sample characteristics (e.g., matrix; dry weight), sample preparation (e.g., sample volume), and analytical dilutions. RLs represent the lower bound of reliable laboratory data using multiple instruments and are the equivalent of method quantitation limits (the minimum concentration that can be measured and reported). The RL reported for each sample is the lowest reliable concentration available and is used as the sample quantitation limit (QL) for this risk assessment. RLs are not available for tentatively identified compounds (TICs).

For the purposes of this risk assessment, a positive result included values at and below the RL. If a chemical was not detected in any sample, it was eliminated from

the list of chemicals of potential concern. If a chemical was detected in some but not all samples, one-half the RL was used as a proxy concentration for non-detects.

Analytical results associated with unusually high RLs were eliminated from the quantitative risk assessment. RLs were considered unusually high if the proxy concentration (one-half the RL) exceeded positive results for the same chemical in other samples.

Chemicals for which positive data are available in at least one sample are listed in Table 6-1. Data associated with the chemicals to which no uncertainties are attached concerning the assigned identity of the chemical or the significance of site-related concentrations compared to background concentrations (inorganic chemicals only), are appropriate for use in the quantitative risk assessment.

6.2.4 Step 4: Data Qualifiers or Codes

Data qualifiers or codes were presented with the analytical results so that uncertainties could be identified and evaluated. Data with qualifiers that indicate known identities, but uncertain concentrations, were used in this risk assessment. No constituents were eliminated as chemicals of potential concern based on laboratory qualifiers that indicated known identities, but uncertain concentrations. Laboratory qualifier codes associated with the 1992 analytical data are described below.

All Methods

B Blank subtraction was not performed for analytes detected in associated system, method, or field blank. Use of these data in the risk assessment is discussed in Section 6.2.5.

Table 6-1

Contaminants Positively Detected in Soil at Landfill No. 3, Cannon AFB, New Mexico

Analytes	Chemical of Potential Concern	Rationale for Assessment
ORGANICS		
Acetone	no	Less than 10 times the TB and EB
Acetonitrile	no	Tentatively Identified Compound
Aldrin	yes	Detected frequently
Benzene	no	Does not meet 5% frequency requirements
Bis(2-ethylhexyl)phthalate	yes	Detected frequently
Benzo(a)anthracene	no	Does not meet 5% frequency requirements
Benzo(a)pyrene	no	Does not meet 5% frequency requirements
Benzo(g,h,i)perylene	no	Does not meet 5% frequency requirements
Benzo(b)flouranthene	no	Does not meet 5% frequency requirements
Benzo(k)flouranthene	no	Does not meet 5% frequency requirements
beta-BHC	yes	Detected frequently
4-Chloro-3-methylphenol	no	Does not meet 5% frequency requirements
Chrysene	no	Does not meet 5% frequency requirements
Chloroform	no	Does not meet 5% frequency requirements
Chlorocyclohexene	no	Does not meet 5% frequency requirements
Cyclohexanediol	no	Tentatively Identified Compound
Cyclohexenone	no	Tentatively Identified Compound
Cyclohexenol	no	Tentatively Identified Compound
2-Chlorophenol	no	Does not meet 5% frequency requirements
Cyclohexane	no	Tentatively Identified Compound
delta-BHC	yes	Detected frequently
Di-n-octylphthalate	no	Does not meet 5% frequency requirements
Decanal	no	Tentatively Identified Compound
Dieldrin	no	Does not meet 5% frequency requirements

Table 6-1
(Continued)

Analytes	Chemical of Potential Concern	Rationale for Assessment
4,4'-DDD	yes	Detected frequently
4,4'-DDE	yes	Detected frequently
4,4'-DDT	yes	Detected frequently
1,1-Dichloroethene	no	Does not meet 5% frequency requirements
Diesel *	yes	Detected frequently
Ethylbenzene	no	Does not meet 5% frequency requirements
Ethylacetate	no	Tentatively Identified Compound
Ethyl ester acetic acid	no	Tentatively Identified Compound
Endosulfan II	no	Does not meet 5% frequency requirements
Endrin	no	Does not meet 5% frequency requirements
Endrin ketone	no	Does not meet 5% frequency requirements
Endrin aldehyde	no	Does not meet 5% frequency requirements
Flouranthene	no	Does not meet 5% frequency requirements
gamma-BHC	yes	Detected frequently
2-Hexanone	no	Does not meet 5% frequency requirements
Heptachlor epoxide	yes	Detected frequently
Heptane	no	Tentatively Identified Compound
Hydrocarbons	yes	Detected frequently
Hydroxymethyl pentanone	no	Tentatively Identified Compound
Heptachlor	no	Does not meet 5% frequency requirements
Indeno(1,2,3-cd)pyrene	no	Does not meet 5% frequency requirements
4-Methyl-2-pentanone	no	Less than 5 times the TB and MB
Methyl acetate	no	Tentatively Identified Compound
Methyl ethyl ketone	no	Less than 10 times the TB and MB
3-Methylpentane	no	Tentatively Identified Compound
Methoxychlor	no	Does not meet 5% frequency requirements

Table 6-1
(Continued)

Analytes	Chemical of Potential Concern	Rationale for Assessment
Methylene chloride	no	Less than 10 times the TB and MB
Methylcyclohexane	no	Tentatively Identified Compound
2,4-Pentanedione	no	Tentatively Identified Compound
2-Pentanol	no	Tentatively Identified Compound
PCB-1254	no	Does not meet 5% frequency requirements
PCB-1260	no	Does not meet 5% frequency requirements
Pinene	no	Tentatively Identified Compound
2-Propanol	no	Tentatively Identified Compound
Phenanthrene	no	Does not meet 5% frequency requirements
Pyrene	no	Does not meet 5% frequency requirements
2-Propylfuran	no	Tentatively Identified Compound
2,4,5-T	no	Does not meet 5% frequency requirements
Tetrahydrofuran	yes	Detected frequently
1,1,1-Trichloroethane	no	Does not meet 5% frequency requirements
Trichloropropene	yes	Detected frequently
Toluene	yes	Detected frequently
Trimethylcyclohexane	no	Tentatively Identified Compound
Unknown	no	Tentatively Identified Compound
Unknown 1	no	Tentatively Identified Compound
Unknown 2	no	Tentatively Identified Compound
Unknown 3	no	Tentatively Identified Compound
Unknown 4	no	Tentatively Identified Compound
Unknown 5	no	Tentatively Identified Compound
Unknown 6	no	Tentatively Identified Compound
Unknown 7	no	Tentatively Identified Compound
Unknown 8	no	Tentatively Identified Compound

Table 6-1
(Continued)

Analytes	Chemical of Potential Concern	Rationale for Assessment
Unknown 9	no	Tentatively Identified Compound
Unknown alchol	no	Tentatively Identified Compound
Unknown aldehyde	no	Tentatively Identified Compound
Unknown aldehyde 1	no	Tentatively Identified Compound
Unknown aldehyde 2	no	Tentatively Identified Compound
Unknown aldehyde 3	no	Tentatively Identified Compound
Unknown aldehyde 4	no	Tentatively Identified Compound
Unknown alkane	no	Tentatively Identified Compound
Unknown alkane 1	no	Tentatively Identified Compound
Unknown alkane 2	no	Tentatively Identified Compound
Unknown alkane 3	no	Tentatively Identified Compound
Unknown alkane 4	no	Tentatively Identified Compound
Unknown alkane 5	no	Tentatively Identified Compound
Unknown C6 alkane	no	Tentatively Identified Compound
Unknown C8 alkane	no	Tentatively Identified Compound
Unknown C9 alkane	no	Tentatively Identified Compound
Unknown C10 alkane	no	Tentatively Identified Compound
Unknown alkene	no	Tentatively Identified Compound
Unknown alkene 1	no	Tentatively Identified Compound
Unknown carboxylic acid	no	Tentatively Identified Compound
Unknown cyclic ether	no	Tentatively Identified Compound
Unknown cyclohexanone	no	Tentatively Identified Compound
Unknown cyclohexediol	no	Tentatively Identified Compound
Unknown cyclohexene	no	Tentatively Identified Compound
Unknown cyclohexene 1	no	Tentatively Identified Compound
Unknown cyclopentane	no	Tentatively Identified Compound

Table 6-1
(Continued)

Analytes	Chemical of Potential Concern	Rationale for Assessment
Unknown ester	no	Tentatively Identified Compound
Unknown heptane	no	Tentatively Identified Compound
Unknown hydrocarbon	no	Tentatively Identified Compound
Unknown hydrocarbon 1	no	Tentatively Identified Compound
Unknown hydrocarbon 2	no	Tentatively Identified Compound
Unknown hydrocarbon 3	no	Tentatively Identified Compound
Unknown hydrocarbon 4	no	Tentatively Identified Compound
Unknown hydrocarbon 5	no	Tentatively Identified Compound
Unknown hydrocarbon 6	no	Tentatively Identified Compound
Unknown hydrocarbon 7	no	Tentatively Identified Compound
Unknown hydrocarbon 8	no	Tentatively Identified Compound
Unknown hydrocarbon 9	no	Tentatively Identified Compound
Unknown hydrocarbon 10	no	Tentatively Identified Compound
Unknown hydrocarbon 11	no	Tentatively Identified Compound
Unknown hydrocarbon 12	no	Tentatively Identified Compound
Unknown hydrocarbon 13	no	Tentatively Identified Compound
Unknown hydrocarbon 14	no	Tentatively Identified Compound
Unknown hydrocarbon 15	no	Tentatively Identified Compound
Unknown hydrocarbon 16	no	Tentatively Identified Compound
Unknown hydrocarbon 17	no	Tentatively Identified Compound
Unknown hydrocarbon 18	no	Tentatively Identified Compound
Unknown ketone	no	Tentatively Identified Compound
Unknown ketone 1	no	Tentatively Identified Compound
Unknown phenol	no	Tentatively Identified Compound
Unknown terpene	no	Tentatively Identified Compound
Xylenes	no	Does not meet 5% frequency requirements

Table 6-1
(Continued)

Analytes	Chemical of Potential Concern	Rationale for Assessment
INORGANICS		
Aluminum	no	Within background concentrations
Antimony	no	Within background concentrations
Arsenic	no	Within background concentrations
Barium	no	Within background concentrations
Beryllium	no	Within background concentrations
Cadmium	no	Within background concentrations
Calcium	no	Necessary nutrient
Chromium	no	Within background concentrations
Cobalt	no	Within background concentrations
Copper	no	Within background concentrations
Iron	no	Necessary nutrient
Lead	no	Within background concentrations
Magnesium	no	Necessary nutrient
Manganese	no	Within background concentrations
Mercury	no	Within background concentrations
Nickel	no	Within background concentrations
Potassium	no	Necessary nutrient
Selenium	no	Within background concentrations
Sodium	no	Necessary nutrients
Vanadium	no	Within background concentrations
Zinc	no	Within background concentrations

TB - Trip Blank
EB - Equipment Blank
MB - Method Blank
* - Result did not match characteristic diesel pattern, but elutes in the assigned retention time window. To provide the most conservative estimate of risk, the contaminant was quantitated as diesel.

@ Reported result was less than five times the QL. The reported value was used in the risk assessment.

J The RL is higher than the reported result. The value was used in the risk assessment.

Methods 8080/8150

G Presence of analyte confirmed by second column analyses but concentration is uncertain.

Method 8015M (Diesel)

G Result does not match the characteristic diesel pattern, but elutes in the retention time window, so was quantitated as diesel (See Appendix L).

6.2.5 Step 5: Blanks

Field and laboratory blanks were included in the analytical program to provide an indication of the introduction of constituents into samples during collection or analysis. Positive results qualified by the presence of the analyte in associated blanks were evaluated according to USEPA guidance (USEPA, 1989a). Sample results for common laboratory contaminants (acetone, methyl ethyl ketone, methylene chloride, toluene, and the phthalate esters) were considered positive only if the concentration in a sample exceeded ten times the maximum amount detected in any associated blank. If the concentration of a common laboratory contaminant was less than or equal to ten times the blank concentration, the constituent was considered a laboratory contaminant; the blank concentration was considered to be the RL. Chemicals that are not common laboratory contaminants were evaluated in the same way, but five times the maximum blank-related concentration was used to distinguish between non-detects and contamination.

If all results for a chemical were considered to be non-detects or the number of results were below the allowable frequency of 5%, that chemical was eliminated from the list of chemicals of potential concern. Table 6-1 identifies those analytes eliminated for these reasons. Appendix D presents analytical data and blank data for the list of positive chemicals.

6.2.6 Step 6: Tentatively Identified Compounds (TICs)

The mass spectral analyses of samples for VOCs and SVOCs result in the identification and quantitation of compounds given in the Target Compound List (TCL). Sometimes the mass spectra indicate the presence of additional organic compounds that are not on the TCL. These spectra are compared to spectra in the mass spectral data library, and the compounds are tentatively identified based on similarities to the library spectra. These compounds are called tentatively identified compounds (TICs), and the assigned identity and quantitation of the compound is, in most cases, highly uncertain. If a compound cannot be identified by the mass spectral data library, then the compound is listed as an unknown compound or an unknown of a specific organic group (e.g., ester, carboxylic acid, alkane, etc.). TICs listed as unknowns cannot be identified. TICs that are assigned a tentative name could be quantified relative to compound. However, this would require recollecting a sample and obtaining a standard containing the TIC. This is not typically done. TICs may be intermediate breakdown or degradation products of larger organic compounds.

Compounds which are unknowns are not included in the list of concern since risk assessments can only be conducted on an identified or tentatively identified compound (a named TIC). The risk associated with a TIC is always uncertain since the actual identity and concentration of the compound is uncertain. SW-846 provides procedures to estimate the concentration of TICs. These estimates, however, are highly uncertain and could be orders of magnitude higher or lower than the actual concentration. When evaluating TIC data, it is important to note that the assigned

identity may be incorrect and that the quantitation is likely to be inaccurate. For the Landfill No. 3 evaluation, many TICs were eliminated from the risk assessment, as per EPA risk assessment guidance, after reviewing frequencies of detection and estimated concentration ranges. Tetrahydrofuran and trichloropropene(s) were TICs included in the risk assessment because there were many detects at relatively high estimated concentrations. However, cyclohexanone and ethyl ester acetic acid were not included in the risk assessment because although the compounds were detected many times, the data were associated with multiple cases of blank contamination.

6.2.7 Step 7: Background Concentration Comparison

Background concentrations for metals at CAFB were collected in December of 1991. Soil samples were taken from two on-base sites outside landfill areas. Analytical results from these two sites were compiled and a range for background concentrations was developed for each metal analyzed. Appendix F presents background information for metals, and Table 5-2 presents the upper tolerance limits (UTLs) calculated from these data. Averages of analytical results and the highest detected concentrations for metals collected at Landfill No. 3 in 1992 and 1985 were compared to these background ranges. Those metals for which the average and highest concentration reported were within background ranges included aluminum, arsenic, beryllium, cadmium, cobalt, manganese, mercury and vanadium. Antimony, barium, chromium, copper, lead, nickel, selenium, and zinc had averages within background ranges, but one or more values were reported above the upper limit of the background range. An evaluation of background and landfill concentrations for these metals indicated no differences between background and site samples.

The Wilcoxon rank sum test was performed on landfill and background results for barium, chromium, lead, and nickel. There were not enough detects in the background data for antimony, copper, selenium, and zinc to run a statistical analysis. For these metals, sample and background concentrations were compared using reporting

limit ranges, maximum concentrations detected, and averages that included half the reporting limit as a proxy result for all non-detects. These comparisons provided a valid method to determine if site samples differed from naturally occurring background concentrations. A discussion of statistical methods and background concentrations is presented in Appendix E.

6.2.8 Steps 8 and 9: Data Set Used in the Risk Assessment

USEPA guidance (USEPA, 1989a) stipulates that the list of chemicals of potential concern include chemicals that were:

1) Positively detected in at least one sample in a given medium, including: a) chemicals with no qualifiers attached (excluding samples with unusually high RLs); and b) Chemicals with qualifiers attached that indicate known identities but unknown concentrations (e.g.; J-qualified data);

2) Detected at levels significantly above levels of the same chemicals detected in associated blank samples; and

3) Detected at levels significantly above naturally occurring levels of the same chemicals.

Appendix D presents all analytical data used in this risk assessment for chemicals of potential concern.

USEPA's stated preference is to include all chemicals that meet the three criteria described above. However, evaluation of detection frequency is one procedure for reducing the number of chemicals included in the quantitative risk assessment. Chemicals that are infrequently detected may be artifacts in the data resulting from sampling, analytical, or other problems, and therefore may not be related to site operations or disposal practices. For this assessment, a chemical was eliminated from the list of chemicals of potential concern if:

1) It was detected infrequently (less than 5%) or not at all in samples;

2) It was not detected at high concentrations (greater than or equal to five times the sample RL) in any sample; and

3) There is no reason to believe that the chemical may be present.

Chemicals eliminated from the list of chemicals of potential concern by these criteria are identified in Table 6-1.

Several pesticides, their metabolites, and hydrocarbons were eliminated from the list of chemicals of concern and from the quantitative risk assessment based on detection frequency and detection below QLs. Chemicals that fall into this category are listed below:

- Benzene ;
- Benzo(a)anthracene;
- Benzo(a)pyrene;
- Benzo(g,h,i)perylene;
- Benzo(b)fluoranthene;
- Benzo(k)fluoranthene;
- Chrysene;
- Dieldrin;
- Endosulfan II;
- Endrin;
- Endrin aldehyde;
- Endrin ketone;
- Fluoranthene;
- Heptachlor;
- Indeno(1,2,3-cd)pyrene;
- Methoxychlor;
- Phenanthrene;
- Pyrene; and
- 2,4,5-trichlorophenol.

However, these chemicals may have historical importance because pesticide containers were burned in trenches and the remaining debris and ash were buried during the operation of Landfill No. 3. A qualitative discussion of the potential impact of these chemicals on the risk assessment is presented in Sections 6.5.7. The uncertainties associated with deleting these chemicals from the quantitative risk assessment are addressed in Section 6.5.8. This approach was also taken for di-n-octylphthalate, 1,1-dichloroethene, ethylbenzene, 2-hexanone, and polychlorinated biphenyls (PCBs) because these chemicals could be associated with wastes previously deposited at the site.

6.2.9 Data Limitations/Data Gaps

During this investigation only soil samples were collected and analyzed, no groundwater and air samples were taken. This limits the assessment of chemicals of concern to contaminants found in the soil on or beneath Landfill No. 3. Because only three surface soil samples were collected, the surface data was not as inclusive as subsurface data which included 12 borings and 8 to 12 samples per boring. Limitations of analytical methods in detection of chemicals below the instrument detection limit, use of estimated values below the reporting limit, and values that were close to the reporting limit further limit the data used in this risk assessment. Limitations of analytical methods tend to result in underestimation of risks. Use of estimated values tend to result in overestimation of concentrations and the use of values close to the reporting limit could either over- or under-estimate contaminant concentrations. The elimination of chemicals from the list of chemicals of concern may have historical importance and, therefore, the quantitative risk assessment could potentially result in an underestimation of risk. However, the potential risks associated with these chemicals were assessed qualitatively and are considered to be insignificant (refer to Section 6.5.7).

6.3 Exposure Assessment

Exposure assessment is the determination or estimation (qualitative or quantitative) of the magnitude, frequency, duration, and route of human exposure to the chemicals of potential concern that are present at, or may have migrated from a site. The following subsections discuss the conceptual site model, including the source of contamination, potential migration pathways, and potentially exposed populations. A discussion of exposure pathways, exposure scenarios, quantification of exposure, and uncertainties associated with the exposure assessment are also included. Sections 2 and 3 provide detailed descriptions of the physical characteristics of the base and the surrounding area. A brief description of the exposure setting is presented in Section 6.1.

6.3.1 Exposure Assessment Methodology

Human exposure to the chemicals of potential concern were evaluated by performing the following tasks:

1. Identification of releases into various media;
2. Determination of fate and transport in release media;
3. Evaluation of exposure points and exposure routes;
4. Determination of exposure scenarios;
5. Quantification of estimated exposure concentrations; and
6. Estimation of chemical intakes.

Air impacts were estimated using predictive equations recommended by the USEPA. Emission rates of chemical compounds derived from volatilization and wind entrainment of contaminated dust from Landfill No. 3 were estimated and input into the USEPA-approved Industrial Source Complex Short-Term (ISCST2) dispersion model to estimate worst-case maximum short-term (hourly) and average annual chemical concentrations in the atmosphere at the periphery of the landfill. The predicted

concentrations were then used to estimate health risks to the exposed populations. The methodology used to calculate air emissions is presented in Appendix G-1. Groundwater flow and contaminant transport were modeled using analytical solutions for estimating the time of travel of soil moisture through unsaturated soil from the bottom of the landfill to the Ogallala aquifer, assuming steady-state conditions in the soil column. Appendix G-2 contains a discussion of the methodology used to calculate groundwater concentrations.

6.3.2 Conceptual Site Model

Based on available information, a conceptual site model was developed to provide an understanding of the sources of contaminants, potential migration pathways of contaminants, and potential receptors considering geologic and hydrologic information. The conceptual site model is presented schematically in Figure 6-2 and provides the basis for the human health and ecological risk assessment. Chemicals of potential concern identified for use in this risk assessment include:

- Aldrin;
- beta-BHC;
- delta-BHC;
- gamma-BHC (lindane);
- Bis(2-ethylhexyl)phthalate;
- 4,4'-DDD;
- 4,4'-DDE;
- 4,4'-DDT;
- Diesel Fuel;
- Heptachlor Epoxide;
- Hydrocarbons;
- Tetrahydrofuran;
- Toluene; and
- Trichloropropene.

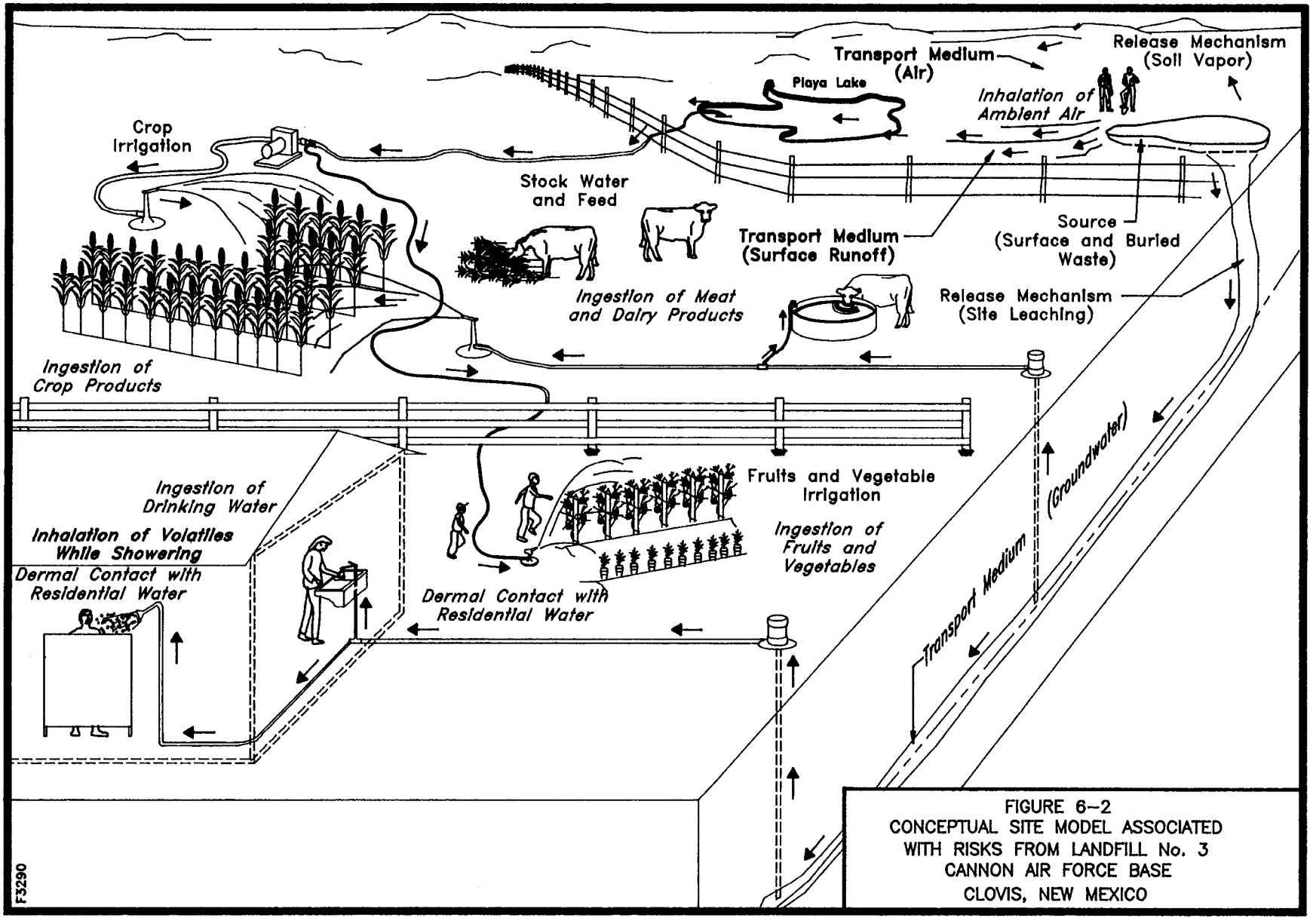


FIGURE 6–2
CONCEPTUAL SITE MODEL ASSOCIATED
WITH RISKS FROM LANDFILL No. 3
CANNON AIR FORCE BASE
CLOVIS, NEW MEXICO

Potentially sensitive members of the population who may be exposed to chemicals originating from Landfill No. 3 include: children, the elderly, and those with preexisting conditions that may be aggravated by exposure to chemicals of potential concern. Locations where sensitive members of the population might reside include hospitals, retirement/nursing homes, schools, nurseries, and day care centers. Medical services for CAFB personnel and their dependents are provided by two general hospitals in the surrounding communities and by the base hospital. The High Plains Hospital is located several miles east of the base, toward Clovis, New Mexico. On-base support facilities, including schools and day care centers are located primarily northwest of the airfield area upgradient and generally upwind of Landfill No. 3. Nearby off-base facilities include a dairy, a barber shop, and a convenience store (Allsups); however, these facilities represent the general population and not the sensitive subpopulations.

6.3.3 Identification of Exposure Pathways

An exposure pathway describes the course a chemical or physical agent takes from the source to the exposed individual. A complete pathway is generally comprised of the following: 1) a source and mechanism of chemical release; 2) a retention or transport medium; 3) a point of potential human contact with the contaminated medium; and 4) an exposure route (i.e., ingestion, inhalation, dermal contact). The following subsections contain information about contaminant sources and receiving media at the site, the fate and transport of chemicals of concern, and exposure points and routes.

6.3.3.1 Sources and Receiving Media

For the purposes of this risk assessment, the source of contamination is represented by the wastes that have been applied to Landfill No. 3 in the past. No further waste application to Landfill No. 3 is projected in the future. These wastes are the sole source of soil, and potential groundwater, surface water, and air contamination

from the landfill. The potential releases to media from contaminants originating at Landfill No. 3 addressed in this risk assessment are those to (1) surface water (playa lake) via runoff from the landfill; and (2) ambient air. Releases to the groundwater have not been included because the time required for the constituents to travel to the groundwater and the assumed attenuation factor indicate that the concentrations of chemicals in the groundwater will be insignificant.

Results of chemical analyses of soil samples collected during the RI indicated that contaminants are present in the soil beneath Landfill No. 3 to depths of 62 feet BGL. Sections 5.1 through 5.3 summarize the analytical data characterizing contamination at the site. Chemicals detected in soil samples that are above reporting limits and the selection of contaminants of potential concern are discussed in Section 6.2. Secondary sources of contamination considered in this risk assessment are surface water and ambient air contaminated with the chemicals of potential concern.

The original release sources (e.g., buried waste and contaminated soil) were considered only indirectly in this risk assessment. Therefore, the results of the risk assessment were based solely on modeled contaminant concentrations.

Releases to Air--To evaluate potential releases to air at Landfill No. 3, volatilization of organic compounds from surface soil contamination, volatilization of organic compounds from buried wastes, and wind entrainment of contaminated dust were considered.

Volatile compounds entrained in the soil may volatilize and eventually disperse into the atmosphere above the ground surface by simple diffusion. The only chemical detected at the site with the potential to volatilize was toluene. No purgeable halocarbons or aromatic compounds were detected in the surficial soil (ranging between 0 to 11 feet) covering the landfill (Radian, 1986). There is a potential for volatile chemicals to migrate through the soil pores and eventually volatilize to the atmosphere.

In order to assume a worst-case scenario that would further support a no-action decision, release of volatile organics from surface and subsurface soils is considered to occur for purposes of this risk assessment. Metals were also detected in surficial soils, but concentrations were not significantly different from background soil concentrations (Radian, 1986). Volatilization of metals is not considered a dominant environmental fate mechanism.

Non-volatile chemicals and metals can potentially enter the atmosphere as a result of wind entrainment of contaminated surface soil. Waste must be present in surface soil and not covered by impervious materials or vegetation to be subject to fugitive dust generation. The generation of fugitive emissions in the form of dust/particulates is effectively prevented, because Landfill No. 3 is currently vegetated. However, to assume a worst-case scenario further supporting a no-action decision, fugitive dust generation was evaluated in this risk assessment.

Organic materials in the waste are subject to microbial decomposition and will generate a variety of gases that may vent to the atmosphere. Low soil moisture content inhibits waste decomposition resulting in a decreased rate of gas formation. Negligible amounts of organic materials were detected at the site; therefore, soil gases generated at Landfill No. 3 were considered to be negligible and are not evaluated for human health risks.

The playa lake north of Landfill No. 3 is recharged primarily by treated effluent from the sewage lagoon and by storm water runoff from the site. Without recharge, playa lakes persist for only a few days or weeks. Water is lost from playa lakes by infiltration to the soil and by evaporation (Radian, 1986). Volatilization of organic compounds from the surface water is possible; however, volatilization of organics from the playa lake is not expected to be significant because contamination of the playa lake with volatile organic compounds is predicted to be minimal. Only toluene has been detected on or near the surface of the landfill. Surface water modeling indicates that the

concentration of toluene should be quite low in the playa lake. Therefore, this scenario was not evaluated in the risk assessment.

Releases to Groundwater--A secondary release mechanism from the soil includes the potential for leaching of chemicals into groundwater. Leachate is composed of liquid present in the waste, liquid entering the unit from precipitation, and chemical compounds that are dissolved or suspended in this liquid. Many factors affect the potential for contaminant migration including: 1) chemical characteristics; 2) waste application practices; and 3) soil characteristics. The maximum excavated depth of the landfill during operation was 20 feet. The landfill is underlain by approximately 55 feet of caliche which may serve as a barrier between the landfill and the underlying Ogallala aquifer. However, additional soil samples collected during the 1992 RI indicated that contaminants have migrated beyond the maximal excavation depth of the landfill and suggests that contaminants may potentially leach to the underlying Ogallala aquifer.

A series of mathematical models were used to estimate the transport and fate of groundwater contaminants migrating from Landfill No. 3 at CAFB. The objective of the analysis was to provide conservative estimates of the maximum concentrations of chemicals of potential concern that would be expected at targeted receptor sites (refer to Appendix G-2 for a detailed discussion of calculations). Fate and transport data were obtained from the Soil Transport and Fate Database, Version 2.0. (Sims et al., 1991).

Migration of soil water and contaminants in the vadose zone beneath Landfill No. 3 was analyzed using an analytical solution for steady state, unsaturated flow. Groundwater flow and contaminant transport in the unconfined aquifer were analyzed with a separate analytical model.

Hydraulically active receptors are defined as those that impact the nature of the groundwater flow field and consequently the contaminant concentrations at the receptor. A hypothetical agricultural well placed at the southeast corner of Landfill No.

3 for modeling purposes, as well as the nine potable water wells located on-base fall into this category. Hydraulically, the wells draw groundwater towards them by creating a cone of depression that does not exist naturally. The hypothetical well was positioned to capture groundwater and contaminants migrating from the site.

Initially, the time of travel of unsaturated soil moisture from the bottom of the landfill to the water table was estimated. The time of travel was estimated to be 173 years. The fate and movement of organic materials in subsurface environments are governed largely by sorption and biodegradation. Sorption affects the rate of travel of organic material, relative to that of water through subsurface systems (McCarty et al., 1981). Solutes that may be sorbed/desorbed on soil, such as metals and pesticides, are expected to migrate at a slower apparent velocity than the soil moisture and will require a longer period of time to reach the water table.

The ultimate fate of organic compounds in the subsurface system depends upon biodegradative processes. The attenuation of organic species from biological, chemical, and physical degradation was estimated assuming a first-order decay mechanism.

Results from groundwater modeling for organic contaminants indicate that even the concentration of the most persistent species for which data were available (4,4'-DDE) can be expected to be attenuated by a factor of more than 10^{15}. Less persistent species can be expected to be attenuated to a greater extent. Even though degradation data were unavailable for several species, it is reasonable to assume that, similar to DDE, all contaminants of concern will be reduced to near zero concentrations by the time they migrate to the water table. Therefore, it was assumed that significant contamination of the water table with contaminants originating at Landfill No. 3 will not occur in the future and this scenario was not evaluated in the risk assessment. Modeling results are presented in Appendix G-2.

Releases to Surface Water--One of the most prominent geomorphic features in the vicinity of CAFB are blowouts. Blowouts are broad shallow depressions that form as a result of soil erosion by wind. Runoff collects in blowouts to form ephemeral playa lakes during periods of rainfall. Generally, drainage in the area of Landfill No. 3 is to the north toward a nearby playa lake. Therefore, direct release of surface contaminants detected at the landfill to surface water may occur at the site. Toluene was the only chemical of concern detected in surficial soils. Metals were also detected in surficial soils, but were not significantly different from background concentrations detected in soils at CAFB. Results from surface water modeling indicated that toluene associated with runoff from the site may potentially contaminate the playa lake located just north of the landfill. Modeling results are presented in Appendix G-2.

6.3.3.2 Fate and Transport in Release Media

Several of the contaminants detected at Landfill No. 3 may be transported from one medium to another by processes of solubilization, adsorption, bioaccumulation, or volatilization. Primary transport media for chemical substances in the environment include the air, groundwater, surface water, and soil. The potentially significant contaminant mechanisms considered for this risk assessment include:

1. Direct release of contaminants in soil to surface water;
2. Emissions to ambient air; and
3. Uptake by plants and animals.

Discharge to and Transport in Surface Water--Generally, drainage in the area is to the north, toward the playa lake, although no defined drainage ways exist within the landfill boundary (Radian, 1986). Therefore, direct release of contaminants detected at the surface of the landfill to the playa lake is possible. Toluene is readily leached from soils with low organic content and is moderately soluble in water.

However, the majority of the contaminants detected at Landfill No. 3 were pesticides which generally are only slightly soluble in water. The transport of these compounds, as well as bis(2-ethylhexyl)phthalate, in runoff is primarily caused by transport of particulates to which these compounds are bound. Because these compounds are bound strongly to soil, they are likely to be subject to sedimentation.

Release to and Transport in Ambient Air--Organic chemicals in the surficial soils of Landfill No. 3 have the potential to volatilize to the atmosphere. Ambient air monitoring has not been conducted at the landfill to determine the contaminants and/or contaminant concentrations in the air. Several of the contaminants detected in soils at Landfill No. 3 have the potential for volatilization from the soil. Non-volatile organics and metals can enter the atmosphere via wind entrainment of contaminated surface soil. Small particles that carry pesticides or their degradation products may be distributed through the air. Potential contamination of the air at the perimeter of Landfill No. 3 was estimated using conservative assumptions such as: 1) no plume rise; 2) concentration over a reduced area of the landfill; and 3) uniform distribution of subsurface contamination.

Uptake by Plants--Land use in the area surrounding CAFB is primarily agricultural. As of 1992, Curry County has a total land area of 897,000 acres with 837,200 acres designated as farm land (Woodward-Clyde, 1992). During the site visit, agricultural fields were noted on the east and south perimeters of Landfill No. 3. The crops grown on the fields vary depending on the season and market prices. The principal crops grown in Curry County include corn, grain, sorghum, wheat, barley, oats, alfalfa, cotton, and various vegetables. Wheat, used for human consumption, is the primary crop grown on the fields adjacent to Landfill No. 3. However, alfalfa, corn and milo are also grown on these fields and are used as cattle feed (Base Natural Resources Environmental Group, 1992). Agricultural crops are subject to accumulation of contaminants via root uptake of any contaminants present in the soil or water used for irrigation. The effluent to the playa lake located just north of Landfill No. 3 is used by a

local farmer for irrigation purposes. Therefore, plants may be potentially exposed to contaminants originating from Landfill No. 3, and it is important to examine the possible accumulation of contaminants in crops. The majority of the chemicals detected at the site are lipophilic and some have long half lives. As a result, they tend to bioaccumulate in the food chain. However, the groundwater modeling indicates these chemicals are not predicted to enter the groundwater in significant quantities. Toluene was the only chemical predicted to migrate to the playa lake (via runoff), which is used by a local farmer for irrigation purposes. Literature has shown that toluene can be detected in aquatic biota, but the concentration of toluene in other foodstuffs has not been thoroughly investigated (ATSDR Toxicological Profile for Toluene, 1989). Although the USEPA considers that levels of toluene in food are not likely to be significant, uptake of toluene into plants was evaluated because of its moderate lipophilicity and potential for bioaccumulation (ATSDR, Toxicological Profile for Toluene, 1989).

Uptake by Livestock--There is a dairy located within two miles (northeast) of Landfill No. 3. Cattle were seen at the perimeter of the Base, northeast of Landfill No. 3 during the site visit. Cattle ranching occurs throughout Curry County, and the land surrounding CAFB consists of irrigated crops and pasture land used in the cattle ranching and dairy business (Radian, 1986). Livestock, including beef and dairy cattle, are subject to accumulation of contaminants originating from the Base via ingestion of contaminants in feed. Several crops that are typically used for livestock feed are grown nearby CAFB. As cattle ingest contaminated feed, the contaminants can be absorbed by the gastrointestinal tract. The more lipophilic compounds may accumulate in the milk and edible meat following gastrointestinal absorption, providing a mechanism for human exposure. Locally raised beef and dairy cattle are sustained primarily (approximately 80%) on locally grown agricultural products (New Mexico Agricultural Extension Office, 1992). To evaluate a worst-case scenario, 100% of the feed for beef cattle and dairy cows was assumed to come from crops grown at the perimeter of Landfill No. 3. Although this worst-case scenario is conservative, it provides additional justification for a no-action decision.

6.3.3.3 Exposure Points and Exposure Routes

Normally, potential pathways are segregated into those that currently exist and those that may exist in the future. Current potential exposure pathways, which are the subject of this section, are those that may exist as a result of the current extent of contamination, combined with existing land use and activity patterns. Human exposure to contaminants originating at Landfill No. 3 could potentially occur on-site and in areas adjacent to the landfill. However, with the exception of metals and toluene detected in surface soils, contamination at the site is subsurface. Access to the site is limited and currently there are no ongoing invasive activities occurring, so direct human contact is highly unlikely. Use of potentially contaminated surface water from the playa lake and groundwater for irrigation of agricultural crops consumed by humans and for feed crops consumed by livestock may serve as indirect pathways of human exposure to contaminants from the landfill. Volatilization of volatile chemicals and fugitive dust generation at the site were also assessed as potential sources of exposure to contaminants originating at Landfill No. 3. Potential site releases are expected to be low-level and relatively continuous in nature. Short-term high level releases are unlikely to occur because the site has been closed since 1967.

Potential receptors considered in this risk assessment are: 1) animal and plant receptors; 2) people who consume commercially produced agricultural crops grown at the perimeter of the site; 3) people who consume meat and/or milk from livestock fed on crops grown at the site perimeter; and 4) Base personnel and on-site workers exposed to fugitive dust and volatilization of chemicals at the site. Future land uses in the vicinity of the base will not significantly alter the exposure points and exposure routes. The size of the potentially exposed populations could change in the future; however, it would likely increase for some exposure routes and decrease for others.

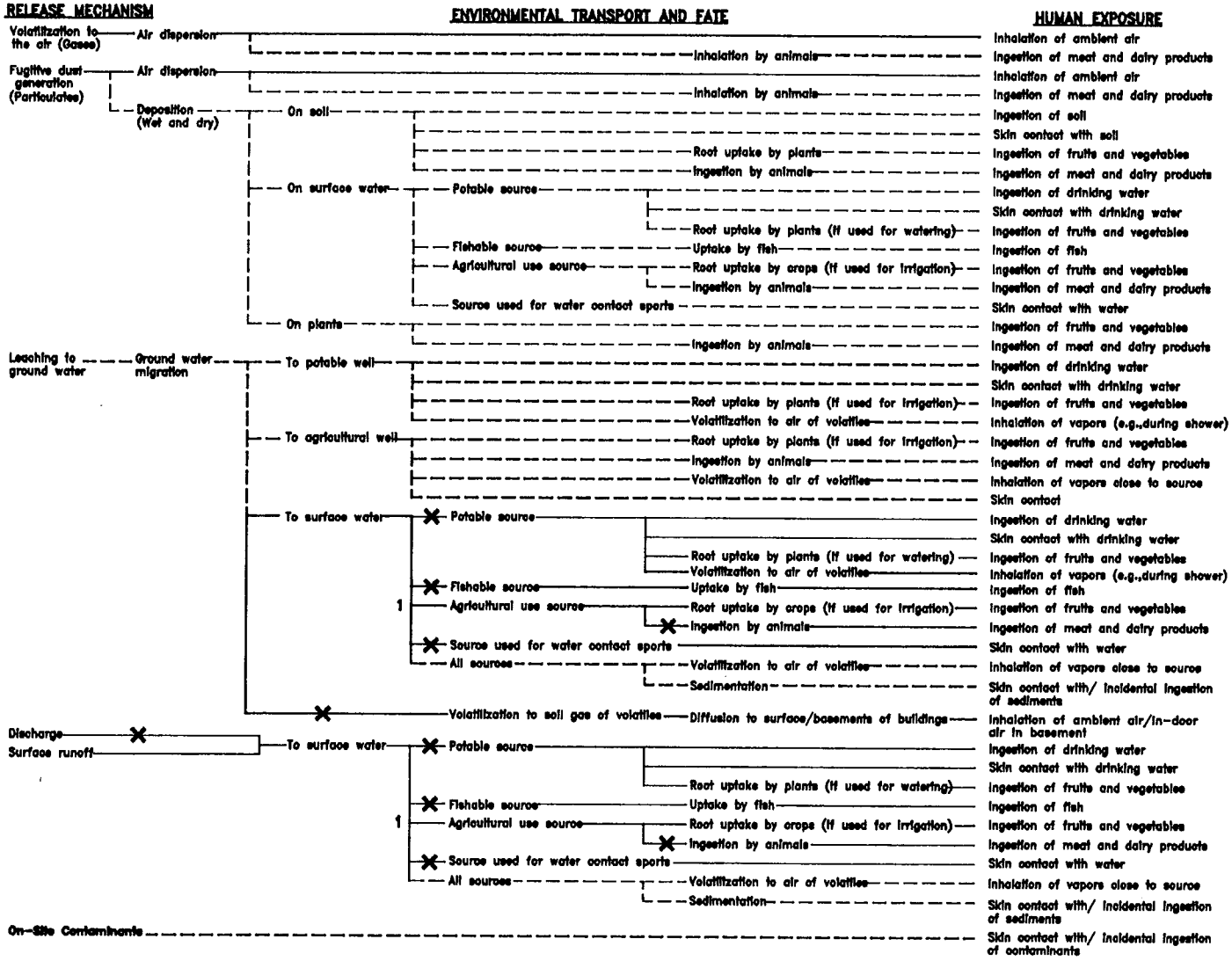
Potential receptors described in 1 through 3 above may be overly conservative because toluene uptake by plants is considered to be insignificant by the USEPA (ASTDR, Toxicological Profile for Toluene, 1989). However, the data on which the USEPA based this conclusion are incomplete. Toluene is moderately lipophilic, which usually increases the potential for uptake by root systems. Therefore, in order to evaluate a worst-case scenario, uptake of toluene by plant systems followed by consumption of these plants by both humans and livestock were evaluated in this risk assessment.

6.3.4 Exposure Pathways

This section of the risk assessment depicts potential pathways for contaminants originating at Landfill No. 3 to move from the point of release to the point of human exposure. Potential exposure pathways associated with identified receptors were evaluated to determine whether they were complete and significant. The route can include media other than the source and the receptor must engage in activity that will cause the exposure to occur. Figure 6-3 depicts potential pathways for contaminants originating at Landfill No. 3 to move from the point of release to points of human exposure. Pathways that are not complete have been crossed out and numbered to correspond with explanatory footnotes. Pathways that are completed but judged insignificant are indicated with dashed lines. Potentially significant pathways that exist at the site are indicated with bold, solid lines and include:

1) Ingestion of agricultural crops: migration to surface water; irrigation of crops with surface water; uptake by plants; ingestion of plants by humans.

2) Ingestion of milk and meat: consumption of contaminated crops by cattle; transfer of contaminants to beef or milk; ingestion of beef or milk by humans.



Legend

- Pathway is Terminated
- Pathway is not Significant
- Pathway is Potentially Significant

Notes

1. One farmer in the area draws water from the playa lake for irrigation purposes.

FIGURE 6-3
ENVIRONMENTAL FATE AND TRANSPORT
LANDFILL No. 3
CANNON AIR FORCE BASE
CLOVIS, NEW MEXICO

F3291

3) Inhalation of vapor phase chemicals at the site: volatilization from soil; inhalation of volatilized chemicals in ambient air.

4) Inhalation of fugitive dust generated at the site: entrainment of contaminants in soil; dispersion into the atmosphere above the site; inhalation of fugitive dust.

These four pathways are quantified in this risk assessment.

Pathways that may be complete but are likely to pose insignificant human health risks include: 1) ingestion and dermal contact with potentially contaminated groundwater during future domestic use; 2) inhalation of vapors volatilized from the playa lake; 3) dermal contact with surficial soils at the site; and 4) dermal contact with surface water drawn from the playa lake for agricultural purposes. The contribution of these exposure pathways is likely to be minor by comparison to exposure following ingestion of agricultural crops and beef or milk. Potentially exposed populations, exposure media, exposure points, and exposure routes for complete pathways are identified in Table 6-2. Also noted in this table are the decisions to select pathways for quantitative evaluation and the justification for including or excluding each pathway in the risk assessment.

Exposure Scenarios--Base personnel, onsite workers, and individuals living in areas downwind from Landfill No. 3 represent the significant populations potentially exposed to chemicals originating from the site that migrate to the playa lake or are emitted into the atmosphere above the site. The concentration of contaminants in the air originating from Landfill No. 3 is expected to be highest at the site perimeter and this assumption was corroborated by air dispersion modeling results. In order to assume a worst-case scenario, estimated exposure concentrations at the site perimeter, where they are expected to be highest, were used to evaluate the risk associated with all inhalation exposure scenarios. Base personnel and onsite workers working at or near Landfill No. 3 may be exposed chronically or subchronically to air emissions originating from the site

Table 6-2

Potentially Complete Exposure Pathways at Landfill No. 3, Cannon AFB, New Mexico

Exposure Route, Medium, and Exposure Point	Potentially Exposed Population	Pathway Selected for Evaluation	Reason for Selection or Exclusion
Inhalation of volatile chemicals in ambient air at or nearby site	Base personnel, nearby residents, on-site workers	Yes	Emissions of volatile chemicals can result in inhalation exposure of Base personnel, on-site workers and nearby residents.
Inhalation of fugitive dust in ambient air	Base personnel, residents living nearby, and on-site workers.	Yes	Wind entrainment of contaminated soils can result in inhalation exposure of Base personnel, on-site workers and nearby residents.
Ingestion of contaminated soil	Base personnel and trespassers	No	Base personnel not likely to inadvertently ingest soil; area is fenced-trespassers not likely.
Dermal contact with contaminated soil	Base personnel	No	No invasive activities at site; none or limited human exposure.
Ingestion of meat and dairy products from cattle exposed to contaminants from Playa Lake (stock water, irrigation of pasture/feed crops).	Consumers of locally produced meat and dairy products and nearby farm families.	Yes	A dairy exists to the northeast of Landfill No. 3 and several stockyards are located in the vicinity of Cannon AFB.
Dermal contact with chemical in playa lake water during agricultural use.	Off-base farmer drawing water from playa lake potentially contaminated with discharge from site for agricultural purposes.	No	Contribution of dermal contact with water drawn from playa lake is likely to be minor by comparison to the contribution of ingestion of agricultural products and livestock.
Dermal contact with chemicals in groundwater during home use.	Off-base residents	No	Modeled groundwater concentrations were too low to pose significant health risks.

Table 6-2

(Continued)

Exposure Route, Medium, and Exposure Point	Potentially Exposed Population	Pathway Selected for Evaluation	Reason for Selection or Exclusion
Inhalation of chemicals volatilized from groundwater during home use (while showering).	Off-base residents	No	Metals do not volatilize and the concentration of volatile chemicals predicted for groundwater are too low to present a human health risk.
Ingestion of contaminated groundwater migrating from site to potable water wells.	On-base workers, base personnel, off-base residents living downgradient from site.	No	Modeled groundwater concentrations were too low to pose significant human health risks.
Ingestion of fruits and vegetables irrigated with surface water drawn from playa lake impacted by runoff from site.	Consumers of locally grown agricultural crops and nearby farm families.	Yes	One farmer draws water from the potentially contaminated Playa Lake for agricultural purposes. There are agricultural wells in the vicinity of Landfill No. 3 that may potentially be contaminated with groundwater migrating from the site.

depending on length of employment (tour of duty). Residents living adjacent to the site, who grow and consume agricultural crops grown at the site perimeter as well as beef and dairy products from livestock fed with these crops, represent a "worst-case" scenario. These individuals may be subject to chronic (long-term) exposure to site-related contaminants. Individuals who consume commercially produced crops grown at the site perimeter and commercially produced beef and milk from livestock sustained on crops grown on the site perimeter, were not assessed because any contaminated commercial products would be widely distributed, thus reducing the potential for individual exposure by comparison to the farm family scenario.

Chronic and subchronic exposure scenarios are based on current predicted lifetime exposures. These scenarios assume exposure to contaminant levels predicted by modeled results at the nearest receptor. The scenarios that were evaluated in the risk assessment are:

<u>Lifetime, off-base residential</u>

1) adult, average
2) adult, reasonable maximum
3) child, average
4) child, reasonable maximum

<u>Occupational</u>

1) adult, average
2) adult, reasonable maximum

Chronic exposure to adults and children was evaluated for: 1) an average case, using 50th percentile values for exposure parameters (i.e., exposure duration and frequency) when available and appropriate; and 2) a reasonable maximum case, using 90th or 95th percentile values for exposure parameters when available and appropriate. Risk estimates for noncarcinogenic effects were predicted for adults and children. Risk

estimates for carcinogenic effects were predicted based on an exposure duration of 70 years.

6.3.5 Quantification of Exposures

This section describes the methodology used to estimate the magnitude, frequency, and duration of exposures for the populations and exposure pathways selected for quantitative evaluation. The exposure concentration estimates in the various exposure media and the methodologies used to obtain these estimates are discussed. Table 6-3 summarizes the average measured soil concentrations. Tables 6-4 and 6-5 summarize the exposure concentration estimates for all exposure media (i.e., soil, surface water, milk, beef, vegetables etc.). In addition, the exposure assumptions and algorithms used to calculate human intake are described.

6.3.5.1 Estimation of Exposure Concentrations

Groundwater--A series of mathematical models were used to estimate the transport and fate of groundwater contaminants migrating from Landfill No. 3 at CAFB. The objective of the analysis was to provide conservative estimates of the maximum concentrations of chemicals of potential concern that would be expected at targeted receptor sites (refer to Appendix G-2 for a detailed discussion of calculations).

Migration of soil water and contaminants in the vadose zone beneath Landfill No. 3 was analyzed using an analytical solution for steady state unsaturated flow. Groundwater flow and contaminant transport in the unconfined aquifer were analyzed with a separate analytical model. Two categories of receptors were considered to represent the potential for human exposure to contaminants originating at Landfill No. 3. These are hydraulically active and hydraulically passive receptors.

Table 6-3

Average Measured Soil Concentrations From 12 Soil Borings at Landfill No. 3, Cannon AFB, New Mexico

Chemicals	Soil Concentration (μg/kg)
Aldrin	2.3E-01
β-BHC	2.4E+03
δ-BHC	3.2E+00
y-BHC	4.7E-01
Bis(2-ethylhexyl)phthalate	2.0E+02
Diesel	6.1E+03
4,4'-DDD	2.4E-01
4,4'-DDE	2.7E-01
4,4'-DDT	6.8E-01
Heptachlor Epoxide	2.7E-01
Hydrocarbons	2.3E-04
Tetrahydrofuran	1.4E-01
Toluene	5.0E+00
Trichloropropene	4.1E-01

Table 6-4

Estimated Exposure Concentrations Associated with Landfill No. 3, Cannon AFB, New Mexico

Chemical	Surface Water mg/L		Ambient Air mg/m³			
			Chronic		Subchronic	
	Average	Reasonable Maximum	Average	Reasonable Maximum	Average	Reasonable Maximum
Aldrin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bis(2-ethylhexyl)phthalate	0.00E+00	0.00E+00	2.81E-08	2.81E-08	6.44E-07	6.44E-07
B-BHC	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
δ-BHC	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-BHC	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4,4'-DDD	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4,4'-DDE	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4,4'-DDT	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Diesel Fuel	0.00E+00	0.00E+00	1.78E-08	1.78E-08	4.08E-07	4.08E-07
Heptachlor Epoxide	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tetrahydrofuran	0.00E+00	0.00E+00	4.06E-07	4.06E-07	9.33E-06	9.33E-06
Toluene	5.00E-02	5.00E-02	2.51E-05	2.51E-05	5.76E-04	5.76E-04
Trichloropropene	0.00E+00	0.00E+00	2.54E-06	2.54E-06	5.83E-05	5.83E-05

Table 6-5

Estimated Exposure Concentrations in Foods Associated with Landfill No. 3, Cannon AFB, New Mexico

Chemical	Fruits mg/kg		Vegetables mg/kg		Meat mg/kg		Dairy mg/kg	
	Average	Reasonable Maximum	Average	Reasonable Maximum	Average	Reasonable Maximum	Average	Reasonable Maximum
Aldrin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bis(2-ethylhexyl) phthalate	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B-BHC	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
δ-BHC	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y-BHC	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4,4'-DDD	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4,4'-DDE	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4,4'-DDT	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Diesel Fuel	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Heptachlor Epoxide	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tetrahydrofuran	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Toluene	2.77E-07	2.77E-07	2.77E-07	2.77E-07	2.00E-07	2.00E-07	6.00E-06	6.00E-06
Trichloropropene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Hydraulically active receptors are defined as those that impact the nature of the groundwater flow field and therefore, the contaminant concentrations at the receptor as well. A hypothetical agricultural well placed at the southeast perimeter of Landfill No. 3 and the nine potable water wells located on-base fall into this category. Hydraulically, the wells draw groundwater towards them by creating a cone of depression that does not exist naturally. A hypothetical well was positioned to capture groundwater and contaminants migrating from the site.

The travel time of soil moisture through unsaturated soil from the bottom of the landfill to the water table was estimated to be 173 years. Solutes that may be sorbed/desorbed on soil, such as metals and pesticides, are expected to migrate at a slower apparent velocity than the soil moisture and will require a longer period of time to reach the water table. The attenuation of organic species from biological, chemical, and physical degradation was estimated assuming a first-order decay mechanism. Given the extended time of travel, even the most persistent species for which data were available (4,4'-DDE) is expected to be attenuated by a factor of more than 10^{15}. Less persistent species are expected to be attenuated to a greater degree. Therefore, organic chemicals of potential concern are predicted to be reduced to near zero concentrations in the water table (refer to Appendix G-2 for a detailed discussion of these calculations).

Surface Water--An estimated concentration at the surface water receptor was derived only for toluene. Although metals were also detected (within range of background levels) in the surficial soils, they adsorb strongly to soils. Metals generally are not very mobile in most soil systems although the rate of transportation is dependent on characteristics of the soil. Therefore, erosion, which is unlikely because of the arid climate, would be required to transport these contaminants to the playa lake.

The concentration of toluene in the playa lake was estimated based on its distribution coefficient (K_d) in sandy soils. The K_d describes the equilibrium concentration ratio of the solute sorbed to the solid phase (the soil) to the solute in the liquid

phase (soil water). The estimated concentration was 47 μg/L (Table 6-4) and was used to estimate the average and reasonable maximum concentrations of chemicals in vegetables, meat and dairy products for the chronic and subchronic exposure scenarios for off-base residents. Under actual field conditions, toluene concentrations in the playa lake water are likely to be less because of non-equilibrium conditions (refer to Appendix G-2 for a detailed discussion of the calculations).

Ambient Air--Emission rates of chemical compounds derived from volatilization and wind entrainment of contaminated dust from Landfill No.3 were estimated using predictive equations recommended by the USEPA. The emission rates were input into the Industrial Source Complex Short-Term (ISCST2) dispersion model to estimate average chemical concentrations in the atmosphere at on-site occupational and off-site residential receptors. The estimated average and reasonable maximum concentrations in air are presented in Table 6-4. The predicted concentrations were then used to estimate health risks to the exposed populations.

The area source algorithm is based on the equation for a finite crosswind line source and requires that each individual area source have the same north-south and east-west dimensions. Because the landfill is irregularly shaped, it was modeled as several area sources by dividing the area into multiple squares that approximate the geometry of the land. Contaminants with a Henry's Law constant of 1×10^{5} atm-m^3/mole or greater and molecular weight less than 200 g/mole, were considered volatile. These compounds were evaluated for various volatilization emission mechanisms. The remaining compounds were considered to be non-volatile and were evaluated for various entrained dust emission mechanisms. Refer to Appendix G-1 for a detailed discussion of the air dispersion calculations.

Vegetables--Potentially contaminated surface water in the vicinity of Landfill No. 3 (playa lake) is used by a local farmer for irrigation purposes. For this risk assessment it was assumed that the use of contaminated water for irrigating farm crops

contributes to concentrations of toluene in edible portions of plants. The concentration of chemicals in plants irrigated with contaminated water depends on the concentration of the chemical in the irrigation water, subsequent concentration of the chemical in the soil, the plant type, as well as other factors.

To derive a concentration in soil from irrigation with water containing contaminants, an irrigation rate of 3,000 L/m^2/year is assumed (an average of approximately 39 inches of water applied over a six-month growing period in this geographic region) (Baes, et al., 1984; Base Natural Resources Environmental Group, 1992). Irrigation is assumed to continue for 30 years for evaluation of long-term exposures because soil concentrations of inorganic chemicals may build up over time. Degradation, chemical transformation, or other soil removal processes were not considered, although these processes likely occur. It was further assumed that the total mass of contaminants resides in the top 15 cm of soil and the soil bulk density was 1333 kg/m^3. Although volatile organic chemicals can be expected to largely volatilize from the irrigation water and soil surface before significant plant uptake can occur, and USEPA considers that levels of toluene in food are likely to be insignificant (ATSDR, Toxicological Profile for Toluene, 1989), toluene was evaluated for this pathway because of its moderate lipophilicity and potential for bioaccumulation (log K_{ow} = 2.7).

Appendix H provides the algorithm and spreadsheet calculations for quantifying contaminant concentrations in soil as a result of irrigation and subsequent uptake into fruits and vegetables. The estimated average and reasonable maximum contaminant concentration in vegetables resulting from irrigation of farm crops with surface water potentially contaminated with toluene is listed in Table 6-5.

Meat and Dairy Products--The use of contaminated surface water for stock water is assumed to contribute to concentrations of toluene in the edible meat of beef cattle and in milk and dairy products. While grazing, cattle also ingest surface soil, which can build up contaminant concentrations if the pasture is irrigated. As cattle

ingest contaminated feed, water, and soil, some chemicals may be absorbed in the animals' gastrointestinal tract. The more lipophilic chemicals may then accumulate in meat.

To estimate the chemical concentration in meat and dairy products, an equation derived from the *Multi-Pathway Health Risk Assessment Input Parameters Guidance Document* was used (Clement, 1988). Appendix H provides the algorithm and spreadsheet calculations for quantifying contaminants concentrations in meat and dairy products as a result of contaminated stock water and feed crops irrigated with contaminated surface water.

Contaminated food sources included in the evaluation are stock water from potentially contaminated playa lake water, feed crops irrigated with surface water drawn from the playa lake, and incidentally ingested soil. Toluene was the only compound modeled to the playa lake. The fraction of feed from a contaminated source was assumed to be 100% for water, feed, and soil. One-hundred percent of all contaminants in the water, feed, and soil was assumed to be bioavailable. A cattle water ingestion rate of 150 kg/day, a consumption rate of 16 kg/day for lactating cows and 8 kg/day for nonlactating cows and cattle (Base Natural Resources Environmental Group, 1992), and a soil ingestion rate of 0.6 kg/day, or 4% of the feed consumption rate (Clement, 1988) per head of cattle were assumed.

Significant accumulation in meat and milk is not expected because of the fairly low transfer coefficients for toluene (refer to Appendix H). This is consistent with data indicating that this compound is readily metabolized by mammals and excreted in urine. There is evidence to suggest that toluene is metabolized to chemically reactive species. However, these species would be expected to react with cellular constituents, thereby reducing their potential toxicity. The half-life for toluene in adipose tissue of humans ranges from 0.5 to 2.7 days (ATSDR, Toxicological Profile for Toluene, 1989).

The estimated average and reasonable maximum concentrations in beef and dairy products, assuming the cattle feed on corn, milo, and alfalfa irrigated with potentially contaminated surface water drawn from the playa lake and potentially contaminated surface water is provided as stock water are presented in Table 6-5.

6.3.6 Estimation of Chemical Intakes for Individual Pathways

Exposure is defined as the contact rate of an organism with a chemical or physical agent. Intake is defined as exposure normalized for time and body weight and is expressed in units of mg chemical/kg body weight-day (USEPA, 1989a).

There are three categories of variables that are used to estimate intake:

1) Chemical-related variables (exposure concentration);

2) Variables that describe the exposed population (contact rate, exposure frequency and duration, and body weight); and

3) Assessment-related variables (averaging time).

The chemical-related variables (exposure concentrations) are presented in Tables 6-4 and 6-5. Tables H4-1 through H4-4 presented in Appendix H summarize the assumptions and algorithms used to estimate exposure for each exposure pathway; the rationale for selecting individual values is explained in footnotes to the tables. The tables in Appendix H also document the equations used for calculating pathway-specific intakes. The generic equation for calculating chemical intakes is presented in Appendix H. Calculated intakes are presented in Appendix I, Table I-1.

Exposure assumptions recommended in the *Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors* (USEPA, 1991), the *Risk Assessment Guidance for Superfund* (USEPA, 1989a), and the *Exposure Factors*

Handbook (USEPA, 1989b) were used when available and applicable. Site-specific and chemical-specific values were used when available data justified their use; otherwise conservative default values were substituted.

6.3.7 Exposure Assessment Uncertainties

Major sources of uncertainty associated with the exposure assessment include:

1) The ability of fate and transport models to realistically simulate the behavior of chemicals in the environment; and

2) The accuracy of exposure assumptions in representing the degree and way in which individuals are exposed.

Uncertainty is addressed in this risk assessment by:

1) Incorporating both average and reasonable maximum values to provide a range of results rather than single values;

2) Using conservative estimates when defining reasonable maximum exposure assumptions in order to protect human health and the environment; and

3) Identifying and discussing the major sources of uncertainty and their effects on the exposure estimates so that the results can be properly interpreted and used for estimation of risks.

6.3.7.1 Fate and Transport Modeling

Release rates to the air, groundwater, and surface water were based on analytical data from the 1992 RI. Estimated releases to various media were assumed to be steady state, indicating that they will not increase or decrease over the assumed periods of time for exposure duration. Therefore, the estimated release rates are

conservatively biased and most likely are overestimated, because contaminant concentrations in the soil should decrease over time as chemicals volatilize to the air, degrade in the soil, and are flushed from the site.

Modeling the fate and transport of contaminants in air and water requires the use of overly simplistic assumptions that do not fully simulate the environment. Realistically, migration of contaminants from the source to receiving media involves numerous complex processes that are not necessarily addressed by the available models.

In many cases, conservative values were used for model input parameters. No pollutant removal by physical and chemical processes were considered and a decay coefficient of 0 was used in the model. Therefore, concentrations predicted at each receptor is a conservative estimate. These conservative assumptions result in higher ground level concentration estimates. In addition, subsurface contamination was assumed to be uniformly mixed. This assumption may or may not be overly conservative. The model used for transport of contaminants in groundwater and surface water uses conservative modeling assumptions to provide estimates of the maximum concentrations at the receptor sites. For groundwater modeling, results were based on time of travel calculations for soil moisture. Solutes, which may sorb/desorb on soil, would be expected to migrate at a slower apparent velocity than soil moisture and, therefore, would require a longer period of time to reach the water table. In addition, the most conservative K_d value was used to estimate the concentration of toluene in the playa lake and may have resulted in overestimation of the exposure concentration.

6.3.7.2 Exposure Parameter Estimation

The standard assumptions regarding body weight, exposure period, life expectancy, population characteristics, and lifestyle may not accurately represent site-specific exposure situations. The assumptions used most likely overestimate human exposures but may underestimate them in some cases. The purpose of exposure

parameter estimations are to reflect realistic, site-specific exposures. However, because exact current and future exposures that more accurately depict all scenarios cannot be determined, assumptions were made that most likely err on the conservative (safe) side to protect human health.

Assumptions regarding exposure parameters that are conservative and may overestimate exposures include:

1) The assumption that water from the playa lake was used as a source of stock water for cattle. The water is used by one farmer for irrigation purposes, but there currently is no information to suggest that the water is used for stock water. However, to assess a worst case scenario, it was assumed that the farmer also uses the water as a source of stock water for cattle.

2) The use of modeled concentrations to represent exposure point concentrations for all exposure scenarios. Actual measured soil concentrations were available, but direct contact with soil was not considered likely.

3) The amount of media intake is assumed to be constant and representative of the exposed population.

4) Exposure is assumed to occur 350 days/year for chronic exposure scenarios for off-base residents involving inhalation of ambient air and consumption of locally produced agricultural, beef, and dairy products. Hypothetical on-site workers are assumed to be exposed by inhalation of ambient air at the perimeter of Landfill No. 3, where contaminant concentrations are expected to be highest, 100 days/year for 2 or 8 hours/day. It is conservative to assume that off-base residents would consume milk, meat, fruit, or vegetables that come from the contaminated source 350 days/year. It is even more conservative to assume that on-site workers would be at the site perimeter 100 days/year for 8 hours/day because there are no known activities which take place at the site.

5) Ambient air concentrations predicted at the site perimeter were used to estimate risks associated with residential exposure. This assumption is overly conservative, because contaminant concentra-

tions in the air would be expected to be diluted at distant sites, such as off-base residences.

6) The use of feed-to-beef and feed-to-milk transfer coefficients that do not account for metabolism and/or disposition of chemicals may also lead to overestimation of exposure.

7) One hundred percent absorption of inhaled and ingested contaminants is assumed.

All of the above exposure assumptions tend to overestimate exposures. No assumptions that tend to underestimate exposures have been identified with respect to exposure parameter estimation.

Exposure parameters used in the assessment represent exposures that may occur considering both current and future land use. Future land use is not expected to differ significantly from current land use practices.

6.4 Toxicity Assessment

Toxicity assessment involves determining whether exposure to an agent can increase the incidence of a particular adverse effect (e.g., cancer, birth defects) in humans, characterizing the nature and strength of evidence of causation, and if sufficient data are available, quantifying the relationship between the dose of the contaminant and the incidence of adverse health effects in the exposed population. Toxicity values are derived from the quantitative dose-response relationship. These values can be used to estimate the incidence or potential for adverse effects as a function of human exposure to the contaminant. This section summarizes the toxicity values used for the risk assessment.

6.4.1 Background

USEPA has performed the toxicity assessment step for numerous chemicals, and the resulting toxicity information and toxicity values have undergone extensive peer review. Toxicity values used to evaluate noncarcinogenic effects (effects other than cancer) include:

- Reference dose (RfD) in units of mg/kg-day; and
- Reference concentration (RfC) in units of mg/m^3.

The RfD and RfC are estimates (with uncertainty spanning an order of magnitude) of the daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a portion of the lifetime, in the case of a subchronic RfC or RfD, or during the lifetime in the case of a chronic RfC or RfD. The RfD is used to evaluate oral and dermal exposures and the RfC is used to evaluate inhalation exposures.

Toxicity values used to evaluate carcinogenic effects include:

- Weight of evidence classification;
- Slope factor (SF) in units of $(mg/kg\text{-}day)^{-1}$; and
- Unit risk for inhalation exposure in units of $(\mu g/m^3)^{-1}$.

The weight of evidence classification is an USEPA classification system for characterizing the extent to which the available data indicate that an agent is a human carcinogen. In assessing the carcinogenic potential of a chemical, USEPA classifies the chemical into one of the following groups, according to the weight of evidence from epidemiological studies and animal studies:

Group A - Human Carcinogen (sufficient evidence of carcinogenicity in humans);

Group B - Probable Human Carcinogen (B1 - limited evidence of carcinogenicity in humans; B2 - sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans);

Group C - Possible Human Carcinogen (limited evidence of carcinogenicity in animals and inadequate or lack of human data);

Group D - Not Classifiable as to Human Carcinogenicity (inadequate or no evidence); or

Group E - Evidence of Noncarcinogenicity for Humans (no evidence of carcinogenicity in adequate studies).

USEPA performs quantitative carcinogenic risk assessments for chemicals in Groups A and B, and on a case-by-case basis for chemicals in Group C. Classification of a chemical as Group D or E precludes performance of quantitative risk assessment. Cancer slope factors are estimated through the use of mathematical extrapolation models, most commonly the linearized multistage model, for estimating the largest possible linear slope (within the 95% confidence limit) at low extrapolated doses that is consistent with the data. The slope factor is characterized as a plausible upper-bound estimate of the probability of a response per unit intake of a chemical over a lifetime. The slope factor is used to estimate an upper-bound probability of an individual developing cancer as a result of a lifetime of exposure to a particular level of a potential carcinogen. The unit risk for drinking water and inhalation is the risk per concentration unit in water (risk per $\mu g/L$) and air (risk per $\mu g/m^3$), respectively.

6.4.2 Sources of Information

This assessment used only toxicity values that have been developed by USEPA. The following sources of information, in order of priority, were consulted to identify toxicity values for chemicals of concern with potential for human exposure:

- USEPA's Integrated Risk Information System (IRIS) - IRIS is updated monthly, provides verified RfDs and slope factors, and is the Agency's preferred source of toxicity information;

- USEPA's Health Effects Assessment Summary Tables (HEAST) - HEAST provides information on interim (not yet verified by US EPA Workgroups) as well as verified RfDs and slope factors and is used only to obtain toxicity values for chemicals not listed in IRIS; and

- Other USEPA documents, such as the Drinking Water Regulations and Health Advisories (USEPA, 1991c).

6.4.3 Toxicity Values Used in the Risk Assessment

This section summarizes the available toxicity information for each of the chemicals of concern with potential for human exposure. Chemicals of concern that were screened out by the exposure assessment (see Section 6.3.4, Exposure Assessment) are not included in the toxicity assessment. The relevant information includes standard USEPA toxicity values and toxicity values derived for use in risk assessment. The information in this section was used in determining the risks associated with noncarcinogenic effects (RfDs), carcinogenic potential (slope factors), and weight of evidence classification. These values are defined and discussed in Section 6.4.1 of the report.

Toxicity Values for Noncarcinogenic Effects

The RfD values for the chemicals of concern are presented in Table 6-6 and were obtained from IRIS dated 12 October 1992, or from the USEPA, HEAST, 1991. Oral RfD values were not available for β-BHC, δ-BHC, 4,4'-DDD, and 4,4'-DDE. Unless a specific dermal RfD was listed by IRIS or HEAST, the RfD for dermal exposures was assumed to be the same as for oral exposures. When available, inhalation RfDs or RfCs were included.

Toxicity Values for Carcinogenic Effects

The slope factors for chemicals of potential concern classified by USEPA as carcinogens are also presented in Table 6-6 and were obtained from an IRIS search dated 12 October 1992 or from HEAST, 1991. The slope factor for dermal exposure was assumed to be the same as the slope factor for oral exposure. When available, inhalation unit risk factors were included.

6.4.4 Health Effects Summaries

This section of the report summarizes the toxicity information available for the noncarcinogenic and carcinogenic effects associated with the chemicals of potential concern. General information on the potential health effects of exposures to the chemicals of potential concern is provided. Toxicity information on noncarcinogenic effects is provided for each contaminant that has an RfD value and includes the data that formed the basis for the determination of the RfD. Information is also included for contaminants for which RfDs were derived. Information on the potential carcinogenic risks includes supporting data for the USEPA carcinogenic classification. Table 6-7 summarizes the available information on human health effects of exposure to chemicals of potential concern. Unless otherwise stated, the information presented below on each of the chemicals of concern is summarized from the information available on IRIS as of 12 October 1992.

Aldrin

Exposure to aldrin is limited, because it is broken down very rapidly to dieldrin in the environment. No increase in mortality from any cause has been reported in workers who had been employed in the manufacture of aldrin for more than four years. Information regarding the respiratory effects of aldrin in humans is limited and conflicting. One occupational exposure study indicated that exposed workers

Table 6-6

Toxicity Values for Chemicals Specific to Landfill No. 3, Cannon AFB, New Mexico

Chemical	EPA Class	Chronic Oral RfD (mg/kg-day)	Subchronic Oral RfD (mg/kg-day)	Chronic Inhalation RfC (mg/m³)	Subchronic Inhalation RfC (mg/m³)	Oral Slope Factor (mg/kg-day)⁻¹	Inhalation Unit Risk 1/(μg/m³)	Inhalation Slope Factor (mg/kg-day)⁻¹
Aldrin	B2	3.00E-05 [i]	3.00E-05 [h]	--	--	1.70E+01 [i]	4.90E-03 [i]	1.70E+01 [h]
beta-BHC	C	--	--	--	--	1.80E+00 [i]	5.3E-04 [i]	--
delta-BHC	D	--	--	--	--	--	--	1.80E+00 [h]
gamma-BHC	B2/C	3.00E-04 [i]	3.00E-03 [h]	--	--	1.30E+00 [h]	3.7E-05	--
Bis(2-ethylhexyl)phthalate	B2	2.00E-02 [i]	2.00E-02 [h]	--	--	1.40E-02 [i]	--	--
4,4'-DDD	B2	--	--	--	--	2.40E-01 [i]	--	--
4,4'-DDE	B2	--	--	--	--	3.40E-01 [i]	--	--
4,4'-DDT	B2	5.00E-04 [i]	5.00E-04 [h]	--	--	3.40E-01 [i]	9.70E-05 [i]	3.40E-01 [h]
Diesel	D	8.00E-03 [p]	8.00E-03 [p]	--	--	--	--	--
Heptachlor epoxide	B2	1.30E-05 [i]	1.30E-05 [h]	--	--	9.10E+00 [i]	2.60E-03 [i]	9.10E+00 [h]
Tetrahydrofuran		--	--	--	--	--	--	--
Toluene	D	2.00E-01 [i]	2.00E+00 [h]	4.00E-01 [i]	2.00E+00 [h]	--	--	
Trichloropropene		5.00E-03 [h]	5.00E-03 [h]	--	--	--	--	--

[h] - HEAST, First Quarter, January, 1991 (USEPA, 1991b).
[i] - IRIS on line search (10/92).
[p] - Provisional Oral RfD.

Table 6-7

Chronic Toxicities

Chemical	Noncarcinogenic Effect		Carcinogenic Effect	
	Target Organ	Critical Effect	Target Organ/ Tumor Type	EPA Class
Aldrin/Dieldrin	Liver Kidney	Lesions occur in both the liver and kidneys after chronic ingestion by laboratory animals.	Liver - hepatomas, hyperplasia, carcinoma.	B2 - Probable Human Carcinogen.
	Central Nervous System (CNS)	Chronic exposure to moderate levels in humans can cause headaches, dizziness, irritability, vomiting, or uncontrolled muscle movements.		
BHC (beta, delta, gamma)	Liver	Hypertrophy was seen in a chronic ingestion study in rats.	Liver - hepatocellular carcinomas	C - Possible Human Carcinogen (beta-BHC). D - Not classified (delta-BHC). B2/C - Probable/Possible Human Carcinogen (gamma-BHC).

Table 6-7

(Continued)

Chemical	Noncarcinogenic Effect		Carcinogenic Effect	
	Target Organ	Critical Effect	Target Organ/ Tumor Type	EPA Class
Bis(2-ethylhexyl)phthalate	Reproductive System	Interference with sperm production, delays in sexual maturation, decreased fertility and deleterious effects on fetal development have been reported in animals exposed to BEHP in the diet.	Liver tumors in rats and mice. Increased incidence of carcinomas and adenomas in rats.	B2 - Probable Human Carcinogen.
	Liver	Increased weight (absolute) in guinea pigs fed diets containing BEHP.		
4,4'-DDD	Thyroid	Atrophy and tumors were seen in rats and mice exposed chronically.	Liver Lung Thyroid	B2 - Probable Human Carcinogen.
4,4'-DDE	Liver Thyroid	Hypertrophy may result after chronic oral exposure of rodents.	Liver - hepatocellular carcinomas.	B2 - Probable Human Carcinogen.

Table 6-7

(Continued)

Chemical	Noncarcinogenic Effect		Carcinogenic Effect	
	Target Organ	Critical Effect	Target Organ/ Tumor Type	EPA Class
4,4'-DDT	Liver	Chronic exposure may result in changes in enzyme levels in rodents.	Liver - carcinomas.	B2 - Probable Human Carcinogen.
	Reproductive System	Some evidence in laboratory animals indicates that heptachlor may decrease fertility and may adversely affect offspring.		
Diesel Fuel	Liver	Fatty changes in the livers of mice have been reported following subchronic inhalation exposure.		D - Not classified as to Human Carcinogenicity

Table 6-7

(Continued)

Chemical	Noncarcinogenic Effect		Carcinogenic Effect	
	Target Organ	Critical Effect	Target Organ/ Tumor Type	EPA Class
Heptachlor Epoxide	Liver	Chronic exposure may result in liver damage including steatosis, fibrosis, or necrosis in addition to increases in relative organ weight.	Liver-carcinomas.	B2 - Probable Human Carcinogen.
	Kidney	Kidney granulomas have been reported.		
	Blood	Increased red blood cell count has been reported in laboratory animals exposed to heptachlor and heptachlor epoxide.		
Toluene	Skin	Irritation to the skin and eyes has been seen in humans.		D - Not Classified as to Human Carcinogenicity.
	Liver Kidney	The weights of the liver and kidneys increased in a subchronic study in rats at moderate to high levels.		
Trichloropropene	Eye	Irritation of the eye has been reported in dogs exposed to trichloropropene by inhalation.		Not Classified

demonstrated no new pulmonary disease or deterioration of existing pulmonary disease (ATSDR, Toxicological Profile for Aldrin/Dieldrin, 1991) although a similar study reported significantly increased incidences of pneumonia and other pulmonary diseases (ATSDR, Draft Toxicological Profile for Aldrin/Dieldrin, 1991). Central nervous system (CNS) excitation culminating in convulsions was the principal toxic effect noted in occupational studies of workers employed in the manufacture or application of aldrin. Short-term exposure to high levels of aldrin caused convulsions and kidney damage. Long-term exposures to lower levels of aldrin may also cause convulsions as a result of aldrin's potential to accumulate within the body. Long-term exposure to moderate levels of aldrin caused headaches, dizziness, irritability, vomiting, or uncontrollable muscle movements. A condition in which aldrin causes the body to destroy its own blood cells has been noted in some sensitive people.

The carcinogenic and reproductive/developmental effects of aldrin in humans are currently unknown. Experimental studies indicate that animals born to mothers that were fed aldrin did not live long. Conflicting results have been obtained in animal studies with regard to the teratogenic potential of aldrin, as well as its effects on reproductive performance. One study revealed detectable levels of dieldrin (a lipid soluble metabolite of aldrin that is toxic and is stored in adipose tissue) in the human placenta, amniotic fluid, and fetal blood. These results suggest that dieldrin can pass through the human placenta and accumulate in the developing fetus. A limited number of epidemiologic studies examining the incidence of cancer in workers exposed to aldrin or dieldrin exist. No evidence for a carcinogenic effect of aldrin in humans was observed in these studies (ATSDR, Toxicological Profile for Aldrin/Dieldrin, 1991).

IRIS lists the chronic oral RfD for aldrin as 3.0E-05 mg/kg-day. This value was determined from a two year chronic study in rats using aldrin. The experimental groups were orally dosed with 0, 0.5, 2, 10, 50, 100 or 150 ppm (in the diet) for two years. Liver lesions characteristic of chlorinated insecticide poisoning were observed at dose levels of 0.5 ppm and greater. These lesions were characterized by enlarged

centrilobular heptic cells, with increased cytoplasmic oxyphilia, and peripheral migration of basophilic granules. A statistically significant increase in liver-to-body weight ratio was observed at all dose levels. Kidney lesions occurred at the highest dose levels. Survival was markedly decreased at dose levels of 50 ppm and greater. A Lowest Observed Adverse Effect Level (LOAEL) of 0.5 ppm was established in this study. A No Observed Adverse Effect Level (NOAEL) was not established.

Additional data are fairly supportive of the findings from the critical study. Effect and no-effect levels are similar (to those found for rats) for liver effects in dogs after 15 months exposure to aldrin in the diet. Liver effects were observed at slightly higher doses in several other subchronic-to-chronic rat and dog studies. Short-term exposure to higher doses resulted in mortality for a number of species.

The uncertainty factor used to derive the RfD for aldrin is 1000. This factor encompasses the uncertainty of extrapolation from animals to humans, the uncertainty in the range of human sensitivities, and an additional uncertainty because the RfD is based on a LOAEL rather than a NOAEL. The confidence level for the RfD value is medium. The supporting study performed histopathologic analysis, but lacked other toxicologic parameters. Confidence in the data base was also medium. There is no inhalation RfD or RfC for aldrin. HEAST lists the subchronic RfD as 3.0E-05 mg/kg-day.

Human carcinogenicity studies are inadequate, but animal carcinogenicity studies are sufficient to classify aldrin as Group B2 - Probable Human Carcinogen. The oral slope factor for aldrin is listed in IRIS as 1.7E+01 $(mg/kg\text{-}day)^{-1}$ and the inhalation unit risk is listed as 4.9E-03 $(\mu g/m^3)^{-1}$. After chronic ingestion of 10 ppm in the diet of mice, a statistically significant increase in hepatomas was observed. Most of these tumors were evaluated to be liver carcinomas. Adequate numbers of animals were treated for a large proportion of their lifetime and the route of treatment was appropriate. HEAST listed an inhalation slope factor of 1.70E+01 $(mg/kg\text{-}day)^{-1}$.

BHC (Beta, Delta and Gamma)

People generally are not exposed to the beta and delta-forms of benzene hexachloride (BHC) separately, but to lindane (gamma-BHC) or to technical-grade BHC (a mixture of the alpha, beta, and delta-forms). Therefore, the health effects of the BHC isomers are considered jointly. The adverse health effects of lindane and the other BHC isomers (alpha, beta, and delta) that have been seen in humans include lung irritation, heart disorders, blood disorders, headache, convulsions, and alterations in levels of sex hormones. These effects were observed in individuals exposed to BHC vapors during its manufacture and/or in individuals accidentally exposed to very large quantities of BHC. Death can result in humans and animals exposed to large amounts of BHC. Liver disease has been reported in animals fed lindane or alpha, beta, or technical-grade BHC and liver cancer has been reported in rodents which received long-term administration of these compounds (ATSDR Toxicological Profile for α,β,γ, and δ-Hexachlorocyclohexane, 1989).

Beta-BHC

There are no oral or inhalation RfD or RfC values listed in IRIS or HEAST for beta-BHC. Beta-BHC is listed as Class C - Possible Human Carcinogen. This classification is supported by an increase in benign liver tumors when mice were exposed to beta-BHC in the diet. The oral slope factor is listed in IRIS as 1.8E+00 $(mg/kg/day)^{-1}$ and the inhalation slope factor is listed in HEAST as 1.8E+00 $(mg/kg\text{-}day)^{-1}$. IRIS lists an inhalation unit risk of 5.3E-04 $(ug/m^3)^{-1}$.

Delta-BHC

Neither a RfD nor a slope factor is given for delta-BHC in IRIS or HEAST. It is classified as Group D - Not Classifiable as to Human Carcinogenicity.

Gamma-BHC (Lindane)

The oral RfD for gamma-BHC is listed in IRIS as 3.0E-04 mg/kg-day. This value is supported by a 12 week study which dosed rats with 0, 0.2, 0.8, 4, 20, or 100 ppm gamma-BHC in the diet. After 12 weeks, 15 animals/sex/group were sacrificed. The remaining rats were fed the control diet for an additional six weeks before sacrifice. Treatment-related effects were noted in mortality, hematology, clinical chemistry, and urinalysis. Rats receiving 20 and 100 ppm gamma-BHC were observed to have greater-than-control incidence of the following: liver hypertrophy, kidney tubular degeneration, hyaline droplets, tubular distension, interstitial nephritis, and basophilic tubules. Because these effects were mild or rare in animals receiving 4 ppm, this value represents a NOAEL. The reviewers of the study calculated the dose to be 0.29 mg/kg/day for males and 0.33 mg/kg/day for females, based on measured food intake. A LOAEL of 20 ppm (converted to 1.55 mg/kg-day for males) was also established.

An uncertainty factor of 1000 was used to determine the RfD for gamma-BHC. A factor of 10 each was employed for use of a subchronic assay, to account for interspecies variation and to protect sensitive human subpopulations. A confidence rating of medium is associated with the RfD for gamma-BHC. This rating reflects that the principal study used an adequate number of animals and measured multiple end-points. There are no inhalation RfD or RfC values currently available. However, a risk assessment for development of an inhalation RfD is under review for this agent. HEAST listed the subchronic RfD as 3.0E-03 mg/kg-day.

Gamma-BHC is classified as a Group B2/C - Carcinogen. HEAST lists the oral slope factor as 1.3E+00 $(mg/kg\text{-}day)^{-1}$. No inhalation unit risk was given.

Bis(2-ethylhexyl)Phthalate

Most information about the health effects of bis(2-ethylhexyl)phthalate (BEHP) has been obtained from animal studies conducted on rodents. BEHP appears to affect rodents differently than humans, making human health effects difficult to predict. Studies in rats indicate that BEHP in the air has no effect on lifespan or the ability to reproduce and, therefore, breathing BEHP does not appear to have serious harmful effects. Adverse health effects resulting from dermal contact with BEHP is not expected because it is not easily absorbed through the skin (ATSDR, Toxicological Profile for Di(2-Ethylhexyl)Phthalate, 1992).

Short-term exposures to BEHP interfered with sperm formation in rodents. Although these effects were reversible, the process of sexual maturation was delayed. Short-term exposure appeared to have no effect on male fertility although long-term exposure resulted in decreased fertility in both males and females. BEHP resulted in deleterious effects on the development of the fetus (low birth weights and skeletal and/or nervous system problems) when pregnant rodents were exposed. Therefore, it is possible that exposure of pregnant women to BEHP could result in similar effects, but this not certain. Long-term exposure of animals to BEHP results in structural and functional changes in the kidney (ATSDR, Toxicological Profile for Di(2-Ethyl-hexyl)phthalate, 1992).

There have been no studies of workers exposed to BEHP that indicate it causes cancer in humans. Ingestion of high doses of BEHP for long periods of time resulted in liver cancer in rats and mice. However, there is disagreement as to whether exposure to BEHP increases the risk of humans for developing cancer because BEHP causes less damage to human livers than rodent livers (ATSDR, Toxicological Profile for Di(2-Ethylhexyl)Phthalate, 1992).

An oral RfD of 2.0E-02 mg/kg-day is listed in IRIS for bis(2-ethyl-hexyl)phthalate based primarily on a subchronic-to-chronic oral bioassay conducted in guinea pigs. Guinea pigs were fed diets containing BEHP for a period of 1 year. Males and females consumed feed containing 0.13%, 0.04%, or control diet. These dietary levels correspond to 64 or 19 mg/kg-day based on measured food consumption. The critical effect observed in this study was increased relative liver weight in females at both doses tested (64 and 19 mg/kg-day). No treatment-related effects were seen on mortality, body weight, kidney weight, or gross pathology and histopathology of kidney, liver, lung, spleen, or testes. A NOAEL was not established in the study but a LOAEL of 19 mg/kg-day was established. An uncertainty factor of 1000 was used. Factors of 10 each were used to account for interspecies variation and protection of sensitive human subpopulations. An additional factor of 10 was used to account for the less than life-time exposure and because, while the RfD was determined from a LOAEL, the effect observed was considered to be minimally adverse. A confidence rating higher than medium for the RfD was precluded by the fact that only two doses of BEHP were used. HEAST lists a subchronic oral RfD of 2.0E-02 mg/kg-day.

USEPA classifies BEHP as a Group B2 -- Probable Human Carcinogen. This is based on animal carcinogenicity data in which rats and mice fed diets containing BEHP demonstrated an increased incidence of hepatocellular carcinomas and combined incidence of carcinomas and adenomas in female rats and both sexes of mice. Data from a mortality study conducted on BEHP production workers exposed to unknown concentrations was considered inadequate for assessing the human carcinogenic potential. The oral slope factor for BEHP is 1.4E-02 $(mg/kg\text{-}day)^{-1}$.

4,4'-DDD, -DDE, DDT

Typically, people are not exposed to 4,4'-DDT, -DDD, or -DDE individually, but rather to a mixture of all three, since 4,4'-DDE and 4,4'-DDD are contaminants, as well as degradation and metabolic products of 4,4'-DDT. Therefore,

the toxicities of DDT, DDE, and DDD should be considered jointly. The human and animal health effects that result from inhalation of 4,4'-DDT, -DDE, or -DDD are currently unknown. The health effects resulting from human exposure to 4,4'-DDT, -DDE, or -DDD in water are also unknown at this time. However, single human exposures to 4,4'-DDT, -DDE, or -DDD in food at doses of 214-571 ppm have resulted in headache, nausea, vomiting, increased heart rate, and convulsions. Long-term human exposures (18 months) to lower doses (22 ppm) of the three compounds in food caused no adverse health effects (ATSDR, Toxicological Profile for p,p'-DDT, DDE, DDD, 1989).

4,4-DDD

The health effects resulting from exposure of animals to 4,4'-DDD in water are not known. A NOAEL of 26 mg/kg-day was identified during short-term exposure (one week) of mice to 4,4'-DDD in the diet. Exposure of rats to 1221 mg/kg-day 4,4'-DDD for 16 days resulted in atrophy of the thymus. NOAELs of 165 and 107 mg/kg-day were identified in chronic studies (78 weeks) using rats and mice, respectively. However, at 85 mg/kg-day, exposure to 4,4'-DDD resulted in thyroid tumors in rats. In a separate study, exposure to 32.5 mg/kg-day 4,4'-DDD caused lung tumors in mice (ATSDR, Toxicological Profile for p,p'-DDT, DDE, DDD, 1989).

Neither IRIS nor HEAST list an oral RfD, inhalation RfD or inhalation RfC.

4,4'-DDD is a Group B2 - Probable Human Carcinogen. This classification is based on the induction of lung tumors in male and female mice, liver tumors in male mice and thyroid tumors in male rats. There are no human carcinogenicity data. The oral slope factor is 2.4E-01 $(mg/kg\text{-}day)^{-1}$. The supporting study used an adequate number of animals, but the slope factor was derived using tumor incidence data from one dose. There is no inhalation unit risk at this time.

4,4'-DDE

The health effects resulting from exposure of animals to 4,4'-DDE in water are not known. Exposure of mice (by gavage) to 26 mg/kg-day 4,4'-DDE for 24 hr/day for one week caused alterations in the liver. When rats were exposed to 28 mg/kg-day 4,4'-DDE by gavage on gestation days 15-19, a decrease in the weight of the ovaries was noted. A NOAEL of 42 mg/kg-day was identified in a long-term (78 weeks) study in which rats were fed 4,4-DDE in the diet. Hamsters fed 41.5 mg/kg/day 4,4-DDE for 128 weeks exhibited necrosis of the liver and when 4,4-DDE was administered by gavage, tumors of the liver were observed. When mice were exposed to 19 mg/kg-day 4,4'DDE in the diet for 78 weeks, liver tumors were also observed (ATSDR, Toxicological Profile for p,p'-DDT, DDE, DDD, 1989).

Neither IRIS nor HEAST list an oral RfD, inhalation RfD or inhalation RfC.

4,4'-DDE is classified as a Group B2 - Probable Human Carcinogen. This classification is based on increased incidence of liver tumors including carcinomas in two strains of mice and in hamsters, and thyroid tumors in female rats when 4,4'-DDE is given in the diet. Human data are not available. The oral slope factor is 3.4E-01 $(mg/kg\text{-}day)^{-1}$. This value is the geometric mean of six slope factors computed from incidence data by sex.

4,4'-DDT

The primary effect of short-term exposure to high levels of 4,4'-DDT is on the nervous system. Oral ingestion of large quantities of 4,4'-DDT have resulted in excitability, tremors, and seizures in humans. Irritation of the eyes, nose, and throat have been reported by people who have come in contact with 4,4'-DDT. Exposure to low doses of DDT on a long-term basis has resulted in changes in the levels of liver

enzymes involved in metabolism of drugs and chemicals, but there was no indication that 4,4'-DDT caused irreversible damage (ATSDR Toxicological Profile for p,p' - DDT, DDE, DDD, 1989).

Studies conducted in laboratory animals suggest that exposure to 4,4'-DDT may have harmful effects on reproduction and may result in an increased occurrence of liver tumors. However, five studies of 4,4'-DDT exposure in humans did not show increases in the number of deaths or cancers (ATSDR Toxicological Profile for p,p' - DDT, DDE, DDD, 1989). Increasing evidence indicates that pesticides, including 4,4'-DDT, can alter immune function in rodents, although studies in humans are limited and ambiguous. In a study of pesticide formulators in India, 73% of workers exposed to 4,4'-DDT had altered levels of serum immunoglobulins, although no increase in infections was noted (Dean et al., 1991).

The oral RfD for 4,4'-DDT is listed in IRIS as 5E-04 mg/kg-day. This value is based on a chronic rat feeding study in which 4,4'-DDT was provided in the diet. Weanling rats were fed commercial DDT in doses of 0, 1, 5, 10, or 50 ppm for 15-27 weeks. Increasing hepatocellular hypertrophy was seen at doses of 5 ppm and greater. Therefore, 5 ppm was established as a LOAEL. A NOAEL of 1 ppm (converted to 0.05 mg/kg-day) was also established in the study. An uncertainty factor of 100 was used to account for interspecies conversion and to protect sensitive human subpopulations (10x each). An uncertainty factor for subchronic to chronic conversion was not included because of corroborating chronic data in the data base. A confidence rating of medium was associated with the RfD and reflects that the principal study was adequate, but of shorter duration than desired. There are no values for the inhalation RfD or RfC at this time. HEAST lists the subchronic oral RfD as 5.0E-04 mg/kg-day.

4,4-DDT is classified as Group B2 - Probable Human Carcinogen. This classification is based on tumors (usually liver) in various mouse strains and three rat studies. Human carcinogenicity data is inadequate. The oral slope factor listed in IRIS

is 3.4E-01 $(mg/kg\text{-}day)^{-1}$. The inhalation unit risk is listed in IRIS as 9.7E-05 $(mg/m^3)^{-1}$. HEAST lists an inhalation slope factor of 3.4E-01 $(mg/kg\text{-}day)^{-1}$.

Diesel Fuel

Fuels are complex hydrocarbon mixtures produced by distillation of crude oil. Therefore, they may contain hundreds of hydrocarbon components, as well as additives. Diesel fuels are middle distillates that are composed of less volatile hydrocarbons, generally coming off the distillation column at temperatures of 150-360 °C. Diesel fuels consist primarily of C_9 and C_{20} hydrocarbons. Marine diesel fuels are comprised roughly of 13% paraffins, 44% aromatics, and 44% naphthalenes (NTP, 1986). Marine diesel fuel may also contain greater than 10% PAHs (polyaromatic hydrocarbons). Soluble, volatile components of these fuel mixtures may consist of benzene, toluene, xylenes, and ethylbenzene.

The data are sufficient to derive a provisional oral RfD for marine diesel fuel based on subchronic inhalation studies. Studies on marine diesel fuel were conducted in beagle dogs, Fischer-344 rats, and C57BL/6 mice. Animals were exposed continuously to 300 mg/m^3 marine diesel fuel for 90 days. A LOAEL of 50 mg/m^3 (converted to 81 mg/kg-day) was identified in the study. This value was based on findings of fatty changes in the livers of female C57BL/6 mice. A provisional RfD of 8.0E-03 mg/kg-day was calculated for diesel fuel. An uncertainty factor of 10,000 was used and accounts for five areas of uncertainty: variation between and within species, use of a LOAEL (in lieu of a NOAEL), extrapolation to chronic duration, and deficiencies in the database (10x each). Overall confidence in this provisional RfD is low reflecting that only two doses were examined, failure to identify a NOAEL, and the use of subchronic inhalation studies for development of a chronic oral RfD (USEPA, 1992).

Based on the available data, diesel fuel can be classified as Group D - Not Classifiable as to Human Carcinogenicity. Epidemiological studies provided no

conclusive evidence for carcinogenicity of diesel fuels to humans and skin painting studies in laboratory animals were inconclusive. Classification of a chemical in weight-of-evidence Group D precludes quantitative risk assessment (USEPA, 1992)

Heptachlor Epoxide

Upon entering the body, heptachlor is metabolized to heptachlor epoxide and other related chemicals. Heptachlor is a major component of the pesticide chlordane. Information regarding human health effects from exposures to heptachlor is sparse. Tremors and convulsions have been reported in experimental animals exposed orally to high levels of heptachlor for short periods of time. Long-term exposure to heptachlor may adversely affect the liver. Animals fed heptachlor in an experimental setting have been reported to have enlarged livers, liver damage, kidney damage, and increased red blood cell count. Tremors and convulsions have also been reported in animals exposed to heptachlor on a long-term basis (ATSDR Toxicological Profile for Heptachlor/Heptachlor Epoxide, 1992).

Heptachlor epoxide is more harmful than heptachlor, primarily because of its ability to be stored in fat for long periods of time. The other breakdown products of heptachlor epoxide generally are less toxic. Long-term exposure to heptachlor epoxide may adversely affect the liver. Animals fed heptachlor epoxide in an experimental setting have been reported to have enlarged livers, liver damage, kidney damage, and increased red blood cell count.

Placental transfer of heptachlor epoxide has been reported following inhalation exposure. Heptachlor epoxide has also been identified in breast milk. This compound has been detected in stillborn infant brain, adrenal, lung, heart, liver, kidney, spleen, and adipose tissues. However, the studies reporting these findings were limited by lack of data concerning route, duration, extent of exposure, and number of cases examined. No gross malformations were reported in any of the stillborn infants.

Although a developing fetus could be exposed to heptachlor epoxide transplacentally, the existing data are inadequate to establish a relationship between exposure and human developmental toxicity (ATSDR Toxicological Profile for Heptachlor/Heptachlor Epoxide, 1992).

The oral RfD for heptachlor epoxide is listed as 1.3E-05 mg/kg-day in IRIS. This value is based on a chronic feeding study conducted in Beagle dogs. Dogs from 23 to 27 weeks of age were fed diets containing 0,0.5, 2.5, 5, or 7.5 ppm of heptachlor epoxide for 60 weeks. The critical effect noted in the study was treatment-related increases in liver-to-body weight ratios. Effects were noted in both males and females and a LEL (Lowest Effect Level) of 0.5 ppm was established. A NOEL (No Observed Effect Level) was not established in this study. An uncertainty factor of 1000 was used to account for inter- and intra-species differences and to account for the fact that a NOEL was not established in the study. The confidence associated with the oral RfD was low, reflecting that the principal study was of low quality and that the database on chronic toxicity is complete but consists of low quality studies. The subchronic RfD listed in HEAST is the same as the chronic RfD (1.3E-05 mg/kg-day) listed in IRIS.

Heptachlor epoxide is classified by the USEPA as Group B2 - Probable Human Carcinogen. Sufficient evidence exists from rodent studies in which liver carcinomas were induced in two strains of mice of both sexes and in CFN female rats. It is also structurally similar to several other liver carcinogens. There are no published epidemiologic evaluations of heptachlor epoxide. The oral slope factor listed in IRIS is 9.1E+00 $(mg/kg\text{-}day)^{-1}$. An inhalation unit risk of 2.63E-03 $\mu g/m^3$ was calculated from oral data.

Tetrahydrofuran

Experimental data on tetrahydrofuran is sparse and conflicting. Irritation of the upper respiratory tract and some injury to the liver and kidneys in a number of

experimental animals exposed to concentrations of tetrahydrofuran at greater than 3,000 ppm has been reported. Tetrahydrofuran is also irritating to the skin of rabbits when applied in aqueous solution at concentrations exceeding 20 percent. Concentrations greater than 25,000 ppm are required to produce anesthesia accompanied by a decrease in blood pressure and strong respiratory stimulation. Subsequent studies indicated that exposure to 200 ppm tetrahydrofuran daily for six-hours produced an observable effect on the pulse pressure of dogs within three or four weeks. However, no demonstrable histopathologic changes in the critical organs of the animals were observed, despite an exposure of nine weeks, followed by an additional three-weeks exposure at approximately twice this level. In this study, tetrahydrofuran did not irritate the skin and did not appear to be a skin sensitizer.

A Threshold Limit Value (TLV) of 200 ppm, as a time-weighted average, and a Short-Term Exposure Level (STEL) of 250 ppm have been recommended to protect against irritative effects during occupational exposure. There is a wide margin of safety between narcotic and systemic effects (ACGIH documentation for Tetrahydrofuran, 1986).

Neither IRIS or HEAST listed EPA-verified values for tetrahydrofuran.

No information on the toxicity of tetrahydrofuran could be located in the available literature.

Toluene

Toluene has the ability to dissolve fats. As a result, it causes pain when it comes in contact with the eye. Damage to the skin may occur upon dermal contact as a result of scattered loss of epithelial cells and solution of some of the fats that occur in these cells. Factory workers handling organic solvents such as toluene have been reported to have low sperm counts, abnormal sperm and varying degrees of infertility

(Thomas, 1991). Toluene has also been reported to cause a decrement of pulmonary function (FEV_1) (Gordon and Amdur, 1991).

A chronic oral RfD value of 2.0E-01 mg/kg-day is listed in IRIS. The subchronic oral RfD listed in HEAST is 2.0E-00 mg/kg-day. These values are based primarily on a subchronic gavage study in which rats were administered varying doses of toluene for 13 weeks. All animals receiving the highest dose (5000 mg/kg) died within the first week. In males, absolute and relative weights of both the liver and kidney were significantly increased at doses greater than or equal to 625 mg/kg. Absolute and relative weights of the liver, kidney, and heart were significantly increased at doses greater than or equal to 1250 mg/kg in females. The NOEL for this study was 312 mg/kg-day based on liver and kidney weight changes in male rats at 625 mg/kg. Because the exposure was for 5 days/week, this dose is converted to 223 mg/kg-day. The LOAEL was 625 mg/kg, which is 446 mg/kg-day when converted.

An uncertainty factor of 1,000 was applied to derive the RfD to account for inter- and intraspecies extrapolations, for subchronic to chronic extrapolation and for limited reproductive and developmental toxicity data. The level of confidence in the oral RfD was medium. This rating reflects that a sufficient number of animals/sex were tested in six dose groups, and that many parameters were studied, but that there was no reproductive study and that the oral studies were all subchronic. The chronic RfC of 4.0E-01 mg/m^3 has been verified according to the new interim methods for developing RfCs and is listed in IRIS. The subchronic inhalation RfC is listed in HEAST as 2.0E+00 mg/m^3.

USEPA has classified toluene as Group D - Not Classifiable as to Human Carcinogenicity. This classification reflects the lack of human carcinogenicity data and inadequate animal data. Therefore, no slope factor is listed.

Trichloropropene

Information on the toxicity of trichloropropene is sparse. Neither an oral RfD nor a slope factor is available for trichloropropene on IRIS. However, HEAST lists chronic and subchronic oral RfDs of 5.0E-03 mg/kg-day for trichloropropene. These values were based on a chronic study conducted in dogs. Inhalation of 18 mg/m^3 trichloropropene for 66 weeks resulted in eye irritation. However, this response was most likely a local response rather than a result of inhalation. An uncertainty factor of 100 is associated with the RfD. Trichloropropene has not been classified by the USEPA as to its carcinogenicity.

6.4.5 Uncertainties Associated with Toxicity Information

Toxicity information for many of the chemicals of concern for this risk assessment was limited. Therefore, varying degrees of uncertainty are associated with the toxicity values presented in this document. Sources of uncertainty associated with toxicity values used in this risk assessment arise from several sources.

A primary source of uncertainty results from the use of information obtained from alternate sources when USEPA-verified toxicity values are not available. It is difficult to assign a level of confidence to these values, although it is appropriate and necessary to use them. Greater uncertainty would result if chemicals that do not have published toxicity values were to be excluded from the assessment.

Physical and chemical descriptions of the exposure atmospheres, amounts to which individuals are exposed, and tissue retention patterns are generally not available for accidental human exposures. Therefore, studies conducted on laboratory animals (under controlled experimental conditions) must, of necessity, be used to provide the exposure, dose, and biological effects data needed to evaluate the toxicity of potentially hazardous materials to which humans may be exposed. However, there are striking

differences between laboratory animals and humans in anatomy and physiology. These differences are sources for variation in the toxic responses exhibited between different species. Complicating extrapolations from animals to man are differences in life span, body size, metabolic routes, and rates of exposure. Occasionally adjustments are made, on a case-by-case basis, for species differences in the rate of metabolism or retention within tissues. However, comparisons between species are usually made by use of standardized sizes or weights. These dose terms do not scale-up identically and are in some cases sources of uncertainty themselves.

Another source of uncertainty related to toxicity information is the use of dose-response information from effects observed at high doses to predict adverse health effects that may occur at the low levels to which humans are likely to be exposed in the environment. Sources of uncertainty occur in the USEPA potency estimates (slope factors) when they are applied to humans exposed to levels of putative carcinogens far below those administered to laboratory animals under experimental conditions. Many substances induce or enhance cancer in animals through processes for which a possible threshold can be identified. These effects usually only occur at very high doses and assuming that a lesser degree of the same effect occurs at lower doses is not necessarily an accurate portrayal of toxicity. This assumption may result in gross overestimation of the health risks associated with a particular chemical.

Two major factors that influence toxicity of chemicals are the duration and frequency of exposure. For many agents, the toxic effects following a single exposure are quite different from those produced by repeated and long-term exposures. In general, fractionation of the dose (or exposure) of a chemical reduces its toxicity. Therefore, a single exposure to a substance may produce an immediate severe effect and yet the same dose divided into multiple exposures may produce an attenuated response or no response at all. Such fractionation effects are generally the result of excretion between successive doses or to partial or full reversal of the injury produced by each exposure prior to the next exposure. Chronic (long-term) toxic effects occur if a chemical accumulates

(absorption exceeds excretion), if it produces irreversible toxic effects, or if there is insufficient time for the individual to recover from the injury within the exposure interval. Therefore, use of information obtained from short-term exposure studies to predict health effects in humans exposed on a long-term basis may be a source of uncertainty.

Uncertainties arise when information gathered in studies using homogenous animal populations (inbred strains) or healthy human populations (occupational exposures) to predict the effects that are likely to occur in the general human population. Human populations are a heterogenous group with variations in genetic constitution, diet, living environments (previous environmental exposures), activity patterns, and cultural patterns. All of these factors may influence metabolism, distribution of chemicals within the body, and susceptibility to the damaging effects of those chemicals. It is now well established that individuals exposed to several chemicals simultaneously or sequentially may exhibit altered pharmacologic or toxicologic responses. Interactions have been noted with respect to hepatotoxicity. For example, many of the chlorinated solvents induce enzymes in the liver that are involved in metabolism of chemicals. Therefore, an individual who is exposed to these chemicals may experience increased or decreased toxicity subsequent to exposure to other chemicals that undergo metabolism.

6.4.6 Summary of Toxicity Assessment

An understanding of the degree of uncertainty associated with toxicity information is an important part of interpreting and using that information to calculate toxicity values. The degree of confidence ascribed to toxicity values depends on both the quality of the critical study from which it was derived and the quantity of supporting data. USEPA-verified RfDs published in IRIS are accompanied by a statement of the confidence that the evaluators have in the RfD. A discussion of confidence ratings and USEPA's classification as to carcinogenicity are presented below.

Oral RfD values were available for 8 of the 13 individual contaminants of potential concern, only diesel did not have an oral RfD published in IRIS or HEAST. USEPA has derived a provisional oral RfD for diesel fuel. This value was obtained from a USEPA memorandum in response to a request for oral systemic and carcinogenic toxicity values for JP-4, JP-5, diesel fuel, and gasoline (AVGAS) found to contaminate soils and groundwater at McChord AFB (Wash Rack/Treatment), Tacoma, WA. The level of confidence in the seven RfDs given on IRIS ranged from low (two chemicals) to medium (five chemicals). One of the chemicals (trichloropropene) for which USEPA has published an RfD did not have a weight-of-evidence classification. This RfD was from HEAST which does not provide this information. Confidence in the provisional RfD for diesel fuel developed by the USEPA was low. Low confidence indicates that the toxicity value may change if additional toxicity data become available. Oral RfDs were not available and were not derived for five chemicals of potential concern.

An inhalation RfD was available only for toluene. A confidence rating cannot be ascribed to this value.

Eleven of the 13 contaminants of potential concern have been classified by the USEPA as to carcinogenic potential. Two chemicals were classified as Group D (Not Classifiable as to Human Carcinogenicity), indicating inadequate or no evidence of carcinogenicity. One of the chemicals of concern (β-BHC) was classified as Group C (Possible Human Carcinogen) based on limited evidence of carcinogenicity in animals and inadequate or lack of human data. One chemical (γ-BHC) was classified as Group B2/C carcinogens because of the uncertainty about its weight-of-evidence classification. Six chemicals were classified as Group B (Probable Human Carcinogen), indicating that there is sufficient evidence of the chemical's carcinogenicity in animals and inadequate or no evidence in humans. No chemicals were classified as Group A (Human Carcinogen).

USEPA-derived oral slope factors were available for eight of the 13 chemicals of potential concern that have been classified as Group A, B, or C carcinogens. Inhalation unit risk factors were available for five of the chemicals.

6.5 Risk Characterization

Risk characterization involves integrating the possible exposure pathways and estimated chemical intakes with the appropriate toxicity values to form quantitative and qualitative expressions of potential health risk. Measured contaminant exposure levels, as well as those predicted by fate and transport modeling, are compared to chemical-specific toxicity information to determine if current or future levels of contamination, at or near the site, warrant concern for human health. The following subsections briefly describe the methodology used to characterize risk, present noncarcinogenic and carcinogenic risk estimates for each exposure scenario, describe uncertainties associated with predicting risk, and identify the key chemicals of potential concern and exposure pathways that drive the risk assessment.

6.5.1 Risk Characterization Methodology

Carcinogenic Effects

The cancer slope factor converts estimated daily intakes to an estimate of incremental risk. Because the slope factor is often an upper 95th percentile confidence limit of the probability of a response based on experimental animal data and an assumption of linearity in the low dose portion of a dose-response curve, the carcinogenic risk estimate is generally an upper-bound estimate. This means "true risk" probably does not exceed the risk estimates generated in this assessment and is likely to be less than the predicted risk (USEPA, 1991).

For carcinogens, probabilities that an individual will develop cancer over a lifetime of exposure are estimated from projected exposure and the cancer slope factor. Exposure is quantified as the amount of a chemical available at the exchange boundary (i.e., skin, lungs, etc.) and available for absorption. The carcinogenic risk is calculated for each exposure scenario using the following equation:

$$\text{Risk} = \text{Exposure} \times \text{Slope Factor}.$$

The USEPA Superfund site remediation goal set forth in the National Contingency Plan (NCP) allows a cancer risk of 1.0E-5 (1 in 10,000) to 1.0E-8 (1 in 10,000,000). This range is designed to be protective of human health.

Noncarcinogenic Effects

To characterize potential noncarcinogenic effects, comparisons are made between projected intakes of substances over a specified time period and toxicity values, primarily oral, dermal, and inhalation reference doses. The ratio of exposure to toxicity value is the hazard quotient (HQ), and the HQ is calculated for each exposure scenario using the following equation:

$$\text{HQ} = \text{Exposure}/\text{RfD}.$$

Note that the HQ is not a statistical probability of a noncarcinogenic effect occurring and should not be interpreted as such. If the exposure level exceeds the appropriate toxicity value (i.e., the hazard quotient is greater than one), there may be cause for concern regarding the potential noncarcinogenic effects as set forth in the NCP.

6.5.2 Potential Exposure Scenarios

To ensure adequate characterization of risk that may be incurred at Landfill No. 3 presently or in the future, two chronic scenarios and one subchronic scenario were identified for human exposure. Land use is not expected to change in the foreseeable future and, therefore, present and future scenarios are assumed to be the same. The chronic exposure scenarios are: 1) off-site residential; and 2) on-site worker. The subchronic exposure scenario is for the on-site worker.

6.5.3 Combining Risks Associated with Chemicals and Exposure Pathways

For each scenario addressed in this risk assessment, the estimated carcinogenic risk for potential carcinogens is generated on a chemical-specific basis for each relevant pathway of exposure. The estimated risk is then summed for each chemical associated with a specific pathway to determine total risk by pathway. To determine the total exposure scenario risk, total risks for all pathways are summed.

The total risk number assumes that different carcinogens affect the same target organ to produce a cancer response, ignoring potential antagonistic or synergistic effects or disparate effects on different target organs. It also assumes that the individual in the exposure scenario is exposed to site-related contaminants at estimated exposure concentrations by all pathways that compose the scenario. The scenarios were constructed to include all potential pathways of exposure and it is possible for a single individual to be exposed by all pathways in a scenario. It is less likely, however, that a single individual will be exposed by each pathway at the conservatively estimated concentrations in the exposure media. For example, it is unlikely that an individual would be chronically exposed to maximum on/off-site ambient air concentrations and to maximum off-site concentrations predicted in agricultural products, because the sources of contamination are in different locations.

Likewise, the estimated hazard quotient for noncarcinogenic effects is generated on a chemical-by-chemical basis for each relevant pathway of exposure. The hazard quotients are then summed for each chemical associated with a specific pathway to determine the hazard index by pathway. The hazard indices for all pathways are finally summed to determine the total hazard index for the exposure scenario.

6.5.4 Documentation of Risk Characterization Results

The exposure and risk calculations were performed by a model (QSMART) to automate the exposure quantification and risk characterization process. The model automates the equations for chemical intake and generates chemical-specific hazard indices for noncarcinogenic effects using RfDs and chemical-specific carcinogenic risk estimates using cancer slope factors. The model sums the resultant values for chemicals in each of the exposure pathways, and across pathways, to generate a total scenario hazard index for noncarcinogenic effects and a total scenario cancer risk for carcinogenic effects. The program also calculates the percentage of the total risk contributed by each individual chemical and pathway of exposure. Appendix I contains the exposure and risk model output.

6.5.5 Risk Characterization for the Present Off-Site Residential Exposure Scenario

This scenario addresses pathways of exposure considered to be complete for off-site residents at the present time based on current use of the land and water. It assumes that land and water use will not change significantly over the duration of exposure. Land use in the immediate vicinity of CAFB is not expected to change in the foreseeable future and, therefore, current and future exposure scenarios and the risks associated with those scenarios are assumed to be similar.

The present off-site residential scenario assumes exposure to site-related contaminants at off-base locations via three pathways of exposure: 1) ingestion of fruits and vegetables; 2) ingestion of meats and dairy products and; 3) inhalation of volatiles and particulates in the ambient air. There is little likelihood that contaminants detected in the soil at Landfill No. 3 will impact off-site surface soils because there is no feasible migration pathway. Therefore, surface soil pathways are not applicable. Currently, one farmer uses surface water drawn from the playa lake for agricultural purposes. Widespread exposure resulting from dermal contact or inhalation of volatiles is unlikely because of the low concentration of volatiles in the playa lake water. Therefore, these pathways have not been included in this risk assessment. Although groundwater samples were not taken during the 1992 RI, groundwater modeling based on soil contaminant concentrations found at Landfill No. 3 indicated that future contamination of the groundwater with contaminants originating at Landfill No. 3 is likely to be insignificant. Therefore, the groundwater ingestion, dermal contact and inhalation of vapor phase chemicals during domestic use pathways have not been included in this assessment.

Exposure concentrations were based on: 1) modeled on-site concentrations in surface water for purposes of predicting uptake and accumulation in fruits, vegetables, meat, and dairy products; and 2) predicted contaminant concentrations in ambient air, based on concentrations in on-site surficial and deep soil samples.

Carcinogenic effects were estimated for adults only. Chronic exposure was evaluated for 1) an average case, using average or 50th percentile values for exposure parameters (e.g., contaminant concentration, body weight, intake rates, exposure duration and frequency); and 2) a reasonable maximum case, using the 95th (occasionally 90th) percentile values for exposure parameters when available and appropriate. Noncarcinogenic effects were evaluated for adults and children with both average and reasonable maximum exposure parameters.

Carcinogenic Effects

Toluene was the only chemical detected in surficial soil samples and is, therefore, the only contaminant estimated to exist in significant quantities in the playa lake water resulting from surface runoff from Landfill No. 3. Toluene has not been classified as to its carcinogenicity by the USEPA. The lack of an oral slope factor precluded evaluation of carcinogenic risks. Therefore, carcinogenic effects were not assessed for ingestion pathways. The lack of inhalation slope factors for contaminants predicted to enter the atmosphere via volatilization (diesel, hydrocarbons, tetrahydrofuran, trichloropropene) or wind entrainment of contaminated surface soil (bis(2-ethylheyxl)phthalate) precluded evaluation of carcinogenic risks associated with the inhalation pathway as well.

Noncarcinogenic Effects

Adults--Tables 6-8 and 6-9 characterize the average and reasonable maximum noncarcinogenic risk for adults, respectively. The total hazard index was 6E-5 for both average and reasonable maximum exposure. These hazard indices suggest that contaminants migrating off-site are not likely to cause adverse noncarcinogenic health effects in residential adults under current exposure conditions. Toluene contributed 100% of the average and reasonable maximum chemical-specific risk. The inhalation pathway contributed 99% of the total risk. USEPA recommends comparing the concentrations of chemicals in ambient air with a reference concentration (RfC) rather than a reference dose (RfD) for assessing inhalation exposure (USEPA, 1990). USEPA has been involved for the last three years in developing a method for derivation of inhalation RfCs. This decision was meant to more clearly distinguish between oral and inhalation exposure. Currently, RfCs are available only for a limited number of compounds. Inhalation RfCs are not available for other contaminants predicted to enter the atmosphere via volatilization (diesel, hydrocarbons, tetrahydrofuran,

Table 6-8

Average Non-Cancer Risk for Exposure to Toluene Associated with Landfill No. 3, Cannon AFB, New Mexico - Present Scenario

Scenario	Inhalation		Ingestion				Total	
	Chronic	Subchronic	Fruits	Vegetables	Meat	Dairy	Chronic	Subchronic
On-site Worker (Adult)	4.0E-06	2.0E-05	NA	NA	NA	NA	4.0E-06	2.0E-05
Off-site Residential (Adult)	6.0E-05	NA	5.0E-10	9.0E-10	7.0E-10	4.0E-08	6.0E-05	NA
Off-site Residential (Child)	6.0E-05	NA	2.0E-09	4.0E-09	2.0E-09	2.0E-07	6.0E-05	NA

NA - Not applicable

Table 6-9

Reasonable Maximum Non-Cancer Risk for Exposure to Toluene Associated with Landfill No. 3, Cannon AFB, New Mexico - Present Scenario

Scenario	Inhalation		Ingestion				Total	
	Chronic	Subchronic	Fruits	Vegetables	Meat	Dairy	Chronic	Subchronic
On-site Worker (Adult)	1.0E-05	6.0E-05	NA	NA	NA	NA	1.0E-05	6.0E-05
Off-site Residential (Adult)	6.0E-05	NA	8.0E-10	2.0E-10	3.0E-09	2.0E-07	6.0E-05	NA
Off-site Residential (Child)	6.0E-05	NA	4.0E-09	7.0E-09	7.0E-09	7.0E-07	6.0E-05	NA

NA - Not applicable

trichloropropene) or wind entrainment of contaminated surface soil (bis(2-ethylheyxl)phthalate). Therefore, the contribution of these chemicals to the total noncarcinogenic risks associated with the inhalation pathway could not be assessed.

Children--Tables 6-8 and 6-9 illustrate the average and reasonable maximum noncarcinogenic risk for children, respectively. The hazard index was 6E-5 for both average and reasonable maximum exposure, suggesting that estimated exposure to children is unlikely to result in adverse noncarcinogenic health effects. Again, toluene contributed 100% of the chemical-specific risk. The inhalation pathway was responsible for 99% of the total risk for average exposure and 98% of the risk for reasonable maximum exposure. Ingestion of beef and dairy products each contributed 1% of the total risk.

6.5.6 Risk Characterization for the Present On-Site Worker Exposure Scenario

This scenario addresses pathways of exposure considered to be complete for an on-site worker. The assumption was made that present on-site contamination will not increase in the future and, therefore, exposure of future on-site workers to contaminants at Landfill No. 3 will be no greater than they are currently.

Surficial and deep soil samples were taken at the site. Laboratory analyses indicated contamination with a variety of chemicals, primarily pesticides, at depths ranging from 0 to 62 feet. The presence of snakes, small animals, and tall grasses indicates little or no disturbances by humans in the area. There are currently no invasive activities at the site and none are planned in the future. Therefore, direct human contact with contaminants in the soil is highly unlikely.

The on-site worker scenario assumes exposure to site-related contaminants via inhalation of contaminants emitted to the atmosphere above the site. Exposure concentrations were based on predicted concentrations at the site perimeter calculated

from measured concentrations in surficial and deep soil samples taken from 12 soil borings within the confines of the landfill. Concentrations of contaminants in the air are expected to be highest at this location.

On-site workers were assumed to be adults. Therefore, noncarcinogenic effects were evaluated for adults only with both average and reasonable maximum exposure parameters. Chronic (25 years) and subchronic (7 years) exposures were assessed. Carcinogenic effects were not evaluated because of the lack of inhalation slope factors.

Noncarcinogenic Effects

Tables 6-8 and 6-9 illustrate the noncarcinogenic risks resulting from average and reasonable maximum on-site worker chronic and subchronic exposure scenarios, respectively. The hazard indices for the average chronic and subchronic exposure scenarios were 4E-6 and 2E-5, respectively. The hazard indices associated with the reasonable maximum chronic and subchronic exposure scenarios were 1E-5 and 6E-5, respectively. Inhalation of toluene was responsible for 100% of the total risk associated with average and reasonable maximum exposure. The risks associated with the subchronic exposure scenarios were calculated from maximum hourly average concentrations and, therefore, resulted in higher hazard indices. Hourly averages are a function of local turbulence and meteorological conditions and represent the highest estimated air concentrations.

6.5.7 Major Factors Driving Risks

The results of this baseline risk assessment should not be interpreted as a characterization of absolute risk. The hazard index estimates discussed below highlight potential sources of risk at the site and support a no-action decision. Inhalation of toluene drives the noncarcinogenic risks. No carcinogenic risks associated with the site

were identified because of the lack of slope factors for the appropriate routes of exposure. Discussions of the magnitude and nature of risks that potentially exist at the site and the major uncertainties affecting the risk estimates are included.

Noncarcinogenic Effects

Exposure via inhalation of toluene volatilized to the atmosphere contributed the majority (98-99%) of the noncarcinogenic risk associated with Landfill No. 3. All of the estimated noncarcinogenic hazard indices for the various exposure scenarios were well below the Superfund site remediation goal of 1.0 for noncarcinogens. This indicates that adverse noncarcinogenic human health effects are unlikely to occur as a result of these exposure scenarios. However, these results should be interpreted with caution. USEPA recommends comparing the concentrations of chemicals in ambient air with a reference concentration (RfC) rather than a reference dose (RfD) for assessing inhalation exposure (USEPA, 1990). However, RfCs are currently available only for a limited number of compounds. An inhalation RfC is currently available for toluene on IRIS, but RfCs were not available for other contaminants predicted to enter the atmosphere via volatilization (diesel, hydrocarbons, tetrahydrofuran, trichloropropene) or wind entrainment of contaminated surface soil bis(2-ethylheyxl)phthalate. Therefore, these chemicals were not evaluated for their contribution to the total noncarcinogenic risk associated with inhalation of ambient air at the site perimeter, where concentrations are expected to be highest. It is possible any or all of these contaminants could contribute to noncarcinogenic risks associated with this exposure scenario.

Nature of Potential Risks at Landfill No. 3

Potential noncarcinogenic risks associated with inhalation of toluene are varied in nature. In humans, toluene is a known respiratory irritant with central nervous system (CNS) effects. Several studies demonstrated toxic effects at concentrations of approximately 100 ppb, which corresponds to a toluene concentration of 376 mg/m^3.

The maximum hourly estimated toluene concentrations (0.58 mg/m^3) at Landfill No. 3 are far below this concentration. Therefore, it can be safely assumed that on-site workers and off-site residents will not experience irritant or CNS effects as a result of inhalation of toluene originating from Landfill No. 3.

Diesel, hydrocarbons, tetrahydrofuran, and trichloropropene may also volatilize to the atmosphere and, therefore, may contribute to the noncarcinogenic risks associated with inhalation of ambient air at or near Landfill No. 3. Bis(2-ethyl-hexyl)phthalate may enter the atmosphere by wind entrainment of contaminated soil. Of these chemicals, trichloropropene and diesel are known to cause toxicity by the inhalation route in laboratory animals. A study conducted on dogs indicated that inhalation of 18 mg/m^3 trichloropropene for 66 weeks resulted in eye irritation. However, this response is not likely caused by inhalation, but rather a local response. Inhalation exposure of mice to marine diesel fuel (50-300 mg/m^3) resulted in hyaline droplet nephropathy and reduced body weight gain. Fatty liver changes and increased lung and liver inflammation were also noted. Similar studies have not been conducted in humans, but it is reasonable to assume that similar effects would be seen in humans exposed to these concentrations of trichloropropene and diesel. However, the maximum hourly estimated trichloropropene and diesel concentrations (5.8E-02 and 4.1E-04 mg/m^3, respectively) were well below the levels used in these studies. Therefore, it can be safely assumed that toxicity will not occur as a result of human exposure to trichloropropene or diesel originating from Landfill No. 3 via inhalation.

Several chemicals that were eliminated from the list of chemicals of concern based on detection frequency may be related to past site operations and/or disposal practices. Pesticide containers were burned in trenches and the remaining debris and ash were buried during the operation of Landfill No. 3. Therefore, pesticides, their metabolites, and hydrocarbons (formed during incomplete combustion of oils, garbage, and other organic substances) may be associated with past activities at this site.

The most important factors to consider when determining the potential effect of including (or deleting) a chemical in the risk assessment are its measured concentration and its toxicity. While hydrocarbons and pesticides may impact considerable toxicity following exposure to high levels, all of the chemicals eliminated from the list of chemicals of concern based on frequency of detection were present below their respective RLs. In addition, detected and modeled concentrations were generally below regulatory standards and guidelines developed to protect human health (see Table 6-10), so a qualitative risk assessment was performed for these chemicals. Toxicological profiles for chemicals that were eliminated from the list of chemicals of potential concern based on detection frequency that may have historical importance are presented in Appendix K.

Table 6-10 presents comparisons between Minimal Risk Levels (MRLs), Maximum Contaminant Levels (MCLs), Threshold Limit Values (TLVs), and levels of exposure expected to cause a cancer rate of 1 in 1,000,000 and modeled concentrations of contaminants that were eliminated from the list of chemicals of concern based on detection frequency. MRLs are derived from short-term animal studies and provide a basis for comparison with levels that humans might encounter in food. Individuals exposed to contaminants in food at concentrations below the MRL are not expected to experience adverse health effects. MCLs are enforceable standards under the Safe Drinking Water Act for specific contaminants in public water supplies. MCLs are defined as the maximum permissible level of a contaminant in water that is delivered to any user of a public water system. Generally, a MCL for a chemical represents the allowable lifetime (70 years) exposure to the compound for a 70 kg adult who is assumed to ingest 2 L of water a day. TLVs refer to airborne concentrations of chemicals. A TLV is the time-weighted average concentration of a particular chemical for a normal 8-hour workday and a 40-hour work week, to which nearly all workers may be repeatedly exposed, without adverse health effects. A cancer risk of 1 in 1,000,000 represents the Superfund site remediation goal for carcinogens. Levels of exposure to various contaminants expected to cause a cancer rate of 1 in 1,000,000 have been calculated

Table 6-10

Comparison of Regulatory and/or Advisory Status and Modeled Concentrations of Chemicals Eliminated from the List of Chemicals of Concern Based on Detection Frequency

Chemical	Regulatory or Advisory Status					Modeled Concentrations		
	MRL (food) (mg/kg unless other units specified)	MCL (mg/L)	TLV ($\mu g/m^3$)	1 in 1E-06 Cancer Risk		Groundwater (mg/L)	Air ($\mu g/m^3$)	Vegetables/ Beef (mg/kg)
				Water (mg/L)	Air ($\mu g/m^3$)			
Benzene	<1E-06	5E-03	NA	1E-03	1E-01	0E+00	4E-08	0+00
Benzo(a)Anthracene	3.6	2E-04	NA	NA	NA	1.8E-05	0+00	1.8E-05
Benzo(a)Pyrene	1.E-02 (mg/kg-day)	2E-04	NA	5E-06	NA	6.2E-08	0+00	1.9E-07
Benzo(g,h,i)Perylene	3.6	NA	NA	NA	NA	0+00	0+00	0+00
Benzo(b)Fluoranthene	3.6	2E-04	NA	NA	NA	1.4E-32	0+00	4E-32
Benzo(k)Fluoranthene	3.6	NA	NA	NA	NA	6.4E-85	0+00	2E-84
Chrysene	3.6	2E-04	NA	NA	NA	2E-04 [a]	0+00	2E-04
1,1-Dichloroethene	3.2E-01	7E-03	2E+04	6E-05	2E-02	0+00	1.9E-07	0+00
Dieldrin	<1E-02 (mg/kg-day)	NA	2.5E+02	2E-06	2E-04	8.6E-09	0+00	6.9E-11
Di-n-Octylphthalate	NA	NA	NA	NA	NA	0+00	0+00	0+00
Endosulfan II	1.4E-02	NA	1E+02	NA	NA	0+00	0+00	0+00
Endrin	1E-02	2E-03	1E+02	NA	NA	1.1E-45	0+00	6.6E-46
Endrin Aldehyde	1E-02 (based on Endrin)	NA	NA	NA	NA	0+00	0+00	0+00

Table 6-10

(continued)

Chemical	Regulatory or Advisory Status					Modeled Concentrations		
	MRL (food) (mg/kg unless other units specified)	MCL (mg/L)	TLV ($\mu g/m^3$)	1 in 1E-06 Cancer Risk		Groundwater (mg/L)	Air ($\mu g/m^3$)	Vegetables/ Beef (mg/kg)
				Water (mg/L)	Air ($\mu g/m^3$)			
Endrin Ketone	1E-02 (based on Endrin)	NA	NA	NA	NA	0+00	0+00	0+00
Ethylbenzene	NA	7E-01	4.3E+05	NA	NA	0+00	1E-08	0+00
Fluoranthene	3.6	NA	NA	NA	NA	7.3E-24	0+00	1.5E-24
Heptachlor	1E-01	4E-04	5E+02	8E-06	8E-04	7.2E-19	0+00	4.3E-20
2-Hexanone	NA	NA	2E+04	NA	NA	0+00	1.7E-07	0+00
Indeno(1,2,3-cd)Pyrene	3.6	2E-04	NA	NA	NA	2E-27	0+00	1.6E-26
Methoxychlor	NA	NA	1E+04	NA	NA	0+00	0+00	0+00
Phenanthrene	3.6	NA	NA	NA	NA	1E-41	2.8E-14	7E-43
PCBs	5E-03 (μg/kg-day)	5E-04	5E+02	5E-06	NA	0+00	0+00	0+00
Pyrene	3.6	NA	NA	NA	NA	1.1E-39	0+00	2.2E-40
2-,4,5-Trichlorophenol	NA	NA	NA	NA	NA	0+00	2E-07	0+00
Xylenes	NA	1E+01	4.3E+05	NA	NA	0+00	0+00	0+00

[a] - Meets but does not exceed MCL.

from cancer potency estimates by the Carcinogen Assessment Group (CAG) of the EPA and are available on IRIS. The values are presented in Table 6-10. It should be emphasized, however, that these calculations are based on animal testing and represent the upper limit of the probable risk to humans. Therefore, actual human risks are likely to be much lower.

The regulatory standards presented in Table 6-10 can be used as a screening method to evaluate the potential for adverse human health effects. With the exception of groundwater concentrations of chrysene, none of the modeled concentrations meet or exceed regulatory standards. The estimated chrysene concentration in groundwater meets the federal MCL established for this chemical but does not exceed the maximum permissible level allowable in water that is delivered to users of public water systems. Therefore, it is reasonable to conclude that serious adverse health effects are not likely to result from human exposure to the concentration of contaminants detected at Landfill No. 3 and that elimination of these chemicals from the quantitative risk assessment does not impact the validity of the baseline risk assessment.

6.5.8 Uncertainties Associated with Risk Characterization

Risk characterization results are not actual representations of risk but rather conditional estimates of risk that should be interpreted in light of the considerable number of assumptions required to quantify exposure, intake and dose-response. Uncertainties associated with identification of chemicals of potential concern, exposure assessment, and toxicity assessment all contribute to the level of confidence that can be placed on the risk characterization results. The uncertainties associated with these steps are discussed in previous sections of the report and are summarized in this section to facilitate interpretation of the risk characterization.

Identification of Contaminants of Potential Concern

Uncertainties associated with identification of chemicals of potential concern are discussed in detail in Section 6.2.9 (Data Limitations/Data Gaps) and include:

- Elimination of chemicals from the list of chemicals of concern that may have historical importance;
- Limitations of the analytical methods in detection of chemicals in the sampled soil below the instrument detection limit;
- Use of estimated values below the reporting limit and values close to reporting limits;
- Use of potentially false negatives; and
- The generally small number of samples and locations used to evaluate background concentrations of inorganic chemicals.

Exposure Assessment

Sources of uncertainty associated with the exposure assessment are discussed in Section 6.3.7. The primary sources of uncertainty that can limit the accuracy of the assessment were:

- Analytical data used to estimate release rates to the environment;
- The ability of fate and transport models to realistically simulate the behavior of chemicals in the environment; and
- The accuracy of exposure assumptions in representing the degree and magnitude of exposure.

Toxicity Assessment

Sources of uncertainty associated with the toxicity assessment are discussed in detail in Section 6.4.5. The major source of uncertainty is the lack of verified toxicity values for several chemicals and include:

- The lack of inhalation RfCs for bis(2-ethylhexyl)phthalate, diesel, tetrahydrofuran, and trichloropropene;
- Medium confidence rating for USEPA-verified RfC value for toluene;
- The lack of verified inhalation slope factors for all of the contaminants evaluated; and
- Inability to evaluate the possible synergistic or antagonistic effects of the mixture of chemicals detected at the site.

The most significant uncertainties associated with Risk Characterization are the limitations of analytical methods and fate and transport models, in addition to the lack of verifiable toxicity values. The majority of the tasks performed during risk assessment utilize conservative assumptions, which tend to result in overestimation of risk (use of estimated values below instrument detection levels; exposure assumptions which tend to be conservative). However, the limitations associated with analytical methods, the lack of EPA-verified toxicity values for some chemicals, and elimination of chemicals from the list of chemicals of concern could result in an underestimation of risks. Alternately, many of the uncertainties associated with risk assessment have the potential to either over- or underestimate the risk associated with exposure.

6.6 Environmental Evaluation

This section presents a qualitative evaluation of potential adverse impacts of contamination from Landfill No. 3 on critical habitats and endangered species in the

area. A description of the site, and the nature and extent of the contaminants of concern, were presented earlier in this report. Information for this qualitative evaluation was adapted from an ecological risk assessment of CAFB prepared by Woodward-Clyde and Consultants (Woodward-Clyde, 1992).

6.6.1 Local Ecology

CAFB and surrounding areas are part of the High Plains grasslands. Much of the natural grassland ecology has been disrupted by agricultural practices. Small trees and large shrubs are located around riparian areas and playa lakes. The areas surrounding CAFB are used for crops and livestock. Common agriculture crops grown in the area include wheat, sorghum, and alfalfa.

Landfill No. 3 is vegetated with a variety of grasses. The area is not maintained in any manner and the grass is tall. Grainfields lie east and south of the landfill separated by a narrow fence-line corridor. A playa lake is located 465 feet to the north on a down gradient (surface) slope from the landfill.

6.6.2 Threatened and Endangered Species

Table 6-11 lists threatened and endangered species, and species of high federal concern historically inhabiting areas within CAFB and surrounding Curry County. The Baird's sparrow and the ferruginous hawk are known to occur in this area. However, both birds are infrequent visitors in the area. The Baird's sparrow may be found in the area from early August and departs by November. The ferruginous hawk may occasionally feed on the base, but does not reside there because of lack of suitable nesting habitat.

Table 6-11

Federal- and State-Protected Animals Potentially Occurring in the Vicinity of Cannon AFB (Curry County), New Mexico

Common Name	Scientific Name	Federal Status	State Status
Birds			
Baird's sparrow	*Ammodramus bairdii*		Endangered (group 2)
Bald eagle	*Haliaeetus leucocephalus*	Endangered	Endangered (group 2)
Peregrine falcon	*Falco perigrinus*	Endangered	Endangered (group 1)
Long-billed curlew	*Numenius americnus*		Endangered (group 2)
Western snowy plover	*Charadrius aleandrus nivosis*		Endangered (group 2)
Mammals			
Black-footed ferret	*Mustela nigripes*	Endangered	Possibly Extinct
Swift fox	*Vulpes velox*		Endangered (group 2)
Reptiles			
Texas horned lizard	*Phrynosoma cornutum*		Endangered (group 2)

Endangered (group 1): Species whose prospects of survival or recruitment within the state are in jeopardy.
Endangered (group 2): Species whose prospects of survival or recruitment within the state are likely to become jeopardized in the foreseeable future.
Possible Extinct: Potentially no longer in existence in the state.
Source: Woodward-Clyde, 1992.

6.6.3 Other Species

Small amphibians and reptiles are known to occupy areas in and around CAFB. The pocket gopher and the deer mouse are two common small mammals found at CAFB. Both animals inhabit areas covered with small shrubs and grasses similar to Landfill No. 3. Pheasant, quail, and migratory waterfowl feed on waste grains in the fields adjacent to the landfill. Waterfowl, mostly dabbler ducks, utilize the playa lake as a resting and feeding area during migration. The primary predators in the area are several species of raptors. Mated pairs of Mississippi Kite, recently removed from New Mexico's protected species list, have been spotted on the base defending territory near the golf course. Occasionally a big game animal such as the longhorn antelope, has been spotted in the vicinity.

6.6.4 Potential Exposure of Wildlife to Chemicals of Potential Concern

Animals that inhabit Landfill No. 3 and utilize nearby areas such as the playa lake are potentially exposed to chemicals originating from Landfill No. 3. It is not possible to assess effects on all species potentially impacted by exposure to chemicals of concern at Landfill No. 3. Ducks have been chosen as the indicator species to represent potential impacts of chemicals at the landfill on wildlife in the area. Dabbler ducks, which include gadwalls, mallards, pintails, shovelers and widgeons, make up the majority of wildlife found at CAFB. The ducks are not usually found at Landfill No. 3; however, they spend a majority of their time resting at the nearby playa lake and feeding in the adjacent grain fields.

6.6.5 Qualitative Risk Assessment

Potential exposure of ducks to contaminants originating at Landfill No. 3 is via surface water flowing downgradient to the playa lake, 465 meters to the north. Mean annual precipitation for the area is 15 inches with low monthly averages of 0.4 inches

during the winter months. Because of the low annual precipitation, few chemicals are likely to be carried from the landfill to the playa lake.

Ducks typically begin migrating through the Clovis area by late October and reach their highest numbers by mid-November. The majority of the ducks have continued southward migration by the time the lakes are frozen, which is usually at the beginning of January. During mild winters, ducks can remain in the vicinity until mid-March. The average amount of time ducks spend in the area is between 1.5 and 3 months.

Considering the low precipitation and the amount of time the ducks are found in the area, the level of exposure is likely to be low.

6.7 Conclusions for Baseline Risk Assessment

The baseline risk assessment for CAFB Landfill No. 3 indicates that there is little likelihood that adverse human health effects will occur as a result of exposure to contaminants originating at the site. Toluene has been classified by the USEPA as Group D - Not Classifiable as to Human Carcinogenicity, indicating that there is insufficient information to classify this compound as a carcinogen. Therefore, the lack of an oral slope factor for toluene precluded the evaluation of carcinogenic risks for ingestion pathways. The lack of inhalation slope factors for contaminants predicted to enter the atmosphere via volatilization (diesel, hydrocarbons, tetrahydrofuran, and trichloropropene) or wind entrainment of contaminated surface soil bis(2-ethylhexyl)phthalate precluded evaluation of carcinogenic risks associated with the inhalation pathway as well. While the lack of slope factors for the appropriate routes of exposure does not necessarily indicate the these chemicals are without carcinogenic potential, it does suggest that there is insufficient data to classify the chemicals as carcinogens.

All of the estimated noncarcinogenic hazard indices for the various exposure scenarios were well below the Superfund site remediation goal of 1.0 for noncarcinogens. Although these results indicate that adverse noncarcinogenic human health effects are unlikely to occur as a result of these exposure pathways, the results should be interpreted with caution. RfCs were not available for several contaminants predicted to enter the atmosphere (diesel, tetrahydrofuran, and trichloropropene), so these chemicals were not evaluated for their contribution to the total noncarcinogenic risk associated with inhalation of ambient air at the site perimeter. It is possible that these contaminants could contribute to the noncarcinogenic risks associated with the inhalation exposure scenario. Of these chemicals, only diesel is known to cause toxicity by the inhalation route in laboratory animals. It is not known whether similar effects would occur in humans, but according to model results, the maximum hourly estimated concentration of diesel in ambient air was well below the concentrations to which animals were exposed in this study. Therefore, it seems unlikely that toxicity will occur in human populations as a result of exposure to contaminants originating at Landfill No. 3.

Results from the environmental evaluation indicate that the level of exposure of wildlife known to inhabit the landfill and surrounding areas to contaminants present at the site is likely to be low. Therefore, the potential adverse impacts of contamination from Landfill No. 3 on critical habitats and endangered species in the area is judged to be insignificant.

7.0 RECOMMENDATIONS AND CONCLUSIONS

Field activities were completed in 1992 to collect soil samples from Landfill No. 3 at CAFB. The soil samples were analyzed for various chemical parameters to provide information concerning possible contamination from the landfill. Chemical analysis results were verified through extensive QA/QC measures, including a 10% CLP data validation effort. The review indicated that the chemical data are acceptable and defensible. Data show that quality control mechanisms were effective in ensuring measurement data reliability within expected limits of sampling and analytical error.

A baseline risk assessment was performed in accordance with EPA guidance documents using the chemical results from the soil samples and the knowledge of CAFB personnel. The risk assessment indicates that, based on current knowledge, there is little likelihood that adverse human health effects will occur as a result of exposure to contaminants originating at the site. Migration of contaminants to the groundwater was shown to be insignificant. In addition, the qualitative evaluation of potential adverse impacts of contaminants originating at Landfill No. 3 on critical habitats and endangered species in the area indicates that deleterious effects from the site contaminants are unlikely. Therefore, the results of the risk assessment indicate that, based on existing data and conservative assumptions, the risk to human health and the environment are acceptable.

This investigation addressed the 20- to 60-foot depth interval. The vertical extent of organics in the soil has not been delineated beyond this interval. However, the risk assessment has demonstrated that the risks from deep soil contamination are insignificant. Only TICs (tentatively identified compounds), potential laboratory contaminants and trace amounts of pesticides have been identified in the soil below the base of the landfill. The identification and quantitation of TICs is highly uncertain and is likely to be inaccurate (Section 6.2.6). Potential laboratory

contamination (e.g., TRPH, diesel) is discussed in Sections 5.3, 6.2.2 and the Quality Control Summary Report (QCSR). The pesticide residuals may result from the activities associated with the adjacent agricultural production.

The risk assessment has demonstrated that the risk to groundwater is insignificant; therefore, groundwater monitoring is not necessary for the site. Additionally, the drilling of borings to groundwater or the installation of wells creates the potential of introducing contaminants (via a new, direct pathway or by carrying contaminated soil down with the drilling tools or well materials) into the aquifer. For this reason, drilling to groundwater under or adjacent to the landfill is not recommended.

No further action is recommended. Upon completion of the RFI, CAFB will submit a Class III permit modification for Landfill No. 3.

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VOLUME I A
RFI REPORT

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70, 77, 92, 93, 94, 103, 127

RCRA FACILITY INVESTIGATION

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CANNON AIR FORCE BASE

NEW MEXICO

Prepared for
Cannon Air Force Base
27 CES/CEVR
Environmental Flight

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GLOSSARY OF TERMS

AGE	Aerospace Ground Equipment
ARAR	Applicable or Relevant and Appropriate Requirement
BRA	Baseline Risk Assessment
C.E.	Civil Engineering
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CMS	Corrective Measures Study
COC	Chemicals of concern **or** chain of custody
DQCR	Daily Quality Control Report
EPA	Environmental Protection Agency
HSWA	Hazardous and Solid Waste Management Act
IRIS	Integrated Risk Information System
NMED	New Mexico Environment Department
OWS	Oil water separator
PAH	Polynuclear aromatic hydrocarbons
PCB	Polychlorinated biphenyls
QA/QC	Quality assurance/quality control
QAPP	Quality Assurance Project Plan
QCSR	Quality Control Summary Report
RBC	Risk-based concentration
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
SVOC	Semivolatile organic compound
SWMU	Solid Waste Management Unit
TAL	Target Analyte List
TCL	Target Compound List
TPH	Total petroleum hydrocarbons
TRPH	Total recoverable petroleum hydrocarbons
USACE	United States Army Corps of Engineers
UTL	Upper tolerance limit
VOC	Volatile organic compound
W-C	Woodward-Clyde

EXECUTIVE SUMMARY

Cannon Air Force Base has been in operation for more than 50 years as a military air base. Through the course of these operations numerous aircraft and equipment maintenance processes have been conducted, and the Air Force is currently investigating the potential that some of these operations may have contaminated the environment. Cannon AFB operates in compliance with the terms of a RCRA Permit issued jointly by the United States EPA and the State of New Mexico. This permit includes a listing of three groups of Solid Waste Management Units (SWMUs) that have been identified as Appendix I, II, and III SWMUs. This RCRA Facility Investigation (RFI) is directed at 16 of the group of SWMUs listed in Appendix III of the permit, and is being completed as required by the terms of the permit.

Woodward-Clyde (W-C) has completed the RFI under contract with the U.S. Army Corps of Engineers (USACE), Omaha District. Prior to initiating the field sampling activities W-C submitted work plans covering the description of work and supplementing the work plans prepared by Cannon AFB Environmental Flight. These work plans were reviewed by the USACE and Cannon AFB Environmental Flight and approved with revisions as complying with the terms and scope of the EPA approved documents.

The RFI field investigation was completed during August and September of 1993, and it consisted of sampling surface and subsurface soils and at one site surface water and pond sediment. The field work also included collection of additional mapping data, and a field survey of the sampling points. Base personnel were interviewed to develop background information on operations, both currently and historically, for each of the subject sites. The samples were transported to ENSECO Rocky Mountain Analytical Laboratories for chemical testing which was completed in mid-October.

The sampling rationale was developed to collect samples in the locations and depths likely to be the most heavily contaminated at each facility.

The RFI includes a screening level Risk Evaluation using Risk Based Concentrations (RBCs) calculated as action levels as outlined in RCRA Subpart S Guidance. These RBCs are very conservative (generally comparable to a one in ten million risk of added cancer). The highest

detected concentrations of chemicals of concern have been compared to the RBCs, or background, or State of New Mexico requirements where applicable, for each SWMU in accordance with the decision process outlined in the work plans. Sites for which the risk screening indicates the potential for unacceptable risk to human health or the environment have been recommended to be included in the Baseline Risk Assessment (BRA) being completed following the RFI, and in some cases additional data collection has been recommended prior to completion of the BRA.

It is anticipated that the conservative determination of RBCs for the risk screening in this RFI will be protective of the ecology as well. A detailed ecological risk assessment will be included in the baseline risk assessment for any sites not screened out in this RFI.

The SWMUs in the Appendix III list are as follows:

Site	SWMU Number
AGE Maintenance Shop	31
Oil/Water Sep #196	46
Oil/Water Sep #494	47
Oil/Water Sep #375	51
Oil/Water Sep #379	57
Oil/Water Sep #5077a,b,&c	61, 62, 63
Oil/Water Sep #326	70
Oil/Water Sep #5120	92
Oil/Water Sep #5121	93
Oil/Water Sep #5144	94
Oil/Water Sep #4095	127
Lead/Acid Battery Area	55
CE Container Storage Area	77
Wastewater Playa Lake	103

The USACE Scope of Services outlined the required chemical tests in accordance with the EPA approved work plan. Testing was in accordance with EPA SW-846 methodology and the analyte list at each SWMU was selected from the following groups on the basis of the potential contamination indicated by the past and current operations at each SWMU.

- Target Compound List (TCL) volatile organic compounds
- Semivolatile organic compounds
- Target Analyte List (TAL) metals
- Total petroleum hydrocarbons (TPH)
- Pesticides/PCBs
- Herbicides
- Total lead
- Acidity
- Appendix IX list of chemicals for surface water

Laboratory analytical data was validated in accordance with USACE and EPA guidance as outlined in the Quality Assurance Project Plan, and the validated data is the basis for the recommendations.

The following sections discuss for each SWMU the contamination found (if any), the results of the screening level risk evaluation, and the recommendations resulting from the evaluation.

SWMU NO. 31 - AGE MAINTENANCE PAD

The Aerospace Ground Equipment (AGE) Maintenance Pad is a paved area outside to the southeast of Building 186. The area is used for maintenance of ground equipment associated with the base aircraft operations. Potential contaminants include JP-4, mineral and synthetic oils, and diesel fuel.

Samples of soil from the surface and the subsurface to 10 feet below ground surface (bgs) were collected from four locations adjacent to the edge of the paved area. The locations were selected where rainwater and wash water may have carried oily contaminants from the slab onto the ground. Target analytes for samples collected included VOCs, SVOCs, TAL metals, and TPH.

It was found that barium, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, cadmium, chromium, chrysene, indeno(1,2,3-cd)pyrene, lead, and TPH concentrations exceeded the risk screening criteria. It was concluded that there is enough data available to complete a baseline risk assessment, and it is recommended that the risk assessment be done.

SWMU NO. 46 - OWS NO. 196

The Oil/Water Separator (OWS) at Building 196 serves aircraft service and maintenance operations in that building. Potential contaminants include petroleum and synthetic lubricating oils, fuels, greases, solvents, and metals.

Samples of soil at depths beginning just beneath the pavement and extending to 10 feet bgs were taken from three soil borings adjacent to the OWS. The locations were as close as possible to the OWS to assure detection of any significant leakage. Target analytes for the samples collected included VOCs, SVOCs, TAL metals, and TPH.

It was found that antimony and barium were the only chemicals detected in the soil at concentrations in excess of the risk screening criteria. These two metals were found to be naturally occurring and not SWMU-related chemicals. No further action is recommended at SWMU 46.

SWMU NO. 47 - OWS NO. 494

SWMU No. 47 is comprised of a sand trap and an OWS, each serving different parts of the Auto Hobby Shop in Building 494. The OWS serves the floor drain system in the main shop area, and the sand trap serves the floor drain in the engine/auto wash and prep room. The potential contaminants include petroleum and synthetic lubricating oils, fuels, greases, solvents, paint chips and metals.

Samples of soil from the surface and the subsurface to a depth of 10 feet bgs were collected. The locations were selected to assure detection of significant leakage or spillage from the subject units and their operation. Target analytes for the samples collected included VOCs, SVOCs, TAL metals, and TPH.

It was found that none of the maximum concentration levels detected exceeded risk screening criteria. Cobalt was detected at a maximum concentration of 5.4 mg/kg, and there is no toxicity data on which to base an RBC calculation. The detected levels of cobalt are essentially at or below background ranges naturally occurring and it was concluded that the cobalt is not a SWMU-related contaminant. No further action is recommended at SWMU 47.

SWMU NO. 51 - OWS NO. 375

SWMU 51 is an OWS serving Building 375 within the motor pool compound. The OWS serves floor drains in the engine shop area of the building. The potential contaminants include petroleum and synthetic lubricating oils, fuels, greases, solvents, and metals.

Samples of soil from three borings adjacent to the OWS were collected from depths ranging from just below the pavement to 10 feet below the pavement surface. The target analytes for the samples included VOCs, SVOCs, TAL metals, and TPH.

It was found that barium, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene, and TPH exceeded the risk screening criteria. It is concluded that the available data is sufficient to complete a baseline risk assessment, and it is recommended that the risk assessment be done.

SWMU NO. 57 - OWS NO. 379

SWMU 57 is an OWS serving the floor drains in the firetruck maintenance area in Building 379. The potential contaminants include petroleum and synthetic lubricating oils, fuels, greases, solvents, and metals.

Samples of soil from three borings adjacent to the OWS were collected from depths ranging from just below the pavement to 10 feet below the pavement surface. The target analytes for the samples included VOCs, SVOCs, TAL metals, and TPH.

It was found that no contaminants exceeded the risk screening criteria. No further action is recommended at SWMU 57.

SWMU NO.'s 61, 62, AND 63 - SAND TRAPS NO. 5077A, B, AND OWS NO. 5077C

SWMUs 61 and 62 are sand traps beneath the drains for each of the wash rack areas in the Civil Engineering Squadron compound. SWMU 63, originally designated as an OWS, is another sand trap serving these wash racks. To avoid confusion with past reports, this unit

is still designated an OWS for this report. Potential contaminants include petroleum and synthetic lubricating oils, fuels, greases, solvents, and metals.

Samples of soil from two borings adjacent to each of the sand traps and the OWS were collected from depths ranging from the near surface (or just below the pavement) to 10 feet below the ground (or pavement) surface. The target analytes for the samples included VOCs, SVOCs, TAL metals, and TPH.

It was found that for SWMU 61, barium was the only analyte for which the detected concentration exceeded the risk screening criteria. The maximum barium concentration of 727 mg/kg is within the background range for the Cannon AFB area and it is concluded that barium is a naturally occurring element and not a site-related contaminant.

It was found for SWMU 62 that no analytes exceeded the risk screening criteria.

No further action is recommended for SWMU 61 nor SWMU 62.

It was found for SWMU 63 that barium, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene exceeded the risk screening criteria. It was concluded that the available data is sufficient to complete a baseline risk assessment, and it is recommended that the risk assessment be done.

SWMU NO. 70 - OWS NO. 326

SWMU 70 is an OWS with a leaching well serving the floor drains for the fuel truck maintenance operations in Building 326. Potential contaminants are petroleum and synthetic lubricating oils, greases, solvents, fuels, and metals.

The original sampling plan included two 20-foot-deep borings adjacent to the OWS, and three 60-foot-deep borings adjacent to the leaching well. The two 20-foot-deep borings and one and one-half of the 60-foot-deep wells had been completed when high levels of volatile emissions required the use of respirators by the crews. It was concluded at this point that the objectives had been achieved. Heavy petroleum contamination was encountered throughout the depth of the borings, with the worst areas near the leaching well. Twenty-six soil samples

were collected. The target analytes for the samples were VOCs, SVOCs, TAL metals, and TPH.

It was found that antimony, benzene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene, and TPH exceeded the risk screening criteria for SWMU 70. It was concluded that not enough data was available to complete a baseline risk assessment for SWMU 70. It is recommended that additional investigations be completed to define the extent of contamination sufficiently to complete a baseline risk assessment, and that information be collected to support decisions regarding the applicability of preliminarily identified corrective measures such as microbial degradation through bioventing, in-situ treatment, or natural attenuation. The recommendations include completion of a baseline risk assessment following the additional investigation.

SWMU NO. 92 - OWS NO. 5120

SWMU 92 is an OWS with a leach well discharge located east of Power Check Pad 5120. The OWS served the former aircraft service and maintenance associated with Building 5120 which has been removed from the site. The OWS is no longer in service, but it and the leach well and an oil recovery tank remain in place. Potential contaminants include JP-4 fuel, petroleum and synthetic lubricating oils, greases, solvents, and metals.

Two borings were advanced to a depth of 20 feet bgs adjacent to the OWS and three borings were advanced to a depth of 60 feet bgs adjacent to the leach well. Thirty five soil samples were collected from the borings. The target analytes for the samples included VOCs, SVOCs, TAL metals, and TPH.

It was found that benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene, and lead exceed the risk screening criteria. It has been concluded that the available data is sufficient to complete a baseline risk assessment, and it is recommended that the risk assessment be done.

SWMU NO. 93 - OWS NO. 5121

SWMU 93 was an OWS with a leach well serving Power Check Pad 5121. It was removed in 1988 when Building 5121 was demolished. Facility 5123 has been constructed over the former location of Building 5121, and the sampling for this effort has been adjacent to Building 5123 in the vicinity formerly occupied by the OWS and the leach field. Potential contaminants include JP-4 fuel, petroleum and synthetic lubricating oils, greases, solvents, and, metals.

Three borings were advanced to a depth of 60 feet bgs adjacent to the vicinity of OWS 5121 and the leach field. Twenty-seven soil samples were collected from the borings. The target analytes included VOCs, SVOCs, TAL metals, and TPH.

It was found that barium, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene exceeded the risk screening criteria. It was concluded that the data available is sufficient to complete a baseline risk assessment, and it is recommended that the risk assessment be done.

SWMU NO. 94 - OWS NO. 5144

SWMU 94 is comprised of three sand traps serving an automobile wash rack adjacent to the Army, Air Force Exchange Service (AAFES) service station, east of the intersection of D.L. Ingram Street and Argentia Avenue. The sand trap in the grassy area adjacent to the wash racks was previously designated as an OWS, and the term OWS is used for this unit throughout this report. The facility is out of service, and serves as covered parking for local workers' vehicles. Potential contaminants include lubricating oils, fuels, greases, solvents, and metals.

Two borings were advanced adjacent to each of the units to a depth of 10 feet bgs or the pavement surface. Twenty-four soil samples were collected from the borings. The target analytes for the samples were VOCs, SVOCs, TAL metals, and TPH.

It was found that antimony, barium, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, beryllium, indeno(1,2,3-cd)pyrene, and TPH exceeded the risk

screening criteria. It was concluded that the available data is sufficient to complete a baseline risk assessment, and it is recommended that the risk assessment be done.

SWMU NO. 127 - SAND TRAP AND LEACH FIELDS AT THE POL WASH RACK

SWMU 127 is a sand trap at the POL Wash Rack and the old and new leach fields that have received and now receive wastewater from the wash rack. There is a new OWS in a concrete vault in the line that was built in 1991. The vault was visually inspected at the premobilization visit. There was no evidence of any oil spillage or leakage. The OWS is not defined as a part of SWMU 127. The wash rack is used to wash fuel trucks used to fuel aircraft on the flight line. The potential contaminants include JP-4 fuel, grease, and motor oils.

Two borings were advanced to a depth of 10 feet bgs adjacent to the sand trap. Three borings were advanced to a depth of 60 feet bgs within each of the leach field areas. Sixty-two soil samples were collected from the borings. The target analytes included VOCs, SVOCs, TAL metals, and TPH.

It was found that antimony, barium, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, beryllium, chrysene, and indeno(1,2,3-cd)pyrene, exceed the risk screening criteria. It has been concluded that the available data is sufficient to complete a baseline risk assessment, and it is recommended that the risk assessment be done.

SWMU NO. 55 - LEAD ACID BATTERY ACCUMULATION SITE

SWMU 55 is an area located in the northernmost corner of the fenced motorpool compound. It is used to store used lead acid motor vehicle batteries on pallets for eventual disposal. The potential contaminants include lead and sulfuric acid.

Three borings were advanced to a depth of 20 feet bgs at representative locations within the storage area. Fifteen soil samples were collected from the borings. Target analytes were total lead and acidity.

It was found that none of the analytes exceeded risk screening criteria, and no further action is recommended for SWMU 55.

SWMU NO. 77 - CIVIL ENGINEERING CONTAINER STORAGE AREA

SWMU 77 is a fenced area, paved with concrete, that is used to store miscellaneous material, drums, transformers, and other supplies. The potential contaminants include waste oil, solvents, aviation fuel, waste paint materials, PCBs, and pesticides.

Six soil borings were advanced to a depth of 20 feet bgs or below the pavement surface. Two of the borings were located within the fenced compound, and four were drilled in the soil just off the edge of the slab where it appeared that drainage was flowing off the slab. Thirty soil samples were collected from the borings. Target analytes included VOCs, SVOCs, TAL metals, TPH, PCBs, pesticides, and herbicides.

It was found that antimony, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, beryllium, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, and TPH exceed the risk screening criteria. It has been concluded that the available data is sufficient to complete a baseline risk assessment, and it is recommended that the risk assessment be done.

SWMU NO. 103 - WASTEWATER PLAYA LAKE

SWMU 103 is a natural playa that has been used to receive drainage from sanitary and industrial sewers basewide since the early history of the base. Portions of the effluent have been treated, and the Playa Lake now receives the overflow from two aeration lagoons. The Playa Lake is used by a nearby farmer for irrigation.

The potential contaminants include organic compounds, metals, PCBs, pesticides, and herbicides.

Four samples of the sludge and sediment from the bottom of the lake were collected with a ponar dredge, and three surface water samples from about 3 feet below the water surface were collected in a 3-liter bailer. The target analytes included the Appendix IX list of analytes for

the surface water, and VOCs, SVOCs, TAL metals, TPH, PCBs, pesticides, and herbicides for the sediment.

It was found that the surface water samples contained no contaminants at concentrations in excess of the risk screening criteria. The sludge/sediment samples contained concentrations of beryllium, silver, vanadium, and TPH in excess of the risk-based screening criteria.

It has been concluded that the available data is sufficient to complete a baseline risk assessment for all pathways except the groundwater. It is recommended that a risk assessment be done.

SUMMARY OF RECOMMENDATIONS

SWMU NUMBER	RECOMMENDATION
31	BRA
46	NFA
47	NFA
51*	BRA
57	NFA
61	NFA
62	NFA
63*	BRA
70	FI and BRA
92*	BRA
93*	BRA
94*	BRA
127	BRA
55	NFA
77	BRA
103	BRA

NOTE: The key to column 2 above is as follows:

- BRA = Baseline Risk Assessment
- NFA = No Further Action
- FI and BRA = Further Investigation and Baseline Risk Assessment

*It should be noted that for these SWMUs, because the contaminants only slightly exceeded the risk screening criteria, it is unlikely that the BRA will result in a recommendation for corrective measures.

1.0
INTRODUCTION

1.1 BACKGROUND AND AUTHORITY

Cannon Air Force Base (AFB) is a permitted RCRA facility operating in accordance with the terms of a permit issued jointly by the United States Environmental Protection Agency (EPA) and the New Mexico Environment Department (NMED) effective October 3, 1989. This permit sets forth the conditions within which Cannon AFB can be operated as a hazardous waste facility. The authority for regulation of hazardous waste activities at Cannon AFB through this permit is derived from the Federal Resource Conservation and Recovery Act (RCRA) and its reauthorization in the form of the Hazardous and Solid Waste Amendments of 1984 (HSWA) as well as the New Mexico Hazardous Waste Management Act.

A portion of this permit governs the investigation and, where required, the implementation of corrective measures to mitigate the effects on the environment of releases of petroleum products and other chemicals that may have been released from various Solid Waste Management Units (SWMUs) at the Base. One hundred twenty-eight SWMUs were identified at Cannon AFB during the RCRA Facility Assessment completed in 1988 for the EPA by A. T. Kearney. Seventy-three of the SWMUs were identified for further investigation and were divided into three groups (Appendix I through III). Appendix I and Appendix II SWMUs have been investigated under other programs, and sixteen of the Appendix III SWMUs are the subject of this RCRA Facility Investigation (RFI) Report.

These regulatory considerations notwithstanding, the United States Air Force (USAF) has in place an independent program to manage its waste generation and disposal activities. Compliance with the terms of the RCRA Permit is a portion of the overall environmental management program at Cannon AFB.

This RFI was authorized and funded by the USAF through the United States Army Corps of Engineers (USACE).

1.2 PURPOSE AND SCOPE OF REPORT

The purpose of the RFI is to obtain the data necessary to characterize the nature and extent of contamination to the degree necessary to support recommendations for further studies to identify corrective measures alternatives for each SWMU or to recommend "no further action" if warranted. The data collected during the RFI will be used to determine whether a significant release has occurred at a SWMU and to evaluate human health and ecologic risks. The data quality objective process is used to ensure that data of sufficient quantity and quality are collected to achieve this purpose.

The scope of this RFI has been specified by the USACE on behalf of the USAF to require the contractor to address the 16 SWMUs listed in Appendix III of the RCRA Permit at Cannon AFB. The field investigation has been limited to soil and surface water sampling in the areas of potential releases from each SWMU. No background samples were collected, since the previous work involved an extensive basewide collection of background data for inorganic materials. Also, no geotechnical laboratory tests were included in the scope of work for this RFI report. Soil borings were advanced at appropriate locations adjacent to each SWMU and soil samples were collected for the purpose of determining the degree of contamination, if any, that existed in the soil.

The scope includes identification of significant exposure pathways and chemicals of concern and a risk screening to determine whether a significant risk to human health is posed by contaminants at each site. A Baseline Risk Assessment (BRA) will be completed and reported under separate cover for each SWMU that is not eliminated from consideration by virtue of the risk screening.

The Appendix III SWMUs are listed in Table 1-1.

1.3 REGULATORY SUMMARY

This RFI has been completed in accordance with the work plan prepared by the Environmental Management Branch, Civil Engineering Squadron, Cannon AFB, as approved by the USEPA with emendations. This work is directed at compliance with the terms of the RCRA Permit for Cannon AFB dated October 3, 1989.

1.4 CANNON AFB OPERATIONAL HISTORY

Cannon AFB is located in Curry County, New Mexico, approximately 7 miles west of the City of Clovis. The base is situated on approximately 4,320 acres of land. The vicinity map of Cannon AFB is shown on Figure 1-1 and the site map of Cannon AFB is shown on Figure 1-2. Off-base facilities include the Melrose Bombing Range.

Cannon AFB dates to 1929, when Portair Field was established on the site. Portair Field was a civilian passenger terminal for early commercial transcontinental flights. In 1942, the Army Air Corps took control of the civilian airfield and it became known as the Clovis Army Air Base. In early 1945, the base was renamed Clovis Army Air Field. Flying, bombing, and gunnery classes continued through the end of World War II. By mid-1946, however, the airfield was placed on a reduced operational status and flying activities decreased. The installation was deactivated in May 1947. The types of aircraft stationed at Cannon AFB from 1942 to 1947 included B-17, B-24, and B-29 heavy bombers.

The base was reassigned to the Tactical Air Command in July 1951. The first unit, the 140th Fighter-Bomber Wing, arrived in October of that year. The airfield was formally reactivated in November 1951 as Clovis Air Force Base. Between 1952 and 1957, the 50th and 388th Fighter-Bomber Wings were activated, and, upon their transfer, were replaced by the 312th and 474th Groups. Predominant aircraft stationed at Cannon AFB from 1951 to 1957 included the P-51 "Mustang" fighter and the F-86 "Sabre" fighter jet.

In June 1957, the base became a permanent installation and was renamed Cannon Air Force Base in honor of the late General John K. Cannon, a former commander of the Tactical Air Command. In October 1957, the 312th and 474th Fighter-Bomber Groups were redesignated tactical fighter wings and the 832nd Air Division was activated to oversee their activities.

In 1959, the 312th Tactical Fighter Wing (TFW) was deactivated and replaced at Cannon AFB by the 27th TFW. In December 1965, the base's mission changed to that of a replacement training unit, and the 27th TFW became the largest such unit in the Tactical Air Command. The predominant aircraft stationed at Cannon AFB from 1957 to 1965 was the F-100 "Super Sabre" fighter jet.

The 832nd Air Division was deactivated in July 1975, leaving the 27th TFW the principal Air Force unit at Cannon AFB. In early 1981, the 27th TFW was designated a Rapid Deployment Joint Task Force member.

The primary mission of Cannon AFB has remained relatively unchanged since 1965; i.e., to develop and maintain an F-111 tactical fighter wing capable of day, night, and all-weather combat operations and to provide replacement training of combat aircrews for tactical organizations worldwide. Aircraft stationed at Cannon AFB since 1965 include the F-100 "Super Sabre" fighter jet (1957-1969), the F-111A (1969), the F-111E (1969-1971) and the F-111D (1971-present). There are approximately 70 F-111D aircraft assigned to Cannon AFB. The total work force on Cannon AFB numbers approximately 4,000, which includes 3,500 military and 450 civil service.

In 1992, Cannon AFB became part of the Air Combat Command (ACC) as the result of the overall realignment of Air Force Commands and the ongoing downsizing of the U. S. Military.

1.5 PREVIOUS INVESTIGATIONS

Prior to this RFI, investigative activities completed at Cannon AFB include the following:

- IRP Records Search - CH2M Hill - 1983
- Preliminary Review/VSI Report - RCRA Facility Assessment - A.T. Kearney - 1987
- RCRA Facility Investigation Work Plan for 27 SWMUs - Lee Wan and Associates, Inc. - 1990
- RI Investigation - Appendix I SWMUs - W-C - 1991-1992 (18 SWMUs called "First Third")

- RFI - Landfills 1 and 2 - W-C - 1992-1993

- RFI - Appendix II SWMUs - through USACE, Albuquerque, NM - 1993

Concurrently with the RFI on Appendix III SWMUs, W-C is completing Phase II RFI activities at the Old Entomology Rinse Area and at Landfill 5 under separate task orders. Investigations are also being completed at Landfills 3 and 4 and at Landfill 25.

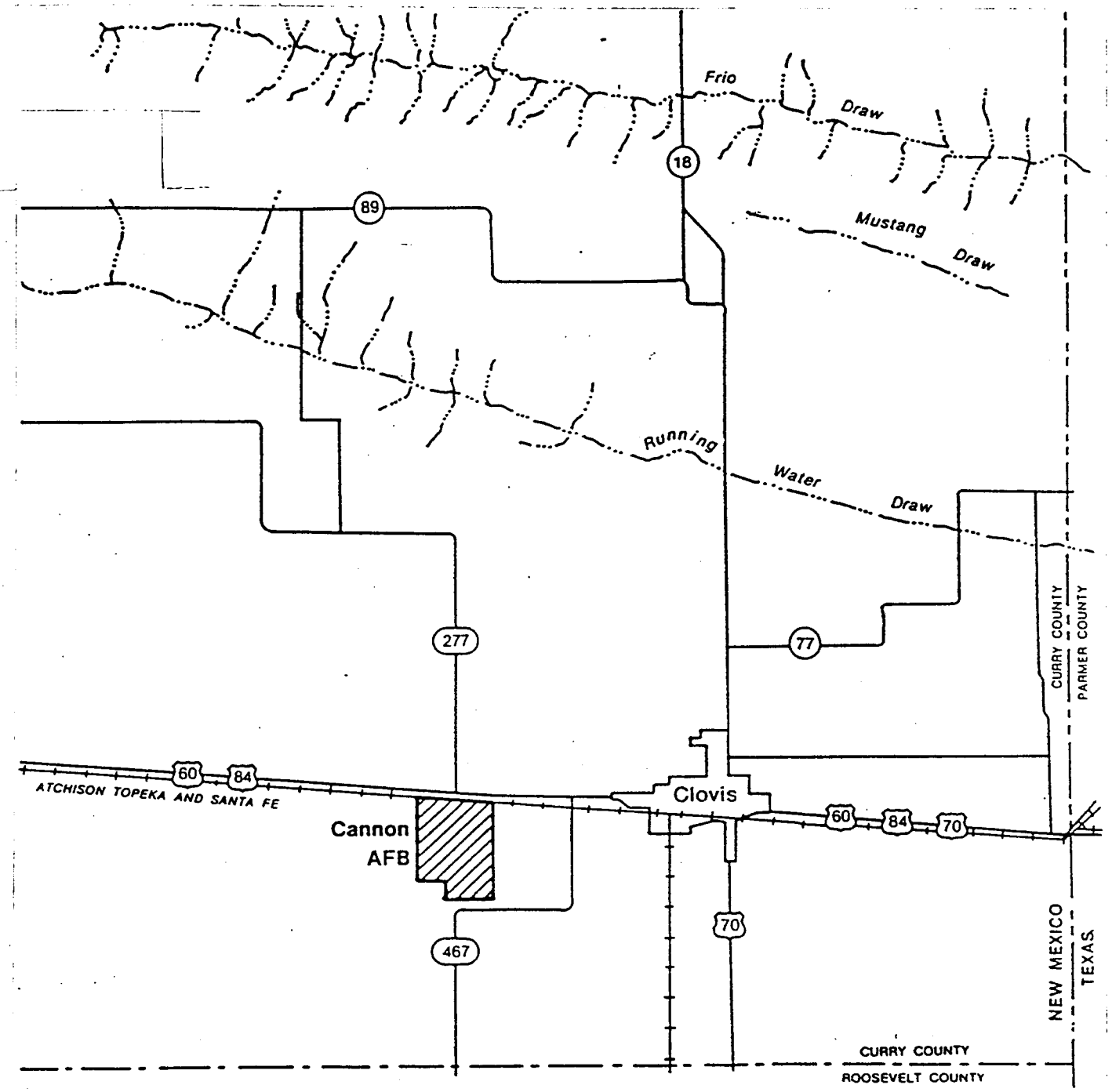
1.6 ORGANIZATION OF REPORT

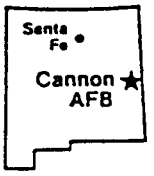
The report is organized as shown in the table of contents, reporting activities and recommendations essentially in the order they were completed. The discussion of results and recommendations for each individual SWMU are presented (one site per section) in Sections 6.0 through 19.0, and the recommendations are recapped in summary form in Section 20.

TABLE 1-1

LIST OF APPENDIX III SWMUs

Site	SWMU Number
AGE Maintenance Shop	31
Oil/Water Sep #196	46
Oil/Water Sep #494	47
Oil/Water Sep #375	51
Oil/Water Sep #379	57
Oil/Water Sep #5077a,b,&c	61, 62, 63
Oil/Water Sep #326	70
Oil/Water Sep #5120	92
Oil/Water Sep #5121	93
Oil/Water Sep #5144	94
Oil/Water Sep #4095	127
Lead/Acid Battery Area	55
CE Container Storage Area	77
Wastewater Playa Lake	103





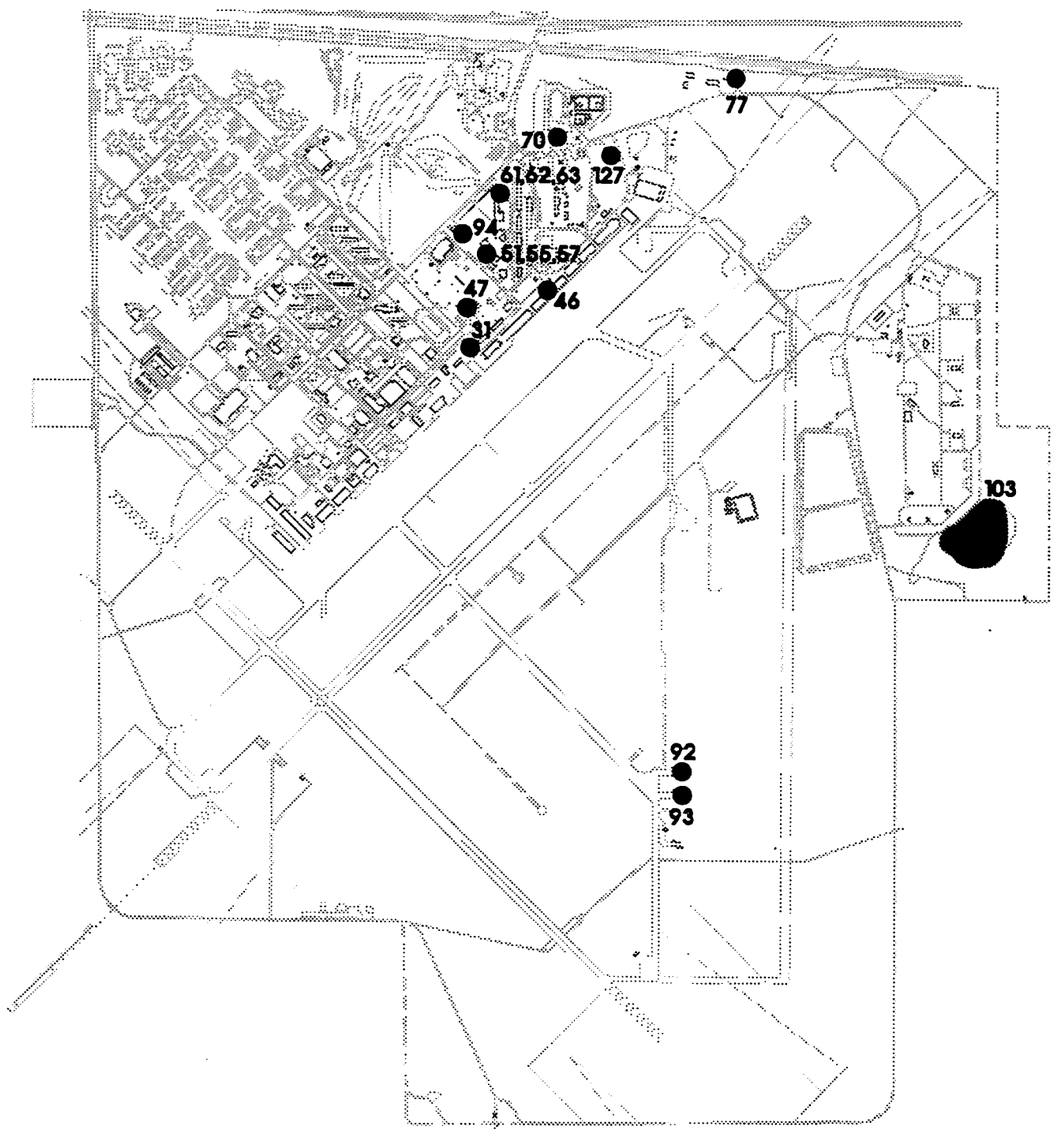
0 5
MILES

SOURCE: FINAL REPORT, IRP PHASE II

N

DRN BY: JTA/SCR	DATE: 08/18/93	VICINITY MAP CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W	FIG. NO. 1-1
CHK'D BY:	DATE:			

CAD FILE: FS8X11.DWG 08/18/1993 15:55



LEGEND

31 ● SOILD WASTE MANAGEMENT UNIT (SWMU) LOCATION AND NUMBER

SWMU No.	DESIGNATED AREA
31	AGE MAINTENANCE SHOP PAD
46	OIL/WATER SEPARATOR No. 196
47	OIL/WATER SEPARATOR No. 494
51	OIL/WATER SEPARATOR No. 375
55	LEAD ACID BATTERY ACCUMULATION POINT
57	OIL/WATER SEPARATOR No. 379
61	SAND TRAP No. 5077a
62	SAND TRAP No. 5077b
63	OIL/WATER SEPARATOR No. 5077c
70	OIL/WATER SEPARATOR No. 326
77	CIVIL ENGINEERING CONTAINER STORAGE AREA
92	OIL/WATER SEPARATOR No. 5120
93	OIL/WATER SEPARATOR No. 5121
94	OIL/WATER SEPARATOR No. 5144
103	WASTEWATER PLAYA LAKE
127	SAND TRAP AT POL WASHRACK

N

2000 1000 0 2000

SCALE IN FEET

DRN. BY: CJG	DATE: 08/16/93	SITE PLAN AND LOCATION OF INVESTIGATED SWMU SITES CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W	FIG. NO. 1-2
CHK'D. BY:	REVISION: 0			

2.0
CANNON AFB FACILITY DESCRIPTION

2.1 SETTING - PHYSICAL GEOGRAPHY

Cannon AFB is situated in the Southern High Plains Physiographic Province in the Llano Estacado subprovince. 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 (W-C 1991).

2.2 DEMOGRAPHICS AND LAND USE NEAR CANNON AFB

Cannon AFB is located just south of U.S. Highway 60-84 in a farming and ranching area (Figure 1-1). The majority of the land surrounding Cannon AFB is productive, irrigated farmland or grassland. The major crops are wheat, sorghum, sugar beets, corn, cotton, alfalfa, barley, and peanuts. The land is also used for cattle grazing, both beef and dairy, and Clovis is considered the "Cattle Capital of the Southwest." There were 32,767 people living in Clovis in 1990, while the Cannon AFB population was estimated to be 4,650 in 1990 (W-C 1991).

2.3 CLIMATOLOGY

The climate of east-central New Mexico is classified as tropical semi-arid, with summer temperature and precipitation maxima. Average monthly temperatures range from a January low of 12°C (39°F) to a July high of 26°C (78°F). Extreme daily temperatures range from -24°C (-11°F) to 41°C (106°F) (Lee Wan and Associates 1990b). Average monthly precipitation ranges from 1 cm (0.4 inches) in winter to 6.9 cm (2.7 inches) in July (AWS 1986). The maximum recorded 24-hour rainfall is 12.2 cm (4.8 inches), which occurred in August. Rainfall occurs on eight or more days per month during the summer precipitation maximum. Mean annual precipitation is approximately 41 cm (16 inches). The mean annual evapotranspiration rate is 181.4 cm/yr (71.4 inches/yr) (Lee Wan and Associates 1990b). Prevailing winds are from the west at an average of 5 k/hr (3.1 mph) during fall, winter, and spring. During the summer, winds are from the south at an average of 3.7 km/hr (2.3 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 break up, and solar heating of the earth's surface causes vertical mixing in the atmosphere.

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 (average 5 k/hr) (W-C 1991).

2.4 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 as shown in Figure 2-1.

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 nonconformity having relief of up to several hundred feet (Lee Wan and Associates 1990b).

Overlying the Dockum Group redbeds is the Ogallala Formation. 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 feet to 415 feet in thickness. The incised upper surface of Triassic redbeds strongly influences Ogallala thickness. Stream valleys in the post-Triassic nonconformity are deep and trend dominantly east-west. 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 (1990b), 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 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 deposit. 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 1990b). As reported by Lee Wan and Associates (1990b), five zones have been distinguished within the Ogallala of east central New Mexico on the basis of clay minerals. Smectites (montmorillonites) and attapulgite (with sepeotite) 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.

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 2-1. 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. As reported in Lee Wan and Associates (1990b) radiocarbon dates for the upper "climax" caliche range from ~27,000 yrs. Before Present (B.P.) to ~42,000 yrs. B.P.

Caliche is relatively soluble in acidic water (pH < 7) or in waters containing dissolved CO_2. 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 uppermost caliche, termed the "climax" caliche, is pisolitic (Lee Wan and Associates 1990b). 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 may be thin or absent below playas (W-C 1991).

2.5 HYDROGEOLOGY

The lower portion of the Ogallala Formation is the primary regional aquifer for both potable and irrigation water. No deeper aquifers are utilized 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 (Lee Wan and Associates 1990b). The Ogallala aquifer has a southeasterly regional gradient of about 13 feet/mile. 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 1990b). Water quality is generally good, with hardness and fluorides being somewhat high (Lee Wan and Associates 1990b).

At Cannon AFB, the Ogallala aquifer has an average saturated thickness of 120 feet based on mid-1960s data. Saturated thickness ranges from 93 to 143 feet, and is influenced by the configuration of the erosional nonconformity surface marking the top of the Dockum Group. The local groundwater gradient is southeasterly at 7.5 feet/mile (Lee Wan and Associates 1990a). Figure 2-2 shows water table elevation contours for 1984. 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 776 l/min (205 gpm) to 4,353 l/min (1150 gpm). Specific capacities range from 0.14 m^3/m (11.4 gal/feet) to 0.35 m^3/m (27.9 gal/feet) (Lee Wan and Associates, 1990b).

Very rough estimates of hydraulic conductivity were made from well pump tests in water wells 5 and 9 (Figure 2-3) using the Theis equation. An estimate of hydraulic conductivity for water well 8 was based on water level recovery data using the Bouwer and Rice approach (Lee Wan and Associates 1990b). 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 first approximations.

Hydraulic conductivity values for water wells 5 and 9 were found to be approximately 2.0×10^{-3} 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. As reported in Lee Wan and Associates (1990b) a groundwater flow velocity of about 45 m/yr (150 feet/yr) has been estimated. This calculates out to a hydraulic conductivity of approximately 1.0×10^{-1} cm/sec. Again, this appears to be low when compared with published data (Freeze and Cherry 1979).

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 1990b) indicated that interstitial and interstratified clays are abundant in the Ogallala Formation. Additional aquifer testing will be required if it becomes necessary to more accurately determine hydraulic conductivity.

Recharge to the Ogallala is primarily through precipitation. As reported in Lee Wan and Associates (1990b), a recharge rate of 0.5 inches/year as calculated using the Theis equation. Lee Wan and Associates (1990b) reported that the recharge rate may be as much as 1.0 inches/yr. 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 allows deep percolation to the aquifer. The occurrence of this process is evidenced by the presence of clay deposits in, and thin or nonexistent caliche layers directly below, playas. Caliche is soluble in acidic rain waters, and is leached over time to form percolation pathways.

Discharge from the Ogallala 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 the rate of recharge. Water levels in the Ogallala have declined steadily from the 1930s to the present. A decline of 50 to 100 feet has been observed in the area around Clovis, New Mexico for the period from the 1930s to 1980. Lee Wan and Associates (1990b), states "the largest area of water level decline exceeding 100 feet occurs south of the Canadian River extending from Curry Co., New Mexico to Crosby Co., Texas."

The dominant uses of groundwater in the Cannon AFB area are for potable and irrigation water. Numerous wells are found in the Cannon AFB area, most of which provide only irrigation water (Figure 2-3).

The Ogallala 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 (W-C 1991).

2.6 SOILS

Soils in the vicinity of Cannon AFB are classified as SM to SC under the Unified Classification Systems, and as aridisols (calciorthids) under the Soil Conservation Service Comprehensive Soil Classification System. The following summary is based on the Soil Conservation Service Curry County Soil Survey as reported in Lee Wan and Associates (1990b).

The most common soil type on the base is the Amarillo fine sandy loam, 0 to 2 percent slope phase (map symbol Ab Figure 2-4). 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 Amarillo fine sandy loam is present on all relatively flat surfaces at the base, but is also found on slopes associated with playas (map symbol Ac).

Clovis fine sandy loams, 0-2 percent slope phase (map symbol Cb) and 2-5 percent slope phase (map symbol Cc), are very similar to Amarillo fine sandy loams. 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 M6) are found. Mausker fine sandy loams have no B horizons and are very calcareous. The calcic C horizon is within 2 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 (Lee Wan and Associates 1990b).

2.7 BACKGROUND SOIL AND WATER QUALITY

The natural soils in the vicinity of Cannon AFB are alkaline and rich in metals in general. Typically high concentrations of aluminum, iron, magnesium, Manganese, and potassium combine with elevated levels of many other metals in the natural soils. Calcium is naturally present in the soils at levels up to nearly 200,000 mg/kg. Tightly cemented layers of "caliche" are present in several horizons in the natural soils and the Ogallala aquifer below.

The uppermost groundwater aquifer is the Ogallala, and the groundwater is more than 200 feet deep. The groundwater from the lower portions of the aquifer is used for drinking water and irrigation and industrial applications. No deeper aquifers are utilized in the vicinity of Cannon AFB. The water quality is generally good, with dissolved solids ranging from 250 to 500 mg/L (Gutentag et al. 1984) and fluorides ranging from 2.2 to 2.7 mg/L (William Matotan and Associates, Inc. 1985).

The background levels of inorganic compounds in soil at Cannon AFB are presented in Table 2-2 in the form of a mean value and statistical information on the ranges encountered for each element.

The general water quality from the Ogallala aquifer over a broad region is presented in Table 2-3, and water quality data for samples from production wells and monitoring wells within the bounds of Cannon AFB are presented in Table 2-4.

These tables of background data have been adapted from a draft report by Woodward-Clyde dated March 1993 entitled "Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater at Cannon Air Force Base, Clovis, New Mexico". This report summarizes background data for soil and groundwater from numerous past investigations in the vicinity.

The mean values and upper tolerance limits (UTLs) presented in Table 2-2 are the background levels used in the screening of soil chemical results for this RFI. In addition to comparison to the UTL of the basewide background data (which is necessarily from a limited data set), other sources of naturally-occurring metals concentrations, such as USGS (1984), were considered when determining whether metals concentrations are within background levels.

2.8 BIOLOGICAL RESOURCES

Land adjacent to Cannon AFB is primarily used for agriculture, and there is little natural vegetation remaining in the area. The wildlife species that are common to agricultural areas throughout the region include bobwhite quail and pheasant. There are a few playa lakes in the area; these 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 (W-C 1991).

2.8.1 Plant Resources

The climate of the Base area is considered to be 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 Base. Woodlands composed of large shrubs and small trees are confined to riparian areas and playa lakes in the vicinity (W-C 1991).

The following plants are candidate species for the Federal List of Endangered and Threatened Wildlife and Plants and are found within a 50-mile radius of Cannon AFB: chatterbox orchid (*Epipactus gigantea*), spiny aster (*Aster harridus*), Whittmans milkvetch (*Asragalus witmanil*), dune unicorn plant (*Proboscidea sabulosa*), and the tall plains spruce (*Eupjorbia strictior*). The dune unicorn plant is also on the state endangered plant species list. No federally protected endangered plants are known to be present on the Base (Lee Wan and Associates 1990b).

2.8.2 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 utilize the rivers, playa lakes, and reservoirs of the region.

Two National Wildlife Refuges (NWRs) are located on the periphery of the Base area. 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, two federally listed endangered animal species, the bald eagle and peregrine falcon, are known to inhabit the area within a 50-mile radius of Cannon AFB. The New Mexico Department of Game and Fish also indicated that the state endangered Mississippi Kite, Baird's Sparrow, and the Black-Footed Ferret may also occur in the vicinity of the Base. The federal- and state-protected species are listed in Table 2-1.

Within Curry County, the only state-protected bird that is expected to occur is the Mississippi Kite. In New Mexico, since the early 1960s, this kite summers regularly and breeds in the Clovis region. The birds frequent the golf course at Cannon AFB. Two other state-protected birds that may occur within Curry County are the McCown's Longspur and Baird's Sparrow. These two species have not been sighted regularly in recent years, however. No information is available on the McCown's Longspur in New Mexico; however, Baird's Sparrow occurs mainly in autumn during migration in the eastern plains and southern lowlands. 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 the loss of shrubby shortgrass habitats.

State-protected birds known to occur infrequently are the bald eagle and the peregrine falcon. 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 nests 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 breeds statewide in New Mexico, but mainly west of the eastern plains (Source: Draft Environmental Impact Statement - Cannon AFB 1990).

TABLE 2-1

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

Common Name	Scientific Name	Federal Status	State Status
Birds			
Mississippi kite	Ictinia mississippiensis		Endangered (Group 2)
Barid's sparrow	Ammodramus baridii		Endangered (Group 2)
Bald eagle	Haliaeetus leucocephalus	Endangered	Endangered (Group 2)
Peregrine falcon	Falco perigrinus	Endangered	Endangered (Group 1)
Mammals			
Black-footed ferret	Mustela nigripes	Endangered	Possibly Extinct

Endangered (Group 1): Species whose prospects of survival or recruitment within the state are in jeopardy.

Endangered (Group 2): Species whose prospects of survival or recruitment within the state are likely to become jeopardized in the foreseeable future.

Possibly Extinct: Potentially no longer in existence in the state.

Source: Lee Wan and Associates 1990

TABLE 2-2

SUMMARY OF BACKGROUND ELEMENTAL CONCENTRATIONS[1] IN SOIL SAMPLES (2) CANNON AFB, NEW MEXICO

Element	Mean ($\bar{x}$)	Standard Deviation (SD)	95% Tolerance Limits of Background Concentrations[4] ($\bar{x}$)±2SD
Aluminum	5,700	2,420	860 - 10,540
Antimony	6.75[3]	-	-
Arsenic	3.5	6.0	0 - 15.5
Barium	166	238	0 - 642
Beryllim	0.41	0.16	0.09 - 0.73
Cadmium	1.1[3]	-	-
Calcium	69,200	58,600	0 - 186,400
Chromium	6.98	2.78	1.42 - 12.5
Cobalt	2.5	1.0	0.5 - 4.5
Copper	5.40[3]	-	-
Iron	4,780	1,970	840 - 8,720
Lead	7.12	9.35	0 - 25.8
Magnesium	4,650	3,570	0 - 11,790
Manganese	72.0	46.0	0 - 164
Mercury	0.11[3]	-	-
Nickel	5.0	2.0	1.0 - 9.0
Potassium	1,360	606	148 - 2,572
Selenium	8.23[3]	-	-
Silver	1.2[3]	-	-
Sodium	514[3]	-	-
Thallium	0.50[3]	-	-
Vanadium	14.9	5.20	4.50 - 25.3
Zinc	11.3	5.29	0.72 - 21.9

[1] All concentrations are in milligrams per kilogram (mg/kg).
[2] Compiled from data collected by W-C for the RFI and RI (W-C 1992 and W-C 1993) and Walk, Haydel & Associates for the IRP (Walk, Haydel & Associates 1990).
[3] These mean values are determined from a set of numbers including some reporting limits for nondetect results. The actual mean background concentrations are likely less than these values.
[4] Values are equivalent to 95% upper and lower tolerance limits of background concentrations.

TABLE 2-3

REGIONAL WATER QUALITY[1] - OGALLALA AQUIFER[2]

	Sherman Co. Nebraska	Laramie Co. Wyoming	Red Willow Co. Nebraska	Kit Carson Co. Colorado	Kiowa Co. Colorado	Stanton Co. Kansas	Meade Co. Kansas	Union Co. New Mexico	Roberts Co. Texas	Gaines Co. Texas	Gaines Co. Texas	Mean ($\bar{x}$)
Silica	63	28	58	36	22	20	23	38	27	58	64	40
Calcium	94	45	56	30	228	51	63	56	46	72	231	88
Magnesium	14	5.5	15	10	114	20	19	34	18	20	225	45
Sodium and Potassium	21	6.4	19	27	226	35	245	17	37	44	845	138
Bicarbonate	336	157	200	181	184	180	210	215	243	221	282	219
Sulfate	18	6.5	13	10	1,170[5]	8.1	94	49	32	104	1,351[5]	260
Chloride	18	2.8	3.9	3.0	143	30	350[5]	46	28	43	1,109[5]	162
Fluoride	---	0.4	0.8	1.8	4.0[5]	1.4	1.0	1.6	0.8	1.5	4.0[5]	1.6
Nitrate	7.6	7.0	---	7.6	3.9	12[5]	1.7	24[5]	3.9	5.6	4.2	7.0
Dissolved Solids	403	191	273	214	2,140[5]	339	900[5]	372	312	507[5]	3,970[5]	875
pH[3]	7.7	7.4	7.7	8.0	7.7	7.6	7.7	7.4	8.0	7.3	7.4	7.6
Specific Conductance[4]	605	281	420	325	2,630	555	1,650	628	507	675	5,350	1,240

1) Concentrations are in milligrams per liter mg/L) unless otherwise indicated
2) Source: Krothe, et al. 1982
3) pH units
4) Micro mhos µmhos)
5) Exceed U.S. Environmental Protection Agency Regulations (1976, 1977)

TABLE 2-4

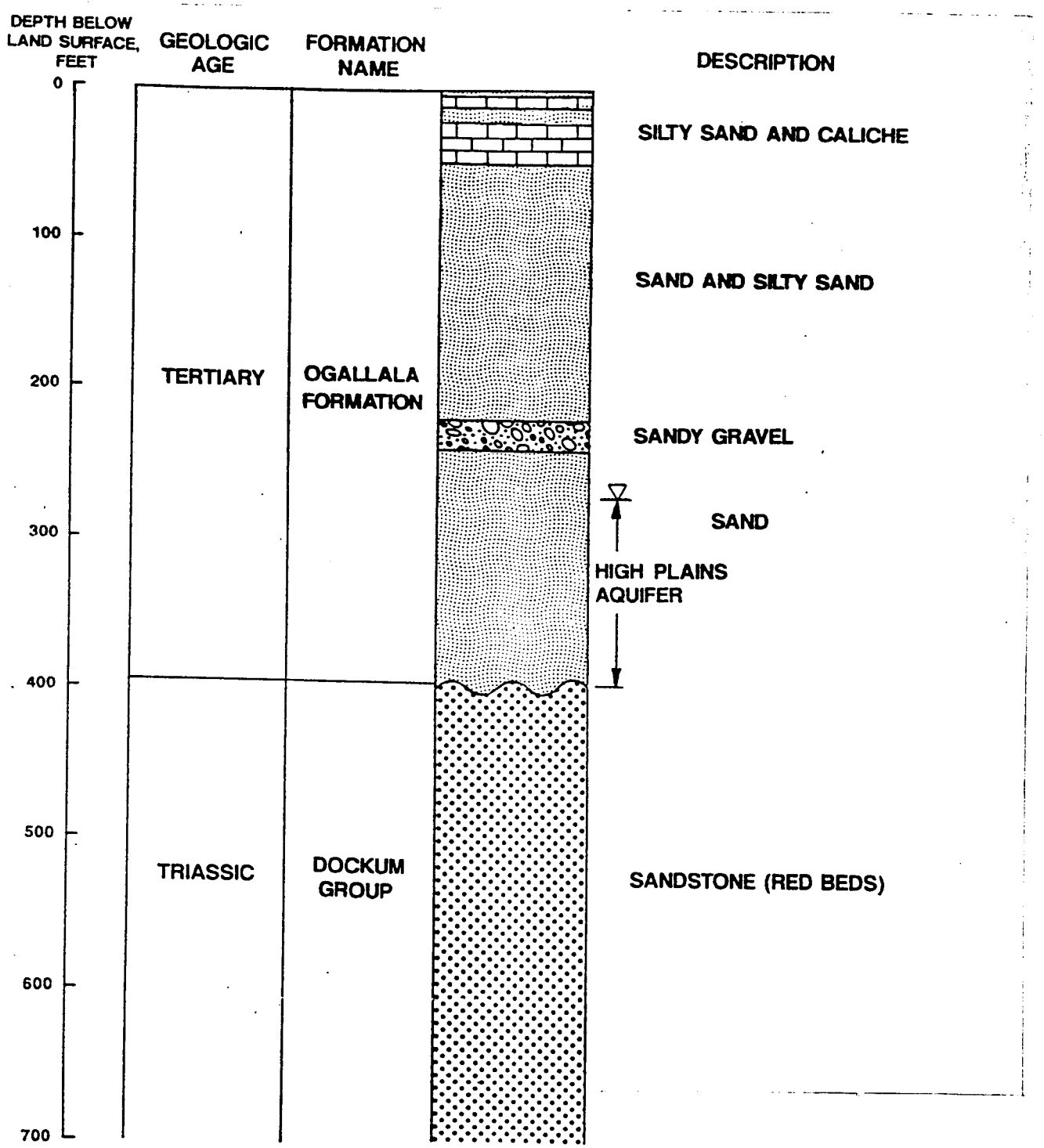
WATER QUALITY SUMMARY[1] FOR CANNON AFB PRODUCTION WELLS AND MONITORING WELLS

	Minimum	Maximum	Mean	MCL[2]
Antimony	0.06U	0.06U	0.06[5]	0.01/0.005[3]
Arsenic	0.005U	0.05U	0.02[5]	0.051
Barium	0.022	0.2	0.50[5]	1.0
Beryllium	0.002U	0.002U	0.002[5]	0.01[3]
Cadmium	0.005U	0.01U	0.0008[5]	0.005[3]
Chloride	42	63.5	52.2	250
Chromium	0.01U	0.001	0.04[5]	0.01
Cobalt	0.01U	0.01U	0.01[5]	*
Copper	0.01U	0.02U	0.012[5]	1.0[4]
Cyanide	0.005U	0.005U	0.005[5]	0.2
Fluoride	1.8	2.6	2.3	2
Lead	0.005U	0.05U	0.015[5]	0.05
Manganese	0.00	0.01U	0.0075[5]	0.05
Mercury	0.0002U	0.003	0.001[5]	0.002
Nickel	0.04U	0.032	0.04[5]	1.0[3]
Nitrate	0.9	6.6	1.8	10.0
Selenium	0.01UJ	0.0049J	0.01[5]	0.05
Silver	0.01U	0.05U	0.02[5]	1.0[4]
Sulfate	115	132	125	250
Thallium	0.01U	0.01U	0.01[5]	0.022/0.001[3]
Tin	0.1U	0.1U	0.1[5]	*
Uranium	0.0036	0.0062	0.0046	5.0
Vanadium	0.02	0.031	0.026	*
Zinc	0.0041J	0.09	0.05	5.0
TDS	385	479	451	500
pH (units)	7.5	7.95	7.78	6.5 - 8.5

MCL = Maximum contaminant level
UJ = Estimated as non-detect at the CRQL
J = Estimated value
U = Not detected
CRQL = Contract Required Quantitation Limit

* No primary or secondary MCL or proposed MCL as of March 1992

[1] All concentrations are in milligrams per liter (mg/L). Values calculated from historical data for Cannon AFB wells 1, 2, 3, 4, 7, 8, 113A, and 101E for period from 1966 through 1991.
[2] Primary MCL in effect as of July 30, 1992
[3] Proposed primary MCL
[4] Secondary MCL in effect as of July 30, 1992
[5] Detection limits (using one times the value) were also used to calculate means.



LEGEND

LITHOLOGIC CONTACT

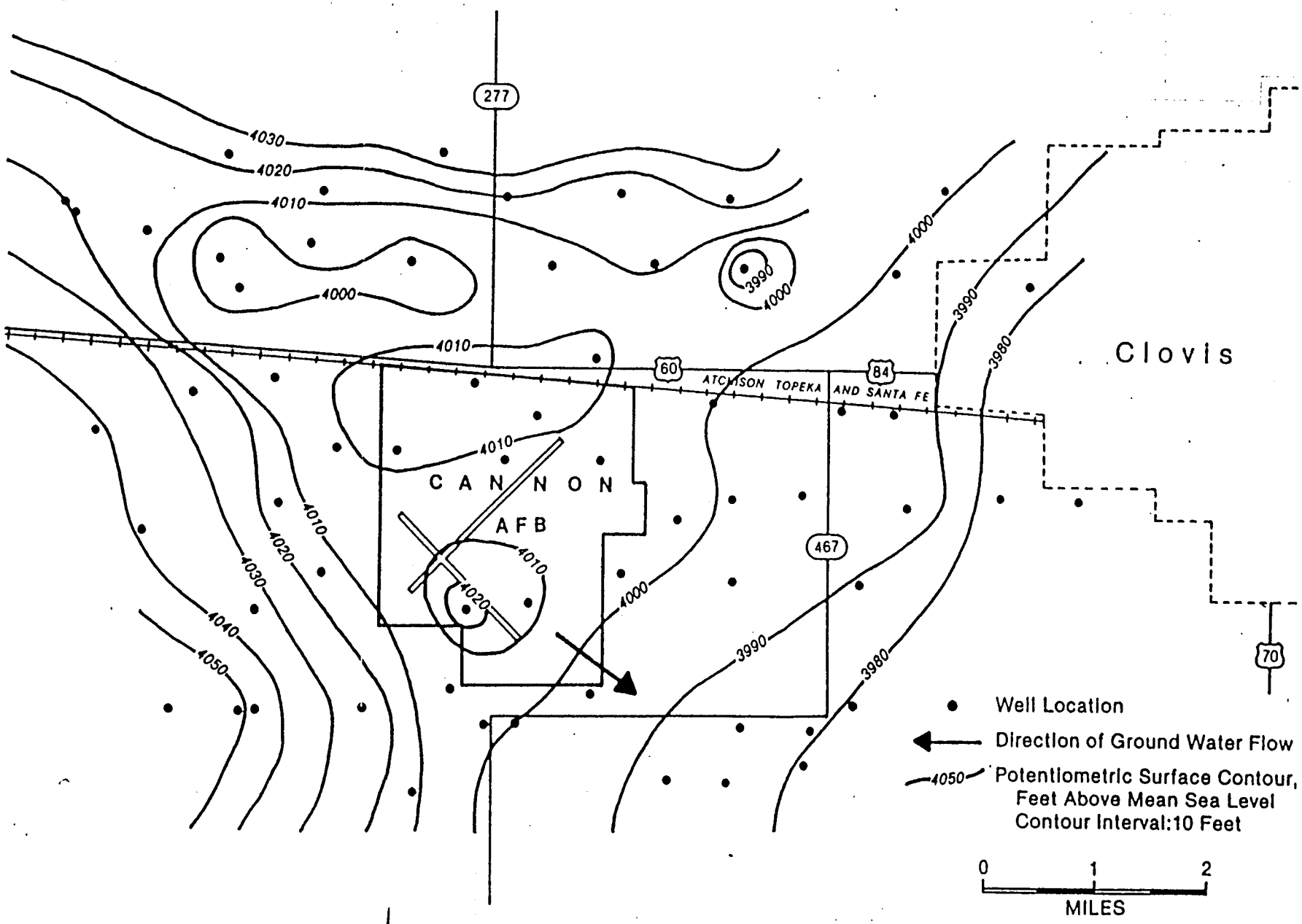
UNCONFORMITY

WATER LEVEL

SOURCE: MODIFIED FROM GUTENTAG ET.AL., 1984

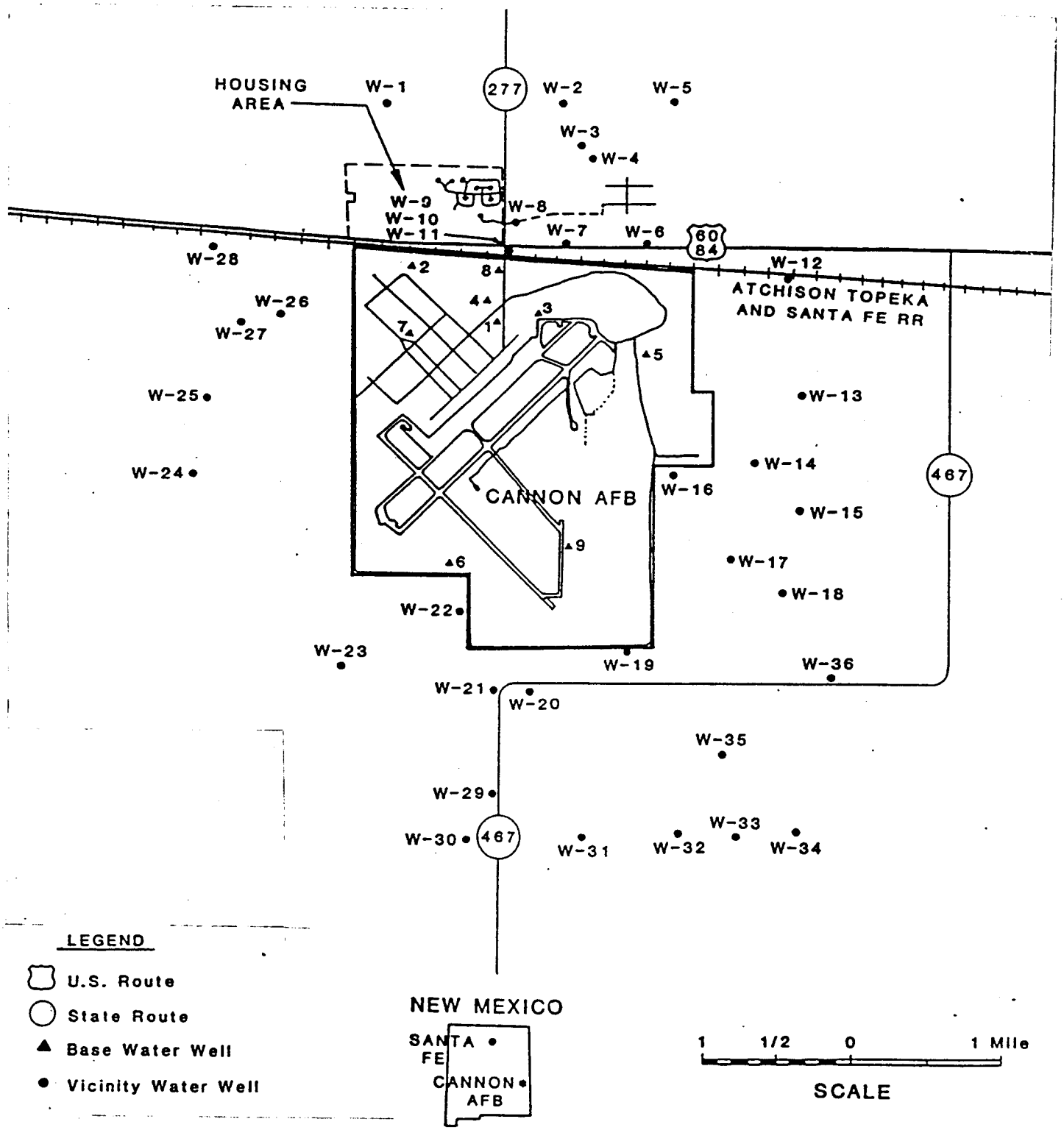
DRN BY: LLG/SCR	DATE: 08/18/93	GENERALIZED GEOLOGIC STRATA AT CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W	FIG. NO. 2-1
CHK'D BY:	DATE:			

CAD FILE: 1311X8.DWG 08/18/1993 11:19



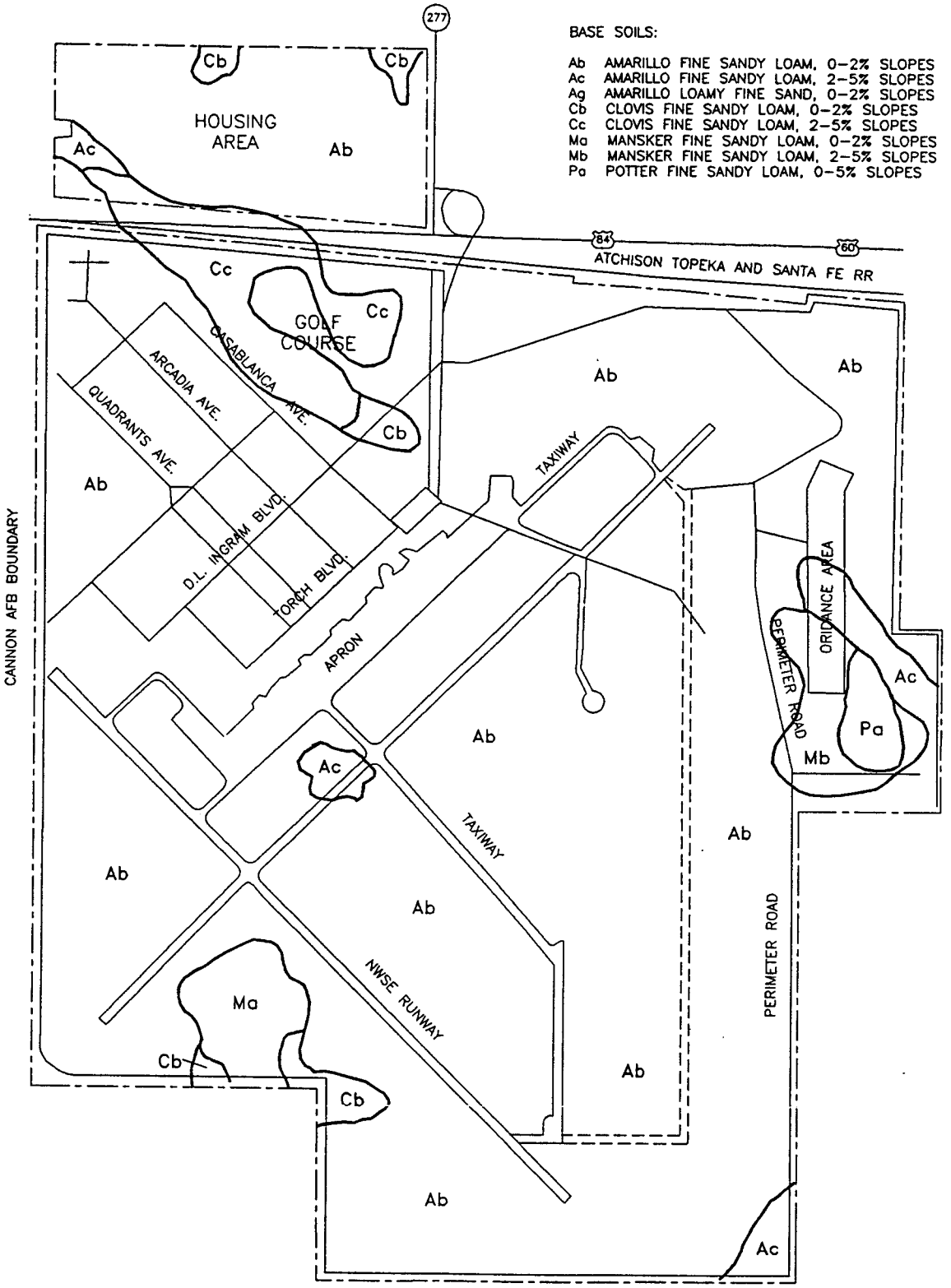
SOURCE: FINAL REPORT, IRP PHASE II

DRN BY: JTA/SCR	DATE: 08/18/93	POTENTIOMETRIC SURFACE CONTOUR MAP, VICINITY OF CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W	FIG. NO. 2-2
CHK'D BY:	REVISION: 0			



BASE MAP ADAPTED FROM: FINAL REPORT, IRP PHASE II

DRN BY: JTA/SCR	DATE: 08/18/93	WATER WELL LOCATIONS ON AND NEAR CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W	FIG. NO. 2-3
CHK'D BY:	DATE:			



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

N

2000 1000 0 2000

SCALE IN FEET

DRN BY: SCR	DATE: 08/18/93	DISTRIBUTION OF SOILS, BY TYPE CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W	FIG. NO. 2-4
CHK'D BY:	DATE:			

3.0
RCRA FACILITY INVESTIGATION APPROACH

3.1 RFI OBJECTIVES AND APPROACH

The specific objectives of the RFI at Cannon AFB are to:

- Characterize the physical setting and nature and extent of potential hazardous wastes associated with each SWMU

- Evaluate the data collected to identify potential migration pathways and feasible potential corrective measures

- Perform a Screening-Level Risk Assessment to evaluate human health risks associated with chemicals found at each SWMU (Note: A Baseline Risk Assessment will be required to support final recommendations on sites not eliminated by the screening-level assessment)

- Develop recommendations for each SWMU regarding further investigation thru corrective measures studies or, where supported by the findings of the RFI, no further action.

The RFI has been completed in accordance with EPA Guidance outlined in "RCRA Facility Investigation (RFI) Guidance, Volumes 1-4, EPA 530/SW-89-031, May 1989". The investigation incorporated the use of the Data Quality Objectives (DQO) Process to establish data quality requirements appropriate for the intended use of the data (USEPA 1987).

3.2 METHODOLOGIES - INITIAL EVALUATION

The program approach for the RFI for the 16 Appendix III SWMUs at Cannon AFB is to review known information including results of past investigations, become familiar with past and present operations and the physical setting at each SWMU, then through use of the Data Quality Objectives Process, identify data needs and formulate a sampling plan to collect the

necessary data for each SWMU. The rationale for sampling locations, number of samples and analytical parameters are presented in the Work Plan and in the Field Sampling Plan. Samples taken are listed in tables in sections 6.0 thru 19.0. A discussion of the Data Quality Objectives (DQO) process and how it was used in the RFI is presented in the following section.

3.2.1 Data Quality Objectives (DQOs) Process

3.2.1.1 Purpose of Data Quality Objectives

DQOs are quantitative and qualitative statements derived from the outputs of each step of the DQO process that:

- clarify the study objectives;
- define the most appropriate type of data to collect;
- determine the most appropriate conditions from which to collect the data; and
- specify the required decision accuracy parameters that will be used as the basis for establishing the quantity and quality of data needed to support the decision.

The DQOs are then used to develop a scientific and resource-effective sampling design.

3.2.1.2 Data Quality Objectives Process

The DQO process is a series of planning steps based on the Scientific Method that is designed to ensure that the type, quantity, and quality of environmental data used in decision making are appropriate for the intended application.

The DQO process was developed by the EPA to help Agency personnel avoid collecting data that are inconsequential to decision making. The process allows the decision makers to define their data requirements and acceptable levels of decision errors during planning, before they

collect the data. Application of the DQO process should result in data collection designs (sampling plans) that will yield results of appropriate quality for defensible decision making.

The DQO process consists of a number of steps and is often divided into three stages as illustrated in Table 3-1. The DQO process is integrated with development of the sampling and analysis plans and will be revised, as needed, based upon the results of each data collection activity. This process is outlined below.

Stage 1 - Identify Decision Types (Initial Evaluation)

Stage 1 of the DQO process identifies the individuals responsible for decisions, data uses, and available data; determines if additional data is needed; and identifies the types of decisions which will be made regarding site remediation. Available information on each SWMU at Cannon AFB has been compiled and analyzed to describe suspected sources, contaminant pathways, and potential receptors. Stage 1 results in the specification of the decision making process, identification of why additional data is needed, and sets the foundation for Stages 2 and 3 of the DQO development process as shown in Table 3-1.

Stage 2 - Identify Data Uses/Needs (Work Plan Rationale)

Stage 2 specifies the data (quantity/quality) necessary to meet the objectives set in Stage 1. This stage stipulates criteria for determining data adequacy. Stage 2 includes selection of the sampling approaches and the analytical options used for the site.

Stage 3 - Design Data Collection Program

Stage 3 specifies how to assemble data collection components and develop data collection documentation. Methods have been specified by which acceptable data was obtained to make decisions. This information was provided in the sampling and analysis plans.

3.2.1.3 Integration of Data Quality Objectives with the Sampling and Analysis Plan and the Quality Assurance Plan

During Stage 2 of the DQO process, specific DQOs were developed based on media or sample activity. The intent of Stage 3 was to compile the information and DQOs developed for specific tasks into a comprehensive data collection program. The output of the DQO process is a well-defined sampling and analysis plan with summary information provided in the work plan. The sampling and analysis plan identified the individuals responsible and the procedures for field activities and sample analysis.

The DQO process also develops the requirements for assessing the quality of any data in the RFI program and determines data acceptability according to the RFI requirements. This review is the process of data acceptance and management and is addressed in the Quality Assurance Project Plan and the Data Management Plan (DMP).

The three-stage DQO process was used to define the data objectives, specific task objectives, and quality assurance objectives for the Cannon AFB RFI as discussed in below.

3.2.2 Past Waste Management Practices

Information regarding specific past waste management practices for Cannon AFB is contained in past investigation reports and a summary of those practices is presented here as they relate to the 16 Appendix III SWMUs investigated in this RFI. A list of the SWMUs (identified during the USEPA RCRA Facility Assessment) being investigated is shown in Table 1-1 and SWMU locations are shown on Figure 1-2. A more detailed description of past waste management practices and potential contaminants are discussed on a SWMU-by-SWMU basis in this Report. In general, base waste management activities included:

- Solid and hazardous waste disposal in landfills
- Fire training exercises using aircraft fuels
- Wastewater treatment activities
- Landfarming of fuel tank bottom sludges
- Collection of spent materials from aircraft engine testing/cleaning

- Disposal of industrial and sanitary wastewater potentially containing spent cleaning agents/oils into the sanitary sewer which ultimately discharged to the Playa Lake (SWMU #103)

The waste management practices that relate to the Appendix III SWMUs can be used to divide the SWMUs into five categories as follows:

- **Ten Sites with OWSs** to remove petroleum products and other Light Nonaqueous-Phase Liquids (LNAPLs) from washwater or storm water prior to discharge to a sewer. The objective is to investigate the potential soil contamination (and groundwater, if appropriate) that could have resulted from a release of these materials through spillage, overflow, or leakage of the separator.

- **The AGE Maintenance Shop Building Pad** (SWMU 31), where servicing of equipment may have created a release of petroleum products into the soil below.

- **The Lead/Acid Battery Storage Area** (SWMU 55), where lead acid batteries could have released their fluid into the ground.

- **Civil Engineering Container Storage Area** (SWMU 77), where a variety of materials have been stored over the years and could have been released to the soil below.

- **The Wastewater Playa Lake** (SWMU 103), which has been the main receptor of industrial wastewater and sewage since the beginning of base operations in 1942. This playa now receives overflow from the wastewater lagoons, runoff from storm water on nearby soils, and it is used by a neighboring farmer for irrigation purposes.

Each of the above categories of waste disposal practices will be discussed further in Sections 6 through 19.

3.2.3 Behavior Of Contaminant Plumes

The "pendant plume" model of contaminant migration in a semi-arid region with a deep unconfined water table forms the conceptual basis for soil and groundwater sampling at Cannon AFB (Kearney, 1987). Site-specific sampling plans are designed to account for the presence of clays, caliche, and release quantities. The pendant plume model for subsurface contaminant mitigation is discussed below in more detail.

The behavior of contaminants in unsaturated clay-rich sediments and soils is a complex physicochemical process. Due to the depth to the water table (>200 ft) and lack of precipitation and water infiltration as a contaminant carrier, only large or continuous releases of liquid contaminants may be expected to reach the water table. The presence of low permeability (but not impermeable) caliche layers, as well as chemically active (i.e., high Cation Exchange Capacity [CEC]) clays, will also act to impede contaminant migration. Capillarity will also have a role in attenuating contaminant migration. As illustrated in Figure 3-1, a relatively small contaminant release will tend to form a "pendant plume". A pendant plume extends downward from the release site with little lateral spread. Downward migration will continue until capillarity and clay adsorption eliminates free liquids (i.e., liquids which can be drained rapidly by gravity. Pendant plumes may spread laterally if low permeability layers are encountered during downward movement (Figure 3-1) . However, in the absence of a carrier fluid such as water, lateral spread will be severely limited.

Relatively large plumes may not be fully attenuated by caliche or clays and may reach the water table. Figure 3-1 illustrates this situation. In this instance, a water table with a low gradient could limit the rate of migration.

Caliche, as a low-permeability barrier, will act to retard downward movement of the contaminant plume. However, lateral spreading immediately above the caliche layer may occur. As a rule of thumb, a difference of permeability of two orders of magnitude or more will provide an effective barrier in the absence of significant head differences. While the vertical migration pathway provides a significant change in head, if generally small quantities of liquids are involved it is unlikely that the liquids would migrate to a great depth through competent caliche given the complex nature of flow in the unsaturated zone. However,

migration along fractures in the caliche, where present, may allow deeper migration in some locations.

Clays, zeolites (e.g., heulandite), metal oxides, and humus are chemically active soil/sediment constituents which can impede or trap migrating contaminants. These particulates have large surface areas and slight to moderate electronegative surface and interlayer charges. Cationic contaminants in water may partition and adsorb to clay or humus. The degree of partitioning depends on clay CEC; amount of humus; types and concentrations of natural and contaminant ions; ionic valency; and the presence of dissolved organic co-contaminants (Matthess 1984). Multivalent cationic metals will tend to strongly sorb to clays. Semivolatile organics may also be sorbed to clays and humus. However, volatile organics such as xylene will not sorb and may actually increase permeability relative to organics. Areas in which fuel releases have occurred will, therefore, typically be sampled to greater depths than areas in which only metals or heavy petroleum are of concern.

3.3 METHODOLOGIES - CONCEPTUAL MODELS

The initial step in the evaluation of each SWMU was the development of an Exposure Pathway Flow Chart (EPFC), which provides a framework for evaluating potential risks associated with the SWMU, aids in the identification of data needs, and assists in the identification of appropriate preliminary remediation goals targeted to significant exposure pathways. The EPFC was used initially to assist in the development of the sampling strategy for each SWMU. Upon completion of the field sampling program, the EPFC was reviewed and modified (if necessary) in order to re-evaluate the SWMU, taking into consideration the analytical results and fate and transport properties of SWMU-related chemicals.

Figures 3-2 through 3-6 show EPFCs with chemical sources and potential human exposure pathways typical of SWMUs studied in this RFI. 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 SWMU-related chemicals of concern occurs. An exposure pathway consists of four 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 transported chemicals (e.g., a domestic drinking water well)

- A human intake mechanism (e.g., inhalation or ingestion) at the point of exposure

All four elements must be present for an exposure pathway to be complete and for chemical exposure to occur. In the EPFCs, 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.

Potential exposure pathways were evaluated with respect to potential chemical sources at each SWMU. Exposure pathways are considered to be potentially complete if there are chemical release and transport mechanisms and identified exposure points and receptors for that exposure pathway. Incomplete exposure pathways do not result in actual exposure to human or environmental receptors and, therefore, do not pose a potential risk. Incomplete exposure pathways are not shown on the EPFCs. Insignificant pathways are those that could conceivably be complete and result in an exposure, but the resulting exposure would undoubtedly be at levels that would not pose a significant risk.

The potential sources of chemical emissions from the SWMUs are presented in Figures 3-2 through 3-6. Many of the SWMUs are OWSs, which are potential sources for petroleum hydrocarbons and solvents. The primary source is generally waste (e.g., fuels, oils, and solvents) that has leaked from the separator system into subsurface soils or has been discharged or spilled on surface soil; the secondary sources are other media, such as subsurface soil or water, impacted by the primary source.

Chemicals from the primary or secondary source may be transported away from the primary source area, affecting other media that may in turn 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.

SWMU-related chemicals in soils may infiltrate/percolate through the soil and be released to groundwater. At some SWMUs, exposure may occur through surface water; therefore, a potential surface water exposure pathway could occur.

Other types of release mechanisms, such as direct contact, surface runoff, wind erosion, or volatilization to the atmosphere, are also depicted in the EPFCs. A portion of the SWMUs may be covered with clean soil or pavement; therefore, surface transport of chemicals by storm water runoff will be limited in extent. Transport by storm runoff is not considered a significant pathway for human exposure, for example, at an underground OWS. Where a SWMU is covered by pavement, exposures will only be considered potentially significant for future-use scenarios (i.e., if the pavement is removed). Volatilization of chemicals and release of airborne particulates via wind erosion are potentially significant pathways of on-site inhalation exposure if significant surface contamination exists. Direct contact with contaminated soil via dermal contact and incidental soil ingestion is another potentially significant exposure pathway. Storm water runoff, volatile emissions, wind erosion, and direct contact with soil are not secondary release mechanisms at SWMUs covered by pavement or buildings.

3.3.1 Oil Water Separators (OWSs)

In summary, the potentially significant exposure pathways for the OWSs (Figure 3-2) were identified as:

<u>Soils (Current Use)</u>

- Ingestion of and dermal contact with surface soils by base workers/ hypothetical construction workers

- Inhalation of volatile emissions or airborne particulate matter released from soil by base workers/hypothetical construction workers

Soils (Hypothetical Excavation)

- Ingestion of and dermal contact with subsurface soils by hypothetical construction workers

- Inhalation of volatile emissions or airborne particulate matter released from subsurface soil by hypothetical construction workers

Groundwater

- Ingestion, dermal contact, and inhalation of groundwater during domestic use by hypothetical off-base residents or on-base users

3.3.2 AGE Maintenance Shop Pad

In summary, the potentially significant exposure pathways for AGE Maintenance Shop Pad (Figure 3-3) were identified as:

Soils (Current Use)

- Ingestion of and dermal contact with surface soils by base workers/hypothetical construction workers

- Inhalation of volatile emissions or airborne particulate matter released from surface soil by base workers/hypothetical construction workers

Soils (Hypothetical Excavation)

- Ingestion of and dermal contact with subsurface soils by hypothetical construction workers

- Inhalation of volatile emissions or airborne particulate matter released from subsurface soil by hypothetical construction workers

Groundwater

- Ingestion, dermal contact, and inhalation of groundwater during domestic use by hypothetical off-base residents or by on-base users

Storm Water Runoff (Current or Future Use)

- Ingestion of and dermal contact with soil/sediment by base workers/hypothetical construction workers

- Inhalation of volatile emissions or airborne particulate matter released from soil/sediment by base workers/future construction workers

3.3.3 Lead Acid Battery Storage Area

In summary, the potentially significant exposure pathways for the lead acid battery storage area (Figure 3-4) were identified as:

Soils (Hypothetical Excavation)

- Ingestion of and dermal contact with surface and subsurface soils by hypothetical construction workers

- Inhalation of volatile emissions or airborne particulate matter released from surface and subsurface soil by hypothetical construction workers

Groundwater

- Ingestion, dermal contact, and inhalation of groundwater during domestic use by hypothetical off-base residents or by on-base users

3.3.4 Civil Engineering Container Storage Area

In summary, the potentially significant exposure pathways for the civil engineering container storage area (Figure 3-5) are identified as:

Soils (Current Use)

- Ingestion of and dermal contact with surface soils by base workers/hypothetical construction workers

- Inhalation of volatile emissions or airborne particulate matter released from surface soil by base workers/hypothetical construction workers

Soils (Hypothetical Excavation)

- Ingestion of and dermal contact with subsurface soils by hypothetical construction workers

- Inhalation of volatile emissions or airborne particulate matter released from subsurface soil by hypothetical construction workers

Groundwater

- Ingestion, dermal contact, and inhalation of groundwater during domestic use by hypothetical off-base residents or by on-base users

3.3.5 Wastewater Playa Lake

In summary, the potentially significant exposure pathways for the wastewater Playa Lake (Figure 3-6) are identified as:

Sediments (Current Use)

- Ingestion of and dermal contact with surface sediments by base workers, hypothetical construction workers, and trespassers

Surface Water (Current Use)

- Ingestion of and dermal contact with surface water by hypothetical construction workers, base workers, and trespassers

Groundwater (Hypothetical Resident)

- Ingestion, dermal contact, and inhalation of groundwater during domestic use by hypothetical off-base residents

Irrigation Water (Current Use)

- Inhalation of volatiles from and dermal contact with irrigation (lake) water by farmer

3.4 OVERVIEW OF WORK PLAN RATIONALE AND RISK SCREENING

The Work Plan rationale used was established to achieve the DQOs. This forms the basis for completing the RFI.

The focus of the RFI has been the investigation of potential soil, sediment, and surface water contamination that may have resulted from current or historical activities at 16 SWMUs located on Cannon AFB. The DQO process has been used to develop sampling plans and sample locations for the 16 SWMUs. The resulting sample locations are shown in figures in Sections 6 through 19. The overall objective of this investigation at each SWMU was to evaluate whether or not a release of SWMU-related chemicals has occurred which could pose a significant risk to human health or the environment.

3.4.1 Data Quality Objectives (DQOs)

The above approach suggested the following Data Quality Objectives.

- Collect environmental data of sufficient quality and quantity to characterize the nature and extent of contamination resulting from a release of SWMU-related chemicals to the degree that the potential for significant risk to human health or the environment can be determined.

- Collect environmental data of sufficient quality and quantity to evaluate the potential for releases to migrate toward receptors in all significant pathways as determined from conceptual modeling.

- Collect environmental data of sufficient quality to be used in a Health and Environmental Assessment, and collect data of sufficient quantity to address all appropriate 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.

3.4.2 Data Quality Objectives Evaluation Process

The following decision process was used to assess the SWMU data needs and investigative approach for a SWMU. The DQO evaluation process was designed to provide data of sufficient quality and quantity to evaluate whether a release has occurred from a SWMU that could pose a risk to human health or the environment and to evaluate the need for additional data to complete a baseline risk assessment (BRA) and possibly a Corrective Measure Study. The procedures used to assess the data needs and investigative approach at each SWMU included:

- Assessment of existing site information to gather information regarding potential site-related chemicals and identification of suspected sites of potential releases. Potential site-related chemicals were identified based on known uses of the site. The potential site-related chemicals have been determined by information provided concerning operating activities of each SWMU. If the list of potential site-related chemicals could not be reduced based on known uses of the site, the hazardous compounds identified in the QAPP were considered the potential site-related chemicals. Sampling locations were identified based on information regarding releases that may have occurred from the SWMU (i.e., areas where the highest concentrations of SWMU-related chemicals are expected). Sampling locations were finalized by integrating the sampling locations from the Cannon AFB June 1992 FSP with the locations needed to fulfill the data needs required by the data quality objectives.

- Soil, sediment, and surface water data were collected to characterize the nature and extent of contamination that has been released from each SWMU, including an evaluation of the potential for chemicals of concern to be transported to the groundwater at concentrations that may pose a human health threat. The nature and extent was characterized at the suspected release sites; i.e., the areas with greatest concentrations of chemicals of concern to determine whether a release had occurred which could pose a risk to human health or the environment. In addition, nature and extent was characterized so that appropriate exposure pathways could be addressed in a BRA.

- Analytical results were evaluated and chemicals of concern were identified.

- Potential impact to groundwater was evaluated by determining if the vertical distribution of contamination decreases with depth. Further investigation may be required in those cases where a significant decrease in contaminant levels is not found at deeper sampling points.

- Maximum detected soil, sediment, and surface water concentrations of chemicals of concern were compared to conservative risk-based concentrations

(RBCs) to evaluate whether a release had occurred that may pose an unacceptable risk to human health or the environment in the present or future.

- On those sites where concentrations of any SWMU-related chemicals of concern exceeded RBCs, a BRA has been recommended.

- If the concentration of none of the SWMU-related chemicals of concern exceeded RBCs, the concentration of contaminants was judged to be insignificant and, therefore, no further investigation was recommended.

A decision diagram (Figure 3-7) was developed for the Cannon AFB RFI SWMUs to present a logical decision process that was used to evaluate the data resulting from the investigation at each SWMU to assure that project objectives are met. This diagram shows the decision process to evaluate the soils and sediment/surface water exposure pathway.

3.4.3 RFI Investigation Decision Process

The RFI soils investigation decision process was designed to identify appropriate recommended actions for disposition of each SWMU investigated based on three alternative recommended actions for any given SWMU: no further action, interim action, and further investigation and evaluation in a final RFI/Corrective Measures Study (CMS). The recommendation for the selection of alternative action for each SWMU depended upon whether chemicals of concern were detected in soils at levels that may pose an unacceptable risk to human health or the environment.

The decision process was implemented by first evaluating and summarizing existing historical information and analytical data collected for each of the SWMUs. Historical information was used to identify potential chemicals of concern and to identify potential sites of chemical release at a SWMU. Then environmental media were sampled and analyzed for potential chemicals of concern. The analyte lists from which chemicals of concern were selected are discussed in the QAPP. Sampling was focused at points of potential releases from the SWMUs. SWMU-related chemicals of concern were selected by identifying chemicals reported above the analytical reporting limits. Metals that did not exceed background levels were not included as chemicals of concern. Organic chemicals that do not have EPA toxicity

factors were not considered as chemicals of concern. Concentrations of chemicals of concern detected at each SWMU were evaluated for potential human health and environmental risks by completing a screening-level risk evaluation.

The risk evaluations are screening-level because they compare maximum detected concentrations (which are higher than concentrations to which people or ecological receptors would routinely be exposed) to highly conservative (protective) health risk-based criteria. For example, health risk-based criteria used in the evaluations are based on residential exposure assumptions, which are more stringent than criteria based on industrial use. Health risk-based criteria are based on 10^{-7} excess cancer risk or hazard quotient equal to 0.1. This conservative approach permits identifying SWMUs that pose no unacceptable risk under highly conservative exposure assumptions and that, therefore, warrant no further evaluation or action, and identifying other SWMUs that may warrant further evaluation based on exceedance of stringent risk-based criteria.

The results of this screening-level risk evaluation were used to analyze each SWMU and make recommendations regarding the three alternatives stated above. The recommendations were made on the following basis:

- If no threat to human health exists based on comparison of maximum concentrations to stringent screening criteria, and no potential threat to the environment is apparent, then no further action was recommended.

- If an unacceptable threat to human health or the environment is imminent, a source is well defined, and a source control is readily identified, an interim action to control the source was recommended.

- If there is a potential threat to human health, the SWMU will be further evaluated by completing a Baseline Risk Assessment (BRA) on the SWMU.

3.4.4 Description of the Decision Process

The objective of the decision process was to evaluate each SWMU and to recommend appropriate actions for each SWMU. This decision process was designed for evaluation of the investigative results from the RFI on each SWMU and the screening-level risk evaluation. This process has also been used for the evaluation of existing historical data and the development of a sampling program designed to sample locations where the greatest contamination would be expected if releases had occurred. Figure 3-7 presents the decision diagram that was followed for the SWMU investigations. The decision process consists of nine steps, which are described below.

Step 1: Evaluate analytical results from each SWMU to identify chemicals of concern (COCs). COCs are defined as chemicals whose concentrations exceed background levels, that are potentially SWMU-related, and that have EPA-established toxicity values or that can otherwise be evaluated semiquantitatively on a health-risk basis (e.g., lead).

Step 2: Evaluate the potential impact to groundwater by assessing the vertical distribution of contamination. If significant concentrations of chemicals of concern do not decrease with depth, the impact to groundwater cannot be assessed, so further investigation will be recommended. Proceed to Step 3. If the concentrations of chemicals of concern decrease with depth, proceed to Step 4.

Step 3: Consult with project managers to develop investigation approach to collect data to characterize the potential for contaminants to be transported to groundwater. Proceed to Step 2.

Step 4: Compare the maximum concentrations detected at the SWMU with RBCs. Samples will be taken at locations where the greatest contamination would be expected if releases had occurred (based on exposure pathway evaluation and field screening techniques). Therefore, the maximum chemical concentration detected at each SWMU is likely to be the maximum concentration present at the SWMU, and will thus represent the concentration that would pose the

upper-bound estimate of human health risks at the SWMU. If no SWMU concentrations of COCs exceed RBCs, then no further action will be recommended. If any COCs are detected at concentrations exceeding RBCs, proceed to Step 5.

Step 5: Evaluate available data to determine if they are adequate to complete a BRA. If data are not adequate to complete a BRA, proceed to Step 6. If data are adequate to complete a BRA, proceed to Step 7.

Step 6: Consult with project managers and recommend collection of additional data as needed.

Step 7: Complete a BRA for the SWMU. The BRA uses more detailed assessment methodologies (e.g., calculation of reasonable maximum exposure point concentrations based on all data from the SWMU and evaluation of site-specific exposure scenarios) than are applied in the screening-level evaluation. This more detailed evaluation is not needed at SWMUs that do not pose unacceptable risks based on the conservative screening-level risk evaluation. If no unacceptable risk is present, no further action for the SWMU will be recommended. If an unacceptable risk is present, proceed to Step 8.

Step 8: Evaluate the BRA to evaluate whether there is an imminent threat to human health. If an imminent health threat is present, an interim action will be recommended; proceed to Step 9. If no imminent threat is present, proceed to Step 10.

Step 9: Recommend design and implementation of Interim Action.

Step 10: Conduct a Corrective Measures Study for the SWMU.

3.4.5 Screening-Level Health Risk Evaluation Methodology

This section describes the approach used in the screening-level health risk evaluation for each SWMU. Potential human health impacts were evaluated by comparing maximum chemical concentrations found at that SWMU with risk-based concentrations (RBCs) that were calculated for this report using conservative health-based criteria.

The goal of this evaluation process was to determine whether or not a release has occurred at a SWMU that could pose a potential risk to human health or the environment. The risk-based approach outlined in this section provides an upper-bound estimate of potential human health impacts because conservative screening criteria and maximum chemical concentrations were used to estimate potential impacts. If no potential human health or environmental risks were indicated for a given SWMU using these conservative criteria, then no further investigation was recommended for a SWMU.

3.4.5.1 Derivation of Screening Criteria

Using RCRA guidance, the maximum concentrations of SWMU chemicals were compared with risk-based criteria. These criteria were derived using the methodology described in RCRA Proposed Action Levels (EPA 1990).

The RBCs were calculated using the methodology defined in RCRA Subpart S to calculate RCRA Action Levels; however, unlike Subpart S action levels, these RBCs were based on 10^{-7} excess cancer risk or 0.1 hazard quotient. Subpart S Action Levels are based on 1×10^{-6} excess cancer risk for Class A (known) and Class B (probable) human carcinogens and a 1×10^{-5} excess cancer risk for Class C (possible) carcinogens, or a hazard quotient equal to 1 for ingestion assuming residential exposures. The more restrictive (protective) risk level of 10^{-7} was used as mutually agreed with USACE during project negotiation meetings, for screening in order to account for the possible additive effects of multiple exposure routes in addition to ingestion (i.e., dermal contact and inhalation of vapors or particulates released from soil), and exposure to multiple chemicals. The main source for the critical toxicity values (slope factors and reference doses) used to calculate RBCs was the EPA's computer database, the Integrated Risk Information System [IRIS] (EPA 1993). If no data were available in IRIS, other sources were used. These sources are referenced in the Risk-Based

Concentrations of Detected Chemicals Table 3-2. It must be emphasized that this is a highly conservative approach used for screening purposes only; risks that would be estimated in a SWMU-specific quantitative risk assessment are likely to be much lower than the risk levels calculated using these screening criteria. The formula used for calculating RBCs for carcinogens in soil was:

$$RBC\ (mg/kg) = \frac{TR * BW * ED}{SF * IR * CF * AF * AT}$$

where:

TR = target carcinogenic risk (1×10^{-7})
BW = average weight of adults (70 kg)
AT = assumed lifetime, averaging time (70 yr
IR = soil ingestion rate (0.1 g/day)
CF = conversion factor (0.001 kg/g)
AF = absorption factor (1)
ED = exposure duration (70 yr)
SF = chemical specific slope factor $(mg/kg\text{-}d)^{-1}$

For noncarcinogens, RBCs are the concentrations in soil that are estimated to result in a "hazard quotient" (HQ) of 0.1 to a resident at the SWMU. A hazard quotient is the ratio of the estimated daily dose from the assumed exposure to a reference dose (RfD), established by EPA, that is considered safe for a lifetime of daily exposure. A hazard quotient of 1 means that no toxic effects are likely to occur, even to sensitive individuals exposed for a lifetime. A hazard quotient above 1 does not mean that toxic effects will necessarily occur, but that further evaluation of exposures and chemical toxicity is required. The more conservative HQ of 0.1 was used for screening to account for exposure to multiple chemicals and for exposure routes other than ingestion, such as dermal contact with water or soil and inhalation of vapors or particulates released from soil. This is a highly conservative approach used for screening purposes only. The formula used for calculating RBCs for noncarcinogens in soil was calculated:

$$RBC\ (mg/kg) = \frac{RfD * BW * HQ}{IR * AF * CF}$$

where:

RfD	=	chemical specific oral Reference dose (mg/kg-day)
BW	=	weight of 5-year-old child (16 kg)
IR	=	soil ingestion rate (0.2 g/day)
AF	=	absorption factor (1)
CF	=	conversion factor (0.001)
HQ	=	hazard quotient of (0.1)

The formula used for calculating RBC's for noncarcinogens in water was:

$$RBC\ (mg/L) = \frac{RfD * BW * HQ}{IR * AF}$$

where:

RfD	=	chemical specific oral Reference dose
BW	=	average body wight of adults (70 Kg)
HQ	=	Hazard quotient of (0.1)
IR	=	groundwater ingestion rate (2 L/day)
AF	=	absorption factor (1)

A maximum chemical concentration that exceeds a screening-level RBC does not mean that a health risk exists, because the maximum concentration detected is not the concentration to which people would routinely be exposed, and the exposure assumptions used to derive the RBCs are for residential land use (not realistic for these SWMUs) and are not SWMU-specific. For example, the EPA-suggested intake parameters assume (1) that soil ingestion rates are 200 mg/day for children age 0 to 6 and 100 mg/day for adults, even though recent studies cited by EPA indicate soil ingestion rates may be significantly lower (by a factor of 4 or 5; Calabrese et al. 1989; Davis et al 1990); (2) that all of the soil/dust ingested per day is from contaminated soils at the SWMU; and (3) that exposure occurs daily for 70 years for water ingestion, 5 years at the "child" soil ingestion rate of 200 mg/day for noncarcinogens,

and 70-year adult lifetime exposure for carcinogens. These assumptions could overestimate "reasonable maximum exposures", even for residential use. In addition, the water risk based concentration assumes that surface water is used as a drinking water source. The wastewater Playa Lake is not used as a drinking water source and it is extremely unlikely that it ever will be. None of these "default" assumptions apply to current or likely future exposures at Cannon AFB. Based on the preliminary exposure evaluation, no residential exposures of any duration or magnitude occur or are likely to occur at these SWMUs. Occupational exposures are significantly less than residential, and conditions such as cold weather and clean soil cover would reduce or prevent contact with potentially contaminated soil.

It is important to note that RBCs are not cleanup goals. Cleanup goals are determined on a SWMU-specific basis. Rather, comparing soil concentrations to screening-level RBCs based on residential use, a 10^{-7} excess cancer risk level, and a HQ of 0.1 for noncarcinogens was adopted as a means of screening whether the chemicals in soils could pose a threat to human health. If the screening-level RBCs were not exceeded, no further action was recommended. If the screening-level RBCs were exceeded, a BRA will be performed in the final RFI.

3.4.6 Ecological Risk

It is anticipated that the conservative determination of RBCs for the risk screening in this RFI will be protective of the ecology as well. A detailed ecological risk assessment will be included in the baseline risk assessment for any sites not screened out in this RFI.

TABLE 3-1

DQO THREE-STAGE PROCESS

STAGE 1	STAGE 2	STAGE 3
IDENTIFY DECISION TYPES	IDENTIFY DATA USES/NEEDS	DESIGN DATA COLLECTION PROGRAM
• Identify and involve data users	• Identify data uses	• Assemble data collection components
• Evaluate available data	• Identify data types	• Develop data collection documentation
• Develop conceptual model	• Identify data quality needs	
• Specify objectives/decisions	• Identify data quantity needs	
	• Evaluate sampling/analysis options	
	• Review PARCC parameters	

TABLE 3-2
RISK-BASED CONCENTRATIONS OF DETECTED CHEMICALS

Chemical	Carcinogen Class	Noncarcinogenic effects Oral RfD	Carcinogenic effects Oral slope factor	Subpart S Soils (mg/kg)	1 X 10-7 RBCs (mg/kg)	0.1 HQ RBC (mg/kg)	Reference of tox factors
1,2-Dichloropropane		0.004				3 E+01	1
2-Butanone	D	0.05		4000		4 E+02	
2-Hexanone		under review					4
2-Methylnaphthalene		no data in IRIS					7
4-Mthyl-2-Pentanone		0.05				4 E+02	3,6
4-Nitrophenol		under review					4
Acenaphthene		0.06				5 E+02	1
Acetone	D	0.1		8 E+03		8 E+02	
alpha-chlordane	B2	0.00006	1.3	5 E-01	5 E-02	5 E-01	
Aluminum		no toxicity data					
Anthraecene		0.3				2 E+03	1
Antimony	D	0.0004		3 E+01		3 E+00	
Arsenic	A	0.0003	1.75	80	4 E-02	2 E+00	1
Barium	D	0.07		4000		6 E+02	1
Benzene	A		0.029		2 E+00		1
Benzo(a)anthracene	B2		1.06		7 E-02		8
Benzo(a)pyrene	B2		7.3		1 E-02		1,8
Benzo(b)fluoranthene	B2		1.02		7 E-02		8
Benzo(g,h,i)perylene		no data in IRIS					7
Benzo(k)fluoranthene	B2		0.4		2 E-01		8
Beryllium	B2	0.005	4.3		2 E-02	4 E+01	1
Bis(2-ethylhexyl)phthalate	B2	0.02	0.014		5 E+00	2 E+02	1
Bromodichloromethane	B2	0.02	0.13	6 E-01	5 E-01	2 E+02	9
Bromoform	D	0.02		2 E+03		2 E+02	9
Butyl Benzyl Phthalate		0.2				2 E+03	1
Cadmium	B1	0.001		40		8 E+00	1
Calcium		no data in IRIS					7
Carbon disulfide	D	0.1		6 E+03		8 E+02	
Carbon tetrachloride	B2	0.0007	0.13	5 E+00	5 E-01	6 E+00	9
Carbazole		no tocixity data	0.02		4 E+00		10
Chlorobenzene	D	0.02		2 E+03		2 E+02	1
Chloroform	B2	0.01	0.0061	100	1 E+01	8 E+01	1
Chloromethane		no toxicity data					

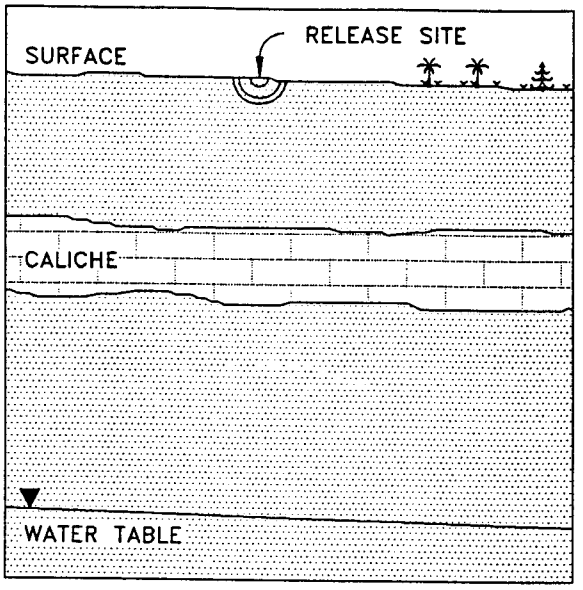
TABLE 3-2
RISK-BASED CONCENTRATIONS OF DETECTED CHEMICALS

Chemical	Carcinogen Class	Noncarcinogenic effects Oral RfD	Carcinogenic effects Oral slope factor	Subpart S Soils (mg/kg)	1 X 10-7 RBCs (mg/kg)	0.1 HQ RBC (mg/kg)	Reference of tox factors
Chromium VI	A	0.005		400		4 E+01	1
Cobalt		under review					4
Copper	D	0.037				3 E+02	7
Crysene	B2		0.032		2 E+00		8
DDD	B2		0.24	3 E+00	3 E-01		1
DDE	B2		0.34	2 E+00	2 E-01		1
DDT	B2	0.0005	0.34	2 E+00	2 E-01	4 E+00	1
Dibenzo(a,h)anthracene	B2		8.1		9 E-03		8
Dibenzofuran	D	no data					7
1,2-Dichloroethane	B2		0.091	8 E+00	8 E-01		9
1,1-Dichloroethylene	C	0.009	0.6	1 E+01	1 E-01	7 E+01	1
1,2-Dichloroethene (total)		0.02				2 E+02	1
Di-n-butyl Phthalate		0.1				8 E+02	1
Di-n-octyl Phthalate		0.02				2 E+02	1
Ethylbenzene	D	0.1		8 E+03		8 E+02	1
Fluoranthene		0.04				3 E+02	1
Fluorene		0.04				3 E+02	1
gamma-chlordane	B2	0.00006	1.3	5 E-01	5 E-02	5 E-01	1
Indeno(1,2,3-cd)pyrene	B2		1.69		4 E-02		8
Iron		no data in IRIS					7
Lead	B2	NA	NA			5 E+02	2
Manganese	D	0.14				1 E+03	1
Mercury	D	0.0003		20		2 E+00	3,4
Methylene chloride	B	0.06	0.0075	90	9 E+00	5 E+02	1
Naphthalene		0.04				3 E+02	6
Nickel	D	0.02		2000		2 E+02	1
Pentachlorophenol	B2	0.03	0.12	2 E+03	6 E-01	2 E+02	1
Phenanthrene		no data					7
Potassium		no data					
Pyrene		0.03				2 E+02	1
Selenium		0.005				4 E+01	1
Silver	D	0.003		20		2 E+01	1
Sodium		no data in IRIS					7

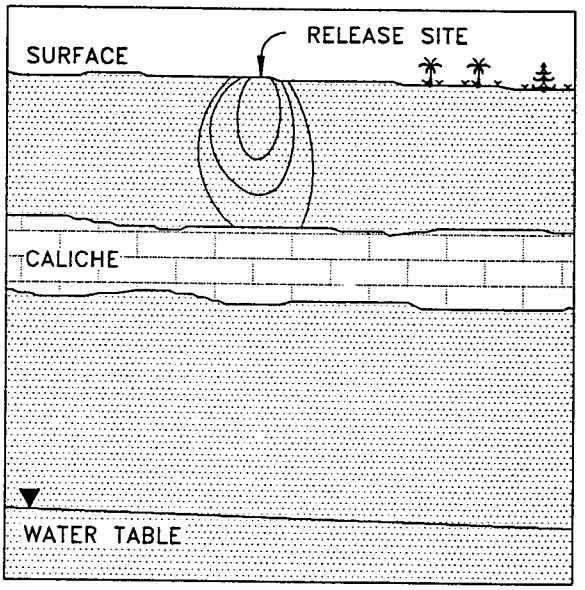
TABLE 3-2
RISK-BASED CONCENTRATIONS OF DETECTED CHEMICALS

Chemical	Carcinogen Class	Noncarcinogenic effects Oral RfD	Carcinogenic effects Oral slope factor	Subpart S Soils (mg/kg)	1 X 10-7 RBCs (mg/kg)	0.1 HQ RBC (mg/kg)	Reference of tox factors
Styrene	C	0.2		2 E+04		2 E+03	9
1,1,2,2-Tetrachloroethane	C		0.2	4 E+01	4 E-01		9
Tetrachloroethylene	B2	0.01	0.051	1 E+01	1 E+00	8 E+01	3
Thallium		0.0008				6 E+00	
Toluene	D	0.2		2 E+04		2 E+03	1
1,1,1-Trichloroethane	D	0.09		7 E+03		7 E+02	3
Trichloroethylene	B2		0.011	6 E+01	6 E+00		3
Vanadium		0.007				6 E+01	4,6
Xylenes	D	2		2 E+05		2 E+04	1
Zinc		0.3				2 E+03	1

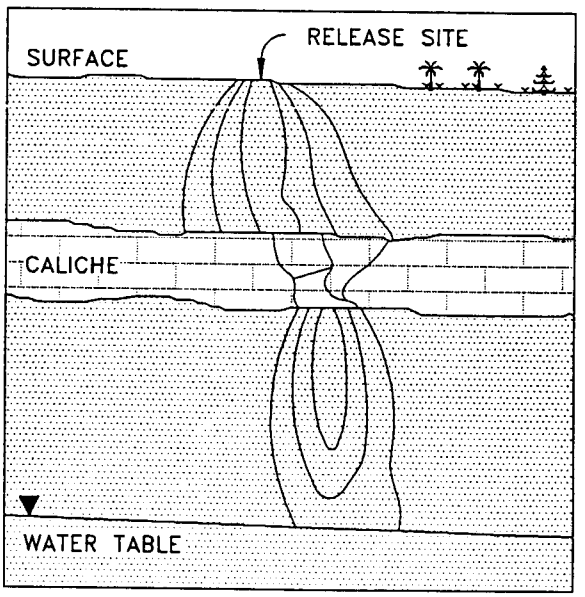
1 = Verifiable in IRIS
2 = Lead Uptake Biokinetic model 4.0 as suggested in OSWER directive #9355.4-02, Interim guidance on establishing lead soil cleanup levels.
3 = Withdrawn from IRIS
4 = Under review in IRIS
5 = Converted from 1.3 mg/L
6 = HEAST 1992
7 = No data in IRIS
8 = ICF - Clement Associates, 1988 (chemical-specific potency factor x benzo(a)pyrene slop factor).
9= HEAST 1991
10=HEAST 1993
NA = Not available



A. SINGLE EVENT RELEASE OF A SMALL QUANTITY.



A. SINGLE EVENT RELEASE OF A LARGE QUANTITY.



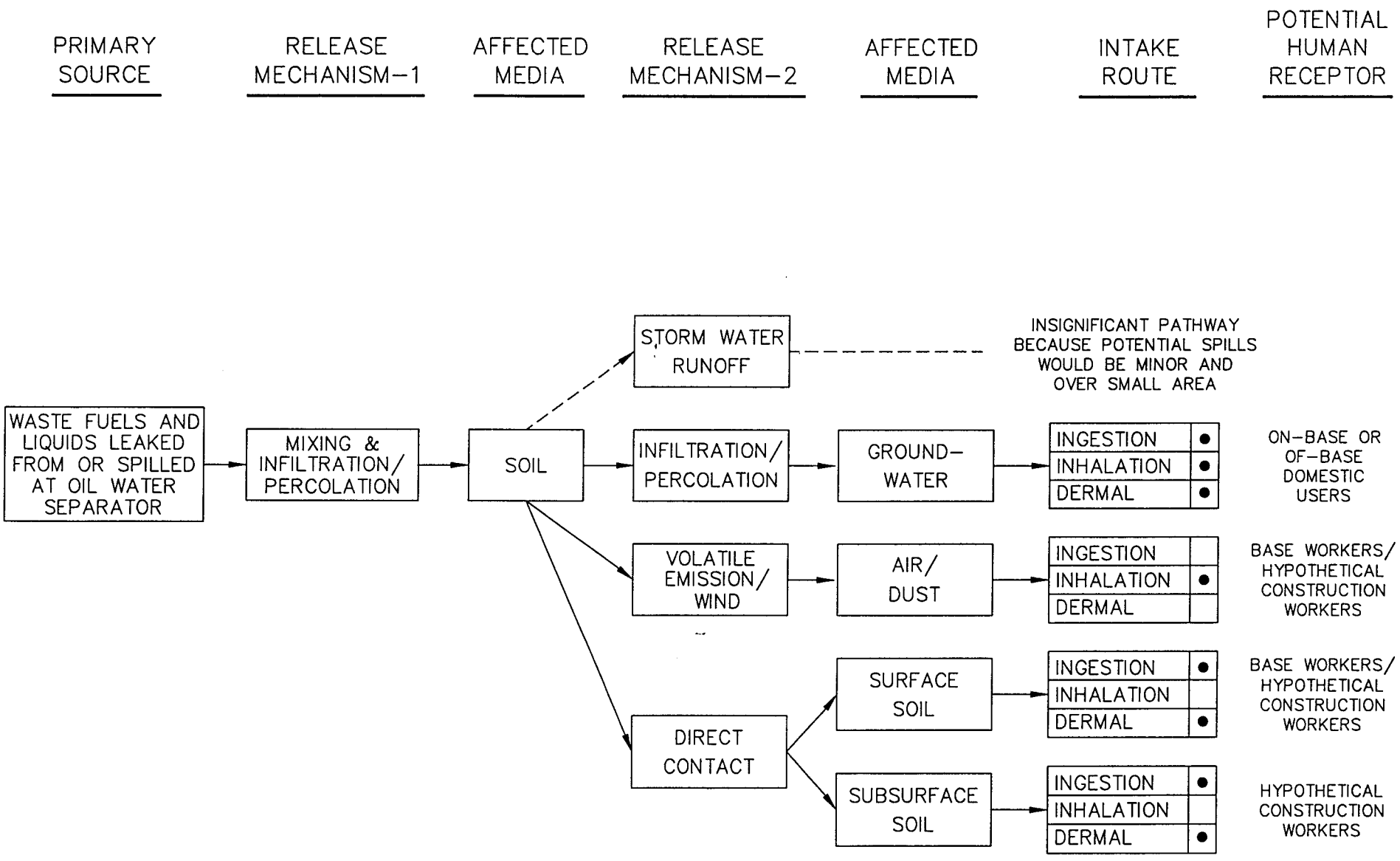
A. CONTINUOUS RELEASE OF CONTAMINANTS. NOTE MIGRATION OF LIQUIDS THROUGH FRACTURES IN THE CALICHE.

NO SCALE

DRN BY JWB	DATE 08/19/92	PENDANT PLUMES CANNON AIR FORCE BASE NEW MEXICO	PROJECT No.	FIG. No.
CHK'D BY	REVISIONS: 0		C3M11W	3-1

CAD FILE: C3M11W14.DWG 08/19/1993 15:08

CAD FILE: C3M11W15.DWG V=SEPARATORS 11/22/1993 11:05



NOTE:

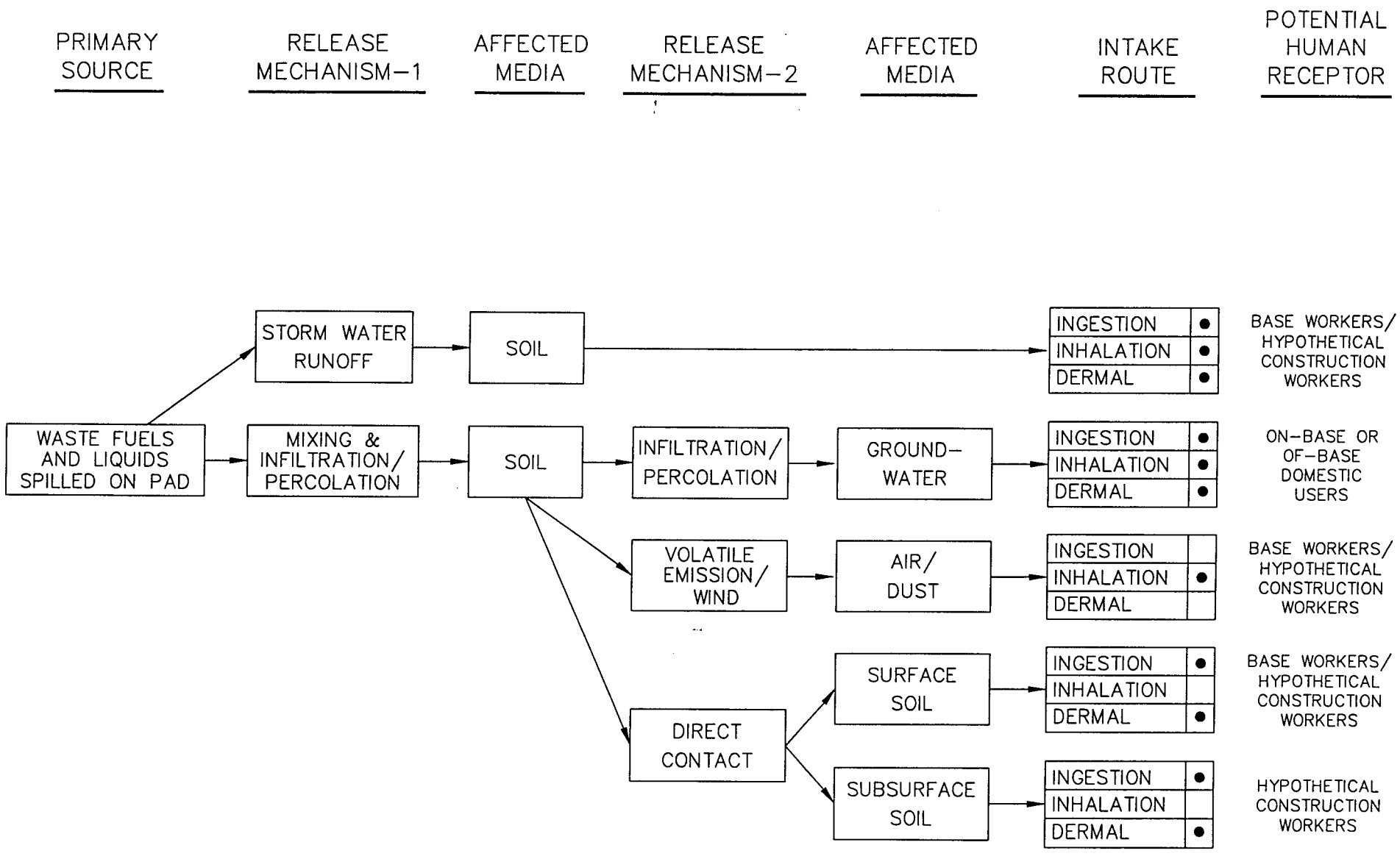
SOLID LINES REPRESENT POTENTIALLY COMPLETE PATHWAYS

DASHED LINES REPRESENT INCOMPLETE OR INSIGNIFICANT PATHWAYS

ONLY FUTURE USE EXPOSURES WILL BE CONSIDERED FOR SOILS PRESENTLY COVERED BY PAVEMENT

DRN BY JWB	DATE 08/19/93	EXPOSURE PATHWAY FLOW CHART OIL WATER SEPARATORS (SWMU's 46,47,51,57,61,62,63,70,92,93,94,127) CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO.	FIG. NO.
CHK'D BY .	REVISIONS: 0		C3M11W	3-2

CAD FILE: C3M11W15.DWG V=MAINTINANCE 11/22/1993 11:05



NOTE:

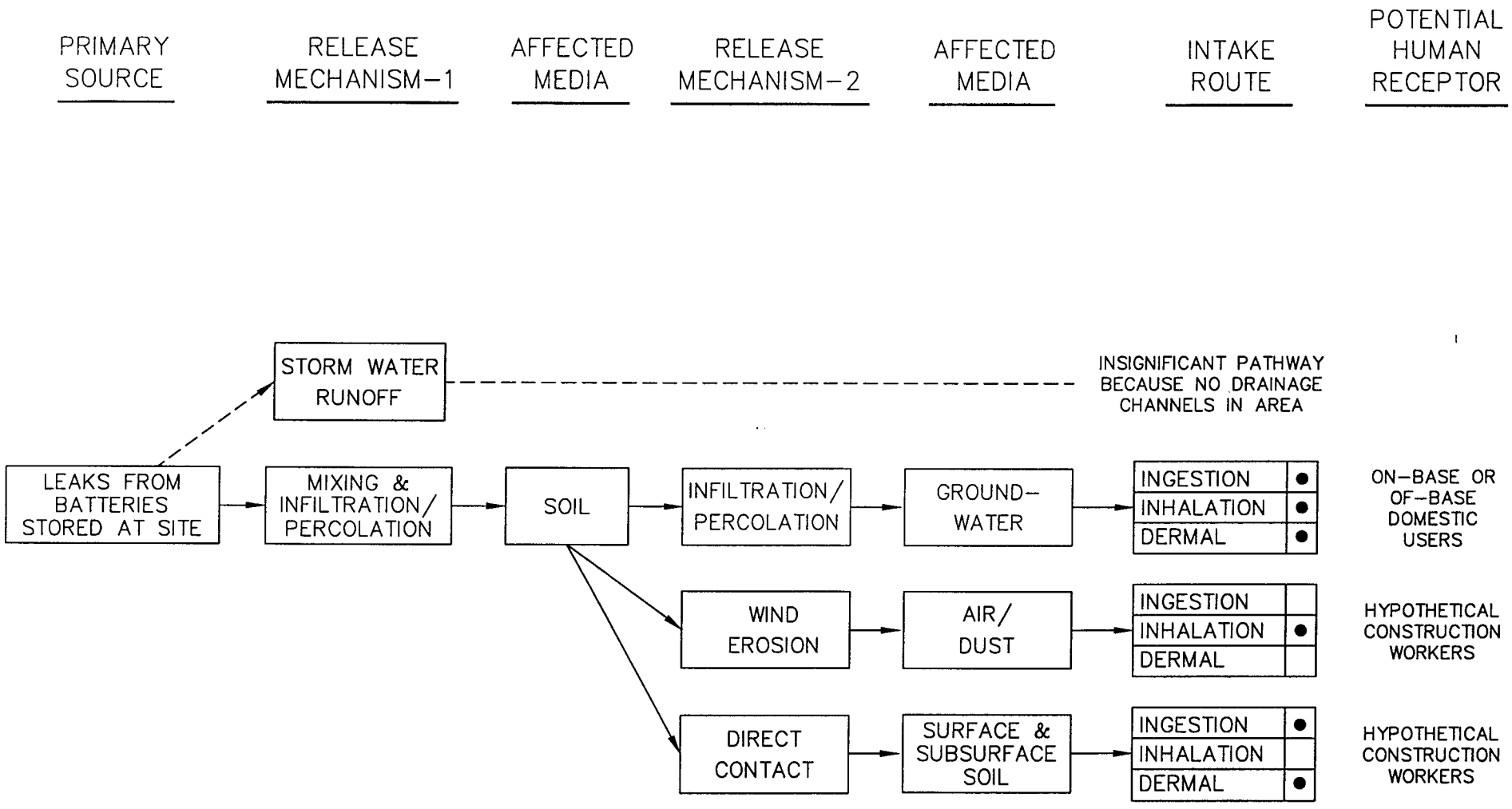
SOLID LINES REPRESENT POTENTIALLY COMPLETE PATHWAYS

DASHED LINES REPRESENT INCOMPLETE OR INSIGNIFICANT PATHWAYS

ONLY FUTURE USE EXPOSURES WILL BE CONSIDERED FOR SOILS PRESENTLY COVERED BY PAVEMENT

DRN BY JWB	DATE 08/19/93	EXPOSURE PATHWAY FLOW CHART AGE MAINTINANCE SHOP PAD SWMU - 31 CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO.	FIG. NO.
CHK'D BY .	REVISIONS: 0		C3M11W	3-3

CAD FILE: C3M11W15.DWG V=BATTERY 11/23/1993 7:55



NOTE:

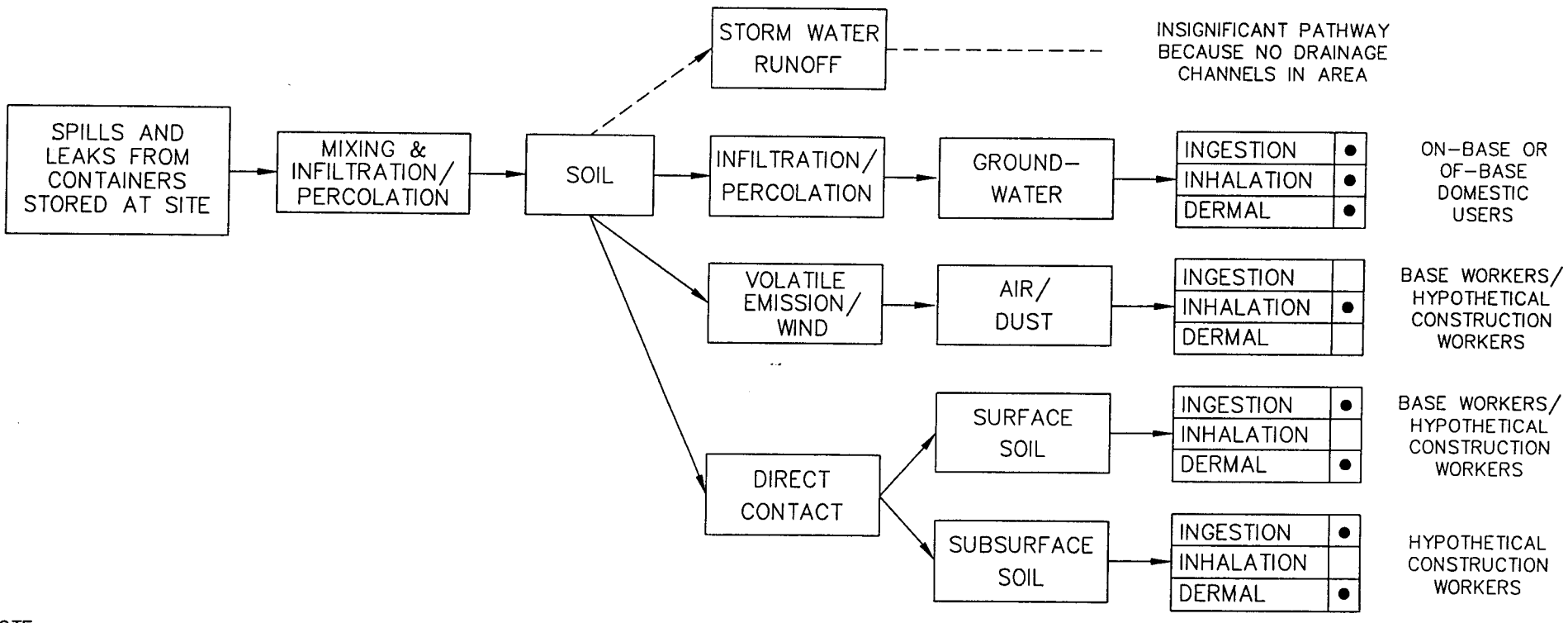
SOLID LINES REPRESENT POTENTIALLY COMPLETE PATHWAYS

DASHED LINES REPRESENT INCOMPLETE OR INSIGNIFICANT PATHWAYS

ONLY FUTURE USE EXPOSURES WILL BE CONSIDERED FOR SOILS PRESENTLY COVERED BY PAVEMENT

DRN BY JWB	DATE 08/19/93	EXPOSURE PATHWAY FLOW CHART LEAD ACID BATTERY STORAGE SITE SWMU - 55 CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO.	FIG. NO.
CHK'D BY .	REVISIONS: 0		C3M11W	3-4

CAD FILE: C3M11W15.DWG V=STORAGE 11/22/1993 11:05



NOTE:

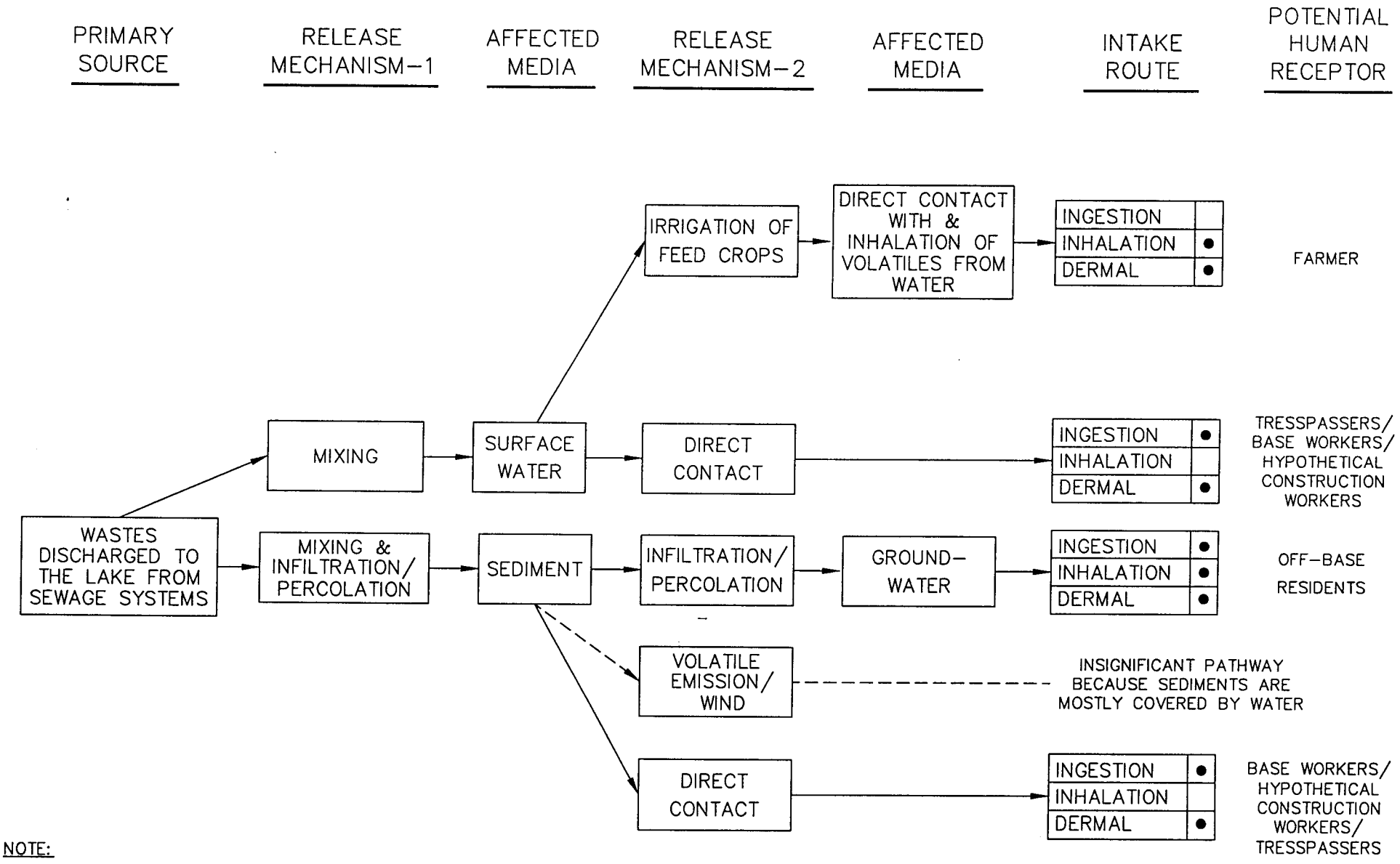
SOLID LINES REPRESENT POTENTIALLY COMPLETE PATHWAYS

DASHED LINES REPRESENT INCOMPLETE OR INSIGNIFICANT PATHWAYS

ONLY FUTURE USE EXPOSURES WILL BE CONSIDERED FOR SOILS PRESENTLY COVERED BY PAVEMENT

DRN BY JWB	DATE 08/19/93	EXPOSURE PATHWAY FLOW CHART CIVIL ENGINEERING CONAINER STORAGE AREA SWMU - 77 CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO.	FIG. NO.
CHK'D BY .	REVISIONS: 0		C3M11W	3-5

CAD FILE: C3M11WT5.DWG V=LAKE 11/22/1993 11:05



NOTE:

SOLID LINES REPRESENT POTENTIALLY COMPLETE PATHWAYS

DASHED LINES REPRESENT INCOMPLETE OR INSIGNIFICANT PATHWAYS

DRN BY JWB	DATE 08/19/93	EXPOSURE PATHWAY FLOW CHART WASTEWATER PLAYA LAKE SWMU - 103 CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO.	FIG. NO.
CHK'D BY .	REVISIONS: 0		C3M11W	3-6

CANNON AIR FORCE BASE
DECISION DIAGRAM FOR SCREENING LEVEL RISK EVALUATION

OBJECTIVE: DETERMINE IF A RELEASE OF SWMU - RELATED CHEMICALS OF CONCERN HAS OCCURRED THAT COULD POSE A POTENTIAL RISK TO HUMAN HEALTH OR THE ENVIRONMENT.

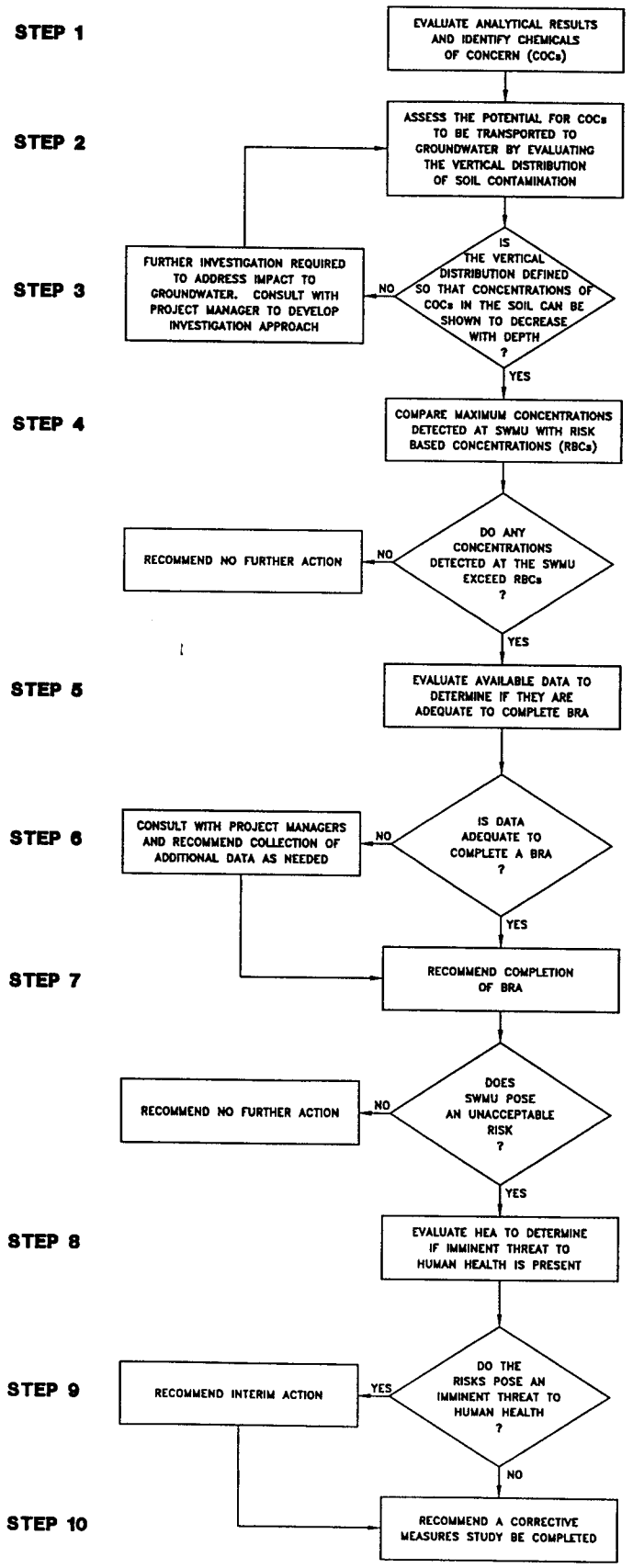


FIGURE 3-7

CAD FILE: C3M11W16.DWG 11/22/1993 11:09

4.0
FIELD INVESTIGATION

4.1 FACILITY INSPECTION AND REVIEW

A pre-field investigation site visit to Cannon AFB took place prior to the start-up of work plan document preparation and fieldwork. The on-site visit provided a means to become familiar with the base personnel, policies, and individual SWMUs targeted under this RFI. Attendees at these discussions included all critical project personnel, including the Cannon AFB CES/CEV project manager, the USACE project manager and technical specialist, and the W-C project manager, risk assessment specialist and field manager. Topics covered during these conversations included: base security requirements, policies, and access permits; utility clearances and activity permits for proposed drill sites; sources and acquisition of engineering plans and as-built drawings for targeted facilities to provide for accurate location of proposed soil borings; and the logistical requirements for field operations and the staging of supplies.

The facility review included field visits to all 16 SWMUs to be investigated under this RFI. Facility managers were contacted during these visits wherever possible to provide them notification of the upcoming fieldwork, to determine optimal times of performing fieldwork so as to minimize its impact to ongoing unit operations, and to generate first person information concerning the targeted facility's history and current use. Field visits also provided an opportunity to observe and evaluate potential health and safety concerns at investigation sites, thus allowing a proactive approach to mitigate identified hazards which could potentially impact the successful and timely completion of the project.

4.2 SURFACE SOIL SAMPLING

Surface soil samples were taken at or near all soil boring sites to help evaluate the potential risk to human health and the environment any discovered releases of SWMU-related compounds may represent. These samples were typically collected from a depth of 0.2 to 0.5 feet in areas of soil cover with decontaminated stainless steel implements. The sample material was dug up completely by hand with the tools provided, or alternatively, the augers

on the drill rig were used to break up the hardened surface soils and the sample was collected immediately below this disturbed zone. Where pavement was present, holes were cut into this surface and the drill rig and stainless steel split-spoon sampler were used to collect the soil directly below the pavement soil contact. Sample containers for VOC analysis were filled immediately with soil from the sampler. The remaining soil was then homogenized and used to fill any additional sample containers required for that site. Collected samples were labeled and placed in an ice-filled cooler for preservation. All tools and bowls used for sample collection were decontaminated after use by washing in a liquinox/water solution, rinsing in potable water and rinsing again with a liberal spray of deionized water. Surface soil sampling activities followed the applicable Standard Operating Procedure (SOP) included in the QAPP (W-C 1993).

4.3 SOIL BORING DRILLING AND SAMPLING

Soil borings were drilled and sampled using two CME-55 hollow-stem auger drill rigs. Each drill rig was equipped with nominal 8-inch O.D. hollow-stem augers, two 2-foot stainless-steel, California split-spoon samplers, and hydraulically operated automatic sampling hammers.

The soil samples were collected by driving a decontaminated, 2.5-inch I.D. by 2-foot-long stainless steel split-spoon sampler through the targeted depth interval. Blow counts were recorded to provide standard penetration test data for each interval sampled. The sampler was retrieved from the boring and opened for sample recovery. Sample containers for VOC samples were filled first directly from the split spoon. Once these samples were secured, the remaining material was homogenized in a stainless-steel bowl and placed in the remaining sample containers. If recovered sample volume was inadequate for the targeted interval, a decontaminated split-spoon sampler was reinserted into the boring and driven deeper to assure that sufficient material was collected for analysis. On the successful completion of sampling at each target interval, the hollow-stem augers advanced the boring to the top of the next sample interval, where the process was repeated.

All sampling equipment was decontaminated between sample intervals with a liquinox/water solution wash, potable water rinse and a final rinse of deionized water sprayed liberally over

the equipment. Soil boring, drilling, and sampling activities followed the applicable SOPs included in the QAPP (W-C 1993).

4.4 SURFACE WATER AND SEDIMENT SAMPLING

Surface water and sludge samples were collected from the Playa Lake to investigate the possible presence of compounds detrimental to human health and the environment which may be entering the environment from this source. Surface water samples were collected for analysis to provide characterization of its chemical content and the risk it may represent. These samples were collected with a decontaminated teflon bailer from an anchored boat at three different locations on the pond. The bailer was lowered over the side of the boat and attempts were made to consistently fill it from 0.5 to 3.5 feet deep without including any bottom sludges in the sample. On recovery of water in the bailer, containers for VOC analysis were filled first, with containers for other analytes following as described in the applicable SOP. Once collected, the sample containers were placed in an ice-filled cooler for preservation prior to shipment to the analytical laboratory.

Sludge from the lake bottom was collected with a petite ponar dredge dropped from a boat situated at four different locations on the lake surface. This spring-loaded, clamshell-type sampling device was allowed to settle on to the bottom surface, then tripped to scoop up sludge to a probable depth of approximately 0.3 to 0.4 feet below the lake bottom surface. The sludge filled sampler was brought to the surface and excess water was allowed to drain before the sample material was placed in a decontaminated stainless steel bowl. Aliquots for VOC analysis were collected from relatively consolidated sludge. The residual sludge was homogenized and placed in the remaining sample containers. Excess sample was discarded into the lake before moving to the next sample location.

4.5 SURVEY OF SAMPLING LOCATIONS

On the completion of field activities, the locations of all soil boring sites were accurately surveyed in terms of northing, easting, and elevation relative to the Cannon AFB coordinate system. Boring sites were also located relative to significant nearby physical features such as building corners and street intersections. All survey work was performed by a surveyor licensed by the state of New Mexico. The data generated during this site survey were used

to accurately depict the locations of soil borings in figures found elsewhere within this document. A table containing the actual coordinates and elevations of all soil borings drilled under this investigation is also available in the Appendixes to the RFI Report.

5.0
DATA REVIEW, QUALITY ASSURANCE AND ASSESSMENT

5.1 GENERAL

The data review process was implemented to assess the quality of data resulting from the field sampling program with respect to the quality assurance objectives established for the project. Data assessment for each SWMU involved a consideration of the major data uses, the decision types, the identification of data which were qualified or otherwise did not meet Cannon AFB RFI QAPP (W-C 1993) requirements, and limitations on data in order to evaluate the appropriate usage of the data in supporting decisions to be made at each SWMU.

5.2 DATA REVIEW PROCESS

Analytical laboratory results were reviewed following the procedures described below utilizing the quality control (QC) data specified in the Cannon AFB RFI QAPP for the respective EPA analytical methodologies. The QC elements reviewed in laboratory analytical data packages included the following: completeness of the data package; compliance with required holding times; presence or absence of analytes in method blanks and field blanks; results of laboratory control samples; recoveries of surrogate spikes in samples; results of matrix spike samples, matrix duplicates (metals); and field duplicate samples.

The analytical data received from the laboratory have been summarized and are included in the Cannon AFB RFI Quality Control Summary Report (QCSR) as an appendix to this RFI report. The laboratory flagged data **J** when a result was below reporting limits to indicate that the concentration reported is an estimated value. Also, the laboratory flagged data **D** to indicate sample dilution. The data review procedures used are described in this section. Qualified data are addressed in the QCSR and in the text for each SWMU. The data, including all W-C qualifiers, are presented in the data summary tables for each SWMU.

Based on results of the data review process, sample data may have been qualified as **J** (estimated), **UJ** (not detected/estimated), **NJ** (presumptive presence/estimated), or **R** (rejected). The review process was performed in accordance with the Cannon AFB RFI QAPP (W-C 1993) with guidance from the EPA Contract Laboratory Program (CLP), National Functional Guidelines for Organic Data Review (EPA 1991) and the Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses (EPA 1988). Although the data packages provided were not CLP deliverables, the guidance was followed where applicable.

In accordance with these guidelines, professional judgment was invoked in certain areas in determining the need for data qualification. Professional judgment as prescribed by the Functional Guidelines involves a secondary evaluation of data with respect to qualifications, which takes into account additional knowledge based on experience with laboratory practices, analyte-specific factors, such as chemical properties, and other current resolution of technical issues addressed in the literature. A **Q** qualifier was used to indicate where professional judgment on the part of the data reviewer indicated that the data may not be SWMU-related and the data user is advised of the limitations associated with the data.

The data review process results are presented in the respective analytical results section for each SWMU. Each SWMU-specific QC review details quality control issues associated with the analysis of the sample, describes what data (if any) qualification was required, and describes how professional judgment was used.

5.2.1 Completeness of Data Package

Data packages were reviewed to make certain that they contained the data contractually required in the deliverable. This included checking the data package for the results of each analyte requested for each field sample submitted in the analytical batch, along with the requested QC documentation for the respective EPA methods.

5.2.2 Holding Times

Sample holding times were calculated from the date of sampling as determined from the Chain-of-Custody (COC) forms to the date of sample extraction/analysis. Holding times were compared to the criteria specified in Tables 5-1a, 5-1b, and 5-1c of the Cannon AFB RFI QAPP (W-C 1993). If the sample analysis was conducted outside of the required holding times, all results for that sample were qualified as estimated **J** or **UJ** or rejected **R**, depending on the severity of the holding time exceedance in accordance with EPA Functional Guidelines.

5.2.3 Blanks and Rinsates

The same guidelines were applied to the results of method blanks, field blanks, and rinsate blanks in the evaluation and usage of blank results. If analytes were reported in the laboratory method blank, but not in samples associated with the method blank, data were not qualified. If analytes were reported in the method blank and in associated samples, the following actions were taken:

- No positive sample results were reported unless the concentration of the analyte in the sample exceeded 10 times (10x) the amount in any blank for the common laboratory contaminants methylene chloride, acetone, 2-butanone, and common phthalate esters, or exceeded 5 times (5x) the amount for other compounds.

- When the sample results were greater than the reporting limit, but less than the required multiple (5x or 10x) of the blank result, sample results were qualified as not detected **U**, and the reporting limit raised to the sample concentration.

- When the sample results were less than the reporting limits and less than the required multiple of the blank result, sample results were qualified as not detected **U** at the reporting limit. Also, all sample results less than the reporting limits for common laboratory contaminants were qualified as not detected **U** based on professional judgment as described in Section 5.2.

- When the sample results were greater than the required multiple (5x or 10x) of the blank result, sample results were reported without a **U** qualification.

The compounds methylene chloride, acetone, and 2-butanone, which are common laboratory contaminants, were detected in a number of samples throughout the analytical program. In some instances, these analytes were not always identified in the associated blanks, or the analyte in the sample was reported at greater than 10x the concentration reported for the associated blank. When these compounds were reported in a sample, but were not qualified **U** based on the procedures outlined above, the data reviewer may have qualified the result **Q** indicating that the compound may not be SWMU-related.

This professional judgment may be based on the compound's prevalence in other blanks or upon knowledge of the typical sources for the occurrence of these compounds in samples. For example, phthalates may result from contamination by gloves, laboratory equipment, or other materials used in the sampling or analytical program.

5.2.4 Surrogates and Laboratory Control Samples

Criteria for recovery of surrogates spiked into samples are listed in Table 4-3 of the Cannon AFB RFI QAPP (W-C 1993). If any one surrogate for volatile organic analyses or any two surrogates for semivolatile organic analyses were out of specification due to recoveries greater than the upper evaluation limit, positive results for that fraction were qualified as estimated **J**; nondetect data did not require qualification. If recoveries were less than the lower evaluation limit, but greater then 10 percent, positive results for that fraction were qualified as estimated **J** and nondetect results were qualified as estimated **UJ** unless otherwise noted in the QC review report. If any surrogate in a fraction had a recovery less than 10 percent, positive results were qualified as estimated **J**, and nondetect results for that fraction were qualified as rejected **R**. Surrogate recovery review is not applicable to total petroleum hydrocarbons (TPH) or metals analyses.

For the organics analyses, a laboratory control sample (LCS) is a sample of a well-characterized matrix spiked with known amounts of the target compounds appropriate to the method being used. LCS results provide a measure of the accuracy and, if analyzed

in duplicate, the precision of the laboratory analysis on target compounds. Sample results associated with LCS which were outside the evaluation limits were qualified **J** as estimated.

5.2.5 Matrix Spike/Matrix Spike Duplicate Samples

Matrix spike/matrix spike duplicate (MS/MSD) samples were analyzed for organics and matrix spike/duplicate (MS/D) samples were analyzed for metals. Evaluation criteria for accuracy (percent recovery) and precision (relative percent difference [RPD]) of these MS/MSD and MS/D samples are listed in Table 4-4 of the Cannon AFB RFI QAPP (W-C 1993).

For organic MS/MSD samples with percent recoveries greater than the upper evaluation limit nondetect sample results were acceptable, and reported sample values were qualified as estimated **J**. For percent recoveries less than the lower evaluation limit both nondetect and reported sample results were qualified as estimated **J**. For MS or MSD samples with spike recoveries less than 10 percent for organics and less than 30 percent for metals analyses, nondetect sample results were rejected **R** and reported values were qualified as estimated **J**. MS and MSD samples where RPDs were greater than 100 percent were qualified as unusable **R**.

In general for soil samples, only the sample results for the sample on which the MS/MSD was prepared were qualified using the above guidelines. However, using informed professional judgment in conjunction with a review of the other QC criteria, the data reviewer may have determined the need for qualification of other sample data for the analytical batch for the SWMU. In general for water samples, all sample results associated with the MS were qualified using the above guidelines. However, using informed professional judgment in conjunction with a review of the other QC criteria, the data reviewer may have determined that the results of the MS affected only the sample spiked, in which case qualification was limited to only the sample used to prepare the MS. Details of and rationale for such judgments are provided in the QCSR.

5.2.6 Field Duplicate Samples

Precision evaluation criteria of 35 percent relative percent difference (RPD) for soil samples and 25 percent for aqueous samples were considered if the analyte concentrations were greater then 5x the reporting limit. For analytical results less than or equal to 5x the reporting limit, precision evaluation limits of ± 2x the reporting limit were utilized. Duplicate results were evaluated on a case-by-case basis to determine if qualification of data was necessary. Where it was determined that qualification based on field duplicate samples was justified, an estimated **J** data qualifier was assigned to the results for the affected analyte in the samples associated with it.

5.3 MEASUREMENT OF QUALITY ASSURANCE OBJECTIVES

5.3.1 Precision

Precision is the measure of variability between individual sample measurements under prescribed conditions. Precision is assessed by replicate measurements of known standards and analysis of duplicate environmental samples. Precision was assessed by evaluating the RPDs obtained from results of laboratory control samples, matrix spike duplicate samples, and field duplicate samples. Evaluation criteria were specified in Table 4-2a through 4-2d of the Cannon AFB RFI QAPP (W-C 1993). Results are detailed in the QCSR.

5.3.2 Accuracy

Accuracy is the degree of agreement of a measurement to an accepted reference or true value. Accuracy was assessed by evaluating the percent recoveries of spiked analytes in laboratory control samples, matrix spike samples, and also surrogate compounds which were added to analytical samples. Evaluation criteria were specified in Table 4-2 of the Cannon AFB RFI QAPP (W-C 1993). Results are detailed in the QCSR.

5.3.3 Completeness

Following the QC review of the data packages for each SWMU, the data were assessed with respect to the fulfillment of quality assurance objectives and usability. The completeness for

laboratory analytical data for each SWMU was calculated by the ratio of acceptable (including estimated) analyses requested on the samples submitted for analysis.

$$\%\ Complete = \frac{Valid\ Analytical\ Results\ [including\ estimated\ (J)\ results]}{Total\ Number\ of\ Analytical\ Results\ Requested}$$

The percent completeness with respect to overall project objectives for each SWMU was evaluated for data required to make decisions on a case-by-case basis.

5.3.4 Representativeness

Representativeness is the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness of the analytical results with respect to the medium sampled can be assessed by comparing the results for collocated field duplicate sample pairs collected from a SWMU.

As stated in the EPA Functional Guidelines, there are no review criteria for field duplicate analyses. However, each SWMU-specific QC Review in the QCSR contains a qualitative assessment of data representativeness as defined by the Cannon AFB QAPP (W-C 1993).

5.3.5 Comparability

Comparability expresses the confidence with which one data set can be compared to another. Data are comparable when collection techniques and measurement procedures, methods, and reporting are equivalent for the samples within the sample set. Each SWMU-specific QC Review in the QCSR contains a qualitative assessment of data comparability.

5.4 SAMPLE REPORTING LIMITS

The sample reporting limit (RL) is the lowest concentration of an analyte that can be reported by the laboratory to be present in a sample with a specified level of confidence. The RLs are a function of the sample characteristics, method quantitation, and laboratory performance.

Method quantitation limits are determined by the laboratory and defined as the level at which the laboratory can reliably quantitate the concentration of an analyte on multiple analyses. The RLs can be equal to the method quantitation limits, but often are above since method quantitation limit studies are performed using laboratory-prepared samples (spiked deionized [DI] water); whereas, environmental samples are naturally more variable. For the Cannon project, Enseco-Rocky Mountain reporting limits for organics were equal to the practical quantitation limit, and for the metals the reporting limits were equal to the instrument detection limit. Factors which prevent RL from being as low as a method quantitation limit are discussed below.

1. High concentrations of target or nontarget analytes may require that the sample extract be diluted to avoid saturation of the detector or to quantify the analyte concentration within the calibration range of the instrument. Consequently, RLs are elevated in proportion to the dilution factor.

2. Matrix interferences may require that the sample be diluted to reduce or eliminate the interference. Consequently, the RLs are elevated in proportion to the dilution factor.

3. Analytical results and RLs are corrected for the moisture content of the sample. The RLs listed in the Cannon AFB RFI QAPP (W-C 1993) for soil are based on wet weight. RLs calculated by the laboratory for soil on a dry weight basis will be higher. Because moisture content can vary from sample to sample, RLs will vary accordingly.

4. The physical characteristics of the matrix do not permit concentration to the required final volume during sample preparation resulting in a larger sample extract volume and consequently an elevation in RLs.

NOTE: While data is not qualified based on elevated reporting limits, the possibility exists that the organic compounds may have been diluted below the instrument detection limit.

The presence of high concentrations of petroleum hydrocarbons may have interfered or affected the analyses, resulting in qualification or elevated reporting limits for a number of samples collected at Cannon AFB SWMUs.

In a given sample, one or more of these effects may be exhibited. When the reporting limits have been elevated as a result of one or more of the above causes, surrogate or target compounds present at low concentrations may not be detected.

These limitations on data for contaminants of concern are discussed on a case-by-case basis.

5.5 DATA ASSESSMENT

The assessment of data for each SWMU involved a consideration of the major data uses, the potential decisions, the identification of data which were qualified or otherwise deviated from Cannon AFB RFI QAPP (W-C 1993) requirements, and limitations associated with the evaluation of data use in supporting decisions to be made at each SWMU.

5.5.1 Uses of Data

The major uses for data collected in the RFI were:

- Characterization of the nature and extent of contamination at a SWMU
- Fate and transport evaluation and conceptual modeling of contaminants
- Human and ecological risk assessment
- Recommendations on whether corrective action may be warranted

Characterization of the nature and extent of contamination released from a SWMU included identifying specific compounds and their concentrations present in environmental media (e.g., soil, groundwater). Nature and extent characterization also involved consideration of the lateral and vertical distribution within certain spatial and temporal boundaries in environmental media of contamination released from a SWMU.

Conceptual fate and transport modeling was conducted to determine whether contaminants released from a SWMU might be transported from the SWMU to points where the potential

for exposure to human or ecological receptors exists. Fate and transport evaluation also involved evaluation of the potential for contaminants to transfer from one medium to another (e.g., volatilization from soil to air), and for contaminants to undergo chemical transformations in the environment (e.g., hydrolysis, biodegradation).

Consideration relating to nature and extent as well as the fate and transport evaluation will be further developed and used in risk assessments for sites not eliminated by the screening process, to determine whether populations are likely to have unacceptable exposures to contaminants released from a SWMU, and if they are exposed, to evaluate the likelihood of detrimental health effects. The results of the risk assessments will be used to determine if corrective action is recommended for a SWMU.

5.5.2 Summary of Data Quality Requirements

Data collected in the RFI must be of known quality to support the uses for which it is intended. That is, the data must be able to support remedial decisions concerning the respective SWMUs. One purpose of the RFI was to determine whether a SWMU requires corrective action based on the results of the risk assessment. Therefore, the data collected must be able to support such a recommendation. Data must be able to characterize what chemicals were released from the SWMU and, at an acceptable level of uncertainty, what their concentrations are in environmental media of concern at potential exposure points. RLs must meet the levels necessary to determine whether analytes are present at concentrations of concern (i.e., above risk-based concentrations).

Inherent to providing defensible data is the need for a QA/QC program. The QA/QC program must have measurement tools so that data collected will be of known quality. QA/QC objectives for sampling and analysis were developed for this project which use as indicators: precision, accuracy, completeness, comparability, and representativeness.

Data was also collected to characterize the physical setting (e.g., geological, hydrogeological, and surface features).

5.5.3 Data Usability

For each SWMU, a determination of data usability was made with respect to project data quality objectives (DQOs). Sampling issues and data review issues were discussed in terms of the appropriateness of using the data as intended as well as making recommendations or limitations on data usage. These discussions addressed items such as elevated reporting limits, analytes suspected as laboratory contaminants, potential bias in results, and professional judgment utilized in the data review.

6.1 SITE BACKGROUND

6.1.1 Site Description

The AGE Maintenance Shop Pad is an open concrete area adjacent to the southeast side of the AGE Maintenance Shop, located in Building No. 186. The pad is approximately 60 to 70 feet wide and 240 feet long (Figure 6-1). A wash rack occupies an area about 45 feet square beyond the southeast edge of the pad. The AGE Drainage Ditch (SWMU No. 34, investigated in the Appendix I RI) lies to the southeast of the maintenance pad and carries runoff to the northeast.

6.1.2 Site History

The maintenance pad has been active since 1971. Water from washing and surface or storm water, potentially contaminated with JP-4, oils, and diesel fuel, flows off the pad to the southeast. The Appendix I RI investigation of soils lining the AGE Drainage Ditch, southeast of the AGE pad, found negligible to nondetectable levels of target contaminants in the soils sampled.

6.1.3 Current Use

Maintenance on aeronautical ground equipment is performed in Building No. 186 and on the south and east sections of the pad. The wash rack (not a target of this investigation) is frequently used to wash and clean support vehicles and equipment. The wash rack is separately drained to an adjacent OWS which was a part of the Appendix II investigation. A portion of the drainage from the pad reportedly drains into a sand trap at the northwest corner of the wash rack. This sand trap reportedly empties into the OWS.

6.1.4 Potential Contaminants

Potential contaminants include JP-4, mineral and synthetic oils, and diesel fuel.

6.2 FIELD INVESTIGATION AND DATA COLLECTION

6.2.1 Soils Sampling

Four 10-foot soil borings were drilled and soil samples collected in areas where wash-down water from the maintenance pad enters the AGE ditch and along expansion joints or cracks in the maintenance pad to determine if a release of SWMU-related chemicals posing a hazard to human health or the environment has occurred at these points. Boring numbers and sample descriptions are in Table 6-1 and Figure 6-1. Boring 03101 was drilled in a slight drainage channel entering the AGE ditch to sample the effect maintenance pad runoff may have on the soil at this location. Surface soils at this site are discolored and vegetation within the channel appears distressed. Since this drainage ditch receives runoff from locations other than the AGE Maintenance Shop, other sources may be contributing contaminants to this sample location. Boring 03102 was drilled in an area of soil cover near the AGE ditch to determine the presence and the lateral extent of potential contaminants in soils at this point. Soils at this site did not appear contaminated and vegetation appeared normal. The high density of buried utilities under the maintenance pad forced the relocation of two borings from the pad itself to nearby sites. Boring 03103 was located just off the slab to the west of the Wash Rack near the expansion joint to ascertain the presence and extent of possible contamination at these points. Small piles of stained soil observed at this location suggest that oily soils have been deposited here. Boring 03104 was located about 10 feet southwest of Boring 03103, just off the edge of the AGE pad. No surface staining was evident at this site.

Soil samples were collected from the 0- to 0.5-foot, 1.5- to 3.5-foot, 4- to 6-foot, and 8- to 10-foot depth intervals in Borings 03101 and 03102 and from the 0.5- to 2-foot, 2- to 4-foot, and 8- to 10-foot depth intervals in Borings 03103 and 03104 as specified in the Field Sampling Plan and the Sample Summary Tables. The samples were collected in accordance with QAPP SOP No. 6 - Surface Soil Sampling and QAPP SOP No. 7 - Subsurface Drilling and Sampling. Target analytes included VOCs, SVOCs, metals, and TPH. Surficial samples from the 0 to .5-foot interval were collected in areas of soil cover from the 0.2- to 0.5-foot

depth interval to provide a worst-case situation for risk assessment purposes if SVOC contamination was found in these samples. In areas of pavement or concrete surfaces, soil sampling began immediately below the pavement/soil contact.

6.2.2 Geologic Summary of Boring Logs

Logs from the four soil borings drilled in this SWMU indicate a consistent subsurface environment. Fill consisting of sandy clays and silts ranging from 0.5 to 3.5 feet thick underlie the physical facility. This soil is underlain by interbedded light, yellowish white sandy clay and a reddish brown sandy clay, each ranging in thickness from 2 to 7 feet. Soils are dry to moist, and firm to hard with occasional angular, white gravel. Visible indications of contamination were observed in two of the boring locations. Stained surface soils at Boring 03101 did not persist below approximately 0.5 feet deep, and OVA readings were low at depths below 3 feet. Soils with a black greasy appearance and a petroleum odor were described in Boring 03103 encountered at the 0.5- to 2-foot depth interval, but this indication did not persist below 1.5 feet in depth. Soils from Borings 03102 and 03104 had no visual indications of contamination. See copies of boring logs in Appendix B - Volume IV.

6.2.3 Site Topography

The maintenance pad has a slight gradient to the southeast, which directs surface runoff from the area north and east of Building 186 toward the AGE ditch. Runoff northwest of the wash rack is directed along an expansion joint southwestward off of the pad.

6.3 CHEMICAL INVESTIGATION RESULTS

6.3.1 General

Samples were collected as identified in Section 6.2 to comply with permit and compliance agreement requirements. Soil samples were collected from 4 borings (03101, 03102, 03103, and 03104). Sampling and analyses performed are summarized in Table 6-1. A summary of the analytical results for these soil samples are provided in Table 6-2a for near-surface soils and Table 6-2b for subsurface soils. For each sample type, the tables provide results for

analytes only if they were detected at least once in this type of sample collected at the SWMU. Complete analytical summary results are provided in the QCSR (Appendix A).

6.3.2 Organic Results For Near-Surface Soil Samples

The near-surface soil samples collected at this SWMU (CAN031-0311-0000, CAN031-0311-0002, CAN031-0312-0000, CAN031-0312-0002, CAN031-0313-0000, CAN031-0313-0002, CAN031-0314-0000, CAN031-0314-0002) were analyzed for SVOCs, metals, and TPH as indicated in Table 6-1.

Other than acetone and methylene chloride, which were qualified non-detected after they were determined to be laboratory contaminants (see Section 4.1.4 of the QCSR), the only VOC reported was 3.6J μg/kg tetrachloroethene (PCE) reported for sample CAN031-03113-0000. Results reported for SVOCs were primarily polycyclic aromatic hydrocarbons (PAHs). Except for the compound bis(2-ethylhexyl)phthalate, which was qualified nondetected after it was determined to be a laboratory contaminant, carbazole was the only SVOC reported (500 μg/kg reported for sample CAN031-0311-0000) that would not be considered a PAH. PAHs were reported for two samples and included the compounds anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene, 2-methylnaphthalene, phenanthrene, and pyrene. Summing PAH concentrations, sample CAN031-0311-0000 had the highest total PAH reported at 32,700 μg/kg and sample CAN031-0312-0002 had total PAH reported at 253 μg/kg. Petroleum hydrocarbons were detected in samples CAN031-0312-0002, CAN031-0312-0000, CAN031-0311-0000 and CAN031-0313-0000 at 81 mg/kg, 973 mg/kg, 3,180 mg/kg, and 4,070 mg/kg.

6.3.3 Organic Results For Subsurface Soil Samples

The subsurface soil samples collected at this SWMU (CAN031-0311-0004, CAN031-0311-0008, CAN031-0312-0004, CAN031-0312-0008, CAN031-0313-0004, CAN031-0313-0008, CAN031-0314-0004, and CAN031-0314-0008) were analyzed for VOCs, SVOCs, metals, and TPH as indicated in Table 6-1. No organic compounds were detected above reporting limits.

6.3.4 Inorganic Results

Metals analyses were performed on samples collected from this SWMU as indicated in Table 6-1. The range of results for metals reported in these soil samples are summarized in Table 6-A:

TABLE 6-A

Analyte	Frequency Reported	Lowest Detection	Sample Location	Highest Detection	Sample Location
Aluminum	16/16	2160 mg/kg	0314-0008	9430 mg/kg	0314-0000
Antimony	1/16	1.9 mg/kg	0311-0000	(Only detection)	
Arsenic	16/16	1.1 mg/kg	0311-0008	4.6 mg/kg	0314-0000
Barium	16/16	81.2 mg/kg	0311-0004	1460 mg/kg	0311-0000
Beryllium	12/16	0.22 mg/kg	0312-0000	0.69 mg/kg	0314-0000
Cadmium	4/16	0.63 mg/kg	0312-0002	8.7 mg/kg	0311-0000
Calcium	16/16	4200 mg/kg	0314-0000	222,000 mg/kg	0314-0008
Chromium	16/16	2.3 mg/kg	0314-0008	130 mg/kg	0311-0000
Cobalt	15/16	1.7 mg/kg	0311-0008	5.1 mg/kg	0314-0000
Copper	16/16	1.5 mg/kg	0314-0008	61.4 mg/kg	0311-0000
Iron	16/16	1680 mg/kg	0314-0008	10,700 mg/kg	0314-0000
Lead	16/16	1.9 mg/kg	0314-0008	930 mg/kg	0311-0000
Magnesium	16/16	1150 mg/kg	0311-0000	3970 mg/kg	0312-0008
Manganese	All results rejected during data review				
Mercury	0/16	-	-	-	-
Nickel	16/16	3.6 mg/kg	0314-0008	9.7 mg/kg	0314-0000
Potassium	15/16	666 mg/kg	0311-0002	1610 mg/kg	0314-0000
Selenium	4/16	0.12 mg/kg	0311-0008	0.24 mg/kg	0313-0000
Silver	0/16	-	-	-	-
Sodium	1/16	193 mg/kg	0313-0000	(Only detection)	
Thallium	0/16	-	-	-	-
Vanadium	16/16	6 mg/kg	0314-0008	23.4 mg/kg	0312-0008
Zinc	16/16	5.6 mg/kg	0314-0008	479 mg/kg	0311-0000

Note: See Table 6-3 for comparison to background ranges.

6.4 SWMU-SPECIFIC DATA ASSESSMENT

6.4.1 General

This assessment of AGE Maintenance Shop Pad data is an evaluation of quality issues that could affect the major data uses. In general, the objective of the RFI was identification and quantification of the nature and extent of the contamination, which was necessary to meet

permit and compliance agreement requirements, and to support an evaluation of the risk to human health and the environment.

6.4.2 Sampling Issues

A review of the data contained in the log books and the Daily Quality Control Reports (DQCRs) for SWMU 31 indicate that there were no sampling issues that would impact data usability. QC issues are discussed in detail in the QCSR in Appendix A, and copies of the DQCRs are included in that appendix.

6.4.3 Data Review Issues

For laboratory analytical data, QA/QC objectives were specified in the Cannon AFB QAPP (W-C 1993). The objectives were used as indicators of the quality necessary to support identification and quantitation of potential chemicals of concern. The data review is presented in Section 4.1 of the Quality Control Summary Report (QCSR) located in Appendix A. As presented in the QCSR, data for the analytes aluminum, barium, calcium, selenium, thallium, and acenaphthene were qualified as estimated concentrations and manganese data were qualified rejected.

Selenium, thallium, and acenaphthene data were qualified estimated to indicate a potential low bias, and barium data were qualified estimated to indicate a potential high bias. When a low bias is indicated, actual concentrations may be higher than the reported results. Use of this data in risk assessment may underestimate risk. Similarly, when a high bias is indicated, actual concentrations may be lower than the reported results. Use of this data in risk assessment may overestimate risk.

Aluminum and calcium data were qualified estimated due to precision that did not meet the QA\QC criteria defined for this project. Poor precision could be attributed to errors in sampling and analysis; however, since the other analytes which were sampled and analyzed in the same procedure (Method 6010) met QA/QC criteria, this variation is likely due to sample heterogeneity.

For ICP metals analyses, the only indicator of data accuracy is the results of the matrix spike. Manganese data were rejected based on MS/MSD recoveries over 500 percent, which is considerably above the 125 percent criteria defined for this project. All samples analyzed for this SWMU had manganese concentrations reported; however, because the accuracy criteria have been exceeded, it cannot be determined whether the identification of manganese can be relied upon, and, therefore, the data were rejected.

The uncertainty in the actual concentration reported for estimated data does not affect the usability of the data for identification of chemicals in characterizing the nature and extent of contamination at this SWMU.

6.4.4 Limitations

Elevated reporting limits may limit the usability of the data due to low level analytes being diluted to below the instrument detection limits. That is, chemicals may be reported as nondetect when they are actually present in a sample at low levels. Section 4.1.6 of the QCSR (Appendix A) presents a discussion of elevated reporting limits; however, only mercury had significantly elevated reporting limits (i.e., by a factor of 100 or more), and the elevated reporting limits for mercury were not above levels of concern. There were also elevated reporting limits for lead and TPH analyses; however, there is no impact on the usability of the associated data because the analytes were reported above elevated reporting limits.

6.4.5 Summary

Overall, data generated during the study of SWMU 31 were determined to meet quality criteria. In conjunction with the analytical data review, other information, including field observations, were evaluated in the assessment of the usability of SWMU 31 data. The data support identification of the nature and extent of contamination, except for manganese data, and provide reasonable concentration for use in risk assessment.

6.5 NATURE AND EXTENT OF CONTAMINATION

The sampling at this facility was directed at areas just off the edge of the pavement where materials spilled during equipment maintenance would be expected to run off or be carried by wash water or storm water. The surface samples at two of the four borings were found to be contaminated with petroleum hydrocarbons in excess of 1,000 mg/kg. The maximum is 4,070 mg/kg at the surface of Boring 03103. These surface samples were also contaminated with elevated levels of various SVOCs at or slightly above reporting limits. In general, there is no significant contamination in the samples below 2 feet of depth, and the surface contamination appears to be closely adjacent to the edge of the pavement. The contaminated surface soils could have resulted from materials involved in the equipment maintenance or possibly from the asphalt pavement or a combination of both sources.

6.6 COMPARISON OF METALS CONCENTRATIONS TO BACKGROUND

Results of the comparison of metal concentrations in soil to background levels for SWMU 31 are given in Table 6-3. A summary of the results of the comparison is presented here.

Metals are natural constituents of soils. SWMU concentrations of metals were evaluated to assess whether the metals in environmental samples exceed background levels. Metals that occur in concentrations within background levels are not considered SWMU-related chemicals of concern and are not evaluated further.

The maximum concentration of each detected metal at each SWMU was compared to the upper tolerance limit of the background data. The upper tolerance limit (UTL) was defined as the mean plus two times the standard deviation. This is, for all practical purposes, equal to the 90% upper confidence limit of the 95th percentile which is equal to the mean plus the standard deviation times the *k* statistic. The background data set used consisted of 37 data points (W-C 1993), so the *k* statistic equals 2.02 (Gilbert 1987).

The maximum detected concentrations of antimony, barium, cadmium, chromium, cobalt, copper, lead, nickel, selenium, and zinc exceeded the UTL of the background data. Therefore, these metals were compared to risk based concentrations at SWMU 31.

6.7 RISK SCREENING

6.7.1 Exposure Pathway Flow Chart

The Preliminary Exposure Pathway Flow Chart (EPFC) applicable to SWMU 31, the AGE Maintenance Shop Pad, is shown in Figure 3-3. It shows that the potentially complete exposure pathways are ingestion of soil, inhalation of soil particulates, dermal exposure to contaminated soil, inhalation of airborne chemicals released from soil, and ingestion, inhalation, and dermal exposure to groundwater (if drinking water supplies were affected).

6.7.2 Screening of Contaminants Against RBCs (and Other Criteria)

Maximum detected concentrations of organic compounds and metals that exceeded background were compared to screening-level risk-based concentrations (RBCs) (see Section 3.4.5.1 for derivations of RBCs) and other screening criteria in Table 6-4. Screening-level criteria other than RBCs include the state of New Mexico's TPH cleanup level of 1,000 mg/kg (NMED 1993) and the EPA's recommended soil lead level of 500 mg/kg (EPA 1990). The TPH soil clean-up concentration of 1,000 mg/kg is not a risk-based concentration, nor is it a relevant-and-applicable standard for the SWMUs in this investigation. Rather, it is a conservative value originally derived for the cleanup of fuel-contaminated soils at underground storage tank sites. Risk-based concentrations for TPH, measured as fresh fuels (e.g., gasoline or diesel), are at least an order of magnitude higher for occupational exposures. The concentration of 500 mg/kg is the most conservative concentration in the recommended range of 500 to 1,000 mg/kg as a lead level in residential soil based on EPA's Uptake Biokinetic Model (EPA 1990). Compounds with no toxicity factors cannot be evaluated in the risk screening since RBCs cannot be calculated. These compounds, at the concentrations that were measured in soil, are not likely to have a impact on the results of the screening comparison to RBCs. The comparison for SWMU 31 shows that maximum detected concentrations of barium, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, cadmium, chromium, chrysene, indeno(1,2,3-cd)pyrene, lead, and TPH exceed RBCs.

This comparison of maximum detected concentrations to RBCs to evaluate potential risk is very conservative (health-protective), and actual impacts are likely to be lower than those

suggested by exceedances of conservative criteria. For example, maximum detected concentrations are likely to overestimate actual concentrations to which people would be exposed. Furthermore, the screening criteria are based on highly conservative residential exposure assumptions and target risk levels that may not be pertinent to current or future use of the SWMU. The RBCs used in this evaluation are calculated using RCRA Action Level methodology; however, the RBCs are more health-protective than conventional RCRA Action Levels because a target excess cancer risk level of 1×10^{-7} (1 in 10,000,000) and a hazard quotient of 0.1 were used to account for exposures to multiple chemicals and for exposure routes other than soil ingestion. Conventional RCRA Action Levels are calculated based on a cancer risk of 1×10^{-6} and a noncancer hazard of 1.0.

The purpose of the comparison to RBCs is to determine whether or not chemical releases (characterized by maximum detected concentrations) have occurred at SWMU 31 that could pose potential risks based on conservative health-based criteria. Since maximum concentrations of chemicals listed above exceed screening level criteria, further evaluation or investigation of chemical concentrations and probable exposures is warranted.

6.8 SUMMARY AND RECOMMENDATIONS

Sixteen soil samples were collected and analyzed from four 10-foot-deep soil borings at SWMU 31. A screening-level risk evaluation was performed by comparing maximum detected concentrations to background levels and RBCs. Six organic compounds and four metals were found at levels that exceeded RBCs and other screening level criteria.

The highest concentrations for all chemicals of concern were found in the shallow surface soils. The concentrations decreased with depth in all cases, except for methylene chloride which is considered a laboratory artifact; therefore, the vertical extent of contamination has been characterized by the borings, and the potential for the groundwater beneath SWMU 31 to be impacted can be characterized. The potential for impacts to groundwater is considered to be low because the depth of groundwater is greater than 200 feet, and sampling demonstrates that contaminants are not being significantly transported vertically below the SWMU. It appears that the data now available for SWMU 31 are sufficient to complete a Baseline Risk Assessment, and it is recommended that the risk assessment be done.

TABLE 6-1

SUMMARY OF ANALYTICAL AND QA/QC SAMPLING
AGE MAINTENANCE SHOP PAD (SWMU NO. 31)
CANNON AFB, NEW MEXICO

Sample Location	Target Interval (ft-bgs)	Sample Identification Number	QA/QC Type	Sample Matrix	Analytical Parameters				Sample Containers		
					VOCs	SVOCs	Metals	TRPH	40 ml VOA vials	4 oz. jars	8 oz. jars
Boring 03101	0 - 0.5	CAN031-0311-0000		Soil		X	X	X			1
	1.5 - 3.5	CAN031-0311-0002		Soil			X	X			1
	4 - 6	CAN031-0311-0004		Soil			X	X			1
	8 - 10	CAN031-0311-0008		Soil	X		X	X			1
Boring 03102	0 - 0.5	CAN031-0312-0000		Soil			X	X			1
	0 - 0.5	CAN031-0312-3161	FD	Soil			X	X			1
	0 - 0.5	CAN031-0312-3101	MRD	Soil			X	X			1
	1.5 - 3.5	CAN031-0312-0002		Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN031-0312-3162	FD	Soil	X	X				2	
	1.5 - 3.5	CAN031-0312-3102	MRD	Soil	X	X				2	
	4 - 6	CAN031-0312-0004		Soil			X	X			1
	8 - 10	CAN031-0312-0008		Soil	X	X	X	X		1	1
	8 - 10	CAN031-0312-6008	MS/MSD	Soil	X	X	X	X		1	2
Boring 03103	0.5-2	CAN031-0313-0000		Soil	X	X	X	X			1
	2 - 4	CAN031-0313-0002		Soil		X	X	X			1
	4 - 6	CAN031-0313-0004		Soil			X	X			1
	8 - 10	CAN031-0313-0008		Soil			X	X			1
Boring 03104	0.5 - 2	CAN031-0314-0000		Soil			X	X			1
	2 - 4	CAN031-0314-0002		Soil	X	X	X	X		2	1
	2 - 4	CAN031-0314-3163	FD	Soil	X	X	X	X		2	1
	2 - 4	CAN031-0314-3103	MRD	Soil	X	X	X	X		2	1
	4 - 6	CAN031-0314-0004		Soil			X	X			1
	8 - 10	CAN031-0314-0008		Soil	X	X	X	X		2	1

TABLE 6-1

SUMMARY OF ANALYTICAL AND QA/QC SAMPLING
AGE MAINTENANCE SHOP PAD (SWMU NO. 31)
CANNON AFB, NEW MEXICO

Sample Location	Target Interval (ft-bgs)	Sample Identification Number	QA/QC Type	Sample Matrix	Analytical Parameters				Sample Containers		
					VOCs	SVOCs	Metals	TRPH	40 ml VOA vials	4 oz. jars	8 oz. jars
Boring 03104, cont.		CAN031-0314-3151	AB	Water	X				2		
		CAN031-0314-3171	RB	Water	X				2		
		CAN031-0314-3181	DW	Water	X				2		
		CAN031-0314-3191	TB	Water	X				1		

AB = Ambient blank
DW = Decontamination water
FB = Field blank
MRD = Missouri River Division
MS/MSD = Matrix spike/matrix spike duplicate
RB = Rinsate blank
TB = Trip blank

See Figure 6-1 for locations of the borings.

TABLE 6-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 31

LOCATOR	CAN031-0311-0000			CAN031-0311-0002			CAN031-0312-0000			CAN031-0312-0002			CAN031-0313-0000			CAN031-0313-0002		
LAB SAMPLE NUMBER	0311830016SA			0311830017SA			0311830010SA			0311830011SA			0311830002SA			0311830003SA		
COLLECT DATE	09/12/93			09/12/93			09/12/93			09/12/93			09/12/93			09/12/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)																		
Tetrachloroethene										<	5.6	U	3.6	6.1				
Semivolatile Organics (ug/kg)																		
Anthracene	600	4100	J							<	370	U	<	8000	U	<	390	U
Benzo(a)anthracene	2400	4100	J							<	370	U	<	8000	U	<	390	U
Benzo(a)pyrene	2700	4100	J							<	370	U	<	8000	U	<	390	U
Benzo(b)fluoranthene	5600	4100								65	370	J	<	8000	U	<	390	U
Benzo(g,h,i)perylene	2600	4100	J							<	370	U	<	8000	U	<	390	U
Carbazole	500	4100	J							<	370	U	<	8000	U	<	390	U
Chrysene	3100	4100	J							<	370	U	<	8000	U	<	390	U
Fluoranthene	5600	4100								55	370	J	<	8000	U	<	390	U
Indeno(1,2,3-cd)pyrene	2300	4100	J							<	370	U	<	8000	U	<	390	U
2-Methylnaphthalene	<	4100	U							45	370	J	<	8000	U	<	390	U
Phenanthrene	3200	4100	J							44	370	J	<	8000	U	<	390	U
Pyrene	4600	4100								44	370	J	<	8000	U	<	390	U
Metals (mg/kg)																		
Aluminum	5660	12.5		4160	24.1		4260	10.5		5430	11.2		6650	12.2		5740	11.7	
Antimony	1.9	7.5	J	<	14.4	U	<	6.3	U	<	6.7	U	<	7.3	U	<	7	U
Arsenic	3.2	0.62		2.3	0.6		2.4	0.52		2.9	0.56		4.4	0.61		2.2	0.59	
Barium	1460	1.2	J	120	2.4	J	166	1	J	201	1.1	J	229	1.2	J	119	1.2	J
Beryllium	0.36	0.25		0.26	0.48	J	0.22	0.21		0.27	0.22		0.25	0.24		0.25	0.23	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 6-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 31

LOCATOR	CAN031-0311-0000			CAN031-0311-0002			CAN031-0312-0000			CAN031-0312-0002			CAN031-0313-0000			CAN031-0313-0002		
LAB SAMPLE NUMBER	0311830016SA			0311830017SA			0311830010SA			0311830011SA			0311830002SA			0311830003SA		
COLLECT DATE	09/12/93			09/12/93			09/12/93			09/12/93			09/12/93			09/12/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Cadmium	8.7	0.62		<	1.2	U	0.85	0.52		0.63	0.56		4.4	0.61		<	0.59	U
Calcium	6270	25		205000	48.1		48600	20.9		94400	22.3		42400	24.4		108000	23.4	
Chromium	130	1.2		4.2	2.4		9.9	1	J	8	1.1	J	24.3	1.2		6	1.2	
Cobalt	3.4	1.2		2.3	2.4	J	2.6	1		3.2	1.1		3.5	1.2		3.2	1.2	
Copper	61.4	2.5		2.7	4.8	J	9.3	2.1		10.9	2.2		18.8	2.4		4.7	2.3	
Iron	7150	12.5		3290	24.1		5570	10.5		6420	11.2		7950	12.2		5470	11.7	
Lead	930	125		3.5	1.2		46.9	5.2		22.3	5.6		77.7	6.1		4.7	0.59	
Magnesium	1150	25		2450	48.1		1810	20.9		2210	22.3		2310	24.4		1940	23.4	
Nickel	7.2	5		4.9	9.6	J	5.8	4.2		6.9	4.5		6.8	4.9		5.7	4.7	
Potassium	867	625		666	1200	J	1100	523		954	558		1550	610		998	586	
Selenium	<	1.2	UJ	<	1.2	UJ	<	1	UJ	<	1.1	UJ	0.24	1.2	J	<	1.2	UJ
Sodium	<	625	U	<	1200	U	<	523	U	<	558	U	193	610	J	<	586	U
Vanadium	13.8	1.2		10.4	2.4		13.8	1		17.1	1.1		16.6	1.2		13.1	1.2	
Zinc	479	2.5		9.2	4.8		57	2.1		33.5	2.2		85.8	2.4		12.6	2.3	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	3180	500		<	48.1	U	973	209		81	44.6		4070	488		<	46.9	U

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 6-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 31

LOCATOR	CAN031-0314-0000			CAN031-0314-0002		
LAB SAMPLE NUMBER	0311830006SA			0311830008SA		
COLLECT DATE	09/12/93			09/12/93		
	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)						
Tetrachloroethene				<	5.8	U
Semivolatile Organics (ug/kg)						
Anthracene				<	380	U
Benzo(a)anthracene				<	380	U
Benzo(a)pyrene				<	380	U
Benzo(b)fluoranthene				<	380	U
Benzo(g,h,i)perylene				<	380	U
Carbazole				<	380	U
Chrysene				<	380	U
Fluoranthene				<	380	U
Indeno(1,2,3-cd)pyrene				<	380	U
2-Methylnaphthalene				<	380	U
Phenanthrene				<	380	U
Pyrene				<	380	U
Metals (mg/kg)						
Aluminum	9430	11.7		6090	11.7	J
Antimony	<	7	U	<	7	U
Arsenic	4.6	0.59		2.6	0.58	
Barium	104	1.2	J	107	1.2	J
Beryllium	0.69	0.23		0.34	0.23	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 6-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 31

LOCATOR	CAN031-0314-0000			CAN031-0314-0002		
LAB SAMPLE NUMBER	0311830006SA			0311830008SA		
COLLECT DATE	09/12/93			09/12/93		
	Result	RL	Qual	Result	RL	Qual
Cadmium	<	0.59	U	<	0.58	U
Calcium	4200	23.5		71300	23.3	J
Chromium	11.8	1.2		6.4	1.2	
Cobalt	5.1	1.2		3.2	1.2	
Copper	7.6	2.3		5.2	2.3	J
Iron	10700	11.7		6030	11.7	J
Lead	9.4	0.59		6.9	1.2	J
Magnesium	2130	23.5		1760	23.3	
Nickel	9.7	4.7		7	4.7	
Potassium	1610	587		1110	583	J
Selenium	0.15	1.2	J	0.16	1.2	J
Sodium	<	587	U	<	583	U
Vanadium	21.2	1.2		13.3	1.2	
Zinc	29.8	2.3		13.2	2.3	
TPH (mg/kg)						
Total Petroleum Hydrocarbons	<	46.9	U	<	46.6	U

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 6-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 31

LOCATOR	CAN031-0311-0004			CAN031-0311-0008			CAN031-0312-0004			CAN031-0312-0008			CAN031-0313-0004			CAN031-0313-0008		
LAB SAMPLE NUMBER	0311830018SA			0311830001SA			0311830014SA			0311830015SA			0311830004SA			0311830005SA		
COLLECT DATE	09/12/93			09/12/93			09/12/93			09/12/93			09/12/93			09/12/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Metals (mg/kg)																		
Aluminum	7690	11.8		3210	11.2		4210	23.5		5820	11.4		4090	23.3		5460	11.4	
Arsenic	2.4	0.59		1.1	0.56		2.2	0.59		2.6	0.57		2.7	0.58		3	0.57	
Barium	81.2	1.2	J	327	1.1	J	273	2.4	J	237	1.1	J	130	2.3	J	411	1.1	J
Beryllium	0.29	0.24		<	0.22	U	<	0.47	U	0.35	0.23		0.24	0.47	J	0.53	0.23	
Calcium	22900	23.6		60300	22.4		217000	47		68100	22.9		142000	46.6		50700	22.8	
Chromium	8.2	1.2		3.8	1.1		6.5	2.4		6.1	1.1		4.9	2.3		6.1	1.1	
Cobalt	4.4	1.2		1.7	1.1		2.4	2.4		3.1	1.1		2.5	2.3		3	1.1	
Copper	5.9	2.4		2.2	2.2		3.6	4.7	J	3.8	2.3		2.7	4.7	J	3.6	2.3	
Iron	8140	11.8		3320	11.2		3930	23.5		5900	11.4		4050	23.3		5580	11.4	
Lead	6.7	1.2		4.5	1.1		5.4	0.59		6.6	0.57		4	0.58		5.8	1.1	
Magnesium	2000	23.6		2200	22.4		3250	47		3970	22.9		2500	46.6		2960	22.8	
Nickel	7.4	4.7		3.6	4.5	J	5.7	9.4	J	6.3	4.6		5.9	9.3	J	6.5	4.6	
Potassium	1450	590		892	560		688	1180		1090	572		762	1170		1140	570	
Selenium	<	1.2	UJ	0.12	1.1	J	<	1.2	UJ	<	1.1	UJ	<	1.2	UJ	<	1.1	UJ
Vanadium	16.4	1.2		11.2	1.1		14	2.4		23.4	1.1		15.4	2.3		22.6	1.1	
Zinc	18.8	2.4		8	2.2	J	9.6	4.7		12.9	2.3		9.8	4.7		12.1	2.3	

NOTE: Results presented here are only those chemicals which were detected at least once in near-surface soils at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value. RL = Reporting Limit.
U = Nondetected value. Qual = Qualifier

TABLE 6-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 31

LOCATOR	CAN031-0314-0004			CAN031-0314-0008		
LAB SAMPLE NUMBER	0311830009SA			0311830019SA		
COLLECT DATE	09/12/93			09/12/93		
	Result	RL	Qual	Result	RL	Qual
Metals (mg/kg)						
Aluminum	4830	23.5		2160	23.3	
Arsenic	3.1	0.59		1.5	0.58	
Barium	1130	2.4	J	143	2.3	J
Beryllium	<	0.47	U	<	0.47	U
Calcium	156000	47		222000	46.5	
Chromium	4.5	2.4		2.3	2.3	
Cobalt	2.4	2.4		<	2.3	U
Copper	2.5	4.7	J	1.5	4.7	J
Iron	4570	23.5		1680	23.3	
Lead	4.1	0.59		1.9	0.58	
Magnesium	3390	47		2920	46.5	
Nickel	6.2	9.4	J	3.6	9.3	J
Potassium	844	1180	J	<	1160	U
Selenium	<	1.2	UJ	<	1.2	UJ
Vanadium	18.7	2.4		6	2.3	
Zinc	11.9	4.7		5.6	4.7	

NOTE: Results presented here are only those chemicals which were detected at least once in near-surface soils at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J = Estimated value.
R = Rejected value. RL = Reporting Limit.
U = Nondetected value. Qual = Qualifier

TABLE 6-3

COMPARISON OF MAXIMUM DETECTED METAL CONCENTRATIONS TO BACKGROUND(1)
SWMU 31, CANNON AFB
AGE Maintenance Shop Pad

Sample ID	Metal	Maximum detected concentration	Range of background concentrations (2)	Upper tolerance limit (UTL) background concentration(3)	Does maximum detected exceed UTL background
CAN031-0314-0000	Aluminum	9430	1410 - 11,000	10,540	N
CAN031-0311-0000	Antimony	1.9	<5 - <13	*	Y
CAN031-0314-0000	Arsenic	4.6	0.67 - 28	15.5	N
CAN031-0311-0000	Barium	1460	14.5 - 1200	642	Y
CAN031-0314-0000	Beryllium	0.69	0.17 - 0.77	0.73	N
CAN031-0311-0000	Cadmium	8.7	<0.51 - 4.2	*	Y
CAN031-0311-0000	Chromium	130	4 - 15.4	12.5	Y
CAN031-0314-0000	Cobalt	5.1	0.85 - 5.3	4.5	Y
CAN031-0311-0000	Copper	61.4	<2 - 18.4	*	Y
CAN031-0311-0000	Lead	930	1.1 - 46	25.8	Y
CAN031-0314-0000	Nickel	9.7	1.3 - 9.8	9	Y
CAN031-0314-0000	Potassium	1610	354 - 2770	2,572	N
CAN031-0313-0000	Selenium	0.24	<0.21 - 124	*	Y
CAN031-0312-0008	Vanadium	23.4	5.2 - 28.3	25.3	N
CAN031-0311-0000	Zinc	479	<4.3 - 27.5	21.9	Y

(1) All units in mg/kg.
(2) Compiled from data collected by Woodward Clyde for the RFI and RI (WCC 1992 and WCC 1993) and Walk, Haydel and Associates for the IRP (Walk, Haydel and Associates 1990).
Summarized in "Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater at Cannon AFB, NM (WCC 1993)
(3) Upper Tolerance Limit (UTL) of the mean = mean + 2*standard deviation. This is for all practicle purposes the same as the 90% upper confidence limit of the 95th percentile where UTL = mean + standard deviation *k, where k=2.02 for n=37 .
* Data insufficient to calculate UTL of background concentration

TABLE 6-4

COMPARISON OF MAXIMUM DETECTED CONCENTRATIONS WITH RBCs(1)
SWMU 31, CANNON AFB
AGE Maintenance Shop Pad

Sample ID	Analyte	Maximum Detected	RBC (2)	Maximum Detected Exceed RBC
CAN031-0312-0002	2-Methylnaphthalene	0.045	NTF	N
CAN031-0311-0000	Anthracene	0.6	2000	N
CAN031-0311-0000	Antimony	1.9	3	N
CAN031-0311-0000	**Barium**	**1460**	**600**	**Y**
CAN031-0311-0000	**Benzo(a)anthracene**	**2.4**	**0.07**	**Y**
CAN031-0311-0000	**Benzo(a)pyrene**	**2.7**	**0.01**	**Y**
CAN031-0311-0000	**Benzo(b)fluoranthene**	**5.6**	**0.07**	**Y**
CAN031-0311-0000	Benzo(g,h,i)perylene	2.6	NTF	N
CAN031-0311-0000	**Cadmium**	**8.7**	**8**	**Y**
CAN031-0311-0000	Carbazole	0.5	4	N
CAN031-0311-0000	**Chromium**	**130**	**40**	**Y**
CAN031-0311-0000	**Chrysene**	**3.1**	**2**	**Y**
CAN031-0314-0000	Cobalt	5.1	NTF	N
CAN031-0311-0000	Copper	61.4	300	N
CAN031-0311-0000	Fluoranthene	5.6	300	N
CAN031-0311-0000	**Indeno(1,2,3-cd)pyrene**	**2.3**	**0.04**	**Y**
CAN031-0311-0000	**Lead (3)**	**930**	**500**	**Y**
CAN031-0314-0000	Nickel	9.7	200	N
CAN031-0311-0000	Phenanthrene	3.2	NTF	N
CAN031-0311-0000	Pyrene	4.6	200	N
CAN031-0313-0000	Selenium	0.24	40	N
CAN031-0313-0000	Tetrachloroethene	0.0036	1	N
CAN031-0313-0000	**Total Petroleum Hydrocarbons (4)**	**4070**	**1000**	**Y**
CAN031-0311-0000	Zinc	479	2000	N

NTF = No EPA Established Toxicity Factor

(1) All units in mg/kg

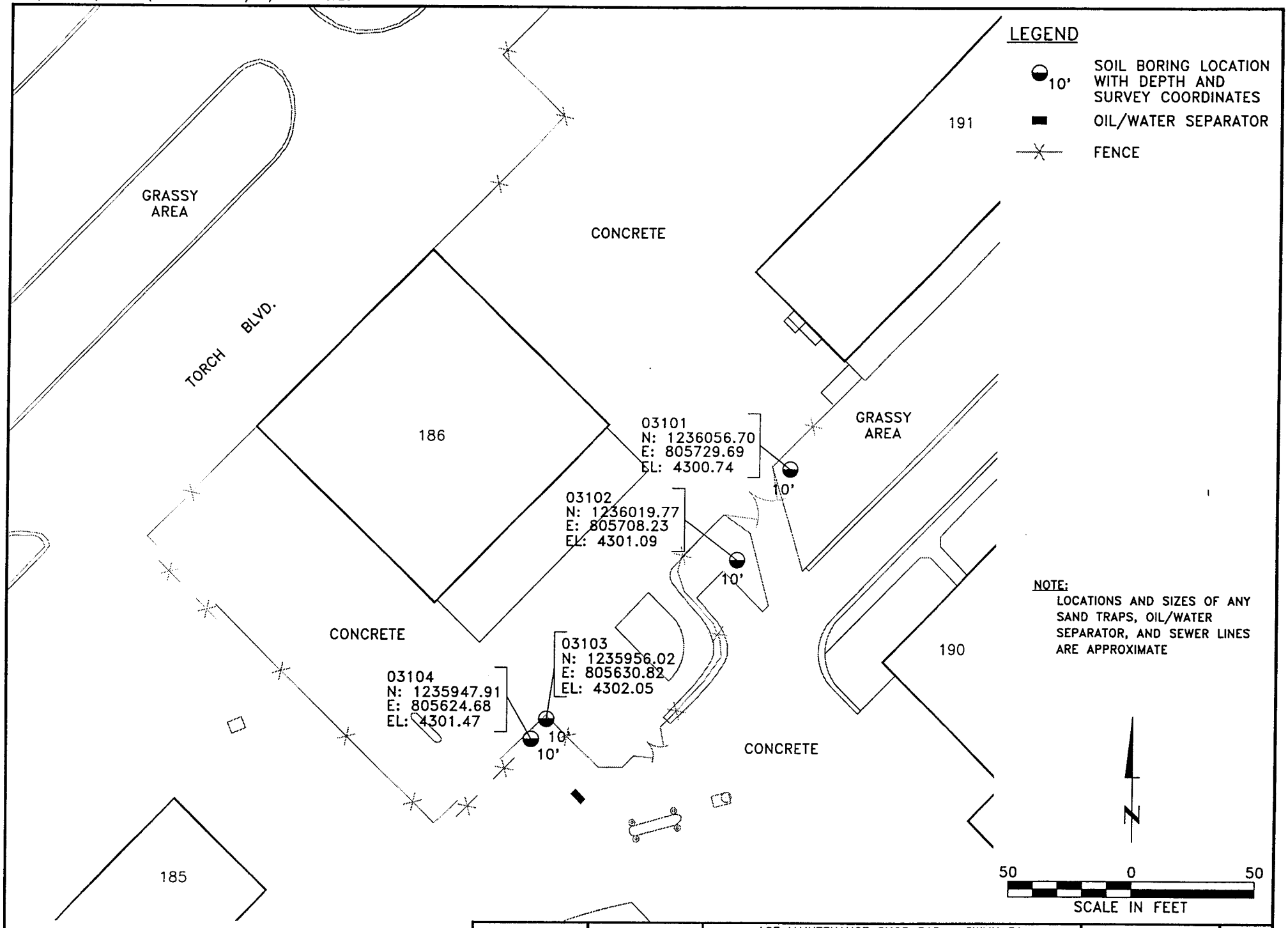
(2) Risk-based concentration

(3) EPA suggests 500-1,000 mg/kg as allowable concentration for residential soils based on EPA's IUBK Lead Model (EPA 1990)

(4) New Mexico recommended soil cleanup level for fuel contaminated soil.

Note: Only metals that exceed background appear in this table.

T:\CANNON\C3M11W\C3M11W02 11/23/1993 8:23



SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

DRN BY: SCR	DATE: 08/16/93	AGE MAINTENANCE SHOP PAD - SWMU 31 SITE MAP AND BORING LOCATIONS CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W
CHK'D BY: .	REVISION: 0		FIG. NO. 6-1

7.1 SITE BACKGROUND

7.1.1 Site Description

OWS 196 is located at the south corner of Building 196 (Figure 7-1) between Buildings 195 and 196. The OWS is an underground concrete unit with a 560-gallon main compartment and a 135-gallon oil compartment. The OWS measures approximately 7 feet by 9 feet in plan and extends about 7.5 feet below the pavement surface. The immediate area around the OWS is paved with approximately 0.5 feet of asphalt.

7.1.2 Site History

The OWS has reportedly received wash water generated from aircraft maintenance operations in Building 196, an aircraft maintenance hangar. Oils recovered by the OWS are directed to the 135-gallon holding tank for later pumping, and the wastewater is discharged to the sanitary sewer line. The OWS has been active since 1969.

7.1.3 Current Use

The OWS reportedly receives wash water generated from aircraft maintenance operations in Building 196. The oils recovered by the OWS are directed to the 135-gallon holding tank for later pumping, and the wastewater is discharged to the sanitary sewer line.

7.1.4 Potential Contaminants

Potential contaminants include petroleum and synthetic lubricating oils, fuels, greases, solvents, and metals.

7.2 FIELD INVESTIGATION AND DATA COLLECTION

7.2.1 Soils Sampling

Three 10-foot soil borings were drilled and sampled to evaluate whether spillage or leakage from the OWS or its connecting pipes have resulted in a release of SWMU-related chemicals. Borings were located as close as possible to the OWS to sample soils at potential release points, such as the inlet and outlet pipes, and to determine the vertical extent of contamination if discovered.

Soil samples were collected from the 0.5- to 2-foot, 2- to 4-foot, 4- to 6-foot, and 8- to 10-foot depth intervals as specified in the Field Sampling Plan and the Sample Summary Tables. The samples for the upper interval were taken from the soils immediately underlying the pavement at this site. Target analytes included VOCs, SVOCs, metals, and TRPH. Subsurface soil samples were collected in accordance with the QAPP SOP No. 7 - Subsurface Soil Drilling and Sampling. No visual evidence of contamination was observed on the surface asphalt or in the soil samples collected from this SWMU.

7.2.2 Geologic Summary of Boring Logs

Boring logs from the three borings completed at this SWMU indicate a reddish brown sandy clay fill up to 8 feet deep around the OWS. The fill is moist with a trace of gravel. Native soil is inferred as a light yellow-white sandy clay with red mottling. This soil is firm and dry with some gravel noted on the boring logs. Moisture content in both fill and native soil increased in Boring 04603 at 7 feet, which may indicate a leak in the OWS outflow pipe. No visual indications of subsurface contamination were observed at this site. (See copies of boring logs in Appendix B, Volume IV.)

7.2.3 Site Topography

The SWMU is in a relatively flat area with a slight gradient providing drainage to the southeast towards the flight line.

7.3 CHEMICAL INVESTIGATION RESULTS

7.3.1 General

Samples were collected as identified in Section 7.2 to comply with permit and compliance agreement requirements. Soil samples were collected from three borings (04601, 04602, and 04603). Sampling and analyses performed are summarized in Table 7-1. A summary of the analytical results for these soil samples is provided in Table 7-2a for near-surface soils and Table 7-2b for subsurface soils. For each sample type, the tables provide results for analytes only if they were detected at least once in this type of sample collected at the SWMU. Complete analytical summary results are provided in the QCSR (Appendix A).

7.3.2 Organic Results For Near-Surface Soil Samples

The near-surface soil samples collected at this SWMU (CAN046-0461-0000, CAN046-0461-0002, CAN046-0462-0000, CAN046-0312-0002, CAN046-0463-0000, and CAN046-0463-0002) were analyzed for VOCs, SVOCs, metals, and TPH as indicated in Table 7-1.

Other than acetone and methylene chloride, which were qualified nondetected after they were determined to be laboratory contaminants (see Section 4.1.4 of the QCSR), the VOCs reported were 4.3 μg/kg, 1,1,1-trichloroethane reported for sample CAN046-0462-0002, 1.5 μg/kg ethylbenzene reported for sample CAN046-461-0000, toluene reported for samples CAN046-0461-000, CAN046-0461-0002, CAN046-0463-0000, and CAN046-0463-0002 at 2.6 μg/kg, 1.5 μg/kg, 1.2 μg/kg, and 15 μg/kg, respectively. Total xylenes were reported for samples CAN046-0461-0000, CAN046-0461-0002, and CAN046-0463-0000 at 5.4 μg/kg, 2.5 μg/kg, and 2.6 μg/kg, respectively. Results reported for SVOCs were primarily polycyclic aromatic hydrocarbons (PAHs). PAHs were reported for two samples and included the compounds benzo(b)fluoranthene, fluoranthene, fluorene, and pyrene. Summing PAH concentrations, sample CAN046-0461-0000 had total PAH reported at 87 μg/kg. Results for TPH included concentrations reported in samples CAN046-0461-0000, CAN046-0461-0002, CAN046-0462-0000, and CAN046-0463-0002 at 222 mg/kg, 91 mg/kg, 326 mg/kg, and 295 mg/kg, respectively.

7.3.3 Organic Results For Subsurface Soil Samples

The subsurface soil samples collected at this SWMU (CAN046-0461-0004, CAN046-0461-0008, CAN046-0462-0004, CAN046-0462-0008, CAN046-0463-0004, CAN046-0463-0008, were analyzed for VOCs, SVOCs, metals, and TPH as indicated in Table 7-1.

Other than acetone and methylene chloride, which were qualified nondetect after they were determined to be laboratory contaminants (see Section 4.1.4 of the QCSR), the only VOCs reported were toluene in samples CAN046-0461-0004, CAN046-0463-0004, and CAN046-0463-0008, at 3.7 μg/kg, 2.1 μg/kg, and 3.3 μg/kg, respectively, and total xylenes in sample CAN046-0463-0004 at 3.3 μg/kg. No SVOCs were detected above reporting limits. The only results for TPH were concentrations reported for samples CAN046-0461-0004 and CAN046-0463-0004 at 146 mg/kg and 155 mg/kg, respectively.

7.3.4 Inorganic Results

Metals analyses were performed on samples collected from this SWMU as indicated in Table 7-1. The range of results for metals reported in these soil samples are summarized in Table 7-A.

TABLE 7-A

Analyte	Frequency Reported	Lowest Detection	Sample Location	Highest Detection	Sample Location
Aluminum	12/12	1970 mg/kg	0462-0008	10200 mg/kg	0461-0002
					0461-0004
Antimony	3/12	6.3 mg/kg	0463-0004	6.7 mg/kg	0461-0000
					0461-0002
Arsenic	12/12	1.3 mg/kg	0462-0002	2.9 mg/kg	0461-0002
Barium	12/12	77.3 mg/kg	0462-0000	1290 mg/kg	0461-0008
Beryllium	12/12	0.49 mg/kg	0463-0000	0.6 mg/kg	0462-0002
Cadmium	0/12	-	-	-	-
Calcium	12/12	2290 mg/kg	0462-0000	255,000 mg/kg	0462-0004
Chromium	8/12	3.5 mg/kg	0462-0002	8.7 mg/kg	0463-0004
Cobalt	8/12	3.3 mg/kg	0463-0000	4 mg/kg	0463-0004
Copper	10/12	4 mg/kg	0461-0008	8.1 mg/kg	0463-0002
Iron	12/12	1590 mg/kg	0462-0008	9210 mg/kg	0463-0004
Lead	12/12	1.8 mg/kg	0462-0008	29.4 mg/kg	0461-0002
Magnesium	12/12	977 mg/kg	0462-0000	3820 mg/kg	0461-0008
Manganese	12/12	22.1 mg/kg	0462-0008	224 mg/kg	0462-0000
Mercury	0/12	-	-	-	-
Nickel	8/12	6.6 mg/kg	0462-0000	9.2 mg/kg	0463-0002
Potassium	11/12	447 mg/kg	0462-0008	1990 mg/kg	0463-0004
Silver	0/12	-	-	-	-
Selenium	0/12	-	-	-	-
Sodium	0/12	-	-	-	-
Thallium	3/12	0.12 mg/kg	0461-0002	0.13 mg/kg	0463-0002
					0461-0004
Vanadium	12/12	6 mg/kg	0462-0008	22.2 mg/kg	0462-0002
Zinc	10/12	4.3 mg/kg	0462-0008	23.9 mg/kg	0463-0002

Note: See Table 7-3 for comparison to background ranges.

7.4 SWMU-SPECIFIC DATA ASSESSMENT

7.4.1 General

This assessment of the OWS 196 data is an evaluation of quality issues that could affect the major data uses. In general, the objective of the RFI was identification and quantification of the nature and extent of the contamination, which was necessary to meet permit and compliance agreement requirements, and to support an evaluation of the risk to human health and the environment.

7.4.2 Sampling Issues

A review of the data contained in the log books and the Daily Quality Control Reports (DQCRs) for SWMU 46 indicate that there were no sampling issues that would impact data usability. QC issues are discussed in detail in the QCSR in Appendix A, and copies of the DQCRs are included in that appendix.

7.4.3 Data Review Issues

For laboratory analytical data, QA/QC objectives were specified in the Cannon AFB QAPP (W-C 1993). The objectives were used as indicators of the quality necessary to support identification and quantitation of potential chemicals of concern. The data review is presented in Section 4.2 of the Quality Control Summary Report (QCSR) located in Appendix A. As presented in the QCSR, data for the analytes selenium, thallium, and benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, dibenzo(a,h)anthracene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, and di-n-octyl phthalate were qualified as estimated concentrations and nondetected data were qualified rejected **R** in the ambient blank sample CAN046-0462-4651.

Selenium and thallium data were qualified estimated to indicate a potential low bias, and the SVOC data for the analytes listed above were qualified estimated to indicate a potential high bias. When a low bias is indicated, actual concentrations may be higher than the reported results. Use of this data in risk assessment may underestimate risk. Similarly, when a high bias is indicated, actual concentrations may be lower than the reported results. Use of this data in risk assessment may overestimate risk.

Aluminum, antimony, barium, calcium, chromium, manganese, potassium, and zinc data were qualified estimated due to precision that did not meet the QA/QC criteria defined for this project. Poor precision could be attributed to errors in sampling and analysis; however, since the other analytes which were sampled and analyzed in the same procedure (Method 6010) met QA/QC criteria, this variation is likely due to sample heterogeneity.

The uncertainty in the actual concentration reported for estimated data does not affect the usability of the data for identification of chemicals in characterizing the nature and extent of contamination at this SWMU.

7.4.4 Limitations

Elevated reporting limits may limit the usability of the data due to low level analytes being diluted to below the instrument detection limits. That is, chemicals may be reported as nondetect when they are actually present in a sample at low levels. Section 4.2.6 of the QCSR (Appendix A) presents a discussion of elevated reporting limits; however, only VOC data for sample CAN046-0463-0008 had significantly elevated reporting limits (i.e., by a factor of 100 or more). Elevated reporting limits for this sample were due to high analyte detections. There were no other instances of elevated reporting limits in this SWMU. The possibility exists that low level analytes in the above VOC sample have been masked by elevated reporting limits. However, there is no expected impact on the usability of the associated data, because contamination at the SWMU can be sufficiently characterized with samples above and below this location of elevated reporting limits.

7.4.5 Summary

Overall, data generated during the study of SWMU 46 were determined to meet quality criteria. In conjunction with the analytical data review, other information including field observations were evaluated in the assessment of the usability of SWMU 46 data. The data support identification of the nature and extent of contamination and provide reasonable concentrations for use in risk assessment.

7.5 NATURE AND EXTENT OF CONTAMINATION

SWMU 46 is an OWS serving Building 196. Three borings in close proximity to the separator were each advanced to a depth of 10 feet. Two of the three borings had low, but measurable levels of petroleum hydrocarbons in the samples nearest the surface (326 mg/kg maximum), but in general, the samples appeared relatively free of organic contamination. There was no visible evidence of spills or leaks in the vicinity, and the entire area around the separator is paved. Building 196 is on the flight line at Cannon AFB.

7.6 COMPARISON OF METALS CONCENTRATIONS TO BACKGROUND

Metals are natural constituents of soils. SWMU concentrations of metal were evaluated to assess whether the metals in environmental samples exceed background levels. Metals that occur in concentrations within background levels are not considered SWMU-related chemicals of concern and are not evaluated further.

The maximum concentration of each detected metal at each SWMU was compared to the upper tolerance limit of the background data. The upper tolerance limit (UTL) was defined as the mean plus two times the standard deviation. This is for all practical purposes equal to the 90% upper confidence limit of the 95th percentile which is equal to the mean plus the standard deviation times the *k* statistic. The background data set used consisted of 37 data points (W-C 1993), so the *k* statistic equals 2.02 (Gilbert 1987).

Results of the comparison of metal concentrations in soil to background levels for SWMU 46 are given in Table 7-3. A summary of the results of the comparison is presented here.

The maximum detected concentrations of antimony, barium, copper, lead, nickel, thallium, and zinc exceeded the UTL of the background data. Therefore, these metals will be compared to risk-based concentrations at SWMU 46.

7.7 RISK SCREENING

7.7.1 Exposure Pathway Flow Chart

The Preliminary Exposure Pathway Flow Chart (EPFC) applicable to SWMU 46, OWS 196, is shown in Figure 3-2. It shows that the potential exposure pathways are ingestion of soil, inhalation of soil particulates, dermal exposure to contaminated soil, inhalation of airborne chemicals released from soil, and ingestion, inhalation, and dermal exposure to groundwater (if drinking water supplies were affected). Storm water runoff is considered to be an insignificant pathway because potential spills would be minor and over a small area.

7.7.2 Screening of Contaminants Against RBCs (and Other Criteria)

Maximum detected concentrations of organic compounds and metals that exceeded background were compared to screening-level RBCs (see Section 3.4.5.1 for derivations of RBCs) and other screening criteria in Table 7-4. Screening-level criteria other than RBCs include the state of New Mexico's TPH cleanup level of 1,000 mg/kg (New Mexico Environment Department 1993) and the EPA's recommended soil lead level of 500 mg/kg (EPA 1990). The TPH soil clean-up concentration of 1,000 mg/kg is not a risk-based concentration, nor is it a relevant-and-applicable standard for the SWMUs in this investigation. Rather it is a conservative value originally derived for the cleanup of fuel-contaminated soils at underground storage tank sites. Risk-based concentrations for TPH, measured as fresh fuels (e.g., gasoline or diesel), are at least an order of magnitude higher for occupational exposures. The concentration of 500 mg/kg is the most conservative concentration in the recommended range of 500 mg/kg to 1,000 mg/kg as a lead level in residential soil based on EPA's Uptake Biokinetic Model (EPA 1990). Compounds with no toxicity factors cannot be evaluated in the risk screening since RBCs cannot be calculated. These compounds, at the concentrations that were measured, are not likely to significantly affect the results of the comparison to RBCs. The comparison for SWMU 46 shows that maximum detected concentrations of antimony and barium exceed RBCs. Fuels and solvents were not detected above screening-level criteria.

This comparison of maximum detected concentrations to RBCs is very conservative (health-protective) and actual impacts are likely to be lower than those suggested by exceedances of conservative criteria. For example, maximum detected concentrations are likely to overestimate actual concentrations to which people would be exposed. Furthermore, the screening criteria are based on highly conservative residential exposure assumptions and target risk levels that may not be pertinent to current or future use of the SWMU. The RBCs used in this evaluation are calculated using RCRA Action Level methodology; however, the RBCs are more health-protective than conventional RCRA Action Levels because a target excess cancer risk level of 1×10^{-7} (1 in 10,000,000) and a hazard quotient of 0.1 were used to account for exposures to multiple chemicals and for exposure routes other than soil ingestion. Conventional RCRA Action Levels are calculated based on a cancer risk of 1×10^{-6} and a noncancer hazard of 1.0.

The purpose of the comparison to RBCs is to determine whether or not chemical releases (characterized by maximum detected concentrations) have occurred at SWMU 46 that could pose potential risks based on conservative health-based criteria. Only the maximum concentrations of antimony and barium exceed screening-level criteria (by factors of approximately 2).

7.8 SUMMARY AND RECOMMENDATIONS

Twelve soil samples were collected and analyzed from three 10-foot soil borings at SWMU 46. Maximum detected concentrations were compared to background levels and RBCs. Two metals were found at levels that exceeded RBCs.

The highest concentration for barium was found at the 8-foot depth, and the highest concentration of antimony was detected at the 2-foot depth. The highest detected concentration of barium was slightly larger than the range of background concentrations previously measured at the site (Table 7-3). The average concentration for barium in the western United States is 670 ppm (Shacklette and Boerngen 1984) and has a typical range in native soil of 100 to 3,500 ppm (Dragun 1988). There appears to be a trend of higher barium concentrations at approximately the 8-foot depth that is corresponding with a caliche layer in the soil. Barium occurs in veins in limestone with calcite or as residual masses in clay overlying limestone and sandstone. In places, barium acts as a cement in sandstone. The higher barium concentrations may be a result of the carbonate-rich horizons that are common in semiarid and arid soils (Birkeland 1984). If the barium were from contamination, there would be higher levels in the near-surface sample due to its adsorption properties. The high concentration of calcium in these samples is excellent evidence of the caliche layer which is likely to also be the source of the barium.

The maximum concentration of antimony detected at this SWMU was 6.7 mg/kg. The range of naturally-occurring antimony reported for the conterminous United States (Shacklette et al. 1984) is nondetect to 8.8 mg/kg. Therefore, the antimony reported at this SWMU is considered to be at naturally-occurring levels.

Since there is no evidence of a significant release of wastes from this SWMU (i.e., only very low concentrations of organic compounds, most of which are common laboratory

contaminants, were detected), and since there is no evidence that barium and antimony were present in significant quantities in waste streams at this SWMU, it is unlikely that these metals are SWMU-related chemicals. Therefore, it is concluded that these metals are naturally-occurring and are not SWMU-related. Since no SWMU-related chemicals exceeded RBCs, further investigation is not warranted at this SWMU.

The vertical extent of contamination has been characterized by the borings and the potential for groundwater beneath SWMU 46 to be impacted can be characterized. The potential for impacts to groundwater is considered to be low because the detected levels of analytes at SWMU 46 are negligible, the depth to groundwater is greater than 200 feet, evaporation exceeds infiltration, and sampling demonstrated that contaminants are not being transported vertically below the SWMU. Since there is no evidence of a significant release of SWMU-related chemicals, no further action is recommended at this SWMU.

TABLE 7-1

SUMMARY OF ANALYTICAL AND QA/QC SAMPLING
OIL/WATER SEPARATOR NO. 196 (SWMU NO. 46)
CANNON AFB, NEW MEXICO

Sample Location	Target Interval (ft-bgs)	Sample Identification Number	QA/QC Type	Sample Matrix	Analytical Parameters				Sample Containers		
					VOCs	SVOCs	Metals	TRPH	40 ml VOA vials	4 oz. jars	8 oz. jars
Boring 04601	0.5 - 2	CAN046-0461-0000		Soil	X	X	X	X		2	1
	2 - 4	CAN046-0461-0002		Soil	X		X	X		2	1
	4 - 6	CAN046-0461-0004		Soil	X		X	X		2	1
	8 - 10	CAN046-0461-0008		Soil	X	X	X	X		2	1
	8 - 10	CAN046-0461-6008	MS/MSD	Soil	X	X	X	X		2	2
Boring 04602	0.5 - 2	CAN046-0462-0000		Soil	X		X	X		2	1
	2 - 4	CAN046-0462-0002		Soil	X		X	X		2	1
	4 - 6	CAN046-0462-0004		Soil	X		X	X		2	1
	8 - 10	CAN046-0462-0008		Soil	X		X	X		2	1
Boring 04603	0.5 - 2	CAN046-0463-0000		Soil	X	X	X	X		2	1
	0.5 - 2	CAN046-0463-4661	FD	Soil	X	X	X	X		2	1
	2 - 4	CAN046-0463-0002		Soil	X		X	X		2	1
	4 - 6	CAN046-0463-0004		Soil	X		X	X		2	1
	8 - 10	CAN046-0463-0008		Soil	X	X	X	X		2	1
	8 - 10	CAN046-0463-4662	FD	Soil	X		X	X		2	1
	8 - 10	CAN046-0463-4601	MRD	Soil	X	X	X	X		2	1
		CAN046-0463-4651	AB	Water	X				2		
		CAN046-0463-4671	RB	Water	X				2		
		CAN046-0463-4681	DW	Water	X				2		
		CAN046-0463-4691	TB	Water	X				2		

AB = Ambient blank
DW = Decontamination water
FB = Field blank
MRD = Missouri River Division
MS/MSD = Matrix spike/matrix spike duplicate
RB = Rinsate blank
TB = Trip blank
See Figure 7-1 for locations of the borings.

TABLE 7-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 46

LOCATOR	CAN046-0461-0000			CAN046-0461-0002			CAN046-0462-0000			CAN046-0462-0002			CAN046-0463-0000			CAN046-0463-0002		
LAB SAMPLE NUMBER	0314030010SA			0314030011SA			0314010013SA			0314010014SA			0314030015SA			0314030016SA		
COLLECT DATE	09/24/93			09/24/93			09/23/93			09/23/93			09/24/93			09/24/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)																		
Ethylbenzene	1.5	5.9	J	<	6	U	<	5.7	U	<	5.9	U	<	5.3	U	<	5.8	U
Toluene	2.6	5.9	J	1.5	6	J	<	5.7	U	<	5.9	U	1.2	5.3	J	15	5.8	
1,1,1-Trichloroethane	<	5.9	U	<	6	U	<	5.7	U	4.3	5.9	J	<	5.3	U	<	5.8	U
Xylenes (total)	5.4	5.9	J	2.5	6	J	<	5.7	U	<	5.9	U	2.6	5.3	J	<	5.8	U
Semivolatile Organics (ug/kg)																		
Benzo(b)fluoranthene	<	390	J										46	350	J			
Fluoranthene	47	390	J										48	350	J			
Fluorene	40	390	J										<	350	U			
Pyrene	<	390	U										70	350	J			
Metals (mg/kg)																		
Aluminum	9270	11.9		10200	11.9		5210	11.4		6250	23.4		9290	10.6	J	9300	11.6	
Antimony	6.7	7.1	J	6.7	7.2	J	<	6.8	U	<	14.1	U	<	6.4	U	<	7	U
Arsenic	2.5	0.59		2.9	0.6		1.6	0.57		1.3	0.59		2.2	0.53		2.8	0.58	
Barium	188	1.2		587	1.2		77.3	1.1		632	2.3		144	1.1	J	381	1.2	
Beryllium	0.56	0.24		0.51	0.24		0.52	0.23		0.6	0.47		0.49	0.21		0.54	0.23	
Calcium	66400	23.8		85200	23.9		2290	22.8		129000	46.8		26200	21.2		61200	23.2	
Chromium	7.3	1.2		6.2	1.2		6.2	1.1		3.5	2.3		8.1	1.1	J	7.7	1.2	
Cobalt	3.6	1.2		3.7	1.2		3.5	1.1		3.5	2.3		3.3	1.1		3.7	1.2	
Copper	7.4	2.4		6.1	2.4		5.7	2.3		6.1	4.7		6.7	2.1	J	8.1	2.3	
Iron	8300	11.9		8040	11.9		6650	11.4		5880	23.4		8490	10.6		9140	11.6	
Lead	23.1	3		29.4	6		5.8	0.57		3.5	0.59		20.2	2.7		17.1	2.9	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 7-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 46

LOCATOR	CAN046-0461-0000			CAN046-0461-0002			CAN046-0462-0000			CAN046-0462-0002			CAN046-0463-0000			CAN046-0463-0002		
LAB SAMPLE NUMBER	0314030010SA			0314030011SA			0314010013SA			0314010014SA			0314030015SA			0314030016SA		
COLLECT DATE	09/24/93			09/24/93			09/23/93			09/23/93			09/24/93			09/24/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Magnesium	2370	23.8		2740	23.9		977	22.8		2180	46.8		1900	21.2		2580	23.2	
Manganese	153	1.2		132	1.2		224	1.1		118	2.3		172	1.1		172	1.2	
Nickel	8.4	4.8		8.5	4.8		6.6	4.6		<	9.4	U	8.1	4.2		9.2	4.6	
Potassium	1680	595		1890	597		1150	569		1340	1170		1800	531	J	1890	579	
Thallium	<	0.59	U	0.12	0.6	J	<	0.57	U	<	1.2	J	<	0.53	U	0.13	0.58	J
Vanadium	17.8	1.2		18.9	1.2		16.9	1.1		14.4	2.3		18.5	1.1		22.2	1.2	
Zinc	22	2.4		20.9	2.4		14.1	2.3		14.9	4.7		22.1	2.1	J	23.9	2.3	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	225	47.6		91	47.8		<	45.5	U	<	46.8	U	326	42.4		295	46.3	
Water Quality (percent)																		
Water	16	0.1		16	0.1		12	0.1		15	0.1		5.8	0.1		14	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 7-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 46

LOCATOR	CAN046-0461-0004			CAN046-0461-0008			CAN046-0462-0004			CAN046-0462-0008			CAN046-0463-0004			CAN046-0463-0008		
LAB SAMPLE NUMBER	0314030012SA			0314030013SA			0314010015SA			0314010016SA			0314030017SA			0314030018RA		
COLLECT DATE	09/24/93			09/24/93			09/23/93			09/23/93			09/24/93			09/24/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)																		
Toluene	3.7	5.8	J	<	6	U	<	6.1	U	<	5.8	U	2.1	5.8	J	2.4	5	J
Xylenes (total)	<	5.8	U	<	6	U	<	6.1	U	<	5.8	U	3.3	5.8	J	<	5	U
Semivolatile Organics (ug/kg)																		
Fluoranthene				<	390	U												
Phenanthrene				<	390	U												
Metals (mg/kg)																		
Aluminum	10200	11.5		4210	59.8		2580	61.2		1970	57.5		9190	11.6				
Antimony	<	6.9	U	<	35.9	U	<	36.7	U	<	34.5	U	6.3	7	J			
Arsenic	2.6	0.58		2.2	0.6		1.8	0.61		1.5	0.58		2.5	0.58				
Barium	163	1.2		1290	6		140	6.1		275	5.8		132	1.2				
Beryllium	0.54	0.23		<	1.2	U	<	1.2	U	<	1.2	U	0.59	0.23				
Calcium	46200	23		204000	120		255000	122		243000	115		25800	23.2				
Chromium	8.1	1.2		<	6	U	<	6.1	U	<	5.8	U	8.7	1.2				
Cobalt	3.6	1.2		<	6	U	<	6.1	U	<	5.8	U	4	1.2				
Copper	7.2	2.3		4	12	J	<	12.2	U	<	11.5	U	7.6	2.3				
Iron	8810	11.5		3580	59.8		2490	61.2		1590	57.5		9210	11.6				
Lead	20.5	2.9		3.1	0.6		2.8	1.2		1.8	0.58		18.5	2.9				
Magnesium	2220	23		3820	120		3180	122		3050	115		2010	23.2				
Manganese	171	1.2		39.6	6		30.8	6.1		22.1	5.8		206	1.2				
Nickel	8.9	4.6		<	23.9	U	<	24.5	U	<	23	U	8.4	4.6				
Potassium	1880	575		1260	2990	J	<	3060	U	447	2880	J	1990	580				

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 7-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 46

LOCATOR	CAN046-0461-0004			CAN046-0461-0008			CAN046-0462-0004			CAN046-0462-0008			CAN046-0463-0004			CAN046-0463-0008		
LAB SAMPLE NUMBER	0314030012SA			0314030013SA			0314010015SA			0314010016SA			0314030017SA			0314030018RA		
COLLECT DATE	09/24/93			09/24/93			09/23/93			09/23/93			09/24/93			09/24/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Thallium	0.13	0.58	J	<	1.2	U	<	1.2	J	<	1.2	J	<	0.58	U			
Vanadium	19.2	1.2		14.4	6		9.8	6.1		6	5.8		20	1.2				
Zinc	23.3	2.3		8.1	12	J	<	12.2	U	4.3	11.5	J	22.4	2.3				
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	146	46		<	47.9	U	<	49	U	<	46	U	155	46.4				
Water Quality (percent)																		
Water	13	0.1		16	0.1		18	0.1		13	0.1		14	0.1				

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 7-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 46

LOCATOR	CAN046-0463-0008		
LAB SAMPLE NUMBER	0314030018SA		
COLLECT DATE	09/24/93		
	Result	RL	Qual
Volatile Organics (ug/kg)			
Toluene	<	580	U
Xylenes (total)	<	580	U
Semivolatile Organics (ug/kg)			
Fluoranthene	45	380	J
Phenanthrene	39	380	J
Metals (mg/kg)			
Aluminum	4030	57.6	
Antimony	<	34.6	U
Arsenic	1.7	0.58	
Barium	165	5.8	
Beryllium	<	1.2	U
Calcium	224000	115	
Chromium	<	5.8	U
Cobalt	<	5.8	U
Copper	4.4	11.5	J
Iron	3330	57.6	
Lead	2.2	0.58	
Magnesium	3530	115	
Manganese	39.7	5.8	
Nickel	<	23	U
Potassium	977	2880	J

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 7-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 46

LOCATOR	CAN046-0463-0008		
LAB SAMPLE NUMBER	0314030018SA		
COLLECT DATE	09/24/93		
	Result	RL	Qual
Thallium	<	1.2	U
Vanadium	13.9	5.8	
Zinc	<	11.5	U
TPH (mg/kg)			
Total Petroleum Hydrocarbons	<	46.1	U
Water Quality (percent)			
Water	13	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix ___.
J = Estimated value.
R = Rejected value. D = Sample was diluted for analysis.
U = Nondetected value. RL = Reporting Limit.

TABLE 7-3

COMPARISON OF MAXIMUM DETECTED METAL CONCENTRATIONS TO BACKGROUND(1)
SWMU 46, CANNON AFB
Oil/Water Separator No. 196

Sample ID	Metal	Maximum detected concentration	Range of background concentrations (2)	Upper tolerance limit (UTL) background concentration(3)	Does maximum detected exceed UTL background
CAN046-0461-0004	Aluminum	10200	1410 - 11,000	10,540	N
CAN046-0461-0002	Antimony	6.7	<5 - <13	*	Y
CAN046-0461-0002	Arsenic	2.9	0.67 - 28	15.5	N
CAN046-0461-0008	Barium	1290	14.5 - 1200	642	Y
CAN046-0462-0002	Beryllium	0.6	0.17 - 0.77	0.73	N
CAN046-0463-0004	Chromium	8.7	4 - 15.4	12.5	N
CAN046-0463-0004	Cobalt	4	0.85 - 5.3	4.5	Y
CAN046-0463-0002	Copper	8.1	<2 - 18.4	*	Y
CAN046-0461-0002	Lead	29.4	1.1 - 46	25.8	Y
CAN046-0463-0002	Nickel	9.2	1.3 - 9.8	9	Y
CAN046-0463-0002	Thallium	0.13	0.14 - <0.23	*	Y
CAN046-0463-0002	Vanadium	22.2	5.2 - 28.3	25.3	N
CAN046-0463-0002	Zinc	23.9	<4.3 - 27.5	21.9	Y

(1) All units in mg/kg.
(2) Compiled from data collected by Woodward Clyde for the RFI and RI (WCC 1992 and WCC 1993) and Walk, Haydel and Associates for the IRP (Walk, Haydel and Associates 1990).
Summarized in "Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater at Cannon AFB, NM (WCC 1993)
(3) Upper Tolerance Limit (UTL) of the mean = mean + 2*standard deviation. This is for all practicle purposes the same as the 90% upper confidence limit of the 95th percentile where UTL = mean + standard deviation *k, where k=2.02 for n=37 .
* Data insufficient to calculate UTL of background concentration

TABLE 7-4

COMPARISON OF MAXIMUM CONCENTRATIONS WITH RBCs(1)
SWMU 46, CANNON AFB
Oil/Water Separator No. 196

Sample ID	Analyte	Maximum Detected	RBC (2)	Maximum Detected Exceed RBC
CAN046-0462-0002	1,1,1-Trichloroethane	0.0043	700	N
CAN046-0461-0002	**Antimony**	**6.7**	**3**	**Y**
CAN046-0461-0008	**Barium**	**1290**	**600**	**Y**
CAN046-0463-0000	Benzo(b)fluoranthene	0.046	0.07	N
CAN046-0463-0002	Copper	8.1	300	N
CAN046-0461-0000	Ethylbenzene	0.0015	800	N
CAN046-0463-0000	Fluoranthene	0.048	300	N
CAN046-0461-0000	Fluorene	0.04	300	N
CAN046-0461-0002	Lead (3)	29.4	500	N
CAN046-0463-0002	Nickel	9.2	200	N
CAN046-0463-0008	Phenanthrene	0.039	NTF	N
CAN046-0463-0000	Pyrene	0.07	200	N
CAN046-0463-0002	Thallium	0.13	6	N
CAN046-0463-0002	Toluene	0.015	2000	N
CAN046-0463-0000	Total Petroleum Hydrocarbons (4)	326	1000	N
CAN046-0461-0000	Xylenes (total)	0.0054	20000	N
CAN046-0463-0002	Zinc	23.9	2000	N

NTF = No EPA Established Toxicity Factor

(1) All units in mg/kg

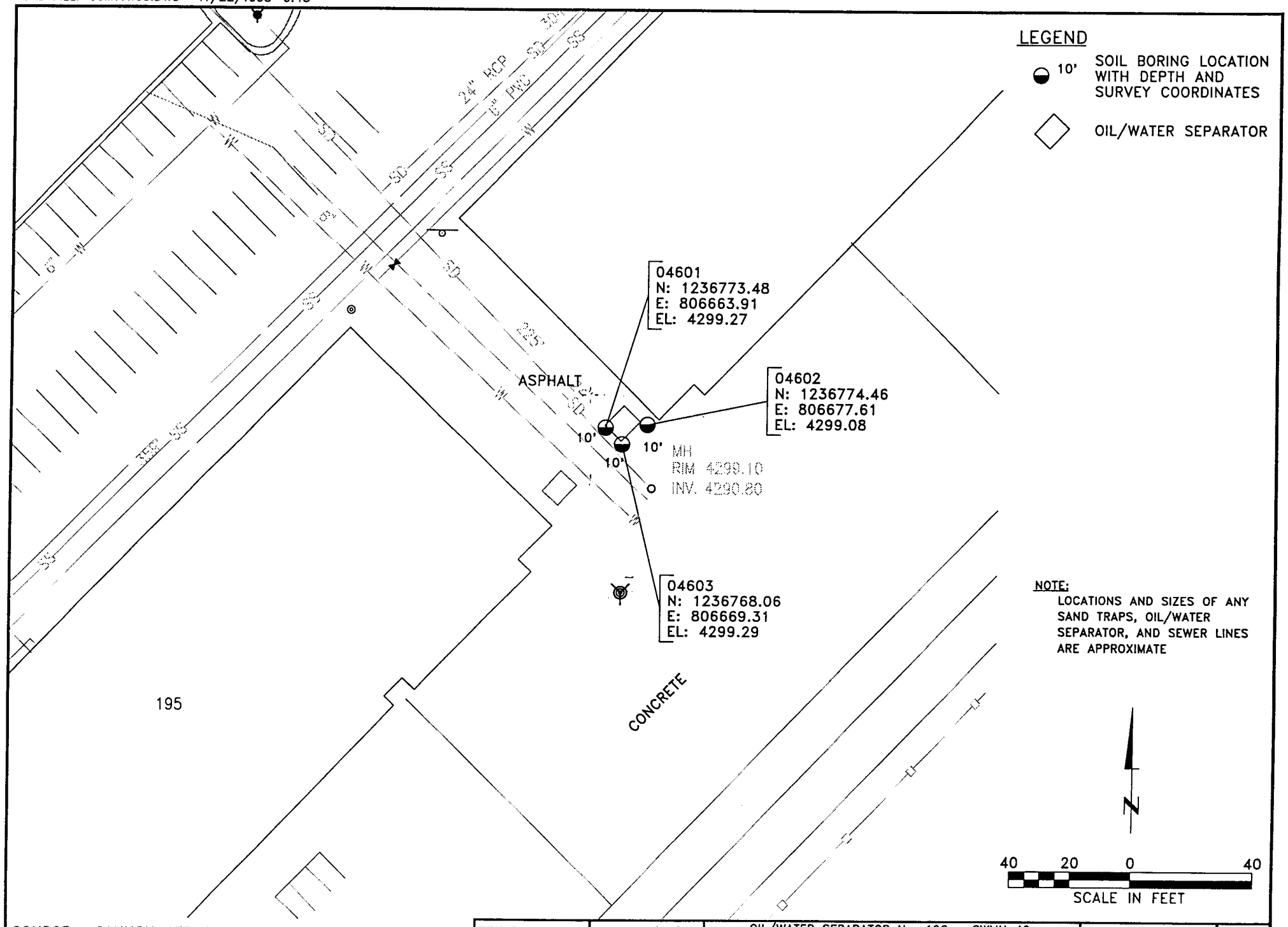
(2) Risk-based concentration

(3) EPA suggests 500-1,000 mg/kg as allowable concentration for residential soils based on EPA's IUBK Lead Model (EPA 1990)

(4) New Mexico recommended soil cleanup level for fuel contaminated soil.

Note: Only metals that exceeded background appear in this table.

CAD FILE: COMHW03.DWG 11/22/1993 9:13



SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

DRN BY: CJG	DATE: 08/16/93	OIL/WATER SEPARATOR No. 196 – SWMU 46 SITE PLAN AND BORING LOCATIONS CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W	FIG. NO. 7–1
CHK'D BY: .	REVISION: 0			

8.1 SITE BACKGROUND

8.1.1 Site Description

This SWMU includes OWS 494, located beneath the asphalt drive adjacent to the northeast wall of Building 494 (Auto Hobby Shop), and a large sand trap located at the east corner of the building. The OWS consists of an underground concrete unit with a 50-gallon main compartment and a 50-gallon oil compartment. The OWS measures about 1 foot by 2.5 feet, with a depth estimated to be less than 10 feet. The 200-gallon concrete sand trap measures 4 feet by 5 feet in plan and extends about 4 feet below the ground surface in a grassy area near the southeast corner of Building 494 (Figure 8-1). The OWS and sand trap receive wash water generated from personal vehicle maintenance operations by off-duty Air Force personnel in the Auto Hobby Shop housed within Building 494.

8.1.2 Site History

The OWS reportedly receives wash down water via floor sump and drain pipe in the main shop area of Building 494. The sand trap reportedly receives wash water from the engine/auto wash and prep stall at the southeast corner of Building 494. The OWS and sand trap have been active since 1982.

8.1.3 Current Use

The oils recovered by the OWS are directed to the 50-gallon holding tank in the OWS, and the waste water is discharged to the sanitary sewer line. The sand trap catches debris from engine steam-cleaning and body washing before directing the wastewater to the sanitary sewer.

8.1.4 Potential Contaminants

Potential contaminants at this SWMU include petroleum and synthetic lubricating oils, fuels, greases, solvents, paints chips, and metals.

8.2 FIELD INVESTIGATION AND DATA COLLECTION

8.2.1 Soils Sampling

Five 10-foot soil borings were drilled and sampled to determine the presence and extent of a possible SWMU-related chemical release from these sources. All borings were located as close as possible around the targeted structures. Three borings at the OWS were drilled using a drill rig and hollow-stem augers, while two hand borings were advanced in soils around the sand trap. Heavy utility interference around the sand trap disallowed the originally proposed boring sites. The two boring locations which were cleared near the sand trap were several feet away from the sand trap's inflow and outflow lines to provide for field personnel safety. Boring 04704 was located approximately 5 feet northwest of its originally proposed location at the sand trap inlet near Building 494. Boring 04705 was located approximately 7 feet southeast of its originally proposed location at the sand trap outlet. These sampling locations are close enough to encounter any significant contamination from the sand trap.

Soil samples were collected from the 0- to 0.5-foot, 2- to 4-foot, 4- to 6-foot, and 8- to 10-foot depth intervals of Boring 04701, 0.5- to 2-foot, 2- to 4-foot, 4- to 6-foot, and 8- to 10-foot depth intervals of Borings 04702 and 04703, and 0- to 0.5-foot, 1.5- to 3.5-foot, 4- to 6-foot, and 8- to 10-foot depth intervals of Borings 04704 and 04705 as specified in the Field Sampling Plan and the Sample Summary Tables. Samples from the upper interval were taken from the soils immediately underlying pavement where encountered or approximately 0.2 to 0.5 feet below the surface in vegetated areas to provide a worst-case situation for risk assessment purposes in the event that semivolatile contamination was discovered during this investigation. Target analytes for samples collected included VOCs, SVOCs, metals, and TRPH. Surficial and subsurface soil samples were collected in accordance with QAPP SOP No. 6 - Surficial Soil Sampling and No. 7 - Subsurface Soil Drilling and Sampling. No visual evidence of contamination was observed on the asphalt surface or in the soil samples collected from this SWMU.

8.2.2 Geologic Summary of Boring Logs

Borings 04701, 04702, and 04703 were drilled through asphalt pavement 0.4 feet thick. The locations of Borings 04704 and 04705 had a soil surface. Drill logs indicate probable fill consisting of a hard, red, sandy-silty clay from the surface to a depth of 4 to 5 feet. This soil is moist with concrete chips in the upper interval of Boring 04704. A dry and hard, light yellowish-white sandy clay with red mottling throughout and some gravel was encountered at approximately 4 feet. A caliche zone 3 to 4.3 feet thick, consisting of hard, dry, light yellowish white, fine silty sand was encountered at a depth of 4 to 4.7 feet in Borings 04704 and 04705 before reentering the light colored, mottled clay. Increased moisture content found in the upper portions of the soil borings may be attributable to precipitation percolating through cracks in the pavement or domestic water use on the soil covered areas. Downward penetration of fluids is likely retarded or prevented by the thick layer of caliche. (See boring logs in Appendix B - Volume IV.)

8.2.3 Site Topography

The site is virtually flat with a slight gradient draining runoff to the northeast. The OWS is located beneath an asphalt driveway, and the sand trap is located beneath soil vegetated with shrubs.

8.3 CHEMICAL INVESTIGATION RESULTS

8.3.1 General

Samples were collected as identified in Section 8.2 to comply with permit and compliance agreement requirements. Soil samples were collected from 5 borings (04701, 04702, 04703, 04704, and 04705). Sampling and analyses performed are summarized in Table 8-1. A summary of the analytical results for these soil samples is provided in Table 8-2a for near surface soils and Table 8-2b for subsurface soils. For each sample type, the tables provide results for analytes only if they were detected at least once in this type of sample collected at the SWMU. Complete analytical summary results are provided in the QCSR (Appendix A).

8.3.2 Organic Results For Near-surface Soil Samples

The near-surface soil samples collected at this SWMU (CAN047-0471-0000, CAN041-0471-0002, CAN047-0472-0000, CAN047-0472-0002, CAN047-0473-0000, CAN047-0473-0002, CAN047-0474-0000, CAN047-0474-0002, CAN047-0475-0000 and CAN047-0475-0002) were analyzed for VOCs, SVOCs, metals and TPH as indicated in Table 8-1.

Other than acetone, 2-butanone, and methylene chloride, which were qualified nondetected after they were determined to be laboratory contaminants (see Section 4.3.4 of the QCSR), the only VOCs reported were toluene and xylene. Toluene was detected in samples CAN047-0475-0000, CAN047-0472-003, CAN047-0473-0000, CAN047-0474-0000, CAN047-0474-0002 and CAN047-0475-0002 at 1.2 μg/kg, 1.6 μg/kg, 1.8 μg/kg, 2.4 μg/kg, 2.6 μg/kg and 4.8 μg/kg, respectively. Xylene was detected in samples CAN047-0474-0002, CAN047-0474-0000, CAN047-0473-0000, CAN047-0475-0002, and CAN047-0475-0000 at 2 μg/kg, 2.6 μg/kg, 2.8 μg/kg, 6.2 μg/kg and 6.4 μg/kg, respectively.

Other than bis(2-ethylhexyl)phthalate and di-n-butylphthalate, which were considered common laboratory contaminants, results reported for SVOCs were primarily polycyclic aromatic hydrocarbons (PAHs), benzo(b)fluoranthene, fluoranthene, and pyrene. These PAHs were detected in samples CAN047-0474-0000 and CAN047-0475-0000. Summing PAH concentrations, for sample CAN047-0474-0000 the total PAH concentration was 131 μg/kg, and for CAN047-0475-0000 the total PAH concentration was 122 μg/kg. Butyl benzyl phthalate was detected in sample CAN047-0474-0000 at 100 μg/kg and in CAN047-0475-0000 at 210 μg/kg. Petroleum hydrocarbons were detected in samples CAN047-0473-0000, CAN047-0472-0000, CAN047-0474-0002, CAN047-0474-0000, CAN047-0475-0000, and CAN047-0475-0002 at 46.2 mg/kg, 56.2 mg/kg, 56.5 mg/kg, 74.2 mg/kg, 76.6 mg/kg, and 198 mg/kg, respectively.

8.3.3 Organic Results For Subsurface Soil Samples

The subsurface soil samples collected at this SWMU (CAN047-0471-0004, CAN047-0471-0008, CAN047-0472-0004, CAN047-0472-0008, CAN047-0473-0004, CAN047-0473-0008, CAN047-0474-0004, CAN047-0474-0008, CAN047-0475-0004 and CAN047-0475-0008)

were analyzed for VOCs, SVOCs, metals, and TPH as indicated in Table 8-1. No organic compounds were detected above reporting limits for the subsurface samples.

8.3.4 Inorganic Results

Metals analyses were performed on samples collected from this SWMU as indicated in Table 8-1. The range of results for metals reported in these soil samples are summarized in Table 8-A:

TABLE 8-A

Analyte	Frequency Reported	Lowest Detection	Sample Location	Highest Detection	Sample Location
Aluminum	20/20	2540 mg/kg	0472-0004	9090 mg/kg	0471-0000
Antimony	2/20	1.5 mg/kg	0471-0002 0471-0008		
Arsenic	20/20	1.2 mg/kg	0472-0008	3.0 mg/kg	0474-0002
Barium	20/20	89 mg/kg	0475-0000	428 mg/kg	0471-0004
Beryllium	18/20	0.15 mg/kg	0475-0004	0.67 mg/kg	0471-0000
Cadmium	7/20	0.57 mg/kg	0473-0002	3.3 mg/kg	0471-0004
Calcium	20/20	4560 mg/kg	0471-0000	255,000 mg/kg	0473-0002
Chromium	17/20	2.3 mg/kg	0471-0004	10.8 mg/kg	0471-0000
Cobalt	18/20	1.3 mg/kg	0473-0004	5.4 mg/kg	0471-0000
Copper	18/20	1.5 mg/kg	0472-0008	9.3 mg/kg	0471-0000
Iron	20/20	2060 mg/kg	0472-0008	9970 mg/kg	0474-0002
Lead	20/20	1.2 mg/kg	0472-0004	15.4 mg/kg	0474-0000
Magnesium	20/20	2060 mg/kg	0472-0008	9970 mg/kg	0474-0000
Manganese	20/20	27.7 mg/kg	0472-0004	240 mg/kg	0471-0000
Mercury	0/16	-	-	-	-
Nickel	17/20	4.3 mg/kg	0471-0008	906 mg/kg	0471-0000
Potassium	19/20	558 mg/kg	0472-0004	1860 mg/kg	0471-0000
Selenium	1/20	0.24 mg/kg	0474-0000	(Only detection)	
Silver	5/20	0.33 mg/kg	0473-0000	0.64 mg/kg	0471-0008
Sodium	10/20	163 mg/kg	0471-0008	609 mg/kg	0471-0002
Thallium	0/20	-	-	-	-
Vanadium	20/20	6.6 mg/kg	0472-0008	24.6 mg/kg	0471-0000
Zinc	20/20	6.3 mg/kg	0472-0008	32.2 mg/kg	0474-0000

Note: See Table 8-3 for comparison to background ranges.

8.4 SWMU-SPECIFIC DATA ASSESSMENT

8.4.1 General

This assessment of OWS 494 data is an evaluation of quality issues that could affect the major data uses. In general, the objective of the RFI was identification and quantification of the nature and extent of the contamination, which was necessary to meet permit and compliance agreement requirements, and to support an evaluation of the risk to human health and the environment.

8.4.2 Sampling Issues

A review of the data contained in the log books and the Daily Quality Control Reports (DQCRs) for SWMU 31 indicate that there were no sampling issues that would impact data usability. QC issues are discussed in detail in the QCSR in Appendix A, and copies of the DQCRs are included in that appendix.

8.4.3 Data Review Issues

For laboratory analytical data, QA/QC objectives were specified in the Cannon AFB QAPP (W-C 1993). The objectives were used as indicators of the quality necessary to support identification and quantitation of potential chemicals of concern. The data review is presented in Section 4.1 of the Quality Control Summary Report (QCSR) located in Appendix A. As presented in the QCSR, data for the following metals: aluminum, chromium, potassium, magnesium, manganese, nickel, selenium, and thallium were qualified as estimated concentrations, and barium data were qualified rejected.

Selenium and thallium data were qualified estimated to indicate a potential low bias. When a low bias is indicated, actual concentrations may be higher than the reported results. Use of this data in risk assessment may underestimate risk. Aluminum, chromium, magnesium, manganese, potassium, and nickel were qualified "estimated" due to precision that did not meet the QA\QC criteria defined for this project. Poor precision could be attributed to errors in sampling and analysis; however, since the other analytes which were sampled and analyzed

in the same procedure (Method 6010) met QA/QC criteria, this variation is likely due to sample heterogeneity.

For ICP metals analyses, the only indicator of data accuracy is the results of the matrix spike. Barium data were rejected based on conflicting MS/MSD recoveries (> 200 percent and < 40 percent). Because the accuracy criteria have been exceeded and was conflicting, it can not be determined whether the identification or the quantification of barium data can be relied upon; therefore, the data were rejected.

Five SVOC compounds were qualified estimated to indicate a low bias. Also, nine VOC compounds were qualified estimated to indicate that the GC/MS may be less sensitive to the compounds (see Appendix A Section 4.3.2). All of the associated data was reported nondetect except for toluene and xylene for sample CAN047-0474-0000. Use of this data in risk assessment may underestimate the health risk.

The uncertainty in the actual concentration reported for estimated data does not affect the usability of the data for identification of chemicals in characterizing the nature and extent of contamination at this SWMU.

8.4.4 Limitations

Elevated reporting limits may limit the usability of the data due to low level analytes being diluted to below the instrument detection limits. That is, chemicals may be reported as nondetect when they are actually present in a sample at low levels. Section 4.3.6 of the QCSR (Appendix A) presents a discussion of elevated reporting limits; however, only lead had elevated reporting limits. The elevated reporting limits for lead were not considered to be limiting because they were only elevated by a factor of 5 and lead was detected above the elevated reporting limit.

8.4.5 Summary

Overall, data generated during the study of SWMU 47 were determined to meet quality criteria. In conjunction with the analytical data review, other information including field observations were evaluated in the assessment of the usability of SWMU 47 data. The data

support identification of the nature and extent of contamination, except for barium data, and provide reasonable concentrations for use in risk assessment.

8.5 NATURE AND EXTENT OF CONTAMINATION

SWMU 47 is comprised of two units. The first is an OWS serving Building 494 (the Auto Hobby Shop), and the second is a sand trap serving the engine wash and prep room in Building 494. Three borings in close proximity to the separator and two borings near the sand trap were each advanced to a depth of 10 feet. In general, the samples appeared relatively free of organic contamination. There was no visible evidence of spills or leaks in the vicinity, and the entire area around the separator is paved. The sand trap is beneath a grass and planter area at the southeast corner of the building. The chemical test results do not show any significant organic contamination.

8.6 COMPARISON OF METALS CONCENTRATIONS TO BACKGROUND

Metals are natural constituents of soils. SWMU concentrations of metals were evaluated to assess whether the metals in environmental samples exceed background levels. Metals that occur in concentrations within background levels are not considered SWMU-related chemicals of concern and are not evaluated further.

The maximum concentration of each detected metal at each SWMU was compared to the upper tolerance limit of the background data. The upper tolerance limit (UTL) was defined as the mean plus two times the standard deviation. This is for all practical purposes equal to the 90 percent upper confidence limit of the 95th percentile which is equal to the mean plus the standard deviation times the k statistic. The background data set used consisted of 37 data points (W-C 1993), so the k statistic equals 2.02 (Gilbert 1987).

Results of the comparison of metal concentrations in soil to background levels for SWMU 47 are given in Table 8-3. A summary of the results of the comparison is presented here.

Antimony, cadmium, calcium, cobalt, copper, iron, manganese, nickel, selenium, silver, sodium, and zinc were determined to statistically exceed basewide background levels. These metals will, therefore, be evaluated in the risk screening.

8.7 RISK SCREENING

8.7.1 Exposure Pathway Flow Chart

The Preliminary Exposure Pathway Flow Chart (EPFC) applicable to SWMU 47, OWS 494, is shown in Figure 3-2. It shows that the potential exposure pathways are ingestion of soil, inhalation of soil particulates, dermal exposure to contaminated soil, inhalation of airborne chemicals released from soil, and ingestion, inhalation, and dermal exposure to groundwater (if drinking water supplies were affected). Storm water runoff is considered to be an insignificant pathway because potential spills would be minor and over a small area.

8.7.2 Screening of Contaminants Against RBCs and Other Criteria

Maximum detected concentrations of organic compounds and metals that exceeded background were compared to screening-level RBCs (see Section 3.4.5.1 for derivations of RBCs) and other screening criteria in Table 8-4. Screening-level criteria other than RBCs include the state of New Mexico's TPH clean-up level of 1,000 mg/kg (NMED 1993) and the EPA's recommended soil lead level of 500 mg/kg (EPA 1990). The TPH soil clean-up concentration of 1,000 mg/kg is not an RBC, nor is it a relevant-and-applicable standard for the SWMUs in this investigation. Rather it is a conservative value originally derived for the cleanup of fuel-contaminated soils at underground storage tank sites. Risk-based concentrations for TPH, measured as fresh fuels (e.g., gasoline or diesel), are at least an order of magnitude higher for occupational exposures. The concentration of 500 mg/kg is the most conservative concentration in the recommended range of 500 mg/kg to 1,000 mg/kg as a lead level in residential soil based on EPA's Uptake Biokinetic Model (EPA 1990). Compounds with no toxicity factors cannot be evaluated in the risk screening since RBCs cannot be calculated. These compounds, at the concentrations that were measured in soil, are not likely to significantly affect the results of the comparison to RBCs. The comparison for SWMU 47 shows that no maximum detected concentration exceeds RBCs.

This comparison of maximum detected concentrations to RBCs is very conservative (health-protective) and actual impacts are likely to be lower than those suggested by exceedances of conservative criteria. For example, maximum detected concentrations are

likely to overestimate actual concentrations to which people would be exposed. Furthermore, the screening criteria are based on highly conservative residential exposure assumptions and target risk levels that may not be pertinent to current or future use of the SWMU. The RBCs used in this evaluation are calculated using RCRA Action Level methodology; however, the RBCs are more health-protective than conventional RCRA Action Levels because a target excess cancer risk level of 1×10^{-7} (1 in 10,000,000) and a hazard quotient of 0.1 were used to account for exposures to multiple chemicals and for exposure routes other than soil ingestion. Conventional RCRA Action Levels are calculated based on a cancer risk of 1×10^{-6} and a noncancer hazard of 1.0.

The purpose of the comparison to RBCs is to determine whether or not chemical releases (characterized by maximum detected concentrations) have occurred at SWMU 47 that could pose potential risks based on conservative health-based criteria. Since no maximum concentrations of analytes exceed RBCs, further evaluation or investigation of chemical concentrations and probable exposures is not warranted.

8.8 SUMMARY AND RECOMMENDATIONS

Twenty soil samples were collected and analyzed from five soil borings at SWMU 47. Maximum detected concentrations were compared to background levels and RBCs. Organic compounds and metals were not found at levels that exceeded RBCs or other screening-level criteria.

The highest concentrations for all detected analytes were found in the near-surface soils. The concentrations decreased with depth in all cases except for acetone and 2-butanone, which were highest at the 4-foot depth, and they are considered laboratory artifacts; therefore, the vertical extent of contamination has been characterized by the borings, and the potential for groundwater beneath SWMU 47 to be impacted can be characterized. The potential for impacts is considered to be low because the detected levels of analytes are negligible (all below RBCs) and the depth to groundwater is greater than 200 feet. Therefore, no further action is recommended at SWMU 47.

TABLE 8-1

SUMMARY OF ANALYTICAL AND QA/QC SAMPLING
OIL/WATER SEPARATOR NO. 494 (SWMU NO. 47)
CANNON AFB, NEW MEXICO

Sample Location	Target Interval (ft-bgs)	Sample Identification Number	QA/QC Type	Sample Matrix	Analytical Parameters				Sample Containers		
					VOCs	SVOCs	Metals	TRPH	40 ml VOA vials	4 oz. jars	8 oz. jars
Boring 04701	0 - 0.5	CAN047-0471-0000		Soil	X	X	X	X		2	1
	2 - 4	CAN047-0471-0002		Soil	X		X	X		2	1
	4 - 6	CAN047-0471-0004		Soil	X		X	X		2	1
	8 - 10	CAN047-0471-0008		Soil	X	X	X	X		2	1
	8 - 10	CAN047-0471-6008	MS/MSD	Soil	X	X	X	X		2	2
		CAN047-0471-4751	AB	Water	X				2		
		CAN047-0471-4771	RB	Water	X				2		
		CAN047-0471-4781	DW	Water	X				2		
		CAN047-0471-4791	TB	Water	X				2		
Boring 04702	0.5 - 2	CAN047-0472-0000		Soil	X	X	X	X		2	1
	0.5 - 2	CAN047-0472-4761	FD	Soil	X	X	X	X		2	1
	0.5 - 2	CAN047-0472-4701	MRD	Soil	X	X	X	X		2	1
	2 - 4	CAN047-0472-0002		Soil	X		X	X		2	1
	4 - 6	CAN047-0472-0004		Soil	X	X	X	X		2	1
	8 - 10	CAN047-0472-0008		Soil	X		X	X		2	1
	8 - 10	CAN047-0472-4762	FD	Soil	X		X	X		2	1
	8 - 10	CAN047-0472-4702	MRD	Soil	X	X	X	X		2	1
Boring 04703	0.5 - 2	CAN047-0473-0000		Soil	X		X	X		2	1
	2 - 4	CAN047-0473-0002		Soil	X		X	X		2	1
	4 - 6	CAN047-0473-0004		Soil	X		X	X		2	1
	8 - 10	CAN047-0473-0008		Soil	X		X	X		2	1
Boring 04704	0 - 0.5	CAN047-0474-0000		Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN047-0474-0002		Soil	X		X	X		2	1
	4 - 6	CAN047-0474-0004		Soil	X	X	X	X		2	1
	8 - 10	CAN047-0474-0008		Soil	X		X	X		2	1

TABLE 8-1

SUMMARY OF ANALYTICAL AND QA/QC SAMPLING
OIL/WATER SEPARATOR NO. 494 (SWMU NO. 47)
CANNON AFB, NEW MEXICO

Sample	Target Interval	Sample Identification	QA/QC	Sample	Analytical Parameters				Sample Containers		
Location	(ft-bgs)	Number	Type	Matrix	VOCs	SVOCs	Metals	TRPH	40 ml VOA vials	4 oz. jars	8 oz. jars
Boring 04705	0 - 0.5	CAN047-0475-0000		Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN047-0475-0002		Soil	X		X	X		2	1
	4 - 6	CAN047-0475-0004		Soil	X	X	X	X		2	1
	8 - 10	CAN047-0475-0008		Soil	X		X	X		2	1

AB = Ambient blank
DW = Decontamination water
FB = Field blank
MRD = Missouri River Division
MS/MSD = Matrix spike/matrix spike duplicate
RB = Rinsate blank
TB = Trip blank

See Figure 8-1 for locations of the borings.

TABLE 8-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 47

LOCATOR	CAN047-0471-0000			CAN047-0471-0002			CAN047-0472-0000			CAN047-0472-0002			CAN047-0473-0000			CAN047-0473-0002		
LAB SAMPLE NUMBER	0312760009SA			0312760010SA			0312780001SA			0312780002SA			0312790003SA			0312790004SA		
COLLECT DATE	09/14/93			09/14/93			09/14/93			09/14/93			09/15/93			09/15/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)																		
Toluene	<	5.9	J	<	5.7	U	<	5.6	U	1.6	5.8	J	1.8	5.5	J	<	5.6	U
Xylenes (total)	<	5.9	U	<	5.7	U	<	5.6	U	<	5.8	U	2.8	5.5	J	<	5.6	U
Semivolatile Organics (ug/kg)																		
Benzo(b)fluoranthene	<	390	U				<	370	U									
Butyl benzyl phthalate	<	390	U				<	370	U									
Fluoranthene	<	390	U				<	370	U									
Pyrene	<	390	U				<	370	U									
Metals (mg/kg)																		
Aluminum	9090	11.8		6390	11.3		4150	11.2	J	4730	11.5		4810	11		5680	11.1	
Antimony	<	7.1	U	1.5	6.8	J	<	6.7	U	<	6.9	U	<	6.6	U	<	6.7	U
Arsenic	2.7	0.59		1.9	0.57		2.5	0.56		2.2	0.58		2.5	0.55		2.3	0.56	
Barium	97.5	1.2	J	172	1.1	J	123	1.1	J	127	1.2	J	118	1.1	J	107	1.1	J
Beryllium	0.67	0.24		0.51	0.23		0.47	0.22		0.45	0.23		0.39	0.22		0.56	0.22	
Cadmium	<	0.59	U	0.61	0.57		<	0.56	U	<	0.58	U	0.69	0.55		0.57	0.56	
Calcium	4560	23.6		33300	22.6		23500	22.4		76900	23		25200	22		47000	22.3	
Chromium	10.8	1.2		7.2	1.1		4.8	1.1	J	4.5	1.2		7.2	1.1		7.1	1.1	
Cobalt	5.4	1.2		4.3	1.1		2.6	1.1		3.2	1.2		2.5	1.1		3.6	1.1	
Copper	9.3	2.4		8.3	2.3		4.9	2.2		6	2.3		6.5	2.2		7.3	2.2	
Iron	9720	11.8		6570	11.3		5140	11.2		4850	11.5		5900	11		6790	11.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 8-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 47

LOCATOR	CAN047-0471-0000			CAN047-0471-0002			CAN047-0472-0000			CAN047-0472-0002			CAN047-0473-0000			CAN047-0473-0002		
LAB SAMPLE NUMBER	0312760009SA			0312760010SA			0312780001SA			0312780002SA			0312790003SA			0312790004SA		
COLLECT DATE	09/14/93			09/14/93			09/14/93			09/14/93			09/15/93			09/15/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Lead	9	0.59		6.7	0.57		7.2	0.56		4.6	0.58		9.4	1.1		7.9	2.8	
Magnesium	1910	23.6		1870	22.6		1310	22.4	J	1760	23		1510	22		1990	22.3	
Manganese	240	1.2	J	162	1.1	J	147	1.1	J	118	1.2	J	180	1.1	J	135	1.1	J
Nickel	9.6	4.7		8.3	4.5		5.3	4.5	J	6.4	4.6		5.8	4.4		8	4.5	
Potassium	1860	589		1420	566		997	561	J	1140	576		1120	550		1390	557	
Selenium	<	0.59	U	<	1.1	J	<	0.56	U	<	1.2	J	<	0.55	U	<	1.1	J
Silver	0.53	1.2	J	0.62	1.1	J	<	1.1	U	<	1.2	U	0.33	1.1	J	<	1.1	U
Sodium	347	589	J	609	566		<	561	U	<	576	U	363	550	J	294	557	J
Vanadium	24.6	1.2		16.4	1.1		14.5	1.1		13.4	1.2		15.4	1.1		16.4	1.1	
Zinc	21.7	2.4		15.3	2.3		12.5	2.2		12	2.3		15.8	2.2		15.4	2.2	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	<	47.1	U	<	45.2	U	56.2	44.8		<	46.1	U	46.2	44		<	44.6	U
Water Quality (percent)																		
Water	15	0.1		12	0.1		11	0.1		13	0.1		9.2	0.1		10	0.1	

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A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 8-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 47

LOCATOR	CAN047-0474-0000			CAN047-0474-0002			CAN047-0475-0000			CAN047-0475-0002		
LAB SAMPLE NUMBER	0311900001SA			0311900002SA			0311900005SA			0311900006SA		
COLLECT DATE	09/10/93			09/10/93			09/10/93			09/10/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)												
Toluene	2.4	5.3	J	2.6	5.5	J	1.2	5.2	J	4.8	5.5	J
Xylenes (total)	2.6	5.3	J	2	5.5	J	6.4	5.2		6.2	5.5	
Semivolatile Organics (ug/kg)												
Benzo(b)fluoranthene	46	350	J				48	340	J			
Butyl benzyl phthalate	100	350	J				210	340	J			
Fluoranthene	41	350	J				39	340	J			
Pyrene	44	350	J				35	340	J			
Metals (mg/kg)												
Aluminum	5180	10.6		8670	11		5220	10.4		7530	10.9	
Antimony	<	6.4	U	<	6.6	U	<	6.3	U	<	6.6	U
Arsenic	2	0.53		3	0.55		2.5	0.52		2.8	0.55	
Barium	110	1.1	J	89.7	1.1	J	89	1	J	145	1.1	J
Beryllium	0.38	0.21		0.64	0.22		0.34	0.21		0.39	0.22	
Cadmium	<	0.53	U	<	0.55	U	<	0.52	U	<	0.55	U
Calcium	17000	21.2		6680	22.1		8040	20.8		38300	21.9	
Chromium	6.4	1.1		9.3	1.1		7	1		8.2	1.1	
Cobalt	2.6	1.1		4.6	1.1		2.6	1		3.8	1.1	
Copper	8.2	2.1		8.3	2.2		7.6	2.1		8.6	2.2	
Iron	5880	10.6		9970	11		5990	10.4		8240	10.9	

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A complete summary of chemical results are presented in Appendix A.
J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 8-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 47

LOCATOR	CAN047-0474-0000			CAN047-0474-0002			CAN047-0475-0000			CAN047-0475-0002		
LAB SAMPLE NUMBER	0311900001SA			0311900002SA			0311900005SA			0311900006SA		
COLLECT DATE	09/10/93			09/10/93			09/10/93			09/10/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Lead	15.4	1.1		9.7	1.1		15	2.6		9.8	1.1	
Magnesium	1430	21.2		1740	22.1		1340	20.8		2190	21.9	
Manganese	141	1.1	J	211	1.1	J	133	1	J	198	1.1	J
Nickel	5.9	4.2		8	4.4		5.8	4.2		7.7	4.4	
Potassium	1240	530		1730	551		1430	521		1450	547	
Selenium	0.24	1.1	J	<	1.1	J	<	1	J	<	1.1	J
Silver	<	1.1	U	<	1.1	U	<	1	U	<	1.1	U
Sodium	<	530	U	<	551	U	<	521	U	<	547	U
Vanadium	13.8	1.1		21.8	1.1		13.7	1		18.7	1.1	
Zinc	32.2	2.1		24.8	2.2		29.1	2.1		18.9	2.2	
TPH (mg/kg)												
Total Petroleum Hydrocarbons	74.2	42.4		56.5	44.1		76.6	41.7		198	43.7	
Water Quality (percent)												
Water	5.7	0.1		9.3	0.1		4.1	0.1		8.5	0.1	

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A complete summary of chemical results are presented in Appendix A.
J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 8-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 47

LOCATOR	CAN047-0471-0004			CAN047-0471-0008			CAN047-0472-0004			CAN047-0472-0008			CAN047-0473-0004			CAN047-0473-0008		
LAB SAMPLE NUMBER	0312760011SA			0312760012SA			0312780003SA			0312780004SA			0312790005SA			0312790006SA		
COLLECT DATE	09/14/93			09/14/93			09/14/93			09/14/93			09/15/93			09/15/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Metals (mg/kg)																		
Aluminum	3410	23		4210	11.1		2540	59.8		2970	22.4	J	3300	22.2		5130	11.2	
Antimony	<	13.8	U	1.5	6.7	J	<	35.9	U	<	13.4	U	<	13.3	U	<	6.7	U
Arsenic	2.2	0.58		1.3	0.56		1.7	0.6		1.2	0.56		2	0.56		2.1	0.56	
Barium	428	2.3	J	398	1.1	J	133	6	J	205	2.2	J	132	2.2	J	325	1.1	J
Beryllium	0.26	0.46	J	0.36	0.22		<	1.2	U	0.25	0.45	J	0.27	0.44	J	0.58	0.22	
Cadmium	3.3	1.2		1.3	0.56		<	3	U	<	1.1	U	1.5	1.1		1.4	0.56	
Calcium	201000	46.1		109000	22.2		255000	120		138000	44.8		134000	44.4		107000	22.5	
Chromium	2.3	2.3		3.1	1.1		<	6	U	<	2.2	U	<	2.2	U	4.6	1.1	
Cobalt	2.9	2.3		1.8	1.1		<	6	U	<	2.2	U	1.3	2.2	J	2.8	1.1	
Copper	<	4.6	U	3	2.2		<	12	U	1.5	4.5	J	3.5	4.4	J	3.7	2.2	
Iron	3330	23		2640	11.1		2420	59.8		2060	22.4		3630	22.2		5200	11.2	
Lead	3	2.9		5.8	1.1		2.9	1.2		4.4	0.56		5.3	2.8		5.1	1.1	
Magnesium	3050	46.1		4110	22.2		2940	120		2770	44.8		2260	44.4		3580	22.5	
Manganese	54.2	2.3	J	48.9	1.1	J	27.7	6	J	38	2.2	J	40.3	2.2	J	106	1.1	J
Nickel	<	9.2	U	4.3	4.4	J	<	23.9	U	<	9	U	4.5	8.9	J	5.8	4.5	
Potassium	<	1150	U	1010	556		558	2990	J	703	1120	J	803	1110	J	1310	562	
Silver	<	2.3	U	0.64	1.1	J	<	6	U	<	2.2	U	<	2.2	U	<	1.1	U
Sodium	458	1150	J	163	556	J	<	2990	U	<	1120	U	496	1110	J	252	562	J
Vanadium	14.7	2.3		8.7	1.1		9.4	6		6.6	2.2		11.3	2.2		20.2	1.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 8-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 47

LOCATOR	CAN047-0471-0004			CAN047-0471-0008			CAN047-0472-0004			CAN047-0472-0008			CAN047-0473-0004			CAN047-0473-0008		
LAB SAMPLE NUMBER	0312760011SA			0312760012SA			0312780003SA			0312780004SA			0312790005SA			0312790006SA		
COLLECT DATE	09/14/93			09/14/93			09/14/93			09/14/93			09/15/93			09/15/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Zinc	8.7	4.6		7.5	2.2		10	12	J	6.3	4.5		9.6	4.4		11.9	2.2	
Water Quality (percent)																		
Water	13	0.1		10	0.1		16	0.1		11	0.1		10	0.1		11	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 8-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 47

LOCATOR	CAN047-0474-0004			CAN047-0474-0008			CAN047-0475-0004			CAN047-0475-0008		
LAB SAMPLE NUMBER	0311900003SA			0311900004SA			0311900007SA			0311900008SA		
COLLECT DATE	09/10/93			09/10/93			09/10/93			09/10/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Metals (mg/kg)												
Aluminum	4270	22.6		4570	22.6		4370	11.2		6660	11.2	
Antimony	<	13.6	U	<	13.6	U	<	6.7	U	<	6.7	U
Arsenic	2.3	0.57		2	0.56		2.1	0.56		2.5	0.56	
Barium	155	2.3	J	341	2.3	J	157	1.1	J	426	1.1	J
Beryllium	<	0.45	U	0.23	0.45	J	0.15	0.22	J	0.48	0.22	
Cadmium	<	1.1	U	<	1.1	U	<	0.56	U	<	0.56	U
Calcium	196000	45.3		215000	45.2		176000	22.4		166000	22.3	
Chromium	4.2	2.3		5.2	2.3		4.7	1.1		6.6	1.1	
Cobalt	2.5	2.3		2.1	2.3	J	2	1.1		2.1	1.1	
Copper	3.8	4.5	J	3	4.5	J	5.5	2.2		3.5	2.2	
Iron	3980	22.6		3720	22.6		4090	11.2		5440	11.2	
Lead	3.5	1.1		3.4	1.1		3.6	1.1		5.1	1.1	
Magnesium	2690	45.3		3940	45.2		2370	22.4		4270	22.3	
Manganese	53.4	2.3	J	43.2	2.3	J	63	1.1	J	74.2	1.1	J
Nickel	5.1	9.1	J	5.6	9	J	6.7	4.5		6.3	4.5	
Potassium	806	1130	J	830	1130	J	833	559		1190	558	
Silver	<	2.3	U	<	2.3	U	0.38	1.1	J	<	1.1	U
Sodium	528	1130	J	<	1130	U	207	559	J	<	558	U
Vanadium	13	2.3		14.8	2.3		10.6	1.1		19.4	1.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 8-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 47

LOCATOR	CAN047-0474-0004			CAN047-0474-0008			CAN047-0475-0004			CAN047-0475-0008		
LAB SAMPLE NUMBER	0311900003SA			0311900004SA			0311900007SA			0311900008SA		
COLLECT DATE	09/10/93			09/10/93			09/10/93			09/10/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Zinc	10.9	4.5		11.7	4.5		16	2.2		27.4	2.2	
Water Quality (percent)												
Water	12	0.1		11	0.1		11	0.1		10	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 8-3

COMPARISON OF MAXIMUM DETECTED METAL CONCENTRATIONS TO BACKGROUND(1)
SWMU 47, CANNON AFB
Oil/Water Separator No. 494

Sample ID	Metal	Maximum detected concentration	Range of background concentrations (2)	Upper tolerance limit (UTL) background concentration (3)	Does maximum detected exceed UTL background
CAN047-0471-0000	Aluminum	9090	1410 - 11,000	10,540	N
CAN047-0471-0002	Antimony	1.5	<5 - <13	*	Y
CAN047-0475-0002	Arsenic	2.8	0.67 - 28	15.5	N
CAN047-0471-0004	Barium	428	14.5 - 1200	642	N
CAN047-0471-0000	Beryllium	0.67	0.17 - 0.77	0.73	N
CAN047-0471-0004	Cadmium	3.3	<0.51 - 4.2	*	Y
CAN047-0472-0004	Calcium	255000	1490 - 172,000	186,400	Y
CAN047-0471-0000	Chromium	10.8	4 - 15.4	12.5	N
CAN047-0471-0000	Cobalt	5.4	0.85 - 5.3	4.5	Y
CAN047-0471-0000	Copper	9.3	<2 - 18.4	*	Y
CAN047-0474-0002	Iron	9970	1820 - 11,000	8,720	Y
CAN047-0474-0000	Lead	15.4	1.1 - 46	25.8	N
CAN047-0473-0000	Magnesium	4270	892 - 18,300	11,790	N
CAN047-0471-0000	Manganese	240	22.4 - 216	164	Y
CAN047-0471-0000	Nickel	9.6	1.3 - 9.8	9	Y
CAN047-0471-0000	Potassium	1860	354 - 2770	2,572	N
CAN047-0474-0000	Selenium	0.24	<0.21 - 124	*	Y
CAN047-0471-0008	Silver	0.64	0.51 - 0.93	*	Y
CAN047-0471-0002	Sodium	609	267 - 615	*	Y
CAN047-0471-0000	Vanadium	24.6	5.2 - 28.3	25.3	N
CAN047-0474-0000	Zinc	32.2	<4.3 - 27.5	21.9	Y

(1) All units in mg/kg.
(2) Compiled from data collected by Woodward Clyde for the RFI and RI (WCC 1992 and WCC 1993) and Walk, Haydel and Associates for the IRP (Walk, Haydel and Associates 1990).
Summarized in "Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater at Cannon AFB, NM (WCC 1993)
(3) Upper Tolerance Limit (UTL) of the mean = mean + 2*standard deviation. This is for all practicle purposes the same as the 90% upper confidence limit of the 95th percentile where UTL = mean + standard deviation *k, where k=2.02 for n=37 .
* Data insufficient to calculate UTL of background concentration

TABLE 8-4

COMPARISON OF MAXIMUM CONCENTRATIONS WITH RBCs(1)
SWMU 47, CANNON AFB
Oil/Water Separator No. 494

Sample ID	Analyte	Maximum Detected	RBC (2)	Maximum Detected Exceed RBC
CAN047-0475-0000	Benzo(b)fluoranthene	0.048	0.07	N
CAN047-0475-0000	Butyl benzyl phthalate	0.21	2000	N
CAN047-0471-0000	Cobalt	5.4	NTF	N
CAN047-0471-0000	Copper	9.3	300	N
CAN047-0475-0000	Di-n-butyl phthalate	0.051	800	N
CAN047-0474-0000	Fluoranthene	0.041	300	N
CAN047-0471-0000	Nickel	9.6	200	N
CAN047-0474-0000	Pyrene	0.044	200	N
CAN047-0471-0008	Silver	0.64	20	N
CAN047-0471-0002	Sodium	609	NTF	N
CAN047-0475-0002	Toluene	0.0048	2000	N
CAN047-0475-0002	Total Petroleum Hydrocarbons (3)	198	1000	N
CAN047-0475-0000	Xylenes (total)	0.0064	20000	N
CAN047-0474-0000	Zinc	32.2	2000	N

NTF = No EPA Established Toxicity Factor

(1) All units in mg/kg

(2) Risk-based concentration

(3) New Mexico recommended soil cleanup level for fuel contaminated soil.

Note: Only metals that exceeded background appear in this table.

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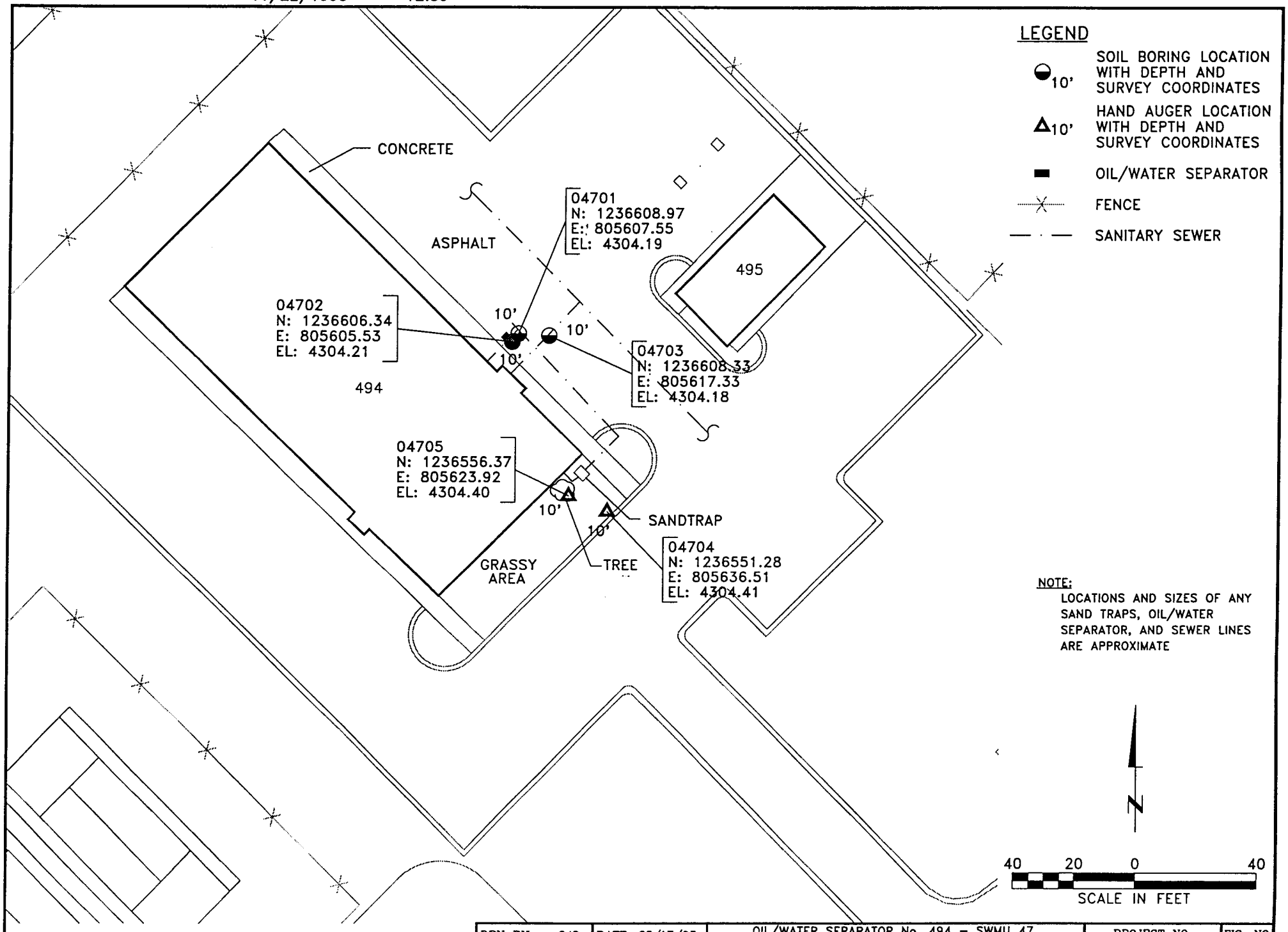


SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

DRN BY: CJG	DATE: 08/17/93	OIL/WATER SEPARATOR No. 494 – SWMU 47 SITE PLAN AND SAMPLE LOCATIONS CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W
CHK'D BY: .	REVISION: 0		FIG. NO. 8-1

9.1 SITE BACKGROUND

9.1.1 Site Description

OWS 375 is located beneath 0.5 feet of asphalt pavement adjacent to the northwest side of Building 375 within the motor pool compound. The OWS is constructed of concrete and consists of a two-compartment underground unit with a nominal capacity of 1,000 gallons (Figure 9-1). The OWS extends about 5.5 feet below the pavement surface.

9.1.2 Site History

The OWS reportedly received wash water generated from light vehicle maintenance operations in Building 375 via a sump and drain pipe in the floor of the building. Oils recovered by the OWS were directed to the holding tank and the wastewater was discharged to the sanitary sewer line. The OWS has been active since 1968.

9.1.3 Current Use

The OWS continues to receive wash water generated from light vehicle maintenance operations in Building 375. The floor sump and drain pipe are still operational and carry fluids to the separator. The oils recovered in the OWS are directed to the holding tank and the wastewater is discharged to the sanitary sewer line.

9.1.4 Potential Contaminants

Potential contaminants include petroleum and synthetic lubricating oils, fuels, greases, solvents, and metals.

9.2 FIELD INVESTIGATION AND DATA COLLECTION

9.2.1 Soils Sampling

Two 10-foot soil borings were located as close as possible to the east and west sides of the OWS to sample the soil at these sites for a possible release of SWMU-related substances as leakage from the separator holding tank. Underground utilities directly northwest of the OWS forced the third boring to be relocated approximately 10 feet northwest of its originally proposed location, near the outflow pipe-sewer line junction. No surface staining of pavement was observed at this site.

Soil samples were collected from the 0.5- to 2-foot, 2- to 4-foot, 4- to 6-foot, and 8- to 10-foot depth intervals as specified in the Field Sampling Plan and Sample Summary Tables. Samples were collected in accordance with QAPP SOP No. 7 - Subsurface Drilling and Sampling. Target analytes included VOCs, SVOCs, metals and TRPH. Samples from the 0.5- to 2-foot interval were collected immediately below the asphalt pavement at this site.

9.2.2 Geologic Summary of Boring Logs

One to three feet of a moist, stiff, red clay fill was observed underlying the asphalt in the area of the OWS. A dry to moist, light yellow and red mottled sandy clay with a trace of gravel was encountered beginning from a depth of 1.5 feet to approximately 4 feet and continuing to the 10-foot depth. No visual indications of contamination were encountered during drilling and sampling activities at this site. (See boring logs in Appendix B, Volume IV.

9.2.3 Site Topography

A gentle northwest gradient leads to a slight drainage channel which ends at a nearby storm sewer.

9.3 CHEMICAL INVESTIGATION RESULTS

9.3.1 General

Samples were collected as identified in Section 9.2 to comply with permit and compliance agreement requirements. Soil samples were collected from three borings (05101, 05102, and 05103). Sampling and analyses performed are summarized in Table 9-1. Summaries of the analytical results for these soil samples is provided in Table 9-2a for near surface soils and Table 9-2b for subsurface soils. For each sample type, the tables provide results for analytes only if they were detected at least once in this type of sample collected at the SWMU. Complete analytical summary results are provided in the QCSR (Appendix A).

9.3.2 Organic Results for Near-Surface Soil Samples

The near-surface soil samples collected at these SWMUs (CAN051-0511-0000, CAN051-0511-0002, CAN051-0512-0000, CAN051-0512-0002, CAN051-0513-0000, and CAN051-0513-0002) were analyzed for SVOCs, VOCs, metals, and TRPH, while subsurface samples were analyzed for VOCs, metals, TPH, and in selected samples, SVOCs as indicated in Table 9-1.

Other than acetone and methylene chloride, which were qualified nondetected after they were determined to be laboratory contaminants (see Section 4.4.4 of the QCSR), the VOCs reported were 2.3 µg/kg, 3.6 µg/kg, 4.8 µg/kg, and 6.6 µg/kg toluene for samples CAN051-0513-0000, CAN051-0513-0002, CAN051-0512-0002, and CAN051-0511-0000 respectively, and 1.3 µg/kg, 1.4 µg/kg, and 1.6 µg/kg total xylenes for samples CAN051-0511-0000, CAN051-0513-0002 and CAN051-0512-0000, respectively. With the exception of di-n-butyl phthalate, which was qualified as nondetected after it was determined to be a laboratory contaminant (see Section 4.1.4 of the QCSR), the results reported for SVOCs were primarily polycyclic aromatic hydrocarbons (PAHs). PAHs were reported for one sample and included the compounds anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene. Summing PAH concentrations, sample CAN051-0513-0002 had total PAHs reported at 8,177 µg/kg. Sample CAN051-0513-0002 also has a reported result of 79 µg/kg carbazole. Results for TPH included concentrations reported in samples CAN051-0512-0000,

CAN051-0512-0002, and CAN051-0513-0002, at 173 mg/kg, 551 mg/kg, and 2,690 mg/kg, respectively.

9.3.3 Organic Results For Subsurface Soil Samples

The subsurface soil samples collected at this SWMU (CAN051-0511-0004, CAN051-0511-0008, CAN051-0512-0004, CAN051-0512-0008, CAN051-0513-0004, and CAN051-0513-0008) were analyzed for VOCs, metals, TPH, and in some samples, SVOCs, while near-surface samples were analyzed for SVOCs, VOCs, metals, and TRPH as indicated in Table 9-1.

Other than acetone and methylene chloride, which were qualified nondetect after they were determined to be laboratory contaminants (see Section 4.1.4 of the QCSR), the only VOC concentrations reported in samples were 26 µg/kg tetrachloroethene, 2.4 µg/kg 1,2-dichloropropane, 4.2 µg/kg 1,2-dichloroethane, and 3.5 µg/kg toluene for sample CAN051-0512-0004. With the exceptions of bis(2-ethylhexyl)phthalate and di-n-butyl phthalate, which were both qualified as nondetected after it was determined that they were laboratory contaminants, no SVOCs were detected above reporting limits. The results for TPH concentrations reported included samples CAN051-0511-0008, CAN051-0512-0008, and CAN051-0512-0004 at 182 µg/kg, 664 µg/kg, and 3,150 µg/kg respectively.

9.3.4 Inorganic Results

Metals analyses were performed on samples collected from this SWMU as indicated in Table 9-1. The range of results for metals reported in these soil samples are summarized in Table 9-A:

TABLE 9-A

Analyte	Frequency Reported	Lowest Detection	Sample Location	Highest Detection	Sample Location
Aluminum	12/12	2310 mg/kg	0512-0004	8120 mg/kg	0511-0000
Antimony	2/12	1.7 mg/kg	0511-0000	1.8 mg/kg	0513-0002
Arsenic	12/12	2 mg/kg	0512-0002	4.5 mg/kg	0513-0002
Barium	12/12	84.7 mg/kg	0513-0000	1370 mg/kg	0513-0004
Beryllium	9/12	0.26 mg/kg	0511-0004	0.62 mg/kg	0511-0000
Cadmium	9/12	0.81 mg/kg	0511-0002	3.4 mg/kg	0512-0008
Calcium	12/12	5360 mg/kg	0511-0000	263000 mg/kg	0512-0008
Chromium	9/12	2.9 mg/kg	0513-0008	9.7 mg/kg	0511-0000
Cobalt	10/12	1.3 mg/kg	0512-0002	4.5 mg/kg	0513-0000
Copper	12/12	2.1 mg/kg	0513-0004	9.4 mg/kg	0511-0000
Iron	12/12	1920 mg/kg	0512-0004	9120 mg/kg	0511-0000
Lead	12/12	1.4 mg/kg	0512-0008	9.1 mg/kg	0511-0000
Magnesium	12/12	1440 mg/kg	0512-0000	3840 mg/kg	0513-0008
Manganese	12/12	29 mg/kg	0512-0004	272 mg/kg	0513-0002
Mercury	0/12	-	-	-	-
Nickel	11/12	2.7 mg/kg	0512-0004	8.9 mg/kg	0511-0000
Potassium	11/12	462 mg/kg	0512-0004	1510 mg/kg	0511-0000
Silver	11/12	0.53 mg/kg	0512-0000	2.5 mg/kg	0512-0008
Selenium	0/12	-	-	-	-
Sodium	10/12	167 mg/kg	0513-0002	904 mg/kg	0512-0008
Thallium	0/12	-	-	-	-
Vanadium	12/12	7.5 mg/kg	0512-0008	21.7 mg/kg	0511-0000
Zinc	12/12	6 mg/kg	0512-0008	22.2 mg/kg	0511-0000

Note: See Table 9-3 for comparison to background.

9.4 SWMU-SPECIFIC DATA ASSESSMENT

9.4.1 General

This assessment of the OWS 375 data is an evaluation of quality issues that could affect the major data uses. In general, the objective of the RFI was identification and quantification of the nature and extent of the contamination, which was necessary to meet permit and compliance agreement requirements, and to support an evaluation of the risk to human health and the environment.

9.4.2 Sampling Issues

A review of the data contained in the log books and the Daily Quality Control Reports (DQCRs) for SWMU 51 indicate that there were no sampling issues that would impact data usability. QC issues are discussed in detail in the QCSR in Appendix A, and copies of the DQCRs are included in that appendix.

9.4.3 Data Review Issues

For laboratory analytical data, QA/QC objectives were specified in the Cannon AFB QAPP (W-C 1993). The objectives were used as indicators of the quality necessary to support identification and quantitation of potential chemicals of concern. The data review is presented in Section 4.4 of the Quality Control Summary Report (QCSR) located in Appendix A. As presented in the QCSR, data for the analytes barium, beryllium, cadmium, chromium, copper, selenium, thallium, and benzene were qualified as estimated concentrations. No data associated with SWMU 51 were rejected.

Barium, selenium, thallium, and benzene data were qualified estimated to indicate a potential low bias. When a low bias is indicated, actual concentrations may be higher than the reported results. Use of this data in risk assessment may underestimate risk. Beryllium, chromium and copper data were qualified "estimated" due to precision that did not meet the QA\QC criteria defined for this project. Poor precision could be attributed to errors in sampling and analysis; however, since the other analytes which were sampled and analyzed in the same procedure (Method 6010) met QA/QC criteria, this variation is likely due to sample heterogeneity.

The uncertainty in the actual concentration reported for estimated data does not affect the usability of the data for identification of chemicals in characterizing the nature and extent of contamination at this SWMU.

9.4.4 Limitations

Elevated reporting limits may limit the usability of the data due to low-level analytes being diluted to below the instrument detection limits. That is, chemicals may be reported as nondetect when they are actually present in a sample at low levels. Section 4.4.6 of the QCSR (Appendix A) presents a discussion of elevated reporting limits. Only lead had elevated reporting limits for samples CAN051-0512-0004 and CAN051-0512-0008, a factor of 50 and 10, respectively. The elevated reporting limits for lead were not considered to be limiting because they were not elevated significantly (i.e., by a factor greater than 100), and lead was detected above the elevated reporting limit in both samples.

9.4.5 Summary

Overall, data generated during the study of SWMU 51 were determined to meet quality criteria. In conjunction with the analytical data review, other information including field observations were evaluated in the assessment of the usability of SWMU 51 data. The data support identification of the nature and extent of contamination and provide reasonable concentration for use in risk assessment.

9.5 NATURE AND EXTENT OF CONTAMINATION

SWMU 51 is an OWS serving Building 375 (a vehicle maintenance shop) in the motor pool compound. Three borings were advanced to a depth of 10 feet in close proximity to the separator. In general the samples appeared relatively free of organic contamination. There was no visible evidence of spills or leaks in the vicinity, and the entire area around the separator is paved. The chemical test results show low levels of organic contamination, including PAHs and TPH.

9.6 COMPARISON OF METALS CONCENTRATIONS TO BACKGROUND

Results of the comparison of metal concentration in soil to background levels for SWMU 51 are given in Table 9-3.

Metals are natural constituents of soils. SWMU concentrations of metal were evaluated to assess whether the metals in environmental samples exceed background levels. Metals that occur in concentrations within background levels are not considered SWMU-related chemicals of concern and are not evaluated further.

The maximum concentration of each detected metal at each SWMU was compared to the upper tolerance limit of the background data. The upper tolerance limit (UTL) was defined as the mean plus two times the standard deviation. This is for all practical purposes equal to the 90 percent upper confidence limit of the 95th percentile which is equal to the mean plus the standard deviation times the k statistic. The background data set used consisted of 37 data points (W-C 1993), so the k statistic equals 2.02.

The maximum detected concentrations of antimony, barium, cadmium, copper, silver, and zinc exceeded the UTL of the background data. Therefore, these metals were compared to risk-based concentrations at SWMU 51.

9.7 RISK SCREENING

9.7.1 Exposure Pathway Flow Chart

The Preliminary Exposure Pathway Flow Chart (EPFC) applicable to SWMU 51, OWS 375, is shown in Figure 3-2. It shows that the potential exposure pathways are ingestion of soil, inhalation of soil particulates, dermal exposure to contaminated soil, and inhalation of airborne chemicals released from soil, ingestion, inhalation, and dermal exposure to groundwater (if drinking water supplies were affected). Storm water runoff is considered to be an insignificant pathway because potential spills would be minor and over a small area.

9.7.2 Screening of Contaminants Against RBCs (and Other Criteria)

Maximum detected concentrations of organic compounds and metals that exceeded background were compared to screening-level RBCs (see Section 3.4.5.1 for derivations of RBCs) and other screening criteria in Table 9-4. Screening-level criteria other than RBCs include the state of New Mexico's TPH cleanup level of 1,000 mg/kg (New Mexico Environment Department 1993) and the EPA's recommended soil lead level of 500 mg/kg

(EPA 1990). The TPH soil clean-up concentration of 1,000 mg/kg is not an RBC, nor is it a relevant-and-applicable standard for the SWMUs in this investigation. Rather it is a conservative value originally derived for the cleanup of fuel-contaminated soils at underground storage tank sites. RBCs for TPH, measured as fresh fuels (e.g., gasoline or diesel), are at least an order of magnitude higher for occupational exposures. The concentration of 500 mg/kg is the most conservative concentration in the recommended range of 500 mg/kg to 1,000 mg/kg as a lead level in residential soil based on EPA's Uptake Biokinetic Model (EPA 1990). Compounds with no toxicity factors cannot be evaluated in the risk screening since RBCs cannot be calculated. These compounds, at the concentrations that were measured in soil, are not likely to significantly affect the results of the comparison to RBCs. The comparison for SWMU 51 shows that maximum detected concentrations of barium, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene, and TPH exceed RBCs.

This comparison of maximum detected concentrations to RBCs is very conservative (health-protective), and actual impacts are likely to be lower than those suggested by exceedances of conservative criteria. For example, maximum detected concentrations are likely to overestimate actual concentrations to which people would be exposed. Furthermore, the screening criteria are based on highly conservative residential exposure assumptions and target risk levels that may not be pertinent to current or future use of the SWMU. The RBCs used in this evaluation are calculated using RCRA Action Level methodology; however, the RBCs are more health-protective than conventional RCRA Action Levels because a target excess cancer risk level of 1×10^{-7} (1 in 10,000,000) and a hazard quotient of 0.1 were used to account for exposures to multiple chemicals and for exposure routes other than soil ingestion. Conventional RCRA Action Levels are calculated based on a cancer risk of 1×10^{-6} and a noncancer hazard of 1.0.

The purpose of the comparison to RBCs is to determine whether or not chemical releases (characterized by maximum detected concentrations) have occurred at SWMU 51 that could pose potential risks based on conservative health-based criteria. Since maximum concentrations of chemicals listed above exceed screening level criteria further evaluation or investigation of chemical concentrations and probable exposures is warranted.

9.8 SUMMARY AND RECOMMENDATIONS

Twelve soil samples were collected and analyzed from three 10-foot soil borings at SWMU 51. Maximum detected concentrations were compared to background levels and RBCs. Four PAHs, TPH, and one metal were found at levels that exceeded RBCs or other screening-level criteria. The results of the comparison of maximum detected concentrations with screening-level RBCs indicate that it is unlikely that a risk assessment will result in a risk level that will require remedial action (i.e., only a few chemicals slightly exceed the RBCs).

The highest concentrations for all chemicals reported above the RBC values were found in the near-surface soils. The concentrations decreased with depth for chemicals that exceeded RBC values; therefore, the vertical extent of contamination has been characterized by the borings and the potential for groundwater beneath SWMU 51 to be impacted can be characterized. The potential for impacts to groundwater is considered to be low because the depth to groundwater is greater than 200 feet, evaporation exceeds infiltration, and sampling demonstrated that contaminants are not significantly being transported vertically below the SWMU. Therefore, it is concluded that available data are sufficient to complete a Baseline Risk Assessment, and it is recommended that the risk assessment be done.

TABLE 9-1

SUMMARY OF ANALYTICAL AND QA/QC SAMPLING
OIL/WATER SEPARATOR NO. 375 (SWMU NO. 51)
CANNON AFB, NEW MEXICO

Sample Location	Target Interval (ft-bgs)	Sample Identification Number	QA/QC Type	Sample Matrix	Analytical Parameters				Sample Containers		
					VOCs	SVOCs	Metals	TRPH	40 ml VOA vials	4 oz. jars	8 oz. jars
Boring 05101	0.5 - 2	CAN051-0511-0000		Soil	X		X	X		2	1
	2 - 4	CAN051-0511-0002		Soil	X		X	X		2	1
	4 - 6	CAN051-0511-0004		Soil	X		X	X		2	1
	8 - 10	CAN051-0511-0008		Soil	X		X	X		2	1
	8 - 10	CAN051-0511-6008	MS/MSD	Soil	X		X	X		2	2
Boring 05102	0.5 - 2	CAN051-0512-0000		Soil	X	X	X	X		2	1
	0.5 - 2	CAN051-0512-5161	FD	Soil	X	X	X	X		2	1
	2 - 4	CAN051-0512-0002		Soil	X		X	X		2	1
	4 - 6	CAN051-0512-0004		Soil	X	X	X	X		2	1
	8 - 10	CAN051-0512-0008		Soil	X		X	X		2	1
	8 - 10	CAN051-0512-5162	FD	Soil	X		X	X		2	1
	8 - 10	CAN051-0512-5101	MRD	Soil	X	X	X	X		2	1
		CAN051-0512-5151	AB	Water	X				2		
		CAN051-0512-5171	RB	Water	X				2		
		CAN051-0512-5181	DW	Water	X				2		
		CAN051-0512-5191	TB	Water	X				2		
Boring 05103	0.5 - 2	CAN051-0513-0000		Soil	X	X	X	X		2	1
	2 - 4	CAN051-0513-0002		Soil	X	X	X	X		2	1
	2 - 4	CAN051-0513-6002	MSD/MSD SVOC only	Soil		X					1
	4 - 6	CAN051-0513-0004		Soil	X		X	X		2	1
	8 - 10	CAN051-0513-0008		Soil	X		X	X		2	1

AB = Ambient blank
DW = Decontamination water
FB = Field blank
MRD = Missouri River Division
MS/MSD = Matrix spike/matrix spike duplicate
RB = Rinsate blank
TB = Trip blank

See Figure 9-1 for locations of the borings.

TABLE 9-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 51

LOCATOR	CAN051-0511-0000			CAN051-0511-0002			CAN051-0512-0000			CAN051-0512-0002			CAN051-0513-0000			CAN051-0513-0002		
LAB SAMPLE NUMBER	0312760001SA			0312760002SA			0312790007SA			0312790016SA			0312760005SA			0312760006SA		
COLLECT DATE	09/14/93			09/14/93			09/15/93			09/15/93			09/14/93			09/14/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)																		
Toluene	6.6	5.9		<	5.7	U	<	5.3	U	4.8	5.9	J	2.3	5.8	J	3.6	5.5	J
Xylenes (total)	1.3	5.9	J	<	5.7	U	1.6	5.3	J	<	5.9	U	<	5.8	U	1.4	5.5	J
Semivolatile Organics (ug/kg)																		
Anthracene							<	350	U				<	380	U	47	370	J
Benzo(a)anthracene							<	350	U				<	380	U	600	370	
Benzo(a)pyrene							<	350	U				<	380	U	830	370	
Benzo(b)fluoranthene							<	350	U				<	380	U	1700	370	
Benzo(g,h,i)perylene							<	350	U				<	380	U	520	370	
Carbazole							<	350	U				<	380	U	79	370	J
Chrysene							<	350	U				<	380	U	970	370	
Fluoranthene							<	350	U				<	380	U	2000	370	
Indeno(1,2,3-cd)pyrene							<	350	U				<	380	U	510	370	
Phenanthrene							<	350	U				<	380	U	800	370	
Pyrene							<	350	U				<	380	U	2000	370	
Metals (mg/kg)																		
Aluminum	8120	11.7		5180	11.5		4910	10.5		5260	23.4		7120	11.5		4010	11.1	
Antimony	<	7	U	1.7	6.9	J	<	6.3	U	<	14	U	<	6.9	U	1.8	6.6	J
Arsenic	2.3	0.59		2.1	0.57		2.1	0.53		2	0.59		2.3	0.58		4.5	0.55	
Barium	115	1.2	J	105	1.1	J	433	1.1		118	2.3		84.7	1.2	J	495	1.1	J
Beryllium	0.62	0.23		0.4	0.23		0.29	0.21	J	0.4	0.47	J	0.56	0.23		0.35	0.22	
Calcium	5360	23.4		43400	22.9		17400	21.1		137000	46.8		7630	23.1		48100	22.1	
Chromium	9.7	1.2		5.6	1.1		7.4	1.1	J	6	2.3		9.2	1.2		7.1	1.1	
Cadmium	<	0.59	J	0.81	0.57	J	<	0.53	U	1.6	1.2		<	0.58	J	0.99	0.55	J

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 9-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 51

LOCATOR	CAN051-0511-0000			CAN051-0511-0002			CAN051-0512-0000			CAN051-0512-0002			CAN051-0513-0000			CAN051-0513-0002		
LAB SAMPLE NUMBER	0312760001SA			0312760002SA			0312790007SA			0312790016SA			0312760005SA			0312760006SA		
COLLECT DATE	09/14/93			09/14/93			09/15/93			09/15/93			09/14/93			09/14/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Cobalt	4.3	1.2		3.1	1.1		2.5	1.1		1.3	2.3	J	4.5	1.2		3.4	1.1	
Copper	9.4	2.3		6.2	2.3		5.2	2.1	J	5.1	4.7		8.1	2.3		5.7	2.2	
Iron	9120	11.7		5380	11.5		6900	10.5		5320	23.4		7720	11.5		5710	11.1	
Lead	9.1	0.59		5.6	1.1		6.5	0.53		3.9	1.2		9	0.58		5.9	1.1	
Magnesium	1680	23.4		1570	22.9		1440	21.1		1940	46.8		1520	23.1		1460	22.1	
Manganese	228	1.2		124	1.1		197	1.1		87.2	2.3		246	1.2		272	1.1	
Nickel	8.9	4.7		6.7	4.6		5.3	4.2		5.1	9.4	J	8.3	4.6		5.8	4.4	
Potassium	1510	585		1100	573		773	527		1100	1170	J	1440	577		782	554	
Silver	0.62	1.2	J	0.71	1.1	J	0.53	1.1	J	1.9	2.3	J	0.62	1.2	J	0.7	1.1	J
Sodium	203	585	J	304	573	J	309	527	J	630	1170	J	190	577	J	167	554	J
Vanadium	21.7	1.2		15.4	1.1		13.8	1.1		12.4	2.3		19.1	1.2		16.3	1.1	
Zinc	22.2	2.3		15.1	2.3		15.9	2.1		14.1	4.7		19.3	2.3		13.7	2.2	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	<	46.8	U	<	45.9	U	173	42.2	J	551	46.8		<	46.2	U	2690	221	
Water Quality (percent)																		
Water	15	0.1		13	0.1		5.1	0.1		15	0.1		13	0.1		9.7	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 9-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 51

LOCATOR	CAN051-0511-0004			CAN051-0511-0008			CAN051-0512-0004			CAN051-0512-0004			CAN051-0512-0008			CAN051-0513-0004		
LAB SAMPLE NUMBER	0312760003SA			0312760004SA			0312790017SA			0316040001SA			0312790018SA			0312760007SA		
COLLECT DATE	09/14/93			09/14/93			09/15/93			09/15/93			09/15/93			09/14/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)																		
1,2-Dichloroethane	<	5.8	U	<	5.7	U	4.2	6.2	J				<	5.5	U	<	5.9	U
1,2-Dichloropropane	<	5.8	U	<	5.7	U	2.4	6.2	J				<	5.5	U	<	5.9	U
Tetrachloroethene	<	5.8	U	<	5.7	U	26	6.2					<	5.5	U	<	5.9	U
Toluene	<	5.8	U	<	5.7	U	3.5	6.2	J				1.7	5.5	J	<	5.9	U
Semivolatile Organics (ug/kg)																		
Chrysene							56	410	J	<	410	U						
Metals (mg/kg)																		
Aluminum	3050	23.3		3830	11.4		2310	24.9					2690	55		2960	23.6	
Arsenic	2.2	0.58		2.4	0.57		2	0.62					2.4	0.55		2	0.59	
Barium	330	2.3	J	190	1.1	J	1100	2.5					1150	5.5		1370	2.4	J
Beryllium	0.26	0.47	J	0.34	0.23		0.29	0.5	J				<	1.1	U	<	0.47	U
Cadmium	2.3	1.2	J	1.6	0.57	J	2.7	1.2					3.4	2.8		2.4	1.2	J
Calcium	198000	46.5		97900	22.8		236000	49.7					263000	110		202000	47.2	
Chromium	<	2.3	U	3.7	1.1		<	2.5	U				<	5.5	U	3.2	2.4	
Cobalt	2.8	2.3		3	1.1		<	2.5	U				<	5.5	U	2.9	2.4	
Copper	2.6	4.7	J	4	2.3		3.3	5	J				2.7	11	J	2.1	4.7	J
Iron	2810	23.3		3980	11.4		1920	24.9					2110	55		2710	23.6	
Lead	2.6	2.9	J	5.8	1.1		5.1	12.4	J				1.4	5.5	J	1.9	3	J
Magnesium	2290	46.5		2540	22.8		2810	49.7					3830	110		3070	47.2	
Manganese	42.3	2.3		90.7	1.1		29	2.5					36.5	5.5		47.6	2.4	
Nickel	4.6	9.3	J	5.5	4.6		2.7	9.9	J				<	22	U	3.6	9.4	J
Potassium	725	1160	J	896	570		462	1240	J				611	2750	J	<	1180	U

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 9-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 51

LOCATOR	CAN051-0511-0004			CAN051-0511-0008			CAN051-0512-0004			CAN051-0512-0004			CAN051-0512-0008			CAN051-0513-0004		
LAB SAMPLE NUMBER	0312760003SA			0312760004SA			0312790017SA			0316040001SA			0312790018SA			0312760007SA		
COLLECT DATE	09/14/93			09/14/93			09/15/93			09/15/93			09/15/93			09/14/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Silver	1.1	2.3	J	0.62	1.1	J	1.5	2.5	J				2.5	5.5	J	<	2.4	U
Sodium	700	1160	J	543	570	J	824	1240	J				904	2750	J	<	1180	U
Vanadium	14	2.3		17.5	1.1		8.5	2.5					7.5	5.5		14.2	2.4	
Zinc	8.5	4.7		11.5	2.3		8.3	5					6	11	J	8.4	4.7	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	<	46.5	U	182	45.6		3150	249					664	44		<	47.2	U
Water Quality (percent)																		
Water	14	0.1		12	0.1		20	0.1		20	0.1		9.2	0.1		15	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 9-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 51

LOCATOR	CAN051-0513-0008		
LAB SAMPLE NUMBER	0312760008SA		
COLLECT DATE	09/14/93		
	Result	RL	Qual
Volatile Organics (ug/kg)			
1,2-Dichloroethane	<	5.5	U
1,2-Dichloropropane	<	5.5	U
Tetrachloroethene	<	5.5	U
Toluene	<	5.5	U
Semivolatile Organics (ug/kg)			
Chrysene	<	360	U
Metals (mg/kg)			
Aluminum	3060	21.9	
Arsenic	2.1	0.55	
Barium	1010	2.2	J
Beryllium	<	0.44	U
Cadmium	2	1.1	J
Calcium	196000	43.9	
Chromium	2.9	2.2	
Cobalt	3.2	2.2	
Copper	2.8	4.4	J
Iron	2470	21.9	
Lead	1.8	2.7	J
Magnesium	3840	43.9	
Manganese	65.1	2.2	
Nickel	5.2	8.8	J
Potassium	785	1100	J

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 9-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 51

LOCATOR	CAN051-0513-0008		
LAB SAMPLE NUMBER	0312760008SA		
COLLECT DATE	09/14/93		
	Result	RL	Qual
Silver	1.1	2.2	J
Sodium	<	1100	U
Vanadium	12.3	2.2	
Zinc	8	4.4	
TPH (mg/kg)			
Total Petroleum Hydrocarbons	<	43.9	U
Water Quality (percent)			
Water	8.8	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 9-3

COMPARISON OF MAXIMUM DETECTED METAL CONCENTRATIONS TO BACKGROUND(1)
SWMU 51, CANNON AFB

Oil/Water Separator No. 375

Sample ID	Metal	Maximum detected concentration	Range of background concentrations (2)	Upper tolerance limit (UTL) background concentration(3)	Does maximim detected exceed UTL background
CAN051-0511-0000	Aluminum	8120	1410 - 11,000	10,540	N
CAN051-0513-0002	Antimony	1.8	<5 - <13	*	Y
CAN051-0513-0002	Arsenic	4.5	0.67 - 28	15.5	N
CAN051-0513-0004	Barium	1370	14.5 - 1200	642	Y
CAN051-0512-0008	Cadmium	3.4	<0.51 - 4.2	*	Y
CAN051-0511-0000	Chromium	9.7	4 - 15.4	12.5	N
CAN051-0513-0000	Cobalt	4.5	0.85 - 5.3	4.5	N
CAN051-0511-0000	Copper	9.4	<2 - 18.4	*	Y
CAN051-0511-0000	Lead	9.1	1.1 - 46	25.8	N
CAN051-0511-0000	Nickel	8.9	1.3 - 9.8	9	N
CAN051-0512-0008	Silver	2.5	0.51 - 0.93	*	Y
CAN051-0511-0000	Vanadium	21.7	5.2 - 28.3	25.3	N
CAN051-0511-0000	Zinc	22.2	<4.3 - 27.5	21.9	Y

(1) All units in mg/kg.
(2) Compiled from data collected by Woodward Clyde for the RFI and RI (WCC 1992 and WCC 1993) and Walk, Haydel and Associates for the IRP (Walk, Haydel and Associates 1990).
Summarized in "Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater at Cannon AFB, NM (WCC 1993)
(3) Upper Tolerance Limit (UTL) of the mean = mean + 2*standard deviation. This is for all practicle purposes the same as the 90% upper confidence limit of the 95th percentile where UTL = mean + standard deviation *k, where k=2.02 for n=37 .
* Data insufficient to calculate UTL of background concentration

TABLE 9-4

COMPARISON OF MAXIMUM CONCENTRATIONS WITH RBCs(1)
SWMU 51, CANNON AFB
Oil/Water Separator No. 375

Sample ID	Analyte	Maximum Detected	RBC (2)	Maximum Detected Exceed RBC
CAN051-0512-0004	1,2-Dichloroethane	0.0042	0.8	N
CAN051-0512-0004	1,2-Dichloropropane	0.0024	30	N
CAN051-0513-0002	Anthracene	0.047	2000	N
CAN051-0513-0002	Antimony	1.8	3	N
CAN051-0513-0004	**Barium**	**1370**	**600**	**Y**
CAN051-0513-0002	**Benzo(a)anthracene**	**0.6**	**0.07**	**Y**
CAN051-0513-0002	**Benzo(a)pyrene**	**0.83**	**0.01**	**Y**
CAN051-0513-0002	**Benzo(b)fluoranthene**	**1.7**	**0.07**	**Y**
CAN051-0513-0002	Benzo(g,h,i)perylene	0.52	NTF	N
CAN051-0512-0008	Cadmium	3.4	8	N
CAN051-0513-0002	Carbazole	0.079	4	N
CAN051-0513-0002	Chrysene	0.97	2	N
CAN051-0511-0000	Copper	9.4	300	N
CAN051-0513-0002	Fluoranthene	2	300	N
CAN051-0513-0002	**Indeno(1,2,3-cd)pyrene**	**0.51**	**0.04**	**Y**
CAN051-0513-0002	Phenanthrene	0.8	NTF	N
CAN051-0513-0002	Pyrene	2	200	N
CAN051-0512-0008	Silver	2.5	20	N
CAN051-0512-0004	Tetrachloroethene	0.026	1	N
CAN051-0511-0000	Toluene	0.0066	2000	N
CAN051-0512-0004	**Total Petroleum Hydrocarbons (3)**	**3150**	**1000**	**Y**
CAN051-0512-0000	Xylenes (total)	0.0016	20000	N
CAN051-0511-0000	Zinc	22.2	2000	N

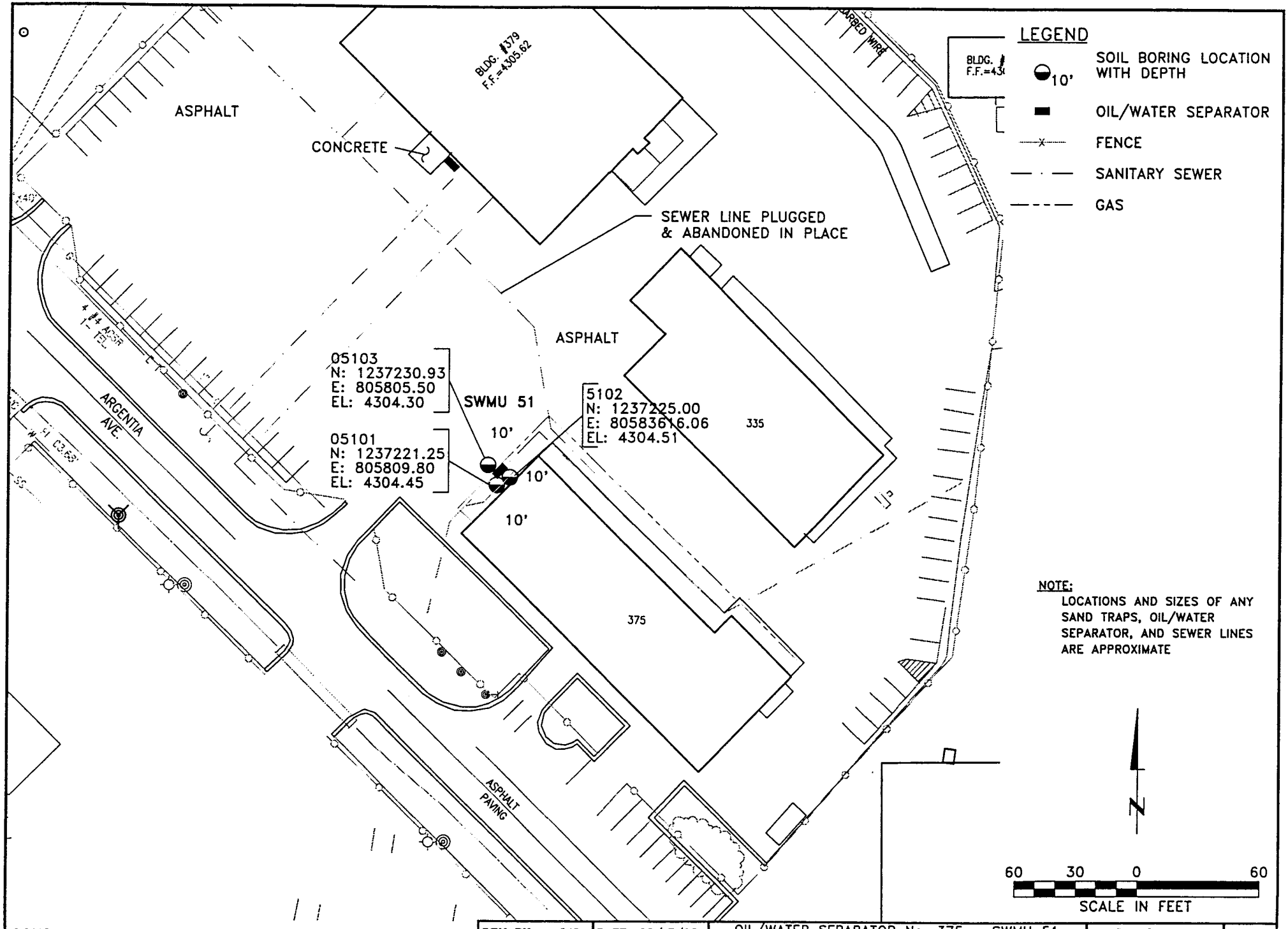
NTF = No EPA Established Toxicity Factor

(1) All units in mg/kg

(2) Risk-based concentration

(3) New Mexico recommended soil cleanup level for fuel contaminated soil.

Note: Only metals that exceeded background appear in this table.



SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

DRN BY: CJG	DATE: 08/17/93	OIL/WATER SEPARATOR No. 375 – SWMU 51 SITE PLAN AND BORING LOCATIONS CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W	FIG. NO. 9–1
CHK'D BY: .	REVISION: 0			

10.1 SITE BACKGROUND

10.1.1 Site Description

OWS 379 is located beneath the pavement adjacent to the southwest side of Building 379 within the motor pool compound. This concrete OWS consists of a two-compartment underground unit with a total capacity of about 500 gallons (Figure 10-1). A floor sump and drain pipe inside Building 379 collect fluids which flow to the OWS outside the building. Engineering drawings show the OWS to measure 5 feet by 6.5 feet and extend approximately 6 feet below the pavement.

10.1.2 Site History

The OWS is reported to have received wash water generated during heavy vehicle maintenance operations in Building 379. The oils recovered by the OWS are directed to the holding tank and wastewater is discharged to the sanitary sewer line. The OWS has been active since 1965.

10.1.3 Current Use

The OWS reportedly continues to receive wash water generated from heavy vehicle maintenance operations in Building 379. Oils recovered by the OWS are directed to the holding tank, while wastewater is discharged to the sanitary sewer line.

10.1.4 Potential Contaminants

Potential contaminants include petroleum and synthetic lubricating oils, fuels, greases, solvents, and metals.

10.2 FIELD INVESTIGATION AND DATA COLLECTION

10.2.1 Soils Sampling

Three 10-foot borings were drilled to sample soils at the periphery of OWS 379 to evaluate whether a release of SWMU-related chemicals posing a hazard to human health or the environment has occurred. These borings were located as close as possible to the OWS to determine if there has been leakage from either the inlet or outlet pipes as well as from the OWS itself. There was no evidence (such as staining of pavement) of a surface spill at this site.

Soil samples were collected from the 0.5- to 2-foot, 2- to 4-foot, 4- to 6-foot, and 8- to 10-foot depth intervals to characterize the vertical distribution of potential contaminants possibly leaking from the OWS as specified in the Field Sampling Plan and Sample Summary Tables. Samples were collected in accordance with QAPP SOP No. 7 - Subsurface Drilling and Sampling. Target analytes included VOCs, SVOCs, metals, and TRPH. Samples from the 0.5- to 2-foot interval were collected from soil immediately below the asphalt pavement covering this site.

10.2.2 Geologic Summary of Boring Logs

The 4 to 5 feet of soil immediately underlying the asphalt pavement is a fill consisting of a firm, red sandy clay with some moisture and a trace of gravel. Soil below this unit is a light yellow sandy clay, with red mottling throughout. It is dry to moist, hard, and with a trace of gravel. A rock-like material, possibly caliche, was noted in Boring 05703 at total depth. While no visual indications of soil contamination were found in these three borings, significant headspace measurements were recorded on soil samples from Boring 05703. Headspace measurements on soil samples from the other borings at this site resulted in nondetections.

10.2.3 Site Topography

The site of the OWS has a slight gradient draining southwestward from Building 379. Surface runoff eventually enters a storm sewer.

10.3 CHEMICAL INVESTIGATION RESULTS

10.3.1 General

Samples were collected as identified in Section 10.2 to comply with permit and compliance agreement requirements. Soil samples were collected from 3 borings (05701, 05702, and 05703). Sampling and analyses performed are summarized in Table 10-1. Summaries of the analytical results for these soil samples is provided in Tables 10-2a and 10-3a for near-surface soils and 10-2b and 10-3b for subsurface soils. For each sample type, the tables provide results for analytes only if they were detected at least once in this type of sample collected at the SWMU group. Complete analytical summary results are provided in the QCSR (Appendix A).

10.3.2 Organic Results for Near-Surface Soil Samples

The near-surface soil samples collected at this SWMU (CAN057-0571-0000, CAN057-0571-0002, CAN057-0572-0000, CAN057-0572-0002, CAN063-0573-0000, and CAN057-0573-0002 were analyzed for VOCs, SVOCs, TPH, and metals as indicated in Table 10-1.

Other than acetone and methylene chloride, which were qualified nondetected after they were determined to be laboratory contaminants (see Section 4.5.4 of the QCSR), the VOCs reported were 1.7J µg/kg ethylbenzene reported for sample CAN057-0572-0000; toluene reported at 3.8 µg/kg and 4.5 µg/kg, and xylenes reported at 7.5 µg/kg and 9.0 µg/kg in samples CAN057-0571-0000 and CAN057-0572-0000, respectively. TPH was also reported at 144 mg/kg and 160 mg/kg in samples CAN057-0571-0000 and CAN057-0572-0000, respectively. No SVOCs were detected above reporting limits.

10.3.3 Organic Results for Subsurface Soil Samples

The subsurface soil samples collected at this SWMU (CAN057-0571-0004, CAN057-0571-0008, CAN057-0572-0004, CAN057-0572-0008, CAN057-0573-0004, CAN057-0573-0008, were analyzed for VOCs, SVOCs, metals, and TPH as indicated in Table 10-1.

Other than acetone and methylene chloride, which were qualified nondetect after they were determined to be laboratory contaminants (see Section 4.1.4 of the QCSR), the VOCs reported were toluene at 1.6 µg/kg, 2.5 µg/kg and 9.2 µg/kg in samples CAN057-0571-0004, CAN057-0573-0008, and CAN057-0572-0008 and xylenes reported at 1.7 µg/kg and 2.3 µg/kg in samples CAN057-0571-0004, CAN057-0573-0008, respectively. TPH was reported in one sample, CAN057-0571-0008, at 49.4 µg/kg. No SVOCs were detected above reporting limits.

10.3.4 Inorganic Results

Metals analyses were performed on samples collected from this SWMU as indicated in Table 10-1. The range of results for metals reported in these soil samples are summarized in Table 10-A:

TABLE 10-A

Analyte	Frequency Reported	Lowest Detection	Sample Location	Highest Detection	Sample Location
Aluminum	12/12	2700 mg/kg	0573-0004	9450 mg/kg	0572-0000
Antimony	0/12				
Arsenic	12/12	1.6 mg/kg	0571-0002	2.7 mg/kg	0572-0000
Barium	12/12	56.9 mg/kg	0572-0002	457 mg/kg	0573-0008
Beryllium	12/12	0.33 mg/kg	0571-0000	0.6 mg/kg	0572-0000
Cadmium	4/12	0.62 mg/kg	0571-0002	3.1 mg/kg	0571-0004
Cadmium	results	rejected			
Calcium	12/12	3740 mg/kg	0572-0002	261,000 mg/kg	0573-0008
Chromium	9/12	2.6 mg/kg	0572-0004	9.7 mg/kg	0572-0000
Cobalt	9/12	2.2 mg/kg	0572-0004	4.2 mg/kg	0571-0002
Copper	10/12	1.8 mg/kg	0573-0008	7.9 mg/kg	0571-0002
Iron	12/12	2180 mg/kg	0573-0008	9390 mg/kg	0572-0000
Lead	12/12	0.91 mg/kg	0573-0008	9.2 mg/kg	0572-0000
Magnesium	12/12	1550 mg/kg	0573-0000	3450 mg/kg	0571-0008
Manganese	12/12	28.7 mg/kg	0573-0004	178 mg/kg	0572-0000

Analyte	Frequency Reported	Lowest Detection	Sample Location	Highest Detection	Sample Location
Mercury	0/12				
Nickel	9/12	4.7 mg/kg	0571-0004	8.9 mg/kg	0573-0002
Potassium	10/12	704 mg/kg	0573-0004	1760 mg/kg	0573-0002
Silver	8/12	0.53 mg/kg	0572-0000	2.7 mg/kg	0573-0008
Selenium	0/12	-	-	-	-
Sodium	9/12	220 mg/kg	0573-0002	1450 mg/kg	0573-0004
Thallium	0/12	-	-	-	-
Vanadium	12/12	5.9 mg/kg	0573-0008	19.0 mg/kg	0572-0000
Zinc	12/12	9.0 mg/kg	0571-0004	22.5 mg/kg	0573-0000

Note: See Table 10-3 for comparison to background.

10.4 SWMU-SPECIFIC DATA ASSESSMENT

10.4.1 General

This assessment of the OWS 379 data is an evaluation of quality issues that could affect the major data uses. In general, the objective of the RFI was identification and quantification of the nature and extent of the contamination, which was necessary to meet permit and compliance agreement requirements, and to support an evaluation of the risk to human health and the environment.

10.4.2 Sampling Issues

A review of the data contained in the log books and the Daily Quality Control Reports (DQCRs) for SWMU 57 indicate that there were no sampling issues that would impact data usability. QC issues are discussed in detail in the QCSR in Appendix A, and copies of the DQCRs are included in that appendix.

10.4.3 Data Review Issues

For laboratory analytical data, QA/QC objectives were specified in the Cannon AFB QAPP (W-C 1993). The objectives were used as indicators of the quality necessary to support identification and quantitation of potential chemicals of concern. The data review is presented in Section 4.5 of the Quality Control Summary Report (QCSR) located in Appendix A. As presented in the QCSR, data for the analytes selenium, thallium, lead, silver, barium, calcium,

manganese, vanadium, and chromium were qualified as estimated concentrations, and cadmium data were qualified rejected **R**.

Selenium, thallium, lead, and silver data were qualified estimated to indicate a potential low bias, When a low bias is indicated, actual concentrations may be higher than the reported results. Use of this data in risk assessment may underestimate risk. Similarly, when a high bias is indicated, actual concentrations may be lower than the reported results. Use of this data in risk assessment may overestimate risk.

Barium, calcium, chromium, manganese, lead, and vanadium data were qualified estimated due to precision that did not meet the QA\QC criteria defined for this project. Poor precision could be attributed to errors in sampling and analysis; however, since the other analytes which were sampled and analyzed in the same procedure (Method 6010) met QA/QC criteria, this variation is likely due to sample heterogeneity.

For ICP metals analyses, the only indicator of data accuracy is the results of the matrix spike. Cadmium data were rejected based on variability in the MS/MSD results. MS recoveries for the cadmium were 9 and 174 percent. All samples analyzed for this SWMU had cadmium concentrations reported; however, because the accuracy criteria have been exceeded, it can not be determined whether the identification of cadmium can be relied upon in 8 of the 12 samples. Therefore, in the eight samples associated with the above MS recoveries, the data were rejected.

The uncertainty in the actual concentration reported for estimated data does not affect the usability of the data for identification of chemicals in characterizing the nature and extent of contamination at this SWMU.

10.4.4 Limitations

Elevated reporting limits may limit the usability of the data due to low level analytes being diluted to below the instrument detection limits. That is, chemicals may be reported as nondetect when they are actually present in a sample at low levels. Section 4.5.6 of the QCSR (Appendix A) presents a discussion of elevated reporting limits; however, no dilutions of samples were required which significantly exceeded established RLs.

10.4.5 Summary

Overall, data generated during the study of SWMU 57 were determined to meet quality criteria. In conjunction with the analytical data review, other information including field observations were evaluated in the assessment of the usability of SWMU 57 data. The data support identification of the nature and extent of contamination, except for the cadmium data, and provide reasonable concentration for use in risk assessment.

10.5 NATURE AND EXTENT OF CONTAMINATION

SWMU 57 is an OWS serving Building 379 (fire truck maintenance shop). Three borings in close proximity to the separator were each advanced to a depth of 10 feet. In general, the samples appeared relatively free of organic contamination. There was no visible evidence of spills or leaks in the vicinity, and the entire area around the separator is paved. The chemical test results do not show any significant organic contamination.

10.6 COMPARISON OF METALS CONCENTRATIONS TO BACKGROUND

Results of the comparison of metal concentration in soil to background levels for SWMU 57 are given in Table 10-3. A summary of the results of the comparison is presented here.

Metals are natural constituents of soils. SWMU concentrations of metals were evaluated to assess whether the metals in environmental samples exceeded background levels. Metals that occur in concentrations within background levels are not considered SWMU-related chemicals of concern and are not evaluated further.

The maximum concentration of each detected metal at each SWMU was compared to the upper tolerance limit of the background data. The upper tolerance limit (UTL) was defined as the mean plus two times the standard deviation. This is for all practical purposes equal to the 90% upper confidence limit of the 95th percentile which is equal to the mean plus the standard deviation times the k statistic. The background data set used consisted of 37 data points (W-C 1993), so the k statistic equals 2.02 (Gilbert 1987).

The maximum detected concentrations of cadmium, copper, silver, and zinc exceeded the (UTL) of the background data. Therefore, these metals were compared to risk based concentrations at SWMU 57.

10.7 RISK SCREENING

10.7.1 Exposure Pathway Flow Chart

The Preliminary Exposure Pathway Flow Chart (EPFC) applicable to SWMU 57, OWS 379, is shown in Figure 3-2. It shows that the potential exposure pathways are ingestion of soil, inhalation of soil particulates, dermal exposure to contaminated soil, inhalation of airborne chemicals released from soil, and ingestion inhalation, and dermal exposure to groundwater (if drinking water supplies were affected). Storm water runoff is considered to be an insignificant pathway because potential spills would be minor and over a small area.

10.7.2 Screening of Contaminants Against RBCs (and Other Criteria)

Maximum detected concentrations of organic compounds and metals that exceeded background were compared to screening-level RBCs (see Section 3.4.5.1 for derivations of RBCs) and other screening criteria in Table 10-4. Screening-level criteria other than RBCs include the state of New Mexico's TPH cleanup level of 1,000 mg/kg (New Mexico Environment Department 1993) and the EPA's recommended soil lead level of 500 mg/kg (EPA 1990). The TPH soil clean-up concentration of 1,000 mg/kg is not a risk-based concentration, nor is it a relevant-and-applicable standard for the SWMUs in this investigation. Rather, it is a conservative value originally derived for the cleanup of fuel-contaminated soils at underground storage tank sites. Risk-based concentrations for TPH, measured as fresh fuels (e.g., gasoline or diesel), are at least an order of magnitude higher for occupational exposures. The concentration of 500 mg/kg is the most conservative concentration in the recommended range of 500 mg/kg to 1,000 mg/kg as a lead level in EPA's Uptake Biokinetic Model (EPA 1990) for residential soil. Compounds with no toxicity factors cannot be evaluated in the risk screening since RBCs cannot be calculated. These compounds are not likely to exhibit significant toxicity and are not likely to pose significant adverse impacts to human health at the concentrations that are typically measured in soil. The comparison for SWMU 57 shows that no maximum detected concentrations exceed RBCs.

This comparison of maximum detected concentrations to RBCs is very conservative (health-protective) and actual impacts are likely to be lower than those suggested by exceedances of conservative criteria. For example, maximum detected concentrations are likely to overestimate actual concentrations to which people would be exposed. Furthermore, the screening criteria are based on highly conservative residential exposure assumptions and target risk levels that may not be pertinent to current or future use of the SWMU. The RBCs used in this evaluation are calculated using RCRA Action Level methodology; however, the RBCs are more health-protective than conventional RCRA Action Levels because a target excess cancer risk level of 1×10^{-7} (1 in 10,000,000) and a hazard quotient of 0.1 were used to account for exposures to multiple chemicals and for exposure routes other than soil ingestion. Conventional RCRA Action Levels are calculated based on a cancer risk of 1×10^{-6} and a noncancer hazard of 1.0.

The purpose of the comparison to RBCs is to determine whether or not chemical releases (characterized by maximum detected concentrations) have occurred at SWMU 57 that could pose potential risks based on conservative health-based criteria. Since no maximum concentrations of analytes exceed screening level criteria, further evaluation or investigation of chemical concentrations and probable exposures is not warranted.

10.8 SUMMARY AND RECOMMENDATIONS

Twelve soil samples were collected and analyzed from three 10-foot deep soil borings at SWMU 57. Maximum detected concentration to background levels and RBCs. Organic compounds and metals were not found at levels that exceeded RBCs or other screening-level criteria.

The highest concentrations for all detected analytes were found in the near-surface soils. The concentrations decreased with depth in all cases except for acetone, methylene chloride, and toluene (all common laboratory contaminants) which were highest (but below RBCs) at the 8-foot depth; therefore, the vertical extent of contamination has been characterized by the borings, and the potential for the groundwater beneath SWMU 57 to be impacted can be characterized. The potential for impacts to groundwater is considered to be low because the detected levels of analytes at SWMU 57 are negligible, the depth to groundwater is greater than 200 feet, evaporation exceeds infiltration, and sampling demonstrates that contaminants

are not significantly being transported vertically below the SWMU. Therefore, no further action is recommended at this site.

TABLE 10-1

SUMMARY OF ANALYTICAL AND QA/QC SAMPLING
OIL/WATER SEPARATOR NO. 379 (SWMU NO. 57)
CANNON AFB, NEW MEXICO

Sample Location	Target Interval (ft-bgs)	Sample Identification Number	QA/QC Type	Sample Matrix	Analytical Parameters				Sample Containers		
					VOCs	SVOCs	Metals	TRPH	40 ml VOA vials	4 oz. jars	8 oz. jars
Boring 05701	0.5 - 2	CAN057-0571-0000		Soil	X	X	X	X		2	1
	0.5 - 2	CAN057-0571-5761	FD	Soil	X	X	X	X		2	1
	2 - 4	CAN057-0571-0002		Soil	X		X	X		2	i
	4 - 6	CAN057-0571-0004		Soil	X		X	X		2	1
	8 - 10	CAN057-0571-0008		Soil	X	X	X	X		2	1
	8 - 10	CAN057-0571-5762	FD	Soil	X		X	X		2	1
	8 - 10	CAN057-0571-5701	MRD	Soil	X	X	X	X		2	1
		CAN057-0571-5751	AB	Water	X				2		
		CAN057-0571-5771	RB	Water	X				2		
		CAN057-0571-5781	DW	Water	X				2		
		CAN057-0571-5791	TB	Water	X				2		
Boring 05702	0.5 - 2	CAN057-0572-0000		Soil	X		X	X		2	1
	2 - 4	CAN057-0572-0002		Soil	X		X	X		2	1
	4 - 6	CAN057-0572-0004		Soil	X		X	X		2	1
	8 - 10	CAN057-0572-0008		Soil	X		X	X		2	1
Boring 05703	0.5 - 2	CAN057-0573-0000		Soil	X	X	X	X		2	1
	2 - 4	CAN057-0573-0002		Soil	X		X	X		2	1
	4 - 6	CAN057-0573-0004		Soil	X	X	X	X		2	1
	4 - 6	CAN057-0573-6004	MS/MSD SVOC only	Soil		X					1
	8 - 10	CAN057-0573-0008		Soil	X		X	X		2	1
	8 - 10	CAN057-0573-6008	MS/MSD	Soil	X	X	X	X		2	2

AB = Ambient blank
DW = Decontamination water
FB = Field blank
MRD = Missouri River Division
MS/MSD = Matrix spike/matrix spike duplicate
RB = Rinsate blank
TB = Trip blank

See Figure 10-1 for locations of the borings.

TABLE 10-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 57

LOCATOR	CAN057-0571-0000			CAN057-0571-0002			CAN057-0572-0000			CAN057-0572-0002			CAN057-0573-0000			CAN057-0573-0002		
LAB SAMPLE NUMBER	0312740017SA			0312740018SA			0312790012SA			0312790013SA			0312790008SA			0312790009SA		
COLLECT DATE	09/15/93			09/15/93			09/15/93			09/15/93			09/15/93			09/15/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)																		
Ethylbenzene	<	5.6	U	<	5.6	U	1.7	5.6	J	<	5.6	U	<	5.5	U	<	5.6	U
Toluene	3.8	5.6	J	<	5.6	U	4.5	5.6	J	<	5.6	U	<	5.5	U	<	5.6	U
Xylenes (total)	7.5	5.6		<	5.6	U	9	5.6		<	5.6	U	<	5.5	U	<	5.6	U
Metals (mg/kg)																		
Aluminum	4790	11.1		7530	11.3		9450	11.2		6780	11.1		8100	11.1		8420	11.2	
Arsenic	2	0.56		1.6	0.56		2.7	0.56		2.1	0.56		2.2	0.55		2	0.56	
Barium	180	1.1		93.7	1.1		106	1.1	J	56.9	1.1	J	71.7	1.1	J	82.7	1.1	J
Beryllium	0.33	0.22		0.58	0.23		0.6	0.22		0.54	0.22		0.52	0.22		0.58	0.22	
Cadmium	0.95	0.56		0.62	0.56				R			R			R			R
Calcium	63800	22.2	J	23700	22.5		19700	22.5		3740	22.3		4730	22.2		38900	22.4	
Chromium	4.4	1.1		7.9	1.1		9.7	1.1	J	7.9	1.1	J	9.5	1.1	J	7.6	1.1	J
Cobalt	2.4	1.1		4.2	1.1		3.7	1.1		3.8	1.1		3.1	1.1		3.7	1.1	
Copper	4.5	2.2		7.9	2.3		7.3	2.2		6.3	2.2		7.2	2.2		7.3	2.2	
Iron	4360	11.1		7210	11.3		9390	11.2		7770	11.1		8720	11.1		8010	11.2	
Lead	6.4	0.56		6.2	0.56		9.2	0.56	J	7.2	0.56	J	7.8	0.55	J	5.9	0.56	J
Magnesium	2520	22.2		1810	22.5		1980	22.5		1680	22.3		1550	22.2		2260	22.4	
Manganese	106	1.1		177	1.1		178	1.1		156	1.1		162	1.1		138	1.1	
Nickel	6	4.4		8.9	4.5		8	4.5		8.1	4.5		7.1	4.4		8.9	4.5	
Potassium	937	556		1460	563		1700	562		1420	557		1520	554		1760	559	
Silver	0.66	1.1	J	0.63	1.1	J	0.53	1.1	J	0.59	1.1	J	0.61	1.1	J	<	1.1	UJ
Sodium	<	556	U	<	563	U	309	562	J	291	557	J	365	554	J	220	559	J

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 10-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 57

LOCATOR	CAN057-0571-0000			CAN057-0571-0002			CAN057-0572-0000			CAN057-0572-0002			CAN057-0573-0000			CAN057-0573-0002		
LAB SAMPLE NUMBER	0312740017SA			0312740018SA			0312790012SA			0312790013SA			0312790008SA			0312790009SA		
COLLECT DATE	09/15/93			09/15/93			09/15/93			09/15/93			09/15/93			09/15/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Vanadium	13.5	1.1		17	1.1		19	1.1		16	1.1		18.3	1.1		15.5	1.1	
Zinc	14.1	2.2		18.4	2.3		20.1	2.2		16.1	2.2		22.5	2.2		21	2.2	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	144	44.4		78.4	45		160	44.9		<	44.5	U	<	44.3	U	<	44.8	U
Water Quality (percent)																		
Water	10	0.1		11	0.1		11	0.1		10	0.1		9.8	0.1		11	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 10-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 57

LOCATOR	CAN057-0571-0004			CAN057-0571-0008			CAN057-0572-0004			CAN057-0572-0008			CAN057-0573-0004		
LAB SAMPLE NUMBER	0312740019SA			0312740020SA			0312790014SA			0312790015SA			0312790010SA		
COLLECT DATE	09/15/93			09/15/93			09/15/93			09/15/93			09/15/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)															
Toluene	1.6	5.9	J	<	5.7	U	<	5.8	U	9.2	5.6		<	6	U
Xylenes (total)	1.7	5.9	J	<	5.7	U	<	5.8	U	<	5.6	U	<	6	U
Metals (mg/kg)															
Aluminum	3860	23.8		4740	22.9		5050	23.1		5590	22.3		2700	59.7	
Arsenic	1.7	0.59		1.6	0.57		1.9	0.58		1.9	0.56		1.7	0.6	
Barium	167	2.4		192	2.3		126	2.3	J	303	2.2	J	165	6	J
Beryllium	<	0.48	U	<	0.46	U	0.38	0.46	J	0.4	0.45	J	<	1.2	U
Cadmium	3.1	1.2		1.9	1.1	J			R			R			R
Calcium	228000	47.5		127000	45.7	J	179000	46.3		123000	44.6		254000	119	
Chromium	<	2.4	U	2.8	2.3		2.6	2.3	J	3.5	2.2	J	<	6	UJ
Cobalt	2.4	2.4		<	2.3	U	2.2	2.3	J	2.8	2.2		<	6	U
Copper	<	4.8	U	<	4.6	U	3.9	4.6	J	3.6	4.5	J	4.2	11.9	J
Iron	3260	23.8		4140	22.9		4070	23.1		4890	22.3		2430	59.7	
Lead	3	0.59		5.7	0.57	J	2.2	2.9	J	3.6	2.8	J	2.2	3	J
Magnesium	2860	47.5		3450	45.7		2440	46.3		3170	44.6		2860	119	
Manganese	47.1	2.4		82.4	2.3	J	49.6	2.3		93.4	2.2		28.7	6	
Nickel	4.7	9.5	J	<	9.1	U	5	9.3	J	5.6	8.9	J	<	23.9	U
Potassium	<	1190	U	<	1140	U	951	1160	J	1220	1120		704	2990	J
Silver	<	2.4	U	<	2.3	U	0.95	2.3	J	1.6	2.2	J	<	6	UJ
Sodium	<	1190	U	418	1140	J	346	1160	J	326	1120	J	1450	2990	J
Vanadium	10.5	2.4		18.9	2.3	J	9	2.3		12.6	2.2		6.8	6	
Zinc	9	4.8		14	4.6		10.9	4.6		11.9	4.5		10.6	11.9	J
TPH (mg/kg)															
Total Petroleum Hydrocarbons	<	47.5	U	49.4	45.7		<	46.3	U	<	44.6	U	<	47.8	U
Water Quality (percent)															
Water	16	0.1		12	0.1		14	0.1		10	0.1		16	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 10-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 57

LOCATOR	CAN057-0573-0008		
LAB SAMPLE NUMBER	0312790011SA		
COLLECT DATE	09/15/93		
	Result	RL	Qual
Volatile Organics (ug/kg)			
Toluene	2.5	5.4	J
Xylenes (total)	2.3	5.4	J
Metals (mg/kg)			
Aluminum	2870	54.1	
Arsenic	2.4	0.54	
Barium	457	5.4	J
Beryllium	<	1.1	U
Cadmium			R
Calcium	261000	108	
Chromium	<	5.4	UJ
Cobalt	<	5.4	U
Copper	1.8	10.8	J
Iron	2180	54.1	
Lead	0.91	1.1	J
Magnesium	3330	108	
Manganese	38.1	5.4	
Nickel	<	21.7	U
Potassium	707	2710	J
Silver	2.7	5.4	J
Sodium	1150	2710	J
Vanadium	5.9	5.4	
Zinc	11.1	10.8	
TPH (mg/kg)			
Total Petroleum Hydrocarbons	<	43.3	U
Water Quality (percent)			
Water	7.7	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 10-3

COMPARISON OF MAXIMUM DETECTED METAL CONCENTRATIONS TO BACKGROUND(1)
SWMU 57, CANNON AFB
Oil/Water Separator No. 379

Sample ID	Metal	Maximum detected concentration	Range of background concentrations (2)	Upper tolerance limit (UTL) background concentration (3)	Does maximum detected exceed UTL background
CAN057-0572-0000	Aluminum	9450	1410 - 11,000	10,540	N
CAN057-0572-0000	Arsenic	2.7	0.67 - 28	15.5	N
CAN057-0573-0008	Barium	457	14.5 - 1200	642	N
CAN057-0572-0000	Beryllium	0.6	0.17 - 0.77	0.73	N
CAN057-0573-0008	Cadmium	3.1	<0.51 - 4.2	*	Y
CAN057-0572-0000	Chromium	9.7	4 - 15.4	12.5	N
CAN057-0571-0002	Cobalt	4.2	0.85 - 5.3	4.5	N
CAN057-0571-0002	Copper	7.9	<2 - 18.4	*	Y
CAN057-0572-0000	Lead	9.2	1.1 - 46	25.8	N
CAN057-0573-0002	Nickel	8.9	1.3 - 9.8	9	N
CAN057-0573-0008	Silver	2.7	0.51 - 0.93	*	Y
CAN057-0572-0000	Vanadium	19	5.2 - 28.3	25.3	N
CAN057-0573-0000	Zinc	22.5	<4.3 - 27.5	21.9	Y

(1) All units in mg/kg.
(2) Compiled from data collected by Woodward Clyde for the RFI and RI (WCC 1992 and WCC 1993) and Walk, Haydel and Associates for the IRP (Walk, Haydel and Associates 1990).
Summarized in "Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater at Cannon AFB, NM (WCC 1993)
(3) Upper Tolerance Limit (UTL) of the mean = mean + 2*standard deviation. This is for all practicle purposes the same as the 90% upper confidence limit of the 95th percentile where UTL = mean + standard deviation *k, where k=2.02 for n=37 .
* = Data insufficient to calculate UTL of background

TABLE 10-4

COMPARISON OF MAXIMUM CONCENTRATIONS WITH RBCs(1)
SWMU 57, CANNON AFB
Oil/Water Separator No. 379

Sample ID	Analyte	Maximum Detected	RBC (2)	Maximum Detected Exceed RBC
CAN057-0571-0004	Cadmium	3.1	8	N
CAN057-0571-0002	Copper	7.9	300	N
CAN057-0572-0000	Ethylbenzene	0.0017	800	N
CAN057-0573-0008	Silver	2.7	20	N
CAN057-0572-0008	Toluene	0.0092	2000	N
CAN057-0572-0000	Total Petroleum Hydrocarbons (3)	160	1000	N
CAN057-0572-0000	Xylenes (total)	0.009	20000	N
CAN057-0573-0000	Zinc	22.5	2000	N

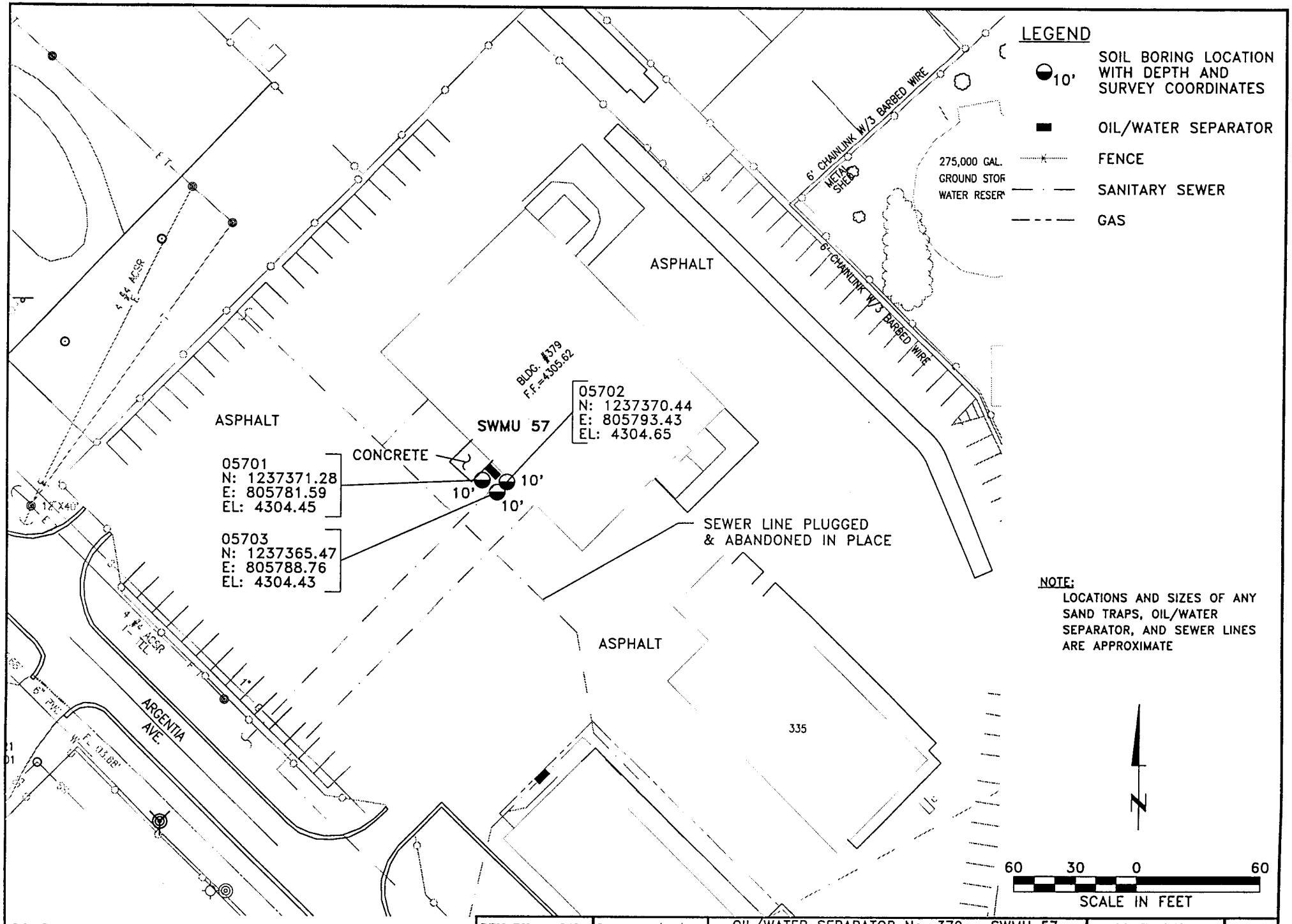
(1) All units in mg/kg

(2) Risk-based concentration

(3) New Mexico recommended soil cleanup level for fuel contaminated soil.

Note: Only metals that exceeded background appear in this table.

CAD FILE: C3M11W05.DWG V=SWMU-57 02/10/94 11:29



SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

DRN BY: CJG	DATE: 08/17/93	OIL/WATER SEPARATOR No. 379 – SWMU 57 SITE PLAN AND BORING LOCATIONS CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W
CHK'D BY: .	REVISION: 0		FIG. NO. 10-1

(4)

VOLUME I B
RFI REPORT

RCRA FACILITY INVESTIGATION

APPENDIX III
SWMUs - PHASE I

CANNON AIR FORCE BASE

NEW MEXICO

Prepared for
Cannon Air Force Base
27 CES/CEVR
Environmental Flight

February 1994

2-1-1994

C3M11W

11.0
SAND TRAP NOs. 5077A AND 5077B AND OIL/WATER SEPARATOR NO. 5077C - SWMU NOs. 61, 62, AND 63

11.1 SITE BACKGROUND

11.1.1 Site Description

Facility 5077 is a vehicle wash rack located in the Civil Engineering Squadron compound. The facility includes two 380-gallon sand traps within the limits of the concrete wash rack and a 1,675-gallon OWS located southeast of the wash rack (Figure 11-1). The sand traps and the OWS are constructed of concrete. As-built plans show the sand traps measure about 3 feet square while the OWS measures about 5 feet by 10-feet. The exact depths of the units are not known, but are expected to be less than 10-feet. The west sand trap (5077a), the east sand trap (5077b), and the OWS (5077c) have been identified as SWMUs 61, 62, and 63, respectively, and were investigated together.

11.1.2 Site History

The sand traps and OWS reportedly received wash water generated from the wash down of motor vehicles. The unit reported to be an OWS has been found to be a single-compartment concrete box with no baffles. Even though it appears to be a sand trap, it will be referenced as an OWS throughout this report.

11.1.3 Current Use

While the sand traps and OWS may receive wash water generated from the wash down of motor vehicles, the wash rack was roped off and appeared to be out of service during the time of the field investigation at this site.

11.1.4 Potential Contaminants

Potential contaminants include petroleum and synthetic lubricating oils, fuels, greases, solvents, and metals.

11.2 FIELD INVESTIGATION AND DATA COLLECTION

11.2.1 Soils Sampling

Six 10-foot borings were drilled to sample the soils at these SWMUs to determine if a release of SWMU-related chemicals posing a significant risk to human health or the environment has occurred as a result of leakage or spillage at these facilities. Borings 06101 and 06102 were located as close as possible to the northwest and southeast corners of Sand Trap No. 5077a. Borings 06201 and 06202 were located at the west and southeast edges of Sand Trap No. 5077b, as close as possible to the inlet and outlet pipes to sample the soils for indications of leaks from these sources. Borings 06301 and 06302 were located as close as possible to the inlet and outlet pipes of OWS No. 5077c to sample the soils for indications of leaks from these sources or from the OWS. No surface staining of concrete or stressed vegetation was evident at any of the soil boring sites.

Soil samples were collected at the 0.5- to 2-foot, 2- to 4-foot, 4- to 6-foot, and 8- to 10-foot depth intervals in SWMUs 61 and 62 and at the 0- to 0.5-foot, 1.5- to 3-foot, 4- to 6-foot, and 8- to 10-foot depth intervals in SWMU 63 as specified in the Field Sampling Plan and the Sample Summary Tables. Samples were collected in accordance with QAPP SOP No. 6 - Surface Soil Sampling and QAPP SOP No. 7 - Subsurface Drilling and Sampling. Target analytes included VOCs, SVOCs, metals and TRPH. Surficial samples in the grass covered area around the OWS were collected at approximately 0.2 to 0.5 feet to provide a worst-case situation for risk assessment purposes in the event that SVOC contaminants are discovered during this investigation. Samples from the 0.5- to 2-foot depth interval were collected from the soils immediately below the concrete covering the wash rack for the paved areas.

11.2.2 Geologic Summary of Boring Logs

Boring logs indicate a reddish, sandy clay/clayey sand underlying the wash rack and OWS to a depth of approximately 6.5 to 7.5 feet. This soil is firm, dry to moist, and has increasing sand content with depth. A dry, light yellowish-white, sandy clay with red mottling and a trace of white gravel clasts is found at depths below about 7 feet. A thicker sequence of the upper reddish soil at the wash rack may indicate the placement of this locally generated material as fill below the concrete. No visual indications of soil contamination were found at these three sites, and all OVA reading were zero or very low (see boring logs in Appendix B, Volume IV).

11.2.3 Site Topography

Drainage from the wash rack flows into the sand traps and the OWS. The area of the OWS is flat with no discernable gradient.

11.3 CHEMICAL INVESTIGATION RESULTS

11.3.1 General

Samples were collected as identified in Section 11.2 to comply with permit and compliance agreement requirements. Soil samples were collected from 6 borings (06101, 06102, 06201, 06202, 06301, and 06302). Sampling and analyses performed are summarized in Table 11-1. Summaries of the analytical results for these soil samples are provided in Tables 11-2a and 11-2c for near-surface soils and 11-2b and 11-2d for subsurface soils. For each sample type, the tables provide results for analytes only if they were detected at least once in this type of sample collected at the SWMU group. Complete analytical summary results are provided in the QCSR (Appendix A).

11.3.2 Organic Results For Near-surface Soil Samples

The near-surface soil samples collected at these SWMUs (CAN061-0611-0000, CAN061-0611-0002, CAN061-0612-0000, CAN061-0612-0002, CAN062-0621-0000, CAN062-0622-0000, CAN062-0622-0002, CAN063-0631-0000, CAN063-0631-0002, CAN063-0632-0000,

and CAN063-0632-0002) were analyzed for VOCs, SVOCs, metals, and TPH as indicated in Table 11-1.

Other than acetone and methylene chloride, which were qualified nondetected after they were determined to be laboratory contaminants (see Section 4.6.4 of the QCSR), the VOCs reported were 1.5 µg/kg 1,2-dichloroethane for sample CAN063-0631-0000; 1.4 µg/kg 1,1,2,2-tetrachloroethane, 9.6 µg/kg 2-hexanone, and 1.2 µg/kg bromoform reported for sample CAN062-0622-0000; toluene for samples CAN061-0611-0000, CAN062-0621-0000, CAN062-0621-0002, and CAN063-0631-0000, at 5 µg/kg, 1.2 µg/kg, 3.4 µg/kg, and 2.7 µg/kg, respectively; total xylenes for samples CAN061-0612-0000 and CAN063-0631-0000 at 2.8 µg/kg and 1.1 µg/kg, respectively. Results reported for SVOCs were primarily polycyclic aromatic hydrocarbons (PAHs). PAHs were reported for two samples and included the compounds 2-methylnaphthalene, acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene. Summing PAH concentrations, sample CAN063-0632-0000 had the highest total PAH reported at 11320 µg/kg and sample CAN063-0631-0000 had total PAH reported at 6153 µg/kg. Except for bis(2-ethylhexyl)phthalate, which was qualified nondetect after it was determined to be a laboratory contaminant, the only SVOCs reported were for samples CAN063-0631-0000 and CAN063-0632-0000 and included butyl benzyl phthalate at 120 µg/kg and 50 µg/kg, respectively, carbazole at 720 µg/kg and 1100 µg/kg respectively, and dibenzofuran at 51 µg/kg and 53 µg/kg respectively. Results reported for TPH included samples CAN063-0632-0000 at 610 mg/kg and CAN063-0631-0000 at 649 mg/kg.

11.3.3 Organic Results For Subsurface Soil Samples

The subsurface soil samples collected at these SWMUs (CAN061-0611-0004, CAN061-0611-0008, CAN061-0612-0004, CAN061-0612-0008, CAN062-0621-0004, CAN062-0621-0008, CAN062-0622-0004, and CAN-0622-0008, CAN063-0631-0004, CAN063-0631-0008, CAN063-0632-0004, and CAN063-0632-0008) were analyzed for VOCs, SVOCs, metals, and TPH as indicated in Table 11-1.

Other than acetone and methylene chloride, which were qualified nondetect after they were determined to be laboratory contaminants (see Section 4.6.4 of the QCSR), the only VOC

reported was 2.1 µg/kg toluene for sample CAN061-0611-0008. SVOCs and TPH were not detected above reporting limits.

11.3.4 Inorganic Results

Metals analyses were performed on samples collected from these SWMUs as indicated in Table 11-1. The range of results for metals reported in these soil samples are summarized in Table 11-A.

TABLE 11-A

Analyte	Frequency Reported	Lowest Detection	Sample Location	Highest Detection	Sample Location
Aluminum	24/24	3040 mg/kg	0622-0008	8910 mg/kg	0631-0002
Antimony	0/24	--	--	--	--
Arsenic	24/24	1.1 mg/kg	0622-0008	4.1 mg/kg	0642-0000
Barium	24/24	28.4 mg/kg	0621-0004	727 mg/kg	0612-0008
Beryllium	24/24	0.27 mg/kg	0631-0000	0.64 mg/kg	0631-0008
Cadmium	7/24	0.69 mg/kg	0612-0004	3 mg/kg	0611-0008
Calcium	24/24	1570 mg/kg	0621-0004	183000 mg/kg	0612-0008
Chromium	23/24	2.1 mg/kg	0631-0008	16.1 mg/kg	0632-0000
Cobalt	23/24	1.7 mg/kg	0611-0008	4.2 mg/kg	0622-0000
Copper	24/24	1.6 mg/kg	0611-0008	11.6 mg/kg	0631-0000
Iron	24/24	2470 mg/kg	0622-0008	9190 mg/kg	0611-0000
Lead	24/24	3.3 mg/kg	0611-0008	84.4 mg/kg	0631-0000
Magnesium	24/24	1240 mg/kg	0621-0002	3660 mg/kg	0631-0008
Manganese	24/24	44.2 mg/kg	0612-0008	383 mg/kg	0631-0000
Mercury	2/24	0.18 mg/kg	0632-0000	0.25 mg/kg	0631-0000
Nickel	24/24	3 mg/kg	0611-0008	8.3 mg/kg	0631-0002
Potassium	24/24	616 mg/kg	0612-0008	1810 mg/kg	0621-0000
Silver	11/24	0.34 mg/kg	0621-0004	1.7 mg/kg	0612-0008
Selenium	0/24	--	--	--	--
Sodium	6/24	173 mg/kg	0621-0008	375 mg/kg	0632-0002
Thallium	0/24	--	--	--	--
Vanadium	24/24	5.6 mg/kg	0611-0008	22.3 mg/kg	0622-0000
Zinc	24/24	6.6 mg/kg	0612-0008	54.9 mg/kg	0631-0000

Note: See Table 11-3 for comparison to background.

11.4 SWMU SPECIFIC DATA ASSESSMENT

11.4.1 General

This assessment of OWS Nos. 5077A, 5077B, 5077C data is an evaluation of quality issues that could affect the major data uses. In general, the objective of the RFI was identification and quantification of the nature and extent of the contamination, which was necessary to meet permit and compliance agreement requirements, and to support an evaluation of the risk to human health and the environment.

11.4.2 Sampling Issues

A review of the data contained in the log books and the Daily Quality Control Reports (DQCR) for SWMUs 61, 62 and 63 indicate that there were no sampling issues that would impact data usability. QC issues are discussed in detail in the QCSR in Appendix A, and copies of the DQCRs are included in that appendix.

11.4.3 Data Review Issues

QA/QC objectives for laboratory analytical data were specified in the Cannon AFB RFI QAPP (W-C 1993). The objectives were used as indicators of the quality necessary to support identification and quantitation of potential chemicals of concern. The data review is presented in Section 4.6 of the Quality Control Summary Report (QCSR) located in Appendix A. As presented in the QCSR, data for the analytes barium, beryllium, calcium, cobalt, copper, nickel, potassium, silver, lead, manganese, selenium, thallium, toluene, xylene, acenaphthalene, anthracene, butyl benzyl, phthalate, benzo(ghi)perylene, carbazole, dibenzofuran, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, and phenanthrene were qualified as estimated concentrations. No data associated with SWMUs 61, 62, or 63 were rejected.

Beryllium, cobalt, copper, lead, nickel, potassium, silver, toluene, xylenes, acenaphthylene, anthracene, butyl benzyl phthalate, carbazole, benzo(ghi)perylene, dibenzofuran, fluorene, indeno(1,2,3-cd)pyrene, and naphthalene data were qualified "estimated" due to detections below reporting limits.

Calcium, lead, manganese, and phenanthrene were qualified "estimated" due to precision that did not meet the criteria defined for this project. Poor precision could be attributed to errors in sampling and analysis: however, since other analytes which were sampled and analyzed in the same procedure (Method 6010, Method 7421, and Method 8270) met QA/QC criteria, this variation is likely due to sample heterogeneity.

Thallium, selenium, and silver were all qualified estimated to indicate a potential low bias, while barium data were qualified estimated to indicate a possible high bias. When a low bias is indicated, actual concentrations may be higher than the reported results. Use of this data in risk assessment may underestimate risk. Similarly, when a high bias is indicated, actual concentrations may be lower than the reported results. Use of this data in risk assessment may overestimate risk.

The uncertainty in the actual concentration reported for estimated data does not affect the usability of the data for identification of chemicals in characterizing the nature and extent of contamination at these SWMUs.

11.4.4 Limitations

Elevated reporting limits may limit the usability of the data due to low level analytes being diluted to below the instrument detection limits. That is, chemicals may be reported as non-detect when they are actually present in a sample at low levels. Section 4.6.6 of the QCSR (Appendix A) presents a discussion of elevated reporting limits. For SWMUs 61, 62, and 63, however, there were no reporting limits significantly elevated (i.e., by a factor of 100 or more) that would impact the usability of the associated data.

11.4.5 Summary

Overall, data generated during the study of SWMUs 61, 62, and 63 were determined to meet quality criteria. In conjunction with the analytical data review, other information including field observations were evaluated in the assessment of the usability of SWMUs 61, 62, and 63 data. The data support identification of the nature and extent of contamination and provide reasonable concentration for use in risk assessment.

11.5 NATURE AND EXTENT OF CONTAMINATION

This group of SWMUs is associated from the wash-water drain line at the Civil Engineering Wash Rack. SWMUs 61 and 62 are sand traps beneath the two wash platforms, and SWMU 63 is an OWS serving both of the sand traps. Two borings in close proximity to each of the units were each advanced to a depth of 10 feet. With the exception of the near-surface samples for both borings at SWMU 63 (the separator), the samples appeared relatively free of organic contamination. There was no visible evidence of spills or leaks in the vicinity, and the entire area around the separator is grassy. The chemical test results do not show any significant organic contamination except for the surface samples at the separator.

In the surface samples near the separator, there were petroleum hydrocarbons detected at levels around 600 mg/kg, and a number of SVOCs were detected at levels ranging from 500 μg/kg to as much as 2,000 μg/kg. Deeper samples in these same borings appeared relatively free of contamination.

11.6 COMPARISON OF METALS CONCENTRATIONS TO BACKGROUND

Results of the comparison of metal concentration in soil to background levels for SWMUs 61, 62, and 63 are given in Tables 11-3a, 11-3b, and 11-3c, respectively. A summary of the results of the comparison is presented here.

Metals are natural constituents of soils. SWMU concentrations of metal were evaluated to assess whether the metals in environmental samples exceed background levels. Metals that occur in concentrations within background levels are not considered SWMU-related chemicals of concern and are not evaluated further.

The maximum concentrations of each detected metal at each SWMU was compared to the upper tolerance limit of the background data. The upper tolerance limit (UTL) was defined as the mean plus two times the standard deviation. This is, for all practical purposes, equal to the 90% upper confidence limit of the 95th percentile which is equal to the mean plus the standard deviation times the k statistic. The background data set used consisted of 37 data points (W-C 1993), so the k statistic equals 2.02.

The maximum detected concentrations of barium, cadmium, copper, and silver at SWMU 61 exceeded the (UTL) of the background data. Therefore, these metals will be compared to risk-based concentrations at SWMU 61.

The maximum detected concentrations of cadmium, copper, and silver exceeded the (UTL) of the background data at SWMU 62. Therefore, these metals will be compared to risk-based concentrations at SWMU 62.

The maximum detected concentrations of barium, cadmium, chromium, copper, lead, mercury, and zinc exceeded the (UTL) of the background data at SWMU 63. Therefore, these metals will be compared to risk-based concentrations at SWMU 63.

11.7 RISK SCREENING (SWMU 61)

11.7.1 Exposure Pathway Flow Chart (SWMU 61)

The Preliminary Exposure Pathway Flow Chart (EPFC) applicable to SWMU 61, Sand Trap No. 5077a, is shown in Figure 3-2. It shows that the potential exposure pathways are ingestion of soil, inhalation of soil particulates, dermal exposure to contaminated soil, inhalation of airborne chemicals released from soil, and ingestion, inhalation, and dermal exposure to groundwater (if drinking water supplies were affected). Storm water runoff is considered to be an insignificant pathway because potential spills would be minor and over a small area.

11.7.2 Screening of Contaminants Against RBCs and Other Criteria (SWMU 61)

Maximum detected concentrations of organic compounds and metals that exceeded background were compared to screening-level RBCs (see Section 3.4.5.1 for derivations of RBCs) and other screening criteria in Table 11-4A. Screening-level criteria other than RBCs include the state of New Mexico's TPH clean-up level of 1,000 mg/kg (New Mexico Environmental Improvement Board 1993) and the EPA's recommended soil lead level of 500 mg/kg (EPA 1990). The TPH soil clean-up concentration of 1,000 mg/kg is not an RBC, nor is it a relevant-and-applicable standard for the SWMUs in this investigation. Rather it is a conservative value originally derived for the cleanup of fuel-

contaminated soils at underground storage tank sites. Risk-based concentrations for TPH, measured as fresh fuels (e.g., gasoline or diesel), are at least an order of magnitude higher for occupational exposures. The concentration of 500 mg/kg is the most conservative concentration in the recommended range of 500 mg/kg to 1,000 mg/kg as a lead level in residential soil based on EPA's Uptake Biokinetic Model (EPA 1990). Compounds with no toxicity factors cannot be evaluated in the risk screening since RBCs cannot be calculated. These compounds, at the concentrations that were measured in soil, are not likely to significantly affect the results of the comparison to RBCs. The comparison for SWMU 61 shows that the maximum detected concentration of barium exceeds its RBC. However, the maximum barium concentration (727 mg/kg) is within the range of background concentrations (14.5 to 1,200 mg/kg) for barium (Table 11-3A). The high concentration of calcium in the same sample is good evidence of the presence of caliche, which is also likely to be the source of the barium. Therefore, since the highest measured concentration is within the range of background concentrations, barium is considered to be naturally-occurring, even though the concentration exceeds the upper tolerance limit of the background concentration (642 mg/kg).

This comparison of maximum detected concentrations to RBCs is very conservative (health-protective), and actual impacts are likely to be lower than those suggested by exceedances of conservative criteria. For example, maximum detected concentrations are likely to overestimate actual concentrations to which people would be exposed. Furthermore, the screening criteria are based on highly conservative residential exposure assumptions and target risk levels that may not be pertinent to current or future use of the SWMU. The RBCs used in this evaluation are calculated using RCRA Action Level methodology; however, the RBCs are more health-protective than conventional RCRA Action Levels because a target excess cancer risk level of 1×10^{-7} (1 in 10,000,000) and a hazard quotient of 0.1 were used to account for exposures to multiple chemicals and for exposure routes other than soil ingestion. Conventional RCRA Action Levels are calculated based on a cancer risk of 1×10^{-6} and a noncancer hazard of 1.0.

The purpose of the comparison to RBCs is to determine whether or not chemical releases (characterized by maximum detected concentrations) have occurred at SWMU 61 that could pose potential risks based on conservative health-based criteria. Since the only chemical that exceeded RBC values was within its measured background range of concentrations, further

evaluation or investigation of chemical concentrations and probable exposures is not warranted.

11.8 SUMMARY AND RECOMMENDATIONS (SWMU 61)

Eight soil samples were collected and analyzed from two soil borings at SWMU 61. Maximum detected concentrations were compared to background levels and RBCs. Organic compounds were not found at levels that exceeded RBCs or other screening-level criteria. The only metal which exceeded the upper tolerance limit for background concentration and RBC was barium at the eight foot depth. However, the barium concentration was within the range of background concentrations; thus it is considered to be naturally-occurring.

The highest concentrations for all organic analytes were found in the near-surface soils. Therefore, the vertical extent of contamination has been characterized by the borings, and the potential for groundwater beneath SWMU 61 to be impacted can be characterized. The potential for impacts to groundwater is considered to be low because the detected levels of analytes are negligible, the depth to groundwater is greater than 200 feet, and sampling demonstrates that contaminants are not significantly being transported vertically below the SWMU. Therefore, no further action is recommended at SWMU 61.

11.9 RISK SCREENING (SWMU 62)

11.9.1 Exposure Pathway Flow Chart (SWMU 62)

The Preliminary Exposure Pathway Flow Chart (EPFC) applicable to SWMU 62, Sand Trap No 5077b, is shown in Figure 3-2. It shows that the potential exposure pathways are ingestion of soil, inhalation of soil particulates, dermal exposure to contaminated soil, inhalation of airborne chemicals released from soil, and ingestion, inhalation, and dermal exposure to groundwater (if drinking water supplies were affected). Storm water runoff is considered to be an insignificant pathway because potential spills would be minor and over a small area.

11.9.2 Screening of Contaminants Against RBCs and Other Criteria (SWMU 62)

Maximum detected concentrations of organic compounds and metals that exceeded background were compared to screening-level RBCs (see Section 3.4.5.1 for derivations of RBCs) and other screening criteria in Table 11-4B. Screening-level criteria other than RBCs include the state of New Mexico's TPH clean-up level of 1,000 mg/kg (New Mexico Environmental Improvement Board 1993) and the EPA's recommended soil lead level of 500 mg/kg (EPA 1990). The TPH soil clean-up concentration of 1,000 mg/kg is not an RBC, nor is it a relevant-and-applicable standard for the SWMUs in this investigation. Rather it is a conservative value originally derived for the cleanup of fuel-contaminated soils at underground storage tank sites. Risk-based concentrations for TPH, measured as fresh fuels (e.g., gasoline or diesel), are at least an order of magnitude higher for occupational exposures. The concentration of 500 mg/kg is the most conservative concentration in the recommended range of 500 mg/kg to 1,000 mg/kg as a lead level in residential soil based on EPA's Uptake Biokinetic Model (EPA 1990). Compounds with no toxicity factors cannot be evaluated in the risk screening since RBCs cannot be calculated. These compounds, at the concentrations that were measured in soil, are not likely to significantly affect the results of the comparison to RBCs. The comparison for SWMU 62 shows that no maximum detected concentrations exceed RBCs.

This evaluation of potential risk is very conservative (health-protective) and actual impacts are likely to be lower than those suggested by exceedances of conservative criteria. For example, maximum detected concentrations are likely to overestimate actual concentrations to which people would be exposed. Furthermore, the screening criteria are based on highly conservative residential exposure assumptions and target risk levels that may not be pertinent to current or future use of the SWMU. The RBCs used in this evaluation are calculated using RCRA Action Level methodology; however, the RBCs are more health-protective than conventional RCRA Action Levels because a target excess cancer risk level of 1×10^{-7} (1 in 10,000,000) and a hazard quotient of 0.1 were used to account for exposures to multiple chemicals and for exposure routes other than soil ingestion. Whereas, conventional RCRA Action Levels are calculated based on a cancer risk of 1×10^{-6} and a noncancer hazard of 1.0.

This comparison of maximum detected concentrations to RBCs is very conservative (health-protective), and actual impacts are likely to be lower than those suggested by exceedances of conservative criteria. For example, maximum detected concentrations are likely to overestimate actual concentrations to which people would be exposed. Furthermore, the screening criteria are based on highly conservative residential exposure assumptions and target risk levels that may not be pertinent to current or future use of the SWMU. The RBCs used in this evaluation are calculated using RCRA Action Level methodology; however, the RBCs are more health-protective than conventional RCRA Action Levels, because a target excess cancer risk level of 1×10^{-7} (1 in 10,000,000) and a hazard quotient of 0.1 were used to account for exposures to multiple chemicals and for exposure routes other than soil ingestion. Whereas, conventional RCRA Action Levels are calculated based on a cancer risk of 1×10^{-6} and a noncancer hazard of 1.0.

The purpose of the comparison to RBCs is to determine whether or not chemical releases (characterized by maximum detected concentrations) have occurred at SWMU 62 that could pose potential risks based on conservative health-based criteria. Since no maximum concentrations of analytes exceed screening level criteria, further evaluation or investigation of chemical concentrations and probable exposures is not warranted.

11.10 SUMMARY AND RECOMMENDATIONS (SWMU 62)

Eight soil samples were collected and analyzed from two 10-foot soil borings at SWMU 62. Maximum detected concentrations were compared to background levels and RBCs. Organic compounds and metals were not found at levels that exceeded RBCs and other screening level criteria.

The highest concentrations for all organic analytes were found in the near-surface soils. The highest concentrations reported for barium, beryllium, and cadmium were at the 8-foot depth (caliche layer). However, these concentrations are less than the upper tolerance limit of the background concentrations. Therefore, the vertical extent of contamination has been characterized by the borings and the potential for groundwater beneath SWMU 62 to be impacted can be characterized. The potential for impacts to groundwater is considered to be low because the detected levels of analytes are negligible, the depth to groundwater is greater

than 200 feet, and sampling demonstrates that contaminants are not being transported vertically beneath the SWMU. Therefore, no further action is recommended at SWMU 62.

11.11 RISK SCREENING (SWMU 63)

11.11.1 Exposure Pathway Flow Chart (SWMU 63)

The Preliminary Exposure Pathway Flow Chart (EPFC) applicable to SWMU 63, OWS No. 5077c, is shown in Figure 3-2. It shows that the potential exposure pathways are ingestion of soil, inhalation of soil particulates, dermal exposure to contaminated soil, inhalation of airborne chemicals released from soil, and ingestion, inhalation and dermal exposure to groundwater (if drinking water supplies were affected). Storm water runoff is considered to be an insignificant pathway because potential spills would be minor and over a small area.

11.11.2 Screening of Contaminants Against RBCs and Other Criteria (SWMU 63)

Maximum detected concentrations of organic compounds and metals that exceeded background were compared to screening-level RBCs (see Section 3.4.5.1 for derivations of RBCs) and other screening criteria in Table 11-4C. Screening-level criteria other than RBCs include the state of New Mexico's TPH clean-up level of 1,000 mg/kg (New Mexico Environmental Improvement Board 1993) and the EPA's recommended soil lead level of 500 mg/kg (EPA 1990). The TPH soil clean-up concentration of 1,000 mg/kg is not an RBC, nor is it a relevant-and-applicable standard for the SWMUs in this investigation. Rather it is a conservative value originally derived for the cleanup of fuel-contaminated soils at underground storage tank sites. Risk-based concentrations for TPH, measured as fresh fuels (e.g., gasoline or diesel), are at least an order of magnitude higher for occupational exposures. The concentration of 500 mg/kg is the most conservative concentration in the recommended range of 500 mg/kg to 1,000 mg/kg as a lead level in residential soil based on EPA's Uptake Biokinetic Model (EPA 1990). Compounds with no toxicity factors cannot be evaluated in the risk screening since RBCs cannot be calculated. These compounds, at the concentrations that were measured in soil, are not likely to significantly affect the results of the comparison to RBCs. The comparison for SWMU 63 shows that maximum detected concentrations of barium, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene exceed RBCs.

This comparison of maximum detected concentrations to RBCs is very conservative (health-protective), and actual impacts are likely to be lower than those suggested by exceedances of conservative criteria. For example, maximum detected concentrations are likely to overestimate actual concentrations to which people would be exposed. Furthermore, the screening criteria are based on highly conservative residential exposure assumptions and target risk levels that may not be pertinent to current or future use of the SWMU. The RBCs used in this evaluation are calculated using RCRA Action Level methodology; however, the RBCs are more health-protective than conventional RCRA Action Levels because a target excess cancer risk level of 1×10^{-7} (1 in 10,000,000) and a hazard quotient of 0.1 were used to account for exposures to multiple chemicals and for exposure routes other than soil ingestion. Conventional RCRA Action Levels are calculated based on a cancer risk of 1×10^{-6} and a noncancer hazard of 1.0.

The purpose of the comparison to RBCs is to determine whether or not chemical releases (characterized by maximum detected concentrations) have occurred at SWMU 63 that could pose potential risks based on conservative health-based criteria. Since maximum concentrations of the chemicals listed above exceed screening level criteria, further evaluation or investigation of chemical concentrations and probable exposures is warranted.

11.12 SUMMARY AND RECOMMENDATIONS (SWMU 63)

Eight soil samples were collected and analyzed from two 10-foot soil borings at SWMU 63. Maximum detected concentrations were compared to background levels and RBCs. One metal and four organics were found at levels that exceeds RBCs or other screening-level criteria. The results of the comparison of maximum detected concentrations with screening-level RBCs indicate that it is unlikely that a risk assessment will result in a risk level that will require remedial action (i.e., only a few chemicals slightly exceed the RBCs).

The highest concentrations for the organics were found at the surface. The highest concentration of barium was detected at the 8-foot depth (caliche layer). However, the concentration of barium was within the range of background concentrations for the site, and it is considered to be naturally-occurring. Therefore, the vertical extent of contamination has been characterized by the borings, and the potential for the groundwater beneath SWMU 63 to be impacted can be characterized. The potential for impacts to groundwater is considered

to be low because the depth to groundwater is greater than 200 feet, and sampling demonstrates that contaminants are not being transported significantly vertically beneath the SWMU. Therefore, it is concluded that available data are sufficient to complete a BRA, and it is recommended that the risk assessment be done.

TABLE 11-1

SUMMARY OF ANALYTICAL AND QA/QC SAMPLING
SAND TRAP NO.s 5077a AND 5077b AND OIL/WATER SEPARATOR NO. 5077c (SWMU NO.s 61, 62, AND 63)
CANNON AFB, NEW MEXICO

Sample Location	Target Interval (ft-bgs)	Sample Identification Number	QA/QC Type	Sample Matrix	Analytical Parameters				Sample Containers		
					VOCs	SVOCs	Metals	TRPH	40 ml VOA vials	4 oz. jars	8 oz. jars
SWMU 61											
Boring 06101	0 - 0.5	CAN061-0611-0000		Soil	X	X	X	X		2	1
	2 - 4	CAN061-0611-0002		Soil	X		X	X		2	1
	4 - 6	CAN061-0611-0004		Soil	X	X	X	X		2	1
	8 - 10	CAN061-0611-0008		Soil	X		X	X		2	1
Boring 06102	0 - 0.5	CAN061-0612-0000		Soil	X	X	X	X		2	1
	2 - 4	CAN061-0612-0002		Soil	X		X	X		2	1
	4 - 6	CAN061-0612-0004		Soil	X		X	X		2	1
	8 - 10	CAN061-0612-0008		Soil	X	X	X	X		2	1
	8 - 10	CAN061-0612-6008	MS/MSD	Soil	X	X	X	X		2	2
SWMU 62											
Boring 06201	0.5 - 2	CAN062-0621-0000		Soil	X	X	X	X		2	1
	2 - 4	CAN062-0621-0002		Soil	X		X	X		2	1
	4 - 6	CAN062-0621-0004		Soil	X		X	X		2	1
	8 - 10	CAN062-0621-0008		Soil	X	X	X	X		2	1
Boring 06202	0.5 - 2	CAN062-0622-0000		Soil	X	X	X	X		2	1
	2 - 4	CAN062-0622-0002		Soil	X		X	X		2	1
	4 - 6	CAN062-0622-0004		Soil	X		X	X		2	1
	8 - 10	CAN062-0622-0008		Soil	X	X	X	X		2	1
	8 - 10	CAN062-0622-6008	MS/MSD	Soil	X	X	X	X		2	2
		CAN062-0622-6251	AB	Water	X				2		
		CAN062-0622-6271	RB	Water	X				2		
		CAN062-0622-6281	DW	Water	X				2		
		CAN062-0622-6291	TB	Water	X				2		

TABLE 11-1

SUMMARY OF ANALYTICAL AND QA/QC SAMPLING
SAND TRAP NO.s 5077a AND 5077b AND OIL/WATER SEPARATOR NO. 5077c (SWMU NO.s 61, 62, AND 63)
CANNON AFB, NEW MEXICO

Sample Location	Target Interval (ft-bgs)	Sample Identification Number	QA/QC Type	Sample Matrix	Analytical Parameters				Sample Containers		
					VOCs	SVOCs	Metals	TRPH	40 ml VOA vials	4 oz. jars	8 oz. jars
SWMU 63											
Boring 06301	0 - 0.5	CAN063-0631-0000		Soil	X	X	X	X		2	1
	0 - 0.5	CAN063-0631-6361	FD	Soil	X	X	X	X		2	1
	0 - 0.5	CAN063-0631-6301	MRD	Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN063-0631-0002		Soil	X		X	X		2	1
	4 - 6	CAN063-0631-0004		Soil	X		X	X		2	1
	8 - 10	CAN063-0631-0008		Soil	X	X	X	X		2	1
Boring 06302	0 - 0.5	CAN063-0632-0000		Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN063-0632-0002		Soil	X		X	X		2	1
	4 - 6	CAN063-0632-0004		Soil	X		X	X		2	1
	8 - 10	CAN063-0632-0008		Soil	X	X	X	X		2	1
	8 - 10	CAN063-0632-6362	FD	Soil	X		X	X		2	1
	8 - 10	CAN063-0632-6302	MRD	Soil	X	X	X	X		2	1

AB = Ambient blank
DW = Decontamination water
FB = Field blank
MRD = Missouri River Division
MS/MSD = Matrix spike/matrix spike duplicate
RB = Rinsate blank
TB = Trip blank

See Figure 11-1 for locations of the borings.

TABLE 11-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 61 AND 62

LOCATOR	CAN061-0611-0000			CAN061-0611-0002			CAN061-0612-0000			CAN061-0612-0002			CAN062-0621-0000			CAN062-0621-0002		
LAB SAMPLE NUMBER	0313790007SA			0313790008SA			0313790011SA			0313790012SA			0314020009SA			0314020010SA		
COLLECT DATE	09/22/93			09/22/93			09/22/93			09/22/93			09/24/93			09/24/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)																		
Bromoform	<	5.8	U	<	5.7	U	<	5.8	U	<	5.6	U	<	5.8	U	<	5.6	U
2-Hexanone	<	12	U	<	11	U	<	12	U	<	11	U	<	12	U	<	11	U
4-Methyl-2-pentanone (MIBK)	<	12	U	<	11	U	<	12	U	<	11	U	<	12	U	<	11	U
1,1,2,2-Tetrachloroethane	<	5.8	U	<	5.7	U	<	5.8	U	<	5.6	U	<	5.8	U	<	5.6	U
Toluene	<	5.8	U	<	5.7	U	5	5.8	J	<	5.6	U	1.2	5.8	J	3.4	5.6	J
Xylenes (total)	<	5.8	U	<	5.7	U	2.8	5.8	J	<	5.6	U	<	5.8	U	<	5.6	U
Metals (mg/kg)																		
Aluminum	8460	11.6		7020	11.3		8300	11.7		7140	11.2		6310	11.5		4370	11.2	
Arsenic	2.1	0.58		1.6	0.57		2	0.58		1.6	0.56		2.5	0.58		2.2	0.56	
Barium	80.7	1.2		69.2	1.1		99.1	1.2		57.7	1.1		72.3	1.2		48	1.1	
Beryllium	0.58	0.23		0.49	0.23		0.59	0.23		0.48	0.22		0.53	0.23		0.36	0.22	
Calcium	2190	23.2		1450	22.6		2380	23.3		2440	22.3		1870	23.1		2350	22.3	
Chromium	8.6	1.2		7.6	1.1		9	1.2		7.3	1.1		7.7	1.2		5.4	1.1	
Cobalt	4	1.2		3	1.1		3.9	1.2		3	1.1		3.6	1.2		2.1	1.1	
Copper	7.2	2.3		6	2.3		6.2	2.3		5.4	2.2		6.9	2.3		4.8	2.2	
Iron	9190	11.6		7780	11.3		9090	11.7		7490	11.2		7630	11.5		5440	11.2	
Lead	7.4	1.2		5.3	0.57		7.3	1.2		4.9	0.56		7	0.58		5.6	0.56	
Magnesium	1530	23.2		1280	22.6		1620	23.3		1270	22.3		1610	23.1		1240	22.3	
Manganese	175	1.2	J	105	1.1	J	178	1.2	J	102	1.1	J	206	1.2		87.7	1.1	
Nickel	7.2	4.6		7.4	4.5		7.4	4.7		6.7	4.5		6.9	4.6		5.3	4.5	
Potassium	1450	579		1280	566		1440	583		1240	558		1810	577		1200	558	
Silver	0.85	1.2	J	0.42	1.1	J	0.91	1.2	J	0.46	1.1	J	0.51	1.2	J	0.59	1.1	J
Sodium	<	579	U	<	566	U	<	583	U	<	558	U	265	577	J	232	558	J
Vanadium	20.1	1.2		17.2	1.1		20.6	1.2		16.2	1.1		20.2	1.2		13.8	1.1	
Zinc	20.6	2.3		17.7	2.3		20.9	2.3		14.6	2.2		16.2	2.3		10.9	2.2	

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A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value.
U = Nondetected value.

QUAL=Qualification
RL = Reporting Limit.

TABLE 11-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 61 AND 62

LOCATOR	CAN061-0611-0000			CAN061-0611-0002			CAN061-0612-0000			CAN061-0612-0002			CAN062-0621-0000			CAN062-0621-0002		
LAB SAMPLE NUMBER	0313790007SA			0313790008SA			0313790011SA			0313790012SA			0314020009SA			0314020010SA		
COLLECT DATE	09/22/93			09/22/93			09/22/93			09/22/93			09/24/93			09/24/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Water Quality (percent)																		
Water	14	0.1		12	0.1		14	0.1		10	0.1		13	0.1		10	0.1	

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A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value.
U = Nondetected value.

QUAL=Qualification
RL = Reporting Limit.

TABLE 11-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 61 AND 62

LOCATOR	CAN062-0622-0000			CAN062-0622-0002		
LAB SAMPLE NUMBER	0314010001SA			0314010002SA		
COLLECT DATE	09/23/93			09/23/93		
	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)						
Bromoform	1.2	5.7	J	<	5.5	U
2-Hexanone	9.6	11	J	<	11	U
4-Methyl-2-pentanone (MIBK)	5.5	11	J	<	11	U
1,1,2,2-Tetrachloroethane	1.4	5.7	J	<	5.5	U
Toluene	<	5.7	U	<	5.5	U
Xylenes (total)	<	5.7	U	<	5.5	U
Metals (mg/kg)						
Aluminum	6960	11.3		5370	11.1	
Arsenic	1.9	0.57		1.8	0.55	
Barium	87.8	1.1	J	53	1.1	J
Beryllium	0.56	0.23		0.36	0.22	
Calcium	1620	22.7		8660	22.1	
Chromium	7.6	1.1		5.6	1.1	
Cobalt	4.2	1.1		2.8	1.1	
Copper	5.7	2.3		5	2.2	
Iron	7960	11.3		5930	11.1	
Lead	7.3	0.57		4.9	0.55	
Magnesium	1940	22.7		1460	22.1	
Manganese	181	1.1		102	1.1	
Nickel	7.8	4.5		6.4	4.4	
Potassium	1380	567		1100	553	
Silver	<	1.1	J	<	1.1	J
Sodium	<	567	U	<	553	U
Vanadium	22.3	1.1		17.1	1.1	
Zinc	16.9	2.3		11.2	2.2	

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A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value.
U = Nondetected value.
QUAL=Qualification
RL = Reporting Limit.

TABLE 11-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 61 AND 62

LOCATOR	CAN062-0622-0000			CAN062-0622-0002		
LAB SAMPLE NUMBER	0314010001SA			0314010002SA		
COLLECT DATE	09/23/93			09/23/93		
	Result	RL	Qual	Result	RL	Qual
Water Quality (percent)						
Water	12	0.1		9.6	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 11-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 61 AND 62

LOCATOR	CAN061-0611-0004			CAN061-0611-0008			CAN061-0612-0004			CAN061-0612-0008			CAN062-0621-0004			CAN062-0621-0008		
LAB SAMPLE NUMBER	0313790009SA			0313790010SA			0313790013SA			0313790014SA			0314020011SA			0314020012SA		
COLLECT DATE	09/22/93			09/22/93			09/22/93			09/22/93			09/24/93			09/24/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)																		
Benzene	<	5.7	U	<	5.7	U	<	5.6	U	<	5.9	U	<	5.5	U	<	5.6	U
Chlorobenzene	<	5.7	U	<	5.7	U	<	5.6	U	<	5.9	U	<	5.5	U	<	5.6	U
1,1-Dichloroethene	<	5.7	U	<	5.7	U	<	5.6	U	<	5.9	U	<	5.5	U	<	5.6	U
Toluene	<	5.7	U	2.1	5.7	J	<	5.6	U	<	5.9	U	<	5.5	U	<	5.6	U
Trichloroethene	<	5.7	U	<	5.7	U	<	5.6	U	<	5.9	U	<	5.5	U	<	5.6	U
Semivolatile Organics (ug/kg)																		
Acenaphthene	<	380	U							<	390	U				<	370	U
4-Chloro-3-methylphenol	<	380	U							<	390	U				<	370	U
2-Chlorophenol	<	380	U							<	390	U				<	370	U
1,4-Dichlorobenzene	<	380	U							<	390	U				<	370	U
2,4-Dinitrotoluene	<	380	U							<	390	U				<	370	U
4-Nitrophenol	<	1800	U							<	1900	U				<	1800	U
N-Nitroso-di-n-propylamine	<	380	U							<	390	U				<	370	U
Pentachlorophenol	<	1800	U							<	1900	U				<	1800	U
Phenol	<	380	U							<	390	U				<	370	U
Pyrene	<	380	U							<	390	U				<	370	U
1,2,4-Trichlorobenzene	<	380	U							<	390	U				<	370	U
Metals (mg/kg)																		
Aluminum	4480	11.5		4970	22.7		5350	11.2		3650	23.6		4260	10.9		3670	11.2	
Antimony	<	6.9	U	<	13.6	U	<	6.7	U	<	14.2	U	<	6.6	U	<	6.7	U
Arsenic	1.8	0.57		1.5	0.57		1.3	0.56		1.7	0.59		1.9	0.55		2.4	0.56	
Barium	82.7	1.1		316	2.3		54.8	1.1		727	2.4		28.4	1.1		158	1.1	
Beryllium	0.31	0.23		0.33	0.45	J	0.36	0.22		0.35	0.47	J	0.4	0.22		0.39	0.22	
Cadmium	1.7	0.57		3	1.1		0.69	0.56		2.6	1.2		<	0.55	U	1.3	0.56	

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A complete summary of chemical results are presented in Appendix A.
J = Estimated value.
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U = Nondetected value. RL = Reporting Limit.

TABLE 11-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 61 AND 62

LOCATOR	CAN061-0611-0004			CAN061-0611-0008			CAN061-0612-0004			CAN061-0612-0008			CAN062-0621-0004			CAN062-0621-0008		
LAB SAMPLE NUMBER	0313790009SA			0313790010SA			0313790013SA			0313790014SA			0314020011SA			0314020012SA		
COLLECT DATE	09/22/93			09/22/93			09/22/93			09/22/93			09/24/93			09/24/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Calcium	101000	22.9		151000	45.4		30400	22.4		183000	47.3		1570	21.8		82500	22.4	
Chromium	3.6	1.1		2.3	2.3		5.5	1.1		2.6	2.4		5.9	1.1		3	1.1	
Cobalt	2.4	1.1		1.7	2.3	J	2.6	1.1		<	2.4	U	1.9	1.1		1.8	1.1	
Copper	3.2	2.3		1.6	4.5	J	3.8	2.2		2.5	4.7	J	4.2	2.2		2.8	2.2	
Iron	4010	11.5		2490	22.7		5320	11.2		2640	23.6		4930	10.9		3460	11.2	
Lead	3.4	2.9		3.3	5.7	J	3.4	1.1		3.6	0.59		4.6	0.55		4.8	0.56	
Magnesium	1970	22.9		3210	45.4		1470	22.4		3510	47.3		1470	21.8		2860	22.4	
Manganese	52.1	1.1	J	53.8	2.3	J	54.6	1.1	J	44.2	2.4	J	62.3	1.1		78.3	1.1	
Mercury	<	0.11	U	<	0.11	U	<	0.11	U	<	0.12	U	<	0.11	U	<	0.11	U
Nickel	5.2	4.6		3	9.1	J	6.3	4.5		4.6	9.5	J	5.8	4.4		4.7	4.5	
Potassium	838	573		734	1130	J	998	561		616	1180	J	1300	546		1100	560	
Selenium	<	1.1	J	<	1.1	J	<	1.1	J	<	1.2	J	<	0.55	U	<	0.56	J
Silver	0.64	1.1	J	1.2	2.3	J	0.58	1.1	J	1.7	2.4	J	0.34	1.1	J	<	1.1	U
Sodium	<	573	U	<	1130	U	<	561	U	<	1180	U	223	546	J	173	560	J
Thallium	<	1.1	J	<	1.1	J	<	0.56	U	<	1.2	J	<	0.55	U	<	1.1	J
Vanadium	10.5	1.1		5.6	2.3		12.3	1.1		8.8	2.4		13.4	1.1		15.4	1.1	
Zinc	9.7	2.3		7.4	4.5		17.2	2.2		6.6	4.7		10.3	2.2		9.4	2.2	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	<	45.8	U	<	45.4	U	<	44.8	U	<	47.3	U	<	43.7	U	<	44.8	U
Water Quality (percent)																		
Water	13	0.1		12	0.1		11	0.1		15	0.1		8.4	0.1		11	0.1	

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A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 11-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 61 AND 62

LOCATOR	CAN062-0622-0004			CAN062-0622-0008		
LAB SAMPLE NUMBER	0314010003SA			0314010004SA		
COLLECT DATE	09/23/93			09/23/93		
	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)						
Benzene	<	5.4	U	<	5.7	U
Chlorobenzene	<	5.4	U	<	5.7	U
1,1-Dichloroethene	<	5.4	U	<	5.7	U
Toluene	<	5.4	U	<	5.7	U
Trichloroethene	<	5.4	U	<	5.7	U
Semivolatile Organics (ug/kg)						
Acenaphthene				<	380	U
4-Chloro-3-methylphenol				<	380	U
2-Chlorophenol				<	380	U
1,4-Dichlorobenzene				<	380	U
2,4-Dinitrotoluene				<	380	U
4-Nitrophenol				<	1800	U
N-Nitroso-di-n-propylamine				<	380	U
Pentachlorophenol				<	1800	U
Phenol				<	380	U
Pyrene				<	380	U
1,2,4-Trichlorobenzene				<	380	U
Metals (mg/kg)						
Aluminum	3930	10.8		3040	22.9	
Antimony	<	6.5	U	<	13.7	U
Arsenic	1.2	0.54		1.1	0.57	
Barium	45	1.1	J	334	2.3	J
Beryllium	0.41	0.22		0.59	0.46	
Cadmium	<	0.54	U	<	1.1	U

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A complete summary of chemical results are presented in Appendix A.
J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 11-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 61 AND 62

LOCATOR	CAN062-0622-0004			CAN062-0622-0008		
LAB SAMPLE NUMBER	0314010003SA			0314010004SA		
COLLECT DATE	09/23/93			09/23/93		
	Result	RL	Qual	Result	RL	Qual
Calcium	2160	21.5		136000	45.8	
Chromium	5.3	1.1		<	2.3	U
Cobalt	2.1	1.1		2.1	2.3	J
Copper	3.5	2.2		2.1	4.6	J
Iron	4610	10.8		2470	22.9	
Lead	4.2	0.54		4	0.57	
Magnesium	1300	21.5		3510	45.8	
Manganese	75	1.1		56.3	2.3	
Mercury	<	0.11	U	<	0.11	U
Nickel	5.5	4.3		4.5	9.2	J
Potassium	938	538		740	1140	J
Selenium	<	0.54	U	<	1.1	J
Silver	<	1.1	J	<	2.3	J
Sodium	295	538	J	<	1140	U
Thallium	<	0.54	U	<	1.1	J
Vanadium	12.9	1.1		9.5	2.3	
Zinc	9.7	2.2		7.9	4.6	
TPH (mg/kg)						
Total Petroleum Hydrocarbons	<	43	U	<	45.8	U
Water Quality (percent)						
Water	7.1	0.1		13	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 11-2c
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 61 AND 62

LOCATOR	CAN063-0631-0000			CAN063-0631-0000			CAN063-0631-0002			CAN063-0632-0000			CAN063-0632-0000			CAN063-0632-0002		
LAB SAMPLE NUMBER	0312140001SA			0314020007SA			0312140002SA			0312140005SA			0314020013SA			0312140006SA		
COLLECT DATE	09/13/93			09/13/93			09/13/93			09/13/93			09/13/93			09/13/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)																		
1,2-Dichloroethane				1.5	5.2	J	<	5.5	U				<	5.3	U	<	5.6	U
Toluene				2.7	5.2	J	<	5.5	U				<	5.3	U	<	5.6	U
Xylenes (total)				1.1	5.2	J	<	5.5	U				<	5.3	U	<	5.6	U
Semivolatile Organics (ug/kg)																		
Acenaphthene	58	340	J							120	340	J						
Anthracene	96	340	J							210	340	J						
Benzo(a)anthracene	370	340								1000	340							
Benzo(a)pyrene	460	340								900	340							
Benzo(b)fluoranthene	990	340	J							1800	340							
Benzo(g,h,i)perylene	280	340	J							390	340							
Butyl benzyl phthalate	120	340	J							50	340	J						
Carbazole	66	340	J							100	340	J						
Chrysene	720	340	J							1100	340							
Dibenzofuran	51	340	J							53	340	J						
Fluoranthene	900	340	J							1700	340							
Fluorene	59	340	J							100	340	J						
Indeno(1,2,3-cd)pyrene	250	340	J							400	340							
2-Methylnaphthalene	120	340	J							<	340	U						
Naphthalene	80	340	J							<	340	U						
Phenanthrene	670	340	J							1400	340							
Pyrene	1100	340	J							2200	340							

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 11-2c
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 61 AND 62

LOCATOR	CAN063-0631-0000			CAN063-0631-0000			CAN063-0631-0002			CAN063-0632-0000			CAN063-0632-0000			CAN063-0632-0002		
LAB SAMPLE NUMBER	0312140001SA			0314020007SA			0312140002SA			0312140005SA			0314020013SA			0312140006SA		
COLLECT DATE	09/13/93			09/13/93			09/13/93			09/13/93			09/13/93			09/13/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Metals (mg/kg)																		
Aluminum	3430	10.4					8910	11		3790	10.3					7150	11.1	
Arsenic	2.2	0.52					2.6	0.55		4.1	0.52					2	0.56	
Barium	717	1					96.9	1.1		279	1					74.8	1.1	
Beryllium	0.27	0.21					0.61	0.22		0.28	0.21					0.5	0.22	
Cadmium	0.85	0.52					<	0.55	U	0.81	0.52					<	0.56	U
Calcium	44500	20.8	J				2690	22		65700	20.6					2440	22.2	
Chromium	11.9	1	J				9.7	1.1		16.1	1					8.3	1.1	
Cobalt	2.4	1					4	1.1		2.2	1					3.6	1.1	
Copper	11.6	2.1					7.4	2.2		10.2	2.1					5.5	2.2	
Iron	5120	10.4					8920	11		4580	10.3					7250	11.1	
Lead	84.4	5.2	J				12	1.1		82.6	5.2					6.2	1.1	
Magnesium	1970	20.8					1770	22		1940	20.6					1300	22.2	
Manganese	383	1	J				177	1.1		156	1					144	1.1	
Mercury	0.25	0.1					<	0.11	U	0.18	0.1					<	0.11	U
Nickel	8.2	4.2					8.3	4.4		5.6	4.1					7.6	4.4	
Potassium	898	519					1640	549		1150	516					1260	555	
Sodium	<	519	U				<	549	U	<	516	U				375	555	J
Vanadium	14.2	1					19.2	1.1		11.5	1					15.1	1.1	
Zinc	54.9	2.1					20.7	2.2		54.2	2.1					15.2	2.2	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	649	41.6					<	43.9	U	610	41.2					<	44.4	U
Water Quality (percent)																		
Water	3.8	0.1		4.2	0.1		8.9	0.1		3	0.1		4.9	0.1		10	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 11-3a

COMPARISON OF MAXIMUM DETECTED METAL CONCENTRATIONS TO BACKGROUND (1)
SWMU 61, CANNON AFB
Oil/Water Separator No. 5077a

Sample ID	Metal	Maximum detected concentration	Range of background concentrations (2)	Upper tolerance limit (UTL) background concentration (3)	Does maximum detected exceed UTL background
CAN061-0611-0000	Aluminum	8460	1410 - 11,000	10,540	N
CAN061-0611-0000	Arsenic	2.1	0.67 - 28	15.5	N
CAN061-0612-0008	Barium	727	14.5 - 1200	642	Y
CAN061-0612-0000	Beryllium	0.59	0.17 - 0.77	0.73	N
CAN061-0611-0008	Cadmium	3	<0.51 - 4.2	*	Y
CAB061-0612-0008	Calcium	183,000	1490-172,000	186,400	N
CAN061-0612-0000	Chromium	9	4 - 15.4	12.5	N
CAN061-0611-0000	Cobalt	4	0.85 - 5.3	4.5	N
CAN061-0611-0000	Copper	7.2	<2 - 18.4	*	N
CAN061-0611-0000	Lead	7.4	1.1 - 46	25.8	N
CAN061-0612-0000	Nickel	7.4	1.3 - 9.8	9	N
CAN061-0612-0008	Silver	1.7	0.51 - 0.93	*	N
CAN061-0612-0000	Vanadium	20.6	5.2 - 28.3	25.3	N
CAN061-0612-0000	Zinc	20.9	<4.3 - 27.5	21.9	N

(1) All units in mg/kg.
(2) Compiled from data collected by Woodward Clyde for the RFI and RI (WCC 1992 and WCC 1993) and Walk Haydel and Associates for the IRP (Walk, Haydel and Associates 1990).
Summarized in "Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater at Cannon AFB, NM (WCC 1993)
(3) Upper Tolerance Limit (UTL) of the mean = mean + 2*standard deviation. This is for all practicle purposes the same as the 90% upper confidence limit of the 95th percentile where UTL = mean + standard deviation *k, where k=2.02 for n=37 .
* Data insufficient to calculate UTL of background

TABLE 11-3b

COMPARISON OF MAXIMUM DETECTED METAL CONCENTRATIONS TO BACKGROUND (1)
SWMU 62, CANNON AFB

Oil/Water Separator No. 5077b

Sample ID	Metal	Maximum detected concentration	Range of background concentrations (2)	Upper tolerance limit (UTL) background concentration (3)	Does maximum detected exceed UTL background
CAN062-0622-0000	Aluminum	6960	1410 - 11,000	10,540	N
CAN062-0621-0000	Arsenic	2.5	0.67 - 28	15.5	N
CAN062-0622-0008	Barium	334	14.5 - 1200	642	N
CAN062-0622-0008	Beryllium	0.59	0.17 - 0.77	0.73	N
CAN062-0621-0008	Cadmium	1.3	<0.51 - 4.2	*	N
CAN062-0622-0008	Calcium	136,000	1490-172,000	186,000	n
CAN062-0621-0000	Chromium	7.7	4 - 15.4	12.5	N
CAN062-0622-0000	Cobalt	4.2	0.85 - 5.3	4.5	N
CAN062-0621-0000	Copper	6.9	<2 - 18.4	*	N
CAN062-0622-0000	Lead	7.3	1.1 - 46	25.8	N
CAN062-0622-0000	Nickel	7.8	1.3 - 9.8	9	N
CAN062-0621-0002	Silver	0.59	0.51 - 0.93	*	N
CAN062-0622-0000	Vanadium	22.3	5.2 - 28.3	25.3	N
CAN062-0622-0000	Zinc	16.9	<4.3 - 27.5	21.9	N

(1) All units in mg/kg.
(2) Compiled from data collected by Woodward Clyde for the RFI and RI (WCC 1992 and WCC 1993) and Walk Haydel and Associates for the IRP (Walk, Haydel and Associates 1990).
Summarized in "Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater at Cannon AFB, NM (WCC 1993)
(3) Upper Tolerance Limit (UTL) of the mean = mean + 2*standard deviation. This is for all practicle purposes the same as the 90% upper confidence limit of the 95th percentile where UTL = mean + standard deviation *k, where k=2.02 for n=37 .
* Data insufficient to calculate UTL of background

TABLE 11-3c

COMPARISON OF MAXIMUM DETECTED METAL CONCENTRATIONS TO BACKGROUND (1)
SWMU 63, CANNON AFB

Oil/Water Separator No. 5077c

Sample ID	Metal	Maximum detected concentration	Range of background concentrations (2)	Upper tolerance limit (UTL) background concentration (3)	Does maximum detected exceed UTL background
CAN063-0631-0002	Aluminum	8910	1410 - 11,000	10,540	N
CAN063-0632-0000	Arsenic	4.1	0.67 - 28	15.5	N
CAN063-0632-0008	Barium	751	14.5 - 1200	642	Y
CAN063-0631-0008	Beryllium	0.64	0.17 - 0.77	0.73	N
CAN063-0631-0000	Cadmium	0.85	<0.51 - 4.2	*	N
CAN063-0631-0008	Calcium	115,000	1490-172,000	186,400	N
CAN063-0632-0000	Chromium	16.1	4 - 15.4	12.5	Y
CAN063-0631-0002	Cobalt	4	0.85 - 5.3	4.5	N
CAN063-0631-0000	Copper	11.6	<2 - 18.4	*	N
CAN063-0631-0000	Lead	84.4	1.1 - 46	25.8	Y
CAN063-0631-0000	Mercury	0.25	<0.1 - <0.12	*	Y
CAN063-0631-0002	Nickel	8.3	1.3 - 9.8	9	N
CAN063-0631-0002	Vanadium	19.2	5.2 - 28.3	25.3	N
CAN063-0631-0000	Zinc	54.9	<4.3 - 27.5	21.9	Y

(1) All units in mg/kg.
(2) Compiled from data collected by Woodward Clyde for the RFI and RI (WCC 1992 and WCC 1993) and Walk Haydel and Associates for the IRP (Walk, Haydel and Associates 1990).
Summarized in "Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater at Cannon AFB, NM (WCC 1993)
(3) Upper Tolerance Limit (UTL) of the mean = mean + 2*standard deviation. This is for all practicle purposes the same as the 90% upper confidence limit of the 95th percentile where UTL = mean + standard deviation *k, where k=2.02 for n=37 .
* Data insufficient to calculate UTL of background concentration

TABLE 11-4A

COMPARISON OF MAXIMUM CONCENTRATIONS WITH RBCs (1)
SWMU 61, CANNON AFB
Oil/Water Separator No. 5077a

Sample ID	Analyte	Maximum Detected	RBC (2)	Maximum Detected Exceed RBC
CAN061-0612-0008	Barium	727	600	Y
CAN061-0611-0008	Cadmium	3	8	N
CAN061-0611-0008	Copper	7.2	300	N
CAN061-0612-0008	Silver	1.7	20	N
CAN061-0612-0000	Toluene	0.005	2000	N
CAN061-0612-0000	Xylenes (total)	0.0028	20000	N

(1) All units in mg/kg

(2) Risk based concentration

Note: Only metals that exceeded background appear in this table.

TABLE 11-4B

COMPARISON OF MAXIMUM CONCENTRATIONS WITH RBCs (1)
SWMU 62, CANNON AFB
Oil/Water Separator No. 5077b

Sample ID	Analyte	Maximum Detected	RBC (2)	Maximum Detected Exceed RBC
CAN062-0622-0000	1,1,2,2-Tetrachloroethane	0.0014	0.4	N
CAN062-0622-0000	2-Hexanone	0.0096	NTF	N
CAN062-0622-0000	4-Methyl-2-pentanone (MIBK)	0.0055	400	N
CAN062-0622-0000	Bromoform	0.0012	200	N
CAN062-0621-0008	Cadmium	1.3	8	N
CAN062-0621-0000	Copper	6.9	300	N
CAN062-0622-0000	Silver	0.59	20	N
CAN062-0621-0002	Toluene	0.0034	2000	N

NTF = No Established EPA Toxicity Factor
(1) All units in mg/kg
(2) Risk based concentration
Note: Only metals that exceeded background appear in this table.

TABLE 11-4C
COMPARISON OF MAXIMUM CONCENTRATIONS WITH RBCs (1)
SWMU 63, CANNON AFB
Oil/Water Separator No. 5077c

Sample ID	Analyte	Maximum Detected	RBC (2)	Maximum Detected Exceed RBC
CAN063-0631-0000	1,2-Dichloroethane	0.0015	0.8	N
CAN063-0631-0000	2-Methylnaphthalene	0.12	NTF	N
CAN063-0632-0000	Acenaphthene	0.12	500	N
CAN063-0632-0000	Anthracene	0.21	2000	N
CAN063-0632-0008	Barium	751	600	Y
CAN063-0632-0000	Benzo(a)anthracene	1	0.07	Y
CAN063-0632-0000	Benzo(a)pyrene	0.9	0.01	Y
CAN063-0632-0000	Benzo(b)fluoranthene	1.8	0.07	Y
CAN063-0632-0000	Benzo(g,h,i)perylene	0.39	NTF	N
CAN063-0631-0000	Butyl benzyl phthalate	0.12	2000	N
CAN063-0631-0000	Cadmium	0.85	8	N
CAN063-0632-0000	Carbazole	0.1	4	N
CAN063-0632-0000	Chromium	16.1	40	N
CAN063-0632-0000	Chrysene	1.1	2	N
CAN063-0631-0000	Copper	11.6	300	N
CAN063-0632-0000	Dibenzofuran	0.053	NTF	N
CAN063-0632-0000	Fluoranthene	1.7	300	N
CAN063-0632-0000	Fluorene	0.1	300	N
CAN063-0632-0000	Indeno(1,2,3-cd)pyrene	0.4	0.04	Y
CAN063-0631-0000	Lead (3)	84.4	500	N
CAN063-0631-0000	Mercury	0.25	2	N
CAN063-0631-0000	Naphthalene	0.08	300	N
CAN063-0632-0000	Phenanthrene	1.4	NTF	N
CAN063-0632-0000	Pyrene	2.2	200	N
CAN063-0631-0000	Toluene	0.0027	2000	N
CAN063-0631-0000	Total Petroleum Hydrocarbons (4)	649	1000	N
CAN063-0631-0000	Xylenes (total)	0.0011	20000	N
CAN063-0631-0000	Zinc	54.9	2000	N

NTF = No EPA Established Toxicity Factor

(1) All units in mg/kg

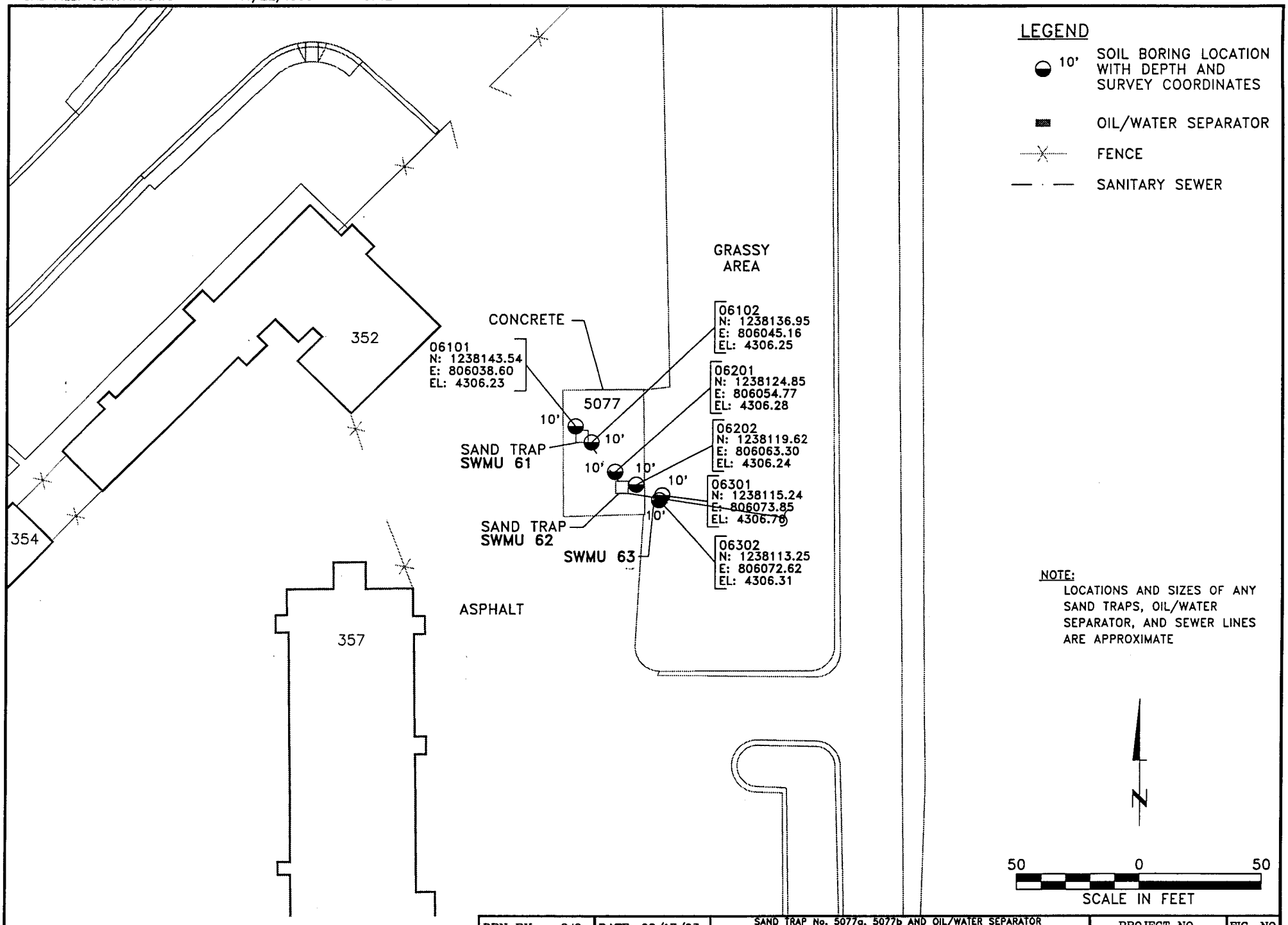
(2) Risk-based concentration

(3) EPA suggests 500-1,000 mg/kg as allowable concentration for residential soils based on EPA's IUBK Lead Model (EPA 1990)

(4) New Mexico recommended soil cleanup level for fuel contaminated soil.

Note: Only metals that exceeded background appear in this table.

CAD FILE: C3M11W6.DWG 11/22/1993 9:42



SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

DRN BY: CJG	DATE: 08/17/93	SAND TRAP No. 5077a, 5077b AND OIL/WATER SEPARATOR No. 5077c – SWMU 61, 62 & 63 SITE PLAN AND BORING LOCATIONS CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W
CHK'D BY: .	REVISION: 0		FIG. NO. 11–1

12.1 SITE BACKGROUND

12.1.1 Site Description

OWS 326 is located in a grassy area near the northwest corner of the POL maintenance facility in Building 326 (Figure 12-1). A floor sump with a drain pipe collects and directs fluids from the maintenance bays to the OWS outside the building. The OWS is constructed of steel and consists of a two-compartment underground unit with a 50-gallon OWS compartment and a detached 220-gallon oil storage tank. As-built drawings indicate the OWS measures about 1.5 feet by 2 feet in plan and extends about 6 feet below the ground surface. The oil storage tank is strapped to a 4-foot by 7-foot concrete pad that was constructed about 7 feet below the top of the concrete sidewalk. Water from the OWS discharged to a leach well 7 feet north of the OWS.

An area of stressed and dead vegetation approximately 2.5 feet by 4 feet in size was observed during field activities in a slight depression to the northwest of the OWS. The vegetation appears to have been impacted by material overflowing from the OWS. This may have been due to poor drainage allowing rainwater to run into the separator.

12.1.2 Site History

The OWS reportedly received wash water and floor drainage generated from JP-4 fuel truck maintenance operations taking place in Building 326. Petroleum products recovered by the OWS were directed to the 220-gallon holding tank for temporary storage until it was routinely pumped and recycled. The associated wastewater was discharged to a 5-foot diameter by 5-foot deep, gravel-filled leach well located 7-feet north of the OWS. The OWS and leach well have been active since 1958. Following drilling operations in September 1993 the drain pipe from Building 326 was plugged, thereby, deactivating the OWS.

12.1.3 Current Use

The OWS has been removed from service.

12.1.4 POTENTIAL CONTAMINANTS

Potential contaminants at this SWMU include JP-4 fuel, petroleum, and synthetic lubricating oils, greases, solvents, fuels, and metals.

12.2 FIELD INVESTIGATION AND DATA COLLECTION

12.2.1 Soils Sampling

The sampling objective at OWS 326 and the associated leach field was to determine if a release of SWMU-related chemicals posing a significant risk to human health or the environment has occurred due to spillage or leakage from the OWS or as seepage from the leach well. To check for leakage from the OWS, two 20-foot deep borings were drilled and sampled to sample the soils as close as possible to the inlet and outlet of the OWS. These two borings, 07004 and 07005, are located at the southeast and northeast corners of the OWS, respectively. Soil samples were collected at the surface and at the 1.5- to 3-foot, 4- to 6-foot, 8- to 10-foot, 13- to 15-foot, and 18- to 20-foot depth intervals as specified in the Field Sampling Plan and the Sample Summary Tables.

Three 60-foot deep soil borings to explore the vertical extent of possible leachate originating from the leach well were planned at the northwest, north, and east flanks of the well. Soil samples were collected at the surface and at the 1.5- to 3-foot, 4- to 6-foot, 8- to 10-foot, 18-to 20-foot, 28- to 30-foot, 38- to 40-foot, 48- to 50-foot, and 58- to 60-foot depth intervals in Boring 07001 as specified in the Field Sampling Plan and the Sample Summary Tables. Projected to have the same sampling schedule, Boring 07002 was sampled only at the surface and at the 1.5- to 3-foot, 4- to 6-foot, 8- to 10-foot, and 18- to 20-foot depth intervals before being abandoned due to high concentrations of petroleum products being encountered in the soil at 20 feet. Boring 07003 was not drilled, at the direction of the USACE project manager, due to the likelihood of encountering additional heavy contamination in drilling, and since the objective of the drilling for this phase of the study had already been achieved.

Samples were collected in accordance with QAPP SOP No. 6 - Surface Soil Sampling and QAPP SOP No. 7-Subsurface Drilling and Sampling. Target analytes for all borings include VOCs, SVOCs, metals and TRPH. Surficial samples were collected approximately at the 0.2-to 0.5-foot depth interval to provide a worst-case situation for risk assessment purposes in the event that SVOC contaminants were discovered during this investigation. All borings drilled in this SWMU exhibited very strong visual evidence of contamination supported by very high headspace measurements from subsurface samples collected.

12.2.2 Geologic Summary of Boring Logs

The stratigraphy of this site consists of a shallow zone of possible fill material overlying a sequence of clayey silts. These soils show increasing calcic content and become more coarse with depth to a fine- to medium-grained sand. Soil color ranges from dark or reddish-brown at the surface to pinkish at a depth of 60 feet. Discoloration of soil ranged from black spotting to pervasive black and gray staining throughout the contaminated soil matrix. The more visibly contaminated soils also exhibit a higher moisture content, probably attributable to the contaminating fluids. The 38- to 60-foot interval in Boring 07001 shows a decrease in staining, and below the 18-foot level in Boring 07005, staining greatly decreases. All four borings drilled show visual evidence of heavy contamination throughout their depth, and high headspace measurements coincident with observed staining and odors.

12.2.3 SITE TOPOGRAPHY

The site is flat with a slight gradient from the OWS to the north.

12.3 CHEMICAL INVESTIGATION RESULTS

12.3.1 General

Samples were collected as identified in Section 12.2 to comply with permit and compliance agreement requirements. Soil samples were collected from 4 borings (07001, 07002, 07004, and 07005). Sampling and analyses performed are summarized in Table 12-1. A summary of the analytical results for these soil samples are provided in Table 12-2a for near-surface soils and Table 12-2b for subsurface soils. For each sample type, the tables provide results

for analytes only if they were detected at least once in this type of sample collected at the SWMU. Complete analytical summary results are provided in the QCSR (Appendix A).

12.3.2 Organic Results For Near-surface Soil Samples

The near-surface soil samples collected at this SWMU (CAN070-0701-0000, CAN070-0701-0002, CAN070-0702-0000, CAN070-0702-0002, CAN070-0703-0000, CAN070-0703-0002, CAN070-0704-0000, CAN070-0704-0002, CAN070-0705-0000, and CAN070-0705-0002 were analyzed for VOCs, SVOCs, metals, and TPH as indicated in Table 12-1.

Other than acetone and methylene chloride, which were qualified nondetected after they were determined to be laboratory contaminants (see Section 4.7.4 of the QCSR), the VOCs reported as detected were ethylbenzene, toluene, and total xylenes. Ethylbenzene was detected in samples CAN070-0702-0002, and CAN070-0701-0000 at 2500 µg/kg, and 42000 µg/kg respectively. Toluene was detected in samples CAN070-0702-0000, CAN070-0702-0002, CAN070-0701-0002, and CAN070-0701-0000 at 2.7 µg/kg, 820 µg/kg, 4400 µg/kg, and 32000 µg/kg, respectively. Total xylenes were detected in samples CAN070-0704-0002, CAN070-0702-0002, CAN070-0701-0002, and CAN070-0701-0000 at 420 µg/kg, 22,000 µg/kg, 96,000 µg/kg, 140,000 µg/kg, respectively.

Other than bis(2-ethylhexyl)phthalate which was determined to be nondetected on the basis of being considered a common laboratory contaminant, results reported for SVOCs were primarily polycyclic aromatic hydrocarbons (PAHs). The PAHs detected in sample CAN070-0702-0000 had a total concentration of 4,221 µg/kg and included the compounds 2-methylnaphthalene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene and pyrene. Naphthalene was also detected in samples CAN070-0701-0002 and CAN070-0701-0000 with concentrations of 7,600 µg/kg and 9,500 µg/kg, while 2-methylnaphthalene was detected in samples CAN070-0704-0000, CAN070-0701-0000, and CAN070-0701-0002 at 640 µg/kg, 21,000 µg/kg, and 23,000 µg/kg, respectively. Carbazole was detected in sample CAN070-0702-0000 at 55 µg/kg. All of the eight near-surface soil samples analyzed for TPH had reported results ranging from 72.4 mg/kg in sample CAN070-0705-0002 to 8620 mg/kg in sample CAN070-0701-0002.

12.3.3 Organic Results For Subsurface Soil Samples

The subsurface soil samples collected at this SWMU (CAN070-0701-0004, CAN070-0701-0008, CAN070-0701-0018, CAN070-0701-0028, CAN070-0701-0038, CAN070-0701-0048, CAN070-0701-0058, CAN070-0702-0004, CAN070-0702-0008, CAN070-0702-0018, CAN070-0704-0013, CAN070-0704-0018, CAN070-0705-0004, CAN070-0705-0008, and CAN070-0705-0018 were analyzed for VOCs, and TPH while CAN070-0704-0004, and CAN070-0704-0008 were analyzed for VOCs, SVOCs, and TPH as indicated in Table 12-1.

Other than acetone and methylene chloride and 2-butanone which are considered common laboratory contaminants, the only VOCs detected in subsurface samples were benzene ranging from 2,100 µg/kg in sample CAN070-0701-0008 to 75,000 µg/kg in sample CAN070-0702-0004, ethylbenzene ranging form 1,100 µg/kg in sample CAN070-0704-0013 to 340,000 µg/kg in sample CAN070-0702-0004, toluene ranging from 840 µg/kg in sample CAN070-0702-0002 to 510,000 µg/kg in sample CAN070-0702-0004, and total xylenes ranging from 50 µg/kg in sample CAN070-0704-0004 to 890,000 µg/kg in sample CAN070-0702-0004. Two samples had reported detections of SVOCs for sample CAN070-0702-0008 with 39,000 µg/kg 2-methylnaphthalene, and 24,000 µg/kg naphthalene, and sample CAN070-0704-0004 with 5,700 µg/kg 2-methylnaphthalene. Petroleum hydrocarbons were detected in seventeen of the eighteen samples ranging from 2,100 mg/kg in sample CAN070-0705-0004, to 28900 mg/kg in sample CAN070-0705-0008.

12.3.4 Inorganic Results

Metals analyses were performed on samples collected from this SWMU as indicated in Table 12-1. The range of results for metals reported in these soil samples are summarized in Table 12-A.

TABLE 12-A

Analyte	Frequency Reported	Lowest Detection	Sample Location	Highest Detection	Sample Location
Aluminum	26/26	3900 mg/kg	0701-0058	11,600 mg/kg	0701-0004
Antimony	5/26	6.8 mg/K	0701-0028	14.3 mg/kg	0701-0018
Arsenic	26/26	1.1 mg/kg	0701-0058	4.3 mg/kg	0702-0018
--	--	--	and 0705-0008	--	--
Barium	26/26	72.9 mg/kg	0705-0013	629 mg/kg	0701-0018
Beryllium	26/26	0.17 mg/kg	0701-0038	0.64 mg/kg	0701-0004
Cadmium	9/26	0.48 mg/kg	0705-0004	1.4 mg/kg	0705-0000
Calcium	26/26	8580 mg/kg	0701-0002	135000 mg/kg	0701-0018
Chromium	26/26	1.9 mg/kg	0704-0013	14 mg/kg	0705-0000
Cobalt	26/26	1.2 mg/kg	0701-0058	5 mg/kg	0701-0002
Copper	26/26	2.1 mg/kg	0701-0038	14.9 mg/kg	0705-0000
Iron	26/26	3110 mg/kg	0701-0058	109000 mg/kg	0701-0002
Lead	26/26	2.8 mg/kg	0701-0058	251 mg/kg	0705-0000
Magnesium	26/26	1410 mg/kg	0704-0000	6070 mg/kg	0701-0048
Manganese	21/26	48.5 mg/kg	0701-0038	277 mg/kg	0701-0002
Mercury	1/26	0.12 mg/kg	0705-0008	--	--
Nickel	26/26	3.2 mg/kg	0701-0058	11.2 mg/kg	0701-0002
Potassium	26/26	787 mg/kg	0701-0058	2780 mg/kg	0701-0018
Selenium	0/24	--	--	--	--
Silver	6/26	0.54 mg/kg	0702-0004	0.92 mg/kg	0701-0058
Sodium	4/26	190 mg/kg	0701-0058	366 mg/kg	0702-0008
Thallium	3/26	0.12 mg/kg	0702-0004	0.15 mg/kg	0701-0002
Vanadium	26/26	12.4 mg/kg	0705-0018	23.6 mg/kg	0701-0002
Zinc	26/26	7.7 mg/kg	0701-0058	51.8 mg/kg	0705-0000

Note: See Table 12-3 for comparison to background.

12.4 SWMU SPECIFIC DATA ASSESSMENT

12.4.1 General

This assessment of the OWS No. 326 data is an evaluation of quality issues that could affect the major data uses. In general, the objective of the RFI was identification and quantification of the nature and extent of the contamination, which was necessary to meet permit and compliance agreement requirements, and to support an evaluation of the risk to human health and the environment.

12.4.2 Sampling Issues

A review of the data contained in the log books and the Daily Quality Control Reports (DQCR) for SWMU 70 indicate that there were no sampling issues that would impact data usability. QC issues are discussed in detail in the QCSR in Appendix A, and copies of the DQCRs are included in that appendix.

12.4.3 Data Review Issues

For laboratory analytical data, QA/QC objectives were specified in the Cannon AFB QAPP (W-C 1993). The objectives were used as indicators of the quality necessary to support identification and quantitation of potential chemicals of concern. The data review is presented in Section 4.1 of the Quality Control Summary Report (QCSR) located in Appendix A. As presented in the QCSR, data for metal analytes selenium, thallium, silver, barium, sodium, manganese, and various VOC and SVOC analytes (summarized in Table 4.7-1) were qualified as estimated concentrations. Additionally, sodium and manganese data were qualified rejected **R**.

Selenium, thallium, manganese, sodium, barium, silver, and various VOC and SVOC data were qualified estimated to indicate a potential low bias. When a low bias is indicated, actual concentrations may be higher than the reported results. Use of this data in risk assessment may underestimate risk. Similarly, when a high bias is indicated, actual concentrations may be lower than the reported results. Use of this data in risk assessment may overestimate risk.

Barium, calcium, chromium, manganese, lead, and vanadium data were qualified estimated due to precision that did not meet the QA/QC criteria defined for this project. Poor precision could be attributed to errors in sampling and analysis; however, since the other analytes which were sampled and analyzed in the same procedure (Method 6010) met QA/QC criteria, this variation is likely due to sample heterogeneity.

For ICP metals analyses, the only indicator of data accuracy is the results of the matrix spike. Manganese and Sodium data were rejected based MS recoveries below 10 percent and above 200 percent, respectively. All samples analyzed for this SWMU had manganese and sodium concentrations reported; however, because the accuracy criteria have been exceeded, it can

not be determined whether the identification of these analytes can be relied upon in 5 of the 26 sample results. Therefore, with both analytes, five samples associated with the above MS recoveries, were rejected.

The uncertainty in the actual concentration reported for estimated data does not affect the usability of the data for identification of chemicals in characterizing the nature and extent of contamination at this SWMU.

12.4.4 Limitations

Elevated reporting limits may limit the usability of the data due to low level analytes being diluted to below the instrument detection limits. That is, chemicals may be reported as nondetect when they are actually present in a sample at low levels. Section 4.1.6 of the QCSR (Appendix A) presents a discussion of elevated reporting limits. Twelve samples analyzed for VOCs, four samples analyzed for SVOCs, three samples analyzed for TPH, six samples analyzed for Selenium, and two samples analyzed for lead required dilutions which significantly exceeded established RLs. There is no impact on the usability of the associated data because the analytes were reported above elevated reporting limits for TPH, selenium, and lead. For VOCs and SVOCs listed in the Reporting Limit Section of the data review (Section 4.7.6), the possibility exists that organic compound have been diluted below instrument detection limits and thus effect nondetected data use for risk assessment in these samples.

12.4.5 Summary

Overall, data generated during the study of SWMU 70 were determined to meet quality criteria. In conjunction with the analytical data review, other information including field observations were evaluated in the assessment of the usability of SWMU 70 data. The data support identification of the nature and extent of contamination, except for the manganese and sodium data, provide reasonable concentration for use in risk assessment.

12.5 NATURE AND EXTENT OF CONTAMINATION

SWMU 70 is an OWS with a gravel filled leach well serving the fuel truck maintenance operations in Building 326. Two borings in close proximity to the separator were each advanced to a depth of 20 feet. Two borings in close proximity to the leach field were advanced to depths of 20 feet and 60 feet. All of the borings revealed soil contaminated with petroleum hydrocarbons throughout their depths. The contamination varied in amount from slightly visible to oil saturated. The chemical test results indicated mostly organic compounds associated with JP-4 jet fuel, but there may be other petroleum products involved. There is no evidence of chlorinated solvents found in any of the sample, but it is anticipated that elevated levels of SVOCs including PAHs are present in most samples. The PAHs were diluted out of most of the samples in the laboratory preparation, but they were detected in one of the samples not requiring dilution at levels in the 300 to 600 microgram/kilogram range.

12.6 COMPARISON OF METALS CONCENTRATIONS TO BACKGROUND

Results of the comparison of metal concentration in soil to background levels for SWMU 70 are given in Table 12-3. A summary of the results of the comparison is presented here.

Metals are natural constituents of soils. SWMU concentrations of metal were evaluated to assess whether the metals in environmental samples exceed background levels. Metals that occur in concentrations within background levels are not considered SWMU-related chemicals of concern and are not evaluated further.

The maximum concentration of each detected metal at each SWMU was compared to the upper tolerance limit of the background data. The upper tolerance limit (UTL) was defined as the mean plus two times the standard deviation. This is, for all practical purposes, equal to the 90% upper confidence limit of the 95th percentile which is equal to the mean plus the standard deviation times the k statistic. The background data set used consisted of 37 data points (WCC 1993), so the k statistic equals 2.02 (Gilbert 1987).

The maximum detected concentrations of aluminum, antimony, cadmium, cobalt, copper, lead, mercury, silver, thallium, and zinc exceeded the (UTL) of the background data. Therefore, these metals will be compared to risk-based concentrations at SWMU 70.

12.7 RISK SCREENING

12.7.1 Exposure Pathway Flow Chart

The Preliminary Exposure Pathway Flow Chart (EPFC) applicable to SWMU 70, OWS No. 326, and associated leach field is shown in Figure 3-2. It shows that the potential exposure pathways are ingestion of soil, inhalation of soil particulates, dermal exposure to contaminated soil, inhalation of airborne chemicals released from soil, and ingestion, inhalation, and dermal exposure to groundwater (if drinking water supplies were affected). Storm water runoff is considered to be an insignificant pathway because potential spills would be minor and over a small area.

12.7.2 Screening of Contaminants Against RBCs and Other Criteria

Two 20-foot and three 60-foot borings were planned at this SWMU; however, since significant contamination was encountered at the bottoms of the first four borings, it was concluded that the planned field investigation would not be able to define the vertical limits of the contamination. Therefore, since the remaining borings were in heavy contamination, the field investigation was discontinued until a decision can be made regarding the approach for further investigation. Therefore, not all of the planned data were collected, and the vertical and horizontal limits of contamination at this SWMU remain undefined. The following discussion is an evaluation of the data that were collected at this SWMU.

Maximum detected concentrations of organic compounds and metals that exceeded background were compared to screening-level RBCs (see Section 3.4.5.1 for derivations of RBCs) and other screening criteria in Table 12-4. Screening-level criteria other than RBCs include the state of New Mexico's TPH clean-up level of 1,000 mg/kg (New Mexico Environmental Improvement Board 1993) and the EPA's recommended soil lead level of 500 mg/kg (EPA 1990). The TPH soil clean-up concentration of 1,000 mg/kg is not a risk-based concentration, nor is it a relevant-and-applicable standard for the SWMUs in this investigation. Rather it is a conservative value originally derived for the cleanup of fuel-contaminated soils at underground storage tank sites. Risk-based concentrations for TPH, measured as fresh fuels (e.g., gasoline or diesel), are at least an order of magnitude higher for occupational exposures. The concentration of 500 mg/kg is the most

conservative concentration in the recommended range of 500 mg/kg to 1,000 mg/kg as a lead level in residential soil based on EPA's Uptake Biokinetic Model (EPA 1990). Compounds with no toxicity factors cannot be evaluated in the risk screening since RBCs cannot be calculated. These compounds, at the concentrations that were measured, are not likely to significantly affect the results of the comparison to RBCs. The comparison for SWMU 70 shows that maximum detected concentrations of antimony, benzene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene, and TPH exceed RBCs.

This comparison of maximum detected concentrations to RBCs is very conservative (health-protective), and actual impacts are likely to be lower than those suggested by exceedances of conservative criteria. For example, maximum detected concentrations are likely to overestimate actual concentrations to which people would be exposed. Furthermore, the screening criteria are based on highly conservative residential exposure assumptions and target risk levels that may not be pertinent to current or future use of the SWMU. The RBCs used in this evaluation are calculated using RCRA Action Level methodology; however, the RBCs are more health-protective than conventional RCRA Action Levels because a target excess cancer risk level of 1×10^{-7} (1 in 10,000,000) and a hazard quotient of 0.1 were used to account for exposures to multiple chemicals and for exposure routes other than soil ingestion. Conventional RCRA Action Levels are calculated based on a cancer risk of 1×10^{-6} and a noncancer hazard quotient of 1.0.

The purpose of this comparison of concentrations to RBCs is to determine whether or not chemical releases (characterized by maximum detected concentrations) have occurred at SWMU 70 that could pose potential risks based on conservative health-based criteria. Since maximum concentrations exceed screening level criteria further evaluation or investigation of chemical concentrations and probable exposures is warranted.

12.8 SUMMARY AND RECOMMENDATIONS

Two 20-foot and three 60-foot deep soil borings were planned at SWMU 70. Twenty-six soil samples were collected from the first four borings before sampling was stopped. Maximum detected concentrations were compared to background levels and RBCs. One metal, six organics and TPH were found at levels that exceed RBCs or other screening-level criteria. Therefore, a risk assessment is recommended for this SWMU. However, since the vertical

and lateral limits of the contamination have not been characterized, further fieldwork is recommended at this SWMU. The goals of the additional fieldwork will be to collect sufficient data so that a risk assessment can be completed and recommendations for potential site remediation can be made.

It is recommended that the limits of contamination both vertically and horizontally be determined. This can be readily accomplished through use of soil gas surveying, additional soil borings and immunoassay tests to verify when clean soils are found.

Although it is recommended that a limited number of soil samples be tested for the full suite of VOCs, SVOCs, and TPH, it would not be necessary to test for more than TPH on most samples to verify the extent of contamination. To facilitate future corrective measures studies, it is recommended that representative soil samples be tested for geotechnical properties (grain size distribution, Atterberg limits, porosity, and permeability) and for ambient microbial activities potentially in the soil.

12.9 PRELIMINARY DISCUSSION OF CORRECTIVE MEASURES

A preliminary review of potential corrective measures points toward consideration of natural attenuation and/or in situ microbial degradation. This would most likely be in the form of bioventing or other processes to enhance microbial action in the contaminated soil areas.

The likely first step would be the emptying and removal of the OWS and the associated oil recovery tank, leach well, and underground piping. This process would generate some oily soil that could be treated by microbial degradation at a location on base remote from Building 326 or disposed off-Base, depending on regulatory and economic limitations. The excavated area (about ten feet maximum depth) would be backfilled with clean soil.

At this point, with the source removed, consideration could be given to the risk of further migration, and a corrective measures study would look at a range of actions from natural attenuation with no further action, up to more aggressive measures to further reduce the contaminant levels. The practicality of employing in situ microbial degradation would be evaluated as part of this study.

TABLE 12-1

SUMMARY OF ANALYTICAL AND QA/QC SAMPLING
OIL/WATER SEPARATOR NO. 326 (SWMU NO. 70)
CANNON AFB, NEW MEXICO

Sample Location	Target Interval (ft-bgs)	Sample Identification Number	QA/QC Type	Sample Matrix	Analytical Parameters				Sample Containers		
					VOCs	SVOCs	Metals	TRPH	40 ml VOA vials	4 oz. jars	8 oz. jars
Boring 07001	0 - 0.5	CAN070-0701-0000		Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN070-0701-0002		Soil	X	X	X	X		2	1
	4 - 6	CAN070-0701-0004		Soil	X		X	X		2	1
	8 - 10	CAN070-0701-0008		Soil	X		X	X		2	1
	18 - 20	CAN070-0701-0018		Soil	X		X	X		2	1
	28 - 30	CAN070-0701-0028		Soil	X		X	X		2	1
	38 - 40	CAN070-0701-0038		Soil	X		X	X		2	1
	48 - 50	CAN070-0701-0048		Soil	X		X	X		2	1
	58 - 60	CAN070-0701-0058		Soil	X		X	X		2	1
Boring 07002	0 - 0.5	CAN070-0702-0000		Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN070-0702-0002		Soil	X		X	X		2	1
	4 - 6	CAN070-0702-0004		Soil	X		X	X		2	1
	8 - 10	CAN070-0702-0008		Soil	X	X	X	X		2	1
	8 - 10	CAN070-0702-6008	MS/MSD	Soil	X	X	X	X		2	2
	18 -20	CAN070-0702-0018		Soil	X		X	X		2	1
Stopped Drilling @ 20'	28 - 30	CAN070-0702-0028		Soil	X		X	X		2	1
	38 - 40	CAN070-0702-0038		Soil	X		X	X		2	1
	48 - 50	CAN070-0702-0048		Soil	X		X	X		2	1
	58 - 60	CAN070-0702-0058		Soil	X		X	X		2	1
Boring 07003 (Boring not completed)	0 - 0.5	CAN070-0703-0000		Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN070-0703-0002		Soil	X		X	X		2	1
	4 - 6	CAN070-0703-0004		Soil	X		X	X		2	1
	8 - 10	CAN070-0703-0008		Soil	X		X	X		2	1
	8 - 10	CAN070-0703-7061	FD	Soil	X		X	X		2	1
	8 - 10	CAN070-0703-7001	MRD	Soil	X	X	X	X		2	1
	18 -20	CAN070-0703-0018		Soil	X		X	X		2	1
	28 - 30	CAN070-0703-0028		Soil	X		X	X		2	1
	38 - 40	CAN070-0703-0038		Soil	X		X	X		2	1
	48 - 50	CAN070-0703-0048		Soil	X		X	X		2	1
	58 - 60	CAN070-0703-0058		Soil	X		X	X		2	1

TABLE 12-1

SUMMARY OF ANALYTICAL AND QA/QC SAMPLING
OIL/WATER SEPARATOR NO. 326 (SWMU NO. 70)
CANNON AFB, NEW MEXICO

Sample Location	Target Interval (ft-bgs)	Sample Identification Number	QA/QC Type	Sample Matrix	Analytical Parameters				Sample Containers		
					VOCs	SVOCs	Metals	TRPH	40 ml VOA vials	4 oz. jars	8 oz. jars
Boring 07004	0 - 0.5	CAN070-0704-0000		Soil	X	X	X	X		2	1
	0 - 0.5	CAN070-0704-7062	FD	Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN070-0704-0002		Soil	X		X	X		2	1
	4 - 6	CAN070-0704-0004		Soil	X	X	X	X		2	1
	4 - 6	CAN070-0704-6004	MS/MSD SVOC only	Soil		X					1
	8 - 10	CAN070-0704-0008		Soil	X		X	X		2	1
	8 - 10	CAN070-0704-7002	MRD	Soil	X	X	X	X		2	1
	13 - 15	CAN070-0704-0013		Soil	X		X	X		2	1
	18 - 20	CAN070-0704-0018		Soil	X		X	X		2	1
Boring 07005	0.5 - 2	CAN070-0705-0000		Soil	X		X	X		2	1
	2 - 4	CAN070-0705-0002		Soil	X		X	X		2	1
	4 - 6	CAN070-0705-0004		Soil	X		X	X		2	1
	8 - 10	CAN070-0705-0008		Soil	X		X	X		2	1
	8 - 10	CAN070-0705-6008	MS/MSD	Soil	X		X	X		2	2
	13 - 15	CAN070-0705-0013		Soil	X		X	X		2	1
	18 - 20	CAN070-0705-0018		Soil	X		X	X		2	1
		CAN070-0705-7051	AB	Water	X				2		
		CAN070-0705-7071	RB	Water	X				2		
		CAN070-0705-7081	DW	Water	X				2		
		CAN070-0705-7091	TB	Water	X				2		

AB = Ambient blank
DW = Decontamination water
FD = Field duplicate
MRD = Missouri River Division
MS/MSD = Matrix spike/matrix spike duplicate
RB = Rinsate blank
TB = Trip blank

See Figure 12-1 for locations of the borings.

TABLE 12-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 70

LOCATOR	CAN070-0701-0000			CAN070-0701-0002			CAN070-0702-0000			CAN070-0702-0002			CAN070-0704-0000			CAN070-0704-0000		
LAB SAMPLE NUMBER	0314030001SA			0314030002SA			0314040002SA			0314040003SA			0312150001SA			0314040011SA		
COLLECT DATE	09/23/93			09/23/93			09/24/93			09/24/93			09/14/93			09/14/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)																		
Ethylbenzene	42000	28000		<	5800	U	<	5.4	UJ	2500	1400					<	5.5	UJ
Toluene	32000	28000		4400	5800	J	2.7	5.4	J	820	1400	J				<	5.5	UJ
Xylenes (total)	140000	28000		96000	5800		<	5.4	UJ	22000	1400					<	5.5	UJ
Semivolatile Organics (ug/kg)																		
Anthracene	<	38000	U	<	39000	U	53	350	J				<	3600	U			
Benzo(a)anthracene	<	38000	U	<	39000	U	320	350	J				<	3600	U			
Benzo(a)pyrene	<	38000	U	<	39000	U	290	350	J				<	3600	U			
Benzo(b)fluoranthene	<	38000	U	<	39000	U	540	350	J				<	3600	U			
Benzo(g,h,i)perylene	<	38000	U	<	39000	U	140	350	J				<	3600	U			
Carbazole	<	38000	U	<	39000	U	55	350	J				<	3600	U			
Chrysene	<	38000	U	<	39000	U	460	350					<	3600	U			
Fluoranthene	<	38000	U	<	39000	U	760	350					<	3600	U			
Indeno(1,2,3-cd)pyrene	<	38000	U	<	39000	U	140	350	J				<	3600	U			
2-Methylnaphthalene	21000	38000	J	23000	39000	J	170	350	J				640	3600	J			
Naphthalene	9500	38000	J	7600	39000	J	68	350	J				<	3600	U			
Phenanthrene	<	38000	U	<	39000	U	410	350					<	3600	U			
Pyrene	<	38000	U	<	39000	U	870	350					<	3600	U			
Metals (mg/kg)																		
Aluminum	7890	11.4		10800	11.7		7400	10.7		6940	11		5880	11				
Arsenic	2.5	0.57		2.8	0.58		2.7	0.54		2.6	0.55		3	0.55				

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value. QUAL = Qualification
R = Rejected value. D = Sample was diluted for analysis.
U = Nondetected value. RL = Reporting Limit.

TABLE 12-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 70

LOCATOR	CAN070-0701-0000			CAN070-0701-0002			CAN070-0702-0000			CAN070-0702-0002			CAN070-0704-0000			CAN070-0704-0000		
LAB SAMPLE NUMBER	0314030001SA			0314030002SA			0314040002SA			0314040003SA			0312150001SA			0314040011SA		
COLLECT DATE	09/23/93			09/23/93			09/24/93			09/24/93			09/14/93			09/14/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Barium	139	1.1		116	1.2		150	1.1	J	148	1.1	J	124	1.1				
Beryllium	0.53	0.23		0.59	0.23		0.45	0.21		0.5	0.22		0.46	0.22				
Cadmium	0.68	0.57		<	0.58	U	1.2	0.54		0.86	0.55		0.74	0.55				
Calcium	45100	22.8		8580	23.4		27400	21.4		59400	22		16900	21.9				
Chromium	8.1	1.1		11.4	1.2		11.4	1.1		7	1.1		13.5	1.1				
Cobalt	3.1	1.1		5	1.2		3.4	1.1		3.2	1.1		2.9	1.1				
Copper	8.6	2.3		9	2.3		8.7	2.1		7.9	2.2		11.2	2.2				
Iron	7880	11.4		10900	11.7		7400	10.7		6890	11		6770	11				
Lead	45.2	5.7		8.4	1.2		28.2	2.7		10.7	1.1		82.7	27.4				
Magnesium	2150	22.8		2400	23.4		1840	21.4		2120	22		1410	21.9				
Manganese	211	1.1		277	1.2		<		R	<		R	134	1.1				
Nickel	7.7	4.6		11.2	4.7		7	4.3		7.1	4.4		6.5	4.4				
Potassium	1960	570		2000	585		1910	536		1570	550		1540	548				
Silver	<	1.1	U	<	1.2	U	0.57	1.1	J	0.6	1.1	J	<	1.1	U			
Sodium	<	570	U	<	585	U	<	536	U	199	550	J	<	548	UJ			
Thallium	<	0.57	UJ	0.15	0.58	J	<	0.54	UJ	<	0.55	UJ	<	0.55	UJ			
Vanadium	19.6	1.1		23.6	1.2		17.3	1.1		17	1.1		15.5	1.1				
Zinc	29.2	2.3		25.9	2.3		28.4	2.1		18.5	2.2		37.7	2.2				
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	7720	2280		8620	2340		353	42.8		5890	440		4740	1100				
Water Quality (percent)																		
Water	12	0.1		14	0.1		6.6	0.1		9.1	0.1		8.7	0.1		8.3	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value. QUAL = Qualification
R = Rejected value. D = Sample was diluted for analysis.
U = Nondetected value. RL = Reporting Limit.

TABLE 12-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 70

LOCATOR	CAN070-0704-0002			CAN070-0705-0000			CAN070-0705-0000			CAN070-0705-0002		
LAB SAMPLE NUMBER	0312150003SA			0312150008SA			0314040013SA			0312780007SA		
COLLECT DATE	09/14/93			09/14/93			09/14/93			09/14/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)												
Ethylbenzene	<	57	U				<	5.4	U	<	5.8	U
Toluene	<	57	U				<	5.4	U	1.4	5.8	UJ
Xylenes (total)	420	57					<	5.4	U	<	5.8	U
Semivolatile Organics (ug/kg)												
Anthracene												
Benzo(a)anthracene												
Benzo(a)pyrene												
Benzo(b)fluoranthene												
Benzo(g,h,i)perylene												
Carbazole												
Chrysene												
Fluoranthene												
Indeno(1,2,3-cd)pyrene												
2-Methylnaphthalene												
Naphthalene												
Phenanthrene												
Pyrene												
Metals (mg/kg)												
Aluminum	7290	11.4		7070	10.9					9240	11.6	
Arsenic	2	0.57		3	0.54					2.8	0.58	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value. QUAL = Qualification
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TABLE 12-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 70

LOCATOR	CAN070-0704-0002			CAN070-0705-0000			CAN070-0705-0000			CAN070-0705-0002		
LAB SAMPLE NUMBER	0312150003SA			0312150008SA			0314040013SA			0312780007SA		
COLLECT DATE	09/14/93			09/14/93			09/14/93			09/14/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Barium	97.6	1.1		116	1.1					98.6	1.2	
Beryllium	0.44	0.23		0.49	0.22					0.62	0.23	
Cadmium	<	0.57	U	1.4	0.54					<	0.58	U
Calcium	18300	22.7		29200	21.8					11100	23.1	
Chromium	7.4	1.1		14	1.1					8.9	1.2	
Cobalt	3.6	1.1		3	1.1					4	1.2	
Copper	7.2	2.3		14.9	2.2					7.4	2.3	
Iron	7300	11.4		7400	10.9					9210	11.6	
Lead	18.6	5.7		251	27.2					10.2	1.2	
Magnesium	1610	22.7		1870	21.8					1850	23.1	
Manganese	159	1.1		167	1.1					204	1.2	J
Nickel	7.3	4.5		7.1	4.4					8.9	4.6	
Potassium	1370	568		1820	544					1730	578	
Silver	<	1.1	U	<	1.1	U				<	1.2	J
Sodium	<	568	UJ	<	544	UJ				<		R
Thallium	<	0.57	U	<	0.54	U				<	0.58	U
Vanadium	16.3	1.1		16.5	1.1					18.8	1.2	
Zinc	17.6	2.3		51.8	2.2					20.9	2.3	
TPH (mg/kg)												
Total Petroleum Hydrocarbons	8350	454		7680	1090					72.4	46.2	
Water Quality (percent)												
Water	12	0.1		8.1	0.1		8.2	0.1		13	0.1	

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R = Rejected value. D = Sample was diluted for analysis.
U = Nondetected value. RL = Reporting Limit.

TABLE 12-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 70

LOCATOR	CAN070-0701-0004			CAN070-0701-0008			CAN070-0701-0018			CAN070-0701-0028			CAN070-0701-0038			CAN070-0701-0048		
LAB SAMPLE NUMBER	0314030003SA			0314030004SA			0314030005SA			0314030006SA			0314030007SA			0314030008SA		
COLLECT DATE	09/23/93			09/23/93			09/23/93			09/23/93			09/23/93			09/23/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)																		
Benzene	<	5.8	U	2100	6000	J	<	2900	U	<	5700	U	<	5700	U	<	1900	U
Ethylbenzene	<	5.8	U	13000	6000		7200	2900		25000	5700		12000	5700		7600	1900	
Toluene	<	5.8	U	12000	6000		840	2900	J	9900	5700		7500	5700		3400	1900	
Xylenes (total)	<	5.8	U	56000	6000		27000	2900		93000	5700		56000	5700		39000	1900	
Semivolatile Organics (ug/kg)																		
2-Methylnaphthalene																		
Naphthalene																		
Metals (mg/kg)																		
Aluminum	11600	11.5		5970	12		10100	23		9160	11.4		5500	11.4		7040	11.4	
Antimony	13	6.9		<	7.2	U	14.3	13.8		6.8	6.8		8.3	6.8		8	6.8	
Arsenic	2.6	0.58		2	0.6		2.4	0.58		2.4	0.57		1.2	0.57		1.6	0.57	
Barium	87.7	1.2		116	1.2		629	2.3		144	1.1		161	1.1		183	1.1	
Beryllium	0.64	0.23		0.24	0.24		0.49	0.46		0.58	0.23		0.17	0.23	J	0.22	0.23	J
Cadmium	<	0.58	U	<	0.6	U	<	1.2	U	<	0.57	U	<	0.57	U	<	0.57	U
Calcium	43700	23		31500	24		135000	46.1		49200	22.7		33400	22.7		28200	22.8	
Chromium	9.4	1.2		5.9	1.2		4.5	2.3		6.3	1.1		3.9	1.1		6.6	1.1	
Cobalt	4.5	1.2		3	1.2		3	2.3		3.3	1.1		1.3	1.1		2.2	1.1	
Copper	8.7	2.3		4.9	2.4		5.7	4.6		4.8	2.3		2.1	2.3	J	3.3	2.3	
Iron	10200	11.5		6130	12		7270	23		7260	11.4		4410	11.4		5510	11.4	
Lead	12.7	1.2		13.6	1.2		6.3	1.2		6.6	0.57		3.7	0.57		4.9	0.57	
Magnesium	2810	23		1450	24		5600	46.1		5110	22.7		5840	22.7		6070	22.8	

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U = Nondetected value. RL = Reporting Limit.

TABLE 12-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 70

LOCATOR	CAN070-0701-0004			CAN070-0701-0008			CAN070-0701-0018			CAN070-0701-0028			CAN070-0701-0038			CAN070-0701-0048		
LAB SAMPLE NUMBER	0314030003SA			0314030004SA			0314030005SA			0314030006SA			0314030007SA			0314030008SA		
COLLECT DATE	09/23/93			09/23/93			09/23/93			09/23/93			09/23/93			09/23/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Manganese	242	1.2		145	1.2		99.4	2.3		68.9	1.1		48.5	1.1		59.3	1.1	
Mercury	<	0.12	U	<	0.12	U	<	0.12	U	<	0.11	U	<	0.11	U	<	0.11	U
Nickel	11.1	4.6		7.1	4.8		8.7	9.2	J	7.5	4.5		4.2	4.5	JJ	6.1	4.6	
Potassium	2040	575		1150	601		2780	1150		2650	569		1190	568		1620	569	
Silver	<	1.2	U	<	1.2	U	<	2.3	U	<	1.1	U	<	1.1	U	<	1.1	U
Sodium	<	575	U	<	601	U	<	1150	U	<	569	U	<	568	U	<	569	U
Thallium	0.13	0.58	J	<	0.6	UJ	<	1.2	U	<	0.57	U	<	0.57	U	<	0.57	U
Vanadium	20.2	1.2		15.1	1.2		18	2.3		22	1.1		16.5	1.1		19.6	1.1	
Zinc	25.2	2.3		16.4	2.4		18.4	4.6		17.7	2.3		8.3	2.3		11.2	2.3	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	<	46	U	6140	481		5040	461		7040	2270		3140	454		3790	455	
Water Quality (percent)																		
Water	13	0.1		17	0.1		13	0.1		12	0.1		12	0.1		12	0.1	

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R = Rejected value. D = Sample was diluted for analysis.
U = Nondetected value. RL = Reporting Limit.

TABLE 12-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 70

LOCATOR	CAN070-0701-0058			CAN070-0702-0004			CAN070-0702-0008			CAN070-0702-0018			CAN070-0704-0004			CAN070-0704-0008		
LAB SAMPLE NUMBER	0314040001SA			0314040004SA			0314040005SA			0314040006SA			0312150004SA			0312150005SA		
COLLECT DATE	09/24/93			09/24/93			09/24/93			09/24/93			09/14/93			09/14/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)																		
Benzene	<	5600	U	75000	61000		<	15000	U	<	12000	U	<	58	U	<	5.8	U
Ethylbenzene	19000	5600		340000	61000		74000	15000		33000	12000		<	58	U	<	5.8	U
Toluene	9500	5600		510000	61000		79000	15000		22000	12000		<	58	U	<	5.8	U
Xylenes (total)	130000	5600		890000	61000		260000	15000		160000	12000		50	58	JJ	<	5.8	U
Semivolatile Organics (ug/kg)																		
2-Methylnaphthalene							39000	80000	J				5700	38000	J			
Naphthalene							24000	80000	J				<	38000	U			
Metals (mg/kg)																		
Aluminum	3900	11.2		6180	12.2		6430	12.1		4970	11.9		7330	11.6		6520	11.6	
Antimony	<	6.7	U	<	7.3	U	<	7.3	U	<	7.1	U	<	7	U	<	7	U
Arsenic	1.1	0.56		2.2	0.61		2.1	0.61		4.3	0.59		2.6	0.58		2.4	0.58	
Barium	98.4	1.1	J	118	1.2	J	148	1.2	J	110	1.2		148	1.2		250	1.2	
Beryllium	0.19	0.22	J	0.51	0.24		0.54	0.24		0.43	0.24		0.52	0.23		0.45	0.23	
Cadmium	1.4	0.56		<	0.61	U	1.2	0.61		0.73	0.59		<	0.58	U	<	0.58	U
Calcium	69300	22.5		20800	24.4		84600	24.2		54700	23.8		23500	23.2		61900	23.2	
Chromium	2.8	1.1		7.3	1.2		6.4	1.2		5.6	1.2		7.7	1.2		6.3	1.2	
Cobalt	1.2	1.1		3.2	1.2		2.4	1.2		2.5	1.2		3.9	1.2		3.5	1.2	
Copper	2.1	2.2	J	9.5	2.4		7.3	2.4		4.4	2.4		7.2	2.3		6	2.3	
Iron	3110	11.2		6440	12.2		5320	12.1		5030	11.9		7570	11.6		6830	11.6	
Lead	2.8	0.56		23.9	3		8.7	1.2		8.4	1.2		14.4	2.9		10.2	5.8	
Magnesium	4450	22.5		1640	24.4		2340	24.2		2390	23.8		1750	23.2		2320	23.2	

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TABLE 12-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 70

LOCATOR	CAN070-0701-0058			CAN070-0702-0004			CAN070-0702-0008			CAN070-0702-0018			CAN070-0704-0004			CAN070-0704-0008		
LAB SAMPLE NUMBER	0314040001SA			0314040004SA			0314040005SA			0314040006SA			0312150004SA			0312150005SA		
COLLECT DATE	09/24/93			09/24/93			09/24/93			09/24/93			09/14/93			09/14/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Manganese	<		R	<		R	<		R	66.8	1.2		168	1.2		164	1.2	
Mercury	<	0.11	U	<	0.12	U	<	0.12	U	<	0.12	U	<	0.12	U	<	0.12	U
Nickel	3.2	4.5	J	6.8	4.9		6.6	4.8		6	4.8		8	4.6		7.9	4.6	
Potassium	787	562		1440	610		1340	606		1980	595		1400	581		1320	580	
Silver	0.92	1.1	J	0.54	1.2	J	0.63	1.2	J	0.69	1.2	J	<	1.2	U	<	1.2	U
Sodium	190	562	J	<	610	U	366	606	J	359	595	J	<	581	UJ	<	580	UJ
Thallium	<	1.1	J	0.12	0.61	J	<	1.2	U	<	0.59	U	<	0.58	U	<	0.58	UJ
Vanadium	16.6	1.1		18.5	1.2		19	1.2		15.5	1.2		17.5	1.2		17.1	1.2	
Zinc	7.7	2.2		18.5	2.4		16.5	2.4		13.6	2.4		19.2	2.3		16.1	2.3	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	5710	450		19200	2440		7580	485		6970	476		8470	465		8570	464	
Water Quality (percent)																		
Water	11	0.1		18	0.1		17	0.1		16	0.1		14	0.1		14	0.1	

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TABLE 12-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 70

LOCATOR	CAN070-0704-0013			CAN070-0704-0018			CAN070-0705-0004			CAN070-0705-0008			CAN070-0705-0013			CAN070-0705-0018		
LAB SAMPLE NUMBER	0312150006SA			0312150007SA			0312780008SA			0312780009SA			0312780010SA			0312780011SA		
COLLECT DATE	09/14/93			09/14/93			09/14/93			09/14/93			09/14/93			09/14/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)																		
Benzene	<	560	U	<	12000	U	<	570	U	26000	25000		<	24000	U	<	12000	U
Ethylbenzene	1100	560		28000	12000		<	570	U	240000	25000		45000	24000		<	16000	U
Toluene	<	560	U	<	12000	U	<	570	U	300000	25000		49000	24000		16000	12000	
Xylenes (total)	6700	560		150000	12000		<	570	U	590000	25000		190000	24000		110000	12000	
Semivolatile Organics (ug/kg)																		
2-Methylnaphthalene																		
Naphthalene																		
Metals (mg/kg)																		
Aluminum	4180	22.5		5930	23		7940	11.3		5930	12.3		6010	12.1		6500	11.5	
Antimony	<	13.5	U	<	13.8	U	<	6.8	U	<	7.4	U	<	7.3	U	<	6.9	U
Arsenic	1.8	0.56		2.1	0.58		2.8	0.57		1.1	0.62		1.8	0.61		1.6	0.58	
Barium	221	2.3		285	2.3		131	1.1		90.3	1.2		72.9	1.2		208	1.2	
Beryllium	0.31	0.45	J	0.39	0.46	J	0.6	0.23		0.51	0.25		0.41	0.24		0.49	0.23	
Cadmium	<	1.1	U	<	1.2	U	0.48	0.57	J	<	0.62	U	<	0.61	U	<	0.58	U
Calcium	128000	45.1		121000	46		20600	22.6		68600	24.7		58800	24.2		83300	23	
Chromium	1.9	2.3	J	4	2.3		8.2	1.1		6.5	1.2		5.5	1.2		5	1.2	
Cobalt	2.6	2.3		2.6	2.3		3.5	1.1		2.7	1.2		2.5	1.2		2.5	1.2	
Copper	2.6	4.5	J	4.2	4.6	J	8	2.3		5.4	2.5		4.9	2.4		3.9	2.3	
Iron	3970	22.5		4950	23		7860	11.3		4550	12.3		4370	12.1		4970	11.5	
Lead	6.1	2.8		6.4	0.58		38.7	11.3		18.4	3.1		19.1	3		7.5	0.58	
Magnesium	3200	45.1		4510	46		1860	22.6		2300	24.7		2330	24.2		2960	23	

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TABLE 12-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 70

LOCATOR	CAN070-0704-0013			CAN070-0704-0018			CAN070-0705-0004			CAN070-0705-0008			CAN070-0705-0013			CAN070-0705-0018		
LAB SAMPLE NUMBER	0312150006SA			0312150007SA			0312780008SA			0312780009SA			0312780010SA			0312780011SA		
COLLECT DATE	09/14/93			09/14/93			09/14/93			09/14/93			09/14/93			09/14/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Manganese	51	2.3		61.7	2.3		162	1.1	J	66.4	1.2	J	53.9	1.2	J	72.9	1.2	J
Mercury	<	0.11	U	<	0.12	U	<	0.11	U	<	0.12	U	0.12	0.12		<	0.12	U
Nickel	5.3	9	J	6	9.2	JJ	8.1	4.5		6.1	4.9		5.1	4.8		5.2	4.6	
Potassium	1150	1130		1930	1150		1660	565		1440	616		1600	606		1940	575	
Silver	<	2.3	U	<	2.3	U	<	1.1	UJ	<	1.2	UJ	<	1.2	UJ	<	1.2	UJ
Sodium	<	1130	UJ	<	1150	UJ	<		R	<		R	<		R	<		R
Thallium	<	1.1	UJ	<	1.2	UJ	<	0.57	UJ	<	1.2	UJ	<	1.2	UJ	<	1.2	UJ
Vanadium	14	2.3		13.2	2.3		18.6	1.1		19.5	1.2		14.8	1.2		12.4	1.2	
Zinc	9.2	4.5		11.9	4.6		21.2	2.3		17.4	2.5		19.9	2.4		13.4	2.3	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	8370	451		9980	1150		2100	226		28900	2470		15500	1210		10200	1150	
Water Quality (percent)																		
Water	11	0.1		13	0.1		12	0.1		19	0.1		17	0.1		13	0.1	

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TABLE 12-3

COMPARISON OF MAXIMUM DETECTED METAL CONCENTRATIONS TO BACKGROUND (1)
SWMU 70, CANNON AFB

Oil/Water Separator No. 326 and Leach Field

Sample ID	Metal	Maximum detected concentration	Range of background concentrations (2)	Upper tolerance limit (UTL) background concentration (3)	Does maximum detected exceed UTL background
CAN070-0701-0004	Aluminum	11600	1410 - 11,000	10,540	Y
CAN070-0701-0018	Antimony	14.3	<5 - <13	*	Y
CAN070-0702-0018	Arsenic	4.3	0.67 - 28	15.5	N
CAN070-0701-0018	Barium	629	14.5 - 1200	642	N
CAN070-0701-0004	Beryllium	0.64	0.17 - 0.77	0.73	N
CAN070-0701-0058	Cadmium	1.4	<0.51 - 4.2	*	Y
CAN070-0702-0000	Chromium	11.4	4 - 15.4	12.5	N
CAN070-0701-0002	Cobalt	5	0.85 - 5.3	4.5	Y
CAN070-0702-0004	Copper	9.5	<2 - 18.4	*	Y
CAN070-0701-0000	Lead	45.2	1.1 - 46	25.8	Y
CAN070-0705-0013	Mercury	0.12	<0.1 - <0.12	*	Y
CAN070-0701-0002	Nickel	0.0112	1.3 - 9.8	9	N
CAN070-0701-0058	Silver	0.92	0.51 - 0.93	*	Y
CAN070-0701-0002	Thallium	0.15	0.14 - <0.23	*	Y
CAN070-0701-0002	Vanadium	23.6	5.2 - 28.3	25.3	N
CAN070-0701-0000	Zinc	29.2	<4.3 - 27.5	21.9	Y

(1) All units in mg/kg.
(2) Compiled from data collected by Woodward Clyde for the RFI and RI (WCC 1992 and WCC 1993) and Walk Haydel and Associates for the IRP (Walk, Haydel and Associates 1990).
Summarized in "Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater at Cannon AFB, NM (WCC 1993)
(3) Upper Tolerance Limit (UTL) of the mean = mean + 2*standard deviation. This is for all practicle purposes the same as the 90% upper confidence limit of the 95th percentile where UTL = mean + standard deviation *k, where k=2.02 for n=37 .
* Data insufficient to calculate UTL of background concentration

TABLE 12-4

COMPARISON OF MAXIMUM CONCENTRATIONS WITH RBCs (1)
SWMU 70, CANNON AFB

Oil/Water Separator No. 326 and Leach Field

Sample ID	Analyte	Maximum Detected	RBC (2)	Maximum Detected Exceed RBC
CAN070-0702-0008	2-Methylnaphthalene	39	NTF	N
CAN070-0701-0004	Aluminum	11600	NTF	N
CAN070-0702-0000	Anthracene	0.053	2000	N
CAN070-0701-0018	Antimony	14.3	3	Y
CAN070-0702-0004	Benzene	75	2	Y
CAN070-0702-0000	Benzo(a)anthracene	0.32	0.07	Y
CAN070-0702-0000	Benzo(a)pyrene	0.29	0.01	Y
CAN070-0702-0000	Benzo(b)fluoranthene	0.54	0.07	Y
CAN070-0702-0000	Benzo(g,h,i)perylene	0.14	NTF	N
CAN070-0701-0058	Cadmium	1.4	8	N
CAN070-0702-0000	Carbazole	0.055	4	N
CAN070-0702-0000	Chrysene	0.46	2	N
CAN070-0701-0002	Cobalt	5	NTF	N
CAN080-0702-0004	Copper	9.5	300	N
CAN070-0702-0004	Ethylbenzene	340	800	N
CAN070-0702-0000	Fluoranthene	0.76	300	N
CAN070-0702-0000	Indeno(1,2,3-cd)pyrene	0.14	0.04	Y
CAN070-0701-0000	Lead (3)	45.2	500	N
CAN070-0705-0013	Mercury	0.12	2	N
CAN070-0702-0004	Methylene chloride	45	9	Y
CAN070-0702-0008	Naphthalene	11.2	300	N
CAN070-0702-0000	Phenanthrene	0.41	NTF	N
CAN070-0702-0000	Pyrene	0.87	200	N
CAN070-0058	Silver	0.92	20	N
CAN070-0701-0002	Thallium	0.15	6	N
CAN070-0702-0004	Toluene	510	2000	N
CAN070-0705-0008	Total Petroleum Hydrocarbons (4)	28900	1000	Y
CAN070-0702-0004	Xylenes (total)	890	20000	N
CAN070-0701-0000	Zinc	29.2	2000	N

NTF = No EPA Established Toxicity Factor

(1) All units in mg/kg

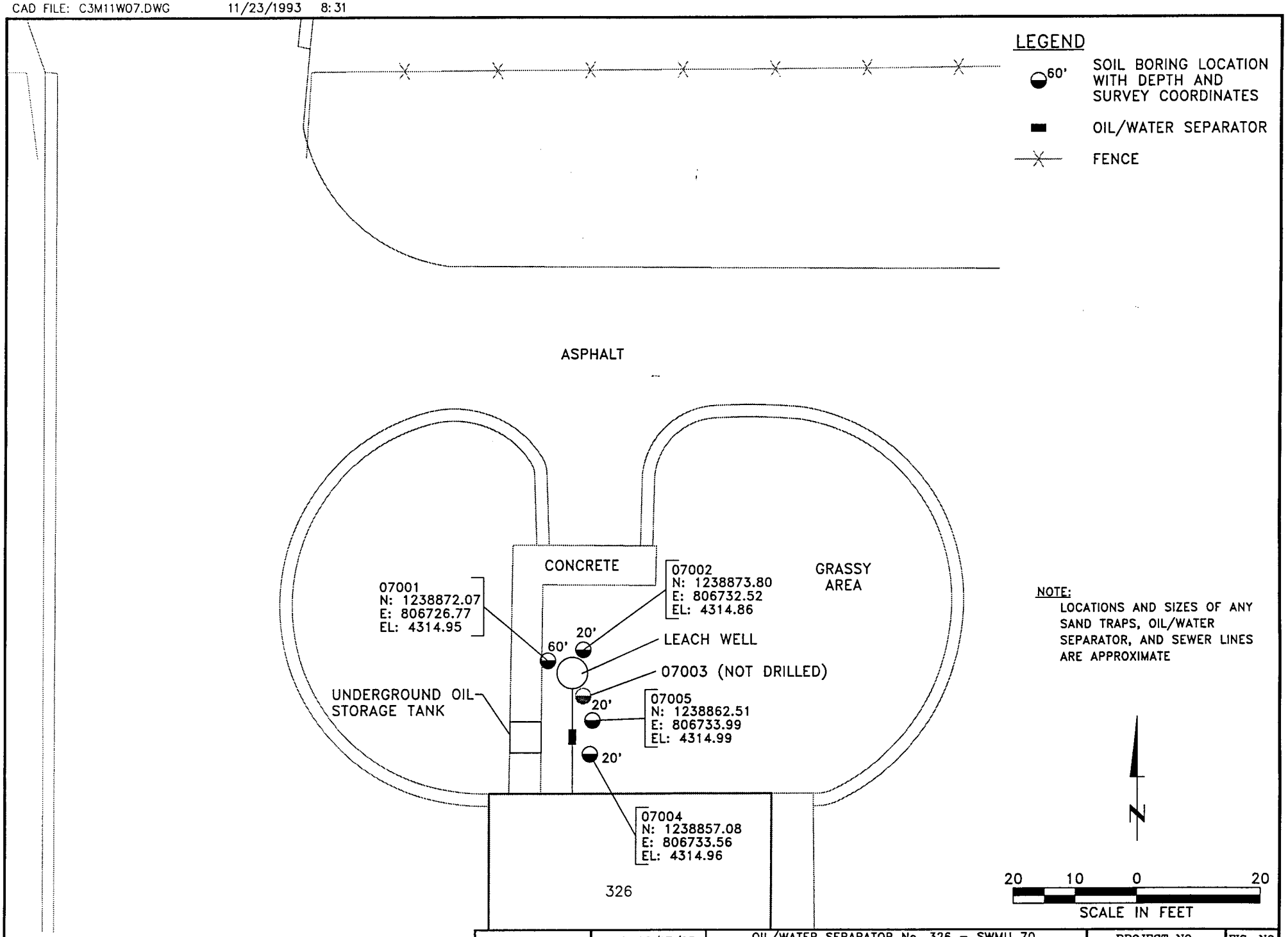
(2) Risk-based concentration

(3) EPA suggests 500-1,000 mg/kg as allowable concentration for residential soils based on EPA's IUBK Lead Model (EPA 1990)

(4) New Mexico recommended soil cleanup level for fuel contaminated soil.

Note: Only metals that exceeded background appear in this table.

CAD FILE: C3M11W07.DWG 11/23/1993 8:31



SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

DRN BY: CJG	DATE: 08/17/93	OIL/WATER SEPARATOR No. 326 – SWMU 70 SITE PLAN AND BORING LOCATIONS CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W
CHK'D BY:	REVISION: 0		FIG. NO. 12-1

13.1 SITE BACKGROUND

13.1.1 Site Description

OWS 5120 is located in a grassy area east of Power Check Pad No. 5120 (Figure 13-1). The OWS is a two-compartment unit with a detached 100-gallon oil storage tank located south of the OWS. The OWS measures 4 feet by 6 feet at the surface. While the exact depths of the OWS and storage tank are unknown, they are believed to be less than 10-feet below ground level.

13.1.2 Site History

The OWS reportedly received waste wash water generated from aircraft maintenance operations in Building 5120. The oils recovered in the OWS were directed to the 100-gallon oil holding tank and the wastewater was discharged to a leach well located approximately 40 feet east of the OWS. OWS 5120 was active from approximately 1957 to 1988 when Facility 5120 was dismantled. The OWS and leach well remain in place.

13.1.3 Current Use

Pad 5120 is currently used for surface storage of aircraft maintenance vehicles and equipment. The OWS is not actively used.

13.1.4 Potential Contaminants

Potential contaminants at this SWMU include JP-4 fuel, petroleum and synthetic lubricating oils, greases, solvents, and metals.

13.2 FIELD INVESTIGATION AND DATA COLLECTION

13.2.1 Soils Sampling

The objective of sampling at the site of OWS 5120 and the associated leach well is to evaluate whether or not a release of SWMU-related chemicals has occurred due to spillage or leakage from the OWS or seepage from the leach well. Two 10-foot deep borings were drilled as close as possible to the north side of the OWS. Soil samples were collected at the surface and from the 1.5- to 3.5-foot, 4- to 6-foot, and 8- to 10-foot depth intervals as specified in the Field Sampling Plan and the Sample Summary Tables.

Three 60-foot deep borings were located in the vicinity of the leach well vent pipe. Soil samples were collected at the surface and at the 1.5- to 3.5-foot, 4- to 6-foot, 8- to 10-foot, 18- to 20-foot, 28- to 30-foot, 38- to 40-foot, 48- to 50-foot, and 58- to 60-foot depth intervals as specified in the Field Sampling Plan and the Sample Summary Tables.

Samples were collected in accordance with QAPP SOP No. 6 - Surface Soil Sampling and QAPP SOP No. 7 - Subsurface Drilling and Sampling. Target analytes for all borings include VOCs, SVOCs, metals and TRPH. Surficial samples were collected approximately at the 0.2 to 0.5-foot depth interval in areas of soil cover to provide a worst-case situation for risk assessment purposes in the event that SVOC contamination was discovered during this investigation.

13.2.2 Geologic Summary of Boring Logs

Soils in the area of the leach well consist of a sandy silt/sandy clay soil, reddish-brown to brown with white, calcareous, patches and streaks. Reworking of the shallow soils in the area of the leach well is indicated by an abandoned asphalt road nearby and occasional pieces of asphalt at a depth of 2 to 3 feet. A 1- to 2-foot interval of apparent gravel up to 3 inches in diameter was encountered in the borings around the leach well at the 6- to 8-foot depth interval and may represent the leach well itself. Additional silt/sandy clay was encountered below the gravels to a depth of approximately 28 feet. This unit is reddish-pink to salmon colored with white to tan mottling and localized zones of slightly coarser grains. It is dry to moist and appears to be calcareous. Fine- to medium-grained, dry reddish to salmon pink

sand with silt and calcareous cement is encountered from 28 to 60-feet below ground surface. Local zones of tightly cemented, dense white to tan caliche, are encountered often from approximately 47 to 60 feet in depth.

Boring logs from the borings in the OWS area indicate a similar soil profile, with more intense mottling and no mention of encountering river gravels. Considering the close proximity of these borings to the OWS, the soils described above are possibly native soils backfilled during construction of the facility.

No visual indications of soil contamination were encountered in any of the borings drilled in this SWMU.

13.2.3 Site Topography

The topography of this site is essentially flat, with evidence of surface improvements, such as grading and reseeding, visible on the ground surface.

13.3 CHEMICAL INVESTIGATION RESULTS

13.3.1 General

Samples were collected as identified in Section 13.2 to comply with permit and compliance agreement requirements. Soil samples were collected from 5 borings (09201, 09202, 09203, 09204, and 09205). Sampling and analyses performed are summarized in Table 13-1. A summary of the analytical results for these soil samples are provided in Tables 13-2a for near-surface soils and Table 13-2b for subsurface soils. For each sample type, the tables provide results for analytes only if they were detected at least once in this type of sample collected at the SWMU. Complete analytical summary results are provided in the QCSR (Appendix A).

13.3.2 Organic Results For Near-surface Soil Samples

The near-surface soil samples collected at this SWMU (CAN092-0921-0000, CAN092-0921-0002, CAN092-0921-0004, CAN092-0922-0000, CAN092-0922-0002, CAN092-0922-0004, CAN092-0923-0000, CAN092-0923-0002, CAN092-0923-0004, CAN092-0924-0000, CAN092-0924-0002, CAN092-0924-0004, CAN092-0925-0000, CAN092-0925-0002 and CAN092-0925-0004) were analyzed for VOCs, SVOCs, metals and TPH as indicated in Table 13-1.

Other than acetone and methylene chloride, which were qualified nondetected after they were determined to be laboratory contaminants (see Section 4.8.4 of the QCSR), four VOC reported as detected in associated samples were ethylbenzene, 1,2-dichloroethane, toluene and xylene. Toluene was detected in samples CAN092-0922-0002, CAN092-0925-0002, CAN092-0294-0000, CAN092-0925-0004, CAN092-0925-0000, CAN092-0921-0000 and CAN092-0922-0004 at 1.1 μg/kg, 1.5 μg/kg, 1.6 μg/kg, 3.6 μg/kg, 4.9 μg/kg, 7.5 μg/kg and 28 μg/kg, respectively. Xylene was detected in samples CAN092-0923-0000, CAN092-0922-0002, CAN092-0923-0002, CAN092-0924-0000, CAN092-0925-0004, CAN092-0925-0000 and CAN092-0921-0000 at 1.4 μg/kg, 1.6 μg/kg, 1.7 μg/kg, 2.5 μg/kg, 2.7 μg/kg, 5.3 μg/kg and 7.2 μg/kg, respectively. In sample CAN092-0925-0000 1.3 μg/kg of 1,2-dichloroethane was detected. Ethylbenzene was detected at 1.5 μg/kg in sample CAN092-0921-0000.

Other than bis(2-ethylhexyl)phthalate and di-n-butylphthalate which were considered common laboratory contaminants, results reported for SVOCs were primarily polycyclic aromatic hydrocarbons (PAHs). Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene and pyrene were detected in four sample from SWMU 92. Summing PAH concentrations, for samples CAN092-0925-0000, CAN092-0922-0000, CAN092-0923-0000 and CAN092-0924-0000 the total PAH concentration were 8400 μg/kg, 1820 μg/kg, 2510 μg/kg and 5230 μg/kg, respectively. Anthracene, another PAH, was detected in only sample CAN092-0924-0004 at a concentration of 37 μg/kg. Besides the PAHs and laboratory contaminants butyl benzyl phthalate and carbazole. Butyl benzyl phthalate was detected in samples CAN092-0923-0000 and CAN092-0922-0000 at 110 and 140 μg/kg, respectively.

Carbazole was detected in samples CAN092-0924-0000 and CAN092-0925-0000 at 38 μg/kg and 89 μg/kg, respectively. Petroleum hydrocarbons were detected in twelve of the fifteen near-surface samples with a concentration range of 44.8 mg/kg for sample CAN092-0924-0004 to 674 mg/kg for sample CAN092-0921-0000.

13.3.3 Organic Results For Subsurface Soil Samples

The subsurface soil samples collected at this SWMU (CAN092-0921-0008, CAN092-0921-0018, CAN092-0921-0028, CAN092-0921-0038, CAN092-0921-0048, CAN092-0921-0058, CAN092-0922-0008, CAN092-0923-0008, CAN092-0924-0008, CAN092-0924-0018, CAN092-0924-0028, CAN092-0924-0038, CAN092-0924-0048, CAN092-0924-0058, CAN092-0925-0008, CAN092-0925-0018, CAN092-0925-0028, CAN092-0925-0038, CAN092-0925-0048 and CAN092-0925-0058) were analyzed for VOCs, metals and TPH as indicated in Table 13-1. Other than acetone and methylene chloride which are considered common laboratory contaminants, the only VOC detected in subsurface samples was toluene. Toluene was detected in samples CAN092-0921-0008, CAN092-0921-0048, CAN092-0921-0028 and CAN092-0921-0038 at 1.8 μg/kg, 2.8 μg/kg, 3.3 μg/kg and 4.1 μg/kg. Petroleum hydrocarbons were not detected in any of the associated subsurface samples.

13.3.4 Inorganic Results

Metals analyses were performed on samples collected from this SWMU as indicated in Table 13-1. The range of results for metals reported in these soil samples are summarized in Table 13-A.

TABLE 13-A

Analyte	Frequency Reported	Lowest Detection	Sample Location	Highest Detection	Sample Location
Aluminum	35/35	1890 mg/kg	0921-0058	8470 mg/kg	0922-0004
Antimony	6/35	5.3 mg/kg	0924-0002	12.2 mg/kg	0924-0008
Arsenic	34/35	0.31 mg/kg	0921-0058	2.7 mg/kg	0924-0000
Barium**	22/35	28.9 mg/kg	0925-0058	391 mg/kg	0925-0018
Beryllium	7/35	0.14 mg/kg	0925-0058	0.63 mg/kg	0922-0002
Cadmium	19/35	0.44 mg/kg	0924-0000	2.3 mg/kg	0921-0048
Calcium	35/35	6450 mg/kg	0922-0002	162,000 mg/kg	0921-0048
Chromium	31/35	1.3 mg/kg	0921-0038	13.9 mg/kg	0925-0000
Cobalt	32/35	0.58 mg/kg	0925-0038	4.5 mg/kg	0922-0002
Copper	35/35	1.2 mg/kg	0921-0038 0921-0058 0925-0038 0925-0058	14.2 mg/kg	0921-0000
Iron	35/35	1280 mg/kg	0921-0048	12,000 mg/kg	0922-0000
Lead	35/35	1.3 mg/kg	0924-0058	502 mg/kg	0921-0000
Magnesium	35/35	1470 mg/kg	0923-0000	12,600 mg/kg	0921-0048
Manganese	35/35	18.8 mg/kg	0924-0038	216 mg/kg	0921-0000
Mercury	0/35	--	--	--	--
Nickel	34/35	1.6 mg/kg	0921-0058	8.5 mg/kg	0923-0000
Potassium	35/35	221 mg/kg	0921-0048	1740 mg/kg	0925-0000
Selenium	0/35	--	--	--	--
Silver	18/35	0.41 mg/kg	0925-0048	2.3 mg/kg	0925-0008
Sodium	1/35	164 mg/kg	0921-0004	(Only detection)	
Thallium	0/35	--	--	--	--
Vanadium	35/35	5.3 mg/kg	0921-0038	18.8 mg/kg	0924-0028
Zinc	35/35	3.3 mg/kg	0921-0048	72.6 mg/kg	0922-0000

Note: See Table 13-3 for comparison to background.

**Barium results were rejected for the following samples: CAN092-0925-0004, CAN092-0925-0008, CAN092-0925-0000, CAN092-0925-0002, CAN092-0921-0000, CAN092-0921-0002, CAN092-0921-0004, CAN092-0921-0008, CAN 092-0921-0018, CAN092-0921-0028, CAN092-0921-0038, CAN092-0921-0048 and CAN092-0921-0058.

13.4 SWMU-SPECIFIC DATA ASSESSMENT

13.4.1 General

This assessment of OWS No. 5120 data is an evaluation of quality issues that could affect the major data uses. In general, the objective of the RFI was identification and quantification of the nature and extent of the contamination, which was necessary to meet permit and compliance agreement requirements, and to support an evaluation of the risk to human health and the environment.

13.4.2 Sampling Issues

A review of the data contained in the log books and the Daily Quality Control Reports (DQCR) for SWMU 92 indicate that there were no sampling issues that would impact data usability. QC issues are discussed in detail in the QCSR in Appendix A, and copies of the DQCRs are included in that appendix.

13.4.3 Data Review Issues

This comparison of maximum detected concentrations to RBCs is very conservative (health-protective) and actual impacts are likely to be lower than those suggested by exceedances of conservative criteria. For example, maximum detected concentrations are likely to overestimate actual concentrations to which people would be exposed. Furthermore, the screening criteria are based on highly conservative residential exposure assumptions and target risk levels that may not be pertinent to current or future use of the SWMU. The RBCs used in this evaluation are calculated using RCRA Action Level methodology; however, the RBCs are more health-protective than conventional RCRA Action Levels because a target excess cancer risk level of 1×10^{-7} (1 in 10,000,000) and a hazard quotient of 0.1 were used to account for exposures to multiple chemicals and for exposure routes other than soil ingestion. Conventional RCRA Action Levels are calculated based on a cancer risk of 1×10^{-6} and a noncancer hazard of 1.0.

For laboratory analytical data, QA/QC objectives were specified in the Cannon AFB QAPP (W-C 1993). The objectives were used as indicators of the quality necessary to support identification and quantitation of potential chemicals of concern. The data review is presented in Section 4.8 of the Quality Control Summary Report (QCSR) located in Appendix A. As presented in the QCSR, data for the analytes antimony, barium, manganese, selenium, thallium, zinc, iron and chromium were qualified as estimated concentrations, and barium data were qualified reject in thirteen of the thirty-six samples analyzed.

Selenium and thallium data were qualified estimated to indicate a potential low bias. When a low bias is indicated, actual concentrations may be higher than the reported results. Use of this data in risk assessment may underestimate risk. Zinc, iron, chromium, lead, and antimony data were qualified estimated to indicate due to precision that did not meet the

QA\QC criteria defined for this project. Poor precision could be attributed to errors in sampling and analysis; however, since the other analytes which were sampled and analyzed in the same procedure (Method 6010) met QA/QC criteria, this variation is likely due to sample heterogeneity. The concentration of arsenic, four VOCs and nine SVOCs were qualified estimated because the analytes were detected and reported below detection limits.

For ICP metals analyses, the only indicator of data accuracy of data accuracy is the results of the matrix spike. Detected barium data were rejected based on a MS recovery greater than 200% for thirteen of the samples associated with SWMU 92. Because the accuracy criteria have been exceeded, it can not be determined whether the identification of manganese can be relied upon; therefore, the data were rejected.

The uncertainty in the actual concentration reported for estimated data does not affect the usability of the data for identification of chemicals in characterizing the nature and extent of contamination at this SWMU.

13.4.4 Limitations

Elevated reporting limits may limit the usability of the data due to low level analytes being diluted to below the instrument detection limits. That is, chemicals may be reported as nondetect when they are actually present in a sample at low levels. Section 4.8.6 of the QCSR (Appendix A) presents a discussion of elevated reporting limits. Lead analyses for samples CAN092-0922-0000, CAN092-0925-0000, and CAN092-0921-0000 required dilutions of 10 times, 10 times and 100 times, respectively. The elevated reporting limits for lead were not considered to limit the usability of the data because lead was detected above the elevated reporting limit in all the samples.

13.4.5 Summary

Overall, data generated during the study of SWMU 92 were determined to meet quality criteria. In conjunction with the analytical data review, other information including field observations were evaluated in the assessment of the usability of SWMU 92 data. The data support identification of the nature and extent of contamination and provide reasonable concentration for use in risk assessment.

13.5 NATURE AND EXTENT OF CONTAMINATION

SWMU 92 is an OWS with a leach well formerly serving Building 5120 (aircraft maintenance operations) in the engine test area. Two borings were advanced to a depth of 10 feet in close proximity to the separator, and three borings were advanced to the depth of 60 feet adjacent to the leach well. In general the samples appeared relatively free of organic contamination. There was no visible evidence of spills or leaks in the vicinity, and the entire area around the separator was unpaved. The chemical test results show low levels of organic contamination, including PAHs and slightly elevated lead levels.

13.6 COMPARISON OF METALS CONCENTRATIONS TO BACKGROUND

Results of the comparison of metal concentration in soil to background levels for SWMU 92 are given in Table 13-3. A summary of the results of the comparison is presented here.

Metals are natural constituents of soils. SWMU concentrations of metal were evaluated to assess whether the metals in environmental samples exceed background levels. Metals that occur in concentrations within background levels are not considered SWMU-related chemicals of concern and are not evaluated further.

The maximum concentration of each detected metal at each SWMU was compared to the upper tolerance limit of the background data. The upper tolerance limit (UTL) was defined as the mean plus two times the standard deviation. This is for all practical purposes equal to the 90% upper confidence limit of the 95th percentile which is equal to the mean plus the standard deviation times the k statistic. The background data set used consisted of 37 data points (WCC 1993), so the k statistic equals 2.02 (Gilbert 1987).

The maximum detected concentrations of cadmium, chromium, copper, lead, silver and zinc exceeded the (UTL) of the background data. Therefore, these metals will be compared to risk-based concentrations at SWMU 92.

13.7 RISK SCREENING

13.7.1 Exposure Pathway Flow Chart

The Preliminary Exposure Pathway Flow Chart (EPFC) applicable to SWMU 92, OWS No. 5120, is shown in Figure 3-2. It shows that the potential exposure pathways are ingestion of soil, inhalation of soil particulates, dermal exposure to contaminated soil, inhalation of airborne chemicals released from soil, and ingestion, inhalation, and dermal exposure to groundwater (if drinking water supplies were affected). Storm water runoff is considered to be an insignificant pathway because potential spills would be minor and over a small area.

13.7.2 Screening of Contaminants Against RBCs and Other Criteria

Maximum detected concentrations of organic compounds and metals that exceeded background were compared to screening-level RBCs (see Section 3.4.5.1 for derivations of RBCs) and other screening criteria in Table 13-4. Screening-level criteria other than RBCs include the state of New Mexico's TPH clean-up level of 1,000 mg/kg (New Mexico Environmental Improvement Board 1993) and the EPA's recommended soil lead level of 500 mg/kg (EPA 1990). The TPH soil clean-up concentration of 1,000 mg/kg is not an RBC, nor is it a relevant-and-applicable standard for the SWMUs in this investigation. Rather it is a conservative value originally derived for the cleanup of fuel-contaminated soils at underground storage tank sites. Risk-based concentrations for TPH, measured as fresh fuels (e.g., gasoline or diesel), are at least an order of magnitude higher for occupational exposures. The concentration of 500 mg/kg is the most conservative concentration in the recommended range of 500 mg/kg to 1,000 mg/kg as a lead level in residential soil based on EPA's Uptake Biokinetic Model (EPA 1990). Compounds with no toxicity factors cannot be evaluated in the risk screening since RBCs cannot be calculated. These compounds, at the concentrations that were measured in soil, are not likely to significantly affect the results of the comparison to RBCs. The comparison for SWMU 92 shows that maximum detected concentrations of benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene and lead exceed RBCs.

This comparison of maximum detected concentrations to RBCs is very conservative (health-protective) and actual impacts are likely to be lower than those suggested by

exceedances of conservative criteria. For example, maximum detected concentrations are likely to overestimate actual concentrations to which people would be exposed. Furthermore, the screening criteria are based on highly conservative residential exposure assumptions and target risk levels that may not be pertinent to current or future use of the SWMU. The RBCs used in this evaluation are calculated using RCRA Action Level methodology; however, the RBCs are more health-protective than conventional RCRA Action Levels because a target excess cancer risk level of 1×10^{-7} (1 in 10,000,000) and a hazard quotient of 0.1 were used to account for exposures to multiple chemicals and for exposure routes other than soil ingestion. Conventional RCRA Action Levels are calculated based on a cancer risk of 1×10^{-6} and a noncancer hazard of 1.0. The results of the comparison of maximum detected concentrations with screening-level RBCs indicate that it is unlikely that a risk assessment will result in a risk level that will require remedial action (i.e., only a few chemicals slightly exceed the RBCs).

The purpose of the comparison to RBCs health risk evaluation is to determine whether or not chemical releases (characterized by maximum detected concentrations) have occurred at SWMU 92 that could pose potential risks based on conservative health-based criteria. Since maximum concentrations of the above listed chemicals exceed screening level criteria further evaluation or investigation of chemical concentrations and probable exposures is warranted.

13.8 SUMMARY AND RECOMMENDATIONS

Thirty-five soil samples were collected and analyzed from five soil borings at SWMU 92. Maximum detected concentrations were compared to background levels and RBCs. The maximum detected concentrations of four organics and lead exceeded RBCs or other screening-level criteria.

The highest concentrations for the organics were detected in near-surface samples. These concentrations decreased with depth in all cases; therefore, the vertical extent of contamination has been characterized by the borings, and the potential for groundwater beneath SWMU 92 to be impacted can be characterized. The potential for impacts to groundwater is considered to be low because the depth to groundwater is greater than 200 feet, and sampling demonstrates that contaminants are not being transported significantly vertically below the SWMU. Therefore, it is concluded that the available data are sufficient

to complete a Baseline Risk Assessment (BRA). Therefore, a risk assessment is recommended for this SWMU.

TABLE 13-1

SUMMARY OF ANALYTICAL AND QA/QC SAMPLING
OIL/WATER SEPARATOR NO. 5120 (SWMU NO. 92)
CANNON AFB, NEW MEXICO

Sample Location	Target Interval (ft-bgs)	Sample Identification Number	QA/QC Type	Sample Matrix	Analytical Parameters				Sample Containers		
					VOCs	SVOCs	Metals	TRPH	40 ml VOA vials	4 oz. jars	8 oz. jars
Boring 09201	0 - 0.5	CAN092-0921-0000		Soil	X		X	X		2	1
	1.5 - 3.5	CAN092-0921-0002		Soil	X		X	X		2	1
	4 - 6	CAN092-0921-0004		Soil	X		X	X		2	1
	8 - 10	CAN092-0921-0008		Soil	X		X	X		2	1
	8 - 10	CAN092-0921-6008	MS/MSD	Soil	X		X	X		2	2
	18-20	CAN092-0921-0018		Soil	X		X	X		2	1
	28 - 30	CAN092-0921-0028		Soil	X		X	X		2	1
	38 - 40	CAN092-0921-0038		Soil	X		X	X		2	1
	48 - 50	CAN092-0921-0048		Soil	X		X	X		2	1
	58 - 60	CAN092-0921-0058		Soil	X		X	X		2	1
Boring 09202	0 - 0.5	CAN092-0922-0000		Soil	X	X	X	X		2	1
	0 - 0.5	CAN092-0922-9261	FD	Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN092-0922-0002		Soil	X		X	X		2	1
	4 - 6	CAN092-0922-0004		Soil	X		X	X		2	1
	8 - 10	CAN092-0922-0008		Soil	X	Z	X	X		2	1
	8 - 10	CAN092-0922-9201	MRD	Soil	X	X	X	X		2	1
Boring 09203	0 - 0.5	CAN092-0923-0000		Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN092-0923-0002		Soil	X	Z	X	X		2	1
	4 - 6	CAN092-0923-0004		Soil	X		X	X		2	1
	8 - 10	CAN092-0923-0008		Soil	X		X	X		2	1
Boring 09204	0 - 0.5	CAN092-0924-0000		Soil	X	X	X	X		2	1
	0 - 0.5	CAN092-0924-6000	MS/MSD SVOC only	Soil		X					1
	1.5 - 3.5	CAN092-0924-0002		Soil	X		X	X		2	1
	4 - 6	CAN092-0924-0004		Soil	X	X	X	X		2	1
	8 - 10	CAN092-0924-0008		Soil	X		X	X		2	1
	8 - 10	CAN092-0924-9262	FD	Soil	X		X	X		2	1
	8 - 10	CAN092-0924-9202	MRD	Soil	X	X	X	X		2	1

TABLE 13-1

SUMMARY OF ANALYTICAL AND QA/QC SAMPLING
OIL/WATER SEPARATOR NO. 5120 (SWMU NO. 92)
CANNON AFB, NEW MEXICO

Sample Location	Target Interval (ft-bgs)	Sample Identification Number	QA/QC Type	Sample Matrix	Analytical Parameters				Sample Containers		
					VOCs	SVOCs	Metals	TRPH	40 ml VOA vials	4 oz. jars	8 oz. jars
Boring 09204, cont.	18-20	CAN092-0924-0018		Soil	X		X	X		2	1
	28 - 30	CAN092-0924-0028		Soil	X		X	X		2	1
	38 - 40	CAN092-0924-0038		Soil	X		X	X		2	1
	48 - 50	CAN092-0924-0048		Soil	X		X	X		2	1
	58 - 60	CAN092-0924-0058		Soil	X		X	X		2	1
Boring 09205	0 - 0.5	CAN092-0925-0000		Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN092-0925-0002		Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN092-0925-6002	MS/MSD SVOC only	Soil		X					1
	4 - 6	CAN092-0925-0004		Soil	X		X	X		2	1
	8 - 10	CAN092-0925-0008		Soil	X		X	X		2	1
	8 - 10	CAN092-0925-6008	MS/MSD	Soil	X		X	X		2	2
	18-20	CAN092-0925-0018		Soil	X		X	X		2	1
	28 - 30	CAN092-0925-0028		Soil	X		X	X		2	1
	38 - 40	CAN092-0925-0038		Soil	X		X	X		2	1
	48 - 50	CAN092-0925-0048		Soil	X		X	X		2	1
	58 - 60	CAN092-0925-0058		Soil	X		X	X		2	1
		CAN092-0925-9251	AB	Water	X				2		
		CAN092-0925-9271	RB	Water	X				2		
		CAN092-0925-9281	DW	Water	X				2		
		CAN092-0925-9291	TB	Water	X				2		

AB = Ambient blank
DW = Decontamination water
FB = Field blank
MRD = Missouri River Division
MS/MSD = Matrix spike/matrix spike duplicate
RB = Rinsate blank
TB = Trip blank

See Figure 13-1 for locations of the borings.

TABLE 13-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 92

LOCATOR	CAN092-0921-0000			CAN092-0921-0002			CAN092-0922-0000			CAN092-0922-0000			CAN092-0922-0002			CAN092-0923-0000		
LAB SAMPLE NUMBER	0313810001SA			0313810002SA			0312140010SA			0314020018SA			0312140011SA			0312140014SA		
COLLECT DATE	09/22/93			09/22/93			09/13/93			09/13/93			09/13/93			09/13/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)																		
1,2-Dichloroethane	<	5.3	U	<	5.3	U				<	5.4	U	<	5.6	U			
Ethylbenzene	1.5	5.3	J	<	5.3	U				<	5.4	U	<	5.6	U			
Toluene	7.5	5.3		<	5.3	U				<	5.4	U	1.1	5.6	J			
Xylenes (total)	7.2	5.3		<	5.3	U				<	5.4	U	1.6	5.6	J			
Semivolatile Organics (ug/kg)																		
Anthracene							<	360	U							<	350	U
Benzo(a)anthracene							190	360	J							180	350	J
Benzo(a)pyrene							210	360	J							220	350	J
Benzo(b)fluoranthene							460	360								490	350	
Benzo(g,h,i)perylene							130	360	J							120	350	J
Butyl benzyl phthalate							140	360	J							110	350	J
Carbazole							<	360	U							<	350	U
Chrysene							300	360	J							280	350	J
Di-n-butyl phthalate							73	360	J							<	350	U
Fluoranthene							490	360								540	350	
Indeno(1,2,3-cd)pyrene							130	360	J							120	350	J
Phenanthrene							220	360	J							340	350	J
Pyrene							450	360								500	350	
Metals (mg/kg)																		
Aluminum	6080	10.6		5670	10.6		5070	10.8					8100	11.2		6040	10.6	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value.
U = Nondetected value.

QUAL=Qualification
RL = Reporting Limit.

TABLE 13-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 92

LOCATOR	CAN092-0921-0000			CAN092-0921-0002			CAN092-0922-0000			CAN092-0922-0000			CAN092-0922-0002			CAN092-0923-0000		
LAB SAMPLE NUMBER	0313810001SA			0313810002SA			0312140010SA			0314020018SA			0312140011SA			0312140014SA		
COLLECT DATE	09/22/93			09/22/93			09/13/93			09/13/93			09/13/93			09/13/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Antimony	<	6.4	U	<	6.4	U	<	6.5	U				<	6.7	U	<	6.4	U
Arsenic	2.3	0.53		2	0.53		2.2	0.54					2.4	0.56		2.5	0.53	
Barium	<		R	<		R	198	1.1					83.6	1.1		96.6	1.1	
Beryllium	0.46	0.21		0.46	0.21		0.29	0.22					0.63	0.22		0.47	0.21	
Cadmium	1.6	0.53		0.59	0.53		1	0.54					<	0.56	U	<	0.53	U
Calcium	58200	21.2		58300	21.3		72500	21.6					6450	22.5		17000	21.2	
Chromium	12.3	1.1		5.9	1.1		13.8	1.1					8.7	1.1		9.3	1.1	
Cobalt	3.4	1.1		3	1.1		2.9	1.1					4.5	1.1		3.3	1.1	
Copper	14.2	2.1		5.7	2.1		6.9	2.2					6.7	2.2		6.7	2.1	
Iron	6470	10.6		6020	10.6		12000	10.8					8560	11.2		7960	10.6	
Lead	502	53		4.6	0.53		64.3	5.4	J				8.4	0.56		12.5	1.1	
Magnesium	2100	21.2		1890	21.3		2810	21.6					1640	22.5		1470	21.2	
Manganese	216	1.1		122	1.1		135	1.1					210	1.1		199	1.1	
Nickel	7.5	4.2		6.6	4.3		8.2	4.3					8.4	4.5		8.5	4.2	
Potassium	1480	530		1130	531		1490	540					1630	561		1290	531	
Silver	0.76	1.1	J	0.73	1.1	J	<	1.1	U				<	1.1	U	<	1.1	U
Vanadium	18.1	1.1		16	1.1		13.1	1.1					18.5	1.1		17.3	1.1	
Zinc	39.3	2.1		13.6	2.1		72.6	2.2					19.3	2.2		44.9	2.1	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	674	42.4		47.6	42.5		278	43.2					<	44.9	U	58.2	42.5	
Water Quality (percent)																		
Water	5.6	0.1		5.9	0.1		7.4	0.1		7.6	0.1		11	0.1		5.8	0.1	

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A complete summary of chemical results are presented in Appendix A.
J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 13-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 92

LOCATOR	CAN092-0923-0000			CAN092-0923-0002			CAN092-0924-0000			CAN092-0924-0002			CAN092-0925-0000			CAN092-0925-0002		
LAB SAMPLE NUMBER	0314020019SA			0312140015SA			0314170001SA			0314170002SA			0313810014SA			0313810015SA		
COLLECT DATE	09/13/93			09/13/93			09/23/93			09/23/93			09/22/93			09/22/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)																		
1,2-Dichloroethane	<	5.3	U	<	5.4	U	<	5.4	U	<	5.4	U	1.3	5.3	J	<	5.3	U
Ethylbenzene	<	5.3	U	<	5.4	U	<	5.4	U	<	5.4	U	<	5.3	U	<	5.3	U
Toluene	<	5.3	U	<	5.4	U	1.6	5.4	J	<	5.4	U	4.9	5.3	J	1.5	5.3	J
Xylenes (total)	1.4	5.3	J	1.7	5.4	J	2.5	5.4	J	<	5.4	U	5.3	5.3		<	5.3	U
Semivolatile Organics (ug/kg)																		
Anthracene				<	360	U	<	350	U				70	350	J	<	350	U
Benzo(a)anthracene				<	360	U	440	350					800	350		<	350	U
Benzo(a)pyrene				<	360	U	640	350					940	350		<	350	U
Benzo(b)fluoranthene				<	360	U	1400	350					2100	350		<	350	U
Benzo(g,h,i)perylene				<	360	U	330	350	J				450	350		<	350	U
Butyl benzyl phthalate				<	360	U	<	350	U				<	350	U	<	350	U
Carbazole				<	360	U	38	350	J				89	350	J	<	350	U
Chrysene				<	360	U	560	350					940	350		<	350	U
Di-n-butyl phthalate				<	360	U	<	350	U				<	350	U	<	350	U
Fluoranthene				<	360	U	600	350					1100	350		<	350	U
Indeno(1,2,3-cd)pyrene				<	360	U	340	350	J				470	350		<	350	U
Phenanthrene				<	360	U	280	350	J				470	350		<	350	U
Pyrene				<	360	U	1200	350					2000	350		<	350	U
Metals (mg/kg)																		
Aluminum				7610	10.8		5420	10.8		6570	10.8		6100	10.6		6260	10.6	

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A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 13-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 92

LOCATOR	CAN092-0923-0000			CAN092-0923-0002			CAN092-0924-0000			CAN092-0924-0002			CAN092-0925-0000			CAN092-0925-0002		
LAB SAMPLE NUMBER	0314020019SA			0312140015SA			0314170001SA			0314170002SA			0313810014SA			0313810015SA		
COLLECT DATE	09/13/93			09/13/93			09/23/93			09/23/93			09/22/93			09/22/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Antimony				<	6.5	U	5.7	6.5	J	5.3	6.5	J	<	6.4	U	<	6.4	U
Arsenic				2.6	0.54		2.7	0.54		2.4	0.54		2.1	0.53		2.1	0.53	
Barium				101	1.1		228	1.1		184	1.1		<		R	<		R
Beryllium				0.54	0.22		0.5	0.22		0.51	0.22		0.42	0.21		0.4	0.21	
Cadmium				<	0.54	U	0.44	0.54	J	<	0.54	U	1.9	0.53		0.89	0.53	
Calcium				12700	21.6		78400	21.5		58700	21.7		53000	21.2		56800	21.2	
Chromium				8.1	1.1		9.1	1.1		5.7	1.1		13.9	1.1		5.3	1.1	
Cobalt				4.4	1.1		2.8	1.1		3.3	1.1		3.4	1.1		2.8	1.1	
Copper				6.9	2.2		7.5	2.2		6.2	2.2		9.8	2.1		5.7	2.1	
Iron				7890	10.8		5910	10.8		6650	10.8		6300	10.6		5800	10.6	
Lead				8.3	0.54		20.9	2.7		5.8	0.54		37.5	5.3		5.7	0.53	
Magnesium				1700	21.6		2650	21.5		2050	21.7		2220	21.2		2030	21.2	
Manganese				195	1.1		130	1.1		149	1.1		182	1.1		122	1.1	
Nickel				8	4.3		7.1	4.3		8	4.3		7.5	4.2		6.1	4.2	
Potassium				1520	540		1550	538		1570	542		1740	531		1270	531	
Silver				<	1.1	U	<	1.1	U	<	1.1	U	1	1.1	J	0.92	1.1	J
Vanadium				17.7	1.1		16.9	1.1		17.2	1.1		17	1.1		14.3	1.1	
Zinc				17.5	2.2		48.4	2.2		14.3	2.2		43.6	2.1		15.7	2.1	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons				49	43.2		159	43		61.5	43.3		295	42.5		120	42.5	
Water Quality (percent)																		
Water	5.6	0.1		7.4	0.1		7	0.1		7.7	0.1		5.8	0.1		5.8	0.1	

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A complete summary of chemical results are presented in Appendix A.
J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 13-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 92

LOCATOR	CAN092-0921-0004			CAN092-0921-0008			CAN092-0921-0018			CAN092-0921-0028			CAN092-0921-0038			CAN092-0921-0048		
LAB SAMPLE NUMBER	0313810003SA			0313810004SA			0313810005SA			0313810006SA			0313810007SA			0313810008SA		
COLLECT DATE	09/22/93			09/22/93			09/22/93			09/22/93			09/22/93			09/22/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)																		
Toluene	<	5.3	U	1.8	5.5	J	<	5.7	U	3.3	5.7	J	4.1	5.4	J	2.8	5.7	J
Semivolatile Organics (ug/kg)																		
Benzo(g,h,i)perylene																		
Metals (mg/kg)																		
Aluminum	6440	10.6		5160	11.1		4520	11.5		4540	11.4		2140	10.8		2320	22.7	
Antimony	<	6.4	U	<	6.6	U	<	6.9	U	<	6.9	U	<	6.5	U	<	13.6	U
Arsenic	1.9	0.53		2.2	0.55		1.4	0.57		0.56	1.1	J	0.58	0.54		0.53	1.1	J
Barium			R			R			R			R			R			R
Beryllium	0.44	0.21		0.43	0.22		0.36	0.23		0.27	0.23		<	0.22	U	<	0.45	U
Cadmium	1.3	0.53		1.2	0.55		1.6	0.57		0.67	0.57		1.1	0.54		2.3	1.1	
Calcium	79800	21.3		89200	22.1		103000	23		62800	22.9		72900	21.6		162000	45.4	
Chromium	6.8	1.1		5.7	1.1		3.4	1.1		3.5	1.1		1.3	1.1		4.8	2.3	
Cobalt	3.2	1.1		2.5	1.1		3	1.1		1.8	1.1		1	1.1	J	<	2.3	U
Copper	5.7	2.1		4.6	2.2		3.3	2.3		2.3	2.3		1.2	2.2	J	2.6	4.5	J
Iron	5980	10.6		4710	11.1		3540	11.5		3210	11.4		1640	10.8		1280	22.7	
Lead	5.5	0.53		5.4	0.55		4.3	0.57		3	0.57		1.9	0.54		2.4	0.57	
Magnesium	2570	21.3		2270	22.1		3350	23		4020	22.9		3180	21.6		12600	45.4	
Manganese	127	1.1		196	1.1		94.2	1.1		49.7	1.1		26.2	1.1		19.7	2.3	
Nickel	6	4.3		5.9	4.4		4.8	4.6		4.1	4.6	J	2.1	4.3	J	<	9.1	U
Potassium	1180	532		1060	553		1430	575		1080	571		498	540	J	221	1130	J

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 13-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 92

LOCATOR	CAN092-0921-0004			CAN092-0921-0008			CAN092-0921-0018			CAN092-0921-0028			CAN092-0921-0038			CAN092-0921-0048		
LAB SAMPLE NUMBER	0313810003SA			0313810004SA			0313810005SA			0313810006SA			0313810007SA			0313810008SA		
COLLECT DATE	09/22/93			09/22/93			09/22/93			09/22/93			09/22/93			09/22/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Silver	0.63	1.1	J	0.74	1.1	J	0.91	1.1	J	1.1	1.1		0.73	1.1	J	1.5	2.3	J
Sodium	164	532	J	<	553	U	<	575	U	<	571	U	<	540	U	<	1130	U
Vanadium	15.5	1.1		15.5	1.1		13.1	1.1		10.5	1.1		5.3	1.1		11.2	2.3	
Zinc	13.8	2.1		15	2.2		10.4	2.3		8.7	2.3		7.3	2.2		3.3	4.5	J
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	64.2	42.6		<	44.3	U	<	46	U	<	45.7	U	<	43.2	U	<	45.4	U
Water Quality (percent)																		
Water	6	0.1		9.6	0.1		13	0.1		12	0.1		7.5	0.1		12	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 13-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 92

LOCATOR	CAN092-0921-0058			CAN092-0922-0004			CAN092-0922-0008			CAN092-0923-0004			CAN092-0923-0008			CAN092-0924-0004		
LAB SAMPLE NUMBER	0313810009SA			0312140012SA			0312140013SA			0312140016SA			0312140017SA			0314170003SA		
COLLECT DATE	09/22/93			09/13/93			09/13/93			09/13/93			09/13/93			09/23/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)																		
Toluene	<	5.7	U	28	5.6		<	5.4	U	<	5.4	U	<	5.6	U	<	5.4	U
Semivolatile Organics (ug/kg)																		
Benzo(g,h,i)perylene							<	360	U							37	360	J
Metals (mg/kg)																		
Aluminum	1890	11.4		8470	11.2		3370	10.8		7020	10.8		3850	22.3		6230	10.8	
Antimony	<	6.9	U	<	6.7	U	<	6.5	U	<	6.5	U	<	13.4	U	9.4	6.5	
Arsenic	0.31	0.57	J	2.3	0.56		1.9	0.54		2.1	0.54		2.2	0.56		2.5	0.54	
Barium			R	120	1.1		115	1.1		90.3	1.1		310	2.2		171	1.1	
Beryllium	<	0.23	U	0.6	0.22		0.3	0.22		0.54	0.22		0.3	0.45	J	0.41	0.22	
Cadmium	0.7	0.57		<	0.56	U	<	0.54	U	<	0.54	U	<	1.1	U	<	0.54	U
Calcium	52400	22.9		21100	22.3		54700	21.5		19400	21.6		131000	44.5		80400	21.6	
Chromium	2.6	1.1		8.5	1.1		2.8	1.1		7.4	1.1		2.1	2.2	J	5	1.1	
Cobalt	0.87	1.1	J	3.9	1.1		1.7	1.1		3.8	1.1		2.9	2.2		2.7	1.1	
Copper	1.2	2.3	J	6.2	2.2		2.2	2.2		6.4	2.2		2.8	4.5	J	5.5	2.2	
Iron	1700	11.4		8270	11.2		3460	10.8		7460	10.8		3800	22.3		6200	10.8	
Lead	2.1	0.57		7.4	1.1		2.5	0.54		6.3	1.1		3.1	0.56		5.5	0.54	
Magnesium	2300	22.9		1750	22.3		1530	21.5		1580	21.6		2550	44.5		2320	21.6	
Manganese	38.4	1.1		185	1.1		49.3	1.1		176	1.1		58.4	2.2		114	1.1	
Nickel	1.6	4.6	J	8.1	4.5		4.4	4.3		7.9	4.3		5.8	8.9	J	7.7	4.3	
Potassium	319	571	J	1610	559		785	538		1380	540		952	1110	J	1420	539	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 13-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 92

LOCATOR	CAN092-0921-0058			CAN092-0922-0004			CAN092-0922-0008			CAN092-0923-0004			CAN092-0923-0008			CAN092-0924-0004		
LAB SAMPLE NUMBER	0313810009SA			0312140012SA			0312140013SA			0312140016SA			0312140017SA			0314170003SA		
COLLECT DATE	09/22/93			09/13/93			09/13/93			09/13/93			09/13/93			09/23/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Silver	0.96	1.1	J	<	1.1	U	<	1.1	U	<	1.1	U	<	2.2	U	<	1.1	U
Sodium	<	571	U	<	559	U	<	538	U	<	540	U	<	1110	U	<	539	U
Vanadium	6.3	1.1		16.6	1.1		12.3	1.1		16.6	1.1		14.6	2.2		17.8	1.1	
Zinc	4.4	2.3		18.5	2.2		8.3	2.2		16.3	2.2		9.1	4.5		13.6	2.2	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	<	45.7	U	<	44.7	U	<	43	U	<	43.2	U	<	44.5	U	44.8	43.1	
Water Quality (percent)																		
Water	12	0.1		11	0.1		7	0.1		7.3	0.1		10	0.1		7.2	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 13-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 92

LOCATOR	CAN092-0924-0008			CAN092-0924-0018			CAN092-0924-0028			CAN092-0924-0038			CAN092-0924-0048			CAN092-0924-0058		
LAB SAMPLE NUMBER	0314170004SA			0314170006SA			0314170007SA			0314170008SA			0314170009SA			0314170010SA		
COLLECT DATE	09/23/93			09/23/93			09/23/93			09/23/93			09/23/93			09/23/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)																		
Toluene	<	5.7	U	<	5.6	U	<	5.9	U	<	5.5	U	<	5.6	U	<	5.5	U
Semivolatile Organics (ug/kg)																		
Benzo(g,h,i)perylene																		
Metals (mg/kg)																		
Aluminum	3840	22.8		3930	11.1		4470	23.6		2730	11		3300	22.4		2780	11	
Antimony	12.2	13.7	J	6.2	6.7	J	<	14.1	U	<	6.6	U	<	13.4	U	6.2	6.6	J
Arsenic	1.8	0.57		1.7	0.56		1.1	0.59		0.96	0.55		0.93	0.56		0.59	0.55	
Barium	226	2.3		80.7	1.1		61.2	2.4		39.8	1.1		116	2.2		123	1.1	
Beryllium	0.38	0.46	J	0.23	0.22		<	0.47	U	<	0.22	U	<	0.45	U	<	0.22	U
Cadmium	<	1.1	U	<	0.56	U	<	1.2	U	<	0.55	U	<	1.1	U	<	0.55	U
Calcium	156000	45.5		62000	22.3		150000	47.1		71600	22.1		145000	44.7		77600	22	
Chromium	<	2.3	U	3	1.1		<	2.4	U	<	1.1	U	<	2.2	U	7.2	1.1	
Cobalt	2.4	2.3		1.5	1.1		<	2.4	U	<	1.1	U	1.6	2.2	J	0.78	1.1	J
Copper	3.7	4.6	J	2.5	2.2		2.8	4.7	J	1.8	2.2	J	5	4.5	J	3.1	2.2	
Iron	3740	22.8		3700	11.1		2740	23.6		2110	11		2190	22.4		2190	11	
Lead	4.4	0.57		3.8	0.56		2.1	0.59		1.5	0.55		1.8	0.56		1.3	0.55	
Magnesium	3470	45.5		2540	22.3		10100	47.1		5430	22.1		8960	44.7		6890	22	
Manganese	68.2	2.3		54.3	1.1		23.9	2.4		18.8	1.1		26.2	2.2		27.7	1.1	
Nickel	7.7	9.1	J	5.5	4.5		4.5	9.4	J	3.7	4.4	J	5.1	8.9	J	3.4	4.4	J
Potassium	1190	1140		1360	557		667	1180	J	628	552		611	1120	J	455	550	J

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 13-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 92

LOCATOR	CAN092-0924-0008			CAN092-0924-0018			CAN092-0924-0028			CAN092-0924-0038			CAN092-0924-0048			CAN092-0924-0058		
LAB SAMPLE NUMBER	0314170004SA			0314170006SA			0314170007SA			0314170008SA			0314170009SA			0314170010SA		
COLLECT DATE	09/23/93			09/23/93			09/23/93			09/23/93			09/23/93			09/23/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Silver	<	2.3	U	<	1.1	U	<	2.4	U	<	1.1	U	<	2.2	U	<	1.1	U
Sodium	<	1140	U	<	557	U	<	1180	U	<	552	U	<	1120	U	<	550	U
Vanadium	15.9	2.3		14.1	1.1		18.8	2.4		6.9	1.1		11.7	2.2		10.4	1.1	
Zinc	10	4.6		8.1	2.2		6	4.7		6.5	2.2		6.4	4.5		5.7	2.2	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	<	45.5	U	<	44.6	U	<	47.1	U	<	44.2	U	<	44.7	U	<	44	U
Water Quality (percent)																		
Water	12	0.1		10	0.1		15	0.1		9.5	0.1		11	0.1		9.1	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 13-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 92

LOCATOR	CAN092-0925-0008			CAN092-0925-0018			CAN092-0925-0028			CAN092-0925-0038			CAN092-0925-0048			CAN092-0925-0058		
LAB SAMPLE NUMBER	0313810017SA			0313740015SA			0313740016SA			0313740017SA			0313740018SA			0313740019SA		
COLLECT DATE	09/22/93			09/22/93			09/22/93			09/22/93			09/22/93			09/22/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)																		
Toluene	<	5.7	U	<	5.7	U	<	5.8	U	<	5.5	U	<	5.6	U	<	5.4	U
Semivolatile Organics (ug/kg)																		
Benzo(g,h,i)perylene																		
Metals (mg/kg)																		
Aluminum	4730	22.9		4540	11.4		3640	11.6		3340	11		3180	11.2		2490	10.7	
Antimony	<	13.8	U	<	6.8	U	<	6.9	U	<	6.6	U	<	6.7	U	<	6.4	U
Arsenic	2.2	0.57		1.1	0.57		0.45	0.58	J	0.69	0.55		0.52	1.1	J	0.41	0.54	J
Barium			R	391	1.1		71	1.2		61.1	1.1		69	1.1	J	28.9	1.1	
Beryllium	0.46	0.46		0.43	0.23		0.19	0.23	J	0.2	0.22	J	0.21	0.22	J	0.14	0.21	J
Cadmium	1.9	1.1		0.98	0.57		1.3	0.58		0.63	0.55		0.97	0.56		<	0.54	U
Calcium	126000	45.9		59900	22.8		93100	23.1		89900	22		87100	22.5		32800	21.4	
Chromium	3.4	2.3		4.7	1.1		3.8	1.2		3.1	1.1		4.3	1.1		2.5	1.1	
Cobalt	2.6	2.3		1.8	1.1		1.4	1.2		0.58	1.1	J	1.1	1.1		0.97	1.1	J
Copper	3.4	4.6	J	3.5	2.3		1.9	2.3	J	1.2	2.2	J	1.7	2.2	J	1.2	2.1	J
Iron	3900	22.9		4450	11.4		2260	11.6		2370	11		2280	11.2		2550	10.7	
Lead	5.4	0.57		4.8	2.8		1.4	0.58		1.4	2.7	J	1.5	0.56		1.6	0.54	
Magnesium	3590	45.9		2880	22.8		9390	23.1		3880	22		8140	22.5		3130	21.4	
Manganese	81.1	2.3		76.3	1.1		22	1.2		21.4	1.1		26.1	1.1		32.5	1.1	
Nickel	5.5	9.2	J	5	4.6		3.5	4.6	J	2.6	4.4	J	2.8	4.5	J	2.3	4.3	J
Potassium	1100	1150	J	1360	569		601	579		669	549		463	562	J	428	536	J

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 13-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 92

LOCATOR	CAN092-0925-0008			CAN092-0925-0018			CAN092-0925-0028			CAN092-0925-0038			CAN092-0925-0048			CAN092-0925-0058		
LAB SAMPLE NUMBER	0313810017SA			0313740015SA			0313740016SA			0313740017SA			0313740018SA			0313740019SA		
COLLECT DATE	09/22/93			09/22/93			09/22/93			09/22/93			09/22/93			09/22/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Silver	2.3	2.3		0.65	1.1	J	0.64	1.2	J	0.78	1.1	J	0.41	1.1	J	0.75	1.1	J
Sodium	<	1150	U	<	569	U	<	579	U	<	549	U	<	562	U	<	536	U
Vanadium	15.9	2.3		15.1	1.1		10.9	1.2		6.5	1.1		12.4	1.1		8.1	1.1	
Zinc	10.5	4.6		10.6	2.3		5.8	2.3		6	2.2		5.8	2.2		5.1	2.1	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	<	45.9	U	<	45.6	U	<	46.3	U	<	43.9	U	<	45	U	<	42.8	U
Water Quality (percent)																		
Water	13	0.1		12	0.1		14	0.1		9	0.1		11	0.1		6.6	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 13-3

COMPARISON OF MAXIMUM DETECTED METAL CONCENTRATIONS TO BACKGROUND (1)
SWMU 92, CANNON AFB
Oil/Water Separator No. 5120

Sample ID	Metal	Maximum detected concentration	Range of background concentrations (2)	Upper tolerance limit (UTL) background concentration (3)	Does maximum detected exceed UTL background
CAN092-0922-0004	Aluminum	8470	1410 - 11,000	10,540	N
CAN092-0924-0000	Arsenic	2.7	0.67 - 28	15.5	N
CAN092-0922-0000	Barium	198	14.5 - 1200	642	N
CAN092-0922-0002	Beryllium	0.63	0.17 - 0.77	0.73	N
CAN092-0921-0048	Cadmium	2.3	<0.51 - 4.2	*	Y
CAN092-0925-0000	Chromium	13.9	4 - 15.4	12.5	Y
CAN092-0922-0002	Cobalt	4.5	0.85 - 5.3	4.5	N
CAN092-0921-0000	Copper	14.2	<2 - 18.4	*	Y
CAN092-0921-0000	Lead	502	1.1 - 46	25.8	Y
CAN092-0923-0000	Nickel	8.5	1.3 - 9.8	9	N
CAN092-0925-0008	Silver	2.3	0.51 - 0.93	*	Y
CAN092-0922-0002	Vanadium	18.5	5.2 - 28.3	25.3	N
CAN092-0922-0000	Zinc	72.6	<4.3 - 27.5	21.9	Y

(1) All units in mg/kg.
(2) Compiled from data collected by Woodward Clyde for the RFI and RI (WCC 1992 and WCC 1993) and Walk Haydel and Associates for the IRP (Walk, Haydel and Associates 1990).
Summarized in "Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater at Cannon AFB, NM (WCC 1993)
(3) Upper Tolerance Limit (UTL) of the mean = mean + 2*standard deviation. This is for all practicle purposes the same as the 90% upper confidence limit of the 95th percentile where UTL = mean + standard deviation *k, where k=2.02 for n=37 .
* Data insufficient to calculate UTL of background concentration.

TABLE 13-4

COMPARISON OF MAXIMUM CONCENTRATIONS WITH RBCs (1)
SWMU 92, CANNON AFB
Oil/Water Separator No. 5120

Sample ID	Analyte	Maximum Detected	RBC (2)	Maximum Detected Exceed RBC
CAN092-0925-0000	1,2-Dichloroethane	0.0013	0.8	N
CAN092-0925-0000	Anthracene	0.07	2000	N
CAN092-0925-0000	Benzo(a)anthracene	0.8	0.07	Y
CAN092-0925-0000	Benzo(a)pyrene	0.94	0.01	Y
CAN092-0925-0000	Benzo(b)fluoranthene	2.1	0.07	Y
CAN092-0925-0000	Benzo(g,h,i)perylene	0.45	NTF	N
CAN092-0922-0000	bis(2-Ethylhexyl)phthalate	0.42	5	N
CAN092-0922-0000	Butyl benzyl phthalate	0.14	2000	N
CAN092-0921-0048	Cadmium	2.3	8	N
CAN092-0925-0000	Carbazole	0.089	4	N
CAN092-0925-0000	Chromium	13.9	40	N
CAN092-0925-0000	Chrysene	0.94	2	N
CAN092-0921-0000	Copper	14.2	300	N
CAN092-0921-0000	Ethylbenzene	0.0015	800	N
CAN092-0925-0000	Fluoranthene	1.1	300	N
CAN092-0925-0000	Indeno(1,2,3-cd)pyrene	0.47	0.04	Y
CAN092-0921-0000	Lead (3)	502	500	Y
CAN092-0925-0000	Phenanthrene	0.47	NTF	N
CAN092-0925-0000	Pyrene	2	200	N
CAN092-0925-0008	Silver	2.3	20	N
CAN092-0922-0004	Toluene	0.028	2000	N
CAN092-0921-0000	Total Petroleum Hydrocarbons (4)	674	1000	N
CAN092-0921-0000	Xylenes (total)	0.0072	20000	N
CAN092-0922-0000	Zinc	72.6	2000	N

NTF = No EPA Established Toxicity Factor

(1) All units in mg/kg

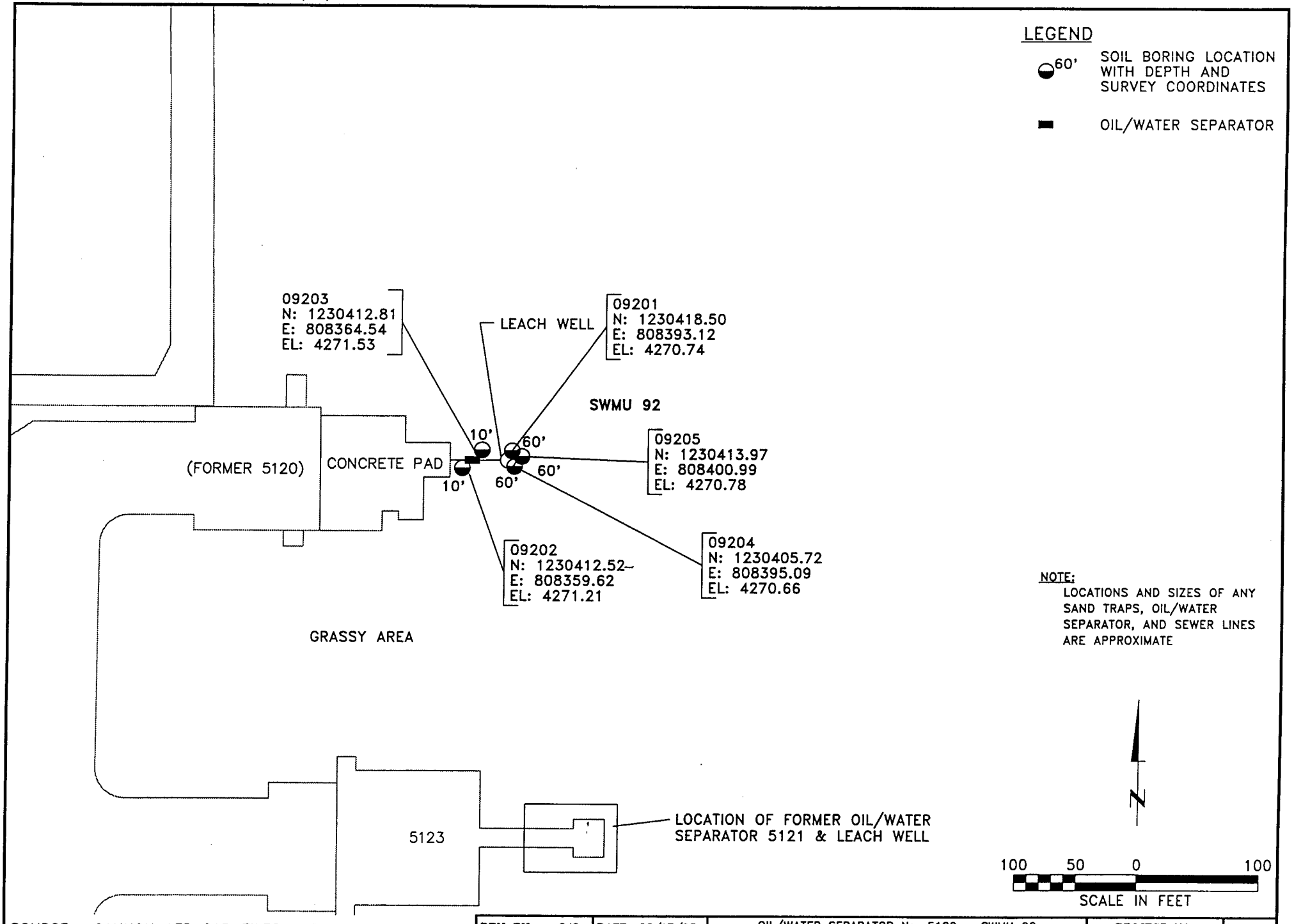
(2) Risk-based concentration

(3) EPA suggests 500-1,000 mg/kg as allowable concentration for residential soils based on EPA's IUBK Lead Model (EPA 1990)

(4) New Mexico recommended soil cleanup level for fuel contaminated soil.

Note: Only metals that exceeded background appear in this table.

CAD FILE: C3M11W08.DWG V=SWMU-92 11/22/1993 8:47



SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

DRN BY: CJG	DATE: 08/17/93	OIL/WATER SEPARATOR No. 5120 – SWMU 92 SITE PLAN AND BORING LOCATIONS CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W
CHK'D BY: .	REVISION: 0		FIG. NO. 13-1

14.1 SITE BACKGROUND

14.1.1 Site Description

The former location of OWS 5121 lies under the hush house portion of Building 5123 which houses a jet engine test facility. The ground surface around the hush house is non-native grasses and soils.

14.1.2 Site History

OWS 5121 was located on the east side of Power Check Pad No. 5121 (Figure 14-1). The OWS was a two-compartment underground unit with a detached 100-gallon oil storage tank which received waste wash water generated from aircraft engine testing and maintenance operations. The oils recovered by the OWS were directed to the 100-gallon oil holding tank and the wastewater was discharged to a leach well located approximately 40 feet east of the OWS. This facility was active from approximately 1957 to 1988 when OWS 5121 and the associated leach well were removed during the demolition of Building 5121. This building was replaced with Facility 5123 which was constructed over the location formerly occupied by OWS 5121.

14.1.3 Current Use

OWS 5121 and the associated leach well no longer exist. Building 5123 is currently used for the testing of jet engines from fighter aircraft.

14.1.4 Potential Contaminants

Potential residual contaminants from the operation of OWS 5121 include JP-4 fuel, petroleum and synthetic lubricating oils, greases, solvents, and metals.

14.2 FIELD INVESTIGATION AND DATA COLLECTION

14.2.1 Soils Sampling

Three, 60-foot-deep soil borings were drilled as close as possible to the former location of the OWS and leach well to sample soils for indications of contaminants which leaked or seeped from these sources. Accurate placement of these borings in the targeted area was impacted by the presence of the Building 5123 foundation and hush house. Two borings were located on the north side of the hush house structure and one on the south side to encompass the location of the former facility.

Soil samples were collected at the surface and at the 1.5- to 3.5-foot, 4- to 6-foot, 8- to 10-foot, 18- to 20-foot, 28- to 30-foot, 38- to 40-foot, 48- to 50-foot, and 58- to 60-foot depth intervals as specified in the Field Sampling Plan and the Sample Summary Tables.

Samples were collected in accordance with QAPP SOP No. 6 - Surface Soil Sampling and QAPP SOP No. 7 - Subsurface Drilling and Sampling. Target analytes for all borings include VOCs, SVOCs, metals and TRPH. Surficial samples in areas of soil cover were collected approximately at the 0.2- to 0.5-foot depth interval to provide a worst-case situation for risk assessment purposes in the event that VOC contamination was discovered during this investigation.

14.2.2 Geologic Summary of Boring Logs

Boring logs for the borings completed at this SWMU include a layer of probable fill consisting of a reddish brown silt with some gravel and occasional asphalt extending from the surface to a depth of 4 feet. This soil grades to a salmon pink calcareous silt with local zones of increased moisture, sand and caliche content to approximately 48 feet in depth. Silty sand predominates from 48 to 60-feet and ranges in color from pinkish to reddish-orange. It is dry with local zones of hard caliche cementing the grains. The variable thickness of this unit depicted in the drill logs is probably attributable to the dynamics of its depositional environment.

No visual indications of subsurface contamination were encountered in the boreholes completed in this SWMU. See copies of the boring logs in Appendix B, Volume V.

14.2.3 SITE TOPOGRAPHY

The topography at SWMU 93 is essentially flat.

14.3 CHEMICAL INVESTIGATION RESULTS

14.3.1 General

Samples were collected as identified in Section 14.2 to comply with permit and compliance agreement requirements. Soil samples were collected from 3 borings (09301, 09302, and 09303). Sampling and analyses performed are summarized in Table 14-1. A summary of the analytical results for these soil samples is provided in Table 14-2a for near-surface soils and 14-2b for subsurface soils. For each sample type, the tables provide results for analytes only if they were detected at least once in this type of sample collected at the SWMU. Complete analytical summary results are provided in the QCSR (Appendix A).

14.3.2 Organic Results For Near-surface Soil Samples

The near-surface soil samples collected at these SWMUs (CAN093-0931-0000, CAN093-0932-0000, CAN093-0933-0000, and CAN093-0932-0002 were analyzed for VOCs, SVOCs, and TPH and samples CAN093-0931-0002, and CAN093-0933-0002 were analyzed for VOCs, metals and TPH as indicated in Table 14-1.

Other than acetone, methylene chloride, and 2-butanone which were qualified nondetected after they were determined to be laboratory contaminants (see Section 4.14.4 of the QCSR), the only VOCs reported were for sample CAN093-0931-0000 with 2.6 μg/kg toluene, and 1.8 μg/kg xylenes (total), sample CAN093-0933-0000 with 4.9 μg/kg toluene, and 1.8 μg/kg xylenes (total), and sample CAN093-0932-0002 with 8 μg/kg toluene. Results reported for SVOCs were primarily polycyclic aromatic hydrocarbons (PAHs). PAHs were reported for two samples and included the compounds benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene,

phenanthrene, and pyrene. Summing PAH concentrations, sample CAN093-0932-0000 had the highest total PAH reported at 902 μg/kg and sample CAN093-0933-0000 had total PAH reported at 835 μg/kg. Results reported for TPH included samples CAN093-0931-0000, CAN093-0932-0000, CAN093-0933-0002, CAN093-0932-0002, CAN093-0933-0000 at 77.4 mg/kg, 255 mg/kg, 294 mg/kg, 311 mg/kg, and 325 mg/kg respectively.

14.3.3 Organic Results For Subsurface Soil Samples

The subsurface soil samples collected at this SWMU (CAN093-0931-0004, CAN093-0931-0008, CAN093-0931-0018, CAN093-0931-0028, CAN093-0931-0038, CAN093-0931-0048, CAN093-0931-0058, CAN093-0932-0004, CAN093-0932-0008, CAN093-0932-0018, CAN093-0932-0028, CAN093-0932-0038, CAN093-0932-0048, CAN093-0932-0058, CAN093-0933-0004, CAN093-0933-0008, CAN093-0933-0018, CAN093-0933-0028, CAN093-0933-0038, CAN093-0933-0048, and CAN093-0933-0058) were analyzed for VOCs, metals, and TPH, samples (CAN093-0933-0048, and CAN093-0931-0004) were additionally analyzed for SVOCs as indicated in Table 14-1.

Other than acetone, methylene chloride, and 2-butanone which were qualified nondetected after they were determined to be laboratory contaminants (see Section 4.1.4 of the QCSR), the twelve VOCs reported as detected were for samples CAN093-0933-0028 with 1.5 µg/kg of 1,1,1-trichloroethane, 1.7 µg/kg of 1,1,2-trichloroethane, 1.4 µg/kg of 1,1-dichloroethene, 3.1 µg/kg of 1,2-dichloroethene (total), 1.6 µg/kg of 1,2 dichloropropane, 2.1 µg/kg of 4-methyl-2-pentanone (MIBK), 1.3 µg/kg of bromodichloromethane, 1.3 µg/kg of carbon disulfide, 1.8 µg/kg of chloroform, 1.5 µg/kg of ethylbenzene, 1.5 µg/kg of styrene, 3.5 µg/kg of xylenes (total), for sample CAN093-0933-0048 carbon disulfide was reported as detected at 1.6 μg/kg. With the exception of 56 µg/kg fluoranthene, and 40 µg/kg pyrene which were reported as detected in sample CAN093-0931-0004, there were no other reported results for the SVOCs analyses. There were no results reported for the TRPH analyses.

14.3.4 Inorganic Results

Metals analyses were performed on samples collected from this SWMU as indicated in Table 14-1. The range of results for metals reported in these soil samples are summarized in Table 14-A.

TABLE 14-A

Analyte	Frequency Reported	Lowest Detection	Sample Location	Highest Detection	Sample Location
Aluminum	27/27	2040 mg/kg	0931-0048	10500 mg/kg	0933-0002
Antimony	1/27	2.3 mg/kg	0931-0018	--	--
Arsenic	27/27	0.37 mg/kg	0931-0058	2.6 mg/kg	0933-0004
Barium	27/27	17.2 mg/kg	0932-0058	1110 mg/kg	0931-0028
Beryllium	19/27	0.11 mg/kg	0931-0058	0.54 mg/kg	0933-0002
Cadmium	20/27	0.61 mg/kg	0933-0058	3 mg/kg	0933-0008
Calcium	27/27	3710 mg/kg	0931-0002	241000 mg/kg	0932-0018
Chromium	24/27	1.85 mg/kg	0931-0038	12.9 mg/kg	0933-0000
Cobalt	26/27	0.58 mg/kg	0931-0048	5 mg/kg	0933-0008
Copper	27/27	0.97 mg/kg	0931-0058	158 mg/kg	0932-0000
Iron	27/27	1230 mg/kg	0931-0048	9110 mg/kg	0933-0002
Lead	27/27	0.92 mg/kg	0931-0002	32.4 mg/kg	0932-0000
Magnesium	27/27	830 mg/kg	0931-0002	33700 mg/kg	0931-0028
Manganese	27/27	20.4 mg/kg	0931-0048	183 mg/kg	0932-0000
Mercury	0/27	--	--	--	--
Nickel	24/27	2 mg/kg	0931-0048	8.4 mg/kg	0933-0008
Potassium	26/27	384 mg/kg	0931-0048	1780 mg/kg	0933-0002
Silver	25/27	0.5 mg/kg	0933-0058	4.8 mg/kg	0932-0018
Selenium	2/27	0.25 mg/kg	0932-0000	0.31 mg/kg	0931-0058
Sodium	14/27	170 mg/kg	0931-0002	472 mg/kg	0931-0028
Thallium	0/27	--	--	--	--
Vanadium	27/27	6.4 mg/kg	0933-0038	21.9 mg/kg	0931-0028
Zinc	27/27	3.8 mg/kg	0931-0048	77.2 mg/kg	0932-0000

Note: See Table 14-3 for comparison to background.

14.4 SWMU-SPECIFIC DATA ASSESSMENT

14.4.1 General

This assessment of OWS 5144 data is an evaluation of quality issues that could affect the major data uses. In general, the objective of the RFI was identification and quantification of the nature and extent of the contamination, which was necessary to meet permit and compliance agreement requirements, and to support an evaluation of the risk to human health and the environment.

14.4.2 Sampling Issues

A review of the data contained in the log books and the Daily Quality Control Reports (DQCR) for SWMU 93 indicate that there were no sampling issues that would impact data usability. QC issues are discussed in detail in Appendix A, and copies of the DQCRs are included in that appendix.

14.4.3 Data Review Issues

For laboratory analytical data, QA/QC objectives were specified in the Cannon AFB QAPP (W-C 1993). The objectives were used as indicators of the quality necessary to support identification and quantitation of potential chemicals of concern. The data review is presented in Section 4.14 of the Quality Control Summary Report (QCSR) located in Appendix A. As presented in the QCSR, data for the analytes arsenic, barium, chromium, manganese, selenium, silver, sodium and thallium were qualified as estimated concentrations and manganese data were qualified rejected. No data associated with SWMU 93 were rejected.

Arsenic, sodium, selenium, thallium, and manganese data were qualified estimated to indicate a potential low bias, and barium and silver data were qualified estimated to indicate a potential high bias. When a low bias is indicated, actual concentrations may be higher than the reported results. Use of this data in risk assessment may underestimate risk. Similarly, when a high bias is indicated, actual concentrations may be lower than the reported results. Use of this data in risk assessment may overestimate risk.

Chromium, lead and manganese were qualified estimated, in field duplicate pairs, due to precision that did not meet the QA\QC criteria defined for this project. Poor precision could be attributed to errors in sampling and analysis; however, since the other analytes which were sampled and analyzed in the same procedure (Method 6010) met QA/QC criteria, this variation is likely due to sample heterogeneity.

The uncertainty in the actual concentration reported for estimated data does not affect the usability of the data for identification of chemicals in characterizing the nature and extent of contamination at this SWMU.

14.4.4 Limitations

Elevated reporting limits may limit the usability of the data due to low level analytes being diluted to below the instrument detection limits. That is, chemicals may be reported as nondetect when they are actually present in a sample at low levels. Section 4.14.6 of the QCSR (Appendix A) presents a discussion of elevated reporting limits. Only lead analyses had elevated reporting limits. The elevated reporting limits for lead does not impact on the usability of the associated data because the analytes were reported above elevated reporting limits and the reporting limits were not elevated by a factor greater than 100.

14.4.5 Summary

Overall, data generated during the study of SWMU 93 were determined to meet quality criteria. In conjunction with the analytical data review, other information including field observations were evaluated in the assessment of the usability of SWMU 93 data. The data support identification of the nature and extent of contamination and provide reasonable concentration for use in risk assessment.

14.5 NATURE AND EXTENT OF CONTAMINATION

SWMU 93 was an OWS with a leach well formerly serving Building 5121 in the engine test area. The OWS and leach well were removed from service and demolished in about 1988 at the time Building 5121 was removed. A new building (5123) has been constructed over the same area. The area adjacent to the former location of the leach well is currently accessible near the new Building 5123, and three borings were advanced to a depth of 60 feet at this location. In general the samples appeared relatively free of organic contamination. There was no visible evidence of spills or leaks in the vicinity, and the entire area around the building was unpaved. The chemical test results show low levels of organic contamination, including PAHs.

14.6 COMPARISON OF METALS CONCENTRATIONS TO BACKGROUND

Results of the comparison of metal concentration in soil to background levels for SWMU 93 are given in Table 14-3. A summary of the results of the comparison is presented here.

Metals are natural constituents of soils. SWMU concentrations of metal were evaluated to assess whether the metals in environmental samples exceed background levels. Metals that occur in concentrations within background levels are not considered SWMU-related chemicals of concern and are not evaluated further.

The maximum concentration of each detected metal at each SWMU was compared to the upper tolerance limit of the background data. The upper tolerance limit (UTL) was defined as the mean plus two times the standard deviation. This is for all practical purposes equal to the 90% upper confidence limit of the 95th percentile which is equal to the mean plus the standard deviation times the k statistic. The background data set used consisted of 37 data points (WCC 1993), so the k statistic equals 2.02 (Gilbert 1987).

The maximum detected concentrations of antimony, barium, cadmium, chromium, cobalt, copper, lead, selenium, silver, and zinc exceeded the (UTL) of the background data. Therefore, these metals will be compared to risk-based concentrations at SWMU 93.

14.7 RISK SCREENING

14.7.1 Exposure Pathway Flow Chart

The Preliminary Exposure Pathway Flow Chart (EPFC) applicable to SWMU 93, Oil/Water Separator No. 5121, is shown in Figure 3-2. It shows that the potential exposure pathways are ingestion of soil, inhalation of soil particulates, dermal exposure to contaminated soil, inhalation of airborne chemicals released from soil, and ingestion, inhalation, and dermal exposure to groundwater (if drinking water supplies were affected). Storm water runoff is considered to be an insignificant pathway because potential spills would be minor and over a small area.

14.7.2 Screening of Contaminants Against RBCs (and other criteria)

Maximum detected concentrations of organic compounds and metals that exceeded background were compared to screening-level RBCs (see Section 3.4.5.1 for derivations of RBCs) and other screening criteria in Table 14-4. Screening-level criteria other than RBCs include the state of New Mexico's TPH cleanup level of 1,000 mg/kg (New Mexico Environmental Improvement Board 1993) and the EPA's recommended soil lead level of 500 mg/kg (EPA 1990). The TPH soil clean-up concentration of 1,000 mg/kg is not an RBC, nor is it a relevant-and-applicable standard for the SWMUs in this investigation. Rather it is a conservative value originally derived for the cleanup of fuel-contaminated soils at underground storage tank sites. Risk-based concentrations for TPH, measured as fresh fuels (e.g., gasoline or diesel), are at least an order of magnitude higher for occupational exposures. The concentration of 500 mg/kg is the most conservative concentration in the recommended range of 500 mg/kg to 1,000 mg/kg as a lead level in residential soil based on EPA's Uptake Biokinetic Model (EPA 1990). Compounds with no toxicity factors cannot be evaluated in the risk screening since RBCs cannot be calculated. These compounds, at the concentrations that were measured in soil, are not likely to significantly affect the results of the comparison to RBCs. The comparison for SWMU 93 shows that maximum detected concentrations of barium, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene exceed RBCs.

This comparison of maximum detected concentrations to RBCs is very conservative (health-protective) and actual impacts are likely to be lower than those suggested by exceedances of conservative criteria. For example, maximum detected concentrations are likely to overestimate actual concentrations to which people would be exposed. Furthermore, the screening criteria are based on highly conservative residential exposure assumptions and target risk levels that may not be pertinent to current or future use of the SWMU. The RBCs used in this evaluation are calculated using RCRA Action Level methodology; however, the RBCs are more health-protective than conventional RCRA Action Levels because a target excess cancer risk level of 1×10^{-7} (1 in 10,000,000) and a hazard quotient of 0.1 were used to account for exposures to multiple chemicals and for exposure routes other than soil ingestion. Conventional RCRA Action Levels are calculated based on a cancer risk of 1×10^{-6} and a noncancer hazard of 1.0.

The purpose of the comparison to RBCs is to determine whether or not chemical releases (characterized by maximum detected concentrations) have occurred at SWMU 93 that could pose potential risks based on conservative health-based criteria. Since maximum concentrations of the above listed chemicals exceed screening level criteria, further evaluation or investigation of chemical concentrations and probable exposures may be warranted. However, exceedances are minimal. The results of the comparison of maximum detected concentrations with screening-level RBCs indicate that it is unlikely that a risk assessment will result in a risk level that will require remedial action (i.e., only a few chemicals slightly exceed the RBCs).

14.8 SUMMARY AND RECOMMENDATIONS

Twenty-seven soil samples were collected and analyzed from three 60-foot deep soil borings at SWMU 93. Maximum detected concentrations were compared to background levels and RBCs. Four organics and one metal were found at levels that exceed RBCs or other screening-level criteria.

The highest concentrations for the organics were for the near-surface samples. The highest concentration for barium was at 28 feet. This concentration is within the range of background concentrations for barium, and the barium concentrations decreased with depth to below the upper tolerance limit for background concentrations. Therefore, the vertical extent of contamination has been characterized by the borings, and the potential for groundwater beneath SWMU 93 to be impacted can be characterized. The potential for impacts to groundwater is considered to be low because the depth to groundwater is greater than 200 feet, and sampling demonstrates that contaminants are not being significantly transported vertically below the SWMU. Therefore, it is concluded that the available data are sufficient to complete a BRA. Therefore, a risk assessment is recommended for this SWMU.

TABLE 14-1

SUMMARY OF ANALYTICAL AND QA/QC SAMPLING
OIL/WATER SEPARATOR NO. 5121 (SWMU NO. 93)
CANNON AFB, NEW MEXICO

Sample Location	Target Interval (ft-bgs)	Sample Identification Number	QA/QC Type	Sample Matrix	Analytical Parameters				Sample Containers		
					VOCs	SVOCs	Metals	TRPH	40 ml VOA vials	4 oz. jars	8 oz. jars
Boring 09301	0 - 0.5	CAN093-0931-0000		Soil	X	X	X	X		2	1
	0 - 0.5	CAN093-0931-9361	FD	Soil	X	X	X	X		2	1
	0 - 0.5	CAN093-0931-9301	MRD	Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN093-0931-0002		Soil	X		X	X		2	1
	4 - 6	CAN093-0931-0004		Soil	X	X	X	X		2	1
	4 - 6	CAN093-0931-6004	MS/MSD (SVOC only)	Soil		X					1
	8 - 10	CAN093-0931-0008		Soil	X		X	X		2	1
	8 - 10	CAN093-0931-6008	MS/MSD	Soil	X		X	X		2	2
	18 - 10	CAN093-0931-0018		Soil	X		X	X		2	1
	28 - 30	CAN093-0931-0028		Soil	X		X	X		2	1
	38 - 40	CAN093-0931-0038		Soil	X		X	X		2	1
	48 - 50	CAN093-0931-0048		Soil	X		X	X		2	1
	58 - 60	CAN093-0931-0058		Soil	X		X	X		2	1
Boring 09302	0 - 0.5	CAN093-0932-0000		Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN093-0932-0002		Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN093-0932-6002	MS/MSD (SVOC only)	Soil		X					
	4 - 6	CAN093-0932-0004		Soil	X		X	X		2	1
	8 - 10	CAN093-0932-0008		Soil	X		X	X		2	1
	8 - 10	CAN093-0932-6008	MS/MSD	Soil	X	X	X	X		2	2
	18 - 20	CAN093-0932-0018		Soil	X		X	X		2	1
	28 - 30	CAN093-0932-0028		Soil	X		X	X		2	1
	38 - 40	CAN093-0932-0038		Soil	X		X	X		2	1
	48 - 50	CAN093-0932-0048		Soil	X		X	X		2	1
	58 - 60	CAN093-0932-0058		Soil	X		X	X		2	1
		CAN093-0932-9351	AB	Water	X				2		
		CAN093-0932-9371	RB	Water	X				2		
		CAN093-0932-9381	DW	Water	X				2		
		CAN093-0932-9391	TB	Water	X				2		

TABLE 14-1

SUMMARY OF ANALYTICAL AND QA/QC SAMPLING
OIL/WATER SEPARATOR NO. 5121 (SWMU NO. 93)
CANNON AFB, NEW MEXICO

Sample Location	Target Interval (ft-bgs)	Sample Identification Number	QA/QC Type	Sample Matrix	Analytical Parameters				Sample Containers		
					VOCs	SVOCs	Metals	TRPH	40 ml VOA vials	4 oz. jars	8 oz. jars
Boring 09303	0 - 0.5	CAN093-0933-0000		Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN093-0933-0002		Soil	X		X	X		2	1
	4 - 6	CAN093-0933-0004		Soil	X		X	X		2	1
	8 - 10	CAN093-0933-0008		Soil	X		X	X		2	1
	8 - 10	CAN093-0933-9362	FD	Soil	X		X	X		2	1
	8 - 10	CAN093-0933-9302	MRD	Soil	X	X	X	X		2	1
	18 - 20	CAN093-0933-0018		Soil	X		X	X		2	1
	28 - 30	CAN093-0933-0028		Soil	X		X	X		2	1
	38 - 40	CAN093-0933-0038		Soil	X		X	X		2	1
	48 - 50	CAN093-0933-0048		Soil	X	X	X	X		2	1
	58 - 60	CAN093-0933-0058		Soil	X		X	X		2	1

AB = Ambient blank
DW = Decontamination water
FB = Field blank
MRD = Missouri River Division
MS/MSD = Matrix spike/matrix spike duplicate
RB = Rinsate blank
TB = Trip blank

See Figure 14-1 for locations of the borings.

TABLE 14-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 93

LOCATOR	CAN093-0931-0000			CAN093-0931-0002			CAN093-0932-0000			CAN093-0932-0002			CAN093-0933-0000			CAN093-0933-0002		
LAB SAMPLE NUMBER	0312740001SA			0312740003SA			0312730001SA			0312730002SA			0312730010SA			0312730011SA		
COLLECT DATE	09/15/93			09/15/93			09/15/93			09/15/93			09/15/93			09/15/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)																		
Toluene	2.6	6.4	J	<	5.4	U	<	5.4	U	8	5.6		4.9	5.3	J	<	5.7	U
Xylenes (total)	1.8	6.4	J	<	5.4	U	<	5.4	U	<	5.6	U	1.8	5.3	J	<	5.7	U
Semivolatile Organics (ug/kg)																		
Benzo(a)anthracene	<	420	U				74	360	J	<	370	U	77	350	J			
Benzo(a)pyrene	<	420	U				62	360	J	<	370	U	84	350	J			
Benzo(b)fluoranthene	<	420	U				73	360	J	<	370	U	140	350	J			
Benzo(g,h,i)perylene	<	420	U				73	360	J	<	370	U	56	350	J			
Chrysene	<	420	U				95	360	J	<	370	U	120	350	J			
Fluoranthene	<	420	U				150	360	J	<	370	U	100	350	J			
Indeno(1,2,3-cd)pyrene	<	420	U				55	360	J	<	370	U	38	350	J			
Pentachlorophenol	45	2000	J				<	1700	U	<	1800	U	<	1700	U			
Phenanthrene	<	420	U				130	360	J	<	370	U	100	350	J			
Pyrene	<	420	U				190	360	J	<	370	U	120	350	J			
Metals (mg/kg)																		
Aluminum	5930	12.8		3950	10.8		7130	10.8		8660	11.1		9380	10.6		10500	11.4	
Arsenic	2.3	0.64		1.6	0.54		2.5	0.54		2	0.56		2.3	0.53		2.5	0.57	
Barium	99.9	1.3	J	51.9	1.1	J	114	1.1	J	126	1.1	J	140	1.1	J	108	1.1	J
Beryllium	0.48	0.26		0.3	0.22		0.44	0.22		0.5	0.22		0.49	0.21		0.54	0.23	
Cadmium	<	0.64	U	<	0.54	U	1.9	0.54		1.2	0.56		1	0.53		1	0.57	
Calcium	14700	25.5		3710	21.6		26600	21.5		54300	22.3		37400	21.1		33400	22.8	
Chromium	9.5	1.3	J	5.3	1.1		7.7	1.1		8.1	1.1		12.9	1.1		11.8	1.1	
Cobalt	3.9	1.3		2.4	1.1		3.6	1.1		3.1	1.1		3.4	1.1		3.9	1.1	
Copper	8.6	2.6		4.5	2.2		158	2.2		7.4	2.2		8.4	2.1		8.5	2.3	
Iron	6980	12.8		4560	10.8		7920	10.8		8220	11.1		8360	10.6		9110	11.4	
Lead	7.3	0.64		5.2	0.54		32.4	2.7		5.8	2.8		10	1.1		11.8	1.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value.
U = Nondetected value.
QUAL=Qualification
RL = Reporting Limit.

TABLE 14-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 93

LOCATOR	CAN093-0931-0000			CAN093-0931-0002			CAN093-0932-0000			CAN093-0932-0002			CAN093-0933-0000			CAN093-0933-0002		
LAB SAMPLE NUMBER	0312740001SA			0312740003SA			0312730001SA			0312730002SA			0312730010SA			0312730011SA		
COLLECT DATE	09/15/93			09/15/93			09/15/93			09/15/93			09/15/93			09/15/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Magnesium	1440	25.5		830	21.6		1740	21.5		2560	22.3		2220	21.1		2310	22.8	
Manganese	155	1.3	J	102	1.1	J	183	1.1		161	1.1		146	1.1		162	1.1	
Nickel	7.2	5.1		4.7	4.3		8.2	4.3		7.5	4.5		7.8	4.2		8.4	4.6	
Potassium	1150	638		760	539		1340	539		1420	557		1630	528		1780	569	
Selenium	<	0.64	U	<	0.54	U	0.25	1.1	J	<	1.1	U	<	0.53	U	<	1.1	UJ
Silver	0.69	1.3	J	0.57	1.1	J	0.72	1.1	J	0.62	1.1	J	1	1.1	J	1.2	1.1	
Sodium	<	638	U	170	539	J	<	539	U	<	557	U	424	528	J	<	569	U
Vanadium	17	1.3		11.9	1.1		16.3	1.1		17.9	1.1		18	1.1		18.9	1.1	
Zinc	25.4	2.6		13.1	2.2		77.2	2.2		18.1	2.2		53.3	2.1		38	2.3	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	77.4	51		<	43.1	U	255	43.1		311	44.6		325	42.2		294	45.6	
Water Quality (percent)																		
Water	22	0.1		7.2	0.1		7.2	0.1		10	0.1		5.3	0.1		12	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value.
U = Nondetected value.

QUAL=Qualification
RL = Reporting Limit.

TABLE 14-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 93

LOCATOR	CAN093-0931-0004			CAN093-0931-0008			CAN093-0931-0018			CAN093-0931-0028			CAN093-0931-0038			CAN093-0931-0048		
LAB SAMPLE NUMBER	0312740004SA			0312740005SA			0312740006SA			0312740007SA			0312740008SA			0312740009SA		
COLLECT DATE	09/15/93			09/15/93			09/15/93			09/15/93			09/15/93			09/15/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)																		
Benzene				<	6.2	U	<	5.6	U	<	6.1	U	<	5.4	U	<	5.5	U
Bromodichloromethane				<	6.2	U	<	5.6	U	<	6.1	U	<	5.4	U	<	5.5	U
Carbon disulfide				<	6.2	U	<	5.6	U	<	6.1	U	<	5.4	U	<	5.5	U
Chlorobenzene				<	6.2	U	<	5.6	U	<	6.1	U	<	5.4	U	<	5.5	U
Chloroform				<	6.2	U	<	5.6	U	<	6.1	U	<	5.4	U	<	5.5	U
1,1-Dichloroethane				<	6.2	U	<	5.6	U	<	6.1	U	<	5.4	U	<	5.5	U
1,1-Dichloroethene				<	6.2	U	<	5.6	U	<	6.1	U	<	5.4	U	<	5.5	U
1,2-Dichloroethene (total)				<	6.2	U	<	5.6	U	<	6.1	U	<	5.4	U	<	5.5	U
1,2-Dichloropropane				<	6.2	U	<	5.6	U	<	6.1	U	<	5.4	U	<	5.5	U
Ethylbenzene				<	6.2	U	<	5.6	U	<	6.1	U	<	5.4	U	<	5.5	U
4-Methyl-2-pentanone (MIBK)				<	12	U	<	11	U	<	12	U	<	11	U	<	11	U
Styrene				<	6.2	U	<	5.6	U	<	6.1	U	<	5.4	U	<	5.5	U
Tetrachloroethene				<	6.2	U	<	5.6	U	<	6.1	U	<	5.4	U	<	5.5	U
Toluene				<	6.2	U	<	5.6	U	<	6.1	U	<	5.4	U	<	5.5	U
1,1,1-Trichloroethane				<	6.2	U	<	5.6	U	<	6.1	U	<	5.4	U	<	5.5	U
1,1,2-Trichloroethane				<	6.2	U	<	5.6	U	<	6.1	U	<	5.4	U	<	5.5	U
Trichloroethene				<	6.2	U	<	5.6	U	<	6.1	U	<	5.4	U	<	5.5	U
Xylenes (total)				<	6.2	U	<	5.6	U	<	6.1	U	<	5.4	U	<	5.5	U
Metals (mg/kg)																		
Aluminum	3740	11.5		4300	12.3		4240	11.3		4550	24.5		2250	10.8		2040	11	
Antimony	<	6.9	U	<	7.4	U	2.3	6.8	J	<	14.7	U	<	6.5	U	<	6.6	U
Arsenic	2.4	0.58		2.1	0.62		1	0.56		1.5	0.61		0.77	0.54		0.44	1.1	JJ
Barium	115	1.2	J	243	1.2	J	76.9	1.1	J	1110	2.5	J	66.3	1.1	J	29.2	1.1	J
Beryllium	0.31	0.23		0.35	0.25		0.45	0.23		<	0.49	U	0.19	0.22	J	0.14	0.22	J
Cadmium	1.9	0.58		1.7	0.62		0.98	0.56		2.8	1.2		0.85	0.54		1.1	0.55	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 14-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 93

LOCATOR	CAN093-0931-0004			CAN093-0931-0008			CAN093-0931-0018			CAN093-0931-0028			CAN093-0931-0038			CAN093-0931-0048		
LAB SAMPLE NUMBER	0312740004SA			0312740005SA			0312740006SA			0312740007SA			0312740008SA			0312740009SA		
COLLECT DATE	09/15/93			09/15/93			09/15/93			09/15/93			09/15/93			09/15/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Calcium	107,000	23.1		94000	24.6		76800	22.6		188000	49.1		69700	21.7		90000	22	
Chromium	4.1	1.2		3.8	1.2		3.3	1.1		5.2	2.5		1.8	1.1		2.1	1.1	
Cobalt	2.3	1.2		3.2	1.2		2.6	1.1		2.5	2.5		1.2	1.1		0.58	1.1	J
Copper	4.3	2.3		3.5	2.5		3.3	2.3		6.9	4.9		1.6	2.2	J	1.3	2.2	J
Iron	3,690	11.5		3850	12.3		3390	11.3		2200	24.5		1600	10.8		1230	11	
Lead	3.5	0.58		3.8	0.62		5.1	0.56		0.92	0.61		1.3	0.54		1.1	0.55	
Magnesium	1750	23.1		2650	24.6		3160	22.6		33700	49.1		4520	21.7		4970	22	
Manganese	59.8	1.2	J	78.1	1.2	J	95.2	1.1	J	26.7	2.5	J	29.1	1.1	J	20.4	1.1	J
Nickel	5.3	4.6		6.2	4.9		4.9	4.5		<	9.8	U	3.1	4.3	J	2	4.4	J
Potassium	823	577		1030	616		1340	565		<	1230	U	653	542		384	549	J
Selenium	<	1.2	UJ	<	0.62	U	<	0.56	U	<	1.2	UJ	<	0.54	U	<	1.1	UJ
Silver	0.52	1.2		0.51	1.2	J	0.67	1.1	J	0.75	2.5	J	<	1.1	U	<	1.1	U
Sodium	<	577	U	259	616	J	229	565	J	472	1230	J	286	542	J	219	549	J
Vanadium	12.2	1.2		16.4	1.2		13.8	1.1		21.9	2.5		6.7	1.1		7	1.1	
Zinc	10	2.3		9.7	2.5		10	2.3		7.5	4.9		5.1	2.2		3.8	2.2	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	ND	46.1	U	<	49.3	U	<	45.2	U	<	49.1	U	<	43.4	U	<	43.9	U
Water Quality (percent)																		
Water				19	0.1		12	0.1		18	0.1		7.8	0.1		8.9	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 14-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 93

LOCATOR	CAN093-0931-0058			CAN093-0932-0004			CAN093-0932-0008			CAN093-0932-0018			CAN093-0932-0028		
LAB SAMPLE NUMBER	0312740010SA			0312730003SA			0312730004SA			0312730005SA			0312730006SA		
COLLECT DATE	09/15/93			09/15/93			09/15/93			09/15/93			09/15/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)															
Benzene	<	5.4	U	<	5.6	U	<	6.2	U	<	5.8	U	<	6.1	U
Bromodichloromethane	<	5.4	U	<	5.6	U	<	6.2	U	<	5.8	U	<	6.1	U
Carbon disulfide	<	5.4	U	<	5.6	U	<	6.2	U	<	5.8	U	<	6.1	U
Chlorobenzene	<	5.4	U	<	5.6	U	<	6.2	U	<	5.8	U	<	6.1	U
Chloroform	<	5.4	U	<	5.6	U	<	6.2	U	<	5.8	U	<	6.1	U
1,1-Dichloroethane	<	5.4	U	<	5.6	U	<	6.2	U	<	5.8	U	<	6.1	U
1,1-Dichloroethene	<	5.4	U	<	5.6	U	<	6.2	U	<	5.8	U	<	6.1	U
1,2-Dichloroethene (total)	<	5.4	U	<	5.6	U	<	6.2	U	<	5.8	U	<	6.1	U
1,2-Dichloropropane	<	5.4	U	<	5.6	U	<	6.2	U	<	5.8	U	<	6.1	U
Ethylbenzene	<	5.4	U	<	5.6	U	<	6.2	U	<	5.8	U	<	6.1	U
4-Methyl-2-pentanone (MIBK)	<	11	U	<	11	U	<	12	U	<	12	U	<	12	U
Styrene	<	5.4	U	<	5.6	U	<	6.2	U	<	5.8	U	<	6.1	U
Tetrachloroethene	<	5.4	U	<	5.6	U	<	6.2	U	<	5.8	U	<	6.1	U
Toluene	<	5.4	U	1.4	5.6	J	<	6.2	U	<	5.8	U	<	6.1	U
1,1,1-Trichloroethane	<	5.4	U	<	5.6	U	<	6.2	U	<	5.8	U	<	6.1	U
1,1,2-Trichloroethane	<	5.4	U	<	5.6	U	<	6.2	U	<	5.8	U	<	6.1	U
Trichloroethene	<	5.4	U	<	5.6	U	<	6.2	U	<	5.8	U	<	6.1	U
Xylenes (total)	<	5.4	U	<	5.6	U	<	6.2	U	<	5.8	U	<	6.1	U
Metals (mg/kg)															
Aluminum	2220	10.8		6410	11.2		5190	12.4		3710	57.6		5350	24.5	
Antimony	<	6.5	U	<	6.7	U	<	7.4	U	<	34.6	U	<	14.7	U
Arsenic	0.37	0.54	JJ	2	0.56		2	0.62		0.78	0.58		0.93	0.61	
Barium	33.6	1.1	J	66.5	1.1	J	200	1.2	J	320	5.8	J	438	2.5	J
Beryllium	0.11	0.22	J	0.44	0.22		0.48	0.25		<	1.2	U	<	0.49	U
Cadmium	0.79	0.54		<	0.56	U	1.1	0.62		3	2.9		1.2	1.2	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 14-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 93

LOCATOR	CAN093-0931-0058			CAN093-0932-0004			CAN093-0932-0008			CAN093-0932-0018			CAN093-0932-0028		
LAB SAMPLE NUMBER	0312740010SA			0312730003SA			0312730004SA			0312730005SA			0312730006SA		
COLLECT DATE	09/15/93			09/15/93			09/15/93			09/15/93			09/15/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Calcium	55400	21.7		19300	22.4		107000	24.8		241000	115		137000	49.1	
Chromium	2.4	1.1		7	1.1		5	1.2		<	5.8	U	4.8	2.5	
Cobalt	0.85	1.1	J	2.8	1.1		2.9	1.2		<	5.8	U	1.4	2.5	J
Copper	0.97	2.2	J	5.9	2.2		5.8	2.5		1.7	11.5	J	8.2	4.9	
Iron	2070	10.8		6830	11.2		4640	12.4		2050	57.6		5300	24.5	
Lead	1.2	0.54		5.5	0.56		2.9	1.2		1.4	2.9	J	1.5	0.61	
Magnesium	2990	21.7		1530	22.4		2890	24.8		7460	115		24800	49.1	
Manganese	27.4	1.1	J	91	1.1		77.1	1.2		21.1	5.8		51.4	2.5	
Nickel	2	4.3	J	7.2	4.5		6.2	5		<	23	U	7.3	9.8	J
Potassium	429	542	J	1240	561		1150	620		426	2880	J	748	1230	J
Selenium	0.31	0.54	J	<	0.56	UJ	<	1.2	UJ	<	1.2	UJ	<	1.2	UJ
Silver	0.73	1.1	J	0.77	1.1	J	0.71	1.2	J	4.8	5.8	J	1.3	2.5	J
Sodium	270	542	J	<	561	U	<	620	J	<	2880	U	379	1230	J
Vanadium	8.9	1.1		14.8	1.1		17.3	1.2		10.8	5.8		17.7	2.5	
Zinc	4.7	2.2		13.7	2.2		13.6	2.5		5.2	11.5	J	14.7	4.9	
TPH (mg/kg)															
Total Petroleum Hydrocarbons	<	43.3	U	<	44.8	U	<	49.6	U	<	46.1	U	<	49.1	U
Water Quality (percent)															
Water	7.7	0.1		11	0.1		19	0.1		13	0.1		18	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 14-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 93

LOCATOR	CAN093-0932-0038			CAN093-0932-0048			CAN093-0932-0058			CAN093-0933-0004			CAN093-0933-0008			CAN093-0933-0018		
LAB SAMPLE NUMBER	0312730007SA			0312730008SA			0312730009SA			0312730012SA			0312730013SA			0312730014SA		
COLLECT DATE	09/15/93			09/15/93			09/15/93			09/15/93			09/15/93			09/15/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)																		
Benzene	<	5.5	U	<	5.8	U	<	5.5	U	<	5.8	U	<	5.9	U	<	5.9	U
Bromodichloromethane	<	5.5	U	<	5.8	U	<	5.5	U	<	5.8	U	<	5.9	U	<	5.9	U
Carbon disulfide	<	5.5	U	<	5.8	U	<	5.5	U	<	5.8	U	<	5.9	U	<	5.9	U
Chlorobenzene	<	5.5	U	<	5.8	U	<	5.5	U	<	5.8	U	<	5.9	U	<	5.9	U
Chloroform	<	5.5	U	<	5.8	U	<	5.5	U	<	5.8	U	<	5.9	U	<	5.9	U
1,1-Dichloroethane	<	5.5	U	<	5.8	U	<	5.5	U	<	5.8	U	<	5.9	U	<	5.9	U
1,1-Dichloroethene	<	5.5	U	<	5.8	U	<	5.5	U	<	5.8	U	<	5.9	U	<	5.9	U
1,2-Dichloroethene (total)	<	5.5	U	<	5.8	U	<	5.5	U	<	5.8	U	<	5.9	U	<	5.9	U
1,2-Dichloropropane	<	5.5	U	<	5.8	U	<	5.5	U	<	5.8	U	<	5.9	U	<	5.9	U
Ethylbenzene	<	5.5	U	<	5.8	U	<	5.5	U	<	5.8	U	<	5.9	U	<	5.9	U
4-Methyl-2-pentanone (MIBK)	<	11	U	<	12	U	<	11	U	<	12	U	<	12	U	<	12	U
Styrene	<	5.5	U	<	5.8	U	<	5.5	U	<	5.8	U	<	5.9	U	<	5.9	U
Tetrachloroethene	<	5.5	U	<	5.8	U	<	5.5	U	<	5.8	U	<	5.9	U	<	5.9	U
Toluene	16	5.5		8	5.8		1.6	5.5	J	<	5.8	U	<	5.9	U	<	5.9	U
1,1,1-Trichloroethane	<	5.5	U	<	5.8	U	<	5.5	U	<	5.8	U	<	5.9	U	<	5.9	U
1,1,2-Trichloroethane	<	5.5	U	<	5.8	U	<	5.5	U	<	5.8	U	<	5.9	U	<	5.9	U
Trichloroethene	<	5.5	U	<	5.8	U	<	5.5	U	<	5.8	U	<	5.9	U	<	5.9	U
Xylenes (total)	<	5.5	U	<	5.8	U	<	5.5	U	<	5.8	U	<	5.9	U	<	5.9	U
Metals (mg/kg)																		
Aluminum	7820	11.1		3380	11.5		3040	11		7490	11.7		3910	58.6		3660	23.4	
Antimony	<	6.6	U	<	6.9	U	<	6.6	U	<	7	U	<	35.2	U	<	14.1	U
Arsenic	0.85	0.55		0.55	1.2	J	0.63	0.55		2.6	0.58		1.3	0.59		1.4	0.59	
Barium	35.9	1.1	J	40.5	1.2	J	17.2	1.1	J	172	1.2	J	697	5.9	J	221	2.3	J
Beryllium	0.32	0.22		0.12	0.23	J	<	0.22	U	0.43	0.23		<	1.2	U	<	0.47	U
Cadmium	<	0.55	U	<	0.58	U	<	0.55	U	1.2	0.58		3	2.9		1.6	1.2	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 14-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 93

LOCATOR	CAN093-0932-0038			CAN093-0932-0048			CAN093-0932-0058			CAN093-0933-0004			CAN093-0933-0008			CAN093-0933-0018		
LAB SAMPLE NUMBER	0312730007SA			0312730008SA			0312730009SA			0312730012SA			0312730013SA			0312730014SA		
COLLECT DATE	09/15/93			09/15/93			09/15/93			09/15/93			09/15/93			09/15/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Calcium	37200	22.1		48100	23.1		13700	22		80300	23.4		221000	117		142000	46.9	
Chromium	4.9	1.1		2.9	1.2		3.6	1.1		5.8	1.2		<	5.9	U	<	2.3	U
Cobalt	1.5	1.1		0.94	1.2	J	1.2	1.1		2.8	1.2		5	5.9	J	2.4	2.3	
Copper	2.5	2.2		2.4	2.3		1.9	2.2	J	5.1	2.3		3.2	11.7	J	2.3	4.7	J
Iron	5050	11.1		2460	11.5		2490	11		6020	11.7		2800	58.6		2850	23.4	
Lead	4.6	0.55		1.8	1.2		1.9	0.55		4.7	2.9		1.9	2.9	J	3	2.9	
Magnesium	8180	22.1		12500	23.1		7340	22		2060	23.4		3930	117		3150	46.9	
Manganese	38.8	1.1		23.7	1.2		31.7	1.1		75.6	1.2		45.2	5.9	J	31.3	2.3	
Nickel	5.4	4.4		2.6	4.6	J	3	4.4	J	7.1	4.7		<	23.4	U	3.9	9.4	J
Potassium	1750	553		563	577	J	442	551	J	1370	585		723	2930	J	1010	1170	J
Selenium	<	1.1	UJ	<	1.2	UJ	<	0.55	U	<	1.2	UJ	<	1.2	UJ	<	1.2	UJ
Silver	0.76	1.1	J	0.65	1.2	J	0.65	1.1	J	0.95	1.2	J	4.3	5.9	J	1.9	2.3	J
Sodium	304	553	J	210	577	J	<	551	U	<	585	U	<	2930	U	<	1170	U
Vanadium	11.8	1.1		13.6	1.2		12.3	1.1		14.1	1.2		10.5	5.9		11.9	2.3	
Zinc	9.4	2.2		4.9	2.3		4.6	2.2		13.6	2.3		9.9	11.7	J	7.4	4.7	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	<	44.2	U	<	46.1	U	<	44	U	<	46.8	U	<	46.9	U	<	46.9	U
Water Quality (percent)																		
Water	9.6	0.1		13	0.1		9.2	0.1		14	0.1		15	0.1		15	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 14-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 93

LOCATOR	CAN093-0933-0028			CAN093-0933-0038			CAN093-0933-0048			CAN093-0933-0058		
LAB SAMPLE NUMBER	0312730015SA			0312730016SA			0312730017SA			0312730018SA		
COLLECT DATE	09/15/93			09/15/93			09/15/93			09/15/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)												
Benzene	<	5.8	U	<	5.4	U	<	5.5	U	<	5.4	U
Bromodichloromethane	1.3	5.8	J	<	5.4	U	<	5.5	U	<	5.4	U
Carbon disulfide	1.3	5.8	J	<	5.4	U	1.6	5.5	J	<	5.4	U
Chlorobenzene	<	5.8	U	<	5.4	U	<	5.5	U	<	5.4	U
Chloroform	1.8	5.8	J	<	5.4	U	<	5.5	U	<	5.4	U
1,1-Dichloroethane	1.6	5.8	J	<	5.4	U	<	5.5	U	<	5.4	U
1,1-Dichloroethene	1.4	5.8	J	<	5.4	U	<	5.5	U	<	5.4	U
1,2-Dichloroethene (total)	3.1	5.8	J	<	5.4	U	<	5.5	U	<	5.4	U
1,2-Dichloropropane	1.6	5.8	J	<	5.4	U	1.5	5.5	J	2.8	5.4	J
Ethylbenzene	1.5	5.8	J	<	5.4	U	<	5.5	U	<	5.4	U
4-Methyl-2-pentanone (MIBK)	2.1	12	J	<	11	U	<	11	U	<	11	U
Styrene	1.5	5.8	J	<	5.4	U	<	5.5	U	<	5.4	U
Tetrachloroethene	1.3	5.8	J	<	5.4	U	<	5.5	U	<	5.4	U
Toluene	<	5.8	U	<	5.4	U	<	5.5	U	1.4	5.4	J
1,1,1-Trichloroethane	1.5	5.8	J	<	5.4	U	<	5.5	U	<	5.4	U
1,1,2-Trichloroethane	1.7	5.8	J	<	5.4	U	<	5.5	U	<	5.4	U
Trichloroethene	<	5.8	U	<	5.4	U	<	5.5	U	<	5.4	U
Xylenes (total)	3.5	5.8	J	<	5.4	U	<	5.5	U	<	5.4	U
Metals (mg/kg)												
Aluminum	4070	23.4		3440	21.8		3760	11		3730	10.8	
Antimony	<	14	U	<	13.1	U	<	6.6	U	<	6.5	U
Arsenic	1.1	0.58		0.88	0.54		0.54	1.1	J	0.57	0.54	
Barium	113	2.3	J	76.7	2.2	J	27.6	1.1	J	43.1	1.1	J
Beryllium	<	0.47	U	<	0.44	U	0.14	0.22	J	0.15	0.22	J
Cadmium	2.8	1.2		2.2	1.1		<	0.55	U	0.61	0.54	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 14-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 93

LOCATOR	CAN093-0933-0028			CAN093-0933-0038			CAN093-0933-0048			CAN093-0933-0058		
LAB SAMPLE NUMBER	0312730015SA			0312730016SA			0312730017SA			0312730018SA		
COLLECT DATE	09/15/93			09/15/93			09/15/93			09/15/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Calcium	153000	46.7		130000	43.6		24500	22.1		41600	21.6	
Chromium	2.8	2.3		2	2.2	J	3.9	1.1		3.2	1.1	
Cobalt	2	2.3	J	1.8	2.2	J	1.2	1.1		1.3	1.1	
Copper	2.5	4.7	J	5.5	4.4		2	2.2	J	2	2.2	J
Iron	2380	23.4		2350	21.8		2890	11		3110	10.8	
Lead	1.1	1.2	J	1.2	1.1		1.3	0.55		1.4	0.54	
Magnesium	12600	46.7		4910	43.6		6800	22.1		5240	21.6	
Manganese	28.8	2.3		32.4	2.2		30.7	1.1		38.1	1.1	
Nickel	4.8	9.3	J	2.6	8.7	J	3.3	4.4	J	3.2	4.3	J
Potassium	590	1170	J	725	1090	J	736	552		670	539	
Selenium	<	1.2	UJ	<	1.1	UJ	<	1.1	UJ	<	1.1	UJ
Silver	2	2.3	J	1.1	2.2	J	0.58	1.1	J	0.5	1.1	J
Sodium	390	1170	J	<	1090	U	299	552	J	219	539	J
Vanadium	15.7	2.3		6.4	2.2		10.4	1.1		11.1	1.1	
Zinc	5.3	4.7		5.9	4.4		6	2.2		6.4	2.2	
TPH (mg/kg)												
Total Petroleum Hydrocarbons	<	46.7	U	<	43.6	U	<	44.2	U	<	43.1	U
Water Quality (percent)												
Water	14	0.1		8.2	0.1		9.5	0.1		7.2	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 14-3

COMPARISON OF MAXIMUM DETECTED METAL CONCENTRATIONS TO BACKGROUND(1)
SWMU 93, CANNON AFB
Oil/Water Separator No. 5121

Sample ID	Metal	Maximum detected concentration	Range of background concentrations (2)	Upper tolerance limit (UTL) background concentration (3)	Does maximum detected exceed UTL background
CAN093-0933-0002	Aluminum	10500	1410 - 11,000	10,540	N
CAN093-0931-0018	Antimony	2.3	<5 - <13	*	Y
CAN093-0931-0028	Barium	1110	14.5 - 1200	642	Y
CAN093-0933-0002	Beryllium	0.54	0.17 - 0.77	0.73	N
CAN093-0933-0008	Cadmium	3	<0.51 - 4.2	*	Y
CAN093-0933-0000	Chromium	12.9	4 - 15.4	12.5	Y
CAN093-0933-0008	Cobalt	5	0.85 - 5.3	4.5	Y
CAN093-0932-0000	Copper	158	<2 - 18.4	*	Y
CAN093-0932-0000	Lead	32.4	1.1 - 46	25.8	Y
CAN093-0933-0002	Nickel	8.4	1.3 - 9.8	9	N
CAN093-0931-0058	Selenium	0.31	<0.21 - 124	*	Y
CAN093-0932-0048	Silver	0.65	0.51 - 0.93	*	Y
CAN093-0931-0028	Vanadium	21.9	5.2 - 28.3	25.3	N
CAN093-0932-0000	Zinc	77.2	<4.3 - 27.5	21.9	Y

(1) All units in mg/kg.
(2) Compiled from data collected by Woodward Clyde for the RFI and RI (WCC 1992 and WCC 1993) and Walk, Haydel and Associates for the IRP (Walk, Haydel and Associates 1990).
Summarized in "Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater at Cannon AFB, NM (WCC 1993)
(3) Upper Tolerance Limit (UTL) of the mean = mean + 2*standard deviation. This is for all practicle purposes the same as the 90% upper confidence limit of the 95th percentile where UTL = mean + standard deviation *k, where k=2.02 for n=37 .
* Data insufficient to calculate UTL background concentration

TABLE 14-4

COMPARISON OF DETECTED CONCENTRATIONS WITH RBCs
SWMU 93, CANNON AFB
Oil/Water Separator No. 5121

Sample ID	Analyte	Maximum Detected	RBC (2)	Maximum Detected Exceed RBC
CAN093-0933-0058	1,2-Dichloropropane	0.0028	30	N
CAN093-0933-0028	4-Methyl-2-pentanone (MIBK)	0.0021	400	N
CAN093-0931-0018	Antimony	2.3	3	N
CAN093-0931-0028	**Barium**	**1110**	**600**	**Y**
CAN093-0933-0028	Benzene	0.0017	2	N
CAN093-0933-0000	**Benzo(a)anthracene**	**0.077**	**0.07**	**Y**
CAN093-0933-0000	**Benzo(a)pyrene**	**0.084**	**0.01**	**Y**
CAN093-0933-0000	**Benzo(b)fluoranthene**	**0.14**	**0.07**	**Y**
CAN093-0932-0000	Benzo(g,h,i)perylene	0.073	NTF	N
CAN093-0933-0028	Bromodichloromethane	0.0013	0.5	N
CAN093-0933-0008	Cadmium	3	8	N
CAN093-0933-0048	Carbon disulfide	0.0016	800	N
CAN093-0933-0028	Chlorobenzene	0.0017	200	N
CAN093-0933-0028	Chloroform	0.0018	10	N
CAN093-0933-0000	Chromium	12.9	40	N
CAN093-0933-0000	Chrysene	0.12	2	N
CAN093-0933-0008	Cobalt	5	NTF	N
CAN093-0932-0000	Copper	158	300	N
CAN093-0932-0000	**Indeno(1,2,3-cd)pyrene**	**0.055**	**0.04**	**Y**
CAN093-0932-0000	Lead (3)	32.4	500	N
CAN093-0931-0000	Pentachlorophenol	0.045	0.6	N
CAN093-0932-0000	Phenanthrene	0.13	NTF	N
CAN093-0932-0000	Pyrene	0.19	200	N
CAN093-0931-0058	Selenium	0.31	40	N
CAN093-0932-0058	Silver	0.65	20	N
CAN093-0933-0028	Styrene	0.0015	2000	N
CAN093-0933-0028	Tetrachloroethene	0.0013	1	N
CAN093-0932-0038	Toluene	0.016	2000	N
CAN093-0933-0000	Total Petroleum Hydrocarbons (4)	325	1000	N
CAN093-0933-0028	Trichloroethene	0.0024	6	N
CAN093-0933-0028	Xylenes (total)	0.0035	20000	N
CAN093-0932-0000	Zinc	77.2	2000	N

NTF = No EPA Established Toxicity Factor

(1) All units in mg/kg

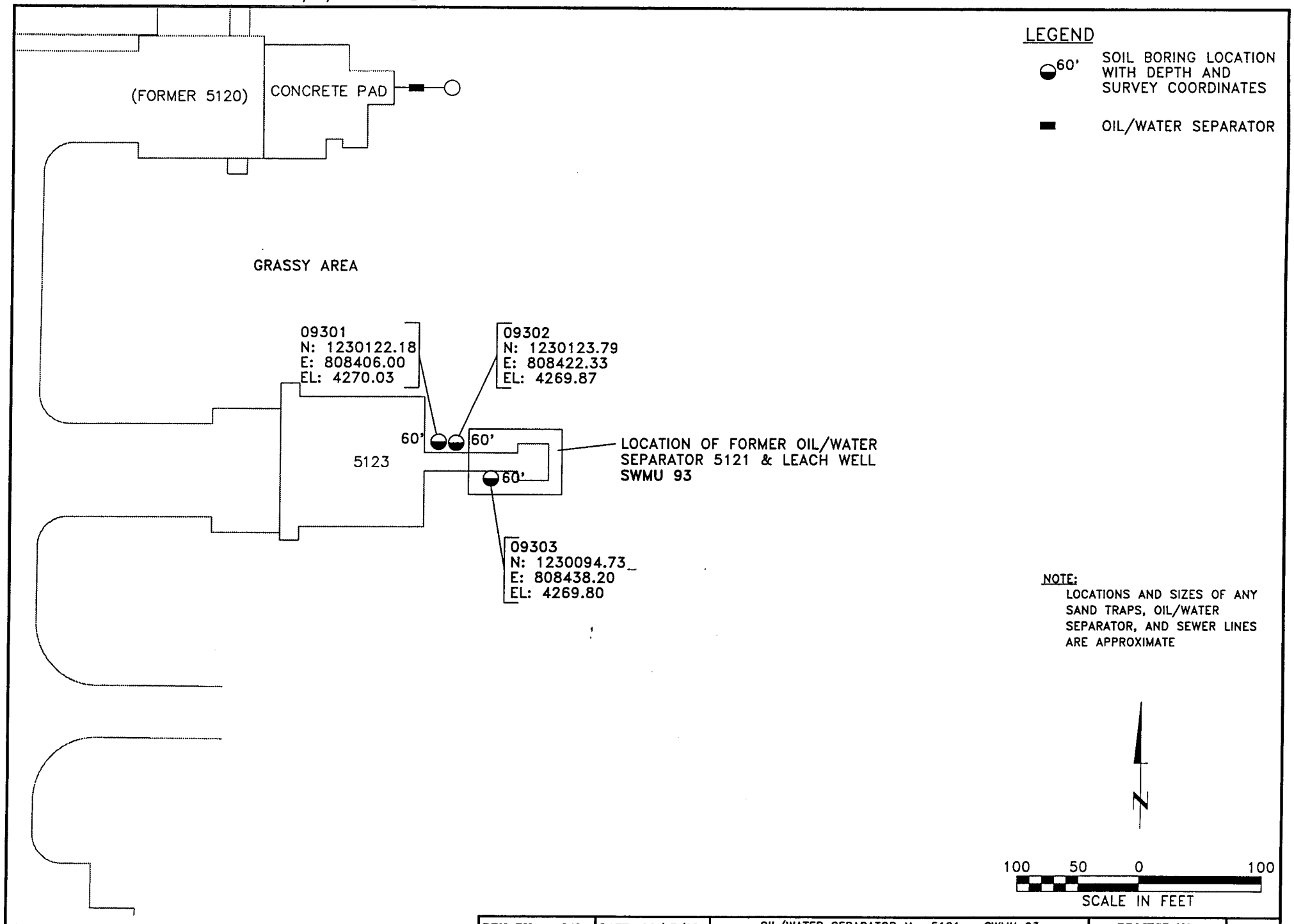
(2) Risk-based concentration

(3) EPA suggests 500-1,000 mg/kg as allowable concentration for residential soils based on EPA's IUBK Lead Model (EPA 1990)

(4) New Mexico recommended soil cleanup level for fuel contaminated soil.

Note: Only metals that exceeded background appear in this table.

CAD FILE: C3M11W08.DWG V=SWMU-93 11/22/1993 9:52



SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

DRN BY: CJG	DATE: 08/17/93	OIL/WATER SEPARATOR No. 5121 – SWMU 93 SITE PLAN AND BORING LOCATIONS CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO.	FIG. NO.
CHK'D BY: .	REVISION: 0		C3M11W	14–1

15.1 SITE BACKGROUND

15.1.1 Site Description

Facility 5144 is a two-bay vehicle wash rack located behind the Army, Air Force Exchange Service (AAFES) service station, east of the intersection of D.L. Ingram Street and Argentia Avenue. The facility has two sand traps within the limits of the concrete wash racks and a 1,700-gallon OWS located in a grassy area northeast of the wash rack (Figure 15-1). The sand traps measure about 3.5 feet by 8 feet in plan, and the OWS measures about 5 feet by 10 feet in plan. The exact depths of the units are not known, but are believed to be less than 10 feet.

15.1.2 Site History

Facility 5144 has been partially dismantled and is no longer used as a wash rack; however, the wash bays, sand traps, and the OWS remain in place. The OWS reportedly received wash-down water from personal vehicle washing operations. Any oils recovered were collected in the 1,700-gallon OWS and the wastewater was discharged to the sanitary sewer line. The sand traps and OWS were active from 1960 to approximately 1988, and their present contents are unknown. The unit originally identified as an OWS was actually found to be a sand trap. To avoid confusion with past reports, it is still referred to as an OWS throughout this report.

15.1.3 Current Use

The wash rack area is currently used to store rental moving trucks and trailers and as a covered parking area for employees in nearby buildings.

15.1.4 Potential Contaminants

Potential contaminants at these facilities include lubricating oils, fuels, greases, solvents, and metals.

15.2 FIELD INVESTIGATION AND DATA COLLECTION

15.2.1 Soils Sampling

The objective of sampling at the site of OWS 5144 and the two sand traps is to evaluate if a release of SWMU-related chemicals has occurred as a result of spillage or leakage from either the wash racks or the OWS.

Four 10-foot soil borings were drilled below the concrete wash racks to sample soils lying as close as possible to the sand traps. These borings were located on expansion joints in the wash rack to check for possible contaminant spillage entering the underlying soil at this point and at the sand trap outlet pipe. Two additional 10-foot borings were located as close as possible to the inlet and outlet pipes for the OWS. Close overhead clearances in the covered wash rack and overhead utilities forced the drilling of three borings with hand implements.

Soil samples were collected at the surface and the 0.5- to 2-foot, 2- to 4-foot, 4- to 6-foot, and 8- to 10-foot depth intervals to characterize the vertical distribution of potential contaminants which may have been released from the sand traps and OWS as specified in the Field Sampling Plan and the Sampling summary Tables. Samples were collected in accordance with QAPP SOP No. 6 - Surface Soil Sampling and QAPP SOP No. 7 - Subsurface Drilling and Sampling. Target analytes include VOCs, SVOCs, metals and TRPH. Surficial samples in the grass covered area around the OWS were collected at approximately 0.2 to .5 feet. Samples from the 0.5- to 2-foot depth interval were collected immediately below the concrete covering the wash rack. No surface staining of concrete or stressed vegetation was observed at this site.

15.2.2 Geologic Summary of Boring Logs

Soils encountered during the drilling of this SWMU is consistent at all boring locations. A brown silt/clay, stiff and dry with some angular gravel, was encountered in the upper 3 to 4.5 feet of all borings. This soil graded to a lighter yellowish-white clay with localized reddish mottling and increasing moisture with depth. Minor soil staining was detected in Borings 09404 and 09405 located on the wash racks. In neither case were indications of contamination observed below 1.5 feet in depth. See copies of the boring logs in Appendix B, Volume V.

15.2.3 Site Topography

Drainage from the uncovered wash rack is collected in the sand trap and directed to the OWS. The covered wash rack receives no consistent runoff. The area of the OWS grades slightly to the east towards a large, northwest-trending surface ditch.

15.3 CHEMICAL INVESTIGATION RESULTS

15.3.1 General

Samples were collected as identified in Section 13.2 to comply with permit and compliance agreement requirements. Soil samples were collected from 6 borings (09401, 09402, 09403, 09404, 09405 and 09406). Sampling and analyses performed are summarized in Table 15-1. A summary of the analytical results for these soil samples are provided in Table 15-2a for near-surface soils and Table 13-5b for subsurface soils. For each sample type, the tables provide results for analytes only if they were detected at least once in this type of sample collected at the SWMU. Complete analytical summary results are provided in the QCSR (Appendix A).

15.3.2 Organic Results For Near-surface Soil Samples

The near-surface soil samples collected at this SWMU (CAN094-0941-0000, CAN094-0941-0002, CAN094-0942-0000, CAN094-0942-0002, CAN094-0943-0000, CAN094-0943-0002, CAN094-0944-0000, CAN094-0944-0002, CAN094-0945-0000,

CAN094-0945-0002, CAN094-0946-0000, and CAN094-0946-0002) were analyzed for VOCs, SVOCs, metals and TPH as indicated in Table 15-1.

Other than acetone and methylene chloride, which were considered to be laboratory contaminants associated with this project (see Section 4.10.4 of the QCSR), ethylbenzene, 1,2-dichloropropane, 1,2-dichloroethane, tetrachloroethene, toluene and xylene were detected in associated samples. In sample CAN094-0941-0002 tetrachloroethene, ethylbenzene and 1,2-dichloroethane were detected at 25 μg/kg, 1.2 μg/kg and 2 μg/kg, respectively. 1,2-dichloropropane was detected at 27 μg/kg in sample CAN094-0946-0004. Ethylbenzene was also detected in sample CAN094-0944-0000 at 2.7 μg/kg. Ethylbenzene, toluene and xylene were detected in more than one of the associated samples. Toluene was detected in samplesCAN094-0944-0002,CAN094-0943-0000,CAN094-0946-0000,CAN094-0941-0000, CAN094-0946-0002, CAN094-0942-0000, CAN094-0941-0002 and CAN094-0941-0002 at 1.2 μg/kg, 1.4 μg/kg, 1.4 μg/kg, 6.1 μg/kg, 9 μg/kg, 10 μg/kg, 11 μg/kg and 49 μg/kg, respectively. Xylenes were detected in samples CAN094-0945-0000, CAN094-0941-0002, CAN094-0942-0000, CAN094-0944-0000 and CAN094-0941-0000 at 4 μg/kg, 4.2 μg/kg 4.7 μg/kg, 6.4 μg/kg and 9.4 μg/kg, respectively.

Other than bis(2-ethylhexyl)phthalate and di-n-butylphthalate which were considered common laboratory contaminants, results reported for SVOCs were primarily polycyclic aromatic hydrocarbons (PAHs) however butyl benzyl phthalate, dibenzofuran and pentachlorophenol were also reported. The PAHs which were detected in samples CAN094-0942-0000, CAN094-0941-0000 and CAN094-0945-0000 are as follows: anthracene benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, chrysene, fluoranthene, fluorene,indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene and pyrene. The total PAH concentrations for CAN094-0945-0000, CAN094-0941-0000, and CAN094-0942-0000 were 990 μg/kg, 1810 μg/kg and 2757 μg/kg, respectively. Benzo butyl phthalate was detected in sample CAN094-0941-0000 at 48 μg/kg. In sample CAN094-0945-0000 dibenzofuran and in sample CAN094-0943-0000 pentachlorophenol were detected at 160 μg/kg and 74 μg/kg, respectively. Petroleum hydrocarbons were detected in seven of the twelve near-surface samples with a concentration range of 61.3 mg/kg for CAN094-0943-0002 to 3600 mg/kg for CAN094-0945-0000.

15.3.3 Organic Results For Subsurface Soil Samples

The subsurface soil samples collected at this SWMU (CAN094-0941-0004, CAN094-0941-0008, CAN094-0942-0004, CAN094-0942-0008, CAN094-0943-0004, CAN094-0943-0008, CAN094-0944-0004, CAN094-0944-0008, CAN094-0945-0004, CAN094-0945-0008, CAN094-0946-0004 and CAN094-0946-0008) were analyzed for VOCs, SVOCs, metals and TPH as indicated in Table 15-1. Other than acetone, 2-butanone and methylene chloride which are considered common laboratory contaminants, the only VOC detected in subsurface samples was toluene. Toluene was detected in samples CAN094-0941-0008, CAN094-0946-0004, CAN094-0944-0004 and CAN094-0946-0008 at 1.3 μg/kg, 1.9 μg/kg, 4.3 μg/kg and 6.2 μg/kg. Petroleum hydrocarbons were detected in samples CAN094-0942-0008, CAN094-0943-0004, and CAN094-0943-0008 at 51.4 mg/kg, 86.2 mg/kg and 91.7 mg/kg.

15.3.4 Inorganic Results

Metals analyses were performed on samples collected from this SWMU as indicated in Table 15-1. The range of results for metals reported in these soil samples are summarized in Table 15-A.

TABLE 15-A

Analyte	Frequency Reported	Lowest Detection	Sample Location	Highest Detection	Sample Location
Aluminum	24/24	2900 mg/kg	0941-0004	10,500 mg/kg	0945-0002
Antimony	1/24	10.6 mg/kg	0945-0008	(Only detection)	
Arsenic	24/24	1.3 mg/kg	0945-0008	3.3 mg/kg	0941-0002
Barium**	16/24	104 mg/kg	0943-0000	1640 mg/kg	0942-0004
Beryllium	19/24	0.23 mg/kg	0941-0002	0.88 mg/kg	0942-0004
Cadmium	9/24	0.8 mg/kg	0944-0000	2.9 mg/kg	0944-0002
Calcium	24/24	4840 mg/kg	0945-0002	233,000 mg/kg	0942-0004
Chromium	18/24	1.9 mg/kg	0945-0004	11.5 mg/kg	0941-0000
Cobalt	20/24	1.7 mg/kg	0944-0000	5.4 mg/kg	0945-0002
Copper	22/24	1.8 mg/kg	0945 0008	11.2 mg/kg	0941-0000
Iron	24/24	2490 mg/kg	0941-0004	10,800 mg/kg	0945-0002
Lead	24/24	2.6 mg/kg	0946-0004	99.2 mg/kg	0942-0000
Magnesium	24/24	1270 mg/kg	0946-0000	3290 mg/kg	0942-0004
Manganese	24/24	31.2 mg/kg	0942-0004	233 mg/kg	0945-0002
Mercury	4/24	0.12 mg/kg	0942-0002	0.48 mg/kg	0941-0000
Nickel	21/24	4.2 mg/kg	0945-0004	11.3 mg/kg	0945-0002
Potassium	23/24	499 mg/kg	0942-0004	1830 mg/kg	0945-0002
Selenium	3/24	0.26 mg/kg	0945-0002	0.34 mg/kg	0945-0000
Silver	5/24	0.51 mg/kg	0944-0004	3 mg/kg	0944-0002
Sodium	3/24	210 mg/kg	0941-0000	332 mg/kg	0941-0002
Thallium	2/24	0.13 mg/kg	0945-0002	0.14 mg/kg	0946-0002
Vanadium	24/24	8.7 mg/kg	0946-0004	23.9 mg/kg	0943-0000
Zinc	23/24	7.4 mg/kg	0942-0004	84.8 mg/kg	0942-0000

Note: See Table 15-3 for comparison to background.

**Barium results were rejected for the following samples: CAN094-0946-0004, CAN094-0946-0008, CAN094-0945-0000, CAN094-0945-0002, CAN094-0945-0004, CAN094-0945-0008, CAN094-0946-0000, and CAN094-0946-0002.

15.4 SWMU-SPECIFIC DATA ASSESSMENT

15.4.1 General

This assessment of OWS 5144 data is an evaluation of quality issues that could affect the major data uses. In general, the objective of the RFI was identification and quantification of the nature and extent of the contamination, which was necessary to meet permit and compliance agreement requirements, and to support an evaluation of the risk to human health and the environment.

15.4.2 Sampling Issues

A review of the data contained in the log books and the Daily Quality Control Reports (DQCR) for SWMU 94 indicate that there were no sampling issues that would impact data usability. QC issues are discussed in the QCSR in Appendix A, and copies of the DQCRs are included in that appendix.

15.4.3 Data Review Issues

For laboratory analytical data, QA/QC objectives were specified in the Cannon AFB QAPP (W-C 1993). The objectives were used as indicators of the quality necessary to support identification and quantitation of potential chemicals of concern. The data review is presented in Section 4.9 of the Quality Control Summary Report (QCSR) located in Appendix A. As presented in the QCSR, data for the analytes aluminum, barium, calcium, selenium, thallium, chromium, iron, manganese, silver, lead, potassium, zinc, several VOCs, and several SVOCs were qualified as estimated concentrations and manganese data were qualified rejected. Barium data were rejected for eight of the twenty-four samples analyzed.

Selenium, thallium, silver, and barium (for three of the twenty-four samples analyzed) data were qualified estimated to indicate a potential low bias, and manganese data were qualified estimated to indicate a potential high bias. Lead data were qualified estimated to indicate a potential high bias in some samples and a potential low bias in other samples. Also VOC data for sample CAN094-0941-0002 were qualified estimated to indicate a potential high bias. When a low bias is indicated, actual concentrations may be higher than the reported results. Use of this data in risk assessment may underestimate risk. Similarly, when a high bias is indicated, actual concentrations may be lower than the reported results. Use of this data in risk assessment may overestimate risk.

Aluminum, calcium, barium, chromium, iron, manganese, potassium, zinc, toluene and pyrene data were qualified estimated, in field duplicate pairs, due to precision that did not meet the QA\QC criteria defined for this project. Poor precision could be attributed to errors in sampling and analysis; however, since the other analytes which were sampled and analyzed in the same procedure (Method 6010) met QA/QC criteria, this variation is likely due to sample heterogeneity.

Several VOCs and SVOCs' data were qualified estimated because the internal standards did not meet the QA/QC criteria, indicating the GC/MS was less sensitive towards these compounds. Estimation of this data does not impact the usability of the data.

For ICP metals analyses, the only indicator of data accuracy is the results of the matrix spike. Barium data were rejected based on MS/MSD recoveries over 200% which is considerably above the criteria defined for this project. Because the accuracy criteria have been exceeded, it can not be determined whether the identification of barium can be relied upon; therefore, the data were rejected.

The uncertainty in the actual concentration reported for estimated data does not affect the usability of the data for identification of chemicals in characterizing the nature and extent of contamination at this SWMU.

15.4.4 Limitations

Elevated reporting limits may limit the usability of the data due to low level analytes being diluted to below the instrument detection limits. That is, chemicals may be reported as nondetect when they are actually present in a sample at low levels. Section 4.9.6 of the QCSR (Appendix A) presents a discussion of elevated reporting limits. Only lead analyses had elevated reporting limits. The elevated reporting limits for lead does not impact on the usability of the associated data because the analytes were reported above elevated reporting limits and the reporting limits were not elevated by a factor greater than 100.

15.4.5 Summary

Overall, data generated during the study of SWMU 94 were determined to meet quality criteria. In conjunction with the analytical data review, other information including field observations were evaluated in the assessment of the usability of SWMU 94 data. The data support identification of the nature and extent of contamination, except for barium data, and provide reasonable concentration for use in risk assessment.

15.5 NATURE AND EXTENT OF CONTAMINATION

SWMU 94 is an OWS with two sand traps serving an auto wash rack behind the AAFES service station. The OWS and sand traps are no longer used, but they are still in place. Two borings were advanced to a depth of 10 feet adjacent to each of the units. In general the samples appeared relatively free of organic contamination. There was no visible evidence of spills or leaks in the vicinity. The entire area around each sand trap (the wash racks) is paved, and the area around the OWS is grassy. Except for minor petroleum staining in the upper foot of soil around the sand traps no evidence of contamination was encountered during sampling. The chemical test results show low levels of organic contamination, including PAHs and TPH predominantly in the shallow samples.

15.6 COMPARISON OF METALS CONCENTRATIONS TO BACKGROUND

Results of the comparison of metal concentration in soil to background levels for SWMU 94 are given in Table 15-3. A summary of the results of the comparison is presented here.

Metals are natural constituents of soils. SWMU concentrations of metal were evaluated to assess whether the metals in environmental samples exceed background levels. Metals that occur in concentrations within background levels are not considered SWMU-related chemicals of concern and are not evaluated further.

The maximum concentration of each detected metal at each SWMU was compared to the upper tolerance limit of the background data. The upper tolerance limit (UTL) was defined as the mean plus two times the standard deviation. This is for all practical purposes equal to the 90% upper confidence limit of the 95th percentile which is equal to the mean plus the standard deviation times the k statistic. The background data set used consisted of 37 data points (W-C 1993), so the k statistic equals 2.02 (Gilbert 1987).

The maximum detected concentrations of antimony, barium, beryllium, cadmium, cobalt, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc exceeded the (UTL) of the background data. Therefore, these metals will be compared to risk-based concentrations at SWMU 94.

15.7 RISK SCREENING

15.7.1 Exposure Pathway Flow Chart

The Preliminary Exposure Pathway Flow Chart (EPFC) applicable to SWMU 94, Oil/Water Separator No. 94, is shown in Figure 3-2. It shows that the potential exposure pathways are ingestion of soil, inhalation of soil particulates, dermal exposure to contaminated soil, inhalation of airborne chemicals released from soil, and ingestion, inhalation and dermal exposure to groundwater (if drinking water supplies were affected). Storm water runoff is considered to be an insignificant pathway because potential spills would be minor and over a small area.

15.7.2 Screening of Contaminants Against RBCs (and other criteria)

Maximum detected concentrations of organic compounds and metals that exceeded background were compared to screening-level RBCs (see Section 3.4.5.1 for derivations of RBCs) and other screening criteria in Table 15-4. Screening-level criteria other than RBCs include the state of New Mexico's TPH cleanup level of 1,000 mg/kg (New Mexico Environmental Improvement Board 1993) and the EPA's recommended soil lead level of 500 mg/kg (EPA 1990). The TPH soil clean-up concentration of 1,000 mg/kg is not an RBC, nor is it a relevant-and-applicable standard for the SWMUs in this investigation. Rather it is a conservative value originally derived for the cleanup of fuel-contaminated soils at underground storage tank sites. Risk-based concentrations for TPH, measured as fresh fuels (e.g., gasoline or diesel), are at least an order of magnitude higher for occupational exposures. The concentration of 500 mg/kg is the most conservative concentration in the recommended range of 500 mg/kg to 1,000 mg/kg as a lead level in residential soil based on EPA's Uptake Biokinetic Model (EPA 1990). Compounds with no toxicity factors cannot be evaluated in the risk screening since RBCs cannot be calculated. These compounds, at the concentrations that were measured in soil, are not likely to significantly affect the results of the comparison to RBCs. The comparison for SWMU 94 shows that maximum detected concentrations of antimony, barium, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, beryllium, indeno(1,2,3-cd)pyrene, and TPH exceed RBCs.

This comparison of maximum detected concentrations to RBCs is very conservative (health-protective) and actual impacts are likely to be lower than those suggested by exceedances of conservative criteria. For example, maximum detected concentrations are likely to overestimate actual concentrations to which people would be exposed. Furthermore, the screening criteria are based on highly conservative residential exposure assumptions and target risk levels that may not be pertinent to current or future use of the SWMU. The RBCs used in this evaluation are calculated using RCRA Action Level methodology; however, the RBCs are more health-protective than conventional RCRA Action Levels because a target excess cancer risk level of 1×10^{-7} (1 in 10,000,000) and a hazard quotient of 0.1 were used to account for exposures to multiple chemicals and for exposure routes other than soil ingestion. Conventional RCRA Action Levels are calculated based on a cancer risk of 1×10^{-6} and a noncancer hazard of 1.0.

The purpose of the comparison to RBCs is to determine whether or not chemical releases (characterized by maximum detected concentrations) have occurred at SWMU 94 that could pose potential risks based on conservative health-based criteria. Since maximum concentrations of the above listed chemicals exceed screening level criteria, further evaluation or investigation of chemical concentrations and probable exposures is warranted. The results of the comparison of maximum detected concentrations with screening-level RBCs indicate that it is unlikely that a risk assessment will result in a risk level that will require remedial action (i.e., only a few chemicals slightly exceed the RBCs).

15.8 SUMMARY AND RECOMMENDATIONS

Twenty-four soil samples were collected and analyzed from six 10-foot deep soil borings at SWMU 94. Maximum detected concentrations were compared to background levels and RBCs. Four organics, TPH and three metals were found at levels that exceed RBCs or other screening-level criteria.

The highest concentrations for the organics and TPH were found in the near-surface samples. The highest concentration for barium was at four feet and decreased to within background concentrations with depth. The vertical extent of contamination has been characterized by the borings, and the potential for groundwater beneath SWMU 94 to be impacted can be characterized. The potential for impacts to groundwater is considered to be low because the depth to groundwater is greater than 200 feet, and sampling demonstrates that contaminants

are not being significantly transported vertically below the SWMU. Therefore, it is concluded that the available data are sufficient to complete a BRA. Therefore a risk assessment is recommended.

TABLE 15-1

SUMMARY OF ANALYTICAL AND QA/QC SAMPLING
OIL/WATER SEPARATOR NO. 5144 (SWMU NO. 94)
CANNON AFB, NEW MEXICO

Sample Location	Target Interval (ft-bgs)	Sample Identification Number	QA/QC Type	Sample Matrix	Analytical Parameters				Sample Containers		
					VOCs	SVOCs	Metals	TRPH	40 ml VOA vials	4 oz. jars	8 oz. jars
Boring 09401	0 - 0.5	CAN094-0941-0000		Soil	X	X	X	X		2	1
	0 - 0.5	CAN094-0941-9461	FD	Soil	X	X	X	X		2	1
	0 - 0.5	CAN094-0941-9401	MRD	Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN094-0941-0002		Soil	X		X	X		2	1
	4 - 6	CAN094-0941-0004		Soil	X	X	X	X		2	1
	8 - 10	CAN094-0941-0008		Soil	X		X	X		2	1
		CAN094-0941-9451	AB	Water	X				2		
		CAN094-0941-9471	RB	Water	X				2		
		CAN094-0941-9481	DW	Water	X				2		
		CAN094-0941-9491	TB	Water	X				2		
Boring 09402	0 - 0.5	CAN094-0942-0000		Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN094-0942-0002		Soil	X		X	X		2	1
	4 - 6	CAN094-0942-0004		Soil	X		X	X		2	1
	8 - 10	CAN094-0942-0008		Soil	X	X	X	X		2	1
	8 - 10	CAN094-0942-9462	FD	Soil	X		X	X		2	1
	8 - 10	CAN094-0942-9402	MRD	Soil	X	X	X	X		2	1
Boring 09403	0.5 - 2	CAN094-0943-0000		Soil	X	X	X	X		2	1
	2 - 4	CAN094-0943-0002		Soil	X		X	X		2	1
	4 - 6	CAN094-0943-0004		Soil	X		X	X		2	1
	8 - 10	CAN094-0943-0008		Soil	X	X	X	X		2	1
	8 - 10	CAN094-0943-6008	MS/MSD SVOC only	Soil		X					1
Boring 09404	0.5 - 2	CAN094-0944-0000		Soil	X		X	X		2	1
	2 - 4	CAN094-0944-0002		Soil	X		X	X		2	1
	4 - 6	CAN094-0944-0004		Soil	X		X	X		2	1
	4 - 6	CAN094-0944-6004	MS/MSD	Soil	X		X	X		2	2
	8 - 10	CAN094-0944-0008		Soil	X		X	X		2	1

TABLE 15-1

SUMMARY OF ANALYTICAL AND QA/QC SAMPLING
OIL/WATER SEPARATOR NO. 5144 (SWMU NO. 94)
CANNON AFB, NEW MEXICO

Sample Location	Target Interval (ft-bgs)	Sample Identification Number	QA/QC Type	Sample Matrix	Analytical Parameters				Sample Containers		
					VOCs	SVOCs	Metals	TRPH	40 ml VOA vials	4 oz. jars	8 oz. jars
Boring 09405	0.5 - 2	CAN094-0945-0000		Soil	X	X	X	X		2	1
	2 - 4	CAN094-0945-0002		Soil	X		X	X		2	1
	4 - 6	CAN094-0945-0004		Soil	X		X	X		2	1
	8 - 10	CAN094-0945-0008		Soil	X		X	X		2	1
Boring 09406	0.5 - 2	CAN094-0946-0000		Soil	X		X	X		2	1
	2 - 4	CAN094-0946-0002		Soil	X		X	X		2	1
	4 - 6	CAN094-0946-0004		Soil	X		X	X		2	1
	8 - 10	CAN094-0946-0008		Soil	X	X	X	X		2	1
	8 - 10	CAN094-0946-6008	MS/MSD	Soil	X	X	X	X		2	2

AB = Ambient blank
DW = Decontamination water
FB = Field blank
MRD = Missouri River Division
MS/MSD = Matrix spike/matrix spike duplicate
RB = Rinsate blank
TB = Trip blank

See Figure 15-1 for locations of the borings.

TABLE 15-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 94

LOCATOR	CAN094-0941-0000			CAN094-0941-0002			CAN094-0942-0000			CAN094-0942-0000			CAN094-0942-0002			CAN094-0943-0000		
LAB SAMPLE NUMBER	0314020002SA			0314020003SA			0312160017SA			0314020006SA			0312160018SA			0314010009SA		
COLLECT DATE	09/24/93			09/24/93			09/24/93			09/24/93			09/13/93			09/23/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)																		
1,2-Dichloroethane	<	5.1	U	2	5.3	J				<	5.3	U	<	5.6	U	<	5.9	U
Ethylbenzene	<	5.1	U	1.2	5.3	J				<	5.3	UJ	<	5.6	U	<	5.9	U
Tetrachloroethene	<	5.1	U	25	5.3	J				<	5.3	UJ	<	5.6	U	<	5.9	U
Toluene	6.1	5.1	J	49	5.3	J				10	5.3	J	<	5.6	U	1.4	5.9	J
Xylenes (total)	9.4	5.1		4.2	5.3	J				4.7	5.3	J	<	5.6	U	<	5.9	U
Semivolatile Organics (ug/kg)																		
Anthracene	<	340	U				37	360	J							<	390	U
Benzo(a)anthracene	110	340	J				230	360	J							<	390	U
Benzo(a)pyrene	170	340	J				340	360	J							<	390	U
Benzo(b)fluoranthene	230	340	J				550	360								<	390	U
Benzo(g,h,i)perylene	160	340	J				160	360	J							<	390	U
Butyl benzyl phthalate	48	340	J				<	360	U							<	390	U
Chrysene	180	340	J				350	360	J							<	390	U
Dibenzofuran	<	340	U				<	360	U							<	390	U
Fluoranthene	200	340	J				440	360								<	390	U
Fluorene	<	340	U				<	360	U							<	390	U
Indeno(1,2,3-cd)pyrene	110	340	J				140	360	J							<	390	U
2-Methylnaphthalene	<	340	U				<	360	U							<	390	U
Pentachlorophenol	<	1600	U				<	1800	U							74	1900	J
Naphthalene	<	340	U				<	360	U							<	390	U

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.

A complete summary of chemical results are presented in Appendix A

J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 15-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 94

LOCATOR	CAN094-0941-0000			CAN094-0941-0002			CAN094-0942-0000			CAN094-0942-0000			CAN094-0942-0002			CAN094-0943-0000		
LAB SAMPLE NUMBER	0314020002SA			0314020003SA			0312160017SA			0314020006SA			0312160018SA			0314010009SA		
COLLECT DATE	09/24/93			09/24/93			09/24/93			09/24/93			09/13/93			09/23/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Phenanthrene	150	340	J				240	360	J							<	390	U
Pyrene	410	340	J				360	360								<	390	U
Metals (mg/kg)																		
Aluminum	3630	10.3		3060	21.1		3830	11					8990	11.3		8670	11.8	
Arsenic	2.7	0.51		3.3	0.53		2.4	0.55					1.9	0.56		2.6	0.59	
Barium	246	1	J	511	2.1		166	1.1					131	1.1		104	1.2	
Beryllium	0.32	0.21		0.23	0.42	J	<	0.22	U				0.44	0.23		0.58	0.24	
Cadmium	1.8	0.51		2	1.1		0.91	0.55					<	0.56	U	<	0.59	U
Calcium	59100	20.5		106000	42.2		61000	22					70200	22.5		26400	23.5	
Chromium	11.5	1	J	3.7	2.1		5.9	1.1					6	1.1		7.9	1.2	
Cobalt	2.3	1		2.1	2.1		2.6	1.1					3.5	1.1		4.4	1.2	
Copper	11.2	2.1		7.7	4.2		10.1	2.2					6.6	2.3		8	2.4	
Iron	5200	10.3		3280	21.1		4510	11					6480	11.3		8290	11.8	
Lead	61.5	5.1		14.6	2.6		99.2	11					5.6	1.1		6.7	0.59	
Magnesium	2000	20.5		3290	42.2		1780	22					2540	22.5		1960	23.5	
Manganese	189	1	J	184	2.1		142	1.1					134	1.1		165	1.2	
Mercury	0.48	0.1		0.26	0.11		0.3	0.11					0.12	0.11		<	0.12	U
Nickel	5.6	4.1		6.3	8.4	J	5.8	4.4					7.9	4.5		8.9	4.7	
Potassium	1430	513	J	997	1060	J	1360	550					1790	564		1660	588	
Selenium	<	0.51	U	<	1.1	UJ	<	0.55	U				<	1.1	UJ	<	0.59	U
Silver	0.54	1	J	<	2.1	U	<	1.1	U				<	1.1	U	<	1.2	U
Sodium	210	513	J	332	1060	J	<	550	U				<	564	U	<	588	U
Thallium	<	0.51	U	<	1.1	UJ	<	0.55	U				<	1.1	UJ	<	0.59	U

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TABLE 15-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 94

LOCATOR	CAN094-0941-0000			CAN094-0941-0002			CAN094-0942-0000			CAN094-0942-0000			CAN094-0942-0002			CAN094-0943-0000		
LAB SAMPLE NUMBER	0314020002SA			0314020003SA			0312160017SA			0314020006SA			0312160018SA			0314010009SA		
COLLECT DATE	09/24/93			09/24/93			09/24/93			09/24/93			09/13/93			09/23/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Vanadium	13.5	1		12.8	2.1		11.1	1.1					13.4	1.1		23.9	1.2	
Zinc	56.3	2.1	J	21.5	4.2		84.8	2.2					18.9	2.3		19	2.4	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	862	82.1		3250	422		247	44					<	45.1	U	<	47	U
Water Quality (percent)																		
Water	2.6	0.1		5.2	0.1		9.1	0.1		5.2	0.1		11	0.1		15	0.1	

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TABLE 15-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 94

LOCATOR	CAN094-0943-0002			CAN094-0944-0000			CAN094-0944-0002			CAN094-0945-0000			CAN094-0945-0002			CAN094-0946-0000		
LAB SAMPLE NUMBER	0314010010SA			0314040007SA			0314040008SA			0311810017SA			0311810018SA			0311810013SA		
COLLECT DATE	09/23/93			09/23/93			09/23/93			09/11/93			09/11/93			09/11/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)																		
1,2-Dichloroethane	<	5.8	U	<	5.9	U	<	5.9	U	<	6	U	<	5.8	U	<	6	U
Ethylbenzene	<	5.8	U	2.7	5.9	J	<	5.9	U	<	6	U	<	5.8	U	<	6	U
Tetrachloroethene	<	5.8	U	<	5.9	U	<	5.9	U	<	6	U	<	5.8	U	<	6	U
Toluene	<	5.8	U	<	5.9	U	1.2	5.9	J	<	6	U	<	5.8	U	1.4	6	J
Xylenes (total)	<	5.8	U	6.4	5.9		<	5.9	U	4	6	J	<	5.8	U	<	6	U
Semivolatile Organics (ug/kg)																		
Anthracene										<	400	U						
Benzo(a)anthracene										<	400	U						
Benzo(a)pyrene										<	400	U						
Benzo(b)fluoranthene										<	400	U						
Benzo(g,h,i)perylene										<	400	UJ						
Butyl benzyl phthalate										<	400	U						
Chrysene										<	400	UJ						
Dibenzofuran										160	400	J						
Fluoranthene										<	400	U						
Fluorene										320	400	J						
Indeno(1,2,3-cd)pyrene										<	400	UJ						
2-Methylnaphthalene										3800	400							
Pentachlorophenol										<	1900	U						
Naphthalene										430	400							

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U = Nondetected value. RL = Reporting Limit.

TABLE 15-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 94

LOCATOR	CAN094-0943-0002			CAN094-0944-0000			CAN094-0944-0002			CAN094-0945-0000			CAN094-0945-0002			CAN094-0946-0000		
LAB SAMPLE NUMBER	0314010010SA			0314040007SA			0314040008SA			0311810017SA			0311810018SA			0311810013SA		
COLLECT DATE	09/23/93			09/23/93			09/23/93			09/11/93			09/11/93			09/11/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Phenanthrene										240	400	J						
Pyrene										<	400	U						
Metals (mg/kg)																		
Aluminum	4500	23.1		7820	11.7		3710	58.9		8400	12		10500	11.5		7160	12	
Arsenic	2	0.58		2.6	0.59		1.8	0.59		2.9	0.6		2.3	0.58		2.6	0.6	
Barium	185	2.3		218	1.2	J	146	5.9	J			R			R			R
Beryllium	0.49	0.46		0.45	0.23		<	1.2	U	0.44	0.24		0.74	0.23		0.45	0.24	
Cadmium	<	1.2	U	0.8	0.59		2.9	2.9		<	0.6	U	<	0.58	U	<	0.6	U
Calcium	125000	46.2		38700	23.4		216000	118		12400	24		4840	23		7840	23.9	
Chromium	<	2.3	U	9.2	1.2		<	5.9	U	9.5	1.2		11.3	1.2		7.9	1.2	
Cobalt	3.1	2.3		1.7	1.2		<	5.9	U	3.2	1.2		5.4	1.2		2.5	1.2	
Copper	4.9	4.6		9.9	2.3		2.2	11.8	J	6.7	2.4		8.2	2.3		5.2	2.4	
Iron	4420	23.1		6280	11.7		3500	58.9		8890	12		10800	11.5		6680	12	
Lead	5.3	0.58		15.2	1.2		3.5	0.59		12.5	1.2	J	7.7	0.58	J	7.5	0.6	J
Magnesium	1880	46.2		2640	23.4		2480	118		1510	24		2250	23		1270	23.9	
Manganese	98.6	2.3		106	1.2		39.7	5.9		86.3	1.2	J	233	1.2	J	61.6	1.2	J
Mercury	<	0.12	U	<	0.12	U	<	0.12	U	<	0.12	U	<	0.12	U	<	0.12	U
Nickel	7.1	9.2	J	5.8	4.7		<	23.5	U	7.1	4.8		11.3	4.6		5.4	4.8	
Potassium	1040	1150	J	1750	585		694	2940	J	1350	600		1830	575		1170	598	
Selenium	<	1.2	UJ	<	1.2	UJ	<	1.2	UJ	0.34	0.6	J	0.26	0.58	J	0.27	0.6	J
Silver	<	2.3	U	0.52	1.2	J	3	5.9	J	<	1.2	UJ	<	1.2	UJ	<	1.2	UJ
Sodium	<	1150	U	<	585	U	<	2940	U	<	600	U	<	575	U	<	598	U
Thallium	<	1.2	UJ	<	0.59	U	<	1.2	UJ	<	1.2	UJ	0.13	1.2	J	<	1.2	UJ

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A complete summary of chemical results are presented in Appendix A

J = Estimated value.

R = Rejected value. QUAL=Qualification

U = Nondetected value. RL = Reporting Limit.

TABLE 15-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 94

LOCATOR	CAN094-0943-0002			CAN094-0944-0000			CAN094-0944-0002			CAN094-0945-0000			CAN094-0945-0002			CAN094-0946-0000		
LAB SAMPLE NUMBER	0314010010SA			0314040007SA			0314040008SA			0311810017SA			0311810018SA			0311810013SA		
COLLECT DATE	09/23/93			09/23/93			09/23/93			09/11/93			09/11/93			09/11/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Vanadium	12.9	2.3		13.4	1.2		11.7	5.9		18.5	1.2		21.4	1.2		15.3	1.2	
Zinc	12.9	4.6		23.6	2.3		11.2	11.8	J	27.2	2.4		23.6	2.3		17.3	2.4	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	61.3	46.2		221	46.8		<	47.1	U	3600	480		<	46	U	251	47.8	
Water Quality (percent)																		
Water	13	0.1		15	0.1		15	0.1		17	0.1		13	0.1		16	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A

J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 15-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 94

LOCATOR	CAN094-0946-0002		
LAB SAMPLE NUMBER	0311810014SA		
COLLECT DATE	09/11/93		
	Result	RL	Qual
Volatile Organics (ug/kg)			
1,2-Dichloroethane	<	5.9	UJ
Ethylbenzene	<	5.9	U
Tetrachloroethene	<	5.9	U
Toluene	9	5.9	
Xylenes (total)	<	5.9	U
Semivolatile Organics (ug/kg)			
Anthracene			
Benzo(a)anthracene			
Benzo(a)pyrene			
Benzo(b)fluoranthene			
Benzo(g,h,i)perylene			
Butyl benzyl phthalate			
Chrysene			
Dibenzofuran			
Fluoranthene			
Fluorene			
Indeno(1,2,3-cd)pyrene			
2-Methylnaphthalene			
Pentachlorophenol			
Naphthalene			

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review

A complete summary of chemical results are presented in Appendix A

J = Estimated value.
R = Rejected value.
U = Nondetected value.

QUAL=Qualification
RL = Reporting Limit.

TABLE 15-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 94

LOCATOR	CAN094-0946-0002		
LAB SAMPLE NUMBER	0311810014SA		
COLLECT DATE	09/11/93		
	Result	RL	Qual
Phenanthrene			
Pyrene			
Metals (mg/kg)			
Aluminum	8090	11.7	
Arsenic	2.6	0.59	
Barium			R
Beryllium	0.63	0.23	
Cadmium	<	0.59	U
Calcium	14800	23.5	
Chromium	9	1.2	
Cobalt	4.6	1.2	
Copper	7.3	2.3	
Iron	8870	11.7	
Lead	8.2	0.59	J
Magnesium	2070	23.5	
Manganese	198	1.2	J
Mercury	<	0.12	U
Nickel	10	4.7	
Potassium	1530	587	
Selenium	<	0.59	U
Silver	<	1.2	UJ
Sodium	<	587	U
Thallium	0.14	1.2	J

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TABLE 15-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 94

LOCATOR	CAN094-0946-0002		
LAB SAMPLE NUMBER	0311810014SA		
COLLECT DATE	09/11/93		
	Result	RL	Qual
Vanadium	18	1.2	
Zinc	20.2	2.3	
TPH (mg/kg)			
Total Petroleum Hydrocarbons	<	46.9	U
Water Quality (percent)			
Water	15	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review

A complete summary of chemical results are presented in Appendix A

J = Estimated value.

R = Rejected value.

QUAL=Qualification

TABLE 15-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 94

LOCATOR	CAN094-0941-0004			CAN094-0941-0008			CAN094-0942-0004			CAN094-0942-0008			CAN094-0943-0004			CAN094-0943-0008		
LAB SAMPLE NUMBER	0314020004SA			0314020005SA			0312160019SA			0312160020SA			0314010011SA			0314010012SA		
COLLECT DATE	09/24/93			09/24/93			09/13/93			09/13/93			09/23/93			09/23/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)																		
1,2-Dichloropropane	<	5.8	U	<	5.6	U	<	6	U	<	6.3	U	<	5.7	U	<	5.6	U
Toluene	11	5.8		1.3	5.6	J	<	6	U	<	6.3	U	<	5.7	U	<	5.6	U
Metals (mg/kg)																		
Aluminum	2900	23.4		3250	22.5		3510	60.4		3400	25.1	J	6120	22.8		3950	11.3	
Antimony	<	14	U	<	13.5	U	<	36.2	U	<	15	U	<	13.7	U	<	6.8	U
Arsenic	1.9	0.58		1.5	0.56		1.4	0.6		1.5	0.63		1.9	0.57		1.6	0.56	
Barium	133	2.3		233	2.2		1640	6		296	2.5	J	117	2.3		472	1.1	
Beryllium	0.31	0.47	J	0.25	0.45	J	0.88	1.2	J	<	0.5	U	0.58	0.46		0.47	0.23	
Cadmium	2.4	1.2		1.4	1.1		<	3	U	<	1.3	U	<	1.1	U	<	0.56	U
Calcium	213000	46.7		118000	44.9		233000	121		178000	50.1	J	102000	45.7		83400	22.5	
Chromium	3.9	2.3		<	2.2	U	<	6	U	<	2.5	UJ	5.6	2.3		2.7	1.1	
Cobalt	2.4	2.3		<	2.2	U	<	6	U	2	2.5	J	3.7	2.3		2.6	1.1	
Copper	4.5	4.7	J	2.3	4.5	J	<	12.1	U	2.8	5	J	5.5	4.6		3.1	2.3	
Iron	2490	23.4		2940	22.5		2790	60.4		2900	25.1	J	6260	22.8		3650	11.3	
Lead	2.8	0.58		3.3	0.56		3.1	3		3	0.63		5.8	0.57		4.8	0.56	
Magnesium	2230	46.7		3160	44.9		3290	121		2780	50.1		2540	45.7		2880	22.5	
Manganese	37.7	2.3		48.5	2.2		31.2	6		38.4	2.5	J	141	2.3		113	1.1	
Nickel	4.3	9.3	J	4.7	9	J	<	24.2	U	4.8	10	J	9.3	9.1		6.4	4.5	
Potassium	533	1170	J	1010	1120	J	499	3020	J	842	1250	J	1310	1140		938	563	
Silver	1.2	2.3	J	<	2.2	U	<	6	U	<	2.5	U	<	2.3	U	<	1.1	U

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A

J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 15-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 94

LOCATOR	CAN094-0941-0004			CAN094-0941-0008			CAN094-0942-0004			CAN094-0942-0008			CAN094-0943-0004			CAN094-0943-0008		
LAB SAMPLE NUMBER	0314020004SA			0314020005SA			0312160019SA			0312160020SA			0314010011SA			0314010012SA		
COLLECT DATE	09/24/93			09/24/93			09/13/93			09/13/93			09/23/93			09/23/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Sodium	<	1170	U	316	1120	J	<	3020	U	<	1250	U	<	1140	U	<	563	U
Vanadium	9.4	2.3		13.8	2.2		10.8	6		9.6	2.5		16.9	2.3		14.3	1.1	
Zinc	8.6	4.7		8.5	4.5		7.4	12.1	J	9	5	J	16.1	4.6		10	2.3	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	<	46.7	U	<	44.9	U	<	48.3	U	51.4	50.1		86.2	45.7		91.7	45	
Water Quality (percent)																		
Water	14	0.1		11	0.1		17	0.1		20	0.1		12	0.1		11	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A

J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 15-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 94

LOCATOR	CAN094-0944-0004			CAN094-0944-0008			CAN094-0945-0004			CAN094-0945-0008			CAN094-0946-0004			CAN094-0946-0008		
LAB SAMPLE NUMBER	0314040009SA			0314040010SA			0311810019SA			0311810020SA			0311810015SA			0311810016SA		
COLLECT DATE	09/23/93			09/23/93			09/11/93			09/11/93			09/11/93			09/11/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)																		
1,2-Dichloropropane	<	5.9	U	<	5.5	U	<	5.6	U	<	5.7	U	27	5.9		<	5.6	U
Toluene	4.3	5.9	J	<	5.5	U	<	5.6	U	<	5.7	U	1.9	5.9	J	6.2	5.6	
Metals (mg/kg)																		
Aluminum	4390	23.5		6090	10.9		3970	22.6		3930	22.6		3330	59.4		4880	11.2	
Antimony	<	14.1	U	<	6.6	U	<	13.6	U	10.6	13.6	J	<	35.6	U	<	6.7	U
Arsenic	1.9	0.59		1.8	0.55		1.5	0.56		1.3	0.57		1.7	0.59		2.2	0.56	
Barium	325	2.3	J	137	1.1	J			R			R			R			R
Beryllium	0.28	0.47	J	0.41	0.22		<	0.45	U	0.24	0.45	J	<	1.2	U	0.35	0.22	
Cadmium	2.2	1.2		1.4	0.55		<	1.1	U	<	1.1	U	<	3	U	<	0.56	U
Calcium	168000	46.9		65800	21.9		130000	45.2		105000	45.2		207000	119		58200	22.3	
Chromium	3.1	2.3		5.6	1.1		1.9	2.3	J	2.8	2.3		<	5.9	U	3.9	1.1	
Cobalt	1.8	2.3	J	2.4	1.1		1.9	2.3	J	2.5	2.3		<	5.9	U	2.4	1.1	
Copper	2.5	4.7	J	4.2	2.2		2.7	4.5	J	1.8	4.5	J	<	11.9	U	2.4	2.2	
Iron	3770	23.5		5720	10.9		4120	22.6		3990	22.6		3200	59.4		4760	11.2	
Lead	3.5	0.59		3.5	0.55	J	3.3	0.56	J	4.1	1.1	J	2.6	0.59	J	4.8	1.1	J
Magnesium	2690	46.9		3210	21.9		2030	45.2		3000	45.2		2190	119		2490	22.3	
Manganese	43.3	2.3		107	1.1		51	2.3	J	70.2	2.3	J	34	5.9	J	81.1	1.1	J
Nickel	4.7	9.4	J	6.2	4.4		4.2	9	J	5.6	9	J	<	23.8	U	4.9	4.5	
Potassium	813	1170	J	1400	547		700	1130	J	910	1130	J	<	2970	U	885	558	
Silver	0.51	2.3	J	<	1.1	J	<	2.3	UJ	<	2.3	UJ	<	5.9	UJ	<	1.1	UJ

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A

J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 15-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 94

LOCATOR	CAN094-0944-0004			CAN094-0944-0008			CAN094-0945-0004			CAN094-0945-0008			CAN094-0946-0004			CAN094-0946-0008		
LAB SAMPLE NUMBER	0314040009SA			0314040010SA			0311810019SA			0311810020SA			0311810015SA			0311810016SA		
COLLECT DATE	09/23/93			09/23/93			09/11/93			09/11/93			09/11/93			09/11/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Sodium	<	1170	U	<	547	U	<	1130	U	<	1130	U	<	2970	U	<	558	U
Vanadium	13.5	2.3		19.4	1.1		10.6	2.3		10.7	2.3		8.7	5.9		17.5	1.1	
Zinc	9.3	4.7		14.4	2.2		9.4	4.5		22	4.5		<	11.9	U	10.8	2.2	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	<	46.9	U	<	43.8	U	<	45.2	U	<	45.2	U	<	47.5	U	<	44.7	U
Water Quality (percent)																		
Water	15	0.1		8.7	0.1		11	0.1		12	0.1		16	0.1		10	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A

J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 15-3

COMPARISON OF MAXIMUM DETECTED METAL CONCENTRATIONS TO BACKGROUND(1)
SWMU 94, CANNON AFB
Oil/Water Separator No. 5144

Sample ID	Metal	Maximum detected concentration	Range of background concentrations (2)	Upper tolerance limit (UTL) background concentration (3)	Does maximum detected exceed UTL background
CAN094-0945-0002	Aluminum	10500	1410 - 11,000	10,540	N
CAN094-0945-0008	Antimony	10.6	<5 - <13	*	Y
CAN094-0941-0002	Arsenic	3.3	0.67 - 28	15.5	N
CAN094-0942-0004	Barium	1640	14.5 - 1200	642	Y
CAN094-0942-0004	Beryllium	0.88	0.17 - 0.77	0.73	Y
CAN094-0944-0002	Cadmium	2.9	<0.51 - 4.2	*	Y
CAN094-0941-0000	Chromium	11.5	4 - 15.4	12.5	N
CAN094-0945-0002	Cobalt	5.4	0.85 - 5.3	4.5	Y
CAN094-0941-0000	Copper	11.2	<2 - 18.4	*	Y
CAN094-0942-0000	Lead	99.2	1.1 - 46	25.8	Y
CAN094-0941-0000	Mercury	0.48	<0.1 - <0.12	*	Y
CAN094-0945-0002	Nickel	11.3	1.3 - 9.8	9	Y
CAN094-0945-0000	Selenium	0.34	<0.21 - 124	*	Y
CAN094-0944-0002	Silver	3	0.51 - 0.93	*	Y
CAN094-0946-0002	Thallium	0.14	0.14 - <0.23	*	Y
CAN094-0943-0000	Vanadium	23.9	5.2 - 28.3	25.3	N
CAN094-0942-0000	Zinc	84.8	<4.3 - 27.5	21.9	Y

(1) All units in mg/kg.
(2) Compiled from data collected by Woodward Clyde for the RFI and RI (WCC 1992 and WCC 1993) and Walk, Haydel and Associates for the IRP (Walk, Haydel and Associates 1990).
Summarized in "Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater at Cannon AFB, NM (WCC 1993)
(3) Upper Tolerance Limit (UTL) of the mean = mean + 2*standard deviation. This is for all practicle purposes the same as the 90% upper confidence limit of the 95th percentile where UTL = mean + standard deviation *k, where k=2.02 for n=37 .
* Data insufficient to calculate UTL of background concentration

TABLE 15-4

COMPARISON OF DETECTED CONCENTRATIONS WITH RBCs(1)
SWMU 94, CANNON AFB
Oil/Water Separator No. 5144

Sample ID	Analyte	Maximum Detected	RBC (2)	Maximum Detected Exceed RBC
CAN094-0941-0002	1,2-Dichloroethane	0.002	0.8	N
CAN094-0946-0004	1,2-Dichloropropane	0.027	30	N
CAN094-0945-0000	2-Methylnaphthalene	3.8	NTF	N
CAN094-0942-0000	Anthracene	0.037	2000	N
CAN094-0945-0008	**Antimony**	**10.6**	**3**	**Y**
CAN094-0942-0004	**Barium**	**1640**	**600**	**Y**
CAN094-0942-0000	**Benzo(a)anthracene**	**0.23**	**0.07**	**Y**
CAN094-0942-0000	**Benzo(a)pyrene**	**0.34**	**0.01**	**Y**
CAN094-0942-0000	**Benzo(b)fluoranthene**	**0.55**	**0.07**	**Y**
CAN094-0941-0000	Benzo(g,h,i)perylene	0.16	NTF	N
CAN094-0942-0004	**Beryllium**	**0.88**	**0.02**	**Y**
CAN094-0941-0000	Butyl benzyl phthalate	0.048	2000	N
CAN094-0944-0002	Cadmium	2.9	8	N
CAN094-0942-0000	Chrysene	0.35	2	N
CAN094-0945-0002	Cobalt	5.4	NTF	N
CAN094-9441-0000	Copper	11.2	300	N
CAN094-0945-0000	Dibenzofuran	0.16	NTF	N
CAN094-0944-0000	Ethylbenzene	0.0027	800	N
CAN094-0942-0000	Fluoranthene	0.44	300	N
CAN094-0945-0000	Fluorene	0.32	300	N
CAN094-0942-0000	**Indeno(1,2,3-cd)pyrene**	**0.14**	**0.04**	**Y**
CAN094-0942-0000	Lead (3)	99.2	500	N
CAN094-0941-0000	Mercury	0.48	2	N
CAN094-0945-0000	Naphthalene	0.43	300	N
CAN094-0945-0002	Nickel	11.3	200	N
CAN094-0943-0000	Pentachlorophenol	0.074	0.6	N
CAN094-0942-0000	Phenanthrene	0.24	NTF	N
CAN094-0941-0000	Pyrene	0.41	200	N
CAN094-0944-0002	Silver	3	20	N
CAN094-0941-0002	Tetrachloroethene	0.025	1	N
CAN094-0946-0002	Thallium	0.14	6	N
CAN094-0941-0002	Toluene	0.049	200	N
CAN094-0945-0000	**Total Petroleum Hydrocarbons (4)**	**3600**	**1000**	**Y**
CAN094-0941-0000	Xylenes (total)	0.0094	20000	N
CAN094-0942-0000	Zinc	84.8	2000	N

NTF = No EPA Established Toxicity Factor

(1) All units in mg/kg

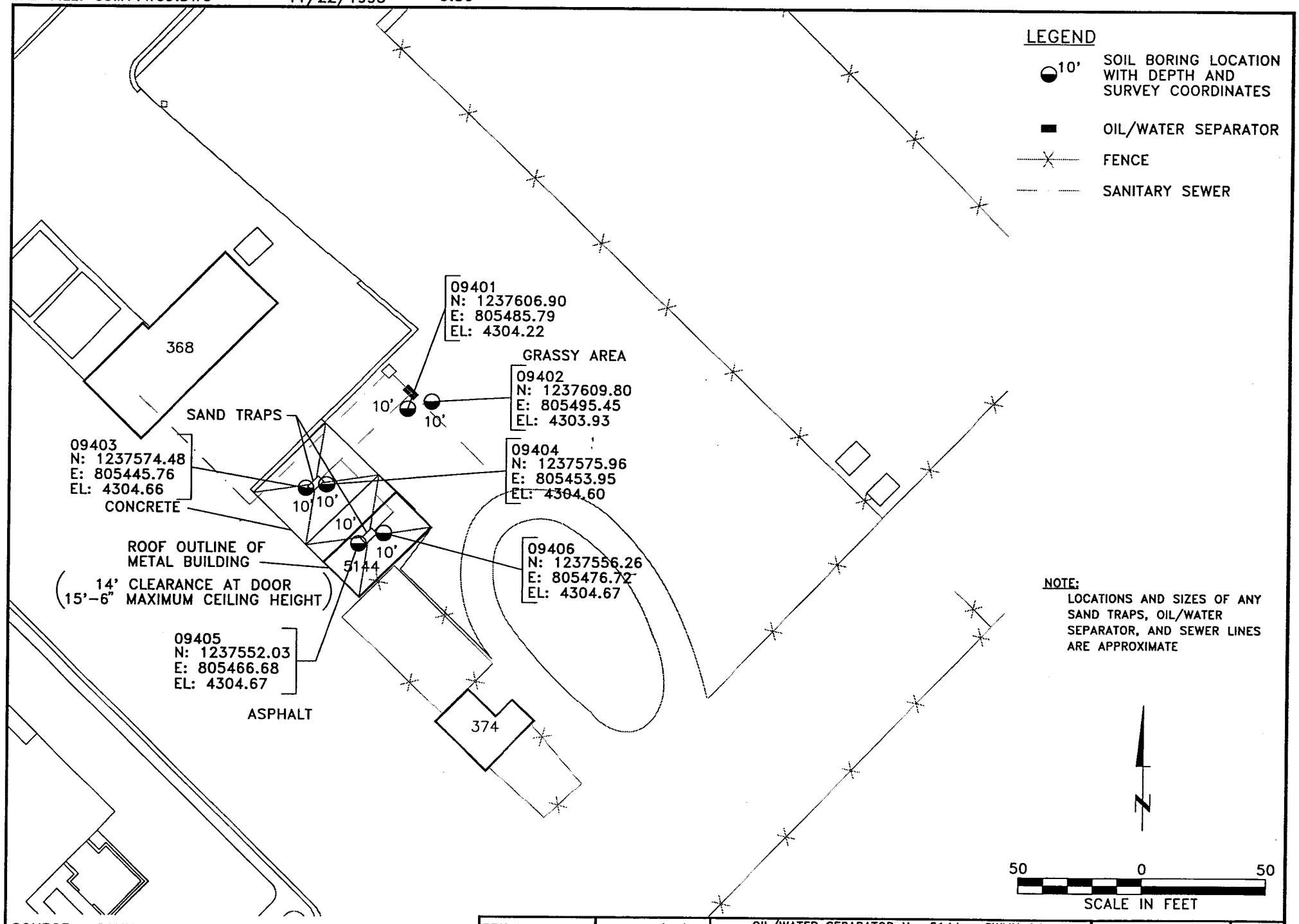
(2) Risk-based concentration

(3) EPA suggests 500-1,000 mg/kg as allowable concentration for residential soils based on EPA's IUBK Lead Model (EPA 1990)

(4) New Mexico recommended soil cleanup level for fuel contaminated soil.

Note: Only metals that exceeded background appear in this table.

CAD FILE: C3M11W09.DWG 11/22/1993 9:56



SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

DRN BY: CJG	DATE: 08/17/93	OIL/WATER SEPARATOR No. 5144 – SWMU 94 SITE PLAN AND BORING LOCATIONS CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W
CHK'D BY: .	REVISION: 0		FIG. NO. 15–1

16.0
SAND TRAP AND LEACH FIELDS AT THE PETROLEUM, OIL, AND LUBRICANTS (POL) WASH RACK - SWMU NO. 127

16.1 SITE BACKGROUND

16.1.1 Site Description

This SWMU is a 135-gallon concrete sand trap and leach field that receives wash water from the POL refueling truck wash rack at Facility 4095 (Figure 16-1). The sand trap measures 2.5 feet by 4.5 feet in plan and extends about 3.5 feet below the pavement. This unit has been active since 1977.

16.1.2 Site History

The sand trap reportedly received wash down water from fuel truck cleaning operations. This wastewater historically was discharged to a leach field located approximately 60-feet northeast of the wash rack. The leach field reportedly ceased to function in the late 1980s, a new leach field was installed approximately 20-feet northeast of the original in May 1991. A new OWS enclosed in a concrete vault was also installed at this time to recover jet fuel which may be released during wash rack operations. The original leach field remains in place, but is bypassed and not used. The OWS vault was inspected during the initial site visit. The unit consists of a three-compartment steel tank with clean-out access for each compartment. There was no evidence of any leakage or spillage, and this OWS was not a part of SWMU 127 investigation sampling.

16.1.3 Current Use

The wash rack sand trap continues to receive heavy usage. The wastewater from the recently installed OWS discharges to a new leach field located northeast of the former leach field and oils recovered are temporarily stored in the separator for future recycling.

16.1.4 Potential Contaminants

Potential contaminants in this SWMU include JP-4 fuel, grease, and motor oil.

16.2 FIELD INVESTIGATION AND DATA COLLECTION

16.2.1 Soils Sampling

The objective of soil sampling at the wash rack sand trap and the associated leach fields was to evaluate whether or not a release of SWMU-related chemicals has occurred from the sand trap or seepage from the two leach fields.

Two 10-foot borings were drilled through holes cut in the concrete wash rack to sample the soil below the pad. Soil samples were collected at the 0.5- to 2-foot, 2- to 4-foot, 4- to 6-foot, and 8- to 10-foot depth intervals to characterize the vertical distribution of possible contaminants as specified in the Field Sampling Plan and the Sample Summary Tables. Minor visual and olfactory indications of contamination, probably attributable to spillage of JP-4 jet fuel on the wash rack, was found in soils directly below the concrete pad.

One 60-foot boring was drilled adjacent to the OWS and five 60-foot borings were drilled within the new and abandoned leach fields. Samples were collected at the surface and at the 1.5- to 3.5-foot, 4- to 6-foot, 8- to 10-foot, 18- to 20-foot, 28- to 30-foot, 38- to 40-foot, 48- to 50-foot, and 58- to 60-foot depth intervals to characterize the vertical distribution of possible leachate contaminants percolating into the soil. Only Boring 12708 located in the new leach field encountered olfactory indications of subsurface contamination beyond the wash rack.

Samples were collected in accordance with QAPP SOP No. 6 - Surface Soil Sampling and QAPP SOP No. 7 - Subsurface Drilling and Sampling. Target analytes for all borings include VOCs, SVOCs, metals and TRPH. Surficial samples were collected directly under the concrete wash rack and approximately at the 0.2- to 0.5-foot depth interval in areas of plant cover to provide a worst-case situation for risk assessment purposes in the event that VOC contamination was discovered during this investigation.

16.2.2 Geologic Summary of Boring Logs

Boring logs from boreholes in the POL wash rack indicate relatively minor petroleum staining with coincidentally high headspace measurements from just below the concrete pad to the base of the inferred fill at 2 feet. The soil ranges from a moist, red silty clay with moderate plasticity (fill) to a light yellow-white clay with some sand to the boring's total depth at 10 feet. This clay is firm and moist, and displays a red mottling in the lighter groundmass.

Soils below a depth of 10 feet in the area of the OWS and the leach fields consist of reddish to salmon pink interbedded sandy silts and clays. This soil displays moderate to high calcic content, manifested as white patches and stringers to tightly cemented tan and pink caliche. Extremely tight caliche formation is probably responsible for the sampler rejection experienced in Boring 12703 (T.D. at 58.7 feet), Boring 12705 (T.D. at 57.3 feet), Boring 12707 (T.D. at 58.5 feet), and Boring 12708 (T.D. at 57.8 feet), which disallowed drilling and recovering the full sample at total depth.

While no deep boring had extensive visual indication of contamination, locally high headspace measurements were observed at 8- to 10-foot, 18- to 20-foot, and 28- to 30-foot depth intervals in Boring 12708. See copies of the boring logs in Appendix B, Volume V.

16.2.3 Site Topography

Drainage from the wash rack flows into the sand trap and the oil/water separator. The surface of the leach field is essentially flat with no discernable gradient.

16.3 CHEMICAL INVESTIGATION RESULTS

16.3.1 General

Samples were collected as identified in Section 10.2 to comply with permit and compliance agreement requirements. Soil samples were collected from 8 borings (12701, 12702, 12703, 12704, 12705, 12706, 12707, and 12708). Sampling and analyses performed are summarized in Table 16-1. Summaries of the analytical results for these soil samples is provided in Table 16-2a for near-surface soils and Table 16-2b for subsurface soils. For each sample type, the

tables provide results for analytes only if they were detected at least once in this type of sample collected at the SWMU group. Complete analytical summary results are provided in the QCSR (Appendix A).

16.3.2 Organic Results For Near-surface Soil Samples

The near-surface soil samples collected at this SWMU (CAN127-1271-0000, CAN127-1271-0002, CAN127-1272-0000, CAN127-1272-0002, CAN127-1273-0000, CAN127-1273-0002, CAN127-1274-0000, CAN127-1274-0002, CAN127-1275-0000, CAN127-1275-0002, CAN127-1276-0000, CAN127-1276-0002, CAN127-1277-0000, CAN127-1277-0002, CAN127-1278-0000, CAN127-1278-0002 were analyzed for VOCs, SVOCs, TPH and metals as indicated in Table 16-1.

Other than acetone and methylene chloride, which were qualified nondetected after they were determined to be laboratory contaminants (see Section 4.10.4 of the QCSR), the VOCs reported were 1.9 µg/kg 1,2-dichloroethane reported for sample CAN127-1276-0000; 1,2-dichloropropane reported at 4.6 µg/kg in sample CAN127-1275-0000; seven near-surface samples were reported with toluene, detections ranged from 15 µg/kg in sample CAN127-1276-0000 to 2.3 µg/kg in sample CAN127-1274-0000; xylenes (total) was reported in five near-surface samples, detections ranged from 12 µg/kg in sample CAN127-1276-0000 to 1.5 µg/kg in two near-surface samples CAN127-1277-0002 and CAN127-1274-0000. TPH was also reported in seven near-surface samples (six of which were at the 0000 depth) and ranged from 344 mg/kg in sample CAN127-1275-0000 to 44.1 mg/kg in sample CAN127-1277-0000. Sample CAN127-1272-0002 was the only near-surface sample reported with a TPH detection (48.7 mg/kg) at the depth of 0002.

Results reported for SVOCs were primarily polycyclic aromatic hydrocarbons (PAHs). Except for the compounds bis(2-ethylhexyl)phthalate and di-n-butyl phthalate which were qualified nondetected after determination that these analytes were laboratory contaminants, carbazole was the only SVOC reported (1500 µg/kg and 46 µg/kg reported for sample CAN127-1275-0000 and CAN127-1273-0000, respectively) that would not be considered a PAH. PAHs were reported for six samples and included the compounds anthracene, acenaphthene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(g,h,i)perylene, chrysene, fluorene, fluoranthene, indeno(1,2,3-cd)pyrene, 2-methylnaphthalene, phenanthrene, and

pyrene. Summing PAH concentrations, sample CAN127-1275-0000 had the highest total PAH reported at 91,740 μg/kg and sample CAN127-1274-0000 had total PAH reported at 1281 μg/kg.

16.3.3 Organic Results For Sub-surface Soil Samples

The sub-surface soil samples collected at this SWMU (CAN127-1271-0004, 1271-0008; CAN127-1272-0004, 1272-0008; CAN127-1273-0004, 1273-0008, 1273-0018,0028,0038,0048 and 0058; CAN127-1274-0004, 1274-0008,0018,0028,0038,0048, and 0058; CAN127-1275-0004, 1275-0008,0018,0028,0038,0048, and 0058; CAN127-1276-0004, 1276-0008, 0018,0028,0038,0048, and 0058; CAN127-1277-0004, 1277-0008,0018,0028,0038,0048, and 0058; CAN127-1278-0004, 1278-0008, 0018,0028,0038,0048, and 0058; were analyzed for VOCs, SVOCs, metals and TPH as indicated in Table 16-1.

Other than acetone and methylene chloride, which were qualified nondetect after they were determined to be laboratory contaminants (see Section 4.1.4 of the QCSR), the VOCs reported were 1,1,1-trichloroethane at 1.8 µg/kg, 1,1-dichloroethene at 1.9 µg/kg, 1,2-dichloroethene at 1.3 µg/kg, benzene at 1.2 µg/kg, carbon disulfide at 2.7 µg/kg chlorobenzene at 1.3 µg/kg, ethylbenzene at 1.3 µg/kg, tetrachloroethene at 2.9 µg/kg trichloroethene at 2.3 µg/kg, toluene at 6.2 µg/kg, and finally xylenes at 2.4 µg/kg in sample CAN127-1275-0018. 1,2-dichloropropane was reported at 5.7 µg/kg, 7.7 µg/kg, and 13 µg/kg in samples CAN127-1274-0048, CAN127-1275-0038, and CAN127-1274-0058, respectively. 14 sub-surface samples were reported with Toluene detections (including the 18 foot section of sample from boring 1275 mentioned above). Toluene ranged from 18 µg/kg in sample CAN127-1275-0008 to 1.2 µg/kg reported in sample CAN127-1273-0058.

SVOCs were detected in one sub-surface sample. Butyl benzyl phthalate was reported at 110 µg/kg in sample CAN127-1271-0004. TPH was reported in five sub-surface soil samples, and ranged from 170 mg/kg in CAN127-1278-0008 to 46.6 µg/kg in CAN127-1271-0004.

16.3.4 Inorganic Results

Metals analyses were performed on samples collected from this SWMU as indicated in Table 16-1. The range of results for metals reported in these soil samples are summarized in Table 16-A.

TABLE 16-A

Analyte	Frequency Reported	Lowest Detection	Sample Location	Highest Detection	Sample Location
Aluminum	62/62	3110 mg/kg	1272-0002	11600 mg/kg	1273-0002
Antimony	1/62	7.8 mg/kg	1275-0000	(detected only once)	
Arsenic	62/62	1.0 mg/kg	1274-0058	2.9 mg/kg	1274-0000
Barium	62/62	12.9 mg/kg	1273-0058	971 mg/kg	1271-0002
Beryllium	56/62	0.16 mg/kg	1273-0058 1276-0058	0.83 mg/kg	1274-0002
Cadmium	20/62	0.49 mg/kg	1274-0000	4.2 mg/kg	1272-0002
Calcium	62/62	4740 mg/kg	1276-0002	248,000 mg/kg	1272-0004
Chromium	49/62	1.9 mg/kg	1274-0028	16.9 mg/kg	1273-0000
Cobalt	58/62	1.1 mg/kg	1275-0058	5.3 mg/kg	1274-0000
Copper	61/62	1.1 mg/kg	1274-0008	54.9 mg/kg	1277-0058
Iron	62/62	2760 mg/kg	1272-0002	10,500 mg/kg	1273-0002
Lead	61/62	1.60 mg/kg	1272-0002	48.2 mg/kg	1276-0000
Magnesium	62/62	1220 mg/kg	1278-0000	11,900 mg/kg	1275-0018
Manganese	62/62	28.0 mg/kg	1275-0028	332 mg/kg	1275-0000
Mercury	1/62	0.11 mg/kg	1278-0000	Hg detected only once	
Nickel	60/62	2.8 mg/kg	1273-0058	12.4 mg/kg	1274-0002
Potassium	62/62	468 mg/kg	1272-0002	2520 mg/kg	1276-0002
Silver	23/62	0.35 mg/kg	1277-0058	3.6 mg/kg	1272-0002
Selenium	1/62	0.27 mg/kg	1274-0000	Se detected	only once
Sodium	0/62				
Thallium	2/62	0.13 mg/kg	1273-0002	0.14 mg/kg	1276-0002
Vanadium	62/62	10 mg/kg	1276-0008	23.0 mg/kg	1274-0000
Zinc	61/62	5.2 mg/kg	1275-0004	38.5 mg/kg	1275-0000

Note: See Table 16-3 for comparison to background.

16.4 SWMU-SPECIFIC DATA ASSESSMENT

16.4.1 General

This assessment of OWS No. 4095 data is an evaluation of quality issues that could affect the major data uses. In general, the objective of the RFI was identification and quantification of the nature and extent of the contamination, which was necessary to meet permit and compliance agreement requirements, and to support an evaluation of the risk to human health and the environment.

16.4.2 Sampling Issues

A review of the data contained in the log books and the Daily Quality Control Reports (DQCR) for SWMU 127 indicate that there were no sampling issues that would impact data usability. QC issues are discussed in detail in the QCSR in Appendix A, and copies of the DQCR are included in that appendix.

16.4.3 Data Review Issues

For laboratory analytical data, QA/QC objectives were specified in the Cannon AFB QAPP (W-C 1993). The objectives were used as indicators of the quality necessary to support identification and quantitation of potential chemicals of concern. The data review is presented in Section 4.10 of the Quality Control Summary Report (QCSR) located in Appendix A. As presented in the QCSR, data for the analytes barium, calcium, chromium, copper, manganese, nickel, cobalt, potassium, vanadium, zinc, selenium, sodium, thallium, cadmium, aluminum, arsenic, iron, TPH and several VOCs were qualified estimated concentrations.

Selenium, thallium, barium and several VOCs' data were qualified estimated to indicate a potential low bias, and selenium data in several samples were qualified estimated to indicate a potential high bias. When a low bias is indicated, actual concentrations may be higher than the reported results. Use of this data in risk assessment may underestimate risk. Similarly, when a high bias is indicated, actual concentrations may be lower than the reported results. Use of this data in risk assessment may overestimate risk.

Calcium, chromium, cobalt, copper, manganese nickel, potassium, vanadium, zinc, cadmium, aluminum, arsenic, iron and TPH data were qualified estimated due to precision that did not meet the QA\QC criteria defined for this project. Poor precision could be attributed to errors in sampling and analysis; however, since the other analytes which were sampled and analyzed in the same procedure (Method 6010) met QA/QC criteria, this variation is likely due to sample heterogeneity.

The uncertainty in the actual concentration reported for estimated data does not affect the usability of the data for identification of chemicals in characterizing the nature and extent of contamination at this SWMU.

16.4.4 Limitations

Elevated reporting limits may limit the usability of the data due to low level analytes being diluted to below the instrument detection limits. That is, chemicals may be reported as nondetect when they are actually present in a sample at low levels. Section 4.16.6 of the QCSR (Appendix A) presents a discussion of elevated reporting limits. Lead analyses was diluted in two samples; however, the elevated reporting limits for lead did not impact the usability of the data because the associated were detected above the elevated reporting limit and the dilution factor was not greater than 100.

16.4.5 Summary

Overall, data generated during the study of SWMU 127 were determined to meet quality criteria. In conjunction with the analytical data review, other information including field observations were evaluated in the assessment of the usability of SWMU 127 data. The data support identification of the nature and extent of contamination and provide reasonable concentration for use in risk assessment.

16.5 NATURE AND EXTENT OF CONTAMINATION

SWMU 127 is a sand trap with two leach fields serving the POL truck wash. The sand trap and a new leach field installed in 1991 are currently being used, and the old leach field is no longer used but still in place. Two borings were advanced to a depth of 10 feet below the

pavement adjacent to the sand trap, and three borings were advanced to 60 feet below ground at appropriate locations within each of the leach fields. In general the samples appeared relatively free of organic contamination. There was no visible evidence of spills or leaks in the vicinity. The entire area around the sand trap (the wash rack) is paved, and the area around the leach fields is grassy. Except for minor petroleum staining in the upper two feet of soil around the sand trap and a few of the samples in one boring (12708) in the leach field no evidence of contamination was encountered during sampling. The chemical test results show low levels of organic contamination, including PAHs and TPH predominantly in the shallow samples.

16.6 COMPARISON OF METALS CONCENTRATIONS TO BACKGROUND

Results of the comparison of metal concentration in soil to background levels for SWMU 127 are given in Table 16-3. A summary of the results of the comparison is presented here.

Metals are natural constituents of soils. SWMU concentrations of metal were evaluated to assess whether the metals in environmental samples exceed background levels. Metals that occur in concentrations within background levels are not considered SWMU-related chemicals of concern and are not evaluated further.

The maximum concentration of each detected metal at each SWMU was compared to the upper tolerance limit of the background data. The upper tolerance limit (UTL) was defined as the mean plus two times the standard deviation. This is for all practical purposes equal to the 90% upper confidence limit of the 95th percentile which is equal to the mean plus the standard deviation times the k statistic. The background data set used consisted of 37 data points (WCC 1993), so the k statistic equals 2.02 (Gilbert 1987).

The maximum detected concentrations of aluminum, antimony, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc exceeded the (UTL) of the background data. Therefore, these metals will be compared to risk-based concentrations at SWMU 127.

16.7 RISK SCREENING

16.7.1 Exposure Pathway Flow Chart

The Preliminary Exposure Pathway Flow Chart (EPFC) applicable to SWMU 127, Oil/Water Separator and Leach Field, is shown in Figure 3-2. It shows that the potential exposure pathways are ingestion of soil, inhalation of soil particulates, dermal exposure to contaminated soil, inhalation of airborne chemicals released from soil, and ingestion, inhalation, and dermal exposure to groundwater (if drinking water supplies were affected). Storm water runoff is considered to be an insignificant pathway because potential spills would be minor and over a small area.

16.7.2 Screening of Contaminants Against RBCs (and other criteria)

Maximum detected concentrations of organic compounds and metals that exceeded background were compared to screening-level RBCs (see Section 3.4.5.1 for derivations of RBCs) and other screening criteria in Table 16-4. Screening-level criteria other than RBCs include the state of New Mexico's TPH cleanup level of 1,000 mg/kg (New Mexico Environmental Improvement Board 1993) and the EPA's recommended soil lead level of 500 mg/kg (EPA 1990). The TPH soil clean-up concentration of 1,000 mg/kg is not an RBC, nor is it a relevant-and-applicable standard for the SWMUs in this investigation. Rather it is a conservative value originally derived for the cleanup of fuel-contaminated soils at underground storage tank sites. Risk-based concentrations for TPH, measured as fresh fuels (e.g., gasoline or diesel), are at least an order of magnitude higher for occupational exposures. The concentration of 500 mg/kg is the most conservative concentration in the recommended range of 500 mg/kg to 1,000 mg/kg as a lead level in residential soil based on EPA's Uptake Biokinetic Model (EPA 1990). Compounds with no toxicity factors cannot be evaluated in the risk screening since RBCs cannot be calculated. These compounds, at the concentrations that were measured in soil, are not likely to significantly affect the results of the comparison to RBCs. The comparison for SWMU 127 shows that maximum detected concentrations of antimony, barium, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, beryllium, chrysene, and indeno(1,2,3-cd)pyrene exceed RBCs.

This comparison of maximum detected concentrations to RBCs is very conservative (health-protective) and actual impacts are likely to be lower than those suggested by exceedances of conservative criteria. For example, maximum detected concentrations are likely to overestimate actual concentrations to which people would be exposed. Furthermore, the screening criteria are based on highly conservative residential exposure assumptions and target risk levels that may not be pertinent to current or future use of the SWMU. The RBCs used in this evaluation are calculated using RCRA Action Level methodology; however, the RBCs are more health-protective than conventional RCRA Action Levels because a target excess cancer risk level of 1×10^{-7} (1 in 10,000,000) and a hazard quotient of 0.1 were used to account for exposures to multiple chemicals and for exposure routes other than soil ingestion. Conventional RCRA Action Levels are calculated based on a cancer risk of 1×10^{-6} and a noncancer hazard of 1.0.

The purpose of the comparison to RBCs is to determine whether or not chemical releases (characterized by maximum detected concentrations) have occurred at SWMU 127 that could pose potential risks based on conservative health-based criteria. Since maximum concentrations of the above listed chemicals exceed screening-level criteria, further evaluation or investigation of chemical concentrations and probable exposures is warranted.

16.8 SUMMARY AND RECOMMENDATIONS

Sixty two soil samples were collected and analyzed from six 60-foot and two 10-foot deep soil borings at SWMU 127. Maximum detected concentrations were compared to background levels and RBCs. Six organics and three metals were found at levels that exceed RBCs or other screening-level criteria.

The highest concentrations for the organics and metals were detected in near-surface samples. The vertical extent of contamination has been characterized by the borings, and the potential for groundwater beneath SWMU 127 to be impacted can be characterized. The potential for impacts to groundwater is considered to be low because the depth to groundwater is greater than 200 feet, and sampling demonstrates that contaminants are not being significantly transported vertically below the SWMU. Therefore, it is concluded that the available data are sufficient to complete a BRA, and it is recommended that a BRA be completed.

TABLE 16-1

SUMMARY OF ANALYTICAL AND QA/QC SAMPLING
SAND TRAP AT POL WASH RACK (SWMU NO. 127)
CANNON AFB, NEW MEXICO

Sample Location	Target Interval (ft-bgs)	Sample Identification Number	QA/QC Type	Sample Matrix	Analytical Parameters				Sample Containers		
					VOCs	SVOCs	Metals	TRPH	40 ml VOA vials	4 oz. jars	8 oz. jars
Boring 12701	0.5 - 2	CAN127-1271-0000		Soil	X	X	X	X		2	1
	2 - 4	CAN127-1271-0002		Soil	X		X	X		2	1
	4 - 6	CAN127-1271-0004		Soil	X	X	X	X		2	1
	4 - 6	CAN127-1271-6004	MS/MSD	Soil	X	X	X	X		2	2
	8 - 10	CAN127-1271-0008		Soil	X		X	X		2	1
Boring 12702	0.5 - 2	CAN127-1272-0000		Soil	X	X	X	X		2	1
	0.5 - 2	CAN127-1272-1261	FD	Soil	X	X	X	X		2	1
	0.5 - 2	CAN127-1272-1201	MRD	Soil	X	X	X	X		2	1
	2 - 4	CAN127-1272-0002		Soil	X	X	X	X		2	1
	4 - 6	CAN127-1272-0004		Soil	X		X	X		2	1
	4 - 6	CAN127-1272-1262	FD	Soil	X		X	X		2	1
	4 - 6	CAN127-1272-1202	MRD	Soil	X	X	X	X		2	1
	8 - 10	CAN127-1272-0008		Soil	X		X	X		2	1
		CAN127-1272-1251	AB	Water	X				2		
		CAN127-1272-1271	RB	Water	X				2		
		CAN127-1272-1281	DW	Water	X				2		
		CAN127-1272-1291	TB	Water	X				2		
Boring 12703	0 - 0.5	CAN127-1273-0000		Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN127-1273-0002		Soil	X		X	X		2	1
	4 - 6	CAN127-1273-0004		Soil	X		X	X		2	1
	8 - 10	CAN127-1273-0008		Soil	X	X	X	X		2	1
	8 - 10	CAN127-1273-6008	MS/MSD	Soil	X	X	X	X		2	2
	18 - 20	CAN127-1273-0018		Soil	X		X	X		2	1
	28 - 30	CAN127-1273-0028		Soil	X		X	X		2	1
	38 - 40	CAN127-1273-0038		Soil	X		X	X		2	1
	48 - 50	CAN127-1273-0048		Soil	X		X	X		2	1
	58 - 60	CAN127-1273-0058		Soil	X		X	X		2	1

TABLE 16-1

SUMMARY OF ANALYTICAL AND QA/QC SAMPLING
SAND TRAP AT POL WASH RACK (SWMU NO. 127)
CANNON AFB, NEW MEXICO

Sample Location	Target Interval (ft-bgs)	Sample Identification Number	QA/QC Type	Sample Matrix	Analytical Parameters				Sample Containers		
					VOCs	SVOCs	Metals	TRPH	40 ml VOA vials	4 oz. jars	8 oz. jars
Boring 12704	0 - 0.5	CAN127-1274-0000		Soil	X	X	X	X		2	1
	0 - 0.5	CAN127-1274-1263	FD	Soil	X		X	X		2	1
	0 - 0.5	CAN127-1274-1203	MRD	Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN127-1274-0002		Soil	X		X	X		2	1
	4 - 6	CAN127-1274-0004		Soil	X		X	X		2	1
	8 - 10	CAN127-1274-0008		Soil	X		X	X		2	1
	18 - 20	CAN127-1274-0018		Soil	X		X	X		2	1
	28 - 30	CAN127-1274-0028		Soil	X		X	X		2	1
	38 - 40	CAN127-1274-0038		Soil	X		X	X		2	1
	48 - 50	CAN127-1274-0048		Soil	X	X	X	X		2	1
	58 - 60	CAN127-1274-0058		Soil	X		X	X		2	1
Boring 12705	0 - 0.5	CAN127-1275-0000		Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN127-1275-0002		Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN127-1275-6002	MS/MSD SVOC only	Soil		X					1
	4 - 6	CAN127-1275-0004		Soil	X		X	X		2	1
	8 - 10	CAN127-1275-0008		Soil	X		X	X		2	1
	8 - 10	CAN127-1275-6008	MS/MSD	Soil	X		X	X		2	2
	18 - 20	CAN127-1275-0018		Soil	X		X	X		2	1
	28 - 30	CAN127-1275-0028		Soil	X		X	X		2	1
	38 - 40	CAN127-1275-0038		Soil	X		X	X		2	1
	48 - 50	CAN127-1275-0048		Soil	X		X	X		2	1
	58 - 60	CAN127-1275-0058		Soil	X		X	X		2	1
Boring 12706	0 - 0.5	CAN127-1276-0000		Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN127-1276-0002		Soil	X		X	X		2	1
	4 - 6	CAN127-1276-0004		Soil	X		X	X		2	1
	8 - 10	CAN127-1276-0008		Soil	X		X	X		2	1
	18 - 20	CAN127-1276-0018		Soil	X	X	X	X		2	1
	28 - 30	CAN127-1276-0028		Soil	X		X	X		2	1
	38 - 40	CAN127-1276-0038		Soil	X		X	X		2	1

TABLE 16-1

SUMMARY OF ANALYTICAL AND QA/QC SAMPLING
SAND TRAP AT POL WASH RACK (SWMU NO. 127)
CANNON AFB, NEW MEXICO

Sample Location	Target Interval (ft-bgs)	Sample Identification Number	QA/QC Type	Sample Matrix	Analytical Parameters				Sample Containers		
					VOCs	SVOCs	Metals	TRPH	40 ml VOA vials	4 oz. jars	8 oz. jars
Boring 12706	48 - 50	CAN127-1276-0048		Soil	X		X	X		2	1
cont.	58 - 60	CAN127-1276-0058		Soil	X		X	X		2	1
Boring 12707	0 - 0.5	CAN127-1277-0000		Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN127-1277-0002		Soil	X		X	X		2	1
	4 - 6	CAN127-1277-0004		Soil	X		X	X		2	1
	8 - 10	CAN127-1277-0008		Soil	X	X	X	X		2	1
	8 - 10	CAN127-1277-6008	MS/MSD	Soil	X	X	X	X		2	2
	18 - 20	CAN127-1277-0018		Soil	X		X	X		2	1
	28 - 30	CAN127-1277-0028		Soil	X		X	X		2	1
	38 - 40	CAN127-1277-0038		Soil	X		X	X		2	1
	48 - 50	CAN127-1277-0048		Soil	X		X	X		2	1
	58 - 60	CAN127-1277-0058		Soil	X		X	X		2	1
Boring 12708	0 - 0.5	CAN127-1278-0000		Soil	X	X	X	X		2	1
	1.5 - 3.5	CAN127-1278-0002		Soil	X		X	X		2	1
	4 - 6	CAN127-1278-0004		Soil	X		X	X		2	1
	8 - 10	CAN127-1278-0008		Soil	X	X	X	X		2	1
	8 - 10	CAN127-1278-1264	FD	Soil	X	X	X	X		2	1
	18 - 20	CAN127-1278-0018		Soil	X		X	X		2	1
	28 - 30	CAN127-1278-0028		Soil	X		X	X		2	1
	38 - 40	CAN127-1278-0038		Soil	X		X	X		2	1
	48 - 50	CAN127-1278-0048		Soil	X		X	X		2	1
	58 - 60	CAN127-1278-0058		Soil	X		X	X		2	1

AB = Ambient Blank
DW = Decontamination Water
FB = Field blank
MRD = Missouri River Division
MS/MSD = Matrix spike/matrix spike duplicate
RB = Rinsate blank
TB = Trip blank
See Figure 16-1 for locations of the borings.

TABLE 16-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1271-0000			CAN127-1271-0002			CAN127-1272-0000			CAN127-1272-0002			CAN127-1273-0000			CAN127-1273-0002		
LAB SAMPLE NUMBER	0313740003SA			0313740004SA			0313740007SA			0313740008SA			0312160001SA			0312160002SA		
COLLECT DATE	09/23/93			09/23/93			09/23/93			09/23/93			09/13/93			09/13/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)																		
1,2-Dichloroethane	<	5.8	U	<	5.8	U	<	5.8	U	<	6	U	<	5.2	U	<	5.5	U
1,2-Dichloropropane	<	5.8	U	<	5.8	U	<	5.8	U	<	6	U	<	5.2	U	<	5.5	U
Toluene	<	5.8	U	<	5.8	U	<	5.8	U	<	6	U	12	5.2		<	5.5	U
Xylenes (total)	<	5.8	U	<	5.8	U	<	5.8	U	<	6	U	3.4	5.2	J	<	5.5	U
Semivolatile Organics (ug/kg)																		
Acenaphthene	<	380	U				<	380	U	<	400	U	<	350	U			
Anthracene	<	380	U				<	380	U	<	400	U	48	350	J			
Benzo(a)anthracene	<	380	U				<	380	U	<	400	U	510	350				
Benzo(a)pyrene	<	380	U				<	380	U	<	400	U	550	350				
Benzo(b)fluoranthene	<	380	U				<	380	U	<	400	U	960	350				
Benzo(g,h,i)perylene	<	380	U				<	380	U	<	400	U	470	350				
Carbazole	<	380	U				<	380	U	<	400	U	46	350	J			
Chrysene	<	380	U				<	380	U	<	400	U	720	350				
Fluoranthene	<	380	U				<	380	U	<	400	U	1500	350				
Fluorene	<	380	U				<	380	U	<	400	U	<	350	U			
Indeno(1,2,3-cd)pyrene	<	380	U				<	380	U	<	400	U	390	350				
2-Methylnaphthalene	<	380	U				<	380	U	<	400	U	<	350	U			
Phenanthrene	<	380	U				<	380	U	<	400	U	570	350				
Pyrene	<	380	U				<	380	U	<	400	U	1400	350				
Metals (mg/kg)																		
Aluminum	9270	11.5		3830	23.1		7220	11.6		3110	60.5		7650	10.5		11600	10.9	
Antimony	<	6.9	U	<	13.8	U	<	6.9	U	<	36.3	U	<	6.3	U	<	6.5	U
Arsenic	2	0.58		2.1	0.58		1.9	0.58		1.6	0.6		2.2	0.52		2.4	0.55	
Barium	91.7	1.2		971	2.3		91.9	1.2		206	6		115	1		99	1.1	
Beryllium	0.67	0.23		0.33	0.46	J	0.53	0.23		<	1.2	U	0.46	0.21		0.7	0.22	

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A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value.
U = Nondetected value.
QUAL=Qualification
RL = Reporting Limit.

TABLE 16-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1271-0000			CAN127-1271-0002			CAN127-1272-0000			CAN127-1272-0002			CAN127-1273-0000			CAN127-1273-0002		
LAB SAMPLE NUMBER	0313740003SA			0313740004SA			0313740007SA			0313740008SA			0312160001SA			0312160002SA		
COLLECT DATE	09/23/93			09/23/93			09/23/93			09/23/93			09/13/93			09/13/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Cadmium	<	0.58	UJ	3	1.2		1.1	0.58		4.2	3		<	0.52	U	<	0.55	U
Calcium	19200	23.1	J	191000	46.1		56900	23.1		247000	121		10300	20.9		14000	21.8	
Chromium	9.9	1.2		4.5	2.3		7.3	1.2		7	6		16.9	1		10.3	1.1	
Cobalt	4.5	1.2		2.5	2.3		3.7	1.2		<	6	U	3.4	1		4.8	1.1	
Copper	8.9	2.3		2.8	4.6	J	7.3	2.3		2.6	12.1	J	6.8	2.1		7.9	2.2	
Iron	8610	11.5		3350	23.1		6380	11.6		2760	60.5		7770	10.5		10500	10.9	
Lead	7.3	0.58		2.7	2.9	J	4.4	2.9		1.6	6	J	30.8	10.5		8	1.1	
Magnesium	2030	23.1		2690	46.1		1890	23.1		2930	121		1570	20.9		2360	21.8	
Manganese	179	1.2		46.9	2.3		138	1.2		37.4	6		166	1		206	1.1	
Mercury	<	0.12	U	<	0.12	U	<	0.12	U	<	0.12	U	<	0.1	U	<	0.11	U
Nickel	10.4	4.6		5.8	9.2	J	8	4.6		5.1	24.2	J	7	4.2		11.4	4.4	
Potassium	1680	577		744	1150	J	1410	579		468	3020	J	1910	523		2400	545	
Selenium	<	1.2	UJ	<	1.2	UJ	<	1.2	UJ	<	1.2	UJ	<	0.52	UJ	<	1.1	UJ
Silver	0.69	1.2	J	1.1	2.3	J	0.68	1.2	J	3.6	6	J	<	1	U	<	1.1	U
Thallium	<	2.3	U	<	1.2	UJ	<	1.2	UJ	<	1.2	UJ	<	0.52	U	0.13	0.55	J
Vanadium	17.9	1.2		14.8	2.3		14.2	1.2		12.4	6		17.6	1		21.4	1.1	
Zinc	21.9	2.3		12.3	4.6		17.4	2.3		6.3	12.1	J	25.4	2.1		24.4	2.2	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	<	46.1	U	<	46.1	U	93.2	46.3		48.7	48.4		66.8	41.9		<	43.6	U
Water Quality (percent)																		
Water	13	0.1		13	0.1		14	0.1		17	0.1		4.5	0.1		8.3	0.1	

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A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value.
U = Nondetected value.
QUAL=Qualification
RL = Reporting Limit.

TABLE 16-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1274-0000			CAN127-1274-0002			CAN127-1275-0000			CAN127-1275-0002			CAN127-1276-0000			CAN127-1276-0002		
LAB SAMPLE NUMBER	0312770001SA			0312770002SA			0312770011SA			0312770012SA			0312160012SA			0312160013SA		
COLLECT DATE	09/14/93			09/14/93			09/14/93			09/14/93			09/13/93			09/13/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)																		
1,2-Dichloroethane	<	5.5	U	<	5.5	U	<	5.2	U	<	5.8	U	1.9	5.2	J	<	5.4	U
1,2-Dichloropropane	<	5.5	U	<	5.5	U	4.6	5.2	J	<	5.8	U	<	5.2	U	<	5.4	U
Toluene	2.3	5.5	J	2.8	5.5	J	5.2	5.2		<	5.8	U	15	5.2		<	5.4	U
Xylenes (total)	1.5	5.5	J	<	5.5	U	<	5.2	U	<	5.8	U	12	5.2		<	5.4	U
Semivolatile Organics (ug/kg)																		
Acenaphthene	<	370	U				150	1400	J	<	380	U	<	340	U			
Anthracene	<	370	U				<	1400	U	<	380	U	<	340	U			
Benzo(a)anthracene	83	370	J				8000	1400		<	380	U	160	340	J			
Benzo(a)pyrene	120	370	J				8600	1400		<	380	U	230	340	J			
Benzo(b)fluoranthene	270	370	J				17000	1400		<	380	U	410	340				
Benzo(g,h,i)perylene	72	370	J				5100	1400		<	380	U	190	340	J			
Carbazole	<	370	U				1500	1400		<	380	U	<	340	U			
Chrysene	210	370	J				14000	1400		<	380	U	300	340	J			
Fluoranthene	300	370	J				17000	1400		<	380	U	570	340				
Fluorene	<	370	U				290	1400	J	<	380	U	<	340	U			
Indeno(1,2,3-cd)pyrene	68	370	J				5100	1400		<	380	U	160	340	J			
2-Methylnaphthalene	<	370	U				<	1400	U	<	380	U	<	340	U			
Phenanthrene	120	370	J				8100	1400		<	380	U	210	340	J			
Pyrene	230	370	J				17000	1400		<	380	U	550	340				
Metals (mg/kg)																		
Aluminum	7490	11.1		9560	11		6530	10.5		8570	23		7170	10.4		11400	10.8	
Antimony	<	6.6	U	<	6.6	U	7.8	6.3		<	13.8	U	<	6.2	U	<	6.5	U
Arsenic	2.9	0.55		2.3	0.55		2.1	0.52		2.1	0.58		2	0.52		2.4	0.54	
Barium	125	1.1	J	75.7	1.1	J	245	1	J	104	2.3	J	74.3	1		105	1.1	
Beryllium	0.82	0.22		0.83	0.22		0.45	0.21		0.65	0.46		0.43	0.21		0.7	0.22	

(1) Results presented here are
A complete summary of chemical results are presented in Appendix A.
J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 16-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1274-0000			CAN127-1274-0002			CAN127-1275-0000			CAN127-1275-0002			CAN127-1276-0000			CAN127-1276-0002		
LAB SAMPLE NUMBER	0312770001SA			0312770002SA			0312770011SA			0312770012SA			0312160012SA			0312160013SA		
COLLECT DATE	09/14/93			09/14/93			09/14/93			09/14/93			09/13/93			09/13/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Cadmium	0.49	0.55	J	<	0.55	U	0.53	0.52		<	1.2	U	<	0.52	U	<	0.54	U
Calcium	7210	22.2		4820	22		45300	21		106000	46.1		6630	20.8		4740	21.6	
Chromium	9.4	1.1		10	1.1		15.3	1		5.8	2.3		9.9	1		9.3	1.1	
Cobalt	5.3	1.1		5.2	1.1		2.8	1		4.3	2.3		2.9	1		4.9	1.1	
Copper	8.5	2.2		8	2.2		25.9	2.1		5.9	4.6		6.3	2.1		8.4	2.2	
Iron	8420	11.1		9250	11		7650	10.5		7920	23		5990	10.4		8990	10.8	
Lead	12.6	2.8		8.4	0.55		29.2	5.2		6.7	0.58		48.2	10.4		9.2	1.1	
Magnesium	1800	22.2		2180	22		1850	21		2640	46.1		1300	20.8		2510	21.6	
Manganese	246	1.1		213	1.1		332	1		127	2.3		141	1		218	1.1	
Mercury	<	0.11	U	<	0.11	U	<	0.1	U	<	0.12	U	<	0.1	U	<	0.11	U
Nickel	9.5	4.4		12.4	4.4		6.8	4.2		10.1	9.2		6.2	4.2		10.5	4.3	
Potassium	1390	554		1760	550		1180	524		1550	1150		2060	519		2520	540	
Selenium	0.27	0.55	J	<	0.55	UJ	<	0.52	UJ	<	1.2	UJ	<	0.52	UJ	<	0.54	UJ
Silver	<	1.1	U	<	1.1	U	<	1	U	<	2.3	U	<	1	U	<	1.1	U
Thallium	<	0.55	U	<	0.55	U	<	0.52	U	<	0.58	UJ	<	0.52	U	0.14	0.54	J
Vanadium	23	1.1		19.2	1.1		16.5	1		15.8	2.3		12.9	1		17.7	1.1	
Zinc	20.4	2.2		21.7	2.2		38.5	2.1		18	4.6		25.3	2.1		24	2.2	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	253	44.3	J	<	44	U	344	83.9		<	46.1	U	80.5	41.6		<	43.2	U
Water Quality (percent)																		
Water	9.7	0.1		9.1	0.1		4.6	0.1		13	0.1		3.8	0.1		7.4	0.1	

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A complete summary of chemical results are presented in Appendix A.

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RL = Reporting Limit.

TABLE 16-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1277-0000			CAN127-1277-0002			CAN127-1278-0000			CAN127-1278-0002		
LAB SAMPLE NUMBER	0311840009SA			0311840010SA			0311840001SA			0311840002SA		
COLLECT DATE	09/12/93			09/12/93			09/12/93			09/12/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)												
1,2-Dichloroethane	<	5.3	U	<	5.4	U	<	5.3	U	<	5.4	U
1,2-Dichloropropane	<	5.3	U	<	5.4	U	<	5.3	U	<	5.4	U
Toluene	5.5	5.3	J	3.8	5.4	J	<	5.3	U	<	5.4	U
Xylenes (total)	5.9	5.3		1.5	5.4	J	<	5.3	U	<	5.4	U
Semivolatile Organics (ug/kg)												
Acenaphthene	<	350	U				<	1400	U			
Anthracene	<	350	U				<	1400	U			
Benzo(a)anthracene	190	350	J				150	1400	J			
Benzo(a)pyrene	180	350	J				180	1400	J			
Benzo(b)fluoranthene	390	350					380	1400	J			
Benzo(g,h,i)perylene	91	350	J				<	1400	U			
Carbazole	<	350	U				<	1400	U			
Chrysene	240	350	J				260	1400	J			
Fluoranthene	470	350					440	1400	J			
Fluorene	<	350	U				<	1400	U			
Indeno(1,2,3-cd)pyrene	93	350	J				<	1400	U			
2-Methylnaphthalene	250	350	J				<	1400	U			
Phenanthrene	190	350	J				190	1400	J			
Pyrene	440	350					360	1400	J			
Metals (mg/kg)												
Aluminum	5640	10.5		8800	10.8		6790	10.5		8050	10.9	
Antimony	<	6.3	U	<	6.5	U	<	6.3	U	<	6.5	U
Arsenic	2.2	0.53		2.8	0.54		2.3	0.53		2.6	1.1	
Barium	84.1	1.1		102	1.1		83.8	1.1		79.4	1.1	
Beryllium	0.49	0.21		0.72	0.22		0.45	0.21		0.68	0.22	

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A complete summary of chemical results are presented in Appendix A.

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R = Rejected value.
U = Nondetected value.

QUAL=Qualification
RL = Reporting Limit.

TABLE 16-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1277-0000			CAN127-1277-0002			CAN127-1278-0000			CAN127-1278-0002		
LAB SAMPLE NUMBER	0311840009SA			0311840010SA			0311840001SA			0311840002SA		
COLLECT DATE	09/12/93			09/12/93			09/12/93			09/12/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Cadmium	<	0.53	U	<	0.54	U	<	0.53	U	<	0.54	U
Calcium	18200	21		16700	21.6		5730	21.1		43500	21.8	
Chromium	9.9	1.1		9.5	1.1		11.3	1.1		8.8	1.1	
Cobalt	3.4	1.1		4.8	1.1		3.3	1.1		4.4	1.1	
Copper	7.1	2.1		9.9	2.2		7.3	2.1		9.1	2.2	
Iron	6260	10.5		8960	10.8		7060	10.5		7800	10.9	
Lead	43.2	5.3		9.2	1.1		42.4	5.3		7.5	0.54	
Magnesium	1340	21		2270	21.6		1220	21.1		2300	21.8	
Manganese	154	1.1		189	1.1		151	1.1		168	1.1	
Mercury	<	0.11	U	<	0.11	U	0.11	0.11		<	0.11	U
Nickel	6.6	4.2		10.4	4.3		6.9	4.2		9.8	4.4	
Potassium	1540	526		1760	539		1630	527		1650	545	
Selenium	<	0.53	UJ	<	1.1	UJ	<	0.53	U	<	1.1	UJ
Silver	0.43	1.1	J	0.47	1.1	J	0.53	1.1	J	0.45	1.1	J
Thallium	<	0.53	U	<	0.54	U	<	0.53	U	<	0.54	U
Vanadium	14.6	1.1		18.6	1.1		14.6	1.1		16.9	1.1	
Zinc	24.1	2.1		21	2.2		22.1	2.1		19.4	2.2	
TPH (mg/kg)												
Total Petroleum Hydrocarbons	44.1	42.1		<	43.1	U	<	42.2	U	<	43.6	U
Water Quality (percent)												
Water	4.9	0.1		7.2	0.1		5.2	0.1		8.2	0.1	

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A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value.
U = Nondetected value.
QUAL=Qualification
RL = Reporting Limit.

TABLE 16-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1271-0004			CAN127-1271-0008			CAN127-1272-0004			CAN127-1272-0008			CAN127-1273-0004			CAN127-1273-0008		
LAB SAMPLE NUMBER	0313740005SA			0313740006SA			0313740009SA			0313740010SA			0312160004SA			0312160003SA		
COLLECT DATE	09/23/93			09/23/93			09/23/93			09/23/93			09/13/93			09/13/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)																		
Benzene	<	5.8	U	<	5.7	U	<	5.9	U	<	5.9	U	<	5.5	U	<	5.5	U
2-Butanone (MEK)	<	12	U	<	11	U	<	12	U	<	12	U	<	11	U	<	11	U
Carbon tetrachloride	<	5.8	U	<	5.7	U	<	5.9	U	<	5.9	U	<	5.5	U	<	5.5	U
Chlorobenzene	<	5.8	U	<	5.7	U	<	5.9	U	<	5.9	U	<	5.5	U	<	5.5	U
1,1-Dichloroethene	<	5.8	U	<	5.7	U	<	5.9	U	<	5.9	U	<	5.5	U	<	5.5	U
1,2-Dichloroethene (total)	<	5.8	U	<	5.7	U	<	5.9	U	<	5.9	U	<	5.5	U	<	5.5	U
1,2-Dichloropropane	<	5.8	U	<	5.7	U	<	5.9	U	<	5.9	U	<	5.5	U	<	5.5	U
Ethylbenzene	<	5.8	U	<	5.7	U	<	5.9	U	<	5.9	U	<	5.5	U	<	5.5	U
Tetrachloroethene	<	5.8	U	<	5.7	U	<	5.9	U	<	5.9	U	<	5.5	U	<	5.5	U
Toluene	<	5.8	U	<	5.7	U	<	5.9	U	<	5.9	U	<	5.5	U	<	5.5	U
1,1,1-Trichloroethane	<	5.8	U	<	5.7	U	<	5.9	U	<	5.9	U	<	5.5	U	<	5.5	U
Trichloroethene	<	5.8	U	<	5.7	U	<	5.9	U	<	5.9	U	<	5.5	U	<	5.5	U
Xylenes (total)	<	5.8	U	<	5.7	U	<	5.9	U	<	5.9	U	<	5.5	U	<	5.5	U
Semivolatile Organics (ug/kg)																		
Butyl benzyl phthalate	110	380	J													<	360	U
Metals (mg/kg)																		
Aluminum	5370	23.1	J	4000	22.8		4240	58.8		4180	23.8		7780	21.8		4420	11	
Arsenic	2.2	0.58	J	1.1	0.57		1.3	0.59		1.1	0.59		2.3	0.55		1.5	0.55	
Barium	285	2.3		163	2.3		435	5.9		98.4	2.4		255	2.2		93.9	1.1	
Beryllium	0.46	0.46		0.28	0.46	J	<	1.2	U	0.34	0.48	J	0.35	0.44	J	0.3	0.22	
Cadmium	2.1	1.2		2	1.1		2.9	2.9		1.8	1.2		<	1.1	U	<	0.55	U
Calcium	137000	46.2		132000	45.7		248000	118		148000	47.5		135000	43.7		85200	22	
Chromium	6	2.3	J	3.5	2.3		<	5.9	U	3.9	2.4		4	2.2		3.4	1.1	
Cobalt	2.9	2.3	J	1.8	2.3	J	<	5.9	U	1.3	2.4	J	3.6	2.2		2	1.1	
Copper	5	4.6	J	2.2	4.6	J	1.9	11.8	J	2.2	4.8	J	5.2	4.4		2.6	2.2	

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A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value.
U = Nondetected value.
QUAL=Qualification
RL = Reporting Limit.

TABLE 16-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1271-0004			CAN127-1271-0008			CAN127-1272-0004			CAN127-1272-0008			CAN127-1273-0004			CAN127-1273-0008		
LAB SAMPLE NUMBER	0313740005SA			0313740006SA			0313740009SA			0313740010SA			0312160004SA			0312160003SA		
COLLECT DATE	09/23/93			09/23/93			09/23/93			09/23/93			09/13/93			09/13/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Iron	4940	23.1	J	3360	22.8		3180	58.8		3210	23.8		6370	21.8		3360	11	
Lead	3.2	1.2		2.5	2.9	J	2.4	2.9	J	2.4	3	J	4.2	0.55		3.2	0.55	
Magnesium	2830	46.2		3330	45.7		4110	118		3370	47.5		3270	43.7		2570	22	
Manganese	69.6	2.3	J	41.4	2.3		43.9	5.9		42.5	2.4		93	2.2		55.8	1.1	
Nickel	7.4	9.2	J	5.2	9.1	J	<	23.5	U	5.2	9.5	J	8.3	8.7	J	4.5	4.4	
Potassium	1010	1160	J	999	1140	J	695	2940	J	1060	1190	J	1740	1090		1270	549	
Silver	1.2	2.3	J	0.84	2.3	J	2.6	5.9	J	1.4	2.4	J	<	2.2	U	<	1.1	U
Vanadium	19.8	2.3	J	11.8	2.3		11.3	5.9		11.2	2.4		17.9	2.2		12.4	1.1	
Zinc	11.8	4.6	J	10	4.6		11.2	11.8	J	9.9	4.8		15.8	4.4		9	2.2	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	46.6	46.2		48.6	45.7		50.1	47.1		<	47.5	U	<	43.7	U	<	43.9	U
Water Quality (percent)																		
Water	14	0.1		12	0.1		15	0.1		16	0.1		8.5	0.1		8.9	0.1	

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A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value.
U = Nondetected value.

QUAL=Qualification
RL = Reporting Limit.

TABLE 16-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1273-0018			CAN127-1273-0028			CAN127-1273-0038			CAN127-1273-0048			CAN127-1273-0058			CAN127-1274-0004		
LAB SAMPLE NUMBER	0312160005SA			0312160006SA			0312160007SA			0312160008SA			0312160009SA			0312770003SA		
COLLECT DATE	09/13/93			09/13/93			09/13/93			09/13/93			09/13/93			09/14/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)																		
Benzene	<	5.6	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.4	U	<	5.5	U
2-Butanone (MEK)	<	11	U	<	11	U	<	11	U	<	11	U	<	11	U	<	11	U
Carbon tetrachloride	<	5.6	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.4	U	<	5.5	U
Chlorobenzene	<	5.6	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.4	U	<	5.5	U
1,1-Dichloroethene	<	5.6	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.4	U	<	5.5	U
1,2-Dichloroethene (total)	<	5.6	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.4	U	<	5.5	U
1,2-Dichloropropane	<	5.6	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.4	U	<	5.5	U
Ethylbenzene	<	5.6	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.4	U	<	5.5	U
Tetrachloroethene	<	5.6	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.4	U	<	5.5	U
Toluene	3.5	5.6	J	<	5.5	U	<	5.5	U	<	5.5	U	1.2	5.4	J	<	5.5	U
1,1,1-Trichloroethane	<	5.6	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.4	U	<	5.5	U
Trichloroethene	<	5.6	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.4	U	<	5.5	U
Xylenes (total)	<	5.6	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.4	U	<	5.5	U
Semivolatile Organics (ug/kg)																		
Butyl benzyl phthalate																		
Metals (mg/kg)																		
Aluminum	5740	22.4		6020	11.1		6610	11.1		5830	11		3840	10.7		3650	22.1	
Arsenic	1.2	0.56		1.3	0.55		1.7	0.55		1.3	0.55		1.1	0.54		2.5	0.55	
Barium	110	2.2		137	1.1		61.9	1.1		106	1.1		12.9	1.1		517	2.2	
Beryllium	0.24	0.45	J	0.23	0.22		0.29	0.22		0.17	0.22	J	0.16	0.21	J	0.4	0.44	J
Cadmium	<	1.1	U	<	0.55	U	<	0.55	U	<	0.55	U	<	0.54	U	<	1.1	U
Calcium	135000	44.8		77500	22.1		50100	22.1		45000	21.9		6730	21.4		149000	44.1	
Chromium	2.8	2.2		2.9	1.1		6.3	1.1		6.2	1.1		3.3	1.1		2.3	2.2	
Cobalt	2.4	2.2		1.2	1.1		1.9	1.1		1.4	1.1		1.4	1.1		2.7	2.2	
Copper	2.3	4.5	J	2	2.2	J	2.2	2.2		1.5	2.2	J	1.3	2.1	J	2.5	4.4	J

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RL = Reporting Limit.

TABLE 16-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1273-0018			CAN127-1273-0028			CAN127-1273-0038			CAN127-1273-0048			CAN127-1273-0058			CAN127-1274-0004		
LAB SAMPLE NUMBER	0312160005SA			0312160006SA			0312160007SA			0312160008SA			0312160009SA			0312770003SA		
COLLECT DATE	09/13/93			09/13/93			09/13/93			09/13/93			09/13/93			09/14/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Iron	4290	22.4		3310	11.1		4680	11.1		4100	11		3020	10.7		3780	22.1	
Lead	4	0.56		3.1	2.8		2.9	0.55		2.3	0.55		1.6	0.54		4.6	0.55	
Magnesium	5250	44.8		6820	22.1		6550	22.1		4660	21.9		2630	21.4		2630	44.1	
Manganese	60.9	2.2		30.5	1.1		58.6	1.1		45.9	1.1		28.7	1.1		62	2.2	
Nickel	5.2	9	J	3.6	4.4	J	4.3	4.4	J	3.7	4.4	J	2.8	4.3	J	6	8.8	J
Potassium	1910	1120		1530	553		1730	553		1470	548		957	535		741	1100	J
Silver	<	2.2	U	<	1.1	U	<	1.1	U	<	1.1	U	<	1.1	U	<	2.2	U
Vanadium	11.2	2.2		13.7	1.1		17.8	1.1		14.6	1.1		13	1.1		15.8	2.2	
Zinc	11.2	4.5		9.8	2.2		11.3	2.2		9.3	2.2		6.8	2.1		8.7	4.4	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	<	44.8	U	<	44.2	U	<	44.2	U	<	43.9	U	<	42.8	U	<	44.1	U
Water Quality (percent)																		
Water	11	0.1		9.6	0.1		9.6	0.1		8.8	0.1		6.6	0.1		9.3	0.1	

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U = Nondetected value. RL = Reporting Limit.

TABLE 16-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1274-0008			CAN127-1274-0018			CAN127-1274-0028			CAN127-1274-0038			CAN127-1274-0048			CAN127-1274-0058		
LAB SAMPLE NUMBER	0312770004SA			0312770005SA			0312770007SA			0312770008SA			0312770009SA			0312770010SA		
COLLECT DATE	09/14/93			09/14/93			09/14/93			09/14/93			09/14/93			09/14/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)																		
Benzene	<	5.7	U	<	5.5	U	<	5.6	U	<	5.6	U	<	5.5	U	<	5.4	U
2-Butanone (MEK)	<	11	U	<	11	U	<	11	U	<	11	U	<	11	U	<	11	U
Carbon tetrachloride	<	5.7	U	<	5.5	U	<	5.6	U	<	5.6	U	<	5.5	U	<	5.4	U
Chlorobenzene	<	5.7	U	<	5.5	U	<	5.6	U	<	5.6	U	<	5.5	U	<	5.4	U
1,1-Dichloroethene	<	5.7	U	<	5.5	U	<	5.6	U	<	5.6	U	<	5.5	U	<	5.4	U
1,2-Dichloroethene (total)	<	5.7	U	<	5.5	U	<	5.6	U	<	5.6	U	<	5.5	U	<	5.4	U
1,2-Dichloropropane	<	5.7	U	<	5.5	U	<	5.6	U	<	5.6	U	5.7	5.5		13	5.4	
Ethylbenzene	<	5.7	U	<	5.5	U	<	5.6	U	<	5.6	U	<	5.5	U	<	5.4	U
Tetrachloroethene	<	5.7	U	<	5.5	U	<	5.6	U	<	5.6	U	<	5.5	U	<	5.4	U
Toluene	<	5.7	U	<	5.5	U	<	5.6	U	2	5.6	J	3.3	5.5	J	1.6	5.4	J
1,1,1-Trichloroethane	<	5.7	U	<	5.5	U	<	5.6	U	<	5.6	U	<	5.5	U	<	5.4	U
Trichloroethene	<	5.7	U	<	5.5	U	<	5.6	U	<	5.6	U	<	5.5	U	<	5.4	U
Xylenes (total)	<	5.7	U	<	5.5	U	<	5.6	U	<	5.6	U	<	5.5	U	<	5.4	U
Semivolatile Organics (ug/kg)																		
Butyl benzyl phthalate													<	360	U			
Metals (mg/kg)																		
Aluminum	3730	22.7		6270	11		4710	22.3		4730	11.2		4870	11		3310	10.8	
Arsenic	1.1	0.57		2.1	0.55		1.3	0.56		1.1	0.56		1.3	0.55		1	0.54	
Barium	100	2.3	J	68.2	1.1	J	74.4	2.2	J	42.6	1.1	J	56.1	1.1	J	17.1	1.1	J
Beryllium	0.35	0.45	J	0.39	0.22		0.26	0.45	J	0.29	0.22		0.22	0.22		0.18	0.22	J
Cadmium	<	1.1	U	<	0.55	U	<	1.1	U	<	0.56	U	<	0.55	U	<	0.54	U
Calcium	154000	45.3		71700	22		102000	44.7		61000	22.4		38100	22		16100	21.6	
Chromium	<	2.3	U	5	1.1		1.9	2.2	J	4.8	1.1		4.8	1.1		3.3	1.1	
Cobalt	2	2.3	J	2.6	1.1		2	2.2	J	1.3	1.1		1.5	1.1		1.5	1.1	
Copper	1.1	4.5	J	3	2.2		1.3	4.5	J	1.3	2.2	J	1.2	2.2	J	1.1	2.2	J

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R = Rejected value.
U = Nondetected value.
QUAL=Qualification
RL = Reporting Limit.

TABLE 16-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1274-0008			CAN127-1274-0018			CAN127-1274-0028			CAN127-1274-0038			CAN127-1274-0048			CAN127-1274-0058		
LAB SAMPLE NUMBER	0312770004SA			0312770005SA			0312770007SA			0312770008SA			0312770009SA			0312770010SA		
COLLECT DATE	09/14/93			09/14/93			09/14/93			09/14/93			09/14/93			09/14/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Iron	3260	22.7		5510	11		3450	22.3		3820	11.2		4150	11		3750	10.8	
Lead	3.2	0.57		4.4	1.1		2.9	0.56		2.4	0.56		2.3	0.55		2	0.54	
Magnesium	3390	45.3		3810	22		4490	44.7		5530	22.4		4410	22		3450	21.6	
Manganese	47.8	2.3		78.7	1.1		39.4	2.2		37.9	1.1		56.9	1.1		48.6	1.1	
Nickel	5.3	9.1	J	5.7	4.4		5.6	8.9	J	4	4.5	J	3.7	4.4	J	3.5	4.3	J
Potassium	874	1130	J	1740	550		910	1120	J	856	561		951	549		562	539	
Silver	<	2.3	U	<	1.1	U	<	2.2	U	<	1.1	U	<	1.1	U	<	1.1	U
Vanadium	10.4	2.3		20.1	1.1		15.8	2.2		18.3	1.1		17.3	1.1		16.2	1.1	
Zinc	7.2	4.5		11.1	2.2		7.1	4.5		8.6	2.2		9.2	2.2		6.1	2.2	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	<	45.3	U	<	44	U	<	44.7	U	<	44.9	U	<	43.9	U	<	43.1	U
Water Quality (percent)																		
Water	12	0.1		9.1	0.1		10	0.1		11	0.1		9	0.1		7.3	0.1	

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TABLE 16-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1275-0004			CAN127-1275-0008			CAN127-1275-0018			CAN127-1275-0028			CAN127-1275-0038			CAN127-1275-0048		
LAB SAMPLE NUMBER	0312770013SA			0312770014SA			0312770015SA			0312770016SA			0312770017SA			0312770018SA		
COLLECT DATE	09/14/93			09/14/93			09/14/93			09/14/93			09/14/93			09/14/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)																		
Benzene	<	5.7	U	<	5.8	U	1.2	5.8	J	<	5.6	U	<	5.5	U	<	5.6	U
2-Butanone (MEK)	<	11	U	<	12	U	<	12	U	<	11	U	<	11	U	<	11	U
Carbon tetrachloride	<	5.7	U	<	5.8	U	2.7	5.8	J	<	5.6	U	<	5.5	U	<	5.6	U
Chlorobenzene	<	5.7	U	<	5.8	U	1.3	5.8	J	<	5.6	U	<	5.5	U	<	5.6	U
1,1-Dichloroethene	<	5.7	U	<	5.8	U	1.9	5.8	J	<	5.6	U	<	5.5	U	<	5.6	U
1,2-Dichloroethene (total)	<	5.7	U	<	5.8	U	1.3	5.8	J	<	5.6	U	<	5.5	U	<	5.6	U
1,2-Dichloropropane	<	5.7	U	<	5.8	U	<	5.8	U	<	5.6	U	7.7	5.5		<	5.6	U
Ethylbenzene	<	5.7	U	<	5.8	U	1.3	5.8	J	<	5.6	U	<	5.5	U	<	5.6	U
Tetrachloroethene	<	5.7	U	<	5.8	U	2.9	5.8	J	<	5.6	U	<	5.5	U	<	5.6	U
Toluene	5.4	5.7	J	18	5.8		6.2	5.8		<	5.6	U	7.2	5.5		12	5.6	
1,1,1-Trichloroethane	<	5.7	U	<	5.8	U	1.8	5.8	J	<	5.6	U	<	5.5	U	<	5.6	U
Trichloroethene	<	5.7	U	<	5.8	U	2.3	5.8	J	<	5.6	U	<	5.5	U	<	5.6	U
Xylenes (total)	<	5.7	U	<	5.8	U	2.4	5.8	J	<	5.6	U	<	5.5	U	<	5.6	U
Semivolatile Organics (ug/kg)																		
Butyl benzyl phthalate																		
Metals (mg/kg)																		
Aluminum	5030	57.2		3630	23.3		10100	57.7		4470	22.5		4860	11.1		4570	11.1	
Arsenic	1.5	0.57		1.3	0.58		1.7	0.58		1	0.56		1	0.55		1.1	0.56	
Barium	435	5.7	J	167	2.3	J	445	5.8	J	65.4	2.2	J	148	1.1	J	36.6	1.1	J
Beryllium	<	1.1	U	0.28	0.47	J	<	1.2	U	0.27	0.45	J	0.33	0.22		0.29	0.22	
Cadmium	<	2.9	U	<	1.2	U	<	2.9	U	<	1.1	U	<	0.55	U	<	0.56	U
Calcium	238000	114		181000	46.6		238000	115		150000	44.9		58900	22.1		76300	22.3	
Chromium	<	5.7	U	<	2.3	U	<	5.8	U	2.1	2.2	J	4.3	1.1		3.4	1.1	
Cobalt	<	5.7	U	2.4	2.3		<	5.8	U	1.5	2.2	J	1.6	1.1		1.5	1.1	
Copper	<	11.4	U	1.8	4.7	J	3.2	11.5	J	1.7	4.5	J	2.7	2.2		1.9	2.2	J

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TABLE 16-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1275-0004			CAN127-1275-0008			CAN127-1275-0018			CAN127-1275-0028			CAN127-1275-0038			CAN127-1275-0048		
LAB SAMPLE NUMBER	0312770013SA			0312770014SA			0312770015SA			0312770016SA			0312770017SA			0312770018SA		
COLLECT DATE	09/14/93			09/14/93			09/14/93			09/14/93			09/14/93			09/14/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Iron	4210	57.2		3300	23.3		5960	57.7		3200	22.5		3900	11.1		3770	11.1	
Lead	3	0.57		2.7	0.58		3.1	0.58		1.7	0.56		1.9	0.55		2.2	0.56	
Magnesium	3940	114		3590	46.6		11900	115		4840	44.9		5590	22.1		5470	22.3	
Manganese	51.4	5.7		34	2.3		46.4	5.8		28	2.2		42.1	1.1		43.1	1.1	
Nickel	<	22.9	U	6.1	9.3	J	7.9	23.1	J	3.5	9	J	4.7	4.4		3.3	4.5	J
Potassium	612	2860	J	854	1160	J	2080	2880	J	700	1120	J	916	554		810	556	
Silver	<	5.7	U	<	2.3	U	<	5.8	U	<	2.2	U	<	1.1	U	<	1.1	U
Vanadium	11.2	5.7		11.1	2.3		18.2	5.8		14.4	2.2		17.2	1.1		19	1.1	
Zinc	5.2	11.4	J	7.3	4.7		<	11.5	U	6.4	4.5		8.2	2.2		8.5	2.2	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	<	45.8	U	<	46.6	U	<	46.1	U	<	44.9	U	<	44.3	U	<	44.5	U
Water Quality (percent)																		
Water	13	0.1		14	0.1		13	0.1		11	0.1		9.7	0.1		10	0.1	

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A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value.
U = Nondetected value.

QUAL=Qualification
RL = Reporting Limit.

TABLE 16-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1275-0058			CAN127-1276-0004			CAN127-1276-0008			CAN127-1276-0018			CAN127-1276-0028			CAN127-1276-0038		
LAB SAMPLE NUMBER	0312770019SA			0312150009SA			0312150010SA			0312150011SA			0312150012SA			0312150013SA		
COLLECT DATE	09/14/93			09/13/93			09/13/93			09/13/93			09/13/93			09/13/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)																		
Benzene	<	5.6	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U
2-Butanone (MEK)	<	11	U	<	11	U	<	11	U	<	11	U	<	11	U	<	11	U
Carbon tetrachloride	<	5.6	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U
Chlorobenzene	<	5.6	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U
1,1-Dichloroethene	<	5.6	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U
1,2-Dichloroethene (total)	<	5.6	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U
1,2-Dichloropropane	<	5.6	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U
Ethylbenzene	<	5.6	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U
Tetrachloroethene	<	5.6	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U
Toluene	<	5.6	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U
1,1,1-Trichloroethane	<	5.6	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U
Trichloroethene	<	5.6	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U
Xylenes (total)	<	5.6	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U
Semivolatile Organics (ug/kg)																		
Butyl benzyl phthalate										<	360	U						
Metals (mg/kg)																		
Aluminum	4270	11.2		6670	21.6		3640	22.1		4530	11		4370	10.9		4500	11	
Arsenic	1.2	0.56		2.5	0.54		1.1	0.55		1.8	0.55		1.9	0.55		1.3	0.55	
Barium	545	1.1	J	107	2.2		95.7	2.2		302	1.1		96.4	1.1		23.7	1.1	
Beryllium	0.3	0.22		0.29	0.43	J	<	0.44	U	0.47	0.22		0.3	0.22		0.23	0.22	
Cadmium	<	0.56	U	<	1.1	U	<	1.1	U	<	0.55	U	<	0.55	U	<	0.55	U
Calcium	73800	22.3		113000	43.3		152000	44.1		68500	21.9		76500	21.8		39300	22.1	
Chromium	2.6	1.1		3.9	2.2		<	2.2	U	2.9	1.1		3	1.1		3.4	1.1	
Cobalt	1.1	1.1		3.3	2.2		2.1	2.2	J	1.9	1.1		1.7	1.1		1.2	1.1	
Copper	1.5	2.2	J	4.8	4.3		1.5	4.4	J	2.7	2.2		2.8	2.2		1.8	2.2	J

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A complete summary of chemical results are presented in Appendix A.

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R = Rejected value.
U = Nondetected value.
QUAL=Qualification
RL = Reporting Limit.

TABLE 16-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1275-0058			CAN127-1276-0004			CAN127-1276-0008			CAN127-1276-0018			CAN127-1276-0028			CAN127-1276-0038		
LAB SAMPLE NUMBER	0312770019SA			0312150009SA			0312150010SA			0312150011SA			0312150012SA			0312150013SA		
COLLECT DATE	09/14/93			09/13/93			09/13/93			09/13/93			09/13/93			09/13/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Iron	3020	11.2		6140	21.6		3050	22.1		3620	11		3250	10.9		3280	11	
Lead	2.5	0.56		5.8	1.1		3.1	1.1		4.5	1.1		3.1	0.55		2.5	1.1	
Magnesium	4490	22.3		3020	43.3		2710	44.1		3320	21.9		5100	21.8		6940	22.1	
Manganese	43.2	1.1		98.5	2.2		31.1	2.2		47.2	1.1		42.5	1.1		32.6	1.1	
Nickel	2.9	4.5	J	9.7	8.7		5.8	8.8	J	4.4	4.4		3.9	4.4	J	3.9	4.4	J
Potassium	787	559		1540	1080		1150	1100		1510	549		1130	546		967	552	
Silver	<	1.1	U	<	2.2	U	<	2.2	U	<	1.1	U	<	1.1	U	<	1.1	U
Vanadium	17.5	1.1		16.4	2.2		10	2.2		12.6	1.1		12.8	1.1		16	1.1	
Zinc	7.9	2.2		14.5	4.3		6.8	4.4		7.8	2.2		7.1	2.2		8.3	2.2	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	<	44.7	U	<	43.3	U	<	44.1	U	<	43.9	U	<	43.7	U	<	44.1	U
Water Quality (percent)																		
Water	10	0.1		7.6	0.1		9.3	0.1		8.8	0.1		8.4	0.1		9.4	0.1	

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A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 16-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1276-0048			CAN127-1276-0058			CAN127-1277-0004			CAN127-1277-0008			CAN127-1277-0018			CAN127-1277-0028		
LAB SAMPLE NUMBER	0312150014SA			0312150015SA			0311840011SA			0311840012SA			0311840013SA			0311840014SA		
COLLECT DATE	09/13/93			09/13/93			09/12/93			09/12/93			09/12/93			09/12/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)																		
Benzene	<	5.5	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.7	U	<	5.6	U
2-Butanone (MEK)	<	11	U	<	11	U	<	11	U	<	11	U	<	11	U	<	11	U
Carbon tetrachloride	<	5.5	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.7	U	<	5.6	U
Chlorobenzene	<	5.5	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.7	U	<	5.6	U
1,1-Dichloroethene	<	5.5	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.7	U	<	5.6	U
1,2-Dichloroethene (total)	<	5.5	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.7	U	<	5.6	U
1,2-Dichloropropane	<	5.5	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.7	U	<	5.6	U
Ethylbenzene	<	5.5	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.7	U	<	5.6	U
Tetrachloroethene	<	5.5	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.7	U	<	5.6	U
Toluene	<	5.5	U	2.5	5.4	J	2.1	5.5	J	<	5.5	U	<	5.7	U	<	5.6	U
1,1,1-Trichloroethane	<	5.5	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.7	U	<	5.6	U
Trichloroethene	<	5.5	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.7	U	<	5.6	U
Xylenes (total)	<	5.5	U	<	5.4	U	<	5.5	U	<	5.5	U	<	5.7	U	<	5.6	U
Semivolatile Organics (ug/kg)																		
Butyl benzyl phthalate										<	360	U						
Metals (mg/kg)																		
Aluminum	4660	11		3630	10.8		6130	10.9		3780	11		6250	11.3		5360	11.1	
Arsenic	1.5	0.55		1.1	0.54		2.8	0.55		1.5	0.55		2.4	0.57		1.4	0.56	
Barium	27.8	1.1		20.6	1.1		72.9	1.1		98.4	1.1		101	1.1		157	1.1	
Beryllium	0.22	0.22		0.16	0.22	J	0.49	0.22		0.37	0.22		0.71	0.23		0.38	0.22	
Cadmium	<	0.55	U	<	0.54	U	1.5	0.55		0.92	0.55		1.1	0.57		1.2	0.56	
Calcium	37000	22		8970	21.6		103000	21.8		104000	22.1		91000	22.7		76300	22.3	
Chromium	3.1	1.1		3.6	1.1		6.1	1.1		<	4.2	U	5.2	1.1	U	5.6	1.1	
Cobalt	2.9	1.1		1.4	1.1		3.2	1.1		2.3	1.1		3.2	1.1		1.4	1.1	
Copper	2	2.2	J	2.7	2.2		5.4	2.2		2.8	2.2		5.5	2.3		2.4	2.2	

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A complete summary of chemical results are presented in Appendix A.

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R = Rejected value.
U = Nondetected value.
QUAL=Qualification
RL = Reporting Limit.

TABLE 16-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1276-0048			CAN127-1276-0058			CAN127-1277-0004			CAN127-1277-0008			CAN127-1277-0018			CAN127-1277-0028		
LAB SAMPLE NUMBER	0312150014SA			0312150015SA			0311840011SA			0311840012SA			0311840013SA			0311840014SA		
COLLECT DATE	09/13/93			09/13/93			09/12/93			09/12/93			09/12/93			09/12/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Iron	3760	11		3430	10.8		5800	10.9		3540	11		5200	11.3		3780	11.1	
Lead	2.6	1.1		2.6	1.1		<	6.1	U	4.6	0.55		7.4	1.1		3.1	0.56	
Magnesium	5240	22		3760	21.6		2630	21.8		2370	22.1		3970	22.7		6170	22.3	
Manganese	111	1.1		30.6	1.1		78.5	1.1		58.3	1.1		93	1.1		35	1.1	
Nickel	4.6	4.4		3.8	4.3	J	7.8	4.4		5.2	4.4		6.7	4.5		4.6	4.5	
Potassium	1010	549		816	540	J	1310	545		1050	552		2010	567		1050	557	
Silver	<	1.1	U	<	1.1	U	0.47	1.1	J	0.54	1.1	J	<	1.1	U	0.43	1.1	J
Vanadium	18.2	1.1		16.3	1.1		18.7	1.1		12.1	1.1		16.2	1.1		15	1.1	
Zinc	8.8	2.2		6.4	2.2		14.4	2.2		9.4	2.2		12.8	2.3		9	2.2	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	<	43.9	U	<	43.2	U	<	43.6	U	<	44.2	U	<	45.4	U	<	44.6	U
Water Quality (percent)																		
Water	8.9	0.1		7.4	0.1		8.3	0.1		9.4	0.1		12	0.1		10	0.1	

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R = Rejected value.
U = Nondetected value.

QUAL=Qualification
RL = Reporting Limit.

TABLE 16-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1277-0038			CAN127-1277-0048			CAN127-1277-0058			CAN127-1278-0004			CAN127-1278-0008			CAN127-1278-0018		
LAB SAMPLE NUMBER	0311840015SA			0311840016SA			0311840017SA			0311840004SA			0311840005SA			0311840006SA		
COLLECT DATE	09/12/93			09/12/93			09/12/93			09/12/93			09/12/93			09/12/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)																		
Benzene	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.6	U	<	5.7	U
2-Butanone (MEK)	<	11	U	<	11	U	<	11	U	<	11	U	6.6	11	J	<	11	U
Carbon tetrachloride	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.6	U	<	5.7	U
Chlorobenzene	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.6	U	<	5.7	U
1,1-Dichloroethene	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.6	U	<	5.7	U
1,2-Dichloroethene (total)	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.6	U	<	5.7	U
1,2-Dichloropropane	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.6	U	<	5.7	U
Ethylbenzene	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.6	U	<	5.7	U
Tetrachloroethene	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.6	U	<	5.7	U
Toluene	1.7	5.5	J	2	5.5	J	2.6	5.5	J	<	5.5	U	<	5.6	U	<	5.7	U
1,1,1-Trichloroethane	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.6	U	<	5.7	U
Trichloroethene	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.6	U	<	5.7	U
Xylenes (total)	<	5.5	U	<	5.5	U	<	5.5	U	<	5.5	U	<	5.6	U	<	5.7	U
Semivolatile Organics (ug/kg)																		
Butyl benzyl phthalate													<	370	U			
Metals (mg/kg)																		
Aluminum	4470	11		4580	11		4370	11.1		4270	21.8		4500	11.1		5730	22.9	
Arsenic	1.3	0.55		1.1	0.55		1.2	0.55		2	0.55		1.7	0.56		2.2	0.57	
Barium	158	1.1		41.7	1.1		84.6	1.1		227	2.2		204	1.1		242	2.3	
Beryllium	0.31	0.22		0.28	0.22		0.27	0.22		0.42	0.44	J	0.46	0.22		0.44	0.46	J
Cadmium	0.86	0.55		<	0.55	U	1.1	0.55		2.6	1.1		1.2	0.56		2.4	1.1	
Calcium	77800	22		58200	22		68400	22.1		166000	43.6		83100	22.2		154000	45.7	
Chromium	6.1	1.1		4.9	1.1	U	6.3	1.1		4	2.2	U	4.9	1.1	U	6.7	2.3	U
Cobalt	1.5	1.1		1.2	1.1		1.7	1.1		2.6	2.2		2.2	1.1	J	2.7	2.3	
Copper	2.2	2.2		2.1	2.2	J	54.9	2.2		4.1	4.4	J	4	2.2		3.7	4.6	J

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R = Rejected value.
U = Nondetected value.

QUAL=Qualification
RL = Reporting Limit.

TABLE 16-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1277-0038			CAN127-1277-0048			CAN127-1277-0058			CAN127-1278-0004			CAN127-1278-0008			CAN127-1278-0018		
LAB SAMPLE NUMBER	0311840015SA			0311840016SA			0311840017SA			0311840004SA			0311840005SA			0311840006SA		
COLLECT DATE	09/12/93			09/12/93			09/12/93			09/12/93			09/12/93			09/12/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Iron	3430	11		3570	11		3370	11.1		4170	21.8		4570	11.1		4780	22.9	
Lead	3.4	0.55		3	0.55		3.9	0.55		4.9	0.55		5.8	0.56		5.1	0.57	
Magnesium	4870	22		5890	22		5920	22.1		2460	43.6		2500	22.2		4940	45.7	
Manganese	40.3	1.1		47.5	1.1		41.3	1.1		57.1	2.2		71.6	1.1		71.1	2.3	
Nickel	4.3	4.4	J	4	4.4	J	4.6	4.4		6.4	8.7	J	6	4.4		7.6	9.1	J
Potassium	891	551		917	550		812	553		850	1090	J	1130	555		1540	1140	
Silver	0.51	1.1	J	0.48	1.1	J	0.35	1.1	J	1.2	2.2	J	0.8	1.1	J	1.6	2.3	J
Vanadium	14.9	1.1		18.2	1.1		20.9	1.1		15.4	2.2		15.2	1.1		17	2.3	
Zinc	7.9	2.2		8.8	2.2		11	2.2		11.1	4.4		11.1	2.2		10.4	4.6	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	<	44.1	U	<	44	U	<	44.2	U	<	43.6	U	170	44.4		55.9	45.7	
Water Quality (percent)																		
Water	9.2	0.1		9.2	0.1		9.5	0.1		8.3	0.1		10	0.1		13	0.1	

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A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value.
U = Nondetected value.

QUAL=Qualification
RL = Reporting Limit.

TABLE 16-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1278-0028			CAN127-1278-0038			CAN127-1278-0048			CAN127-1278-0058		
LAB SAMPLE NUMBER	0311840007SA			0311840008SA			0312160010SA			0312160011SA		
COLLECT DATE	09/12/93			09/12/93			09/13/93			09/13/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)												
Benzene	<	5.6	U	<	5.5	U	<	5.6	U	<	5.6	U
2-Butanone (MEK)	<	11	U	<	11	U	<	11	U	7.1	11	J
Carbon tetrachloride	<	5.6	U	<	5.5	U	<	5.6	U	<	5.6	U
Chlorobenzene	<	5.6	U	<	5.5	U	<	5.6	U	<	5.6	U
1,1-Dichloroethene	<	5.6	U	<	5.5	U	<	5.6	U	<	5.6	U
1,2-Dichloroethene (total)	<	5.6	U	<	5.5	U	<	5.6	U	<	5.6	U
1,2-Dichloropropane	<	5.6	U	<	5.5	U	<	5.6	U	<	5.6	U
Ethylbenzene	<	5.6	U	<	5.5	U	<	5.6	U	<	5.6	U
Tetrachloroethene	<	5.6	U	<	5.5	U	<	5.6	U	<	5.6	U
Toluene	<	5.6	U	<	5.5	U	<	5.6	U	<	5.6	U
1,1,1-Trichloroethane	<	5.6	U	<	5.5	U	<	5.6	U	<	5.6	U
Trichloroethene	<	5.6	U	<	5.5	U	<	5.6	U	<	5.6	U
Xylenes (total)	<	5.6	U	<	5.5	U	<	5.6	U	<	5.6	U
Semivolatile Organics (ug/kg)												
Butyl benzyl phthalate												
Metals (mg/kg)												
Aluminum	7380	11.2		4530	11.1		4490	11.1		4430	11.3	
Arsenic	1.9	0.56		1.3	0.55		1.1	0.56		1.2	0.56	
Barium	189	1.1		74.4	1.1		113	1.1		31.6	1.1	
Beryllium	0.46	0.22		0.31	0.22		<	0.22	U	0.17	0.23	J
Cadmium	0.71	0.56		0.88	0.55		<	0.56	U	<	0.56	U
Calcium	89600	22.5		64200	22.1		58900	22.2		30800	22.6	
Chromium	5.6	1.1		4.7	1.1	U	3.2	1.1		2.7	1.1	
Cobalt	2.4	1.1		1.6	1.1		1.5	1.1		1.4	1.1	
Copper	3.1	2.2		2	2.2	J	1.6	2.2	J	1.8	2.3	J

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value.
U = Nondetected value.

QUAL=Qualification
RL = Reporting Limit.

TABLE 16-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 127

LOCATOR	CAN127-1278-0028			CAN127-1278-0038			CAN127-1278-0048			CAN127-1278-0058		
LAB SAMPLE NUMBER	0311840007SA			0311840008SA			0312160010SA			0312160011SA		
COLLECT DATE	09/12/93			09/12/93			09/13/93			09/13/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Iron	5230	11.2		3430	11.1		2990	11.1		2840	11.3	
Lead	4	0.56		4.2	0.55		2.1	0.56		2.3	0.56	
Magnesium	4850	22.5		3730	22.1		4960	22.2		4400	22.6	
Manganese	68.5	1.1		37.4	1.1		37	1.1		39.5	1.1	
Nickel	6.6	4.5		4.5	4.4		3.7	4.4	J	3.6	4.5	J
Potassium	1580	561		925	553		987	555		1000	564	
Silver	0.48	1.1	J	0.62	1.1	J	<	1.1	U	<	1.1	U
Vanadium	19.8	1.1		14.5	1.1		16.3	1.1		15.7	1.1	
Zinc	11.7	2.2		7.3	2.2		7.2	2.2		7.3	2.3	
TPH (mg/kg)												
Total Petroleum Hydrocarbons	<	44.9	U	<	44.2	U	<	44.4	U	<	45.1	U
Water Quality (percent)												
Water	11	0.1		9.6	0.1		10	0.1		11	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value.
U = Nondetected value.

QUAL=Qualification
RL = Reporting Limit.

TABLE 16-3

COMPARISON OF MAXIMUM DETECTED METAL CONCENTRATIONS TO BACKGROUND(1)
SWMU 127, CANNON AFB

Oil/Water Separator Near Tank 4095 (#1) and Leach Field

Sample ID	Metal	Maximum detected concentration	Range of background concentrations (2)	Upper tolerance limit (UTL) background concentration (3)	Does maximum detected exceed UTL background
CAN127-1273-0002	Aluminum	11600	1410 - 11,000	10,540	Y
CAN127-1275-0000	Antimony	7.8	<5 - <13	*	Y
CAN127-1274-0000	Arsenic	2.9	0.67 - 28	15.5	N
CAN127-1271-0002	Barium	971	14.5 - 1200	642	Y
CAN127-1274-0002	Beryllium	0.83	0.17 - 0.77	0.73	Y
CAN127-1272-0002	Cadmium	4.2	<0.51 - 4.2	*	Y
CAN127-1273-0000	Chromium	16.9	4 - 15.4	12.5	Y
CAN127-1274-0000	Cobalt	5.3	0.85 - 5.3	4.5	Y
CAN127-1277-0058	Copper	54.9	<2 - 18.4	*	Y
CAN127-1276-0000	Lead	48.2	1.1 - 46	25.8	Y
CAN127-1278-0000	Mercury	0.11	<0.1 - <0.12	*	Y
CAN127-1274-0002	Nickel	12.4	1.3 - 9.8	9	Y
CAN127-1274-0000	Selenium	0.27	<0.21 - 124	*	Y
CAN127-1272-0002	Silver	3.6	0.51 - 0.93	*	Y
CAN127-1276-0002	Thallium	0.14	0.14 - <0.23	*	Y
CAN127-1274-0000	Vanadium	23	5.2 - 28.3	25.3	N
CAN127-1275-0000	Zinc	38.5	<4.3 - 27.5	21.9	Y

(1) All units in mg/kg.
(2) Compiled from data collected by Woodward Clyde for the RFI and RI (WCC 1992 and WCC 1993) and Walk, Haydel and Associates for the IRP (Walk, Haydel and Associates 1990).
Summarized in "Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater at Cannon AFB, NM (WCC 1993)
(3) Upper Tolerance Limit (UTL) of the mean = mean + 2*standard deviation. This is for all practicle purposes the same as the 90% upper confidence limit of the 95th percentile where UTL = mean + standard deviation *k, where k=2.02 for n=37 .
* Data insufficient to calculate UTL of background concentration

TABLE 16-4
COMPARISON OF MAXIMUM DETECTED CONCENTRATION WITH RBCs(1)
SWMU 127, CANNON AFB

SWMU No. 127 Oil/Water Separator Near Tank 4095 (#1) and Leach Field

Field ID	Analyte	Result mg/kg	RBC mg/kg	Maximum Detected Exceed RBC?
CAN127-1275-0018	1,1,1-Trichloroethane	0.0018	700	N
CAN127-1275-0018	1,1-Dichloroethene	0.0019	0.1	N
CAN127-1276-0000	1,2-Dichloroethane	0.0019	0.8	N
CAN127-1275-0018	1,2-Dichloroethene ^(total)	0.0013	200	N
CAN127-1274-0058	1,2-Dichloropropane	0.013	30	N
CAN127-1277-0000	2-Methylnaphthalene	0.25	NTF	N
CAN127-1275-0000	Acenaphthene	0.15	500	N
CAN127-1273-0002	Aluminum	11600	NTF	N
CAN127-1273-0000	Anthracene	0.048	2000	N
CAN127-1275-0000	**Antimony**	**7.8**	**3**	Y
CAN127-1271-0002	**Barium**	**971**	**600**	Y
CAN127-1275-0018	Benzene	0.0012	2	N
CAN127-1275-0000	**Benzo(a)anthracene**	**8**	**0.07**	Y
CAN127-1275-0000	**Benzo(a)pyrene**	**8.6**	**0.01**	Y
CAN127-1275-0000	**Benzo(b)fluoranthene**	**17**	**0.07**	Y
CAN127-1275-0000	Benzo(g,h,i)perylene	5.1	NTF	N
CAN127-1274-0002	**Beryllium**	**0.83**	**0.02**	Y
CAN127-1271-0004	Butyl benzyl phthalate	**0.11**	2000	N
CAN127-1272-0002	Cadmium	4.2	8	N
CAN127-1275-0000	Carbazole	1.5	4	N
CAN127-1275-0018	Carbon tetrachloride	0.0027	0.5	N
CAN127-1275-0018	Chlorobenzene	0.0013	200	N
CAN127-1273-0000	Chromium	16.9	40	N
CAN127-1275-0000	**Chrysene**	**14**	**2**	Y
CAN127-1274-0000	Cobalt	5.3	NTF	N
CAN127-1277-0058	Copper	54.9	300	N
CAN127-1275-0018	Ethylbenzene	0.0013	800	N
CAN127-1275-0000	Fluoranthene	17	300	N
CAN127-1275-0000	Fluorene	0.29	300	N
CAN127-1275-0000	**Indeno(1,2,3-cd)pyrene**	**5.1**	**0.04**	Y
CAN127-1276-0000	Lead	48.2	500	N
CAN127-1278-0000	Mercury	0.11	2	N
CAN127-1274-0002	Nickel	12.4	200	N
CAN127-1275-0000	Phenanthrene	8.1	NTF	N
CAN127-1275-0000	Pyrene	17	200	N
CAN127-1272-0002	Silver	3.6	20	N
CAN127-1275-0018	Tetrachloroethene	0.0029	1	N
CAN127-1276-0002	Thallium	0.14	6	N
CAN127-1275-0008	Toluene	0.018	2000	N
CAN127-1278-0008	Total Petroleum Hydrocarbons	170	1000	N
CAN127-1275-0018	Trichloroethene	0.0023	6	N
CAN127-1276-0000	Xylenes (total)	0.012	20000	N
CAN127-1275-0000	Zinc	38.5	2000	N

NTF = No Established EPA Toxicity Factor

(1) All units in mg/kg

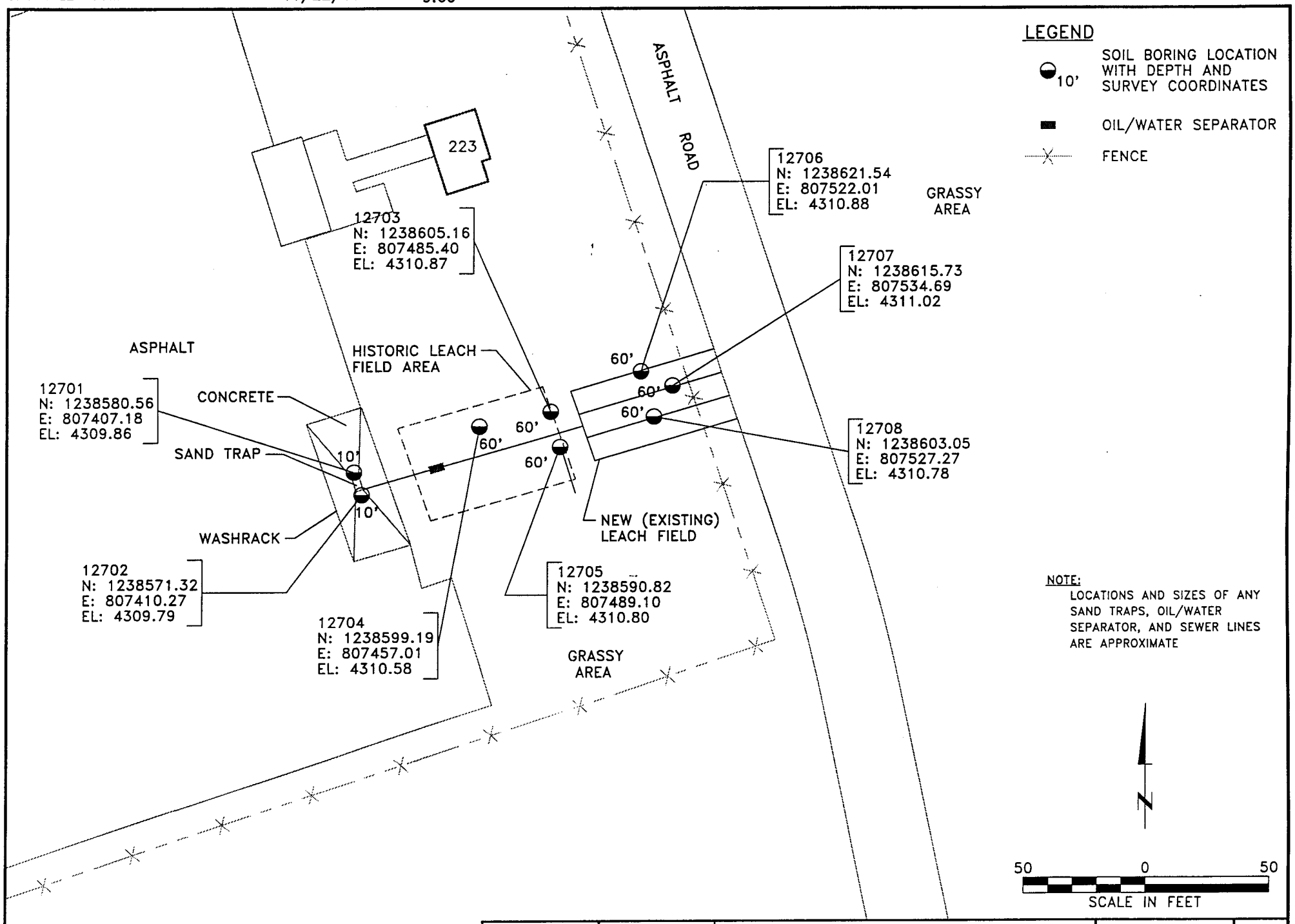
(2) Risk-based concentration

(3) EPA suggests 500-1,000 mg/kg as allowable concentration for residential soils based on EPA's IUBK Lead Model (EPA 1990)

(4) New Mexico recommended soil cleanup level for fuel contaminated soil.

Note: Only metlas that exceeded background appear in this table

CAD FILE: C3M11W10.DWG 11/22/1993 9:60



SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

DRN BY: CJG	DATE: 08/17/93	SAND TRAP AT POL WASHRACK – SWMU 127 SITE PLAN AND BORING LOCATIONS CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W	FIG. NO. 16–1
CHK'D BY: .	REVISION: 0			

17.0
LEAD-ACID BATTERY ACCUMULATION POINT - SWMU NO. 55

17.1 SITE BACKGROUND

17.1.1 Site Description

The lead-acid battery accumulation point consists of asphalt pavement measuring approximately 8 feet square located about 100 feet north of the Vehicle Maintenance Shop, Building 379 (Figure 17-1). The pavement is contiguous with the asphalt parking lot for Building 379 and slopes slightly toward the northwest.

17.1.2 Site History

Used lead-acid vehicle batteries are stored "wet" on pallets on the pavement until a sufficient number are accumulated for sale to a battery recycling company. The lead-acid battery accumulation point has been in operation since 1965.

17.1.3 CURRENT USE

The batteries are prepared for storage by securing the vent caps with tape and by taping the terminals to prevent shorts. The area under the pallets is lined with plastic sheeting covered with baking soda to neutralize any acid which may leak out during storage. The storage area is open to the elements.

17.1.4 Potential Contaminants

Potential contaminants of concern include lead and sulfuric acid.

17.2 FIELD INVESTIGATION AND DATA COLLECTION

17.2.1 Soils Sampling

The objective of sampling at the site of the Lead-Acid Battery Accumulation Point is to evaluate whether or not a release of SWMU-related chemicals posing a hazard to human health or the environment has occurred as a result battery leakage and spillage. Three 20-foot boreholes were drilled and sampled to investigate the vertical extent of any discovered target contaminants in the soil. The soil borings were located along a crack coinciding with the direction of drainage from this area, in a depression on the pavement where surface runoff accumulates, and in an area of suspected runoff accumulation north of the storage area.

Soil samples were collected from directly beneath the asphalt pavement from the 0.5- to 2-foot interval and at the 3- to 5-foot, 8- to 10-foot, 13- to 15-foot, and 18- to 20-foot depth intervals below ground surface as specified in the Field Sampling Plan and the Sample Summary Tables. Target analytes were lead and pH.

Samples were collected in accordance with QAPP SOP No. 6 - Surface Soil Sampling and QAPP SOP No. 7 - Subsurface Drilling and Sampling. Only minor iron oxide surface staining was found on the asphalt pavement, possibly attributable to a leak from the batteries once stored here.

17.2.2 Geologic Summary of Boring Logs

Boring logs indicate the soil under this SWMU progresses downsection through various thicknesses of red, brown, and light yellowish sandy clay/silt with occasional gravel. The log for Boring 05503 indicates a reversal or repetition in the stratigraphy described above indicating an area backfilled during construction of nearby facilities. Minor structures such as reddish dendrites and mottling were noted in the brown and light colored soils, respectively. The soil is dry to damp, resulting in a firm to hard profile. No visual indications of soil contamination were noted for any of the borings drilled in this SWMU. See copies of boring logs in Appendix B, Volume V.

17.2.3 Site Topography

Storm water runoff flows off site to the northwest over the pavement and asphalt parking lot and ultimately into the D.L. Ingram Street drainage ditch.

17.3 CHEMICAL INVESTIGATION RESULTS

17.3.1 General

Samples were collected as identified in Section 17.2 to comply with permit and compliance agreement requirements. Soil samples were collected from 3 borings (05501, 05502 and 05503). Sampling and analyses performed are summarized in Table 17-1. A summary of the analytical results for these soil samples are provided in Tables 17-2a for near-surface soils and Table 17-2b for sub-surface soils. For each sample type, the tables provide results for analytes only if they were detected at least once in this type of sample collected at the SWMU. Complete analytical summary results are provided in the QCSR (Appendix A).

17.3.2 Inorganic Results

For SWMU 55 only lead analyses were performed on samples as indicated in Table 17-1. The range of the lead results reported in these soil samples are summarized in Table 17-A.

TABLE 17-A

Analyte	Frequency Reported	Lowest Detection	Sample Location	Highest Detection	Sample Location
Lead	15/15	0.56 mg/kg	0551-0000	5.3 mg/kg	0551-0013

17.4 SWMU-SPECIFIC DATA ASSESSMENT

17.4.1 General

This assessment of Lead Acid Battery Accumulation Point data is an evaluation of quality issues that could affect the major data uses. In general, the objective of the RFI was

identification and quantification of the nature and extent of the contamination, which was necessary to meet permit and compliance agreement requirements, and to support an evaluation of the risk to human health and the environment.

17.4.2 Sampling Issues

A review of the data contained in the log books and the Daily Control Reports for SWMU 55 indicate that there were no sampling issues that would impact data usability.

17.4.3 Data Review Issues

For laboratory analytical data, QA/QC objectives were specified in the Cannon AFB QAPP (W-C 1993). The objectives were used as indicators of the quality necessary to support identification and quantitation of potential chemicals of concern. The data review is presented in Section 4.11 of the Quality Control Summary Report (QCSR) located in Appendix A. As presented in the QCSR, data for the lead in sample CAN055-0551-0018 was qualified estimated to indicate a low bias. When a low bias is indicated, actual concentrations may be higher than the reported results. Use of this data in risk assessment may underestimate risk. Similarly, when a high bias is indicated, actual concentrations may be lower than the reported results. Use of this data in risk assessment may overestimate risk.

The uncertainty in the actual concentration reported for estimated data does not affect the usability of the data for identification of chemicals in characterizing the nature and extent of contamination at this SWMU.

17.4.4 Limitations

Elevated reporting limits may limit the usability of the data due to low level analytes being diluted to below the instrument detection limits. That is, chemicals may be reported as nondetect when they are actually present in a sample at low levels. Section 4.11.6 of the QCSR (Appendix A) presents a discussion of elevated reporting limits. Lead analyses had elevated reporting limits. The elevated reporting limits for lead did not impact on the usability of the associated data because the elevated reporting limits are not considered to be significant (i.e. greater than 100) and data were reported above the elevated reporting limits.

17.4.5 Summary

Overall, data generated during the study of SWMU 55 were determined to meet quality criteria. In conjunction with the analytical data review, other information including field observations were evaluated in the assessment of the usability of SWMU 55 data. The data support identification of the nature and extent of contamination and provide reasonable concentration for use in risk assessment.

17.5 NATURE AND EXTENT OF CONTAMINATION

SWMU 55 is a paved area in the motor pool compound where lead/acid batteries are stored on pallets awaiting disposal. There were three borings advanced through the pavement to depths of twenty feet below the surface. There was no visible evidence on the surface or in the samples of contamination. The samples were tested for lead and acidity and no elevated levels of either analyte were detected.

17.6 COMPARISON OF METALS CONCENTRATIONS TO BACKGROUND

Results of the comparison of metal concentration in soil to background levels for SWMU 55 are given in Table 17-3. A summary of the results of the comparison is presented here.

Metals are natural constituents of soils. SWMU concentrations of metal were evaluated to assess whether the metals in environmental samples exceed background levels. Metals that occur in concentrations within background levels are not considered SWMU-related chemicals of concern and are not evaluated further.

The maximum concentration of each detected metal at each SWMU was compared to the upper tolerance limit of the background data. The upper tolerance limit (UTL) was defined as the mean plus two times the standard deviation. This is for all practical purposes equal to the 90% upper confidence limit of the 95th percentile which is equal to the mean plus the standard deviation times the k statistic. The background data set used consisted of 37 data points (W-C 1993), so the k statistic equals 2.02 (Gilbert 1987).

Lead was the only metal of concern at this site, and thus, the only metal for which analyzed. The maximum detected concentration of lead did not exceed the (UTL) of the background data. Therefore, no metals will be compared to risk-based concentrations at SWMU 55.

17.7 RISK SCREENING

17.7.1 Exposure Pathway Flow Chart

The Preliminary Exposure Pathway Flow Chart (EPFC) applicable to SWMU 55, Lead-Acid Battery Accumulation Point, is shown in Figure 3-4. It shows that the potential exposure pathways are ingestion of, dermal contact with, and inhalation of airborne chemicals released from soils by a hypothetical construction worker, and ingestion, inhalation, and dermal exposure to groundwater (if drinking water supplies were affected). Storm water runoff is considered to be an insignificant pathway because there are no drainage channels in the area.

17.7.2 Screening of Contaminants Against RBCs (and other criteria)

Because of the nature of this site, lead was the only contaminant of potential concern and acidity the only characteristic of potential concern. Therefore, these were the only two analyses at this site. Since detected lead concentrations did not exceed background levels (Table 17-3), and acidity was reported as nondetect for all of the samples, no comparison to RBCs was conducted. Since background and RBCs were not exceeded, it is not likely that there would be adverse impacts to human health if people were exposed long-term (i.e., 70 years) to soils containing the levels of lead and acidity detected at SWMU 55.

17.8 SUMMARY AND RECOMMENDATIONS

Fifteen soil samples were collected and analyzed from three 20-foot soil borings at SWMU 55. A screening-level evaluation was performed for the site and no samples were above background or levels of concern.

The highest concentration for lead was found in the shallow surface soils. The concentrations decreased with depth; therefore, the vertical extent of contamination has been characterized by the borings and the potential for the groundwater beneath SWMU 55 to be impacted can

be characterized. The potential for impacts to groundwater is considered to be low because the detected levels of analytes are negligible, the depth to groundwater is greater than 200 feet, there will be no further releases of compounds to the soil, and sampling demonstrates that contaminants are not being transported vertically below the SWMU. Therefore, no further action is recommended.

TABLE 17-1

SUMMARY OF ANALYTICAL AND QA/QC SAMPLING
LEAD-ACID BATTERY ACCUMULATION POINT (SWMU NO. 55)
CANNON AFB, NEW MEXICO

Sample Location	Target Interval (ft-bgs)	Sample Identification Number	QA/QC Type	Sample Matrix	Analytical Parameters		Sample Containers	
					pH	Lead	16 oz. poly[1]	8 oz. jars
Boring 05501	0.5 - 2	CAN055-0551-0000		Soil	X	X		1
	3 - 5	CAN055-0551-0003		Soil	X	X		1
	8 - 10	CAN055-0551-0008		Soil	X	X		1
	13 - 15	CAN055-0551-0013		Soil	X	X		1
	18-20	CAN055-0551-0018		Soil	X	X		1
Boring 05502	0.5 - 2	CAN055-0552-0000		Soil	X	X		1
	0.5 - 2	CAN055-0552-5561	FD	Soil	X	X		1
	0.5 - 2	CAN055-0552-5501	MRD	Soil	X	X		1
	3 - 5	CAN055-0552-0003		Soil	X	X		1
	8 - 10	CAN055-0552-0008		Soil	X	X		1
	8 - 10	CAN055-0552-5562	FD	Soil	X	X		1
	13 - 15	CAN055-0552-0013		Soil	X	X		1
	18-20	CAN055-0552-0018		Soil	X	X		1
		CAN055-0552-5551	AB	Water		X	1	
		CAN055-0552-5571	RB	Water		X	1	
		CAN055-0552-5581	DW	Water		X	1	
		CAN055-0552-5591	TB	Water		X	1	
Boring 05503	0.5 - 2	CAN055-0553-0000		Soil	X	X		1
	3 - 5	CAN055-0553-0003		Soil	X	X		1
	3 - 5	CAN055-0553-5563	FD	Soil	X	X		1
	3 - 5	CAN055-0553-5503	MRD	Soil	X	X		1
	8 - 10	CAN055-0553-0008		Soil	X	X		1
	8 - 10	CAN055-0553-6008	MS/MSD	Soil	X	X		2
	13 - 15	CAN055-0553-0013		Soil	X	X		1
	18-20	CAN055-0553-0018		Soil	X	X		1

AB = Ambient blank
DW = Decontamination water
FB = Field blank
MRD = Missouri River Division
MS/MSD = Matrix spike/matrix spike duplicate
RB = Rinsate blank
TB = Trip blank
[1] All 16-oz. polyethylene containers are to have preservative for lead test.
See Figure 17-1 for locations of the borings.

TABLE 17-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 55

LOCATOR	CAN055-0551-0000			CAN055-0551-0003			CAN055-0552-0000			CAN055-0552-0003			CAN055-0553-0000			CAN055-0553-0003		
LAB SAMPLE NUMBER	0312750001SA			0312750002SA			0313820009SA			0313820010SA			0313820004SA			0313820005SA		
COLLECT DATE	09/15/93			09/15/93			09/22/93			09/22/93			09/22/93			09/22/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Metals (mg/kg)																		
Lead	6.1	0.56		4.5	2.8		6.3	0.57		3.3	1.2		8	1.1		3.9	0.58	
Water Quality (percent)																		
Water	10	0.1		11	0.1		12	0.1		14	0.1		11	0.1		14	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 17-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 55

LOCATOR	CAN055-0551-0008			CAN055-0551-0013			CAN055-0551-0018			CAN055-0552-0008			CAN055-0552-0013			CAN055-0552-0018		
LAB SAMPLE NUMBER	0312750003SA			0312750004SA			0312750005SA			0313820011SA			0313820012SA			0313820013SA		
COLLECT DATE	09/15/93			09/15/93			09/15/93			09/22/93			09/22/93			09/22/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Metals (mg/kg)																		
Lead	4.6	2.8		1.2	5.3	J	0.96	1.1	J	4.6	0.67		1	0.57		3.6	0.58	
Water Quality (percent)																		
Water	9.2	0.1		6.3	0.1		10	0.1		25	0.1		12	0.1		14	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 17-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 55

LOCATOR	CAN055-0553-0008			CAN055-0553-0013			CAN055-0553-0018		
LAB SAMPLE NUMBER	0313820006SA			0313820007SA			0313820008SA		
COLLECT DATE	09/22/93			09/22/93			09/22/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Metals (mg/kg)									
Lead	3.5	0.6		2.1	1.3		1.9	0.69	
Water Quality (percent)									
Water	16	0.1		26	0.1		28	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value.
U = Nondetected value.

QUAL=Qualification
RL = Reporting Limit.

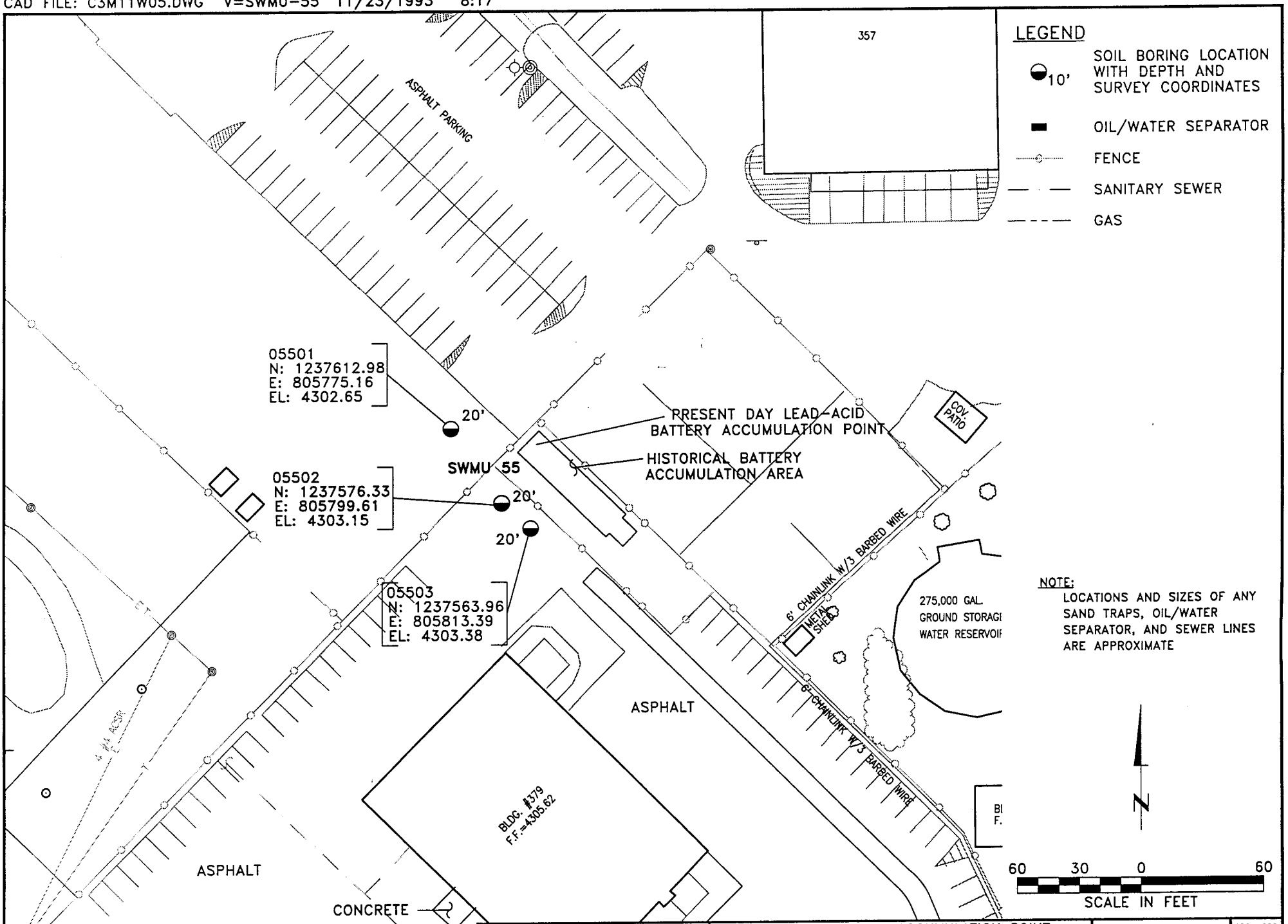
TABLE 17-3

METAL CONCENTRATIONS (1)
SWMU 55, CANNON AFB
Lead and Acid Battery Accumulation Point

Sample ID	Metal	Maximum Detected concentration	Range of background concentrations (2)	Upper tolerance limit (UTL) background concentration (3)	Does maximum detected exceed UTL background
CAN055-0553-0000	Lead	8	1.1 - 46	25.8	N

(1) All units in mg/kg.
(2) Compiled from data collected by Woodward Clyde for the RFI and RI (WCC 1992 and WCC 1993) and Wald, Haydel and Associates for the IRP (Walk, Haydel and Associates 1990).
Summarized in "Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater at Cannon AFB, NM (WCC 1993)
(3) Upper Tolerance Limit (UTL) of the mean = mean + 2*standard deviation. This is for all practicle purposes the same as the 90% upper confidence limit of the 95th percentile where UTL = mean + standard deviation *k, where k=2.02 for n=37 .

CAD FILE: C3M11W05.DWG V=SWMU-55 11/23/1993 8:17



SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

DRN BY: CJG	DATE: 08/17/93	LEAD ACID BATTERY ACCUMULATION POINT SWMU 55 – SITE PLAN AND BORING LOCATIONS CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W	FIG. NO. 17–1
CHK'D BY: .	REVISION: 0			

18.0
CIVIL ENGINEERING CONTAINER STORAGE AREA - SWMU NO. 77

18.1 SITE BACKGROUND

18.1.1 Site Description

The Civil Engineering Container Storage Area (Facility No. 4038) is an open concrete pad measuring approximately 150 feet by 250 feet located east of Building 252 and south of the north boundary fence of the base (Figure 18-1). The concrete pad is secured by an 8-foot high fence with a locked gate. The pad is the remaining floor of the old Portair Airfield Hangar dating back to the 1930s.

18.1.2 Site History

This facility was a passenger terminal for Portair Field during the 1930s and was removed by the Army in 1942. According to historical photographs, the concrete foundation slab had been vacant until the 1970s, and it appears to have been used for storage since that time. Approximately 100 55-gallon drums were stored at the facility during the RFA Visual Site Inspection (Kearney 1987). A preliminary inspection referenced in the A.T. Kearney report indicated that the drums contained varying amounts of water, oil, solvents, and asphaltic material.

18.1.3 Current Use

The Civil Engineering Squadron currently stores supplies and used materials on the concrete pad. The stored items include used transformers, street lights and street signs, PVC piping, and heavy equipment parts.

18.1.4 Potential Contaminants

Potential contaminants at this site include waste oil, solvents, aviation fuel, waste paint materials, PCBs, and pesticides.

18.2 FIELD INVESTIGATION AND DATA COLLECTION

18.2.1 Soils Sampling

The objective of sampling at the Civil Engineering Container Storage Area was to determine if a release of SWMU-related chemicals has occurred due to leakage of stored materials and equipment. To test for this occurrence and determine the vertical extent of possible contaminants, six 20-foot soil borings were drilled to sample soils within and at the perimeter of the Storage Area. Borings were located where it appeared that the likelihood of encountering contamination was maximized, such as channels and low spots where storage pad runoff would flow and collect. Surficial samples were collected from the 0.2- to 0.5-foot depth interval in areas of soil cover to provide a worst-case situation for risk assessment purposes in the event that SVOC contamination was detected during this investigation. The 0.5- to 2-foot depth interval was collected immediately under the concrete pad. Subsurface samples were collected from the 3- to 5-foot, 8- to 10-foot, 13- to 15-foot, and 18- to 20-foot depth intervals as specified in the Field Sampling Plan and the Sampling Summary Tables..

Samples were collected in accordance with QAPP SOP No. 6 - Surface Soil Sampling and QAPP SOP No. 7 - Subsurface Drilling and Sampling. Target analytes for all borings include VOCs, SVOCs, metals, TRPH, PCBs, pesticides, and herbicides.

18.2.2 Geologic Summary of Boring Logs

Soils at this site consist of silty/sandy clays from the surface to the boring's total depth at 20 feet. The soil is varicolored, with brown prevalent at the surface, lightening to salmon pink and buff down section. A light to locally heavy, white to buff caliche matrix cements the grains at depth. More abundant fine sand with silt and clay noted at 11 feet in Boring 07703 suggests that the soil profile consists of thin, interbedded units varying between fine sand and sandy clay. Some thin zones of extremely hard caliche, tan to buff in color are

scattered erratically between the 6-foot and 20-foot intervals of Borings 07701 and 07706 (see copies of the boring logs in Appendix B, Volume X).

18.2.3 Site Topography

The concrete storage pad is nearly flat, so that precipitation runs off on all sides. Native surfaces in the area have no discernable gradient.

18.3 CHEMICAL INVESTIGATION RESULTS

18.3.1 General

Samples were collected as identified in Section 18.2 to comply with permit and compliance agreement requirements. Soil samples were collected from 6 borings (07701, 07702, 07703, 07704, 07705, and 07706). Sampling and analyses performed are summarized in Table 18-1. Summaries of the analytical results for these soil samples is provided in Table 18-2a for near-surface soils and Table 18-2b for subsurface soils. For each sample type, the tables provide results for analytes only if they were detected at least once in this type of sample collected at the SWMU group. Complete analytical summary results are provided in the QCSR (Appendix A).

18.3.2 Organic Results For Near-surface Soil Samples

The near-surface soil samples collected at this SWMU (CAN077-0771-0000, CAN077-0771-0003, CAN077-0772-0000, CAN077-0772-0003, CAN077-0773-0000, CAN077-0773-0003, CAN077-0774-0000, CAN077-0774-0003, CAN077-0775-0000, CAN077-0775-0003, CAN077-0776-0000, CAN077-0776-0003, were analyzed for VOCs, SVOCs, Pesticide/PCBs, Herbicides, TRPH, and metals as indicated in Table 18-1.

Other than acetone and methylene chloride, which were qualified nondetected after they were determined to be laboratory contaminants (see Section 4.12.4 of the QCSR), the VOCs reported were 1.3 µg/kg tetrachloroethene reported as detected for sample CAN077-0775-0003; toluene reported as detected at 3.2 µg/kg and 7.5 µg/kg in samples CAN077-0773-0000 and CAN077-0771-0000; three near-surface samples were reported with

xylenes (total) detections at 1.9 µg/kg, 6.1 µg/kg, and 6.8 µg/kg in respective samples CAN077-0772-0000, CAN077-0773-0000 and CAN077-0771-0000. TPH was reported in five near-surface samples (four of which were at the 0000 depth) and ranged from 10,000 mg/kg in sample CAN077-0774-0003 to 64.0 mg/kg in sample CAN077-0775-0000. Sample CAN077-0774-0003 was the only near-surface sample reported with a TPH detection at a depth of below 0000.

Results reported for SVOCs were primarily polycyclic aromatic hydrocarbons (PAHs). Except for the compounds bis(2-ethylhexyl)phthalate and di-n-butyl phthalate which were qualified nondetected after determination that these analytes were laboratory contaminants, carbazole and two phthalate esters (butyl benzyl phthalate and di-n-octyl phthalate) were the only SVOC reported in near-surface samples that would not be considered a PAH. Carbazole was reported as detected at 41 µg/kg and 43 µg/kg for samples CAN077-0776-0000 and CAN077-0775-0003, respectively. Butyl benzyl phthalate was reported as detected at 39 µg/kg and 83 µg/kg in samples CAN077-0772-0000 and CAN077-0772-0003. Di-n-octyl phthalate was reported at 160 µg/kg in sample CAN077-0772-0000. PAHs were reported for five samples and included the compounds anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, pentachlorophenol and pyrene. Summing PAH concentrations, sample CAN077-0775-0003 had the highest total PAH reported at 5030 µg/kg and sample CAN077-0775-0000 had total PAH reported at 652 µg/kg.

Pesticides were reported in three samples. 4,4-DDE at 2.3 µg/kg was the only Pesticide reported in sample CAN077-0775-0000. Four pesticides were reported in sample CAN077-0776-0000; 4,4-DDE at 3.8 µg/kg, 4,4-DDT at 30 µg/kg, alpha-chlordane at 3.3 µg/kg, and gamma-chlordane at 10 µg/kg. Two pesticides were reported in sample CAN077-0772-0000; alpha-chlordane at 7.8 µg/kg and gamma-chlordane at 6.5 µg/kg. No PCBs or herbicides were reported in near-surface soil samples.

18.3.3 Organic Results For Subsurface Soil Samples

The subsurface soil samples collected at this SWMU (CAN077-0771-0008, 0771-0013, 0771-0018; CAN077-0772-0008, 0772-0013, 0772-0018; CAN077-0773-0008, 0773-0013, 0773-0018; CAN077-0774-0008, 0774-0013, 0774-0018; CAN077-0775-0008, 0775-0013,

0775-0018; CAN077-0776-0008, 0776-0013, 0776-0018, were analyzed for VOCs, SVOCs, pesticide/PCBs, herbicides, metals, and TRPH as indicated in Table 18-1.

Other than acetone and methylene chloride, which were qualified nondetect after they were determined to be laboratory contaminants (see Section 4.12.4 of the QCSR), no VOCs were reported were in subsurface soil samples. 4-Nitrophenol was the only SVOC reported as detected at 58 µg/kg in sample CAN077-0772-0018. No Pesticide/PCBs, herbicide, or TPH analytes were reported in subsurface samples at this SWMU.

18.3.4 Inorganic Results

Metals analyses were performed on samples collected from this SWMU as indicated in Table 18-1. The range of results for metals reported in these soil samples are summarized in Table 18-A.

TABLE 18-A

Analyte	Frequency Reported	Lowest Detection	Sample Location	Highest Detection	Sample Location
Aluminum	26/26	2300 mg/kg	0775-0000	9860 mg/kg	0774-0000
Antimony	2/26	3.1 mg/kg	0772-0003	5.9 mg/kg	0776-0003
Arsenic	26/26	0.95 mg/kg	0776-0018	2.5 mg/kg	0775-0000
Beryllium	21/26	0.23 mg/kg	0776-0018	0.66 mg/kg	0774-0000
Cadmium	13/26	0.58 mg/kg	0775-0008	3.0 mg/kg	0772-0003
Calcium	26/26	1910 mg/kg	0774-0003	275,000 mg/kg	0776-0013
Chromium	22/26	2.1 mg/kg	0775-0000	10.4 mg/kg	0774-0000
Cobalt	25/26	1.4 mg/kg	0775-0000	4.8 mg/kg	0774-0000
Copper	24/26	2.2 mg/kg	0773-0013	11.0 mg/kg	0772-0000
Iron	26/26	2040 mg/kg	0776-0013	10,800 mg/kg	0774-0000
Lead	26/26	1.1 mg/kg	0776-0013	41.0 mg/kg	0776-0000
Magnesium	26/26	1070 mg/kg	0776-0000	7820 mg/kg	0772-0018
Manganese	26/26	12.4 mg/kg	0776-0013	410 mg/kg	0775-0000
Mercury	0/26	--	--	--	--
Nickel	25/26	3.6 mg/kg	0775-0018	8.6 mg/kg	0774-0000
Potassium	26/26	383 mg/kg	0776-0013	1770 mg/kg	0774-0000
Silver	20/26	0.49 mg/kg	0774-0018	2.0 mg/kg	0772-0003
Selenium	0/26	--	--	--	--
Sodium	4/26	171 mg/kg	0773-0013	389 mg/k	0774-0013
Thallium	0/26	--	--	--	--
Vanadium	26/26	8.0 mg/kg	0772-0008	22.5 mg/kg	0774-0000
Zinc	25/26	5.9 mg/kg	0772-0018	73.8 mg/kg	0772-0000

Note: See Table 18-3 for comparison to background.

18.4 SWMU-SPECIFIC DATA ASSESSMENT

18.4.1 General

This assessment of Civil Engineering Container Storage Area data is an evaluation of quality issues that could affect the major data uses. In general, the objective of the RFI was identification and quantification of the nature and extent of the contamination, which was necessary to meet permit and compliance agreement requirements, and to support an evaluation of the risk to human health and the environment.

18.4.2 Sampling Issues

A review of the data contained in the log books and the Daily Quality Control Reports (DQCR) for SWMU 77 indicate that there were no sampling issues that would impact data usability. QC issues are discussed in detail in the QCSR in Appendix A, and copies of the DQCR are included in that appendix.

18.4.3 Data Review Issues

For laboratory analytical data, QA/QC objectives were specified in the Cannon AFB QAPP (W-C 1993). The objectives were used as indicators of the quality necessary to support identification and quantitation of potential chemicals of concern. The data review is presented in Section 4.12 of the Quality Control Summary Report (QCSR) located in Appendix A. As presented in the QCSR, data for the analytes arsenic, aluminum, beryllium, cadmium, chromium, cobalt, copper, barium, calcium, manganese, selenium, silver, lead, iron, magnesium, nickel, zinc, thallium, and four SVOCs' data were qualified as estimated concentrations, and barium data were rejected for six of the twenty-six samples associated with SWMU 77.

Silver, selenium, thallium, and pentachlorophenol data were qualified estimated to indicate a potential low bias, and manganese and lead data were qualified estimated to indicate a potential high bias. When a low bias is indicated, actual concentrations may be higher than the reported results. Use of this data in risk assessment may underestimate risk. Similarly,

when a high bias is indicated, actual concentrations may be lower than the reported results. Use of this data in risk assessment may overestimate risk.

Phenanthrene, fluoranthene, pyrene, aluminum, beryllium, cadmium, chromium, cobalt, copper, iron, magnesium, nickel zinc, barium, and calcium were qualified estimated, in field duplicate pairs, due to precision that did not meet the QA\QC criteria defined for this project. Poor precision could be attributed to errors in sampling and analysis; however, since the other analytes which were sampled and analyzed in the same procedure (Method 6010) met QA/QC criteria, this variation is likely due to sample heterogeneity.

For ICP metals analyses, the only indicator of data accuracy is the results of the matrix spike. Barium data were rejected based on MS/MSD recoveries over 200% which is considerably above the criteria defined for this project. Because it can not be determined whether the identification of barium can be relied upon the data were rejected.

The uncertainty in the actual concentration reported for estimated data does not affect the usability of the data for identification of chemicals in characterizing the nature and extent of contamination at this SWMU.

18.4.4 Limitations

Elevated reporting limits may limit the usability of the data due to low level analytes being diluted to below the instrument detection limits. That is, chemicals may be reported as nondetect when they are actually present in a sample at low levels. Section 4.12.6 of the QCSR (Appendix A) presents a discussion of elevated reporting limits. Three lead, one SVOC and four herbicide analyses had elevated reporting limits. The elevated reporting limits did not impact on the usability of the associated data because the elevated reporting limits are not considered to be significant (i.e., greater than 100). Also, for lead analyses data were reported above the elevated reporting limits.

18.4.5 Summary

Overall, data generated during the study of SWMU 77 were determined to meet quality criteria. In conjunction with the analytical data review, other information including field

observations were evaluated in the assessment of the usability of SWMU 77 data. The data support identification of the nature and extent of contamination and provide reasonable concentration, except barium data, for use in risk assessment.

18.5 NATURE AND EXTENT OF CONTAMINATION

SWMU 77 is a paved, fenced area used by the Civil Engineering Squadron for storage. Six borings were advanced to a depth of 20 feet below the surface, two of them through the paved surface and four of them just off the edge of the paving at visible drainage locations. Although there was no visible evidence of contamination during the sampling process the chemical testing found elevated levels of PAHs and TPH in several of the borings. No serious pattern of heavy contamination was evident.

18.6 COMPARISON OF METALS CONCENTRATIONS TO BACKGROUND

Results of the comparison of metal concentration in soil to background levels for SWMU 77 are given in Table 18-3. A summary of the results of the comparison is presented here.

Metals are natural constituents of soils. SWMU concentrations of metal were evaluated to assess whether the metals in environmental samples exceed background levels. Metals that occur in concentrations within background levels are not considered SWMU-related chemicals of concern and are not evaluated further.

The maximum concentration of each detected metal at each SWMU was compared to the upper tolerance limit of the background data. The upper tolerance limit (UTL) was defined as the mean plus two times the standard deviation. This is, for all practical purposes, equal to the 90% upper confidence limit of the 95th percentile which is equal to the mean plus the standard deviation times the k statistic. The background data set used consisted of 37 data points (WCC 1993), so the k statistic equals 2.02 (Gilbert 1987).

The maximum detected concentrations of antimony, cadmium, cobalt, copper, lead, silver, and zinc exceeded the (UTL) of the background data. Therefore, these metals will be compared to risk-based concentrations at SWMU 77.

18.7 RISK SCREENING

18.7.1 Exposure Pathway Flow Chart

The Preliminary Exposure Pathway Flow Chart (EPFC) applicable to SWMU 77, Civil Engineering Contained Storage Area, is shown in Figure 3-5. It shows that the potential exposure pathways are ingestion of soil, inhalation of soil particulates, dermal exposure to contaminated soil, inhalation of airborne chemicals released from soil, and ingestion, inhalation, and dermal exposure to groundwater (if drinking water supplies were affected). The primary source for SWMU 77 is from spills and leaks from drums that were stored on the concrete pad. Storm water runoff is considered to be an insignificant pathway because there are no drainage channels in the area.

18.7.2 Screening of Contaminants Against RBCs and Other Criteria

Maximum detected concentrations of organic compounds and metals that exceeded background were compared to screening-level RBCs (see Section 3.4.5.1 for derivations of RBCs) and other screening criteria in Table 18-4. Screening-level criteria other than RBCs include the state of New Mexico's TPH clean-up level of 1,000 mg/kg (New Mexico Environmental Improvement Board 1993) and the EPA's recommended soil lead level of 500 mg/kg (EPA 1990). The TPH soil clean-up concentration of 1,000 mg/kg is not an RBC, nor is it a relevant-and-applicable standard for the SWMUs in this investigation. Rather it is a conservative value originally derived for the cleanup of fuel-contaminated soils at underground storage tank sites. Risk-based concentrations for TPH, measured as fresh fuels (e.g., gasoline or diesel), are at least an order of magnitude higher for occupational exposures. The concentration of 500 mg/kg is the most conservative concentration in the recommended range of 500 mg/kg to 1,000 mg/kg as a lead level in residential soil based on EPA's Uptake Biokinetic Model (EPA 1990). Compounds with no toxicity factors cannot be evaluated in the risk screening since RBCs cannot be calculated. These compounds, at the concentrations that were measured in soil, are not likely to significantly affect the results of the comparison to RBCs. The comparison for SWMU 77 shows that maximum detected concentrations of antimony, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, and TPH exceed RBCs.

This comparison of maximum detected concentrations to RBCs is very conservative (health-protective) and actual impacts are likely to be lower than those suggested by exceedances of conservative criteria. For example, maximum detected concentrations are likely to overestimate actual concentrations to which people would be exposed. Furthermore, the screening criteria are based on highly conservative residential exposure assumptions and target risk levels that may not be pertinent to current or future use of the SWMU. The RBCs used in this evaluation are calculated using RCRA Action Level methodology; however, the RBCs are more health-protective than conventional RCRA Action Levels because a target excess cancer risk level of 1×10^{-7} (1 in 10,000,000) and a hazard quotient of 0.1 were used to account for exposures to multiple chemicals and for exposure routes other than soil ingestion. Conventional RCRA Action Levels are calculated based on a cancer risk of 1×10^{-6} and a noncancer hazard of 1.0.

The purpose of the comparison to RBCs is to determine whether or not chemical releases (characterized by maximum detected concentrations) have occurred at SWMU 77 that could pose potential risks based on conservative health-based criteria. Since maximum concentrations of the chemical listed above exceed screening level criteria, further evaluation or investigation of chemical concentrations and probable exposures is warranted.

18.8 SUMMARY AND RECOMMENDATIONS

Thirty soil samples were collected and analyzed from six 20-foot deep soil borings at SWMU 77. Maximum detected concentrations were compared to background levels and RBCs. One metal, five organics, and TPH were found at levels that exceed RBCs or other screening-level criteria.

The highest concentrations for all of the contaminants except suspected laboratory contaminants were detected in the surface or near-surface (i.e., 3-foot depth) samples. Therefore, the vertical extent of contamination has been characterized by the borings, and the potential for the groundwater beneath SWMU 77 to be impacted can be characterized. The potential for impacts to groundwater is considered to be low because the depth to groundwater is greater than 200 feet, and sampling demonstrated that contaminants are not being significantly transported vertically below the SWMU. Therefore, it is concluded that the

available data are sufficient to complete a BRA, and it is recommended that the BRA be completed.

TABLE 18-1

SUMMARY OF ANALYTICAL AND QA/QC SAMPLING
CIVIL ENGINEERING CONTAINER STORAGE AREA (SWMU NO. 77)
CANNON AFB, NEW MEXICO

Sample Location	Target Interval (ft-bgs)	Sample Identification Number	QA/QC Type	Sample Matrix	Analytical Parameters						Sample Containers		
					VOCs	SVOCs	Metals	TRPH	PCBs/Pest	Herbicides	40 ml VOA vials	4 oz. jars	8 oz. jars
Boring 07701	0 - 0.5	CAN077-0771-0000		Soil	X	X	X	X	X	X		2	2
	0 - 0.5	CAN077-0771-7701	FD	Soil	X	X	X	X	X	X		2	2
	0 - 0.5	CAN077-0771-7761	MRD	Soil	X	X	X	X	X	X		2	2
	3 - 5	CAN077-0771-7703		Soil	X	X	X	X	X	X		2	2
	8 - 10	CAN077-0771-7708		Soil	X	X	X	X	X	X		2	2
	13 - 15	CAN077-0771-7713		Soil	X	X	X	X	X	X		2	2
	18 - 20	CAN077-0771-7718		Soil	X	X	X	X	X	X		2	2
Boring 07702	0 - 0.5	CAN077-0772-0000		Soil	X	X	X	X	X	X		2	2
	3 - 5	CAN077-0772-0003		Soil	X	X	X	X	X	X		2	2
	3 - 5	CAN077-0772-6003	MS/MSD	Soil	X	X	X	X	X	X		2	3
	8 - 10	CAN077-0772-0008		Soil	X	X	X	X	X	X		2	2
	13 - 15	CAN077-0772-0013		Soil	X	X	X	X	X	X		2	2
	18 - 20	CAN077-0772-0018		Soil	X	X	X	X	X	X		2	2
		CAN077-0772-7751	AB	Water	X						2		
		CAN077-0772-7771	RB	Water	X	X	X				2'		
		CAN077-0772-7781	DW	Water	X						2		
		CAN077-0772-7791	TB	Water	X						2		
Boring 07703	0.5 - 2	CAN077-0773-0000		Soil	X	X	X	X	X	X		2	2
	3 - 5	CAN077-0773-0003		Soil	X	X	X	X	X	X		2	2
	3 - 5	CAN077-0773-7762	FD	Soil	X	X	X	X	X	X		2	2
	3 - 5	CAN077-0773-7702	MRD	Soil	X	X	X	X	X	X		2	2
	8 - 10	CAN077-0773-0008		Soil	X	X	X	X	X	X		2	2
	13 - 15	CAN077-0773-0013		Soil	X	X	X	X	X	X		2	2
	18 - 20	CAN077-0773-0018		Soil	X	X	X	X	X	X		2	2
Boring 07704	0.5 - 2	CAN077-0774-0000		Soil	X	X	X	X	X	X		2	2
	3 - 5	CAN077-0774-0003		Soil	X	X	X	X	X	X		2	2
	3 - 5	CAN077-0774-6003	MS/MSD	Soil	X	X	X	X	X	X		2	3

TABLE 18-1

SUMMARY OF ANALYTICAL AND QA/QC SAMPLING
CIVIL ENGINEERING CONTAINER STORAGE AREA (SWMU NO. 77)
CANNON AFB, NEW MEXICO

Sample Location	Target Interval (ft-bgs)	Sample Identification Number	QA/QC Type	Sample Matrix	Analytical Parameters						Sample Containers		
					VOCs	SVOCs	Metals	TRPH	PCBs/Pest	Herbicides	40 ml VOA vials	4 oz. jars	8 oz. jars
Boring 07704, cont.	8 - 10	CAN077-0774-0008		Soil	X	X	X	X	X	X		2	2
	13 - 15	CAN077-0774-0013		Soil	X	X	X	X	X	X		2	2
	18 - 20	CAN077-0774-0018		Soil	X	X	X	X	X	X		2	2
Boring 07705	0 - 0.5	CAN077-0775-0000		Soil	X	X	X	X	X	X		2	2
	3 - 5	CAN077-0775-0003		Soil	X	X	X	X	X	X		2	2
	3 - 5	CAN077-0775-7764	FD	Soil	X	X	X	X	X	X		2	1
	8 - 10	CAN077-0775-0008		Soil	X	X	X	X	X	X		2	2
	13 - 15	CAN077-0775-0013		Soil	X	X	X	X	X	X		2	2
	18 - 20	CAN077-0775-0018		Soil	X	X	X	X	X	X		2	2
Boring 07706	0 - 0.5	CAN077-0776-0000		Soil	X	X	X	X	X	X		2	2
	3 - 5	CAN077-0776-0003		Soil	X	X	X	X	X	X		2	2
	3 - 5	CAN077-0776-7764	FD	Soil	X	X	X	X	X	X		2	2
	8 - 10	CAN077-0776-0008		Soil	X	X	X	X	X	X		2	2
	13 - 15	CAN077-0776-0013		Soil	X	X	X	X	X	X		2	2
	18 - 20	CAN077-0776-0018		Soil	X	X	X	X	X	X		2	2

AB = Ambient blank
DW = Decontamination water
FB = Field blank
MRD = Missouri River Division
MS/MSD = Matrix spike/matrix spike duplicate
RB = Rinsate blank
TB = Trip blank

[1] The following additional containers are needed:
2 - 32-oz. jars for SVOC tests
1 - 16-oz. jar for metals tests

See Figure 18-1 for locations of the borings.

TABLE 18-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 77

LOCATOR	CAN077-0771-0000			CAN077-0771-7703			CAN077-0772-0000			CAN077-0772-0003			CAN077-0773-0000			CAN077-0773-0003		
LAB SAMPLE NUMBER	0311810007SA			0311810009SA			0311890001SA			0311890002SA			0313790015SA			0313790016SA		
COLLECT DATE	09/11/93			09/11/93			09/11/93			09/11/93			09/22/93			09/22/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)																		
Tetrachloroethene	<	5.2	U	<	5.7	U	<	5.4	U	<	5.9	U	<	5.8	U	<	5.6	U
Toluene	7.5	5.2		<	5.7	U	<	5.4	U	<	5.9	U	3.2	5.8	J	<	5.6	U
Xylenes (total)	6.8	5.2		<	5.7	U	1.9	5.4	J	<	5.9	U	6.1	5.8		<	5.6	U
Semivolatile Organics (ug/kg)																		
Anthracene	<	340	U	<	380	U	67	360	J	<	390	U	<	380	U	<	370	U
Benzo(a)anthracene	69	340	J	<	380	U	330	360	J	<	390	U	<	380	U	<	370	U
Benzo(a)pyrene	60	340	J	<	380	U	260	360	J	<	390	U	<	380	U	<	370	U
Benzo(b)fluoranthene	110	340	J	<	380	U	510	360		<	390	U	<	380	U	<	370	U
Benzo(g,h,i)perylene	37	340	J	<	380	UJ	140	360	J	<	390	U	<	380	U	<	370	U
Butyl benzyl phthalate	<	340	U	<	380	U	39	360	J	<	390	U	<	380	U	<	370	U
Carbazole	<	340	UJ	<	380	UJ	<	360	U	<	390	U	<	380	U	<	370	U
Chrysene	67	340	J	<	380	UJ	350	360	J	<	390	U	<	380	U	<	370	U
Di-n-octyl phthalate	<	340	U	<	380	U	160	360	J	<	390	U	<	380	U	<	370	U
Dibenz(a,h)anthracene	<	340	U	<	380	U	73	360	J	<	390	U	<	380	U	<	370	U
Fluoranthene	130	340	J	<	380	U	610	360		<	390	U	<	380	U	<	370	U
Indeno(1,2,3-cd)pyrene	<	340	UJ	<	380	UJ	120	360	J	<	390	U	<	380	U	<	370	U
Pentachlorophenol	<	1700	U	<	1800	U	<	1700	U	<	1900	U	<	1800	U	<	1800	U
Phenanthrene	57	340	J	<	380	U	410	360		<	390	U	<	380	U	<	370	U
Pyrene	130	340	J	<	380	U	750	360		<	390	U	<	380	U	<	370	U
Pesticides/PCB's (ug/kg)																		
4,4'-DDE	<	3.4	U	<	3.8	U	<	14	U	<	3.9	U	<	3.8	U	<	3.7	U
4,4'-DDT	<	3.4	U	<	3.8	U	<	14	U	<	3.9	U	<	3.8	U	<	3.7	U
alpha-Chlordane	<	1.8	U	<	1.9	U	7.8	7.4		<	2	U	<	2	U	<	1.9	U
gamma-Chlordane	<	1.8	U	<	1.9	U	6.5	7.4	J	<	2	U	<	2	U	<	1.9	U

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value.
U = Nondetected value.

QUAL=Qualification
RL = Reporting Limit.

TABLE 18-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 77

LOCATOR	CAN077-0771-0000			CAN077-0771-7703			CAN077-0772-0000			CAN077-0772-0003			CAN077-0773-0000			CAN077-0773-0003		
LAB SAMPLE NUMBER	0311810007SA			0311810009SA			0311890001SA			0311890002SA			0313790015SA			0313790016SA		
COLLECT DATE	09/11/93			09/11/93			09/11/93			09/11/93			09/22/93			09/22/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Metals (mg/kg)																		
Aluminum	7100	10.4		7050	22.9		4140	10.8		3240	23.4		7410	11.5		7460	11.2	J
Antimony	<	6.2	U	<	13.7	U	<	6.5	U	3.1	14	J	<	6.9	U	<	6.7	U
Arsenic	2.3	0.52		2.9	0.57		1.7	0.54		2.2	0.59		2.5	0.58		2.1	0.56	
Barium			R			R	135	1.1		130	2.3		79.3	1.2		60.2	1.1	J
Beryllium	0.47	0.21		0.48	0.46		0.25	0.22		<	0.47	U	0.58	0.23		0.54	0.22	J
Cadmium	<	0.52	U	<	1.1	U	<	0.54	U	3	1.2		<	0.58	U	<	0.56	J
Calcium	10900	20.8		115000	45.8		15000	21.7		175000	46.8		2080	23.1		17700	22.5	J
Chromium	8	1		4.1	2.3		6.9	1.1		<	2.3	U	9.5	1.2		7.6	1.1	J
Cobalt	3.3	1		3.5	2.3		2.2	1.1		1.7	2.3	J	4.4	1.2		4	1.1	J
Copper	9.7	2.1		4.2	4.6	J	11	2.2		3.1	4.7	J	8.2	2.3		7.2	2.2	J
Iron	8820	10.4		6900	22.9		6450	10.8		2990	23.4		9330	11.5		7780	11.2	J
Lead	19.6	2.6	J	5.5	0.57	J	27.8	2.7		3.5	0.59		7.5	0.58		7	0.56	
Magnesium	1380	20.8		2940	45.8		1170	21.7		2340	46.8		1360	23.1		1820	22.5	J
Manganese	187	1	J	116	2.3	J	196	1.1		40.2	2.3		244	1.2	J	167	1.1	J
Nickel	6.7	4.2		7.8	9.2	J	5.1	4.3		4.3	9.4	J	7.9	4.6		8.5	4.5	J
Potassium	1440	520		1330	1140		979	541		621	1170	J	1440	577		1500	562	
Silver	<	1	UJ	<	2.3	UJ	0.6	1.1	J	2	2.3	J	0.72	1.2	J	0.56	1.1	J
Vanadium	17.6	1		21.3	2.3		13.7	1.1		10.2	2.3		20.9	1.2		16.9	1.1	
Zinc	38.9	2.1		15	4.6		73.8	2.2		7.5	4.7		19.6	2.3		17.3	2.2	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	129	41.6		<	45.8	U	158	43.3		<	46.8	U	<	46.1	U	<	45	U
Water Quality (percent)																		
Water	3.8	0.1		13	0.1		7.7	0.1		15	0.1		13	0.1		11	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J = Estimated value.

TABLE 18-2a

SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 77

LOCATOR	CAN077-0771-0000			CAN077-0771-7703			CAN077-0772-0000			CAN077-0772-0003			CAN077-0773-0000			CAN077-0773-0003		
LAB SAMPLE NUMBER	0311810007SA			0311810009SA			0311890001SA			0311890002SA			0313790015SA			0313790016SA		
COLLECT DATE	09/11/93			09/11/93			09/11/93			09/11/93			09/22/93			09/22/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual

R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 18-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 77

LOCATOR	CAN077-0774-0000			CAN077-0774-0003			CAN077-0775-0000			CAN077-0775-0003			CAN077-0776-0000			CAN077-0776-0003		
LAB SAMPLE NUMBER	0313790001SA			0313790002SA			0311890006SA			0311890007SA			0311810001SA			0311810002SA		
COLLECT DATE	09/22/93			09/22/93			09/10/93			09/10/93			09/11/93			09/11/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)																		
Tetrachloroethene	<	5.9	U	<	5.8	U	<	5.2	U	1.3	5.4	J	<	5.4	U	<	5.6	U
Toluene	<	5.9	U	<	5.8	U	<	5.2	U	<	5.4	U	<	5.4	U	<	5.6	U
Xylenes (total)	<	5.9	U	<	5.8	U	<	5.2	U	<	5.4	U	<	5.4	U	<	5.6	U
Semivolatile Organics (ug/kg)																		
Anthracene	<	390	U	<	3800	U	<	340	U	150	360	J	57	360	J	<	370	U
Benzo(a)anthracene	<	390	U	<	3800	U	56	340	J	370	360		280	360	J	<	370	U
Benzo(a)pyrene	<	390	U	<	3800	U	54	340	J	350	360	J	200	360	J	<	370	U
Benzo(b)fluoranthene	<	390	U	<	3800	U	120	340	J	630	360		500	360		<	370	U
Benzo(g,h,i)perylene	<	390	U	<	3800	U	<	340	U	160	360	J	110	360	J	<	370	UJ
Butyl benzyl phthalate	<	390	U	<	3800	U	<	340	U	<	360	U	<	360	U	<	370	U
Carbazole	<	390	U	<	3800	U	<	340	U	43	360	J	41	360	J	<	370	UJ
Chrysene	<	390	U	<	3800	U	68	340	J	500	360		420	360	J	<	370	UJ
Di-n-octyl phthalate	<	390	U	<	3800	U	<	340	U	<	360	U	<	360	U	<	370	U
Dibenz(a,h)anthracene	<	390	U	<	3800	U	<	340	U	<	360	U	<	360	U	<	370	U
Fluoranthene	<	390	U	<	3800	U	140	340	J	1100	360		830	360		<	370	U
Indeno(1,2,3-cd)pyrene	<	390	U	<	3800	U	<	340	U	150	360	J	99	360	J	<	370	UJ
Pentachlorophenol	<	1900	U	<	18000	UJ	<	1700	U	<	1700	U	63	1700	J	<	1800	U
Phenanthrene	<	390	U	<	3800	U	94	340	J	800	360		400	360		<	370	U
Pyrene	<	390	U	<	3800	U	120	340	J	820	360		900	360		<	370	U
Pesticides/PCB's (ug/kg)																		
4,4'-DDE	<	3.9	U	<	3.8	U	2.3	3.4	J	<	3.6	U	3.8	7.1	J	<	3.7	U
4,4'-DDT	<	3.9	U	<	3.8	U	<	3.4	U	<	3.6	U	30	7.1		<	3.7	U
alpha-Chlordane	<	2	U	<	2	U	<	1.8	U	<	1.8	U	3.3	3.7	J	<	1.9	U
gamma-Chlordane	<	2	U	<	2	U	<	1.8	U	<	1.8	U	10	3.7		<	1.9	U

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A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value.
U = Nondetected value.

QUAL=Qualification
RL = Reporting Limit.

TABLE 18-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 77

LOCATOR	CAN077-0774-0000			CAN077-0774-0003			CAN077-0775-0000			CAN077-0775-0003			CAN077-0776-0000			CAN077-0776-0003		
LAB SAMPLE NUMBER	0313790001SA			0313790002SA			0311890006SA			0311890007SA			0311810001SA			0311810002SA		
COLLECT DATE	09/22/93			09/22/93			09/10/93			09/10/93			09/11/93			09/11/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Metals (mg/kg)																		
Aluminum	9860	11.7		8330	11.6		2300	20.8		5890	10.8		5420	10.8		5670	11.2	
Antimony	<	7	U	<	6.9	U	<	12.5	U	<	6.5	U	<	6.5	U	5.9	6.7	J
Arsenic	2	0.59		1.5	0.58		2.5	0.52		2.1	0.54		2.3	0.54		1.8	0.56	
Barium	85.6	1.2		73.4	1.2		400	2.1		116	1.1	J			R			R
Beryllium	0.66	0.23		0.6	0.23		<	0.42	U	0.37	0.22		0.37	0.22		0.36	0.22	
Cadmium	<	0.59	U	<	0.58	U	2.4	1		0.62	0.54		<	0.54	U	<	0.56	U
Calcium	2090	23.4		1910	23.1		130000	41.7		48100	21.6	J	12300	21.6		81300	22.4	J
Chromium	10.4	1.2		9.3	1.2		2.1	2.1		6.6	1.1		8.6	1.1		4.6	1.1	
Cobalt	4.8	1.2		4.3	1.2		1.4	2.1	J	3.2	1.1		2.7	1.1		2.6	1.1	
Copper	8.4	2.3		8.2	2.3		4.4	4.2		6.8	2.2		7.3	2.2		4.1	2.2	
Iron	10800	11.7		9340	11.6		4430	20.8		6550	10.8		6490	10.8		5410	11.2	
Lead	8.1	0.59		8	0.58		9.1	1		9.3	1.1		41	2.7	J	5.9	0.56	J
Magnesium	1770	23.4		1670	23.1		1780	41.7		1570	21.6		1070	21.6		1850	22.4	
Manganese	252	1.2	J	228	1.2	J	410	2.1		206	1.1		182	1.1	J	74.9	1.1	J
Nickel	8.6	4.7		8.2	4.6		4	8.3	J	6.9	4.3		5.2	4.3		5.9	4.5	
Potassium	1770	586		1610	578		517	1040	J	1070	541		1010	539		1030	561	
Silver	0.8	1.2	J	0.78	1.2	J	1.6	2.1	J	0.69	1.1	J	<	1.1	UJ	<	1.1	UJ
Vanadium	22.5	1.2		17.9	1.2		11.1	2.1		18.8	1.1		14.4	1.1		12.6	1.1	
Zinc	22.9	2.3		23.6	2.3		17.3	4.2		19.2	2.2		6.2	2.2		11.9	2.2	
TPH (mg/kg)																		
Total Petroleum Hydrocarbons	<	46.9	U	10000	925		64	41.7		<	43.3	U	321	43.1		<	44.9	U
Water Quality (percent)																		
Water	15	0.1		14	0.1		4	0.1		7.5	0.1		7.2	0.1		11	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.
J = Estimated value.

TABLE 18-2a

SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SAMPLES COLLECTED FROM SWMU 77

LOCATOR	CAN077-0774-0000			CAN077-0774-0003			CAN077-0775-0000			CAN077-0775-0003			CAN077-0776-0000			CAN077-0776-0003		
LAB SAMPLE NUMBER	0313790001SA			0313790002SA			0311890006SA			0311890007SA			0311810001SA			0311810002SA		
COLLECT DATE	09/22/93			09/22/93			09/10/93			09/10/93			09/11/93			09/11/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual

R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 18-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 77

LOCATOR	CAN077-0771-7708			CAN077-0771-7713			CAN077-0771-7718			CAN077-0772-0008			CAN077-0772-0013		
LAB SAMPLE NUMBER	0311810010SA			0311810011SA			0311810012SA			0311890003SA			0311890004SA		
COLLECT DATE	09/11/93			09/11/93			09/11/93			09/11/93			09/11/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)															
Toluene	<	5.8	U	2.6	5.5	J	<	5.6	U	<	5.5	U	<	5.8	U
Semivolatile Organics (ug/kg)															
Butyl benzyl phthalate	<	380	U	<	360	U	<	370	U	<	370	U	83	380	J
4-Nitrophenol	<	1800	U	<	1800	U	<	1800	U	<	1800	U	<	1800	U
Metals (mg/kg)															
Aluminum	3910	57.7		4910	21.9		4520	22.2		4740	11.1		5680	23	
Antimony	<	34.6	U	15.2	13.1		<	13.3	U	<	6.7	U	<	13.8	U
Arsenic	1.6	0.58		1.3	0.55		1.1	0.56		1.7	0.55		1.7	0.58	
Barium			R			R			R	503	1.1		372	2.3	
Beryllium	<	1.2	U	<	0.44	U	<	0.44	U	0.34	0.22		<	0.46	U
Cadmium	<	2.9	U	<	1.1	U	<	1.1	U	1.3	0.55		1.5	1.2	
Calcium	252000	115		154000	43.8		119000	44.4		98500	22.2		156000	46	
Chromium	<	5.8	U	<	2.2	U	1.3	2.2	J	3.1	1.1		<	2.3	U
Cobalt	<	5.8	U	1.7	2.2	J	2	2.2	J	1.7	1.1		2.4	2.3	
Copper	<	11.5	U	<	4.4	U	1.2	4.4	J	3	2.2		2.3	4.6	J
Iron	2980	57.7		3610	21.9		3460	22.2		3040	11.1		3990	23	
Lead	2.9	0.58	J	3.3	0.55	J	2.7	0.56	J	5.2	0.55		3.8	0.58	
Magnesium	5070	115		5530	43.8		5710	44.4		3410	22.2		6300	46	
Manganese	35.3	5.8	J	46.6	2.2	J	52.9	2.2	J	62.2	1.1		48.6	2.3	
Nickel	<	23.1	U	5.1	8.8	J	4.3	8.9	J	3.8	4.4	J	6.2	9.2	J
Potassium	703	2880	J	1050	1090	J	761	1110	J	959	555		1320	1150	
Silver	<	5.8	UJ	<	2.2	UJ	<	2.2	UJ	0.6	1.1	J	1.3	2.3	J
Sodium	<	2880	U	<	1090	U	<	1110	U	<	555	U	<	1150	U
Vanadium	11.6	5.8		11.6	2.2		12.6	2.2		8	1.1		15	2.3	
Zinc	6.8	11.5	J	8.3	4.4	J	7.5	4.4		8.6	2.2		7.4	4.6	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value.
U = Nondetected value.

QUAL=Qualification
RL = Reporting Limit.

TABLE 18-2b

SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 77

LOCATOR	CAN077-0771-7708			CAN077-0771-7713			CAN077-0771-7718			CAN077-0772-0008			CAN077-0772-0013		
LAB SAMPLE NUMBER	0311810010SA			0311810011SA			0311810012SA			0311890003SA			0311890004SA		
COLLECT DATE	09/11/93			09/11/93			09/11/93			09/11/93			09/11/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Water Quality (percent)															
Water	13	0.1		8.6	0.1		9.9	0.1		9.9	0.1		13	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value.
U = Nondetected value.

QUAL=Qualification
RL = Reporting Limit.

TABLE 18-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 77

LOCATOR	CAN077-0772-0018			CAN077-0773-0008			CAN077-0773-0013			CAN077-0773-0018			CAN077-0774-0008			CAN077-0774-0013		
LAB SAMPLE NUMBER	0311890005SA			0313790017SA			0313790018SA			0313790019SA			0313790003SA			0313790004SA		
COLLECT DATE	09/11/93			09/22/93			09/22/93			09/22/93			09/22/93			09/22/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)																		
Toluene	<	5.7	U	<	5.6	U	<	5.4	U	<	5.6	U	<	5.7	U	<	5.6	U
Semivolatile Organics (ug/kg)																		
Butyl benzyl phthalate	<	380	U	<	370	U	<	360	U	<	370	U	<	370	U	<	370	U
4-Nitrophenol	58	1800	J	<	1800	U	<	1700	U	<	1800	U	<	1800	U	<	1800	U
Metals (mg/kg)																		
Aluminum	5540	22.8		3670	22.5		3010	10.8		5110	11.2		4030	22.7		5450	22.5	
Antimony	<	13.7	U	<	13.5	U	<	6.5	U	<	6.7	U	<	13.6	U	<	13.5	U
Arsenic	1.6	0.57		1.1	0.56		1	0.54		2.2	0.56		1.2	0.57		0.99	0.56	
Barium	341	2.3		190	2.3		38.9	1.1		106	1.1		597	2.3		454	2.3	
Beryllium	<	0.46	U	0.37	0.45	J	0.26	0.22		0.46	0.22		0.37	0.45	J	0.37	0.45	J
Cadmium	2.1	1.1		2.7	1.1		0.73	0.54		0.92	0.56		2.2	1.1		1.6	1.1	
Calcium	167000	45.6		183000	45.1		43700	21.6		66000	22.5		162000	45.4		158000	45.1	
Chromium	3.2	2.3		2.5	2.3		3.2	1.1		4	1.1		<	2.3	U	3.5	2.3	
Cobalt	1.8	2.3	J	2.1	2.3	J	2.1	1.1		3.1	1.1		2.2	2.3	J	2.7	2.3	
Copper	2.5	4.6	J	2.6	4.5	J	2.2	2.2		4.2	2.2		2.2	4.5	J	2.4	4.5	J
Iron	3660	22.8		2870	22.5		3190	10.8		4330	11.2		2970	22.7		4190	22.5	
Lead	3	0.57		3.4	5.6	J	3.7	2.7		5.6	0.56		3.2	5.7	J	3	0.56	
Magnesium	7820	45.6		4160	45.1		1920	21.6		4180	22.5		4170	45.4		5370	45.1	
Manganese	41.9	2.3		62.9	2.3	J	62.4	1.1	J	124	1.1	J	70.1	2.3	J	54.9	2.3	J
Nickel	4.2	9.1	J	4	9	J	3.9	4.3	J	5.6	4.5		4.7	9.1	J	6	9	J
Potassium	1160	1140		750	1130	J	944	541		1550	562		902	1130	J	1580	1130	
Silver	1.6	2.3	J	1.3	2.3	J	0.59	1.1	J	0.71	1.1	J	1.3	2.3	J	1.2	2.3	J
Sodium	<	1140	U	<	1130	U	171	541	J	336	562	J	<	1130	U	389	1130	J
Vanadium	17	2.3		10.6	2.3		10.2	1.1		18.4	1.1		10.9	2.3		13.1	2.3	
Zinc	5.9	4.6		8	4.5		8.2	2.2		12.4	2.2		8.8	4.5		10.6	4.5	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value.
U = Nondetected value.
QUAL=Qualification
RL = Reporting Limit.

TABLE 18-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 77

LOCATOR	CAN077-0772-0018			CAN077-0773-0008			CAN077-0773-0013			CAN077-0773-0018			CAN077-0774-0008			CAN077-0774-0013		
LAB SAMPLE NUMBER	0311890005SA			0313790017SA			0313790018SA			0313790019SA			0313790003SA			0313790004SA		
COLLECT DATE	09/11/93			09/22/93			09/22/93			09/22/93			09/22/93			09/22/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Water Quality (percent)																		
Water	12	0.1		11	0.1		7.6	0.1		11	0.1		12	0.1		11	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value.
U = Nondetected value.

QUAL=Qualification
RL = Reporting Limit.

TABLE 18-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 77

LOCATOR	CAN077-0774-0018			CAN077-0775-0008			CAN077-0775-0013			CAN077-0775-0018			CAN077-0776-0008			CAN077-0776-0013		
LAB SAMPLE NUMBER	0313790005SA			0311890009SA			0311890010SA			0311890011SA			0311810004SA			0311810005SA		
COLLECT DATE	09/22/93			09/10/93			09/10/93			09/10/93			09/11/93			09/11/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)																		
Toluene	<	5.6	U	<	5.4	U	<	5.6	U	<	5.5	U	<	5.7	U	<	5.7	U
Semivolatile Organics (ug/kg)																		
Butyl benzyl phthalate	<	370	U	<	360	U	<	370	U	<	360	U	<	380	U	<	380	U
4-Nitrophenol	<	1800	U	<	1700	U	<	1800	U	<	1800	U	<	1800	U	<	1800	U
Metals (mg/kg)																		
Aluminum	5360	11.2		4940	10.8		4140	11.1		3110	11		7220	22.8		3080	56.9	
Antimony	<	6.7	U	<	6.5	U	<	6.7	U	<	6.6	U	<	13.7	U	<	34.1	U
Arsenic	1.3	0.56		2.1	0.54		1.6	0.56		1.3	0.55		1.7	0.57		1.1	0.57	
Barium	85.8	1.1		280	1.1		165	1.1		55.3	1.1				R			R
Beryllium	0.39	0.22		0.33	0.22		0.3	0.22		0.25	0.22		0.49	0.46		<	1.1	U
Cadmium	1.2	0.56		0.58	0.54		<	0.56	U	<	0.55	U	<	1.1	U	<	2.8	U
Calcium	105000	22.4		71700	21.7		42100	22.3		35300	22		102000	45.6		275000	114	
Chromium	3.8	1.1		6.1	1.1		3.4	1.1		3	1.1		4	2.3		<	5.7	U
Cobalt	2.4	1.1		2.5	1.1		2	1.1		1.9	1.1		2.1	2.3	J	<	5.7	U
Copper	2.6	2.2		6.4	2.2		7.9	2.2		2.8	2.2		4	4.6	J	<	11.4	U
Iron	3890	11.2		5170	10.8		4330	11.1		3610	11		5750	22.8		2040	56.9	
Lead	4.3	5.6	J	9.4	1.1		5.5	0.56		5.7	1.1		5.7	0.57	J	1.1	0.57	J
Magnesium	6270	22.4		1770	21.7		2090	22.3		1720	22		3320	45.6		5900	114	
Manganese	56.9	1.1	J	120	1.1		90.8	1.1		88.9	1.1		95	2.3	J	12.4	5.7	J
Nickel	5.5	4.5		5.6	4.3		5.2	4.5		3.6	4.4	J	5.7	9.1	J	<	22.8	U
Potassium	1460	561		883	542		892	557		790	551		1300	1140		383	2840	J
Silver	0.49	1.1	J	0.69	1.1	J	0.69	1.1	J	0.86	1.1	J	<	2.3	UJ	<	5.7	UJ
Sodium	349	561	J	<	542	U	<	557	U	<	551	U	<	1140	U	<	2840	U
Vanadium	16.2	1.1		14.9	1.1		17.1	1.1		10.6	1.1		13.7	2.3		10.2	5.7	
Zinc	10.4	2.2		16.2	2.2		10.5	2.2		8.4	2.2		14	4.6		<	11.4	U

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value.
U = Nondetected value.

QUAL=Qualification
RL = Reporting Limit.

TABLE 18-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 77

LOCATOR	CAN077-0774-0018			CAN077-0775-0008			CAN077-0775-0013			CAN077-0775-0018			CAN077-0776-0008			CAN077-0776-0013		
LAB SAMPLE NUMBER	0313790005SA			0311890009SA			0311890010SA			0311890011SA			0311810004SA			0311810005SA		
COLLECT DATE	09/22/93			09/10/93			09/10/93			09/10/93			09/11/93			09/11/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Water Quality (percent)																		
Water	11	0.1		7.7	0.1		10	0.1		9.2	0.1		12	0.1		12	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 18-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 77

LOCATOR	CAN077-0776-0018		
LAB SAMPLE NUMBER	0311810006SA		
COLLECT DATE	09/11/93		
	Result	RL	Qual
Volatile Organics (ug/kg)			
Toluene	<	5.7	U
Semivolatile Organics (ug/kg)			
Butyl benzyl phthalate	<	380	U
4-Nitrophenol	<	1800	U
Metals (mg/kg)			
Aluminum	6310	22.8	
Antimony	<	13.7	U
Arsenic	0.95	0.57	
Barium			R
Beryllium	0.23	0.46	J
Cadmium	<	1.1	U
Calcium	91100	45.7	
Chromium	3.5	2.3	
Cobalt	1.7	2.3	J
Copper	<	4.6	U
Iron	4380	22.8	
Lead	3.2	0.57	J
Magnesium	6100	45.7	
Manganese	43.4	2.3	J
Nickel	4.7	9.1	J
Potassium	1140	1140	
Silver	<	2.3	UJ
Sodium	<	1140	U
Vanadium	13.7	2.3	
Zinc	10	4.6	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value.
U = Nondetected value.

QUAL=Qualification
RL = Reporting Limit.

TABLE 18-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SAMPLES COLLECTED FROM SWMU 77

LOCATOR	CAN077-0776-0018		
LAB SAMPLE NUMBER	0311810006SA		
COLLECT DATE	09/11/93		
	Result	RL	Qual
Water Quality (percent)			
Water	12	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A.

J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 18-3

COMPARISON OF MAXIMUM DETECTED METAL CONCENTRATIONS TO BACKGROUND (1)
SWMU 77, CANNON AFB

Civil Engineering Contained Storage Area

Sample ID	Metal	Maximum detected concentration	Range of background concentrations (2)	Upper tolerance limit (UTL) background concentration (3)	Does maximum detected exceed UTL background
CAN077-0776-0008	Aluminum	7220	1410 - 11,000	10,540	N
CAN077-0776-0003	Antimony	5.9	<5 - <13	*	Y
CAN077-0775-0000	Arsenic	2.5	0.67 - 28	15.5	N
CAN077-0772-0008	Barium	503	14.5 - 1200	642	N
CAN077-0776-0008	Beryllium	0.49	0.17 - 0.77	0.73	N
CAN077-0772-0003	Cadmium	3	<0.51 - 4.2	*	Y
CAN077-0776-0000	Chromium	8.6	4 - 15.4	12.5	N
CAN077-0774-0000	Cobalt	4.8	0.85 - 5.3	4.5	Y
CAN077-0772-0000	Copper	11	<2 - 18.4	*	Y
CAN077-0776-0000	Lead	41	1.1 - 46	25.8	Y
CAN077-0774-0003	Nickel	8.6	1.3 - 9.8	9	N
CAN077-0772-0003	Silver	2	0.51 - 0.93	*	Y
CAN077-0774-0000	Vanadium	22.5	5.2 - 28.3	25.3	N
CAN077-0772-0000	Zinc	73.8	<4.3 - 27.5	21.9	Y

(1) All units in mg/kg.
(2) Compiled from data collected by Woodward Clyde for the RFI and RI (WCC 1992 and WCC 1993) and Walk Haydel and Associates for the IRP (Walk, Haydel and Associates 1990).
Summarized in "Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater at Cannon AFB, NM (WCC 1993)
(3) Upper Tolerance Limit (UTL) of the mean = mean + 2*standard deviation. This is for all practicle purposes the same as the 90% upper confidence limit of the 95th percentile where UTL = mean + standard deviation *k, where k=2.02 for n=37 .
* Data insufficient to calculate UTL of background concentration

TABLE 18-4

COMPARISON OF MAXIMUM CONCENTRATIONS WITH RBCs (1)
SWMU 77, CANNON AFB
Civil Engineering Contained Storage Area

Sample ID	Analyte	Maximum Detected	RBC (2)	Maximum Detected Exceed RBC
CAN077-0776-0000	4,4'-DDE	0.0038	0.2	N
CAN077-0776-0000	4,4'-DDT	0.03	0.2	N
CAN077-0772-0018	4-Nitrophenol	0.058	NTF	N
CAN077-0772-0000	alpha-Chlordane	0.0078	0.05	N
CAN077-0775-0003	Anthracene	0.15	2000	N
CAN077-0776-0003	Antimony	5.9	3	Y
CAN077-0775-0003	Benzo(a)anthracene	0.37	0.07	Y
CAN077-0775-0003	Benzo(a)pyrene	0.35	0.01	Y
CAN077-0775-0003	Benzo(b)fluoranthene	0.63	0.07	Y
CAN077-0775-0003	Benzo(g,h,i)perylene	0.16	NTF	N
CAN077-0772-0013	Butyl benzyl phthalate	0.083	2000	N
CAN077-0772-0003	Cadmium	3	8	N
CAN077-0775-0003	Carbazole	0.043	4	N
CAN077-0775-0003	Chrysene	0.5	2	N
CAN077-0774-0000	Cobalt	4.8	NTF	N
CAN077-0772-0000	Copper	11	300	N
CAN077-0772-0000	Di-n-octyl phthalate	0.16	200	N
CAN077-0772-0000	Dibenz(a,h)anthracene	0.073	0.009	Y
CAN077-0775-0003	Fluoranthene	1.1	300	N
CAN077-0776-0000	gamma-Chlordane	0.01	0.05	N
CAN077-0775-0003	Indeno(1,2,3-cd)pyrene	0.15	0.04	Y
CAN077-0776-0000	Lead (3)	41	500	N
CAN077-0776-0000	Pentachlorophenol	0.063	0.6	N
CAN077-0775-0003	Phenanthrene	0.8	NTF	N
CAN077-0776-0000	Pyrene	0.9	200	N
CAN077-0776-0000	Silver	2	20	N
CAN077-0775-0003	Tetrachloroethene	0.0013	1	N
CAN077-0771-0000	Toluene	0.0075	2000	N
CAN077-0774-0003	Total Petroleum Hydrocarbons (4)	10,000	1000	Y
CAN077-0771-0000	Xylenes (total)	0.0068	20000	N
CAN077-0772-0000	Zinc	73.8	2000	N

NTF = No EPA Established Toxicity Factor

(1) All units in mg/kg

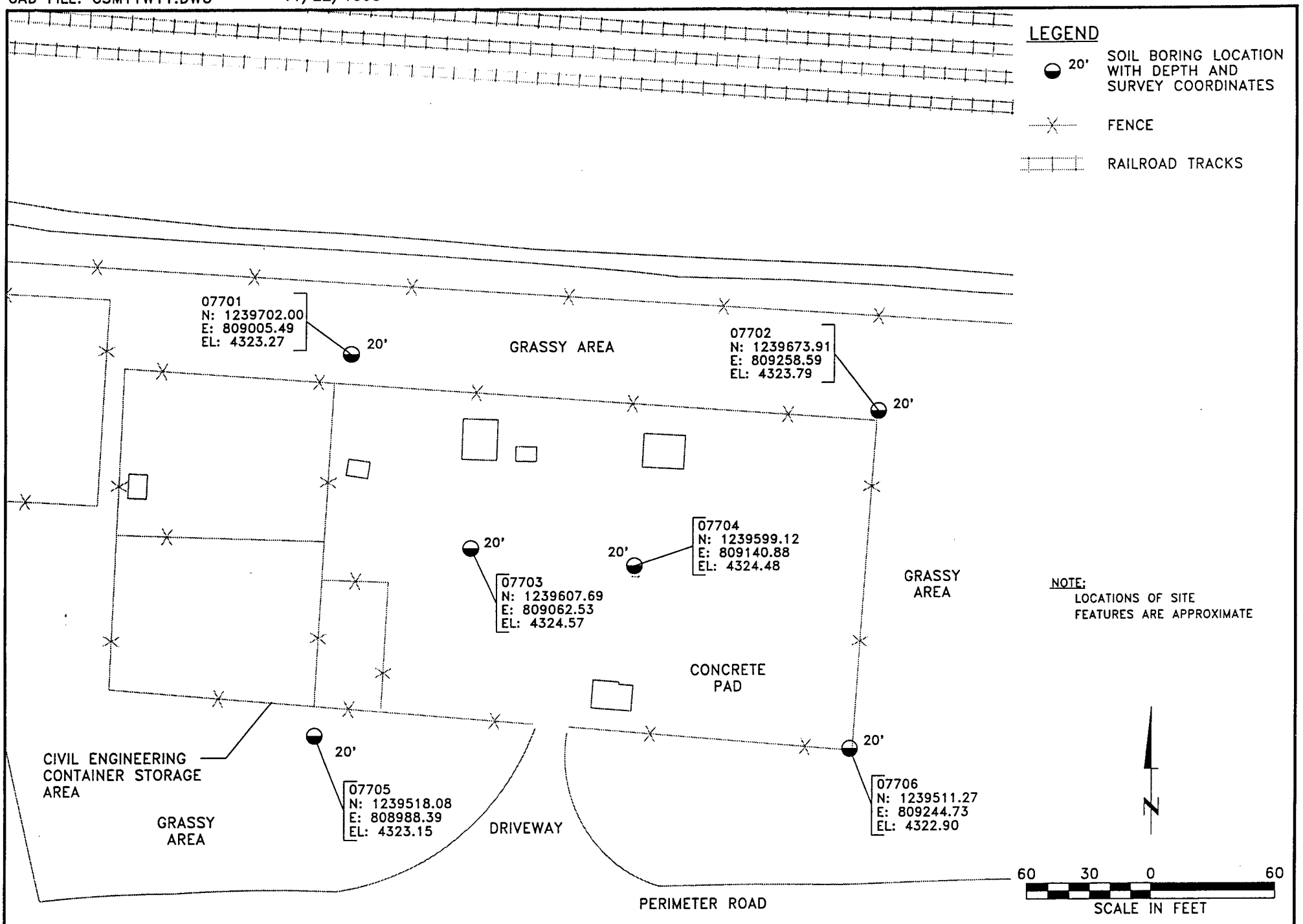
(2) Risk-based concentration

(3) EPA suggests 500-1,000 mg/kg as allowable concentration for residential soils based on EPA's IUBK Lead Model (EPA 1990)

(4) New Mexico recommended soil cleanup level for fuel contaminated soil.

Note: Only metals that exceeded background appear in this table.

CAD FILE: C3M11W11.DWG 11/22/1993 10:03



SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

DRN BY: CJG	DATE: 08/17/93	CIVIL ENGINEERING CONTAINER STORAGE AREA – SWMU 77 SITE PLAN AND BORING LOCATIONS CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W
CHK'D BY: .	REVISION: 0		FIG. NO. 18–1

sampling objectives, sludge samples from four locations and surface water samples from three locations were collected within the limits of the Playa Lake (Figure 19-1) as specified in the Field Sampling Plan. These sample sites were spatially located around the lake to help estimate the relative distribution of potential contaminants in this SWMU.

Samples were collected in accordance with QAPP SOP No. 5 - Sludge and Sediment Sampling and QAPP SOP No. 10 - Surface Water Sampling. Target analytes for the sludge samples include VOCs, SVOCs, metals, TRPH, PCB/pesticides, and herbicides. Surface waters collected were analyzed for the Appendix IX list of chemicals.

19.2.1 Water Sampling

Surface water samples were collected with a decontaminated Teflon bailer dipped into the lake from a small boat. Attempts were made throughout the sampling to collect water from the 0.5- to 3.5-foot interval below the water surface without including any sediment material from the lake bottom. If sediments were recovered, the water was discarded and new water was collected. Sample bottles were filled in the order specified in the applicable QAPP SOP, then transported back to shore for processing and storage in an ice-filled cooler.

19.2.2 Sludge Sampling

Sediment samples were collected in accordance with QAPP SOP No. 5 - Sludge and Sediment Sampling. All samples were collected with a decontaminated, stainless-steel, petite ponar dredge sampler and placed in a stainless-steel bowl. VOC samples were collected first and placed into their respective sample containers. The remaining material was homogenized prior to being placed in the other required sample containers.

19.2.3 Description of Samples

The surface water samples were universally algae-rich, with a medium to olive green color. Suspended algal material was visible in all samples collected. Conductivity was constant for all samples at 5,000 millohms. Water temperature ranged from 20.1°C to 21.9°C and pH ranged from 9.6 to 10.0.

The sludge samples were a consistent black, organic silt with a very fetid, sulfurous odor. One sample site (CAN103-1033) showed a colloidal texture to the sludge which was not apparent at other locations.

19.2.4 Site Topography

The Playa Lake is in a large playa near the ordnance area. The lake is an estimated 1,000 feet across the widest part and an estimated 5 feet deep at the deepest area with a gradually sloping bottom.

19.3 CHEMICAL INVESTIGATION RESULTS

19.3.1 General

Samples were collected as identified in Section 19.2 to comply with permit and compliance agreement requirements. A stainless steel petite ponar dredge was utilized to collect 4 sludge samples (sample location 10301, 10302, 10303, and 10304). Additionally, three surface water samples were collected (sample location 10305, 10306, and 10307). Sampling and analyses performed are summarized in Table 19-1. Summaries of the analytical results are provided in Table 19-2a for sludge samples and Table 19-2b for surface water samples. For each sample type, the tables provide results for analytes only if they were detected at least once in this type of sample collected at the SWMU. Complete analytical summary results are provided in the QCSR (Appendix A).

19.3.2 Organic Results For Sludge Samples

The sludge samples collected at this SWMU (CAN103-1031-5001, CAN103-1032-5001, CAN103-1033-5001, CAN103-1034-5001) were analyzed for VOCs, SVOCs, Metals, TPH, Pesticide/PCB, and Herbicides as indicated in Table 19-1.

Other than acetone, carbon disulfide, and methylene chloride, which were qualified nondetected after they were determined to be laboratory contaminants (see Section 4.13.4 of the QCSR), the only VOCs reported were benzene, 2-butanone, and chloromethane. Benzene was reported at 22J μg/kg, 6.6 μg/kg, and 16 μg/kg for samples CAN103-1032-5001,

CAN103-1033-5001, and CAN103-1034-5001, respectively. Concentrations of 2-butanone were reported at 18J μg/kg and 68 μg/kg for samples CAN103-1033-5001 and CAN103-1034-5001, respectively. Chloromethane was reported at 4J μg/kg for sample CAN103-1031-5001.

Except for bis(2-ethylhexyl)phthalate, di-n-butyl phthalate, and butyl benzyl phthalate, which were qualified nondetect after it was determined they were laboratory contaminants, no other SVOCs were detected for SWMU 103.

19.3.3 Organic Results For Surface Water Samples

The surface water samples collected at this SWMU (CAN103-1035-3000, CAN103-1036-3000, and CAN103-1037-3000) were analyzed for Appendix IX VOCs, SVOCs, Metals, TPH, Pesticide/PCB, and Herbicides as indicated in Table 19-1.

19.3.4 Inorganic Results

Metals analyses were performed on samples collected from this SWMU as indicated in Table 19-1. The range of results for metals reported in these sediment/sludge samples are summarized in Table 19-A.

TABLE 19-A

Analyte	Frequency Reported	Lowest Detection	Sample Location	Highest Detection	Sample Location
Aluminum	4/4	3410	1031-5001	21,300	1032-5001
Antimony	0/7	--	--	--	--
Barium	7/7	0.066	1037-3000	231	1032-5001
Beryllium	2/7	0.69	1033-5001	.99	1034-5001
Cadmium	2/7	2.3	1031-5001	2.6	1034-5001
Chromium	4/7	10.4	1031-5001	35.5	1032-5001
Calcium	4/4	26200	1031-5001	83400	1032-5001
Cobalt	2/7	4	1033-5001	5.9	1034-5001
Copper	7/7	.0051	1036-3000	102	1032-5001
Iron	4/4	3860	1031-5000	18300	1032-5001
Magnesium	4/4	1780	1031-5001	8700	1032-5001
Manganese	4/4	38	1031-5001	228	1032-5001
Nickel	4/7	5.3	1031-5001	27.7	1032-5001
Potassium	4/4	968	1031-5001	4640	1032-5001
Silver	7/7	.0052	1037-3000	33.7	1032-5001
Sodium	4/4	3940	1031-5001	18900	1032-5001
Tin	0/3	---	--	--	--
Vanadium	7/7	0.0048	1036-3000	130	1032-5001
Zinc	7/7	0.014	1036-3007	275	1032-5001
Arsenic	7/7	0.0031	1035-3000	10.8	1032-5001
Lead	5/7	0.006	1036-3000	39.3	1032-5001
Mercury	3/7	0.39	1033-5001	0.51	1034-5001
Selenium	4/7	3.3	1031-5001	13.2	1032-5001
Thallium	0/7	--	--	--	--

Note: See Table 19-3 for background comparison.

19.4 SWMU-SPECIFIC DATA ASSESSMENT

19.4.1 General

This assessment of the Playa Lake data is an evaluation of quality issues that could affect the major data uses. In general, the objective of the RFI was identification and quantification of the nature and extent of the contamination, which was necessary to meet permit and compliance agreement requirements, and to support an evaluation of the risk to human health and the environment.

19.4.2 Sampling Issues

A review of the data contained in the log books and the Daily Quality Control Reports (DQCR) for SWMU 103 indicate that there were no sampling issues that would impact data usability. QC issues are discussed in detail in the QCSR in Appendix A, and copies of the DQCRs are included in that appendix.

19.4.3 Data Review Issues

For laboratory analytical data, QA/QC objectives were specified in the Cannon AFB QAPP (W-C 1993). The objectives were used as indicators of the quality necessary to support identification and quantitation of potential chemicals of concern. The data review is presented in Section 4.13 of the Quality Control Summary Report (QCSR) located in Appendix A. As presented in the QCSR, data for the analytes arsenic, cobalt, lead, mercury, selenium, sodium, thallium, TPH and pyrene were qualified as estimated concentrations. For the sediment samples collected at SWMU 103 all organic data (VOC, SVOC, herbicide and pesticide/PCB data) were qualified estimated. No data associated with this SWMU were rejected.

Arsenic, lead, selenium, sodium, and thallium data were qualified estimated to indicate a potential low bias. Also, pyrene and TPH data for sample CAN103-1036-3000 were qualified estimated to indicate a low bias. When a low bias is indicated, actual concentrations may be higher than the reported results. Use of this data in risk assessment may underestimate risk. Similarly, when a high bias is indicated, actual concentrations may be lower than the reported results. Use of this data in risk assessment may overestimate risk.

Cobalt and mercury data were qualified estimated due to precision that did not meet the QA\QC criteria defined for this project. Poor precision could be attributed to errors in sampling and analysis; however, since the other analytes which were sampled and analyzed in the same procedure (Method 6010) met QA/QC criteria, this variation is likely due to sample heterogeneity.

All organic data for the sediment samples were qualified estimated due to the high moisture content of the sample (greater than 50%) and the reporting of the data on a dry weight basis.

This estimation of the data does not impact the usability of the data for identification of the data.

The uncertainty in the actual concentration reported for estimated data does not affect the usability of the data for identification of chemicals in characterizing the nature and extent of contamination at this SWMU.

19.4.4 Limitations

Elevated reporting limits may limit the usability of the data due to low level analytes being diluted to below the instrument detection limits. That is, chemicals may be reported as nondetect when they are actually present in a sample at low levels. Section 4.13.6 of the QCSR (Appendix A) presents a discussion of elevated reporting limits. Several VOC, SVOC, TPH, ICP metals and pesticide/PCB had elevated reporting limits. The elevated reporting limits for VOC, SVOC, TPH and metals analyses were not above levels of concern (i.e. greater than 100) and will not impact the usability of the data. Nine samples associated with this SWMU had elevated reporting limits for pesticide/PCB analyses by a factor ranging from 15 to 395. With the pesticide/PCB analyses the possibility exists that low level analytes may have been diluted to below the detection limit.

19.4.5 Summary

Overall, data generated during the study of SWMU 103 were determined to meet quality criteria. In conjunction with the analytical data review, other information including field observations were evaluated in the assessment of the usability of SWMU 103 data. The data support identification of the nature and extent of contamination, except for manganese data, and provide reasonable concentration for use in risk assessment.

19.5 NATURE AND EXTENT OF CONTAMINATION

SWMU 103 is a playa lake that has collected natural drainage and industrial and sanitary wastewater since the Base was established in 1942. Samples of the water from the lake and the sludge/sediment from the bottom of the lake were collected for chemical testing. The water showed no visible evidence of contamination other than having a high algae content.

The sludge samples were putrid smelling, and the chemical test results revealed that they contained elevated levels of beryllium, silver, vanadium, and TPH.

19.6 COMPARISON OF METALS CONCENTRATIONS TO BACKGROUND

Results of the comparison of metal concentration in soil to background levels for SWMU 103 are given in Table 19-3. A summary of the results of the comparison is presented here.

Metals are natural constituents of soils. SWMU concentrations of metal were evaluated to assess whether the metals in environmental samples exceed background levels. Metals that occur in concentrations within background levels are not considered SWMU-related chemicals of concern and are not evaluated further.

The maximum concentration of each detected metal at each SWMU was compared to the upper tolerance limit of the background data. The upper tolerance limit (UTL) was defined as the mean plus two times the standard deviation. This is for all practical purposes equal to the 90% upper confidence limit of the 95th percentile which is equal to the mean plus the standard deviation times the k statistic. The background data set used consisted of 37 data points (W-C 1993), so the k statistic equals 2.02 (Gilbert 1987).

The maximum detected concentrations of aluminum, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, potassium, nickel, selenium, silver, sodium, vanadium, and zinc exceeded the (UTL) of the background data. Therefore, these metals will be compared to risk-based concentrations at SWMU 103.

19.7 RISK SCREENING

19.7.1 Exposure Pathway Flow Chart

The Preliminary Exposure Pathway Flow Chart (EPFC) for SWMU 103, the wastewater playa lake (Figure 3-6), shows that the potential exposure pathways are ingestion of sediment, dermal exposure to sediment, ingestion, inhalation and dermal exposure to groundwater (if drinking water supplies were affected), ingestion and dermal exposure to surface water, and dermal contact with and inhalation of irrigation water. Exposure from volatile emissions from

sediments was not considered to be a complete exposure pathway because the sediments are mostly covered by water.

19.7.2 Screening of Contaminants Against RBCs and Other Criteria

Maximum detected concentrations of organic compounds and metals that exceeded background were compared to screening-level RBCs (see Section 3.4.5.1 for derivations of RBCs) and other screening criteria in Table 19-4A and 19-4B for sediments and surface water, respectively. Screening-level criteria other than RBCs include the state of New Mexico's TPH clean-up level of 1,000 mg/kg (New Mexico Environmental Improvement Board 1993), the EPA's recommended soil lead level of 500 mg/kg (EPA 1990), and Federal Maximum Contaminant Level (MCLs) for the surface water. The TPH soil clean-up concentration of 1,000 mg/kg is not an RBC, nor is it a relevant-and-applicable standard for the SWMUs in this investigation. Rather it is a conservative value originally derived for the cleanup of fuel-contaminated soils at underground storage tank sites. Risk-based concentrations for TPH, measured as fresh fuels (e.g., gasoline or diesel), are at least an order of magnitude higher for occupational exposures. The concentration of 500 mg/kg is the most conservative concentration in the recommended range of 500 mg/kg to 1,000 mg/kg as a lead level in residential soil based on in EPA's Uptake Biokinetic Model (EPA 1990). Compounds with no toxicity factors cannot be evaluated in the risk screening since RBCs cannot be calculated. These compounds, at the concentrations that were measured in soil, are not likely to significantly affect the results of the comparison to RBCs. The comparison for SWMU 103 shows that maximum detected concentrations of beryllium, silver, vanadium and TPH exceeds RBCs in lake sediment/sludge samples.

This comparison of maximum detected concentrations to RBCs is very conservative (health-protective) and actual impacts are likely to be lower than those suggested by exceedances of conservative criteria. For example, maximum detected concentrations are likely to overestimate actual concentrations to which people would be exposed. Furthermore, the screening criteria are based on highly conservative residential exposure assumptions and target risk levels that may not be pertinent to current or future use of the SWMU. The RBCs used in this evaluation are calculated using RCRA Action Level methodology; however, the RBCs are more health-protective than conventional RCRA Action Levels because a target

excess cancer risk level of 1×10^{-7} (1 in 10,000,000) and a hazard quotient of 0.1 were used to account for exposures to multiple chemicals and for exposure routes other than soil ingestion. Conventional RCRA Action Levels are calculated based on a cancer risk of 1×10^{-6} and a noncancer hazard of 1.0.

The purpose of the comparison to RBCs is to determine whether or not chemical releases (characterized by maximum detected concentrations) have occurred at SWMU 103 that could pose potential risks based on conservative health-based criteria. Since maximum concentrations of the above listed chemicals exceed screening-level criteria for sediments (soils), further evaluation or investigation of chemical concentrations and probable exposures is warranted. No chemicals were detected in the surface water at concentrations exceeding RBCs or MCLs.

19.8 SUMMARY AND RECOMMENDATIONS

Sediment/sludge samples from 4 locations and surface water samples from 3 locations were collected and analyzed at SWMU 103. Maximum detected concentrations were compared to background levels and RBCs. Three metals and TPH were found at levels that exceeds RBCs or other screening-level criteria for the sediment/sludge samples. The vertical extent of contamination has not been characterized since only surface water and sediment/sludge samples were taken. It has been concluded that the available data are sufficient to complete a BRA for all except the groundwater pathway for this SWMU.

It is recommended that a BRA be completed for SWMU 103.

TABLE 19-1

SUMMARY OF ANALYTICAL AND QA/QC SAMPLING
WASTEWATER PLAYA LAKE (SWMU NO. 103)
CANNON AFB, NEW MEXICO

Sample Location	Target Interval (ft-bgs)	Sample Identification Number	QA/QC Type	Sample Matrix	Analytical Parameters						Sample Containers		
					VOCs	SVOCs	Metals	TRPH	PCBs/Pest	Herbicides	40 ml VOA vials	4 oz. jars	8 oz. jars
10301		CAN103-1031-5001		Sludge	X	X	X	X	X	X		2	2
		CAN103-1031-1061	FD	Sludge	X	X	X	X	X	X		2	2
		CAN103-1031-1001	MRD	Sludge	X	X	X	X	X	X		2	2
		CAN103-1031-1051*	AB	Water	X						2		
		CAN103-1031-1071	RB	Water	X						2		
		CAN103-1031-1081	DW	Water	X						2		
		CAN103-1031-1091*	TB	Water	X						2		
10302		CAN103-1032-5001		Sludge	X	X	X	X	X	X		2	2
		CAN103-1032-6001	MS/MSD	Sludge	X	X	X	X	X	X		2	3
10303		CAN103-1033-5001		Sludge	X	X	X	X	X	X		2	2
10304		CAN103-1034-5001		Sludge	X	X	X	X	X	X		2	2

AB = Ambient blank
DW = Decontamination water
FB = Field blank
MRD = Missouri River Division
MS/MSD = Matrix spike/matrix spike duplicate
RB = Rinsate blank
TB = Trip blank
* Sample not collected

TABLE 19-1

SUMMARY OF ANALYTICAL AND QA/QC SAMPLING
WASTEWATER PLAYA LAKE (SWMU NO. 103)
CANNON AFB, NEW MEXICO

Sample Location	Target Interval (ft-bgs)	Sample Identification Number	QA/QC Type	Sample Matrix	Analytical Parameters	Sample Containers		
					Appendix IX	40 ml VOA vials	16 oz. poly	1-L bottles
10305	0	CAN103-1035-3000		Water	X	3	3[1]	5
		CAN103-1035-1061	FD	Water	X	3	3[1]	5
		CAN103-1035-1001	MRD	Water	X	3	3[1]	5
10306	0	CAN103-1036-3000		Water	X	3	3[1]	5
		CAM103-1036-7000	MS/MSD	Water	X	6	6[1]	10
10307	0	CAN103-1037-3000		Water	X	3	3[1]	5

FB = Field blank
MRD = Missouri River Division
MS/MSD = Matrix spike/matrix spike duplicate

[1] Each of 3 containers has a different preservative for metals tests.
See Figure 19-1 for approximate sampling locations.

TABLE 19-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SEDIMENT SAMPLES COLLECTED FROM SWMU 103

LOCATOR	CAN103-1031-5001			CAN103-1032-5001			CAN103-1033-5001			CAN103-1034-5001		
LAB SAMPLE NUMBER	0313580002SA			0313580003SA			0313580005SA			0313580006SA		
COLLECT DATE	09/21/93			09/21/93			09/21/93			09/21/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Volatile Organics (ug/kg)												
Benzene	<	19	UJ	22	98	J	6.6	19	J	16	25	J
2-Butanone (MEK)	<	39	UJ	<	200	UJ	18	37	J	68	49	J
Carbon disulfide	8.4	19	J	22	98	J	11	19	J	23	25	J
Chloromethane	4	39	J	<	200	UJ	<	37	UJ	<	49	UJ
Semivolatile Organics (ug/kg)												
bis(2-Ethylhexyl)phthalate	2000	1300	J	3900	6500	J	760	1200	J	1700	1600	UJ
Butyl benzyl phthalate	<	1300	UJ	<	6500	UJ	320	1200	J	<	1600	UJ
Di-n-butyl phthalate	<	1300	UJ	<	6500	UJ	200	1200	J	<	1600	UJ
Metals (mg/kg)												
Aluminum	3450	38.5		21300	196		12300	37.4		12300	49.2	
Arsenic	2.4	1.9		10.8	9.8	J	3.3	1.9	J	4.5	2.5	
Barium	90.1	3.9		231	19.6		119	3.7		150	4.9	
Beryllium	<	0.77	U	<	3.9	U	0.69	0.75	J	0.99	0.98	
Cadmium	2.3	1.9		<	9.8	U	<	1.9	U	2.6	2.5	
Calcium	26200	77		83400	393		46400	74.9		77400	98.4	
Chromium	10.4	3.9		35.5	19.6		13.5	3.7		19.8	4.9	
Cobalt	<	3.9	UJ	<	19.6	U	4	3.7		5.9	4.9	
Copper	40.3	7.7		102	39.3		29.4	7.5		44.3	9.8	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.

A complete summary of chemical results are presented in Appendix A

J = Estimated value.
R = Rejected value.
U = Nondetected value.

QUAL=Qualification
RL = Reporting Limit.

TABLE 19-2a
SUMMARY OF CHEMICALS REPORTED FOR NEAR-SURFACE SOIL SEDIMENT SAMPLES COLLECTED FROM SWMU 103

LOCATOR	CAN103-1031-5001			CAN103-1032-5001			CAN103-1033-5001			CAN103-1034-5001		
LAB SAMPLE NUMBER	0313580002SA			0313580003SA			0313580005SA			0313580006SA		
COLLECT DATE	09/21/93			09/21/93			09/21/93			09/21/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Iron	3860	38.5		18300	196		9990	37.4		13100	49.2	
Lead	14.6	1.9		39.3	9.8		16.5	1.9		16.7	2.5	
Magnesium	1780	77		8700	393		4140	74.9		5640	98.4	
Manganese	38	3.9		228	19.6		158	3.7		196	4.9	
Mercury	0.5	0.39	UJ	<	2	U	0.39	0.37		0.51	0.49	
Nickel	5.3	15.4	J	27.7	78.6	J	12.1	15	J	14.6	19.7	J
Potassium	968	1930	J	4640	9820	J	2580	1870		3380	2460	
Selenium	3.3	1.9		13.2	9.8		5.2	1.9	J	4.7	2.5	J
Silver	9.8	3.9		33.7	19.6		9.9	3.7		11.5	4.9	
Sodium	3940	1930	J	18900	9820	J	4230	1870	J	4260	2460	J
Vanadium	27.1	3.9		130	19.6		57.5	3.7		78.9	4.9	
Zinc	90.9	7.7		275	39.3		76.9	7.5		101	9.8	
TPH (mg/kg)												
Total Petroleum Hydrocarbons	2520	154		5890	786		2200	150		2290	197	
Water Quality (percent)												
Water	74	0.1		95	0.1		73	0.1		80	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A
J = Estimated value.
R = Rejected value. QUAL=Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 19-2b
SUMMARY OF CHEMICALS REPORTED FOR SUBSURFACE SOIL SEDIMENT SAMPLES COLLECTED FROM SWMU 103

LOCATOR	CAN103-1035-3000			CAN103-1036-3000			CAN103-1037-3000		
LAB SAMPLE NUMBER	0313580011SA			0313580008SA			0313580009SA		
COLLECT DATE	09/21/93			09/21/93			09/21/93		
	Result	RL	Qual	Result	RL	Qual	Result	RL	Qual
Semivolatile Organics (ug/L)									
Isophorone	<	10	UJ	<	10	U	1.4	10	J
Metals (mg/L)									
Arsenic	0.0031	0.005	J	0.0057	0.005	J	0.0034	0.005	J
Barium	0.076	0.01		0.07	0.01		0.066	0.01	
Copper	0.0069	0.02	J	0.0051	0.02	J	0.0072	0.02	J
Lead	<	0.005	UJ	0.006	0.005	J	<	0.005	UJ
Silver	0.0092	0.01	J	0.0053	0.01	J	0.0052	0.01	J
Vanadium	0.0089	0.01	J	0.0048	0.01	J	0.0081	0.01	J
Zinc	0.019	0.02	J	0.014	0.02	J	0.014	0.02	J
Water Quality (mg/L)									
Cyanide	0.014	0.01		0.011	0.01		<	0.01	U
Sulfide, Total	0.8	0.1		0.57	0.1		0.65	0.1	

(1) Results presented here are only those chemicals which were detected at least once at this SWMU and have passed data review.
A complete summary of chemical results are presented in Appendix A
J = Estimated value.
R = Rejected value. QUAL= Qualification
U = Nondetected value. RL = Reporting Limit.

TABLE 19-3

COMPARISON OF MAXIMUM DETECTED METAL CONCENTRATIONS TO BACKGROUND (1)
SWMU 103, CANNON AFB
Wastewater Playa Lake

Sample ID	Metal	Maximum detected concentration	Range of background concentrations (2)	Upper tolerance limit (UTL) background concentration (3)	Does maximum detected exceed UTL background
CAN103-1032-5001	Aluminum	21300	1410 - 11,000	10,540	Y
CAN103-1032-5001	Arsenic	10.8	0.67 - 28	15.5	N
CAN103-1032-5001	Barium	231	14.5 - 1200	642	N
CAN103-1034-5001	Beryllium	0.99	0.17 - 0.77	0.73	Y
CAN103-1034-5001	Cadmium	2.6	<0.51 - 4.2	*	Y
CAN103-1032-5001	Calcium	83400	1490 - 172,000	186,400	N
CAN103-1032-5001	Chromium	35.5	4 - 15.4	12.5	Y
CAN103-1034-5001	Cobalt	5.9	0.85 - 5.3	4.5	Y
CAN103-1032-5001	Copper	102	<2 - 18.4	*	Y
CAN103-1032-5001	Iron	18300	1820 - 11,000	8,720	Y
CAN103-1032-5001	Lead	39.3	1.1 - 46	25.8	Y
CAN103-1032-5001	Magnesium	8700	892 - 18,300	11,790	N
CAN103-1032-5001	Manganese	228	22.4 - 216	164	Y
CAN103-1034-5001	Mercury	0.51	<0.1 - <0.12	*	Y
CAN103-1032-5001	Nickel	27.7	1.3 - 9.8	9	Y
CAN103-1032-5001	Potassium	4640	354 - 2770	2,572	Y
CAN103-1032-5001	Selenium	13.2	<0.21 - 124	*	Y
CAN103-1032-5001	Silver	33.7	0.51 - 0.93	*	Y
CAN103-1032-5001	Sodium	18900	267 - 615	*	Y
CAN103-1032-5001	Vanadium	130	5.2 - 28.3	25.3	Y
CAN103-1032-5001	Zinc	275	<4.3 - 27.5	21.9	Y

(1) All units in mg/kg.
(2) Compiled from data collected by Woodward Clyde for the RFI and RI (WCC 1992 and WCC 1993) and Walk, Haydel and Associates for the IRP (Walk, Haydel and Associates 1990).
Summarized in "Concentrations of Selected Naturally Occurring Chemical Constituents in Soil and Groundwater at Cannon AFB, NM (WCC 1993)
(3) Upper Tolerance Limit (UTL) of the mean = mean + 2*standard deviation. This is for all practicle purposes the same as the 90% upper confidence limit of the 95th percentile where UTL = mean + standard deviation *k, where k=2.02 for n=37 .
* Data insufficient to calculate UTL of background concentration

TABLE 19-4A

COMPARISON OF MAXIMUM CONCENTRATIONS WITH RBCs (1)
SWMU 103, CANNON AFB

Wastewater Playa Lake

Sludge Sample ID	Analyte	Maximum Detected	RBC(2)	Maximum Detected Exceed RBC
CAN103-1034-5001	2-Butanone (MEK)	0.068	400	N
CAN103-1031-5001	4,4'-DDD	0.22	0.3	N
CAN103-1033-5001	4,4'-DDE	0.045	0.2	N
CAN103-1032-5001	Aluminum	21300	NTF	N
CAN103-1032-5001	Benzene	0.022	2	N
CAN103-1034-5001	Beryllium	0.99	0.02	Y
CAN103-1032-5001	bis(2-Ethylhexyl)phthalate	3.9	5	N
CAN103-1033-5001	Butyl benzyl phthalate	0.32	2000	N
CAN103-1034-5001	Cadmium	2.6	8	N
CAN103-1034-5001	Carbon disulfide	0.023	800	N
CAN103-1031-5001	Chloromethane	0.004	NTF	N
CAN103-1032-5001	Chromium	35.5	40	N
CAN103-1034-5001	Cobalt	5.9	NTF	N
CAN103-1032-5001	Copper	102	300	N
CAN103-1033-5001	Di-n-butyl phthalate	0.2	800	N
CAN103-1032-5001	Iron	18300	NTF	N
CAN103-1032-5001	Lead (3)	39.3	500	N
CAN103-1032-5001	Manganese	228	1000	N
CAN103-1034-5001	Mercury	0.51	2	N
CAN103-1032-5001	Nickel	27.7	200	N
CAN103-1032-5001	Potassium	4640	NTF	N
CAN103-1032-5001	Selenium	13.2	40	N
CAN103-1032-5001	Silver	33.7	20	Y
CAN103-1032-5001	Sodium	18900	NTF	N
CAN103-1032-5001	Total Petroleum Hydrocarbons (4)	5890	1000	Y
CAN103-1032-5001	Vanadium	130	60	Y
CAN103-1032-5001	Zinc	275	2000	N

NTF = No EPA Established Toxicity Factor

(1) All units in mg/kg

(2) Risk-based concentration

(3) EPA suggests 500-1,000 mg/kg as allowable concentration for residential soils based on EPA's IUBK Lead Model (EPA 1990)

(4) New Mexico recommended soil cleanup level for fuel contaminated soil.

Note: Only metals that exceeded background appear in this table.

TABLE 19-4B

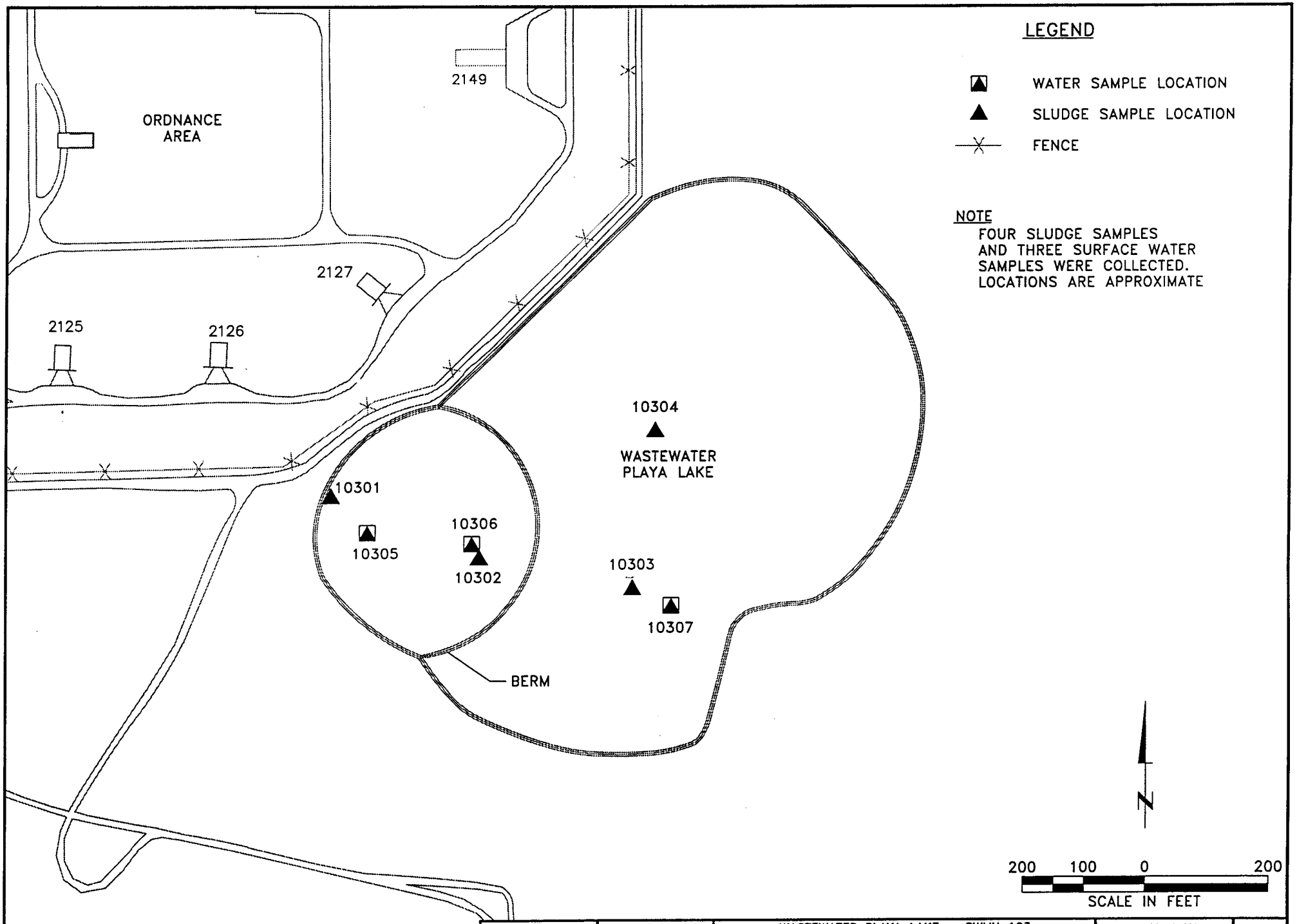
SUMMARY OF DETECTED ANALYTES
SWMU 103, CANNON AFB

Wastewater Playa Lake

Surface Water		Maximum Detected	Action * Levels	Maximum Detected
Sample ID	Analyte	mg/l	mg/l	Exceed Levels
CAN103-1036-3000	Arsenic	0.0057	0.05 (1)	N
CAN103-1035-3000	Barium	0.076	1 (1)	N
CAN103-1037-3000	Copper	0.0072	NA	N
CAN103-1035-3000	Cyanide	0.014	0.07	N
CAN103-1037-3000	Isophorone	0.0014	0.009	N
CAN103-1036-3000	Lead	0.006	.05 (1)	N
CAN103-1035-3000	Silver	0.0092	.05 (1)	N
CAN103-1035-3000	Sulfide, Total	0.8	NA	N
CAN103-1035-3000	Vanadium	0.0089	70	N
CAN103-1035-3000	Zinc	0.019	10.5	N

* Risk-Based Concentration
(1) MCL
NA = Not Available

CAD FILE: C3M11W12.DWG 11/22/1993 10:16



SOURCE: CANNON AFB CAD FILES AND CANNON AFB RFI FIELD SAMPLING PLAN.

DRN BY: CJG	DATE: 08/17/93	WASTEWATER PLAYA LAKE – SWMU 103 SITE PLAN AND SAMPLE LOCATIONS CANNON AIR FORCE BASE NEW MEXICO	PROJECT NO. C3M11W	FIG. NO. 19–1
CHK'D BY: .	REVISION: 0			

20.0
SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

The sixteen SWMUs in the Appendix III group as a whole do not appear to be seriously contaminated. Table 20-1 shows six SWMUs recommended for "No Further Action" on the basis of the risk screening. It shows the remaining ten SWMUs recommended for a baseline risk assessment. Two of these ten (70 and 103) have not had enough investigation to fully support a risk assessment, and it is recommended that additional investigative work be completed prior to the risk assessment.

TABLE 20-1

SWMU Number	Recommendation
31	BRA
46	NFA
47	NFA
51	BRA
57	NFA
61	NFA
62	NFA
63	BRA
70	FI AND BRA
92	BRA
93	BRA
94	BRA
127	BRA
55	NFA
77	BRA
103	BRA

Note: The key to column 2 above is as follows:

- BRA = Baseline Risk Assessment
- NFA = No further action
- FI and BRA = Further investigation and Baseline Risk Assessment

21.0
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