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FINAL RECORD OF DECISION
OPERABLE UNIT 1
LUKE AIR FORCE BASE, ARIZONA

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FINAL
OU-1 Record of Decision
Luke Air Force Base, Arizona

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LIST OF ACRONYMS AND ABBREVIATIONS

A.A.C.	Arizona Administrative Code
ACMs	Asbestos Containing Materials
ADEQ	Arizona Department of Environmental Quality
ADHS	Arizona Department of Health Services
ADWR	Arizona Department of Water Resources
AFB	Air Force Base
AGE	Aircraft Ground Equipment
amsl	Above Mean Sea Level
APC	Air Pollution Control
AR	Administrative Record
ARAR	Applicable or Relevant and Appropriate Requirements
A.R.S.	Arizona Revised Statutes
ATI	Analytical Technologies, Inc.
ATSDR	Agency for Toxic Substances and Disease Registry
AWQS	Aquifer Water Quality Standards
BEP	Bis (2-ethyl hexyl) Phthalate
bgs	Below Ground Surface
BGP	Base General Plan
BNAs	Base/Neutral and Acid Extractable Organic Compounds
BTEX	Benzene, Toluene, Ethylbenzene, and Total Xylenes
BX	Base Exchange
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
CSFs	Cancer Slope Factors
COCs	Constituents of Potential Concern
COECs	Constituents of Ecological Concern
DCE	Dichloroethene
DCP	Dichloropropane
DoD	Department of Defense
DP	Disposal Pit
DPDO	Defense Property Disposal Office
DRMO	Defense Reutilization Marketing Office
EEC	Environmental Engineering Consultants
EE/CA	Engineering Evaluation/Cost Analysis
EI	Ecological Inventory
ELCRs	Excess Lifetime Cancer Risks
EOD	Explosive Ordnance Division
EPCs	Exposure Point Concentrations
ERA	Ecological Risk Assessment
FFA	Federal Facilities Agreement

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

FS	Feasibility Study
FTP	Fire Training Pit
GPLs	Groundwater Protection Levels
GRAs	General Response Actions
HEAST	Health Effects Assessment Summary Tables
HI	Hazard Index
HRS	Hazard Ranking System
HQ	Hazard Quotient
ICE	Internal Combustion Engine
ICP	Institutional Control Plan
IEUBK	Integrated Exposure Uptake Biokinetic
IRIS	Integrated Risk Information System
IRP	Installation Restoration Program
JP	Jet Propulsion
LDR	Land Disposal Restriction
LF	Landfill
LLTD	Low Temperature Thermal Desorption
MAG	Maricopa Association of Governments
MEP	Maximum Extent Practicable
MCLs	Maximum Contaminant Levels
MCLGs	Maxiumum Contaminant Level Goals
MOGAS	Motor Gasoline
MW	Monitoring Well
NAAQS	National Ambient Air Quality Standards
NCP	National Oil and Hazardous Pollution Contingency Plan
NPL	National Priority List
NRC	Nuclear Regulatory Commission
OSHA	Occupational Safety and Health Act
OU	Operable Unit
O&M	Operation and Maintenance
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PCE	Tetrachloroethene
POL	Petroleum, Oil, and Lubricant
PPE	Personal Protective Equipment
PRGs	Preliminary Remediation Goals
PSC	Potential Source of Contamination
QA/QC	Quality Assurance/Quality Control
RA	Remedial Action
RAB	Restoration Advisory Board
RAO	Remedial Action Objective

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RFA	RCRA Facilities Assessment
RfCs	Reference Concentrations
RfDs	Reference Doses
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
ROD	Record of Decision
SB	Soil Borings
SARA	Superfund Amendments and Reauthorization Act
SD	Sediment Sample
SDWA	Safe Drinking Water Act
SG	Soil Gas
SRL	Soil Remediation Level
S/S	Stabilization/Solidification
SVE	Soil Vapor Extraction
TBC	To Be Considered
TCE	Trichloroethene
TP	Test Pit
TPH	Total Petroleum Hydrocarbons
TRC	Technical Review Committee
TRPH	Total Recoverable Petroleum Hydrocarbons
TSD	Treatment, Storage, and Disposal
TVPH	Total Volatile Petroleum Hydrocarbons
UCL	Upper Confidence Level
USACE	United States Army Corps of Engineers
USAF	United States Air Force
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
UTL	Upper Threshold Limit
VEMUR	Voluntary Environmental Mitigation Use Restriction
VOCs	Volatile Organic Compounds
WQARF	Water Quality Assurance Revolving Fund
WSRV	West Salt River Valley
WWTP	Waste Water Treatment Plant

SYMBOLS

kg-day/mg	kilogram-day per milligram
mg/kg-day	milligram per kilogram day
mg/kg	milligrams per kilogram
µg/dL	micrograms per decaliter
µg/kg	micrograms per kilogram
mg/L	milligram per Liter
µg/L	micrograms per liter
µg/ml	micrograms per milliliter
µL	microliter
µm	micrometer

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APPENDICES

1.0 INTRODUCTION

The United States Air Force (USAF) prepared this Record Of Decision (ROD) to document the Remedial Action Plan for Operable Unit No. 1 (OU-1) at Luke Air Force Base, Arizona (Luke AFB). The ROD was prepared in adherence with the rules and regulations of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), the 1986 Superfund Amendments and Reauthorization Act (SARA), and to the extent practical the National Oil and Hazardous Pollution Contingency Plan (NCP). This ROD has three main purposes:

- The ROD serves a legal function in that it certifies that the remedy selection process was carried out in accordance with the procedural and substantive requirements of CERCLA and, to the extent practicable, the NCP;
- The ROD is a technical document that outlines the engineering components and remediation goals of the selected remedy; and
- The ROD is informational, providing the public with a consolidated source of information about the history, characteristics, and risks posed by the conditions at the site, as well as a summary of the cleanup alternatives considered, their evaluation, and the rationale behind the selected remedy.

The Remedial Action Plan presented in this ROD was developed based on the results of the OU-1 Remedial Investigation and Feasibility Study. Detailed results of these studies are provided in the *OU-1 Remedial Investigation, Luke Air Force Base, Volumes I and 2 (Geraghty & Miller, 1997a; AR # 188, 189) and OU-1 Feasibility Study Report, Luke Air Force Base, Arizona* (ARCADIS Geraghty & Miller, 1998a, AR# 207), respectively.

Based on guidance found in the *Interim Final Guidance on Preparing Superfund Decision Documents: The Proposed Plan, The Record of Decision, Explanation of Significant Differences, The Record of Decision Amendment* (U.S. Environmental Protection Agency, 1989a), the ROD has been organized into three distinct sections:

The Declaration functions as an abstract for the key information contained in the ROD;

The Decision Summary provides an overview of the site characteristics, the alternatives evaluated, and the analysis of those options. The Decision Summary also identifies the selected remedy and explains how the remedy fulfills statutory requirements; and

The Responsiveness Summary addresses public comments received on the Proposed Plan and throughout the remedy selection process.

2.0 DECLARATION FOR THE RECORD OF DECISION

2.1 SITE NAME AND LOCATION

Operable Unit No. 1
Luke Air Force Base, Arizona

2.2 STATEMENT OF BASIS AND PURPOSE

This ROD is a decision document that presents the remedial action plan developed for OU-1 of Luke AFB. The ROD summarizes the problems posed by the conditions at OU-1, the remedial alternatives considered for addressing those problems, and the comparative analysis of those alternatives against nine evaluation criteria. The ROD then presents the selected remedy and provides the rationale for that selection.

A remedy was selected for soil impacts at eight potential sources of contamination (PSCs) designated as PSCs RW-02, LF-03, FT-07E, DP-13, LF-14, LF-25, SD-38 and SS-42. Although the OU-1 investigation included the investigation of soils at 25 PSCs and the Base-wide investigation of air, surface water, and groundwater resources, only the soils at the eight PSCs listed above required the selection of a remedy.

This ROD was developed in accordance with the rules and regulations of CERCLA, as amended by the SARA, and to the extent practicable, the procedures outlined in the NCP. This decision document is based on the administrative record for this operable unit which includes, among other documents, the OU- 1 Remedial Investigation Report, Base-wide Risk Assessment, and OU-1 Feasibility Study Report. The USAF, US Environmental Protection Agency (USEPA) and the State of Arizona concur on the selected remedy.

2.3 ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances in the soils at PSCs RW-02, LF-03, FT-07E, DP-13, LF-14, LF-25, SD-38 and SS-42, if not addressed by implementing the response action, may present an imminent and substantial endangerment to public health, welfare, or the environment.

The soils at the remaining 17 PSCs included in the OU-1 investigation and the air, surface water, and groundwater resources of Luke AFB do not pose an imminent and substantial endangerment to public health, welfare, or the environment.

2.4 DESCRIPTION OF THE REMEDY

The remedial alternatives selected for implementation at the eight OU-1 PSCs were developed to address the conditions that exist at each of the sites. The following section provides a brief summary of the remedial alternatives selected for OU-1. Detailed descriptions of the selected remedial alternatives are provided on a site-by-site basis in Section 3.10 of this ROD.

PSC RW-02

Remedial Alternative S-2, Institutional Controls, was selected for implementation at PSC RW-02. The remedial components which will be implemented at PSC RW-02 are listed below.

- A Voluntary Environmental Mitigation Use Restriction (VEMUR) will be executed and recorded to restrict land usage of the site to non-residential purposes.
- The Base General Plan (BGP) will also be modified to place constraints on future residential development of the site.
- A geophysical monitoring program will be designed and implemented to ensure the safety of potential receptors and to provide a warning mechanism in case subsurface conditions change.
- Perimeter fencing will be installed to provide a barrier preventing direct exposure and to prevent inadvertent disturbance of the area.
- An Institutional Control Plan (ICP) will be developed and maintained to document the required institutional controls at PSC RW-02. The ICP will also provide guidance to key personnel who are responsible for the implementation of this remedy.

PSC LF-03

Remedial Alternative S-2, Institutional Controls, was selected for implementation at PSC LF-03 The remedial components which will be implemented at PSC LF-03 are listed below.

- A VEMUR will be executed and recorded to restrict land usage of the site to non-residential purposes.
- The BGP will also be modified to place constraints on future residential development of the site.
- An ICP will be developed and maintained to document the required institutional controls at PSC LF-03 The ICP will also provide guidance to key personnel who are responsible for the implementation of this remedy.

PSC FT-07E

Remedial Alternative S-2, Institutional Controls, was selected for implementation at PSC FT-07E. The remedial components which will be implemented at PSC FT-07E are listed below.

- A VEMUR will be executed and recorded to restrict land usage of the site to non-residential purposes.

- The BGP will also be modified to place constraints on future residential development of the site.

- An ICP will be developed and maintained to document the required institutional controls at PSC FT-07E. The ICP will also provide guidance to key personnel who are responsible for the implementation of this remedy.

PSC DP-13

Remedial Alternative S-2, Institutional Controls, was selected for implementation at PSC DP- 13. The remedial components which will be implemented at PSC DP-13 are listed below.

- A VEMUR will be executed and recorded to restrict land usage of the site to non-residential purposes.

- The BGP will also be modified to place constraints on future residential development of the site.

- Work practices will be regulated by requiring the use of Personal Protective Equipment (PPE) while excavating at the site. These constraints will added to the BGP and implemented through the digging permit process.

- An ICP will be developed and maintained to document the required institutional controls at PSC DP-13. The ICP will also provide guidance to key personnel who are responsible for the implementation of this remedy.

PSC LF-14

Remedial Alternative S-2, Institutional Controls, was selected for implementation at PSC LF- 14. The remedial components which will be implemented at PSC LF-14 are listed below.

- A VEMUR will be executed and recorded to restrict land usage of the site to non-residential purposes.

- The BGP will also be modified to place constraints on future residential development of the site.

- An ICP will be developed and maintained to document the required institutional controls at PSC LF-14. The ICP will also provide guidance to key personnel who are responsible for the implementation of this remedy.

PSC LF-25

Remedial Alternative S-4, Institutional Controls and Ex-Situ Physical Treatment/Metals Recovery, was selected for implementation at PSC LF-25. The remedial components are listed below.

- The area of impacted soils containing constituents of concern (COCs) in excess of evaluation criteria will be further delineated and identified.

- The surficial soil (0 to 2 feet bgs) which contains COCs at concentrations in excess of Arizona soil remediation standards will be scraped and removed.

- Metal shot will be separated from the excavated material soil using mechanical sifting methods and gravimetric separation.

- Recovered metal shot will be recycled or disposed, depending on volume and value, at an off-site facility.

- Soil material will be returned to the scraped surface area, following compliance sampling to ensure soil quality.

- Because the skeet shooting range will remain open and will continue to impact the site, a VEMUR will be executed and recorded to restrict land usage of the site to non-residential purposes.

- The Base General Plan will be modified to place constraints on future residential development of the site.

- Work practices will be regulated by requiring the use of PPE while excavating at the impacted area of the site. These constraints will added to the BGP and implemented through the digging permit process.

- An Institutional Control Plan will be developed and maintained to document the required institutional controls at PSC LF-25 The ICP will also provide guidance to key personnel who are responsible for the implementation of this remedy.

PSC SD-38

Remedial Alternative S-2, Institutional Controls, was selected for implementation at PSC SD-3 8. The remedial components which will be implemented at PSC SD-38 are listed below.

- A VEMUR will be executed and recorded to restrict land usage of the site to non-residential purposes.

- The BGP will also be modified to place constraints on future residential development of the site.

- An ICP will be developed and maintained to document the required institutional controls at PSC SD-38 The ICP will also provide guidance to key personnel who are responsible for the implementation of this remedy.

PSC SS-42

Remedial Alternative S-11, Soil Vapor Extraction, was selected for implementation at PSC SS-42. Remedial components which will be implemented at PSC SS-42 are listed below.

- Install Soil Vapor Extraction (SVE) System.

- Monitor soil and groundwater to confirm effectiveness and potential migration of the COCs.

2.5 DECLARATION

The selected remedies are protective of human health and the environment comply with applicable, relevant, and appropriate requirements (ARARs), and are cost effective. The remedies utilize permanent solutions and alternative treatment technologies to the maximum extent possible. The remedies selected for PSCs RW-02, LF-03, FT-07E, DP-13, LF-14, and SD-38 consist of institutional and engineering controls that do not satisfy statutory preferences for remedies that employ treatment to reduce the toxicity, mobility, or volume. However, the selected remedies are permanent measures that manage the hazards to potential future at-risk receptors. The remedies selected for PSCs LF-25 and SS-42 do satisfy the statutory preference for remedies that employ treatment to reduce the toxicity, mobility, or volume as a principal element. Because the institutional controls at six PSCs will result in constituents of concern remaining on-site above health-based levels in limited areas, a review will be conducted within five years after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

Based on the results of the OU-1 Remedial Investigation and Base-wide risk assessment, the soils at the remaining 17 OU-1 PSCs and the air, surface water, and groundwater resources of Luke AFB do not pose significant threats to human health and the environment and do not required the selection of a remedial alternative. Furthermore, because no engineering or institutional controls are required to prevent unacceptable exposures at these 17 PSCs, a five-year review is not required for any of the PSCs requiring no action.

This decision document, the Record of Decision, presents the selected remedial action plan for Operable Unit No. 1 of Luke Air Force Base, Arizona. This document was developed in accordance with the rules and regulations of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended by the 1986 Superfund Amendments and Reauthorization Act, and to the extent practicable, the National Contingency Plan. This decision document is based on information in the administrative record for this operable unit.

The U.S. Air Force, U.S. Environmental Protection Agency, and the State of Arizona concur on the selected remedy.

This decision document may be executed and delivered in any number of counterparts, each of which when executed and delivered shall be deemed to be an original, but such counterparts shall together constitute one and the same document.

Daniel Opalski, Chief, Federal Facilities
Clean-Up Branch,
US Environmental Protection Agency, Region IX

Date 5/19/99

This decision document, the Record of Decision, presents the selected remedial action plan for Operable Unit No. 1 of Luke Air Force Base, Arizona. This document was developed in accordance with the rules and regulations of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended by the 1986 Superfund Amendments and Reauthorization Act, and to the extent practicable, the National Contingency Plan. This decision document is based on information in the administrative record for this operable unit.

The U.S. Air Force, U.S. Environmental Protection Agency, and the State of Arizona concur on the selected remedy.

This decision document may be executed and delivered in any number of counterparts, each of which when executed and delivered shall be deemed to be an original, but such counterparts shall together constitute one and the same document.

August 16, 1999

Jacqueline Schafer, Director
Arizona Department of Environmental Quality

Date

This decision document, the Record of Decision, presents the selected remedial action plan for Operable Unit No. 1 of Luke Air Force Base, Arizona. This document was developed in accordance with the rules and regulations of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended by the 1986 Superfund Amendments and Reauthorization Act, and to the extent practicable, the National Contingency Plan. This decision document is based on information in the administrative record for this operable unit.

The U.S. Air Force, U.S. Environmental Protection Agency, and the State of Arizona concur on the selected remedy.

This decision document may be executed and delivered in any number of counterparts, each of which when executed and delivered shall be deemed to be an original, but such counterparts shall together constitute one and the same document.

SEP 9 1999

Brigadier General John L. Barry
United States Air Force
Commander, 56th Fighter Wing
Luke Air Force Base, Arizona

Date

This decision document, the Record of Decision, presents the selected remedial action plan for Operable Unit No. 1 of Luke Air Force Base, Arizona. This document was developed in accordance with the rules and regulations of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended by the 1986 Superfund Amendments and Reauthorization Act, and to the extent practicable, the National Contingency Plan. This decision document is based on information in the administrative record for this operable unit.

The U.S. Air Force, U.S. Environmental Protection Agency, and the State of Arizona concur on the selected remedy.

This decision document may be executed and delivered in any number of counterparts, each ofwhich when executed and delivered shall be deemed to be an original, but such counterparts shall together constitute one and the same document.

Rita P. Pearson — September 7, 1999

Ms. Rita P. Pearson, Director
Arizona Department of Water Resources

Date

3.0 DECISION SUMMARY

This section provides a summary of the information used to develop the remedial action plan for OU-1. Background information on Luke AFB is first presented, followed by an overview of the environmental investigations conducted as part of the Superfund process. Community involvement activities are also highlighted. After this background information, the scope and role of OU-1 are detailed. Specific information regarding each of the sites is then summarized along with the results of the field investigations and Base-wide risk assessment. Finally, descriptions of the remedial alternatives that were considered and the rationale for the selection of specific remedial alternatives are provided. Much of the information presented in this summary is contained in detail in the OU-1 Remedial Investigation Report (Geraghty & Miller, Inc. 1997a; AR#188 and 189) and the OU- 1 Feasibility Study Report (ARCADIS Geraghty & Miller, Inc. 1998a; AR#207). The information presented in the Decision Summary provides a basis for the declarations made in Section 2.0 and the rationale for the selected remedy at each PSC.

3.1 SITE NAME, LOCATION, AND DESCRIPTION

Luke AFB covers approximately 4,000 acres west of the Phoenix metropolitan area in Glendale, Arizona (Figure 3-1). Construction of the facility began on March 29,1941. Although only a few essential buildings had been completed, training of the first class of pilots began on June 6, 1941. The facility was originally designated as Luke Field in honor of Frank Luke Jr., a Phoenix native who gained fame as an ace "balloon-buster" in World War I.

During World War II, Luke Field was the largest fighter pilot training facility in the Air Corps. However, with the ending of the war, the number of pilots trained dropped considerably, and the Base was subsequently deactivated on November 30, 1946. Soon after combat developed in Korea, the reorganized USAF reactivated Luke Field, and on February 1, 1951, the facility was renamed Luke Air Force Base. Luke AFB currently hosts the 56th Fighter Wing, whose mission is to provide the world's finest F-16 pilots and crew chiefs for the United States and allied armed forces.

The eastern portion of Luke AFB currently consists of a variety of light industrial facilities, office buildings occupied by administrative and community services, Base barracks, and outdoor recreation centers. The central and western portions of Luke AFB include the runways; open space; and aircraft operation, training, and maintenance facilities. Base residential housing and commercial areas are located to the cast of Luke AFB across Litchfield Park Road.

The Maricopa Association of Governments (MAG, 1993) describes the area surrounding Luke AFB as rural. Scattered rural residential housing exist in the immediate vicinity of the Base, and several larger residential communities have developed at greater distances. Litchfield Park, the nearest residential development, is located approximately two miles to the southeast. Although the surrounding communities are experiencing rapid growth and development, residential development around the perimeter of Luke AFB is unlikely due to land use restrictions imposed by local, city, and county governments.

Luke AFB lies in the West Salt River Valley (WSRV), which is located within the Basin and Range physiographic province. The Basin and Range province consists of narrow, elongated mountain ranges formed by northwesterly trending fault blocks. The WSRV is surrounded by the White Tank Mountains located approximately seven miles to the west; the Sierra Estrella Mountains located approximately seven miles to the south; and the Hieroglyphic Mountains located approximately 15 miles to the north. Elevations at Luke AFB range from 1,110 feet above mean sea level (amsl) at the northwestern corner, to 1080 feet amsl at the southeast comer. The basin slopes downward from northwest to southeast, with an average gradient of 25 feet per mile. Exceptions to the uniform slope occur at low hills, which rise approximately 70 feet above the surrounding areas, to the southeast of the Base.

Water-bearing geologic formations in the WSRV include the upper, middle, and lower alluvial units. Dramatic groundwater level declines have occurred in the area surrounding Luke AFB over the past 50 years due to excessive groundwater pumping for agricultural purposes. Interpolation of data from the regional study of Brown and Pool (Brown and Pool, 1989) and data collected in preparation of Hydrogeological Survey Report (Geraghty & Miller, 1992i) indicates that the upper unit has been completely de-watered in the Luke AFB area, except for localized areas along the Agua Fria River, near the Luke AFB wastewater treatment plant (WWTP). Partial de-watering of the middle unit has also occurred in the Luke AFB area. The upper most aquifer is now the middle unit.

Surface streams and rivers near Luke AFB include the Agua Fria, Salt, and Gila Rivers. These surface water features are dry most of the year and typically convey water only during and immediately following storms. The major streams and rivers in the Luke AFB vicinity begin in the upland, mountainous regions of the Central Highlands or the Colorado Plateau and flow to the south and west to the Colorado River, discharging to the Gulf of California. The Agua Fria River, located approximately two miles east of Luke AFB, is dammed upstream within the Hieroglyphic Mountains. This dam and reservoir allow the water resources of the Agua Fria River to be used for irrigation on a constant basis and also aid in flood control. The Salt and Gila Rivers are also dammed for irrigation and flood control.

3.2 SITE HISTORY AND ENFORCEMENT ACTIVITIES

Aircraft maintenance and light industrial operations in support of the training mission have been in existence at Luke AFB since its inception in 1941. These activities generated potentially hazardous wastes such as petroleum residues, cleaning solvents, and other related materials. Prior to 1972, these wastes were disposed on Base through fire department training exercises, road oiling for dust suppression, and disposal in shallow trenches. Currently, Luke AFB has a proactive pollution prevention program which safely manages the storage, transportation, and disposal of all hazardous and solid wastes. Potentially hazardous wastes have not been disposed at the Base since 1972.

The Department of Defense (DoD) began comprehensive environmental investigations at Luke AFB in 1981 as part of the Installation Restoration Program (IRP). The IRP was developed to investigate past hazardous material handling and disposal practices at military installations. The IRP of Luke AFB progressed through its second of four phases prior to the passage of the Superfund Amendments and Reauthorization Act of 1986 (SARA).

Before the passage of SARA, the USEPA did not supervise the DoD’s IRP program. However, the 1986 SARA amendments to the Comprehensive Environmental Response, Compensation and Liability Act of 1980 gave the USEPA authority to provide supervision and regulatory approval of environmental investigations at all federal facilities, including DoD installations. One of the key provisions of SARA was the requirement that the USEPA establish and maintain a docket of potentially contaminated federal facilities, perform Hazard Ranking System (HRS) scoring on these facilities, and list those facilities exceeding the HRS threshold score on the National Priorities List (NPL).

The USEPA’s initial involvement at Luke AFB began in August 1987 when their auditors inspected the Base and scored it using the HRS. Because the Luke AFB score of 37.93 exceeded the threshold value of 28.5, the USEPA added Luke AFB to the NPL. Listing on the NPL meant that further environmental investigations were to be performed following a strict set of federal regulations, and that the USEPA and appropriate state agencies were to provide regulatory review and oversight.

The regulations governing the implementation of environmental investigations at NPL sites are established in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) which is found in Title 40, Part 300 of the Code of Federal Regulations (CFR). The NCP consists of a multi-phased approach. The eight main steps outlined in the NCP consist of a Preliminary Assessment; Remedial Investigation (RI); Feasibility Study (FS); Proposed Plan; Record of Decision (ROD); Remedial Design (RD); Remedial Action (RA); and Site Close-Out. A flow chart illustrating the main phases of environmental investigations at NPL sites is provided as Figure 3-2.

On September 27, 1990, the USEPA, Arizona Department of Environmental Quality (ADEQ), Arizona Department of Water Resources (ADWR), and USAF signed a Federal Facilities Agreement (FFA) to establish the procedural framework for conducting the required environmental investigations at Luke AFB. The signing of the FFA marked the official beginning of the NPL (or "Superfund") investigation of the Base.

Because the USAF had already conducted several initial environmental investigations at Luke AFB during the IRP, the regulatory agencies considered the preliminary assessment phase of the Superfund process complete at the time of the signing of the FFA. Based on the results of the IRP and other information compiled during the initial planning stages, the FFA parties identified 33 potential sources of contamination (PSCs) for further study.

To aid in the management of the investigation, the FFA parties divided the sites into two operable units, OU-1 and OU-2. OU-1 included the investigation of the soils at 25 PSCs and the Base-wide investigation of air, surface water, and groundwater resources. OU-2 included the investigation of soils at eight sites at which only petroleum-related wastes were disposed. The FFA created this special grouping to put the eight OU-2 sites on a "fast track;" the idea being that grouping sites with common wastes would allow for a timely investigation and cleanup.

As planned, the investigation of the soils at the eight OU-2 sites progressed on an accelerated schedule. From December 1991 through June 1992, field scientists collected soil samples at each of the OU-2 sites. The

OU-2 RI Report (Geraghty & Miller, Inc., 1992; AR# 68 through 74) documented the methodology and results of the investigation. The OU-2 FS report (Geraghty & Miller, Inc., 1993b; AR# 107) evaluated a number of potential remedial alternatives and provided recommendations for each site. As required in the NCP, Luke AFB presented these recommendations to the public for review and comment in the Proposed Plan for OU-2 (Geraghty & Miller, Inc., 1993c; AR# 98). Following the incorporation of public comment, the FFA parties adopted the proposed alternatives by signing the OU-2 ROD in January 1994 (Geraghty & Miller, Inc., 1994; AR # 134). From January 1994 through August 1997, the OU-2 investigation progressed through its RD/RA phases, and close-out of the last OU-2 site occurred in 1998.

Because the OU-1 investigation involved more sites and also included the Base-wide evaluation of air, surface water, and groundwater resources, the OU-1 investigation required a longer period of data collection and monitoring. Fieldwork for the OU-1 RI took place in three phases from October 1991 to September 1996. As part of the OU-1 RI, a Base-wide risk assessment was conducted to evaluate the potential risks to human health and the environment that could result from exposure to the air, soil, surface water, and groundwater at Luke AFB.

The Results of the OU-1 RI and Base-wide risk assessment indicated that the air, surface water, and groundwater resources of Luke AFB do not represent conditions that would pose an imminent and substantial endangerment to public health, welfare, or the environment. However, the soils at eight of the OU-1 PSCs were found to have conditions that could either cause unacceptable human health risks under certain types of land use scenarios or could impact the underlying groundwater. Remedial alternatives were developed for the soils at those eight sites. A remedy selection process was not required for the soils at the remaining 17 PSCs or for the air, surface water, and groundwater resources of the Base.

Remedial alternatives were developed for the soils at the eight sites as part of the OU-1 Feasibility Study (FS). The OU-1 FS report (ARCADIS Geraghty & Miller, Inc. 1998b; AR# 207) provided recommendations for the most appropriate alternative based on the nine selection criteria. As required under Superfund, the recommendations were presented to the public and regulatory agencies for review and comment as the OU-1 Proposed Plan (ARCADIS Geraghty & Miller, Inc., 1998c; AR# 208).

3.3 HIGHLIGHTS OF COMMUNITY PARTICIPATION

The USAF actively encouraged public participation throughout every phase of the Superfund investigation of Luke AFB. CERCLA Section 113(k)(2)(B)(I-v) establishes a number of public participation activities that must be conducted as part of the Superfund decision making process. These requirements are further defined under the NCP, 40 CFR 300. In compliance with these regulations, Luke AFB developed guidance documents to ensure the required public involvement activities were planned and implemented. These documents included: the *Final Base-wide Community Relations Plan, Luke Air Force Base, Arizona* (Geraghty & Miller, 1991c; AR #85) and *Community Relations Plan, Luke Air Force Base*, (ARCADIS Geraghty & Miller, 1998c; AR #209). This section of the ROD briefly summarizes the public participation activities that were conducted as part of the Superfund process.

3.3.1 <u>Public Participation</u>

Since 1991, when remedial investigations began under Superfund at Luke AFB, community relations activities have been conducted to inform the public about the site investigations and provide the opportunity for public input. The following sections describe some of the community relations activities conducted at Luke AFB from 1991 through April 1998, when the Proposed Plan was submitted for public comment.

3.3.1.1 Committee Advisory Boards

As part of the public participation effort, Luke AFB created a Technical Review Committee (TRC) in 1992. The TRC was made up of selected community members, Base personnel, and representatives from the USEPA and ADEQ. The Civil Engineering Squadron Commander, who invited the members to sit on the committee, also chaired the TRC. The TRC met quarterly, and the members were provided with briefings on the status of the project.

As part of a joint effort between the USEPA and the DoD to increase the level of public involvement, the TRC was disbanded in 1995, and a Restoration Advisory Board (RAB) was formed. Unlike the TRC that included only a few selected community members and just heard reports on the project’s progress, RAB meetings are open to the public and their members decide upon the meeting agenda. RAB membership is almost exclusively from the neighboring communities and a community member is elected to co-chair the meetings.

RAB members are given the opportunity to review technical project reports and are responsible for reviewing the project's progress, investigation results, and work plans. RAB members are also encouraged to give advice to the USAF and the regulatory agencies on a variety of issues, such as how to prioritize cleanup efforts and how to address potential community concerns. To that end, the RAB has established a budget subcommittee to help prioritize the project's funding allocations and a Public Outreach Subcommittee to recommend additional public involvement strategies.

3.3.1.2 Administrative Record

Since the beginning of the Superfund Investigation, the USAF has established and maintained an administrative record (AR) to organize all of the documentation related to the decisions made during Superfund investigation. Copies of the AR files have been placed in information repositories that are available for public review. The USAF, USEPA, and ADEQ encourage public review of these documents in order to gain a more comprehensive understanding of the site and Superfund activities that have been conducted. The locations of these repositories are provided in Appendix A.

3.3.1.3 Newsletters

Environmental Restoration Update newsletters were periodically created and distributed to provide background on the history, current status, and future activities related to the Superfund investigation of Luke AFB. These newsletters have been distributed to a mailing list of approximately 1,000. Copies of the past newsletters are available in the AR and information repository.

3.3.1.4 Community Interviews

Community leaders, both on and off the Base, were interviewed in early 1998. The objective was to gauge public interest in the environmental cleanup efforts at Luke AFB, determine what types of concerns exist, and identify additional opportunities for public involvement. Overall, the public perception of Luke AFB is a positive one. The community members who participated in the interviews expressed a low level of concern about the environmental issues at the Base. Key concerns identified during the interviews include aircraft safety, building restrictions placed on neighboring lands, aircraft noise, adequate water supplies and water quality, possible AFB closures, and encroachment by developers.

3.3.1.5 RAB Public Presentations

RAB members participated in a series of speaker training sessions that provided information and materials that they could use in their presentations to other interested community groups. Information regarding the history, current status, and future activities related to the Superfund investigation at Luke AFB were prepared in a variety of forms. Slide show, overhead, and video presentations were developed and made available to the RAB members for use in their presentations to various community groups.

3.3.1.6 Luke Day

Luke AFB opens to the public one day each year during "Luke Day". On April 4, 1998, Luke Day included an air show demonstration by the Thunderbirds. The RAB established a booth and participated throughout Luke Day, presenting information related to the Superfund investigation. The RAB also made comment cards available to the public and received comments during the day.

3.3.2 <u>Public Comment Period</u>

Based on the requirements of CERCLA, as amended, Sections 113(k)(2)(B)(I-v) and the NCP, 40 CFR Part 300(430), there are numerous requirements for community involvement to support the selection of a remedy. The requirements include the development of a community relations program that at a minimum will provide: 1) notice to potentially affected persons and the public of the availability of the Proposed Plan; 2) reasonable opportunity to comment of not less than 30 days on the Proposed Plan and supporting information, including the RI and FS; 3) opportunity of public hearing on the Proposed Plan and supporting information; 4) written summary of and response to each significant comment submitted on the Proposed Plan; and 5) statement of the basis and purpose of the selected action. The following sections describe the community participation efforts undertaken by Luke AFB pertaining to the first three items listed above. The fourth and fifth items are addressed in Section 4 of this ROD.

3.3.2.1 Notice of Availability of the Proposed Plan

Superfund law requires that a notice of availability and a brief analysis of the proposed plan be published in a major local newspaper of general circulation. This notice must include a brief summary of the contents of the plan and announce the beginning of the 30-day public comment period. The OU-1 Proposed

Plan was completed in April 1998, and the notice of availability of the OU-1 Proposed Plan was published in the west Phoenix community section of The Arizona Republic, The Glendale Star, and The Tally Ho newspapers at that time.

3.3.2.2 Availability of the Proposed Plan and Supporting Material in Administrative Record

The Proposed Plan for OU-1 and all supporting material were added to the AR and included in the information repository at each of the libraries identified in Appendix A.

3.3.2.3 30-day Comment Period

A formal 30-day comment period was established in conjunction with the release of the OU-1 Proposed Plan. This comment period provided the public with the opportunity to provide written and oral comments on the proposed remedial alternatives. The comment period began on April 21, 1998 and closed on May 21, 1998.

3.3.2.4 Public Meetings

Superfund regulations require that at least one public meeting be coordinated to allow for comments on the Proposed Plan and the recommended remedial alternatives. Luke AFB hosted six meetings based on input provided from community interviews and the RAB public outreach committee. The six meetings were held during the 30-day public comment period in communities near Luke AFB including: City of Peoria, Sun City, Goodyear, City of Surprise, Sun City West, and the City of Glendale. Each meeting was held at a different location, and various times throughout the day to increase the level of public involvement. The meeting places, dates, and times were included on the notice of availability described above. Additionally, a court reporter was available at the City of Glendale Public Meeting, and a transcript of this meeting was maintained and made available to the public in the administrative record. A schedule of the exact locations, dates, and times of the public meetings can be found in the OU-1 Proposed Plan.

3.4 SCOPE AND ROLE OF THE RESPONSE ACTION

As detailed in the Section 3.2, OU-1 is the last of two operable units to be addressed at Luke AFB and is the focus of this ROD. OU-1 was defined to govern the investigation and potential remediation of air, surface water, and groundwater resources Base wide. In addition, the soils at 25 PSCs that were believed to have been impacted by mainly non-petroleum related wastes were included in OU- 1. The 25 PSCs included in OU-1 are listed below and their locations are shown on Figure 3-3.

- Old Incinerator Site (PSC OT-01).
- Wastewater Treatment Annex Landfill (PSC RW-02).
- Outboard Runway Landfill (PSC LF-03).
- Eastern Portion of North Fire Training Area (PSC FT-07E).
- F- 15 Burial Site (PSC OT-08).
- Canberra Burial Site (PSC OT-09).
- Concrete Rubble Burial Site (PSC OT-10).
- Former Outside Transformer Storage (PSC SS- 11).
- Old Explosive Ordnance Division (EOD) Burial Site (PSC OT-12).
- Drainage Ditch Disposal Area (PSC DP-13).
- Old Salvage Yard Burial Site (PSC LF-14).
- Facility 328 Spill Site (PSC SS-15).
- Facility 321 Underground Storage Tank (UST) (PSC SS-16).
- Former Defense Property Disposal Office (DPDO) Yard (PSC SS- 17).
- Base Exchange (BX) Leaking USTs (PSC ST- 19).
- Oil/Water Separator Canal and Earth Fissures (PSC SD-20).
- Sewage Treatment Plant Effluent Canal (PSC SD-21).
- Base Ammunition Storage Area (PSC DP-24).
- Northwest Landfill (PSC LF-25).
- Hush House Canal (PSC SD-26).
- Northeast Landfill (PSC LF-37).
- Southwest Oil/Water Separator at the Auto Hobby Shop (SD-38).
- Waste Discharge at the Old Lockheed Site (SD-39).
- Skeet Range (OT-41).
- Bulk Fuels Storage (SS-42).

Prior to the beginning of the OU-1 RI field activities, the FFA parties determined that “no further remedial investigations” were needed at eight OU-1 PSCs. Although this agreement was made prior to the beginning of OU-1 field activities, a formal consensus statement documenting the decision was not drafted and signed by all of the FFA parties until August of 1993. A copy of the consensus statement is provided in Appendix B. The eight “no further action” OU-1 PSCs are listed below.

- Old Incinerator Site (PSC OT-01).
- F- 15 Burial Site (PSC OT-08).
- Canberra Burial Site (PSC OT-09).
- Concrete Rubble Burial Site (PSC OT- 10).
- Facility 328 Spill Site (PSC SS-15).

- Facility 321 UST Storage (PSC SS-16)
- BX Leaking UST (PSC ST-19).
- Base Ammo Storage Area (PSC DP-24).

The FFA parties reclassified PSCs OT-0 , OT-08, and OT-09 as “no further action”sites because data obtained during an extensive review of Base records showed that hazardous materials or wastes were never handled or disposed at these areas. PSC DP-24 was removed from the Superfund process because it had mistakenly been included on the list of potentially contaminated sites. PSCs SS-15, SS-16, and ST-19 were removed from the Superfund process and placed under the jurisdiction of the ADEQ UST section. The FFA parties elected to eliminate PSC OT-10 from the list of sites requiring field investigations because that site lies completely within the boundaries of PSC DP-13 and the landfill contents of both sites were presumed similar. Both sites were to be investigated as a single unit which was to be referred to as PSC DP-13.

Beginning in October 1991, field investigations were conducted to evaluate the air, surface water and groundwater resources of the Base and the soils at the remaining 17 OU- 1 PSCs. Because of its complexity, the OU-1 RI field investigation was divided into three phases. The Phase I investigation was conducted from October 1991 through March 1992. Phase II activities were conducted from June 1992 through April 1994. Phase III activities were completed in August and September 1996. Phase III activities were required to collect additional data for risk assessment purposes because the quality of some of the Phase I and Phase II laboratory data were brought into question.

Analytical Technologies, Inc. (ATI) in Phoenix, Arizona analyzed a majority of the soil and groundwater samples collected during the OU-1 Phase I and II investigations. In response to concerns raised by a disgruntled ex-employee, the Arizona Department of Health Services (ADHS), ADEQ, United States Army Corps of Engineers (USACE), USAF, and USEPA conducted an extensive investigation of the ATI Phoenix facility. Throughout 1994 and 1995, the ADHS performed two laboratory audits while the USEPA conducted raw data tape audits of the Luke AFB data. The ADEQ and USACE performed their own investigations and interviewed numerous ATI employees and ex-employees.

Based on the results of the investigation, the FFA parties determined that the volatile (VOC) and semivolatile (BNA) data produced by ATI’s Phoenix laboratory were unable to meet all data quality requirements for the project, and thus, that data could not be used in a quantitative risk assessment. All VOC and BNA data analyzed by the ATI Phoenix laboratory were qualified with a “UQ.” UQ denotes data of unknown quality as determined by the USEPA. There were no problems noted with the fuels data or inorganic (metals) data produced by the ATI Phoenix laboratory. The FFA parties agreed that all fuels and inorganic data collected over the course of the project were acceptable for use in the risk assessment.

The FFA parties met on April 3 and 4, 1996 to determine the most appropriate means of response to the data gaps created by the ATI data quality problem. Because the conclusions of the risk assessment are a primary element for determining appropriate remedial alternatives for a site, the FFA parties determined that additional sampling had to be performed so that a sufficient amount of supplemental data could be collected. The amount of data needed was dependant on site-specific requirements of the quantitative risk assessment.

The methods and rationales used to design and conduct the additional investigations were detailed in the *Final Sampling and Analysis Plan for the Additional Sampling Investigations in Support of the Luke AFB CERCLA Investigation, Luke AFB, Arizona* (Geraghty & Miller, 1996a). Descriptions of the rationale for collecting additional samples, the sampling locations, and sampling depths are included on a site-by-site basis within this report. The samples collected during the Phase III sampling event were analyzed by Quanterra Environmental Services laboratory in Arvada, Colorado.

Following the collection of the supplemental Phase III data, a Base-wide risk assessment was conducted to evaluate the risks to human health and the environment that could potentially result from exposure to the various media (i.e. soil, air, surface water, and groundwater). Again, it is important to note that the volatile and semi-volatile data analyzed by the ATI Phoenix laboratory were not used in the Base-Wide Risk Assessment.

Based on the results of the OU-1 RI field investigation and Base-wide risk assessment, determination was made as to whether the sites were acceptable for unrestricted land use in their current conditions. Unrestricted land use implies that a site can be developed and used for any purpose, including residential development. If a site was not deemed suitable for unrestricted land use, remedial (clean up) alternatives were developed for that site.

Remedial alternatives were also developed for any site that could potentially impact the underlying groundwater resources in the future. The decision-making process used to determine which sites required no further action or the selection of a remedy is illustrated in Figure 3-4.

Results of the OU-1 RI and Base-wide risk assessment showed that the air, surface water and groundwater resources of Luke AFB did not pose threats to human health or the environment. Likewise, the soils at nine OU-1 PSCs were determined to be acceptable for unrestricted land use in their current conditions. These nine OU-1 PSCs; are listed below.

- Former Outside Transformer Storage (PSC SS- 11).
- Old EOD Burial Site (PSC OT-12).
- Former Defense Property Disposal Office (DPDO) Yard (PSC SS- 17).
- Oil/Water Separator Canal and Earth Fissures (PSC SD-20).
- WWTP Effluent Canal (PSC SD-21).
- Hush House Canal (PSC SD-26).
- Northeast Landfill (PSC LF-37).
- Waste Discharge at the Old Lockheed Site (SD-39).
- Skeet Range Canal (OT41).

Seven PSCs were determined to represent conditions that were not acceptable for unrestricted land usage. The soil impact detected at an eighth PSC (SS-42) could potentially leach to the underlying groundwater resources. Remedial alternatives were developed for the soils of the eight sites in the OU-1 FS. These sites include:

- Wastewater Treatment Annex Landfill (PSC RW-02).
- Outboard Runway Landfill (PSC LF-03).
- Eastern Portion of North Fire Training Area (PSC FT-07E).
- Drainage Ditch Disposal Area (PSC DP-13).
- Old Salvage Yard Burial Site (PSC LF-14).
- Northwest Landfill (PSC LF-25).
- Southwest Oil/Water Separator at the Auto Hobby Shop (SD-38).
- Bulk Fuels Storage (SS-42).

PSCs LF-03, FT-07E, DP-13, LF-14, and SD-38, contained concentrations of COCs in the soil that could potentially pose unacceptable health risks if those areas were developed for residential use in the future. Concentrations of COCs in the soils at PSC LF-25 theoretically pose unacceptable risks to future excavation workers. PSC SS-42 was included in the FS because of the high potential for COCs detected in the soils to leach to the groundwater. PSC RW-02 was included in the FS because of the presence of the low-level radioactive waste disposal area.

During the OU-1 FS, remedial alternatives were evaluated for the soils at the eight OU-1 PSCs listed above. The OU-1 FS report (ARCADIS Geraghty & Miller, Inc., 1999b; AR #207) provided recommendations for the appropriate remedial alternative specific to each site. Recommendations developed during this FS were summarized in the OU-1 Proposed Plan (ARCADIS Geraghty & Miller, Inc. 1998c; AR # 208). The OU-1 Proposed Plan was presented to the public and regulatory agencies for review and comment in April and May of 1998.

This ROD serves to document the remedial action plan selected for the soils at each of the eight OU-1 sites requiring further action. The signing of the OU-1 ROD by the FFA parties will end the R1/FS process at Luke AFB. Following the signing of the ROD, the remedial action plan will be implemented in the RD/RA phases. During the RD phase, detailed specifications for the selected remedy will be developed. The design usually takes four months to complete and will begin after the ROD is signed. During the RA phase, the selected remedy will be implemented. After the remedial action plan presented in this ROD is completely and successfully implemented, site close out procedures can begin. The ultimate goal is to de-list Luke AFB from the NPL.

3.5 SUMMARY OF SITE CHARACTERISTICS

Summaries of the site characteristics for each of the 25 OU-1 PSCs are provided below. The following summaries provide a general description of each site and an overview of the past hazardous material handling and disposal practices that occurred in that particular area. Where applicable, the objectives and results of the field investigations conducted at each of the sites are also presented.

One of the main objectives of the field investigations was to identify the Constituents of Concern (COCs) and exposure point concentrations (EPCs). Although this information is further described in conjunction with the Base-wide risk assessment (See Section 3.6), it is important to understand the methods that were used to identify COCs and EPCs in order to fully understand the information provided in the following site characterization summaries. To that end, the following introductory information is provided to explain the procedures used to identify COCs and EPCs.

With the exception of eight “no further action” sites (PSCs OT-01, OT-08, OT-09, OT-10, SS 15, SS16, ST-19, and DP-24) soil samples were collected and analyzed at each of the OU-1 PSCs to determine COCs in soil. As part of the evaluation process, the soil sampling data were first categorized by depth. Depths ranges consisted of surficial (0 to 2 feet below ground surface [bgs]), combined surface and subsurface (0 to 16 feet bgs), and deep (>16 feet bgs). These depths ranges correspond to exposure parameters used in the risk assessment. After sorting the soil data by depth, the data were compared to the USEPA Region IX Preliminary Remediation Goals (PRGs) for unrestricted land use. Analytes detected at a concentration in excess of the USEPA PRGs were identified as COCs.

If soil sampling data at a particular site indicated that a potential existed for impacts to the underlying groundwater, monitoring wells were installed and sampled. Monitoring well sampling results were grouped by PSC as part of the data evaluation process. After the data were grouped by site, the results were compared to the USEPA PRGs to identify COCs. If during any of the sampling events an analyte was detected at a concentration above the USEPA PRGs in any of the monitoring wells at a PSC, that analyte became a COC for the entire site.

Monitoring well sampling data were used in the evaluation of *future* risks but not in the evaluation of current risks because groundwater is not currently being pumped from any of the monitoring wells, and therefore, there is no current exposure to groundwater from the monitoring wells. It should be noted that not every PSC has groundwater COCs for *future* exposure because groundwater monitoring wells were not warranted for every site.

The only *current* exposure to groundwater at Luke AFB is through the Base water distribution system. The Base water distribution system pumps groundwater from a series of specialty designed production wells. None of the production wells are located within PSCs, and none of the monitoring wells currently serve as production wells. Samples of the groundwater pumped from the production wells were collected, analyzed, and compared to the USEPA Region IX PRGs to determine COCs for use in the evaluation of risks associated with *current* groundwater exposure at Luke AFB.

With the current water distribution system, Base workers, military personnel, Base residents, and other potential receptors are exposed to the same groundwater regardless of where on Base they would be working, Therefore, COCs identified for *current* groundwater exposure are the same for all sites.

It should be noted that the mere presence of a COC does not necessarily mean that a hazardous condition exists. This is because the USEPA Region IX PRGs are not cleanup standards, but rather guidance levels used to determine which chemicals required further evaluation. As an example, several naturally occurring compounds, such as arsenic and beryllium, were identified as COCs for both soil and groundwater. However, these compounds were not detected above naturally occurring background levels.

The Base-wide risk assessment provides the evaluation of the significance of the COCs and quantifies the risks associated with exposure. As part of the risk assessment methodology, exposure point concentrations (EPCs) were calculated for use in the evaluation. The USEPA defines the EPC as the concentration of a contaminant occurring at a location of potential contact. In other words, the EPC is the concentration of a contaminant that one can expect to encounter at a site. EPCs were calculated for groundwater, air, surficial soils (0 to 2 feet bgs), and combined surface and subsurface soils (0 to 16 feet bgs). Direct exposure and contact with soil below the depth of 16 feet is unlikely, therefore, deep soils (> 16 feet bgs) data were only used in the vadose zone transport model (see Section 3.6.1.4).

Based on USEPA guidance (USEPA, 1989c), EPCs were calculated for two different types of potential exposure, average exposure and reasonable maximum exposure (RME). The arithmetic average of the detected concentrations of COCs were used as the EPC to estimate average exposure conditions at a site. The statistically derived 95 percent upper confidence limits (UCLs) on the arithmetic average concentrations were used as EPCs to estimate the risks associated with RME exposure at a site. The RME corresponds to a duration and frequency of exposure greater than is expected to occur on an average basis. The RME approach is suggested by the USEPA (USEPA 1989a) to provide a reasonable estimate of the maximum exposure (and therefore risk) that might occur.

Bullets in the following sections provide a summary of the COCs and associated EPCs calculated for the various media at each of the sites. Tables 3-1 through 3-46 summarize the occurrence of COCs at each of the sites. Columns on these tables show the calculated average and UCL values. It is important to note that only data of known quality are presented in the occurrence tables. Data of unknown quality can not be used in a quantitative risk assessment and can not be used to determine COCs or EPCs. This information is further summarized in conjunction with the Base-wide risk assessment in Section 3.6 of this ROD. Detailed information on the identification of COCs, calculation of EPCs, and the use of the data can be found in the *Base-wide Risk Assessment, Luke Air Force Base, Arizona*, (Geraghty & Miller, Inc., 1997b; AR#191, 192).

3.5.1 PSC OT-01 Old Incinerator Site

PSC OT-01 consists of a former 15-ton per day capacity incinerator located near the north gate (Figure 3-3). The incinerator was the main method of disposal for the Base's general refuse from 1941 until deactivation of the Base in 1946. The incinerator was also used intermittently from the time of reactivation of the Base in 1951 until 1953 when it was abandoned because of maintenance problems. The incinerator facility was demolished in 1972. No known or suspected hazardous wastes were disposed at the site. Prior to the beginning of the OU-1 field investigation, the FFA parties concluded that no further remedial investigations were warranted at PSC OT-01. This decision was documented in a consensus statement which is included as Appendix B. Consistent with this agreement, there were no environmental investigations performed at this site during the OU-1 RI.

3.5.2 PSC RWA2 Wastewater Treatment Annex Landfl1l

PSC RW-02 consists of a former 28-acre landfill at the Luke AFB WWTP annex located to the north of Glendale Avenue, two miles east of the main Base (Figure 3-3). The former landfill is located in the northwestern portion of the WWTP annex, adjacent to the western bank of the Agua Fria River. The site served as the Base's main landfill for the disposal of refuse from 1953 until 1970. In 1990, sections of the landfill along the Agua Fria River were exposed due to erosion by stormwater flows.The USACE performed a bank stabilization project to mitigate further erosion.

A small quantity of low-level radioactive electron tubes and dials were buried at the site in 1956. The radioactive material was believed to have been encased in concrete and was disposed in a pit 12 feet deep with 4 feet of concrete cover and 6 feet of earth cover. The radioactive material burial site is currently located within the boundaries of the Defense Reutilization Marketing Office (DRMO) storage yard and is designated by a small concrete marker.

The objectives of the OU-1 RI at PSC RW-02 were to define the boundaries of the landfill, characterize its contents, assess the potential for groundwater impacts, and evaluate the integrity of the concrete containment structure which contains low-level radioactive waste. The investigations consisted of conducting geophysical and soil gas surveys to define the landfill boundaries. Ten test pits were excavated and sampled to characterize the extent and contents of the landfill. Two soil borings were also advanced and sampled near the radiological waste containment structure to assess its integrity. Fourteen soil borings were advanced and sampled to evaluate several potential "hot spots" identified during the soil gas survey. Three groundwater monitoring wells were installed and sampled to assess the potential for impact of the landfill on groundwater.

COCs, and EPCs identified for soil and groundwater at PSC RW-02 are summarized in Tables 3-1 through 3-3. The sample locations where COCs were detected are shown on Figure 3-5. The following bullets summarize the OU-1 RI investigation at PSC RW-02.

- Geophysical logging of the boreholes near the radiological waste containment structure showed gamma counts within the range of natural soils. Concentrations of radionuclides (alpha, beta, radium, and uranium) in soil samples collected adjacent to the monument were not significantly different from background locations, and the results are within the range for natural soils.

- Total Recoverable Petroleum Hydrocarbons (TRPH) were detected in samples collected from five test pits and eight soil borings. The sample collected from Test Pit TP-2 at 3 feet bgs contained the highest detected concentration of TRPH (4,100 milligrams per kilogram [mg/Kg]). TRPH concentrations generally decreased with increasing depth, and the vertical extent of detectable TRPH was defined as less than 20 feet bgs in all but three soil borings.

- Volatile Organic Compounds (VOCs) were not detected in any of the samples. Base, Neutral, and Acid extractable semi-volatile compounds (BNAs) were generally detected only in samples that also contained detectable concentrations of TRPH. The maximum depth at which BNA compounds were detected was 20 feet bgs in Soil Boring SB-5.

- Six test pit samples and five soil boring samples contained metals concentrations above the background Upper Threshold Limit (UTLs) and in excess of the range included in the background data set. With one exception, all samples with elevated metals also contained TRPH.

- Six additional soil borings were advanced at the site in August 1996 in response to concerns of the quality of the VOC and BNA data produced by the ATI Phoenix laboratory. The six additional soil borings were located in the northeast corner and central area of the site.

- None of the five additional samples collected from the northeast corner of the site contained VOCs, and BNA compounds were only detected in one sample (SB-14 surface and sample). This sample contained 10 BNA compounds at relatively low concentrations with pyrene detected at the highest concentration (0.14 mg/Kg).

- At the time of landfilling (1954), the depth to groundwater was approximately 35 feet bgs. Currently, the depth to groundwater is approximately 205 feet bgs. The apparent groundwater gradient at the site is to the northwest.

- The vadose zone transport model (see Section 3.6.1.4) indicates that the highest concentration of modeled constituents that can be expected to leach to the bottom of the vadose zone is TRPH at 1.23 x 10^{-117} mg/L. This concentration is well below laboratory detection limits.

- Groundwater samples collected from three monitoring wells at this site showed no impact to groundwater resources. VOCs were not detected in any of the groundwater samples. The only BNA compound detected was bis-(2-ethylhexyl)phthalate (BEP), a common laboratory contaminant. All detected metals were within naturally occurring background ranges.

- All data of known quality were compared to the USEPA PRGs to establish COCs for the site. As described in Section 3.4, VOC and BNA data produced by the ATI Phoenix laboratory were not used in the COC evaluation because they did not meet stringent data quality standards.

- As shown on Table 3-1, the COCs identified for surficial soils at the site are benzo(a)pyrene, TRPH, and arsenic. EPC concentrations for average exposure to surface soils are: benzo(a)pyrene at 0.098 mg/kg; TRPH at 180 mg/kg; and arsenic at 4.0 mg/kg. EPC concentrations for RME exposure to surface soils are: benzo(a)pyreneat 0.10mg/kg;TRPHat 330 mg/kg; and arsenic at 5.3 mg/kg.

- As shown on Table 3-2, the COCs for combined surface and subsurface soils are benzo(a)pyrene, TRPH, arsenic, beryllium, cadmium, copper, and lead. EPC concentrations for average exposure to combined surface and subsurface soils are: benzo(a)pyrene at 0.10 mg/kg, TRPH at 290 mg/kg, arsenic at 4.9 mg/kg, beryllium at 0.24 mg/kg, cadmium at 2.4 mg/kg, copper at 160 mg/kg, and lead at 56 mg/kg. EPC concentrations for RME exposure to combined surface and subsurface soils are: benzo(a)pyrene at 0.10 mg/kg, TRPH at 530 mg/kg, arsenic at 6.0 mg/kg, beryllium at 0.27 mg/kg, cadmium at 5.0 mg/kg, copper at 370 mg/kg, and lead at 91 mg/kg.

- As shown on Table 3-44, the COCs for current groundwater exposure at the site (production well samples) are bromoform, bromodichloromethane, chloroform, dibromochloromethane, arsenic and fluoride. EPC concentrations for current average exposure to groundwater are: bromoform at 0.0021 milligrams per liter (mg/L); bromodichloromethane at 0.00054 mg/L; chloroform at 0.00030 mg/L; dibromochloromethane at 0.0013 mg/L; arsenic at 0.0094 mg/L; and fluoride at 1.4 mg/L. EPC concentrations for current RME exposure to groundwater are: bromoform at 0.0033 mg/L; bromodichloromethane at 0.00081 mg/L; chloroform at 0.00038 mg/L; dibromochloromethane at 0.0021 mg1L, arsenic at 0.0 12 mg/L; and fluoride at 2.2 mg/L.

- As shown on Table 3-3, COCs for future groundwater exposure are arsenic and lead. EPC concentrations for future average exposure to groundwater are: arsenic at 0.0 10 mg/L and lead at 0.0066 mg/L. EPC concentrations for future RME exposure to groundwater are: arsenic at 0.0 14 mg/L and lead at 0.01 mg/L. These COCs were detected in monitoring wells at the site.

Based on the results of the Base-wide Risk Assessment (see Section 3.6), COCs identified at PSC RW-02 were not present at concentrations high enough to cause adverse health effects under current land use scenarios (military/industrial) or even in the unlikely event the site is converted to residential usage in the future. Results of the vadose zone transport model (see Section 3.6.14) also show that COCs detected in the soil will not migrate to the underlying groundwater resources. There is currently no indication that radionuclides are impacting the soils immediately adjacent to the containment structure as evidenced by geophysical logging and soil sampling results. However, the presence of the low-level radioactive waste containment structure would by itself limit potential future land usage. As a result remedial alternatives were developed for PSC RW-02 in the OU-1 FS.

3.5.3 PSC LF-3 Outboard Runway Landfill

PSC LF-03 consists of a former landfill located on the western side of the Base near the central part of the outboard runway, south of Taxiway F (Figure 3-3). The site occupies approximately 21 acres, 60 percent of which is currently covered by the outboard runway. A bare low-lying area with sparse vegetation occupies the remaining 40 percent of the site. The Base reportedly used the site for limited disposal of refuse from 1951 to 1953. Landfilling operations at this site ceased when the outboard runway was constructed. No known nor suspected industrial type wastes or hazardous wastes were disposed at this site.

The objectives of the RI at PSC LF-03 were to define the boundaries of the former landfill and to characterize its content. Geophysical and soil gas surveys were conducted to define the landfill boundaries and to select locations for test pits. Six test pits were also excavated and sampled to characterize the extent and contents of the landfill. Two soil borings were advanced and sampled in August 1996 to collect additional VOC and BNA data for risk assessment purposes.

COCs and EPCs identified for soil at PSC LF-03 are summarized in Tables 3-4 and 3-5. The sample locations where COCs were detected are shown on Figure 3-6. There were no monitoring wells installed at PSC LF-03, therefore, there are no COCs for future groundwater exposure at this site. The following bullets summarize the OU-1 RI investigation at PSC LF-03.

- Geophysical data showed a large anomalous area in the center of the site which extended underneath the runway. Two other anomalous areas, which were interpreted as possible landfills, are located in the northern half of PSC LF-03 and along its eastern edge.

- TRPH was detected in two of the 13 test pit samples. The highest TRPH concentration (20 mg/Kg) was detected in Test Pit TP-5 at 7 to 8 feet bgs. This was also the deepest detection of TRPH.

- VOCs, BNAs, and cyanide were not detected in any of the test pit samples. Likewise, VOCs and BNAs were not detected in any of the additional soil boring samples advanced in 1996.

- The highest detected concentrations of arsenic (15.9 mg/Kg), cadmium (7.8 mg/Kg), chromium (386 mg/Kg), copper (4,700 mg/Kg), and lead (796 mg/Kg) do exceed their background UTLs and the USEPA PRGs. The highest metals concentrations were detected in the samples collected from Test Pits TP-4 and TP-5. Landfilled metallic debris were noted in both of these areas.

- The leaching model (see Section 3.6.1.4) indicates the highest concentration of modeled constituents that can be expected at the bottom of the vadose zone is TRPH at 2.61 x 10^{-214} mg/L. This concentration is well below laboratory detection levels. The modeling results demonstrate that it's highly unlikely that groundwater impacts will occur as a result of leaching of constituents detected in the soils at PSC LF-03.

- All data of known quality were compared to the USEPA PRGs to establish COCs for the site. As described in Section 3.4, VOC and BNA data produced by the ATI Phoenix laboratory were not used in the COC evaluation because they did not meet stringent data quality standards.

- As shown on Table 3-4, COCs for surficial soils include arsenic and beryllium although both were detected at concentrations below their background UTLs. EPC concentrations for average exposure to surface soil are arsenic at 3.2 mg/kg and beryllium at 0.48 mg/kg. EPC concentrations for RME exposure to surface soil are arsenic at 4.8 mg/kg and beryllium at 0.78 mg/kg.

- As shown on Table 3-5, COCs for the combined surface and subsurface soils are arsenic, beryllium, chromium, copper, and lead. EPC concentrations for average exposure to combined surface and subsurface soil are arsenic at 4.7 mg/kg; beryllium at 0.33 mg/kg; chromium at 71 mg/kg; copper at 450 mg/kg; and lead at 180 mg/kg. EPC concentrations for RME exposure to combined surface and subsurface soil are arsenic at 6.9 mg/kg; beryllium at 0.42 mg/kg; chromium at 140 mg/kg; copper at 1,100 mg/kg; and lead at 340 mg/kg.

- As shown on Table 3-44, the COCs for current groundwater exposure (production well samples) are bromoform, bromodichloromethane, chloroform, dibromochloromethane, arsenic and fluoride. EPC concentrations for current average exposure to groundwater are: bromoform at 0.0021 mg/L; bromodichloromethane at 0.00054 mg/L; chloroform at 0.00030 mg/L; dibromochloromethane at 0.00 13 mg/L, arsenic at 0.0094 mg/L; and fluoride at 1.4 mg/L. EPC concentrations for current RME exposure to groundwater are: bromoform, at 0.0033 mg/L; bromodichloromethane at 0.00081 mg/L; chloroform at 0.00038 mg/L; dibromochloromethane at 0.0021 mg/L, arsenic at 0.012 mg/L; and fluoride at 2.2 mg/L. There are no COCs for future groundwater exposure because there are no monitoring wells.

Based on the results of the Base-wide Risk Assessment (see Section 3.6), COCs identified at PSC LF-03 were not present at concentrations high enough to cause adverse health effects under current land use scenarios (military/industrial). Likewise, results of the vadose zone transport model (see Section 3.6.1.4) show that COCs detected in the soil will not migrate to the underlying groundwater resources. However, the concentration of chromium detected at the site could theoretically cause adverse health affects in the unlikely event that PSC LF-03 were developed for residential purposes in the future.

Numerous metallic wastes were unearthed during test pit excavation at the central portion of the site. Samples of the wastes collected from Test Pit TP-5 at depths of 8 foot bgs and a 7-8 foot bgs contained chromium at concentrations of 349 and 386 mg/kg, respectively. Because the metallic wastes containing elevated concentrations of chromium are buried and extend below the outboard runway, direct exposure is not likely under current land use scenarios. However, long-term exposure to these buried wastes could result if the runways were removed and the site were developed for residential purposes. For this reason, remedial alternatives were developed for PSC LF-03 in the OU-1 FS as a highly protective measure.

3.5.4 PSC FT-07E Eastern Portion of North Fire Training Area

PSC FT-07E is located in the northern portion of the Base, west of Fire Department Training Facility 1355 (Figure 3-3). Fire training activities in the eastern portion of PSC FT-07E began in 1973 when the Base constructed three bermed fire training pits. The two largest training pits were constructed with sprinkler systems to dispense flammable petroleum, oil, and lubricant (POL) waste onto mock aircraft or similar structures. According to Base records, the three pits were active from 1973 until 1989. The two largest pits were designated as Fire Training Pit #3 (FTP-3) and Fire Training Pit #4 (FTP-4). The third pit was identified as Fire Training Pit #6 (FTP-6).

During the IRP investigation, Roy F. Weston, Inc. (Weston) conducted the initial soil and groundwater sampling at Fire Training Pits FTP-3 and FTP4 to verify the presence or absence of contaminants. Four soil boring were advanced to investigate the soils and three monitoring wells (MW- 109, MW-110, and MW- 111) were installed and sampled to assess the potential impact of the fire training activities on groundwater (Roy F. Weston, 1984; AR #4 and Roy F. Weston, 1988; AR# 45).

Following completion of Weston’s activities, the USAF contracted EA Engineering Science and Technology (EA Engineering) to perform additional soil investigations. The main objectives of EA Engineering's investigation were to further characterize the soils at the site and to conduct a remedial preliminary design study for the two largest pits. During the investigation, EA Engineering drilled three additional borings in each of the three pits (FTP-3, FTP-4, and FTP-6).

Based on the results of EA Engineering's investigation (EA Engineering, 1992; AR# 12), the USAF decided to conduct a removal action at Fire Training Pits FTP-3 and FTP-4. An Engineering Evaluation/Cost Analysis (EE/CA) was prepared in 1991 (Geraghty & Miller, Inc., 1991d; AR# 84), and the work plans to conduct a treatability study were prepared in 1992 (EA Engineering Science, 1992, AR# 80, Geraghty & Miller, Inc., 1992h; AR# 81). A pilot study was conducted in January 1992, and based on the results of the test, a soil vapor extraction (SVE) system was installed in March 1992 by Envirocon, Inc.

The SVE system operated from April 1992 through December 1992. Calculations indicate that over 14,000 pounds of contaminants were removed from the soil and destroyed by a thermal oxidizer off-gas treatment system while the system was in operations. Constituents removed during the extraction included 3butanone, benzene, 4-methyl-3-pentanone, toluene, 3-hexanone, ethyl benzene, xylenes, and the general class of petroleum hydrocarbons.The final report, *Final Report. Removal Action North Fire Training Area Luke AFB, Arizona* (Envirocon, Inc., 1993), contains a complete discussion of the removal action.

The objectives of the OU-1 RI at PSC FT-07E were to evaluate the effectiveness of the removal action performed by Envirocon in 1992 and to assess groundwater quality. Fourteen soil borings were advanced and sampled at the two fire training pits where vapor extraction was performed (FTP-3 and FTP-4) to assess effectiveness of remediation, to further evaluate the vertical extent of any constituents still remaining in the soils, and to assess the potential for groundwater impacts beneath the site. Two groundwater monitoring wells (MW-118 and MW-123) were installed at this site during the OU-1 investigation to assess groundwater quality at the site. These two wells were used to supplement the wells installed by Weston during the IRP.

COCs and EPCs identified for soils at PSC FT-07 during pre- and post-remediation sampling are summarized in Tables 3-6 through 3-9. COCs and EPCs identified for groundwater monitoring well samples collected at PSC FT-07 are summarized on Table 3-10. The sample locations where COCs were detected are shown on Figure 3-7. The following bullets summarize the OU-1 RI investigation at PSC FT-07E.

It should be noted that although the SVE removal action successfully reduced contaminant levels in deep soils (>16 feet bgs) at the site, several soil samples collected near the ground surface (0 to 16 feet bgs) during post-remediation sampling contained TRPH and metals at higher concentrations than those detected in pre-remediation sampling. Although the exact reason for this discrepancy cannot be accurately determined, potential reasons could include: the configuration of the SVE system which was designed to treat the deep soils, heterogeneity in the soil matrix, differences in pre- and post-remediation sampling locations, differences in sampling techniques, and differences in analytical laboratory methods.

- Pre-remediation soil sampling investigations conducted by Weston and EA Engineering identified relatively high concentrations of petroleum related residues in soil samples collected beneath Fire Training Pits FTP-3 and FTP-4. In response to the detected impact, the Base conducted a removal action with a SVE system from April to December 1992.

- Prior to conducting the removal action at Fire Training Pit FTP-3, benzene, toluene, ethylbenzene, and total xylenes (BTEX) and TRPH were detected at relatively high concentrations to depths of 30 feet bgs. Benzene was detected in only one sample collected from the center of FTP-3 at a depth of 20 feet bgs. Toluene, ethylbenzene, and xylenes were detected in numerous samples collected from depths ranging from 3 to 30 feet bgs. Toluene and methylene chloride were also detected in a soil sample collected at a depth of 120 feet bgs.

- After the removal action at FTP-3, toluene, ethylbenzene, and xylenes were detected in six samples collected at depths ranging from 4 to 40 feet bgs. TRPH was also detected in samples collected at depths ranging from the surface (0 feet bgs) to a depth of 100 feet bgs. The highest TRPH concentration (27,000 mg/kg) was detected in the 8 to 10 feet bgs sample collected from Soil Boring SB-6. TRPH was detected at 10 mg/kg in the 98 to 100 feet bgs sample collected from Soil Boring SB-6.

- In August of 1996, two additional soil borings were advanced and sampled at FTP-3. The additional soil borings. were drilled to 150 feet bgs. TRPH was detected at a concentration near laboratory detection limits (11 mg/kg) in one sample at a depth of 140 feet bgs, but the 150 feet bgs sample did not contain TRPH. Although VOC compounds (acetone, methylene chloride, ethylbenzene, and toluene) were detected in several samples, only one sample contained detections of VOC compounds that weren't qualified as laboratory contaminants. This sample was collected at a depth of 8 to 10 feet bgs. Based on this data, the vertical extent of VOC and TRPH impact at Fire Training Pit FTP-3 have been defined to laboratory detection limits to a depth of 140 feet bgs.

- Prior to conducting the removal action at Fire Training Pit FTP-4, TRPH and BTEX were detected at relatively high concentrations to depths of 80 feet bgs. Benzene was detected in two samples collected from the center of FTP-4 at a depths of 43 and 88 feet bgs. Toluene, ethylbenzene, and xylenes were detected in numerous samples collected from depths ranging from 0 to 80 feet bgs. Methylene chloride was also detected in a soil sample collected at a depth of 120 feet bgs.

- After the removal action was completed at FTP-4, ethylbenzene and xylenes were the only VOCs detected, and these compounds were only detected at low levels in one surficial sample and its duplicate. TRPH was detected at the highest level (2,000 mg/kg) in surface at Soil Boring SB-2. With the exception of one sample collected from Soil Boring SB-2 at a depth of 70 feet bgs (20 mg/kg), TRPH was not detected below 2 feet bgs at Fire Training Pit FTP-4.

- In August of 1996, one additional soil boring was advanced and sampled at Fire Training Pit FTP-4. The additional soil boring was drilled to 150 feet bgs.TRPH was detected at a concentration of 460 mg/kg in the surficial sample, but was not detected below the depth of 2 feet bgs. Based on this data, the vertical extent of VOC and TRPH impact at Fire Training Pit FTP-4 have been defined to laboratory detection limits to 120 feet bgs.

- During the pre-design study, EA Engineering drilled and sampled a 40-foot deep soil boring at Fire Training Pit FTP-6. Although TRPH and BTEX compounds were not detected in any of the samples, acetone was detected in the 40 foot bgs sample.

- In August of 1996, a 60 foot deep soil boring was advanced and sampled to confirm the acetone detection. No VOCs, including acetone, were detected in any of the samples collected in August of 1996. However, TRPH was detected in the surficial sample at a concentration of 1,200 mg/kg. This was the only sample that contained detectable concentrations of TRPH. The maximum vertical extent of the impact at Fire Training Pit FTP-6 has been defined to laboratory detection limits at this location to a depth of 40 feet bgs.

- The estimated depth to groundwater at the time of initiation of fire training activities at PSC FT-07E was approximately 312 feet bgs. Currently, groundwater occurs below the site at approximately 335 feet bgs. The apparent gradient of the water table is 0.002 foot per feet to the southwest.

- The OU-1 vadose zone transport model (see Section 3.6.1.4) indicates the highest concentration of modeled constituents that can be expected to leach to the bottom of the vadose zone is xylenes at 9.84×10^{-88} mg/L. This concentration is well below laboratory detection limits. Modeling results demonstrate that it is highly unlikely there will be groundwater impacts as a result of existing conditions at PSC FT-07.

- Groundwater quality beneath PSC FT-07 was evaluated using analytical results for groundwater samples collected from Monitoring Wells MW-109, MW-110, MW-111, MW-118, and MW-123. Although the screened intervals are submerged in Monitoring Wells MW-109, MW-110, and MW-111, the screened interval in Monitoring Wells MW-118 and MW-123 have not been submerged.

- Chloroform is the only VOC compound that was consistently detected in groundwater samples collected at the site. Chloroform was detected at concentrations near laboratory detection limits in samples collected from Monitoring Wells MW-110 and MW-123 prior to the second quarter of 1995. Chloroform has not been detected in any of the samples collected after this sampling event. The presence of chloroform in the groundwater samples could indicate that potable water used in fire training exercises has reached and mixed with groundwater.

- Four other VOC compounds (including toluene, DCA, DCBM, and DBCP) have been detected at random occurrences and at low concentrations near laboratory detection limits throughout the monitoring period. These VOC compounds have not been detected in any groundwater samples collected after the first quarter of 1993.

- The only BNA compound ever detected in groundwater samples collected at the site wis BEP, a common laboratory contaminant. BEP was only detected in two samples collected during the third quarter of 1993. BEP has not been detected prior to or after this sampling event.

- All metals concentrations detected in groundwater samples were below their respective background UTLs with the exception of barium. Only one sample collected from Monitoring Well MW- 118 during the third quarter of 1993 contained elevated barium concentrations The highest concentration of barium (0.335 mg/L does exceed its background UTL of 0.27 mg/L.

- Per USEPA guidance, the soil data collected by EA Engineering prior to conducting the SVE removal action were used in the Base-wide risk assessment to evaluate risks associated with current (Military/Industrial) land use scenarios. These data were used to establish a baseline level of risk.

- As shown on Table 3-6, the only COC for pre-remediation surficial soils at PSC FT-07E is TRPH. The EPC for average exposure to TRPH in pre-remediation surface soils is 100 mg/kg. The EPC for RME exposure to TRPH in pre-remediation surface soils is 280 mg/kg.

- As shown on Table 3-8, the COCs for pre-remediation combined surface and subsurface soils (0 to 16 feet bgs) are TRPH and arsenic. EPCs for average exposure to pre-remediation combined surface and subsurface soils are TRPH at 100 mg/kg and arsenic at 1.1 mg/kg. EPCs for RME exposure to pre-remediation combined surface and subsurface soils are TRPH at 190 mg/kg and arsenic at 1.2 mg/kg.

- As shown on Table 3-10, the only COC for future (monitoring well) groundwater exposure is lead. It should be noted that although other VOC compounds (such as toluene, DCA, DCM and DBCP) were detected in monitoring well samples, these compounds were not detected at concentrations above the USEPA PRGs. Therefore, these compounds were not identified as COCs. The EPC for average exposure to lead in future groundwater is 0.0039 mg/L. The EPC for RME exposure to lead in future groundwater is 0.0051 mg/L.

- As shown on Table 3-44, the COCs for current groundwater exposure at the site (production well samples) are bromoform, bromodichloromethane, chloroform, dibromochloromethane, arsenic and fluoride. EPC concentrations for current average exposure to groundwater are: bromoform at 0.0021 milligrams per liter (mg/L); bromodichloromethane at 0.00054 mg/L; chloroform at 0.00030 mg/L; dibromochloromethane at 0.0013 mg/L, arsenic at 0.0094 mg/L; and fluoride at 1.4 mg/L. EPC concentrations for current RME exposure to groundwater are: bromoform at 0.0033 mg/L; bromodichloromethane at 0.00081 mg/L; chloroform at 0.00038 mg/L; dibromochloromethane at 0.0021 mg/L, arsenic at 0.0 12 mg/L; and fluoride at 2.2 mg/L.

- Per USEPA guidance, the soil data collected following the removal action (April and March of 1993 and August of 1996) were used in the Base-wide risk assessment to evaluate risks associated with hypothetical residential use of the site.

- As shown on Table 3-7, the COCs for post remediation surficial soils were TRPH and arsenic. Post-remediation sampling results were used in the evaluation of risks associated with residential use of the site. EPCs for average exposure to post-remcdiation surficial soils are TRPH at 920 mg/kg and arsenic at 5.7 mg/kg. EPCs for RME exposure to post-remediation surficial soils are TRPH at 1,600 mg/kg and arsenic at 7.9 mg/kg.

- As shown on Table 3-9, the COCs for post remediation combined surficial and subsurface soils are also TRPH and arsenic. EPCs for average exposure to post-remediation combined surface and subsurface soils are: TRPH at 3,900 mg/kg and arsenic at 4.1 mg/kg. EPCs for RME exposure to post-remediation combined surface and subsurface soils are TRPH at 7,500 mg/kg and arsenic at 5.2 mg/kg.

Based on the results of the Base-wide Risk Assessment (see Section 3.6), COCs identified at PSC FT-07E were not present at concentrations high enough to cause adverse health effects under current land use scenarios (military/industrial). Results of the vadose zone transport model (see Section 3.6.1.4) also show that COCs detected in the soil will not migrate to the underlying groundwater resources. However, the concentration of TRPH detected at the site during post-remediation sampling could theoretically cause adverse health affects in the unlikely event that PSC FT-07E were developed for residential purposes in the future. For this reason, remedial alternatives were developed for PSC FT-07E in the OU-1 FS as a protective measure.

3.5.5 PSC OT-08 F-15 Burial Site

PSC OT-08 is located in the western portion of the Base between the west perimeter road and the outboard runway, southwest of the Old EOD Burial Pit (Figure 3-3). In 1978, Base personnel buried an F-15 aircraft at this site after it crashed and was destroyed in a fire. The aircraft was reportedly shrouded in plastic prior to disposal. No known or suspected hazardous wastes were disposed at this site. Prior to the beginning of the OU-1 field investigation, the FFA parties concluded that no further remedial investigations were warranted at PSC OT-08. This decision was documented in a consensus statement which is included as Appendix B. Consistent with this agreement, there were no environmental investigations performed at this site during the OU-1 RI.

3.5.6 PSC OT-09 Canberra Burial Site

PSC OT-09 is located north of the old perimeter road at the southern runway clear zone (Figure 3-3). A Canberra aircraft was buried at this site in the early 1950s after it had crashed. No known or suspected hazardous wastes were disposed at this site. Prior to the beginning of the OU-1 field investigation, the FFA parties concluded that no further remedial investigations were warranted at PSC OT-09. This decision was documented in a consensus statement which is included as Appendix B. Consistent with this agreement, there were no environmental investigations performed at this site during the OU-1 RI.

3.5.7 PSC OT-10 Concrete Rubble, Burial Site

PSC OT- 10 is located in the northwest corner of the Base, east of the perimeter road (Figure 3-3). The site is currently used as a radar station and preparedness training area. Concrete and asphalt rubble from runway repair and extension operations were accumulated above ground at this site beginning in 1951. In 1974, all of the accumulated rubble was disposed in a burial pit. Inspection of aerial photographs shows an excavated pit at the site prior to 1974. No known or suspected hazardous wastes were disposed at this site. No previous environmental investigation or sampling was performed at this site prior to the OU-1 RI. Because PSC OT- 10 is located entirely within the boundaries of the Drainage Ditch Disposal Area (PSC DP-13), and the landfill contents are presumed to be similar, the two sites were investigated as a single unit during the OU-1 RI. A consensus statement (included as Appendix B) was signed to formalize this change in designation.

3.5.8 PSC SS-11 Former Outside Transformer Storage

PSC SS-11 consists of a 0.79-acre site located in the northeastern portion of the Base, northeast of Facility 328 and west of Building 360 (Figure 3-3). The Base exterior electric shop used the site prior to 1981 for temporary storage of out-of-service electrical transformers, some of which may have contained polychlorinated biphenyls (PCBs). Approximately 20-percent of the site is covered by bare ground with no vegetation and the remaining 80-percent with degraded asphalt which has been at the site for the past 40 years. The transformers were reportedly stored on the bare ground.

No indication was found from interviews or from records search of any PCB spills or leaks from transformers stored in this area (CH2M HILL, 1982; AR# 3). No previous environmental investigation or sampling was performed at this site prior to the OU-1 RI. During the OU-1 investigation, 42 shallow soil borings (0 to 2 feet bgs) were advanced and sampled to evaluate the potential for PCB impacts which may have resulted from past transformer storage operations at the site.

COCs and EPCs identified for surface soils PSC SS-11 are summarized on Table 3-11. The sample locations where COCs were detected are shown on Figure 3-8. Samples were not collected below the depth of 2 feet bgs, therefore, there are no COCs for combined surface and subsurface soils. Likewise, there were no monitoring wells installed at PSC SS-11, therefore, there are no COCs for future groundwater exposure at this site. The following bullets summarize the OU-1 RI investigation at PSC SS-11.

- Of the 89 soil samples which were analyzed, PCBs were only detected in three samples collected from the eastern boundary of the site. The highest detected PCB concentration was 0.22 mg/kg. PCBs were not detected below the depth of 1 foot bgs.

- The OU-1 vadose zone transport model (see Section 3.6.1.4) indicates that PCBs will not leach to the bottom of the vadose zone. The modeling results demonstrate that it is highly unlikely that there will be groundwater impacts as a result of existing conditions at PSC SS-11.

- As shown on Table 3-11, the only COCs for surficial soils at PSC SS-11 are PCBs. The EPC for average exposure to surface soils is 0.026 mg/kg. The EPC concentration for RME exposure to surface soils is 0.033 mg/kg. As previously mentioned, there are no COCs for subsurface soils.

- As shown on Table 3-44, the COCs for current groundwater exposure (production well samples) are bromoform, bromodichloromethane, chloroform, dibromochloromethane, arsenic and fluoride. EPC concentrations for current average exposure to groundwater are: bromoform at 0.0021 mg/L; bromodichloromethane at 0.00054 mg/L; chloroform at 0.00030 mg/L; dibromochloromethane at 0.0013 mg/L, arsenic at 0.0094 mg/L; and fluoride at 1.4 mg/L. EPC concentrations for current RME exposure to groundwater are: bromoform at 0.0033 mg/L; bromodichloromethane at 0.00081 mg/L; chloroform at 0.00038 mg/L; dibromochloromethane at 0.0021 mg/L, arsenic at 0.012 mg/L; and fluoride at 2.2 mg(L. There are no COCs for future groundwater exposure because there are no monitoring wells.

Based on the results of the Base-wide Risk Assessment (see Section 3.6), COCs identified at PSC SS-11 were not present at concentrations high enough to cause adverse health effects under current land use scenarios (military/industrial) or even in the unlikely event the site is converted to residential usage in the future. Likewise, results of the vadose zone transport model (see Section 3.6.1.4) show that COCs detected in the soil will not migrate to the underlying groundwater resources. As a result, there was no need to evaluate remedial alternatives for PSC SS-11 in the OU-1 FS.

3.5.9 <u>PSC OT-12 Old EOD Burial Site</u>

PSC OT- 12 consists of a 15-acre former landfill area located between the outboard runway and the west perimeter road (Figure 3-3). The majority of the site lies in a low depression covered with bare soil and grass. The site is located just south of the EOD Demolition and Burn Facility #1047, which was constructed in 1963. Historic aerial photographs show a pit located at the site. The pit was probably excavated to dispose of the residue from the incineration or detonation of unused or outdated ordnance. The exact dates of operation of the pit could not be determined; however, it was reportedly in existence in the early 1970s. Currently, all unexploded ordnance is taken to the Gila Bend Auxiliary Field for demolition and disposal. No previous environmental investigation or sampling was performed at this site prior to the OU-1 RI.

The objectives of the RI at PSC OT-12 were to define the boundaries of the former landfill and to characterize its content. During the OU-1 Phase I investigation, geophysical and soil gas surveys were conducted to define the landfill boundaries and to select locations for test pits. During OU-1 Phase II studies, seven test pits were excavated and sampled to characterize the extent and contents of the landfill, and five soil borings were advanced to further define the vertical and lateral extent of constituents of potential concern detected during the test pit sampling. In August 1996, two additional soil borings were advanced and sampled to collect supplemental VOC and BNA data for risk assessment purposes.

COCs and EPCs identified for soils PSC OT-12 are summarized on Tables 3-12 and 3-13. T'he sample locations where COCs were detected are shown on Figure 3-9. There were no monitoring wells installed at PSC OT-12, therefore, there are no COCs for future groundwater exposure at this site. The following bullets summarize the OU-1 RI investigation at PSC OT-12.

- The geophysical survey delineated a prominent anomalous area in the western half of the site which was interpreted as the location of landfilled material.

- The highest detected TRPH concentration was 1,400 mg/kg in the surficial soil sample collected from Soil Boring SB-5. The deepest detected concentrations of TRPH were in samples collected from the test pits at 10 feet bgs.

- Toluene and xylenes were the only detected VOC compounds. These compounds were only detected in one sample collected from Test Pit TP-4. The detected concentration of toluene was 0.1 mg/kg, and the detected concentration of xylenes was 0.07 mg/kg. VOC compounds were not detected below the depth of 6 feet bgs.

- BNA compounds were only detected in nine samples collected during Phase II sampling at relatively low concentrations. The BNA detections were generally associated with TRPH. The deepest detected concentrations of a BNA compound was BEP at 0.36 mg/Kg in the 18 to 20 foot bgs sample collected from SB-3.

- Five samples contained lead concentrations in excess of background ranges. In general, the samples with elevated lead concentrations also contained TRPH. The highest detected concentration of lead was 330 mg/kg. None of the other detected metals concentrations exceed their respective background UTLs.

- Three additional soil bores were advanced in August 1996 in response to concerns of the quality of the VOC and BNA data produced by the ATI Phoenix laboratory. A total of seven additional samples were collected. None of the samples collected from the additional soil borings contained detectable concentrations of VOCs. BNA compounds were only detected in two surficial samples. Sixteen different BNA compounds were detected at low concentrations. Pyrene was detected at the highest concentration (1.4 mg/Kg). BNA compounds were not detected in either of the subsurface samples collected in August of 1996.

- The vadose zone transport model (see Section 3.1.6.4) indicates the highest concentration of modeled constituents that could reach the bottom of the vadose zone is xylenes at 9.84×10^{-92} mg/L. This concentration is well below laboratory detection limits. Modeling results indicate that it is highly unlikely that groundwater impacts will result from existing conditions.

- All data of known quality were compared to the USEPA PRGs to establish COCs for the site. As described in Section 3.4, VOC and BNA data produced by the ATI Phoenix laboratory were not used in the COC evaluation because they did not meet stringent data quality standards.

- As shown on Table 3-12, COCs for surficial soils at PSC OT-12 are TRPH, benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, arsenic, and beryllium. EPC concentrations for average exposure to surface soils are: TRPH at 430 mg/kg; benzo(a)pyrene at 0.40 mg/kg; benzo(a)anthracene at 0.33 mg/kg; benzo(b)fluoranthene at 0.39 mg/kg; dibenzo(a,h)anthracene at 0.18 mg/kg, arsenic at 4.4 mg/kg, and beryllium at 0.33 mg/kg. EPC concentrations for RME exposure to surface soils are: TRPH at 840 mg/kg; benzo(a)pyrene at 1.1 mg/kg; benzo(a)anthracene at 0.81 mg/kg; benzo(b)fluoranthene at 1.2 mg/kg; dibenzo(a,h)anthracene at 0.21 mg/kg, arsenic at 6.4 mg/kg, and beryllium at 0.46 mg/kg.

- As shown on Table 3-13, COCs for combined surface and subsurface soils are TRPH, benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, arsenic, and beryllium. EPC concentrations for average exposure to combined surface and subsurface soils are: TRPH at 170 mg/kg; benzo(a)pyrene at 0.29 mg/kg; benzo(a)anthracene at 0.26 mg/kg; benzo(b)fluoranthene at 0.28 mg/kg; dibenzo(a,h)anthracene at 0.18 mg/kg, arsenic at 4.0 mg/kg, and beryllium at 0.31 mg/kg. EPC concentrations for RME exposure to combined surface and subsurface soils are: TRPH at 290 mg/kg; benzo(a)pyrene at 0.52 mg/kg; benzo(a)anthracene at 0.42 mg/kg; benzo(b)fluoranthene at 0.56 mg/kg; dibenzo(a,h)anthracene at 0.19 mg/kg, arsenic at 4.9 mg/kg, and beryllium at 0.37 mg/kg.

- As shown on Table 3-44, the COCs for current groundwater exposure (production well samples) are bromoform, bromodichloromethane, chloroform, dibromochloromethane, arsenic and fluoride. EPC concentrations for current average exposure to groundwater are: bromoform at 0.0021 mg/L; bromodichloromethane at 0.00054 mg/L; chloroform at 0.00030 mg/L; dibromochloromethane at 0.0013 mg/L, arsenic at 0.0094 mg/L; and fluoride at 1.4 mg/L. EPC concentrations for current RME exposure to groundwater are: bromoform at 0.0033 mg/L; bromodichloromethane at 0.00081 mg/L; chloroform at 0.00038 mg/L; dibromochloromethane at 0.0021 mg/L, arsenic at 0.012 mg/L; and fluoride at 2.2 mg/L. There are no COCs for future groundwater exposure because there are no monitoring wells at the site.

Based on the results of the Base-wide Risk Assessment (see Section 3.6), COCs identified at PSC OT-12 were not present at concentrations high enough to cause adverse health effects under current land use scenarios (military/industrial) or even in the unlikely event the site is converted to residential usage in the future. Likewise, results of the vadose zone transport model (see Section 3.6.1.4) show that COCs detected in the soil will not migrate to the underlying groundwater resources. As a result, there was no need to evaluate remedial alternatives for PSC OT-12 in the OU-1 FS.

3.5.10 PSC DP-13 Drainage Ditch Disposal Area

PSC DP- 13 is located in the northwest corner of the Base (Figure 3-3). This PSC is part of a general landfill area that was expanded to include PSC OT-10 because the site locations overlapped and the presumed buried contents were similar (see Appendix B). During the 1940s, this site was the location of a drainage ditch which was reportedly used for general refuse disposal. The ditch was filled and covered when the Base was deactivated in 1946. Asphalt and concrete rubble stored in the northwest corner of the site was disposed in a burial pit in 1974. No known or suspected industrial-type wastes or hazardous wastes were disposed at this site (CH2M HILL, 1982; AR# 3). Currently, a majority of the site is covered with bare ground. The northern portion of the site is used as a bivouac area for preparedness training. No previous environmental investigation or sampling was performed at this site prior to the OU-1 RI.

Objectives of the RI at PSC DP-13 were to define the boundaries of the former landfill and characterize its contents. During the OU-1 Phase I RI, geophysical and soil gas surveys were conducted to define the landfill boundaries and to select locations for test pits. Phase II activities consisted of excavating fifteen test pits to characterize the extent and contents of the landfill. Ten soil borings were also advanced to further define the vertical and lateral extent of constituents of potential concern detected in the test pit samples. In August of 1996, three additional soil borings were advanced to collect supplemental VOC and BNA data for risk assessment purposes.

COCs and EPCs identified for soil at PSC DP-13 are summarized in Tables 3-14 and 3-15. The sample locations where COCs were detected are shown on Figure 3-10. There were no monitoring wells installed at PSC DP-13, therefore, there are no COCs for future groundwater exposure at this site. The following bullets summarize the OU-1 RI investigation at PSC DP-13.

- The geophysical survey identified several localized areas with anomalous conditions. The anomalous conditions indicated past landfilling activities had occurred. These localized areas were further explored with test pits.

- Although waste was not observed in eight of the test pits, seven pits encountered waste materials including concrete, wood, plastic, asphalt, and wire. Test Pits TP-12 and TP-3 (located within the bivouac area) intercepted an inactive underground utility line. A paint pail and dried paint residue were also observed in Test Pit TP-12.

- VOC compounds were not detected in any of the 37 test pit samples or 33 soil boring samples collected at this PSC.

- TRPH concentrations were detected in 23 of the test pit samples and in 12 of the soil boring samples. The highest TRPH concentrations were detected in soil samples collected from the northern segment of the PSC near Test Pit TP-12. The highest detected concentration of TRPH was 12,000 mg/kg in samples collected at 5 feet bgs. The deepest occurrence of TRPH (50 mg/kg) was at 20 feet bgs in Soil Boring SB-2.

- BNAs were detected in three test pit samples and eight soil boring samples, all collected in the northern portion of the site. BNA detections were generally associated with TRPH. The deepest occurrence of BNAs was at a depth of 16 feet bgs. The two highest detections were for pyrene (1.5 mg/kg) and fluoranthene (1.8 mg/kg) in surficial soil samples.

- Samples of wastes collected at Test Pit TP-12 contained concentrations of chromium, lead, copper, and zinc in excess of background ranges. The chromium and lead concentrations detected in the 5 foot bgs sample collected at TP-12 were 15,900 mg/kg and 36,000 mg/kg, respectively. The highest copper (3,900 mg/kg) and zinc (183 mg/kg) concentrations were detected in the six foot bgs sample.

- The OU-1 vadose zone transport model (see Section 3.6.1.4) indicates the highest concentration of modeled constituents that can be expected at the bottom of the vadose zone is TRPH at 4.25 $x10^{-237}$ mg/L. This concentration is well below laboratory detection limits. The modeling results demonstrate that it is highly unlikely that there will be groundwater impacts as a result of existing conditions at PSC DP-13.

- All data of known quality were compared to the USEPA PRGs to establish COCs for the site. As described in Section 3.4, VOC and BNA data produced by the ATI Phoenix laboratory were not used in the COC evaluation because they did not meet stringent data quality standards.

- As shown on Table 3-14, the COCs for surficial soils at PSC DP-13 are TRPH, arsenic, and beryllium. EPCs for average exposure to surface soils at DP-13 are TRPH at 300 mg/kg; arsenic at 4.7 mg/kg; and beryllium at 0.38 mg/kg. EPCs for RME exposure to surface soils at DP-13 are TRPH at 530 mg/kg, arsenic at 6.3 mg/kg, and beryllium at 0.47 mg/kg.

- As shown on Table 3-15, the COCs for combined surficial and subsurface soils at PSC DP-13 are TRPH, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, arsenic, beryllium, chromium, copper, and lead. EPCs for average exposure to combined surface and subsurface soils at DP-13 are TRPH at 410 mg/kg, benzo(a)anthracene at 0.24 mg/kg, benzo(a)pyrene at 0.23 mg/kg, benzo(b)fluoranthene at 0.27 mg/kg, dibenzo(a,h)anthracene at

0.099 mg/kg, arsenic at 4.2 mg/kg, beryllium at 0.35 mg/kg, chromium at 310 mg/kg, copper at 120 mg/kg, and lead at 700 mg/kg. EPCs for RME exposure to combined surface and subsurface soils are: TRPH at 790 mg/kg, benzo(a)anthracene at 0.33 mg/kg, benzo(a)pyrene at 0.32 mg/kg, benzo(b)fluoranthene at 0.36 mg/kg, dibenzo(a,h)anthracene at 0.11 mg/kg, arsenic at 5.1 mg/kg, beryllium at 0.39 mg/kg, chromium at 820 mg/kg, copper at 250 mg/kg, and lead at 1,800 mg/kg.

- As shown on Table 3-44, the COCs for current groundwater exposure (production well samples) are bromoform, bromodichloromethane, chloroform, dibromochloromethane, arsenic and fluoride. EPC concentrations for current average exposure to groundwater are: bromoform, at 0.0021 mg/L; bromodichloromethane at 0.00054 mg/L; chloroform at 0.00030 mg/L; dibromochloromethane at 0.0013 mg/L, arsenic at 0.0094 mg/L; and fluoride at 1.4 mg/L. EPC concentrations for current RME exposure to groundwater are: bromoform, at 0.0033 mg/L; bromodichloromethane at 0.00081 mg/L; chloroform at 0.00038 mg/L; dibromochloromethane at 0.0021 mg/L, arsenic at 0.012 mg/L; and fluoride at 2.2 mg/L. There are no COCs for future groundwater exposure because there are no monitoring wells at the site.

Based on the results of the Base-wide Risk Assessment (see Section 3.6), COCs identified at PSC DP-13 were not present at areas of current exposure at concentrations high enough to cause adverse health effects. Results of the vadose zone transport model (see Section 3.6.1.4) also showed that COCs detected in the soil will not migrate to the underlying groundwater resources. However, the concentration of chromium and lead detected in a waste samples collected at Test Pit TP-l2 could theoretically cause adverse health affects if long-term exposure were to occur.

Test Pits TP-12 (located near the side of a maintained road within the bivouac area) intercepted an inactive underground utility line. A paint pail and dried paint residue were also observed in Test Pit TP-12. Wastes collected from that test pit at a depth of 5 feet bgs contained chromium at 15,900 mg/kg and lead at 36,000 mg/kg. Because the wastes are buried and the surface area is maintained, direct exposure is not likely under current land use scenarios. However, exposure to these buried wastes could result if excavation were to occur at certain areas of the site or if the site were developed for residential purposes. For this reason, remedial alternatives were developed for PSC DP-13 in the OU-1 FS as a protective measure.

3.5.11 PSC LF-14 Old Salvage Yard Burial Site

PSC LF- 14 consists of a former landfill site located in the northeastern corner of the Base (Figure 3-3). In the 1940s, this site was part of the main drainage canal (unlined) for the north end of the Base. The canal was abandoned when the path of the drainage was changed in the 1950s. The abandoned canal may have been used as a landfill and was completely filled and covered by 1962. According to interviews with Base personnel, PCB-containing transformer fluids may have been disposed in the ditch in the northern portion of this site. The site is currently unpaved and covered with bare ground. No previous environmental investigation or sampling was performed at this site prior to the OU-1 RI.

The objectives of the RI at PSC LF-14 were to define the boundaries of the former drainage ditch landfill and to characterize its content. During the OU-1 investigation, geophysical and soil gas surveys were conducted to define the landfill boundaries and to select locations for test pits. Phase II activities consisted of excavating four test pits and sampling 10 soil borings. Two additional soil borings were advanced in August 1996 to collect supplemental VOC and BNA data for risk assessment purposes.

COCs and EPCs identified for soil at PSC LF-14 are summarized in Tables 3-16 and 3-17. The sample locations where COCs were detected are shown on Figure 3-11. There were no monitoring wells installed at PSC LF-14, therefore, there are no COCs for future groundwater exposure at this site. The following bullets summarize the OU-1 RI investigation at PSC LF-14.

- The geophysical survey at PSC LF- 14 showed anomalies across the entire survey area. However, most of the data collected was considered inconclusive because of interference from a variety of nearby surface debris and other cultural features (e.g. fencing) in the survey area.

- Samples collected from soil borings drilled in the northern limb of the site were the only samples with detections of organic constituents. The highest detected TRPH concentration was 2,400 mg/kg in the surficial sample collected from Soil Boring SB-8. TRPH concentrations decreased with increasing depth and were not detected below the depth of 30 feet bgs.

- The only VOC compound detected was xylenes at a concentration of 0.24 mg/kg in the subsurface sample collected from Soil Boring SB-26.

- BNA compounds were detected in five samples collected from the northern limb of the site. Detected BNA concentrations ranged from trace amounts to a maximum detection of 23 mg/kg of butylbenzylphthalate. BNA detections were generally associated with TRPH and were not detected below 35 feet bgs.

- PCBs were detected at relatively high concentrations in the central section of the northern limb of the site. PCB concentrations ranged from near laboratory detection limits to 2,300 mg/kg. The highest PCB concentration was detected in deep soil collected at Soil Boring SB-8 at a depth of 20 feet bgs.

- The highest detected concentrations of silver (4.8 mg/kg), cadmium (5.7 mg/kg), lead (88 mg/kg), chromium (376 mg/kg), and zinc (737 mg/kg) do exceed their statistically derived background values. All of the samples that contained metals concentrations in excess of background ranges were collected at the surface in the northern limb of the site. TRPH was detected in a majority of the samples with elevated metals concentrations.

- The OU-1 vadose zone transport model indicates the highest concentration of modeled constituents that can be expected at the bottom of the vadose zone is TRPH at 2.47 x 10^{-210} mg/L. This concentration is well below laboratory detection limits. The modeling results demonstrate that it is highly unlikely that there will be groundwater impacts as a result of existing conditions.

- All data of known quality were compared to the USEPA PRGs to establish COCs for the site. As described in Section 3.4, certain site characterization data produced by the ATI Phoenix laboratory were not used in the COC evaluation because they did not meet stringent data quality standards.

- As shown on Table 3-16, COCs for surficial soils at PSC LF-14 are TRPH, PCBs, benzo(a)pyrene, arsenic, beryllium, and chromium. EPCs for average exposure to surficial soil are: TRPH at 540 mg/kg, PCBs at 1.7 mg/kg, benzo(a)pyrene at 0.12 mg/kg, arsenic at 4.1 mg/kg, beryllium at 0.44 mg/kg, and chromium at 51 mg/kg. EPCs for RME exposure to surficial soil are: TRPH at 1,100 mg/kg, PCBs at 3.6 mg/kg, benzo(a)pyrene at 0.15 mg/kg, arsenic at 5.8 mg/kg, beryllium at 0.62 mg/kg, and chromium at 100 mg/kg.

- As shown on Table 3-17, COCs for combined surface and subsurface soils are TRPH, PCBs, benzo(a)pyrene, arsenic, beryllium, and chromium. EPCs for average exposure to combined surface and subsurface soil are: TRPH at 280 mg/kg, PCBs at 1.0 mg/kg, benzo(a)pyrene at 0.13 mg/kg, arsenic at 4.4 mg/kg, beryllium at 0.43 mg/kg, and chromium at 18 mg/kg. EPCs for RME exposure to surficial soil are: TRPH at 570 mg/kg, PCBs at 2.1 mg/kg, benzo(a)pyrene at 0.16 mg/kg, arsenic at 5.4 mg/kg, beryllium at 0.53 mg/kg, and chromium at 21 mg/kg.

- As shown on Table 3-44, the COCs for current groundwater exposure (production well samples) are bromoform, bromodichloromethane, chloroform, dibromochloromethane, arsenic and fluoride. EPC concentrations for current average exposure to groundwater are: bromoform, at 0.0021 mg/L; bromodichloromethane at 0.00054 mg/L; chloroform at 0.00030 mg/L; dibromochloromethane at 0.0013 mg/L, arsenic at 0.0094 mg/L; and fluoride at 1.4 mg/L. EPC concentrations for current RME exposure to groundwater are: bromoform, at 0.0033 mg/L; bromodichloromethane at 0.00081 mg/L; chloroform at 0.00038 mg/L; dibromochloromethane at 0.0021 mg/L, arsenic at 0.012 mg/L; and fluoride at 2.2 mg/L. There are no COCs for future groundwater exposure because there are no monitoring wells at the site.

Based on the results of the Base-wide Risk Assessment (see Section 3.6), COCs identified at PSC LF-14 were not present at areas of potential exposure at concentrations high enough to cause adverse health effects under current land use scenarios. Although relatively high PCB concentrations (2,300 mg/kg) were detected at the site, the depth at which this concentration was detected was greater than 16 feet bgs. As detailed in the Base-wide risk assessment, exposure to soil at depths greater than 16 feet is unlikely, and therefore, data collected below the depth of 16 feet are not incorporated into the risk calculations or occurrence tables.

Sampling results for deep soils (>16 feet bgs) are only used in vadose zone transport model to evaluate the potential for groundwater impacts. Results of the vadose zone transport model (see Section 3.6.1.4) show that COCs detected in the soil at PSC LF-14 will not migrate to the underlying groundwater resources.

However, the concentrations of PCBs and chromium present in combined surface and subsurface soils (0 to 16 feet bgs) could theoretically cause adverse health affects in unlikely event that PSC LF-14 were developed for residential purposes in the future. For this reason, remedial alternatives were developed for PSC LF-14 in the OU-1 FS as a protective measure.

3.5.12 PSC SS-15 Facility 328 Spill Site

PSC SS-15 consists of the Fuels Quality Control Laboratory (Facility 328) in the northeastern portion of the Base (Figure 3-3). The Fuels Quality Control Laboratory performs quality control testing of fuels used in aircraft. A spill of approximately 1000-gallons of fuel was reported to have occurred at this site during replacement of an old underground fuel line with a new aboveground fuel line. This event was attributed to Facility 328, Site Number 15 on page IV-10 of the IRP Phase I Report (CH2M HILL, 1982; AR#3). Because there are no fuel tanks associated with this facility, the reference to Facility 328 was most likely an editorial error. Prior to the beginning ofthe OU-1 field investigation, the FFA parties agreed to remove PSC SS- 15 from the NPL process and placed it under the jurisdiction of the ADEQ UST program for any and all remedial activities. A consensus statement (Appendix B) was signed in 1993 to document this decision. There were no environmental investigations or sampling performed at this site during the OU-1 RI

3.5.13 PSC SS-16 Facility 321 USTs

PSC SS-16 is located in the northeastern portion of the Base (Figure 3-3), east of the Former Outside Transformer Storage Area (PSC SS-11). Facility 321 contains six 50,000-gallon USTs used for storage of motor fuels (MOGAS), diesel fuel, and jet propulsion (JP)-4 jet fuel. Records indicated that spills occur infrequently at Facility 321 as a result of overfilling of tanks. A minor spill, estimated to be less than 1,000 gallons, was reported to have occurred near Facility 321 when the connection was made from underground lines to aboveground lines in 1964. Overfilling spills were reported to be insignificant, and the bulk of the spilled fuel would have evaporated since the area surrounding the tanks is paved. Prior to the beginning of the OU-1 field investigation, the FFA parties agreed to remove PSC SS-16 from the NPL process and placed it under the jurisdiction of the ADEQ UST program for any and all remedial activities. A consensus statement (Appendix B) was signed in 1993 to document this decision. There were no environmental investigations or sampling performed at this site during the OU-1 RI.

3.5.14 PSC SS-17 Former DPDO Yard

PSC SS-17 consists of the former Defense Property Disposal Office (DPDO) facility located in the northeastern corner of the Base (Figure 3-3). The site occupies approximately 13-acres. Forty percent of the site is paved with old asphalt and concrete pads and 60-percent is soil ground cover. During the 1950s and 1960s, hazardous materials and 55-gallon drums of industrial wastes were stored on the floor of the former DPDO building. The hazardous waste included spent thinners and strippers, paint, solvents, mercury- contaminated rags, and asbestos-containing material.

In 1986, all wastes were shipped from the site for proper disposal in California. Soil samples and samples of the concrete pad were collected in May 1986. None of the samples contained detectable concentrations of potential contaminants. The DPDO yard was listed as “closed” on September 21, 1988, with closure acknowledged by ADEQ on September 30,1988. Despite its “closed” status, PSC SS-17 was included in the OU-1 RI.

Objectives of the RI at PSC SS-17 were to assess the surficial and subsurface soils at the site to determine the nature and extent of any detected constituents of potential concern. During the OU-1 investigation, a geophysical survey was conducted to screen for buried drums or other objects that could interfere with drilling. Twelve soil borings were advanced and sampled during Phase II activities. One additional soil boring was sampled in August of 1996 to collect supplemental VOC and BNA data for risk assessment purposes.

COCs and EPCs identified for soil at PSC SS-17 are summarized in Tables 3-18 and 3-19. The sample locations where COCs were detected are shown on Figure 3-12. There were no monitoring wells installed at PSC SS-17, therefore, there are no COCs for future groundwater exposure at this site. The following bullets summarize the OU-1 RI investigation at PSC SS-17.

- TRPH was detected in at least one sample from each boring. The highest TRPH concentrations were reported in the surficial sample collected from Soil Boring SB-5, which contained 7,000 mg/kg. TRPH concentrations were not reported below 28 feet.

- BNA compounds were only detected in one sample. An estimated concentration of 0.7 mg/kg of di-n-octylphthalate was reported in the surficial sample collected from the boring drilled in August 1996. Only one VOC compound was detected (acetone at 0.9 mg/kg) in one surficial sample.

- PCBs were detected in four samples. The highest detected concentration was 0.30 mg/kg in a surficial soil sample.

- The highest detected concentrations of beryllium (2.6 mg/kg), cadmium (24.6 mg/kg), copper (189 mg/kg), lead (169 mg/kg), silver (2 mg/kg), and zinc (366 mg/kg) do exceed their respective background UTLs.

- The OU-1 vadose zone transport model indicates the highest concentration of modeled constituents that can be expected to leach to the bottom of the vadose zone is TRPH at 1.42×10^{-210} mg/L. This concentration is well below laboratory detection limits. The modeling results demonstrate that it is highly unlikely that there will be groundwater impacts as a result of existing conditions at PSC SS-17.

- All data of known quality were compared to the USEPA PRGs to establish COCs for the site. As described in Section 3.4, VOC and BNA data produced by the ATI Phoenix laboratory were not used in the COC evaluation because they did not meet stringent data quality standards.

- As shown on Table 3-18, the COCs for surficial soils at PSC SS-17 are TRPH, PCBs, arsenic and beryllium. EPCs for average exposure to surficial soils are: TRPH at 1,600 mg/kg, PCBs at 0.079 mg/kg, arsenic at 3.1 mg/kg, and beryllium at 0.59 mg/kg. EPCs for RME exposure to surficial soils are: TRPH at 4,000 mg/kg, PCBs at 0.13 mg/kg, arsenic at 4.3 mg/kg, and beryllium at 1.3 mg/kg.

- As shown on Table 3-19, the COCs for combined surface and subsurface soils are TRPH, PCBs, arsenic and beryllium. EPCs for average exposure to combined surface and subsurface soils are: TRPH at 640 mg/kg, PCBs at 0.079 mg/kg, arsenic at 4.0 mg/kg, and beryllium at 0.51 mg/kg. EPCs for RME exposure to surficial soils are: TRPH at 1,300 mg/kg, PCBs at 0.13 mg/kg, arsenic at 5.1 mg/kg, and beryllium at 0.81 mg/kg.

- As shown on Table 3-44, the COCs for current groundwater exposure (production well samples) are bromoform, bromodichloromethane, chloroform, dibromochloromethane, arsenic and fluoride. EPC concentrations for current average exposure to groundwater are: bromoform at 0.0021 mg/L; bromodichloromethane at 0.00054 mg/L; chloroform at 0.00030 mg/L; dibromochloromethane at 0.0013 mg/L, arsenic at 0.0094 mg/L; and fluoride at 1.4 mg/L. EPC concentrations for current RME exposure to groundwater are: bromoform, at 0.0033 mg/L; bromodichloromethane at 0.00081 mg/L; chloroform at 0.00038 mg/L; dibromochloromethane at 0.0021 mg/L, arsenic at 0.012 mg/L; and fluoride at 2.2 mg/L. There are no COCs for future groundwater exposure because there are no monitoring wells at the site.

Based on the results of the Base-wide Risk Assessment (see Section 3.6), COCs identified at PSC SS-17 were not present at concentrations high enough to cause adverse health effects under current land use scenarios (military/industrial) or even in the unlikely event the site is converted to residential usage in the future. Likewise, results of the vadose zone transport model (see Section 3.6.1.4) show that COCs detected in the soil will not migrate to the underlying groundwater resources. As a result, there was no need to evaluate remedial alternatives for PSC SS-17 in the OU-1 FS.

3.5-15 PSC ST-19 BX Leaking USTs

PSC ST-19 consists of an area of soil contamination resulting from leakage of petroleum fuel from former USTs located at the former Base Military Gasoline Station, Facility 299. This facility was located in the northeast portion of the Base (Figure 3-3). The site was used for the dispensing of unleaded gasoline and diesel fuel for use by military vehicles. Currently, this site is covered with asphalt pavement and is part of the Base vehicle maintenance facility. Facility 299 consisted of three 10,000-gallon USTs.

On August 18, 1987, a release of unleaded gasoline at this facility was reported to the ADEQ. Investigation of the site after UST removal confirmed the presence of gasoline contamination. Subsequent subsurface investigations showed the contamination to be confined to depths of less than 70-feet and a limited areal extent. Depth to groundwater is approximately 360 feet bgs. A complete discussion of the site investigation and evaluation is contained in the report *Leaking Underground Storage Tank Assessment-Phase II* (Water Resources Associates, 1989). Upon review of this report, the ADEQ UST Compliance Unit issued a formal case closure letter dated November 1, 1989. Prior to the beginning of the OU-1 field investigation, the FFA parties agreed that the site would remain under the jurisdiction of the ADEQ UST program. A consensus statement (Appendix B) was signed to document this arrangement. There were no environmental investigation or sampling performed at this site during the OU-1 RI.

3.5.16 PSC SD-20 Oil/Water Separator Canal and Earth Fissure

PSC SD-20 consists of a drainage canal located on the southern side of the Base (Figure 3-3). This unlined canal originates at the Oil/Water Separator 912, approximately 100-feet north of ‘N’ Street, and extends southward. The 912 oil/water separator system serves two drainage systems, a 30-inch diameter system for the areas to the northwest and a 43-inch diameter system for an area to the northeast. Occasionally during past storm events, stagnant oily water in the 30-inch subsystem overflowed into the oil/water separator canal. Recent upgrades to the Base sewer system have eliminated the potential for additional discharges to the canal. Two earth fissures, apparently resulting from differential land subsidence, are present at the end of the drainage canal.

During the IRP, Phase II, Stage 2 Investigation, Weston conducted a variety of investigations. The soil-gas survey consisted of collecting soil-gas samples at regular intervals along the canal from its origin to where it crossed the Base boundary, along two perpendicular transects of the canal. Six 100-foot deep soil borings were advanced and sampled, and 20 sediment samples were collected from the canal. Surface-water samples were collected on two separate occasions. The groundwater investigation consisted of installing two groundwater monitoring wells (MW-102 and MW- 103) and collecting three rounds of groundwater samples. Results of this investigation are presented in the Phase II IRP Report (Roy F. Weston, 1988a, b; AR# 8,45).

During the OU-1 investigations, additional soil boring samples, sediment samples, and groundwater samples were collected to determine the presence of constituents of potential concern, to evaluate the dimensions of any impacted areas, and to assess risk. Fourteen soil borings and 18 sediment borings were advanced and sampled. Three groundwater monitoring wells (MW-112S, MW-112D, and MW-113) were also installed and sampled. The three new monitoring wells and two existing monitoring wells (MW-102 and MW-103) were sampled during quarterly and semi-annual base-wide groundwater monitoring.

Additional studies were also performed at the site during the OU-1 RI to evaluate the potential effects of the nearby Luke Salt Body and earth fissures on contaminant transport and migration pathways. A complete discussion of the methodology, insults, and conclusions of the earth fissure study can be found in Appendix R of the OU-1 Remedial Investigation Report (Geraghty & Miller, Inc. 1997a; AR# 188 and 189) and in a separate report which was started by the U.S. Geological Survey and finished by Geraghty & Miller (Geraghty & Miller, 1996b).

COCs and EPCs identified for soil at PSC SD-20 are summarized in Tables 3-20 and 3-22. COCs and EPCs identified for groundwater monitoring well samples collected at PSC SD-20 are summarized on Table 3-22. The sample locations where COCs were detected are shown on Figure 3-13. The following bullets summarize the OU-1 RI investigation at PSC SD-20.

- A total of 62 soil samples and 35 sediment samples were collected and analyzed for TRPH, VOCs, BNAs, and metals.

- TRPH was detected in 23 of the 62 soil boring samples and 16 of the 35 sediment samples collected at PSC SD-20. The highest detected concentration of TRPH was 3,700 mg/kg in the sediment sample collected approximately 400-feet downstream from the head of the canal at a depth of 0 to 1 foot bgs. Detected TRPH concentrations generally decreased with increasing distance from the head of the canal. The deepest detected concentration of TRPH (10 mg/kg) was in the soil sample from the soil boring for groundwater Monitoring Well MW-112D at a depth of 130 to 132 feet bgs.

- VOCs were only detected in soil and sediment samples collected at the head of the canal. Toluene was the only VOC which was detected in any soil or sediment samples collected at the site. The highest detected concentration of toluene was 0.1 mg/kg. The deepest depth at which toluene was detected was 16 feet bgs.

- BNAs were only detected in one soil and two sediment samples collected at the head of the canal. BNA compounds were only detected in samples that also contained TRPH. BNA compounds were not detected below 8 feet bgs.

- The OU-1 vadose zone transport model indicates the highest concentration of modeled constituents that can be expected at the bottom of the vadose zone is TRPH at 1.31×10^{-29} mg/L. This concentration is well below laboratory detection limits. Modeling results demonstrate it is highly unlikely that there will be groundwater impacts as a result of existing conditions at PSC SD-20.

- The doming of the Luke Salt Body has apparently affected the hydrostratigraphic units in this area and has created different hydrogeological regimes in the northern and southern portions of the site. Water level altitudes in wells located at the northern portion of the site (MW-102 and MW-103) are typically 50 to 70-feet lower than wells located at the southern portion of this site (MW-112S, MW-112D, and MW-113). As a result it is not possible to accurately calculate apparent gradients and water level contours for the PSC SD-20 area.

- Groundwater quality at this PSC was assessed by collecting and analyzing groundwater samples from Monitoring Wells MW-102, MW-103, MW-112S, MW-112D, and MW-113.

- TCE, PCE, and toluene have consistently been detected at concentrations near laboratory detection limits in groundwater samples from Monitoring Wells MW-112S and MW-113 prior to the third quarter of 1995. VOC compounds have not been detected in any groundwater samples collected after the second quarter of 1995.

- Only three groundwater samples collected at the site contained detectable concentrations of BNA compounds. BEP was detected in groundwater samples collected from Monitoring Wells MW-102 and MW-103 in the fourth quarter of 1991. BEP has not been detected in any subsequent samples collected from these two wells. Benzoic acid was the only other BNA compound detected in groundwater samples collected at the site. Benzoic acid was detected at a concentration of 40 micrograms per liter (µg/L) in the groundwater sample collected from Monitoring Well MW-112S in the fourth quarter of 1993. BNAs have not been detected prior to or after this isolated occurrence.

- All data of known quality were compared to the USEPA PRGs to establish COCs for the site. As described in Section 3.4, VOC and BNA data produced by the ATI Phoenix laboratory were not used in the COC evaluation because they did not meet stringent data quality standards.

- As shown on Table 3-20, the COCs for surficial soils at PSC SD-20 are TRPH, benzo(a)pyrene, arsenic, and beryllium. EPCs for average exposure to surficial soils are: TRPH at 320 mg/kg, benzo(a)pyrene at 0.19 mg/kg, arsenic at 3.3 mg/kg, and beryllium at 0.41 mg/kg. EPCs for RME exposure to surficial soils are: TRPH at 530 mg/kg, benzo(a)pyrene at 0.21 mg/kg, arsenic at 3.8 mg/kg and beryllium at 0.48 mg/kg.

- As shown on Table 3-21, the COCs for combined surface and subsurface soils at PSC SD-20 are TRPH, benzo(a)pyrene, arsenic, and beryllium. EPCs for average exposure to combined surface and subsurface soils are: TRPH at 210 mg/kg, benzo(a)pyrene at 0.17 mg/kg, arsenic at 4.9 mg/kg, and beryllium at 0.32 mg/kg. EPCs for RME exposure to combined surface and subsurface soils are: TRPH at 360 mg/kg, benzo(a)pyrene at 0.19 mg/kg, arsenic at 5.9 mg/kg and beryllium at 0.37 mg/kg.

- As shown on Table 3-44, the COCs for current groundwater exposure (production well samples) are bromoform, bromodichloromethane, chloroform, dibromochloromethane, arsenic and fluoride. EPC concentrations for current average exposure to groundwater are: bromoform, at 0.0021 mg/L; bromodichloromethane at 0.00054 mg/L; chloroform at 0.00030 mg/L; dibromochloromethane at 0.0013 mg/L, arsenic at 0.0094 mg/L; and fluoride at 1.4 mg/L. EPC concentrations for current RME exposure to groundwater are: bromoform, at 0.0033 mg/L; bromodichloromethane at 0.00081 mg/L; chloroform at 0.00038 mg/L; dibromochloromethane at 0.0021 mg/L, arsenic at 0.0 12 mg/L; and fluoride at 2.2 mg/L.

- As shown on Table 3-22, the COCs for future groundwater exposure at the site are arsenic and lead. COCs for future current groundwater exposure are from monitoring well samples. It should be noted that although other VOC and BNA compounds (such as TCE, PCE, and BEP) were detected in monitoring well samples, these compounds were not detected at concentrations above the USEPA PRGs, and therefore were not identified as COCs. EPCs for future average exposure to groundwater are arsenic at 0.014 mg/L and lead at 0.0067 mg/L. EPCs for future RME exposure to groundwater are arsenic at 0.016 mg/L and lead at 0.010 mg/L.

Based on the results of the Base-wide Risk Assessment (see Section 3.6), COCs identified at PSC SD-20 were not present at concentrations high enough to cause adverse health effects under current land use scenarios (military/industrial) or even in the unlikely event the site is converted to residential usage in the future. Likewise, results of the vadose zone transport model (see Section 3.6.1.4) show that COCs detected in the soil will not migrate to the underlying groundwater resources. As a result, there was no need to evaluate remedial alternatives for PSC SD-20 in the OU-1 FS

3.5.17 PSC SD-21 Wastewater Treatment Plant Effluent Canal

PSC SD-21 is located approximately 2-miles east of the Base, south of Glendale Avenue, adjacent to the west bank of the Agua Fria River (Figure 3-3). Prior 1997, treated effluent was discharged to this canal from the Base WWTP. The canal and associated wetlands comprised approximately 33-acres. The water in the canal is categorized as effluent dominated surface water according to the ADEQ. In 1997, effluent discharge to the canal was discontinued and discharge was piped to the new Luke AFB golf course for irrigation.

In 1986 and 1987, the WWTP effluent canal was assessed during the IRP, Phase II, Stage 2 Investigation (Roy F. Weston, Inc., 1988; AR# 8,45). During this investigation soil gas samples, soil borings samples, and sediment samples were collected along the canal. Effluent samples were collected over three days in January 1987 and additional sampling was conducted in February 1987. A single monitoring well (MW-101) was installed in 1986, and groundwater samples were collected in 1986 and 1987.

During the OU-1 investigations, soil boring samples, sediment samples, surface-water samples, and groundwater samples were collected to determine the presence of constituents of potential concern, to evaluate the dimensions of any impacted areas, and to assess risks associated with the effluent canal.

COCs and EPCs identified for soil at PSC SD-21 are summarized in Tables 3-23 and 3-24. COCs and EPCs identified for sediments at PSC SD-21 are summarized on Table 3-25. COCs and EPCs for surface water and groundwater are summarized on Tables 3-26 and 3-27, respectively. The sample locations where COCs were detected are shown on Figure 3-14. The following bullets summarize the OU-1 RI investigation at PSC SD-21.

- VOC compounds were only detected in one soil boring sample and one sediment sample. The only VOC compound detected in soil boring samples was a trace concentration (<0.1 mg/kg) of toluene in the18 to 20 foot bgs sample collected from Soil Boring SB-4. The only VOC compound detected in sediment samples was 0.6 mg/kg of acetone in sediment sample SD-7.

- BNAs were only detected in three soil boring samples and one sediment samples. A trace level of BEP (<0.17 mg/kg) was detected in the 24 to 26 foot sample from Soil Boring SB-1 and the sediment sample SD-3. BNAs were detected in the 6 to 8 foot sample from Soil Boring SB-3 and the surficial sample from Soil Boring SB-5. BNA compounds were detected at the highest concentration in the surficial sample collected at Soil Boring SB-5. The highest detected concentration of a BNA compound was 1.5 mg/kg of benzo(b)fluoranthene.

- The highest detected concentrations of silver (30 mg/kg), cadmium (3 mg/kg), copper (81.4 mg/kg), lead (48 mg/kg), and zinc (166 mg/kg) in three sediment samples do slightly exceed background ranges. Metals concentrations detected in soil boring samples do not exceed background ranges.

- VOCs were not detected in the surface-water samples. Inorganic constituents detected in surface water samples were within limits numeric water quality standards with only a few exceptions.

- The OU-1 vadose zone transport model indicates the highest concentration of modeled constituents that can be expected to leach to the bottom of the vadose zone is toluene at 2.30×10^{-7} mg/L. Modeling results demonstrate it is highly unlikely that there will be groundwater impacts as a result of existing conditions at PSC SD-21.

- Groundwater samples collected from Monitoring Well MW-101 contained BNA and VOC compounds on only one occasion. The groundwater sample collected during the second quarter of 1994 contained acetone and carbon disulfide at concentrations of 23 and 25 µg/L, respectively. Groundwater samples collected approximately 2 months later did not contain these compounds.

- The highest detected concentrations of metals in groundwater samples were all below their respective background UTLs with the exception of copper. The highest detected concentration of copper (0.092 mg/L) does slightly exceed its background UTL of .056 mg/L, however it is within the range of naturally occurring concentrations included in the background data set.

- All data of known quality were compared to the USEPA PRGs to establish COCs for the site. As described in Section 3.4, VOC and BNA site characterization data produced by the ATT Phoenix laboratory were not used in the COC evaluation because they did not meet stringent data quality standards.

- As shown on Table 3-23, the COCs for surficial soils at PSC SD-21 are benzo(b)fluoranthene, benzo(a)pyrene, dibenzo(a,h)anthracene, arsenic and beryllium. EPCs for average exposure to surficial soils at PSC SD-21 are: benzo(b)fluoranthene at 0.56 mg/kg, benzo(a)pyrene at 0.25 mg/kg, dibenzo(a,h)anthracenc at 0.085 mg/kg, arsenic at 3.9 mg/kg, and beryllium at 0.28 mg/kg. EPCs for RME exposure to surficial soils are: benzo(b)fluoranthene at 1.9 mg/kg, benzo(a)pyrene at 0.74 mg/kg, dibenzo(ah)anthracene at 0.085 mg/kg, arsenic at 5.3 mg/kg, and beryllium at 0.36 mg/kg.

- As shown on Table 3-24, the COCs for combined surface and subsurface soils at PSC SD-21 are benzo(b)fluoranthene, benzo(a)pyrene, dibenzo(ah)anthracene, arsenic and beryllium. EPCs for average exposure to combined surface and subsurface soils at PSC SD-21 are: benzo(b)fluoranthene at 0.32 mg/kg, benzo(a)pyrene at 0.17 mg/kg, dibenzo(a, h)anthracene at 0.085 mg/kg, arsenic at 3.6 mg/kg, and beryllium at 0.26 mg/kg. EPCs for RME exposure to surficial soils are: benzo(b)fluoranthene at 0.80 mg/kg, benzo(a)pyrene at 0.34 mg/kg, dibenzo(a,h)anthracene at 0.085 mg/kg, arsenic at 4.4 mg/kg, and beryllium at 0.30 mg/kg.

- As shown on Table 3-25, the COCs for sediments at PSC SD-21 are arsenic and beryllium. EPCs for average exposure to sediments are: arsenic at 9.2 mg/kg and beryllium at 0.44 mg/kg. EPCs for RME exposure to sediments are arsenic at 15 mg/kg and beryllium at 0.65 mg/kg.

- As shown on Table 3-26, COCs for surface water at PSC SD-21 are arsenic and lead. EPCs for average exposure to surfacewater are arsenic at 0.029 mg/L and lead at 0.031 mg/L, EPCs for RME exposure to surfacewater are arsenic at 0.073 mg/kg and lead at 0.10 mg/L.

- As shown on Table 3-44, the COCs for current groundwater exposure (production well samples) are bromoform, bromodichloromethane, chloroform, dibromochloromethane, arsenic and fluoride. EPC concentrations for current average exposure to groundwater are: bromoform, at 0.0021 mg/L; bromodichloromethane at 0.00054 mg/L; chloroform at 0.00030 mg/L; dibromochloromethane at 0.0013 mg/L, arsenic at 0.0094 mg/L; and fluoride at 1.4 mg/L. EPC concentrations for current RME exposure to groundwater are: bromoform, at 0.0033 mg/L; bromodichloromethane at 0.00081 mg/L; chloroform at 0.00038 mg/L; dibromochloromethane at 0.0021 mg/L, arsenic at 0.012 mg/L; and fluoride at 2.2 mg/L.

- As shown on Table 3-27, COCs for future groundwater exposure are arsenic and lead. These COCs were detected in samples collected from groundwater monitoring wells at the site. EPCs for future average exposure to groundwater are arsenic at 0.0042 mg/L and lead at 0.0030 mg/L. EPCs for future RME exposure to groundwater are arsenic at 0.0078 mg/L and lead at 0.0057 mg/L.

Based on the results of the Base-wide Risk Assessment (see Section 3.6), COCs identified at PSC SD-21 were not present at concentrations high enough to cause adverse health effects under current land use scenarios (military/industrial) or even in the unlikely event the site is converted to residential usage in the future. Likewise, results of the vadose zone transport model (see Section 3.6.1.4) show that COCs detected in the soil will not migrate to the underlying groundwater resources. As a result, there was no need to evaluate remedial alternatives for PSC SD-21 in the OU-1 FS.

3.5.18 PSC DP-24 Base Ammunition Storage Area

PSC DP-24 consists of the Ammunition Storage area located south of the Base along 24th Street (Figure 3-3). The site is generally circular, encompassing approximately 420 acres. The Base has used the site for storage of explosive ordinance and ammunition since the 1950's. During the July 1990 Project Managers Meeting, the site history and conditions were reviewed. Prior to the beginning of the OU-1 field investigation, the FFA parties agreed not to include DP-24 on the list of CERCLA sites because it had been identified as a PSC due to a clerical error that occurred in the compilation of the original list of sites. A consensus statement (Appendix B) was signed to document this decision.

3.5.19 PSC LF-25 Northwest Landfill

PSC LF-25 consists of an area formerly used for landfilling located along the southwest boundary of the Base, between the west perimeter and the northwest runway (Figure 3-3). This narrow site occupies approximately 43-acres. Portions of PSC LF-25 are located immediately downrange of the Base skeet shooting range (PSC OT-41). Small localized sections of the site were used as a landfill for construction debris in the past for an undetermined length of time, but it has not been used since 1989.

In January 1990, a geophysical and organic vapor survey was conducted in the southern part of PSC LF-25. Approximately 80 individual objects were identified and cataloged. The remainder of the site (approximately one-third of the total area) was determined to be clear of metallic objects.

In preparation for the OU-1 investigation, the USAF removed the construction debris which was landfilled in the southern portion of the site to facilitate subsurface sampling at this area. The landfill contents were sifted as they were excavated. The only containers identified were several empty drums labeled as containing concrete curing compound. All excavated material, the majority of which was concrete rubble, was removed and taken to a permitted solid waste construction landfill. The site currently consists of a grassy swale.

The objectives of the RI at PSC LF-25 were to define the boundaries of any former landfills and to characterize their content. During the OU-1 investigations, geophysical and soil gas surveys were conducted to define landfill boundaries and to select locations for test pits. Fifteen test pits were also excavated and sampled. Five soil borings were advanced and sampled to further define the extent of constituents detected in the test pit samples and for risk assessment purposes. Additional sampling was also conducted at this site during the ecological risk assessment field sampling program.

COCs and EPCs identified for soil at PSC LF-25 are summarized in Tables 3-28 and 3-29. The sample locations where COCs were detected are shown on Figure 3-15. There were no monitoring wells installed at PSC LF-25, therefore, there are no COCs for future groundwater exposure at this site. The following bullets summarize the OU-1 RI investigation at PSC LF-25.

- The geophysical data indicated that nearly the entire site is free of anomalies that would suggest the presence of landfilling or past disposal activities. The largest anomalies at the site were associated with stockpiled construction debris and rubble which were removed by the Base just prior to the OU-1 RI.

- TRPH concentrations were detected in 14 of 32 test pit samples and three of ten soil boring samples. The highest detected concentration of TRPH was only 290 mg/kg in the surficial sample collected from Soil Boring SB-1. The sample collected from Test Pit TP-15 at 7 feet bgs showed the deepest detection of TRPH (250 mg/kg).

- The only VOC compound detected was xylenes. A concentration of 0.14 mg/kg of xylenes was detected in the sample collected from Soil Boring SB-4 at a depth of 8 to 10 feet bgs.

- BNA compounds were detected at low concentrations in samples collected from Test Pits TP-10, TP-14, and TP-15 and Soil Boring SB-5. The highest detected concentration was for benzo(b)fluoranthene, which was detected at a concentration of 2.3 mg/kg. Detected BNA concentrations did not exceed a depth of 10 feet bgs.

- The highest detected concentrations of antimony (368 mg/kg), beryllium (7.6 mg/kg), and lead (10,100 mg/kg) do exceed their respective background UTLs and the range of concentrations included in the background data set. The surficial sample collected from Test Pit TP-9 contained the highest concentration of beryllium and elevated concentrations of lead (66 mg/kg). Similarly, the surficial sample collected from Test Pit TP-11 contained the only detection of antimony, slightly elevated concentrations of beryllium, and the highest detected concentration of lead.

- The highest detections of beryllium (7.6 mg/kg), lead (10,100 mg/kg), and antimony (368 mg/kg) appear to be related to the presence of shot associated with the nearby skeet range (PSC OT-41). With only one exception, soil samples containing these metals at concentrations above the background UTLs were collected from Test Pits TP-9, TP-11, and TP-12 which are located directly downrange of the skeet range.

- The OU-1 vadose zone transport model indicates the highest concentration of modeled constituents that can be expected at the bottom of the vadose zone is TRPH at 6.61×10^{-214} mg/L. This concentration is well below laboratory detection limits. Modeling results demonstrate it is highly unlikely that there will be groundwater impacts as a result of existing conditions at PSC LF-25.

- All data of known quality were compared to the USEPA PRGs to establish COCs for the site. As described in Section 3.4, certain site characterization data produced by the ATI Phoenix laboratory were not used in the COC evaluation because they did not meet stringent data quality standards.

- As shown on Table 3-28, COCs for surficial soils at PSC LF-25 are TRPH, antimony, arsenic, beryllium, and lead. EPCs for average exposure to surficial soils are: TRPH at 71 mg/kg, antimony at 24 mg/kg, arsenic at 3.5 mg/kg, beryllium at 1.4 mg/kg, and lead at 610 mg/kg. EPCs for RME exposure to surficial soils are: TRPH at 110 mg/kg, antimony at 61 mg/kg, arsenic at 4.9 mg/kg, beryllium at 2.3 mg/kg, and lead at 1,600 mg/kg.

- As shown on Table 3-29, COCs for combined surface and subsurface soils are TRPH, benzo(a)pyrene, antimony, arsenic, beryllium, and lead. EPCs for average exposure to combined surface and subsurface soils are: TRPH at 43 mg/kg, benzo(a)pyrcne at 0.10 mg/kg, antimony at 12 mg/kg, arsenic at 3.0 mg/kg, beryllium at 1.1 mg/kg, and lead at 290 mg/kg. EPCs for RME exposure to combined surface and subsurface soils are: TRPH at 64 mg/kg, benzo(a)pyrene at 0.10 mg/kg, antimony at 29 mg/kg, arsenic at 3.6 mg/kg, beryllium at 1.5 mg/kg, and lead at 770 mg/kg.

- As shown on Table 344, the COCs for current groundwater exposure (production well samples) are bromoform, bromodichloromethane, chloroform, dibromochloromethane, arsenic and fluoride. EPC concentrations for current average exposure to groundwater are: bromoform, at 0.0021 mg/L; bromodichloromethane at 0.00054 mg/L; chloroform at 0.00030 mg/L; dibromochloromethane at 0.0013 mg/L, arsenic at 0.0094 mg/L; and fluoride at 1.4 mg/L. EPC concentrations for current RME exposure to groundwater are: bromoform, at 0.0033 mg/L; bromodichloromethane at 0.00081 mg/L; chloroform at 0.00038 mg/L; dibromochloromethane at 0.0021 mg/L, arsenic at 0.0 12 mg/L; and fluoride at 2.2 mg/L. There are no COCs for future groundwater exposure because there are no monitoring wells at the site.

Results of the Base-wide Risk Assessment (see Section 3.6) indicate that concentrations of lead and antimony in the surficial soils at PSC LF-25 could potentially cause adverse health effects if prolonged exposure, such as excavation work, were to occur. Only one area of the site, adjacent to the skeet range, contained lead and antimony at elevated concentrations.

Metal shot, containing lead and antimony, still routinely fall on the site because the adjacent Base Skeet Shooting Range is still active. Treatability studies conducted as part of the OU-1 FS (Geraghty & Miller, 1998d) have shown that if the shot is physically removed from the soil, residual lead and antimony concentrations would not present health concerns. Regardless of the source of the lead and antimony contaminants, remedial alternatives were developed for soils at PSC LF-25 in the OU-1 FS as a protective measure.

3.5.20 PSC SD- 26 Hush House Canal

PSC SD-26 consists of a surface drainage canal located southeast of the Hush Houses (Figure 3-3). This canal merges with the Oil/Water Separator canal (PSC SD-20) at a location southwest of the Base Ammunition Storage Area. The combined flows discharge to an area of subsidence fissures. From the mid 1960s until 1993, the oil/water separators attached to the Hush Houses discharged directly into PSC SD-26. The oil/water separators were connected to the Base's WWTP in 1993 and no longer discharge to the canal.

Drainage from the runway and taxiway to the west, and most of the facilities for the 944th Tactical Air Group are also channeled into the Hush House canal. This site was not included in any IRP documents or reports. No previous environmental investigation or sampling was performed at this site prior to the OU-1 RI.

OU-1 Phase I and Phase II activities consisted of collecting sediment samples from 24 locations and drilling 10 soil borings. In August of 1996, three additional soil borings were drilled and sampled to collect supplemental VOC and BNA data for risk assessment purposes. Additional surface sediment samples were also collected in anticipation of a request from the Agency for Toxic Substances and Disease Registry (ATSDR) for data to prepare a health risk assessment.

COCs and EPCs identified for soil at PSC SD-26 are summarized in Tables 3-30 and 3-31. The sample locations where COCs were detected are shown on Figure 3-16. There were no monitoring wells installed at PSC SD-26, therefore, there are no COCs for future groundwater exposure at this site. The following bullets summarize the OU-1 RI investigation at PSC SD-26.

- TRPH concentrations were detected in 21 of the soil boring samples and in 19 of the sediment samples. TRPH concentrations ranged up to 19,000 mg/kg in the surficial sample collected from Soil Boring SB-4. The highest concentrations were detected in soil samples collected near the center of the northern segment of the canal. The deepest occurrence of TRPH was at 38 feet bgs.

- VOCs were detected in two of the 45 soil boring samples, while none of the 49 sediment samples contained VOCs. VOCs were only detected in samples collected from Soil Boring SB-4. The highest detected concentrations were toluene at 3 mg/kg, xylenes at 18 mg/kg, and ethylbenzene at 4 mg/kg. All reported in the surficial sample. The vertical extent of VOCs was limited to 8 feet bgs in Soil Boring SB-4.

- BNAs were detected in ten of the soil boring samples and in two of the sediment samples. BNA compounds were generally associated with TRPH, and were detected in only one sample collected below a depth of 8 feet bgs. This only deep detection was BEP at a depth of 150 feet bgs. BEP is a commonly introduced in the sample at the laboratory.

- The highest detected concentrations of cadmium (4.3 mg/kg) and zinc (199 mg/kg) do exceed statistically derived background UTLs and the range of concentrations included in the background data set. Only three samples contained concentrations of zinc above the background UTL. The distribution and magnitude of these detections are scattered at various depths and locations across the site and do not clearly indicate “hot spots” indicative of past operational practices.

- The OU- 1 vadose zone model indicates the highest concentration of modeled constituents that can be expected at the bottom of the vadose zone is xylenes at 2.93 x 10^{-24} mg/L. This concentration is well below laboratory detection limits. Modeling results demonstrate it is highly unlikely that there will be groundwater impacts as a result of existing conditions at PSC SD-26.

- All data of known quality were compared to the USEPA PRGs to establish COCs for the site. As described in Section 3.4, certain site characterization data produced by the ATI Phoenix laboratory were not used in the COC evaluation because they did not meet stringent data quality standards.

- As shown on Table 3-30, COCs for surficial soils at PSC SD-26 are TRPH, benzo(a)pyrene, arsenic, and beryllium. EPCs for average exposure to surface soils are: TRPH at 460 mg/kg, benzo(a)pyrene at 0.087 mg/kg, arsenic at 4.1 mg/kg, and beryllium at 0.34 mg/kg. EPCs for RME exposure to surface soils are TRPH at 1,100 mg/kg, benzo(a)pyrene at 0.088 mg/kg, arsenic at 4.9 mg/kg and beryllium at 0.38 mg/kg.

- As shown on Table 3-31, COCs for combined surface and subsurface soils are also TRPH, benzo(a)pyrene, arsenic, and beryllium. EPCs for average exposure to combined surface and subsurface soils arc: TRPH at 370 mg/kg, benzo(a)pyrene at 0.087 mg/kg, arsenic at 4.5 mg/kg, and beryllium at 0.30 mg/kg. EPCs for RME exposure to combined surface and subsurface soils are TRPH at 870 mg/kg, benzo(a)pyrene at 0.089 mg/kg, arsenic at 5.3 mglkg and beryllium at 0.34 mg/kg.

- As shown on Table 3-44, the COCs for current groundwater exposure (production well samples) are bromoform, bromodichloromethane, chloroform, dibromochloromethane, arsenic and fluoride. EPC concentrations for current average exposure to groundwater are: bromoform, at 0.0021 mg/L; bromodichloromethane at 0.00054 mg/L; chloroform at 0.00030 mg/L; dibromochloromethane at 0.0013 mg/L, arsenic at 0.0094 mg/L; and fluoride at 1.4 mg/L. EPC concentrations for current RME exposure to groundwater are: bromofonn, at 0.0033 mg/L; bromodichloromethane at 0.00081 mg/L; chloroform at 0.00038 mg/L; dibromochloromethane at 0.0021 mg/L, arsenic at 0.012 mg/L; and fluoride at 2.2 mg/L. There are no COCs for future groundwater exposure because there are no monitoring wells at the site.

Based on the results of the Base-wide Risk Assessment (see Section 3.6), COCs identified at PSC SD-26 were not present at concentrations high enough to cause adverse health effects under current land use scenarios (military/industrial) or even in the unlikely event the site is converted to residential usage in the future. Likewise, results of the vadose zone transport model (see Section 3.6.1.4) show that COCs detected in the soil will not migrate to the underlying groundwater resources. As a result, there was no need to evaluate remedial alternatives for PSC SD-26 in the OU-1 FS.

3.5.21 PSC LF-37 Northeast Landfill

PSC LF-37 is located in the northeast corner of the Base and occupies approximately 11.9 acres (Figure 3-3). The site is currently unpaved except for the perimeter road. The Base canal and a railroad spur are located adjacent to the north side of the site. This site was not investigated in any IRP documents or reports. No previous environmental investigations were performed at this site prior to the OU-1 RI. During the OU- 1 Phase I investigations, a geophysical survey was conducted to determine the extent of the landfill. Phase II activities consisted a soil gas survey and excavating six test pits. In August 1996, one additional soil boring was advanced to collect additional VOC and BNA data for risk assessment purposes.

COCs and EPCs identified for soil at PSC LF-37 are summarized in Tables 3-32 and 3-33. The sample locations where COCs were detected are shown on Figure 3-17. There were no monitoring wells installed at PSC LF-37, therefore, there are no COCs for future groundwater exposure at this site. The following bullets summarize the OU-1 RI investigation at PSC LF-37.

- Numerous geophysical anomalies occur across most of PSC LF-37. Most of these anomalies are interpreted to be associated with buried objects that may be associated with past landfilling or disposal activities.

- TRPHs were detected in three of the 13 test pit samples, ranging in concentrations from 15 to 540 mg/kg. The highest TRPH concentration (540 mg/kg) was detected in a surficial sample collected at Test Pit TP-3. Detected TRPH concentrations were limited to 10 feet bgs.

- VOCs and cyanide were not detected in any of the samples collected at the site.

- BNA compounds were detected in three samples, the surficial sample from Test Pit TP-3, and the surficial and subsurface samples from Soil Boring SB-1. The highest detected BNA compound, 1.2 mg/kg of butylbenzylpthalate, was collected from the surficial sample from Test Pit TP-3.

- The only sample with metals concentrations in excess of the background ranges was collected from Test Pit TP-4 at a depth of 3-7 feet bgs. The highest concentrations of barium (334 mg/kg), cadmium (29.5 mg/kg), copper (561 mg/kg), nickel (58.5 mg/kg), lead (597 mg/kg), and zinc (2,270 mg/kg) were detected in this sample. Several metallic waste materials were noted in this test pit at this depth.

- Samples collected form Test Pit TP-4 at PSC LF-37 were sampled for asbestos and found to contain a non-friable form of asbestos-containing material (ACMs). Non-friable asbestos ACMs are generally not considered a health hazard unless they are subjected to abrasive or damaging conditions which might release asbestos fibers to the air.

- The OU-1 vadose zone transport model indicates the highest concentration of modeled constituents that can be expected to leach to the bottom of the vadose zone is buty](benzyl)phthalate at 1.13 x 10^{-111} mg/L. This concentration is well below laboratory detection limits. The modeling results demonstrate that it is highly unlikely that there will be groundwater impacts as a result of existing conditions at PSC LF-37.

- All data of known quality were compared to the USEPA PRGs to establish COCs for the site. As described in Section 3 4, VOC and BNA data produced by the All Phoenix laboratory were not used in the COC evaluation because they did not meet stringent data quality standards.

- As shown on Table 3-32, COCs for surficial soils at PSC LF-37 are TRPH, benzo(a)pyrene, arsenic, and beryllium. EPCs for average exposure to surficial soils are TRPH at 140 mg/kg, benzo(a)pyrene at 0.15 mg/kg, arsenic at 4.3 mg/kg, and beryllium at 0.40 mg/kg. EPCs for RME exposure to surficial soils are TRPH at 450 mg/kg, benzo(a)pyrene at 0.30 mg/kg, arsenic at 8.5 mg/kg, and beryllium at 0.61 mg/kg.

- As shown on Table 3-33, COCs for combined surface and subsurface soils are TRPH, benzo(a)pyrene, arsenic, beryllium, and lead. EPCs for average exposure to combined surface and subsurface soils are TRPH at 52 mg/kg, benzo(a)pyrene at 0.11 mg/kg, arsenic at 5.4 mg/kg, beryllium at 0.51 mg/kg, and lead at 70 mg/kg. EPCs for RME exposure to combined surface and subsurface soils are TRPH at 130 mg/kg, benzo(a)pyrene at 0.15mg/kg, arsenic at 6.9 mg/kg, beryllium at 0.62 mg/kg, and lead at 160 mg/kg.

- As shown on Table 3-44, the COCs for current groundwater exposure (production well samples) are bromoform, bromodichloromethane, chloroform, dibromochloromethane, arsenic and fluoride. EPC concentrations for current average exposure to groundwater are: bromoform, at 0.0021 mg/L; bromodichloromethane at 0.00054 mg/L; chloroform at 0.00030 mg/L; dibromochloromethane at 0.00 13 mg/L, arsenic at 0.0094 mg/L; and fluoride at 1.4 mg/L. EPC concentrations for current RME exposure to groundwater are: bromoform, at 0.0033 mg/L; bromodichloromethane at 0.00081 mg/L, chloroform at 0.00038 mg/L; dibromochloromethane at 0.0021 mg/L, arsenic at 0.0 12 mg/L; and fluoride at 2.2 mg/L. There are no COCs for future groundwater exposure because there are no monitoring wells at the site.

Based on the results ofthe Base-wide Risk Assessment (see Section 3.6), COCs identified at PSC LF-37 were not present at concentrations high enough to cause adverse health effects under current land use scenarios (military/industrial) or even in the unlikely event the site is converted to residential usage in the future, Likewise, results of the vadose zone transport model (see Section 3.6.1.4) show that COCs detected in the soil will not migrate to the underlying groundwater resources. As a result, there was no need to evaluate remedial alternatives for PSC LF-37 in the OU-1 FS.

3.5.22 PSC SD-38 Oil/Water Separator at the Auto Hobby Shop

PSC SD-38 is located near the middle of the Base at the northwest corner of "D" Street and 3rd Street (Figure 3-3). The site consists of the former oil/water separator serving Building 248, the old Base Auto Hobby Shop. In March 1991, the SD-38 oil/watcr separator was inspected as part of the RCRA Facilities, Assessment (RFA). It was discovered that this oil/water separator did not have a concrete bottom. This separator has since been removed. Samples of the sludge from the bottom of the oil/water separator were submitted for laboratory analysis by the Base. Other than the sludge sampling, no previous investigations or environmental sampling was performed at this site prior to the OU-1 RI.

PSC SD-38 was originally assigned to the OU-2 investigation. In May of 1992 during the OU-2 investigation, three soil borings were advanced and sampled to assess the nature and extent of the impact at the site. Because OU-2 data indicated a deep soil impact and thus a potential threat to groundwater, the site was reclassified as an OU-1 PSC. During the OU-1 investigation, three soil borings were advanced and sampled to further evaluate the vertical and horizontal extent of any impact. A groundwater monitoring well (MW-117) was also installed and sampled it this time to evaluate groundwater quality at the site. In August of 1996, one additional boring was advanced and sampled to collect supplemental VOC and BNA data for use in the risk assessment.

COCs and EPCs identified for soil at PSC SD-38 are summarized in Tables 3-34 and 3-35. COCs and EPCs identified for groundwater monitoring well samples collected at PSC SD-38 are surnmarized on Table 3-36. The sample locations where COCs were detected are shown on Figure 3-18. The following bullets summarize the OU-1 RI investigation at PSC SD-38.

- TRPH was detected in 12 of the 51 soil samples. The highest detected concentration was 58,000 mg/kg in the sample collected directly below the former separator at a depth of 8 feet bgs. The deepest detection of TRPH (90 mg/kg) was at a depth of 256 feet bgs in Soil Boring SB-5 which was also drilled through the center of the former separator.

- VOCs detected in the soil beneath the separator included BTEX TCE, PCE, dichloroethene (DCE), and acetone. The maximum depth at which VOCs were detected was 200 feet bgs. However, all the data with VOC detections did not satisfy data validation requirements for use in the risk assessment. As per USEPA guidance, this data is not presented on the occurrence tables and was not used to determine COCs or EPCs.

- BNA compounds were detected to a maximum depth of 100 feet bgs. The BNA compound detected in the highest concentration was 2-methyl naphthalene at 25 mg/kg. However, all the data with BNA detections did not satisfy validation requirements for use in the risk assessment. As per USEPA guidance, this data is not presented on the occurrence tables and was not used to determine COCs or EPCs.

- In response to concerns of the quality of the VOC and BNA data produced by the ATI Phoenix laboratory, the FFA parties determined that one additional soil boring was to be advanced in August 1996. A total of two additional samples (2 subsurface) were collected. This sampling occurred after the oil/water separator was excavated and removed. VOCs and BNAs were not detected in this boring. The depth of the excavation is not known, however, it is assumed that the impacted soils beneath the separator were removed.

- Lead and antimony were the only two metals detected at concentrations above background ranges. The only samples with elevated metals concentrations were the 6 to 8 feet bgs and 8 to 10 feet bgs samples collected from directly below the separator in Soil Boring SB-3. These samples also contained the highest detected concentrations of organic chemicals.

- The OU-1 vadose zone transport model indicates the highest concentration of modeled constituents that can be expected at the bottom of the vadose zone is 1,2 Dichloroethene at 2.61 x 10^{-5} mg/L. This concentration is well below laboratory detection limits. Modeling results demonstrate it is highly unlikely there will be groundwater impacts as a result of leaching of existing contaminants at PSC SD-38. It should be noted that although the ATI Phoenix laboratory data was not used in the risk assessment, it was used in the vadose zone transport model.

- The estimated depth to groundwater at the time of installation of the oil/water separator in the late 1950s was approximately 230 feet bgs. Currently, groundwater occurs below the site at approximately 315 feet bgs. The apparent gradient and direction of groundwater flow is 0.002 foot per feet to the southwest.

- None of the seven groundwater samples collected at the site during quarterly sampling contained detectable concentrations of VOCs or BNA compounds or metals concentrations above their respective background ranges.

- All data of known quality were compared to the USEPA PRGs to establish COCs for the site. As described in Section 3.4, VOC and BNA data produced by the ATI Phoenix laboratory were not used in the COC evaluation because they did not meet stringent data quality standards.

- As shown on Table 3-34, COCs for surficial soils at PSC SD-38 are arsenic and beryllium. EPCs for average exposure to surficial soils are arsenic at 7.8 mg/kg and beryllium at 0.47 mg/kg. EPCs for RME exposure to surficial soils are arsenic at 16 mg/kg and beryllium at 1.2 mg/kg.

- As shown on Table 3-35, COCs for combined surface and subsurface soils are TRPH, arsenic, beryllium, and lead. EPCs for average exposure to combined surface and subsurface soils are TRPH at 7,700 mg/kg, arsenic at 5.8 mg/kg, beryllium at 0.26 mg/kg, and lead at 54 mg/kg. EPCs for RME exposure to combined surface and subsurface soils are TRPH at 16,000 mg/kg, arsenic at 7.8 mg/kg, beryllium at 0.37 mg/kg, and lead at 120 mg/kg.

- As shown on Table 3-44, the COCs for current groundwater exposure (production well samples) are bromoform, bromodichloromethane, chloroform, dibromochloromethane, arsenic and fluoride. EPC concentrations for current average exposure to groundwater are: bromoform, at 0.0021 mg/L; bromodichloromethane at 0.00054 mg/L; chloroform at 0.00030 mg/L; dibromochloromethane at 0.0013 mg/L, arsenic at 0.0094 mg/L; and fluoride at 1.4 mg/L. EPC concentrations for current RME exposure to groundwater are: bromoform, at 0.0033 mg/L; bromodichloromethane at 0.00081 mg/L; chloroform at 0.00038 mg/L; dibromochloromethane at 0.0021 mg/L, arsenic at 0.0 12 mg/L; and fluoride at 2.2 mg/L.

- As shown on Table 3-36, there are no COCs for future groundwater exposure. Even though monitoring well samples were collected from the site, none ofthe samples contained constituents above the USEPA PRGs, therefore, there were not COCS identified.

Based on the results ofthe Base-wide Risk Assessment (see Section 3.6), COCs identified at PSC SD-38 were not present at areas of potential exposure at concentrations high enough to cause adverse health effects under current land use scenarios. Results of the vadose zone transport model (see Section 3.6.1.4) show that COCs detected in the soil will not migrate to the underlying groundwater resources. However, the concentration of TRPH detected below the former oil/water separator could theoretically cause adverse health affects in unlikely event that PSC SD-38 were developed for residential purposes in the future.

Soil samples collected directly beneath the former oil/water separator at a depth of 8 feet bgs contained TRPH at a concentration of 58,0000 mg/kg. Because the soils containing elevated concentrations of TRPH are located at depth, direct exposure is not likely under current land use scenarios. Prolonged exposure to the TRPH in the subsurface soils could result if the site were developed for residential purposes in the future. As a protective measure, remedial alternatives were developed for PSC SD-38 in the OU-1 FS.

3.5.23 PSC SD-39 Waste Discharge at Old Lockheed Site

PSC SD-39 consists oftwo separate areas located near the northern end ofthe inboard runway (Figure 3-3). According to information obtained during the RFA conducted in March 1991 (Geraghty & Miller, 1993d; AR# 125), the facilities in the area were used by the Base for aircraft ground equipment (AGE) maintenance prior to 1964. Lockheed Aircraft company occupied the facilities in the area from 1964 to 1982. Presently, the facilities are occupied by the 405th TPW Maintenance Shop. This site was identified as a PSC because of the lack of information on the composition and quantity of wastes released. No previous environmental investigation or sampling was performed at this site prior to the OU-1 RI.

During the OU-1 investigation, seven soil boring were advanced and 37 samples were collected to determine the dimensions of any impacted areas. In August of 1996, three additional soil borings were drilled and seven additional samples were collected to supplement the VOC and BNA data for risk assessment purposes. The sample locations where COCs were detected are shown on Figure 3-19. Cocs and EPCs identified for soil at PSC SD-39 are summarized in Tables 3-37 and 3-38. There were no monitoring wells installed at PSC SD-39, therefore, there are no COCs for future groundwater exposure at this site. The following bullets summarize the OU-1 RI investigation at PSC SD-39.

- TRPH was detected in nine of 37 samples that were analyzed for TRPH. TRPH detections were generally limited to surficial soils with the exception of Soil Boring SB-3. The maximum depth at which TRPH was detected was 40 feet bgs in Soil Boring SB-3. The highest detected TRPH concentrations was 2,000 mg/kg in the surficial sample collected from Soil Boring SB-2.

- VOCs were identified in two of 44 samples that were analyzed for VOC compounds. Both samples contained 0.9 mg/kg of PCE. This was the only VOC compound that was detected. VOC compounds were not detected below the depth of 2 feet bgs.

- BNAs were reported in four of the 37 samples that were analyzed for BNA compounds. In general, BNA compounds were only detected in the surficial samples. The surficial sample collected from Soil Boring SB-1 contained the highest detected concentrations and most detected BNA compounds.

- Lead was detected in four surficial samples at concentrations in excess of the background UTL. The highest detected concentration of lead was 125 mg/kg in the duplicate surficial sample collected from Soil Boring SB-1. The surficial samples collected from Soil Boring SB-1 also contained cadmium at concentrations slightly greater than its background UTL. The surficial samples collected from Soil Borings SB-3 and SB-5 contained lead at 36 mg/kg and 25 mg/kg respectively.

- The OU-1 vadose zone transport model indicates the highest concentration of modeled constituents that can be expected at the bottom of the vadose zone is tetrachloroethene (PCE) at 2.68×10^{-8} mg/L. This concentration is well below laboratory detection limits. The modeling results demonstrate that it is highly unlikely that there will be groundwater impacts as a result of existing conditions at PSC SD-39.

- All data of known quality were compared to the USEPA PRGs to establish COCs for the site. As described in Section 3.4, VOC and BNA data produced by the ATI Phoenix laboratory were not used in the COC evaluation because they did not meet stringent data quality standards.

- As shown on Table 3-37, COCs for surficial soils at PSC SD-39 are TRPH and arsenic. EPCs for average exposure to surficial soils are TRPH at 420 mg/kg and arsenic at 7.4 mg/kg. EPCs for RME exposure to surficial soils are TRPH at 950 mg/kg and arsenic at 9.2 mg/kg.

- As shown on Table 3-38, COCs for combined surface and subsurface soils are also TRPH and arsenic. EPCs for average exposure to combined surface and subsurface soils are TRPH at 150 mg/kg and arsenic at 8.0 mg/kg. EPCs for RME exposure to combined surface and subsurface soils are TRPH at 310 mg/kg and arsenic at 9.3 mg/kg.

- As shown on Table 3-44, the COCs for current groundwater exposure (production well samples) are bromoform, bromodichloromethane, chloroform, dibromochloromethane, arsenic and fluoride. EPC concentrations for current average exposure to groundwater are: bromoform, at 0.0021 mg/L; bromodichloromethane at 0.00054 mg/L; chloroform at 0.00030 mg/L; dibromochloromethane at 0.00 13 mg/L, arsenic at 0.0094 mg/L; and fluoride at 1.4 mg/L. EPC concentrations for current RME exposure to groundwater are: bromoform, at 0.0033 mg/L; bromodichloromethane at 0.00081 mg/L; chloroform at 0.00038 mg/L; dibromocbloromethane at 0.0021 mg/L, arsenic at 0.012 mg/L; and fluoride at 2.2 mg/L. There are no COCs for future groundwater exposure because there are no monitoring wells at the site.

Based on the results ofthe Base-wide Risk Assessment (see Section 3.6), COCs identified at PSC SD-39 were not present at concentrations high enough to cause adverse health effects under current land use scenarios (military/industrial) or even in the unlikely event the site is converted to residential usage in the future. Likewise, results of the vadose zone transport model (see Section 3.6.1.4) show that COCs detected in the soil will not migrate to the underlying groundwater resources. As a result, there was no need to evaluate remedial alternatives for PSC SD-39 in the OU-1 FS.

3.5.24 PSC OT-41 Skeet Range

PSC OT-41 consists of the Base Skeet Range. The site occupies approximately 3.27 acres located along the western side of the Base near the southern end of the outboard runway in a triangular extension of the western boundary ofthe Base (Figure 3-3). The paved west perimeter road comprises 5 percent of the site. The remainder of the site is desert soil and grass, except for an unlined irrigation canal which passes through the site. The irrigation canal originates off Base and flows south along the west boundary and exits the Base to the south. The site was identified as a PSC during the RFA because lead shot from skeet shooting could potentially enter the canal and could be transported off Base property.

The area where lead shot and broken clay pigeons primarily fall is not within the boundary of PSC OT-41. Rather, the impact areas for the skeet range is further to the east of the irrigation canal within the boundaries of PSC LF-25. The boundary of PSC OT-41 was established as such because the irrigation canal was the point of interest for the investigation, not the impact area.

During the OU-1 investigation, soil boring samples, sediment samples, and surface water samples were collected to assess risk, to determine the presence of potential constituents of concern, and to evaluate the dimensions of any negatively impacted areas. Special focus was placed on assessing whether or not COCs were migrating off of Base property via the irrigation canal that runs through the site.

Constituents detected in surface soil and sediment are summarized in Tables 3-39 and 3-40, respectively. The sampling locations where COCs were detected are shown on Figure 3-20. The following summarizes the OU-1 RI investigation at OT-41.

- Samples collected from three sediment borings contained concentrations of lead slightly in excess of the background ranges. Both sediment samples collected at SD-2 and SD-4 and the surficial sample collected from SD-5 contained concentrations of lead in excess of the background UTL of 22 mg/kg. The surficial sediment sample collected at SD-5 contained the highest concentration of lead (33 mg/kg). This sample was collected just downstream of the shooting area. However, sediment samples collected further downstream (SD-6) did not contain elevated concentrations of lead. Based on these analytical results, it does not appear that lead is being transported off-site by the irrigation canal which passes through the site.

- Lead was not detected in any of the surface water samples.

- Based on screening against the USEPA Region IX Residential PRGs, there are no COCs for sediments, surface soils, or combined surface and subsurface soils at PSC OT-41. Detected lead concentrations were all below the USEPA Region IX residential PRGs which is 400 mg/kg.

- As shown on Table 3-44, the COCs for current groundwater exposure (production well samples) are bromoform, bromodichloromethane, chloroform, dibromochloromethane, arsenic and fluoride. EPC concentrations for current average exposure to groundwater are: bromoform., at 0.0021 rng/L; bromodichloromethane at 0.00054 mg/L; chloroform at 0.00030 mg/L; dibromochloromethane at 0.0013 mg/L, arsenic at 0.0094 mg/L; and fluoride at 1.4 mg/L. EPC concentrations for current RME exposure to groundwater are: bromoform, at 0.0033 mg/L; bromodichloromethane at 0.00081 mg/L; chloroform at 0.00038 mg/L; dibromochloromethane at 0.0021 mg/L, arsenic at 0.012 mg/L; and fluoride at 2.2 mg/L. There are no COCs for future groundwater exposure because there are no monitoring wells at the site.

Because there are no COCs, there is no risk associated with exposure to the site. As a result, there was no need to evaluate remedial alternatives for PSC OT-41 in the OU- I FS.

3.5.25 PSC SS-42 Bulk Fuels Storage Area

PSC SS-42 consists of a former leaking UST site located within the eastern portion of the bulk fuels storage area of Luke AFB (Figure 3-3). The leaking UST was part of an oil/water separator system that received condensate from the two large aboveground fuel tanks, designated as Tanks #351 and #356.

In March 1993, the leak detection system for the oil/water separator UST sounded, indicating a release had occurred. According to Base personnel, unusually heavy rains caused the soil around the UST to settle. The settling apparently caused the fill line to dislodge from the tank. In response, the oil/water separator and fiberglass UST were removed from service and excavated. In September 1993, a new oil/water separator with an aboveground storage tank was installed approximately 150 feet to the southwest of the original oil/water separator system location.

Environmental investigations in response to the release from the oil/water separator UST began in March 1993. Environmental Engineering Consultants, Inc. (EEC) conducted the initial investigations. From March through July 1993, EEC advanced seven soil borings (UST-1 through UST-7) adjacent to the oil/water separator and leaking UST. The results of the EEC investigation were documented in a report entitled *Report on Subsurface Soil Investigation, Luke Air Force Base, Building 351* (EEC, 1993). Several of the borings; advanced to define the horizontal extent of the impact contained detections of TRPH and benzene, toluene, ethylbenzene, and total xylenes in samples collected at depths between 70 feet and 160 feet bgs. Because of these unexpected detections, the horizontal extent of the impact was not defined by the seven borings advanced by EEC.

After review of the EEC data, the FFA parties added this site as a PSC in the CERCLA investigation. Because of the depth of the impact and magnitude of the release, the FFA parties agreed that additional investigations were warranted because of the potential for groundwater impact. Base-wide groundwater quality is one of the primary elements of the OU-1 RI; therefore, PSC SS-42 was assigned to OU-1 in August 1993.

The objectives of the RI at PSC SS-42 were to define the horizontal extent of the impact detected at the former oil/water separator UST, identify other potential sources of contamination at the site, and to assess the groundwater quality. Initial activities included conducting a geophysical survey to identify underground lines and utilities. A soil-gas scan was also conducted to assess the integrity of the underground distribution system and identify other potential sources of contamination. Sixteen soil borings were advanced and sampled to determine the horizontal and vertical extent of the impacts identified at the site. Four groundwater monitoring wells (MW-119 through MW-121, and MW-125) were also installed and sampled to evaluate the groundwater quality.

Following completion of the OU-1 Phase II investigation, a bioventing treatability study was conducted at the site to determine the effectiveness of bioventing as a remedial alternative. The interim results of the bioventing treatability study are provided in *Bioventing Treatability Field Study Soil Permeability and In-Situ Respiration Test Results, Analysis andRecommendations, PSC SS-42, Luke A ir Force Base, Arizona* (Geraghty & Miller, Inc., 1996c; AR# 178). Initialresults of the study indicated that bioremediation rates were slow, but the soil was permeable enough to effectively implement a SVE test.

In August 1996, the Base initiated a SVE removal action at PSC SS-42. A highly modified internal combustion engine (ICE) is being used to draw contaminated vapors from the ground. This SVE treatability study testing is currently ongoing, and the results are discussed in Section 2.5.1.6 of the OU-1 FS report.

COCs and EPCs identified for soil at PSC SS-42 are summarized in Tables 3-41 and 3-42. COCs and EPCs identified for groundwater monitoring well samples collected at PSC SS-42 are summarized on Table 3-43. The sample locations where COCs were detected are shown on Figure 3-21. Ile following bullets summarize the OU-1 RI investigation at PSC SS-42.

- The soil gas scan at PSC SS-42 included collecting soil gas samples at100 locations, 72 shallow and 28 deep points. Samples were collected and analyzed for total volatile petroleum hydrocarbons TVPH) and VOCs. Three areas showed the highest concentrations of VOCs and TVPH: 1) in the vicinity of the former oil/water separator and UST system, 2) the valves and piping located south of Tank #356, and 3) at the northern end of the abandoned hydrant system located along the eastern side of the site.

- The highest concentrations of organic constituents were detected in soil samples collected at the former UST location in Soil Boring SB-2. The highest concentration of Total Petroleum Hydrocarbons (TPH) by EPA Method 8015 was 33,900 mg/kg at a depth of 70 feet bgs. BTEX compounds were also detected at their highest concentrations at this depth. The deepest sample with detectable TPH was collected at 300 feet bgs in Soil Boring SB-2. The deepest soil sample with detectable BTEX compounds was collected at a depth of 160 feet bgs.

- The impact at the valve cluster for Tank #356 was defined with Soil Boring SB-4. The highest detected TPH concentration was 9,000 mg/kg in the surficial sample. The detected TPH concentrations decreased with increasing depth, and TPH was not detected below the depth of 30 feet. BTEX was only detected in samples collected above 20 feet bgs at this area.

- The third area with hydrocarbon impacts were at the northern end of the abandoned hydrant system. Soil Boring SB-13 was used to define this area. The highest detected concentration of TPH was 8,800 mg/kg. TPH was detected to depths of 70 feet bgs in this area. BTEX compounds were only detected in the sample collected at a depth of 8 feet bgs.

- Based on current water level measurements, the direction of groundwater flow beneath the site is to the southwest. The approximate depth to groundwater is currently 310 feet bgs,

- The OU-1 vadose zone transport model indicates the conditions required to achieve current concentrations are recharge rates of 10 inches per year or greater, and a half-life of 7 or more years. This is based on sensitivity analyses that indicate that, given the appropriate conditions, free product introduced into the system in the early 1950s could be the source of constituents observed in the vadose zone in the vicinity of the oil/water separator. Given these conditions and the fact that constituents are currently found at 300 feet bgs, it is very likely that contamination within the vadose zone will reach groundwater if left untreated.

- Groundwater quality at PSC SS-42 was assessed by sampling Monitoring Wells MW-119, MW-120, MW-121, and MW-125 during quarterly Base-Wide groundwater sampling.

- TPH was detected in three monitoring wells at the site (MW-119, MW-121, and MW-125). TPH was detected in MW-119 in February 1996 and again in May 1996. In July of 1997, TPH was detected in monitoring wells MW-121 and MW-125. The highest detected concentration of TPH was 970 mg/L in the sample collected at MW-121 in July of 1997. Monitoring well MW-121 is located at the point of the release.

- Prior to July of 1997, the only VOC compound detected in groundwater samples was dichloropropane (DCP) at a maximum concentration of 2 µg/L. DCP is a common component of insecticides typically used for agricultural purposes. DCP has been detected in groundwater samples collected on five different occasions from August 1993 through July 1997. DCP has been detected on at least one occasion in each of the four monitoring wells at the site.

- In July of 1997, BTEX compounds were detected for the first time in monitoring well MW-121. This was the only other detection of VOC compounds other than DCP. Benzene was detected at a concentration of 1.8 µg/L, toluene at 6.3 µg/L, ethylbenzene at 4.4 µg/L, and xylenes; were detected at 12 µg/L. All of these concentrations are below the USEPA PRGs, and therefore, these compounds are not considered COCs.

- The concentration of total chromium in the groundwater samples (primary and duplicate) collected from Monitoring Well MW-119 in the fourth quarter of 1993 did exceed the background range of 0.12 mg/L. The primary sample contained 3.84 mg/L and the duplicate sample contained 1.64 mg/L. The detected concentrations (3.84 mg/L and 1.64 mg/L) were an order of magnitude greater than any ofthe other detected concentrations of total chromium detected during Base-wide groundwater sampling. Notations on sampling logs indicated that these samples were turbid. Both of these samples were qualified as “J/estimated” values.

- All data of known quality were compared to the USEPA PRGs to establish COCs for the site. As described in Section 3.4, certain site characterization data produced by the ATI Phoenix laboratory were not used in the COC evaluation because they did not meet stringent data quality standards.

- As shown on Table 3-41, COCs for surficial soils at PSC SS-42 are TPH and benzo(b)fluoranthene. EPCs for average exposure to surficial soils at PSC SS-42 are TPH at 680 mg/kg and benzo(b)fluoranthene at 1.1 mg/kg. EPCs for RME exposure to surficial soils are TPH at 1,800 mg/kg and benzo(b)fluoranthene at 1.4 mg/kg.

- As shown on Table 3-42, COCs for combined surface and subsurface soils at PSC SS-42 are also TPH and benzo(b)fluoranthene. EPCs for average exposure to combined surface and subsurface soils are TPH at 780 mg/kg and benzo(b)fluoranthene at 1.1 mg/kg. EPCs for RME exposure to combined surface and subsurface soils are TPH at 1,500 mg/kg and benzo(b)fluoranthene at 1.4 mg/kg.

- As shown on Table 3-43, COCs for future groundwater exposure are arsenic and chromium. However, chromium is included as a COC for groundwater because of elevated concentrations of total chromium in samples collected from Monitoring Well MW-119 during one sampling event. These samples (primary and duplicate) were turbid and not representative of naturally occurring concentrations. EPCs for future average exposure to groundwater are arsenic at 0.0031 mg/L and chromium at 0.61 mg/L. EPCs for future RME exposure to groundwater are arsenic at 0.0044 mg/L and chromium at 1.7 mg/L.

- As shown on Table 3-44, the COCs for current groundwater exposure (production well samples) are bromoform, bromodichloromethane, chloroform, dibromochloromcthane, arsenic and fluoride. EPC concentrations for current average exposure to groundwater are: bromoform, at 0.0021 mg/L; bromodichloromethane at 0.00054 mg/L; chloroform at 0.00030 mg/L; dibromochloromethane at 0.0013 mg/l, arsenic at 0.0094 mg/L; and fluoride at 1.4 mg/L. EPC concentrations for current RME exposure to groundwater are: bromoform, at 0.0033 mg/L; bromodichloromethane at 0.00081 mg/L; chloroform at 0.00038 mg/L; dibromochloromethane at 0.0021 mg/L, arsenic at 0.012 mg/L; and fluoride at 2.2 mg/L.

Based on the results of the Base-wide Risk Assessment (see Section 3.6), COCs identified at PSC SS-42 were not present at areas of potential exposure at concentrations high enough to cause adverse health effects under current land use scenarios or even under residential use scenarios, However, results of the vadose zone transport model (see Section 3.6.1.4) show that petroleum related contaminants (TPH and BTEX) detected in the soil at PSC SS-42 could migrate to the underlying groundwater resources. Monitoring well sampling indicates that the groundwater is not currently impacted at levels which would warrant groundwater clean up, However, modeling shows that leaching of TPH and BTEX from the soil to the groundwater could occur. As a protective measure, remedial alternatives were developed for the soils at PSC SS-42 in the OU-1 FS.

3.6 HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

Potential threats to human health and the environment associated with exposure to the detected COCs were evaluated as part of the Base-wide risk assessment. Detailed descriptions of the methodology, findings, and conclusions of the Base-wide Risk Assessment are presented in *Remedial Investigation Report, Appendix A Baseline Base-wide Risk Assessment, Luke Air Force Base, Arizona*, (Geraghty & Miller, Inc., 1997b; ARE#191,192). The following sections can only briefly summarize the methods and results of this evaluation.

3.6.1 <u>Human Health Risk Assessment</u>

The methodology used for the human health portion of the Base-wide risk assessment was developed based on criteria established by the USEPA for conducting risk assessments at Superfund sites (USEPA, 1989b,c,d,e; USEPA, 1991a). The following sections briefly summarize the methodology used in the evaluation of human health risks associated with exposure to the COCs detected at each of the OU-1 PSCs

3.6.1.1 Site Characterization

Historic and current land use information for each PSC was used to assess the fate and transport of the COCs after being released to the environment. Land use information was also used to develop possible exposure scenarios. A discussion of historic and current land use for Luke AFB can be found in Section 3.1 of this document. Historic and current land uses at each of the OU-1 PSCs can be found on a site-by-site basis in Section 3.5.1 through 3.5.25.

3.6.1.2 Occurrence of Constituents

The identification of the occurrence of COCs in soil was based on the analytical results of samples collected from 1991 through 1996 during the OU-1 RI. Other data included in the Base-wide risk assessment were collected in 1989 during pre-remediation soil sampling conducted at PSC FT-07E by EA Engineering and data collected in 1993 from PSC SS-42 by EEC.

Monitoring well data collected by Geraghty & Miller from 1991 through 1996 along with production well data collected by Luke AFB personnel from 1994 through 1996 were used to identify the occurrence of constituents in groundwater. The results of an ambient air monitoring program conducted in 1991, during the OU-1 RI, were used to represent the occurrence of constituents in ambient air.

Only data of known quality were selected for use in the risk assessment. As previously discussed in Section 3.4, VOC and BNA data produced by the ATI Phoenix laboratory were not used in the identification of the occurrence of COCs. All data of known quality were tabulated in occurrence tables which summarize the constituents that were detected, the frequency of detection, range of concentrations, the average concentration, and the 95 percent upper confidence level (UCL).

For purposes of the exposure assessment, soil data were reduced and classified as either surficial (0 to 2 feet bgs), combined surface and subsurface (0 to 16 feet bgs), and deep (16 feet bgs and greater). Occurrence tables for the surface soil, combined surface and subsurface soil, groundwater, and surface water and sediment samples (as applicable) are grouped by PSC and presented as Tables 3-1 through 3-43. The occurrence tables for production well groundwater samples are presented as Table 3-44. Occurrence tables for ambient air are presented as Tables 3-45 and 3-46.

3.6.1.3 Selection of COCs

As described in Section 3.5, COCs were selected by comparing the highest detected concentration of a constituent to the USEPA Region IX PRGs for unrestricted (e.g. residential) land use (USEPA, 1996). Constituents detected in soil or groundwater at maximum concentrations below the respective PRGs were not retained as COCs. This method of determining COCs is both protective and conservative because the sampling locations were biased to areas of suspected contamination.

For each of the sites, soil samples were collected and analyzed to determine COCs in soil. As part of the evaluation process, the soil sampling data were first categorized by depth. Depths ranges consisted of surficial(0 to 2 feet bgs), combined surface and subsurface (0 to 16 feet bgs), and deep (> 16 feet bgs). After sorting the soil data by depth, the data were compared to the USEPA Region IX PRGs for unrestricted land use. Analytes detected at a concentration in excess of the USEPA PRGs were identified as COCs.

Monitoring well sampling results were evaluated to determine COCs for future groundwater exposure. Monitoring well sampling data were first grouped by PSC. The results were then compared to the USEPA PRGs to identify COCs. If during any of the sampling events an analyte was detected at a concentration above the USEPA PRGs in any of the monitoring wells at a PSC, that analyte became a COC for the entire site. Monitoring well sampling data were used in the evaluation of *future* risks and not in the evaluation of current risks because groundwater is not currently being pumped from any of the monitoring wells, and therefore, there is no current exposure to groundwater from the monitoring wells.

Samples of the groundwater pumped from the production wells were collected, analyzed, and compared to the USEPA Region IX PRGs to determine COCs for use in the evaluation of risks associated with *current* groundwater exposure at Luke AFB. Because Base workers, military personnel, and other potential receptors would be exposed to the same groundwater regardless of where on Base they would be working, COCs identified for *current* groundwater exposure are the same for all sites.

Identification of COCs in ambient air involved a two step process. First, ambient air samples were collected at various locations in and near the PSCs. The sources of the constituents detected in the air samples were assumed to be the soil, sediments, and surface waters of the various PSCs. Constituents which were detected in the air samples but were not detected in any of the samples from the other media are unlikely to be related to the PSCs and were not evaluated further. As the second part of the process, constituents which were detected in either the soil, sediment, or surface water samples and also in the air samples were screened against the USEPA Region IX PRGs for Unrestricted Land Use.

In general, COCs evaluated in the human health risk assessment for soils include BNAs, TRPH TPH, PCBs, and metals. COCs in groundwater include VOCs and metals. No COCs were identified in ambient air. A summary of the COCs detected in soil and groundwater at individual PSCs is provided in Sections 3.5.1 through 3.5.25 of this document.

3.6.1.4 Fate and Transport of COCs

The fate and transport of COCs after release into the environment was evaluated for each PSC. Mobility of a constituent is dependant on the physical and chemical properties of the constituent and characteristics of the surrounding environment. The fate and transport of the COCs in soil and groundwater is a key component in the exposure assessment process because it assists in determining how a receptor could potentially come into contact with a COC. In general, the COCs identified in soil are non-soluble which limits their movement in soil and potential for leaching to groundwater.

Vadose zone transport modeling was conducted at each of the PSCs to assess whether the constituents detected in the soils and sediments could eventually leach to the groundwater, and if so, to predict the concentrations ofthe constituents at that point. The computer model MULTIMED was used to simulate solute transport in the vadose zone at Luke AFB. MULTIMED is a publicly available computer code developed for the USEPA to simulate one-dimensional vertical flow and transport of soil water in the unsaturated (vadose) zone. Transport processes simulated by MULTIMED include dispersion, adsorption, and first-order decay. Whenever possible, site specific data were used to determine the hydraulic parameters, and transport parameters. In the absence of site specific data, model parameters were estimated from available literature. A conservative approach was employed to predict defensible maximum constituent concentrations.

With the exception of SS-42, the modeling results demonstrate that it is highly unlikely that there will be future groundwater impact as a result of leaching of the contaminants in the soils and sediments at Luke AFB. The climate, high evaporation rate, the presence of only moderately permeable soils, thickness of the vadose zone (greater than 140 ft to 300 ft), low observed soil concentrations, and relatively short half-lives of the detected COCs all contribute to the low potential for ground-water impacts resulting from soil contamination at Luke AFB. The results of the modeling analysis at PSC SS-42 indicate that it is probable that petroleum related contaminants (TPH and BTEX) within the vadose zone could reach the water table assuming a recharge rate of at least 10 inches per year and a half-life of 7 years or more.

3.6.1.5 Toxicity Assessment

The toxicity assessment identified the primary health effects associated with the COCs and presented the carcinogenic and noncarcinogenic toxicity values used to estimate risk. Cancer slope factors (CSFs) have been developed by USEPA's Carcinogenic Exposure Assessment Group for estimating lifetime cancer risks associated with exposure to potentially carcinogenic chemicals. As discussed below in Section 3.6.1.7, CSFs which are expressed in units of kilogram day per milligram (kg-day/mg), are multiplied by the estimated intake of a potential carcinogen, in milligrams per kilogram day (mg/kg-day) to provide an upper bound estimate of the excess lifetime cancer risk associated with exposure at that intake level. The term "upper bound" reflects the conservative estimate of the risks calculated ftom the CSF. Use of this approach makes under estimation of the actual cancer risk highly unlikely. Cancer slope factors are derived from the results of human epidemiological studies or chronic animal bioassays to which animal-to-human extrapolation and uncertainty factors have been applied.

Reference doses (RfDs) have been developed for the USEPA for indicating the potential adverse health effects from exposure to chemicals exhibiting noncarcinogenic effects. RfDs represent “safe levels” below which there would be no adverse health effects. RfDs, which are expressed in units of mg/kg-day, are estimates of lifetime daily exposure levels for humans, including sensitive individuals. Estimated intakes of chemicals from environmental media (e.g., the amount of chemical ingested from contaminated drinking water) can be compared to the RfD. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans). These uncertainty factors help ensure that the RfDs will not underestimate the potential for adverse noncarcinogenic effects to occur.

3.6.1.5.1 Toxicity Values

In the Base-wide risk assessment, CSFs, cancer classifications, RfDs, and reference concentrations (RfCs) were taken from the USEPA Region IX PRGs (1996). If toxicity values were not available in the Region IX PRG document, the toxicity values were taken from Integrated Risk Information System (IRIS) (1996) or, in the absence of IRIS data, the USEPA Health Effects Assessment Summary Tables (HEAST) (USEPA, 1995a) or other sources. Because toxicity values for dermal exposure are rarely available (appropriate toxicity data are scarce), the oral RfD and CSF are adjusted to an absorbed dose, using the constituent-specific oral absorption efficiency, as recommended by the USEPA (1989b), to derive an adjusted RfD and CSF to assess dermal exposure. Constituent-specific absorption efficiencies (both oral and dermal) for organic COCs are provided in Table 3-47. RfDs for the COCs are presented in Table 3-48. CSFs, cancer type or tumor sites, and carcinogen classifications for the COCs at the site are presented in Table 3-49.

3.6.1.6 Conceptual Site Model

During the final step of the exposure assessment process, conceptual site models were developed for each of the PSCs. The conceptual site model includes identification of contaminant sources and points of release to the environment, exposure pathways, exposure points, and potential receptors. Exposure can only occur when a receptor can directly contact released contaminants or when there is a mechanism for the released contaminants to be transported to a receptor. Without exposure, there is no risk; therefore, the exposure assessment is one of the key elements of a risk assessment. Conceptual site models for soil exposure are shown on Figures 3-20 through 3-36. Conceptual site models for groundwater exposure are shown on Figures 3-36 and 3-37.

3.6.1.6.1 Exposure Pathways and Potential Receptors

Exposure pathways and potential receptors were identified for both soil and groundwater at each OU-1 PSC. Exposure point concentrations (EPCs) were then calculated for use in the evaluation. The USEPA defines the EPC as the concentration of a contaminant occurring at a location of potential contact. EPCs were calculated for groundwater, air, surficial soils (0 to 2 feet bgs), and combined surface and subsurface soils (0 to 16 feet bgs). Potential receptors are not typically exposed to soils below the depth of 16 feet, therefore, deep soils (> 16 feet bgs) data were only used in the vadose zone transport model (see Section 3.6.1.4).

In accordance with USEPA guidance (USEPA, 1989d), both average and reasonable maximum exposure (RME) doses were calculated for the potential receptors for each of the identified exposure pathways. The RME approach is suggested by the USEPA (USEPA, 1989b) to provide a reasonable estimate of the maximum exposure (and therefore risk) that might occur. The RME corresponds to a duration and frequency of exposure greater than is expected to occur on an average basis.

Medium-specific arithmetic average concentrations for each of the COCs were used as the EPC to estimate average exposure conditions. The 95 percent UCLs on the arithmetic average concentrations were used as EPCs to estimate the RME. The EPCS are determined from the site data and are the concentrations used with exposure assumptions to estimate exposure doses. Both the UCLs and arithmetic averages for each of the COCs at each PSC can be found on Tables 3-1 through 3-43. Exposure assumptions for soil and groundwater exposures are included on Tables 3-50 and 3-5 1, respectively.

3.6.1.6. 1.1 Soil, Sediment, and Surfacewater

Based on an evaluation of current conditions at the OU-1 PSCs, civilian employees at Luke AFB (Base workers) were identified as the most probable receptors for current or future exposure to soils at all OU-1 PSCs. The potential also exists for military personnel to be periodically exposed to soils at the following

PSCs: RW-02, DP-13, SD-39, and SS-42. Exposure pathways evaluated include ingestion, dermal contact, and dust inhalation.

A portion of PSCs SD-20, SD-2 1, SD-26, and OT-41 include canals. Because the canals extend beyond the Base fence line, the potential exists for the sensitive public receptors (e.g. children) to be exposed to soils and sediments in the canals. PSCs SD-21 and OT-41 are the only canals that typically contain water. Thus, the potential exists for exposure to potentially impacted surfacewater. Exposure pathways evaluated for surfacewater include incidental ingestion and dermal contact through wading. Exposure pathways evaluated for PSCs SD-20 and SD-26, having only dry canal beds, include ingestion, dermal contact, and dust inhalation.

Future exposure pathways evaluated as part of the Base-wide risk assessment include all of the scenarios discussed above plus hypothetical future excavation worker exposure to subsurface soil via ingestion, dermal contact, and dust inhalation. Hypothetical future excavation worker exposure was valuated at all OU-1 PSCs except for PSCs SD-20, SD-21, SD-26, and OT-41.

Although it is unlikely that the active portions of Luke AFB will be used for residential purposes in the future, risks from hypothetical residential exposure to surface and subsurface soil via ingestion, dermal contact, and dust inhalation were evaluated. This evaluation was completed to determine whether the PSCs at Luke AFB are suitable for unrestricted or residential land use at some time in the future.

3.6.1.6.1.2 Groundwater

Based on an evaluation of current and hypothetical future conditions, Base workers involved in general maintenance activities at the OU-1 PSCs could potentially be exposed to constituents in groundwater via ingestion and dermal contact. Military personnel could be exposed during general daily activities at the Base via both dermal contact and ingestion. Base residents could also be exposed to groundwater via ingestion, dermal contact, and inhalation (steam while showering) during normal daily activities.

Production well data were used to evaluate current risks associated with exposure to groundwater at the Base. Hypothetical future risks associated with exposure to groundwater were calculated using data from the PSCs with associated monitoring wells. For the purposes of the risk assessment, monitoring-well data were assumed to be indicative of hypothetical future concentrations in the production wells,

3.6.1.7 Risk Characterization

Quantitative risk estimates were calculated for all current and future exposure pathways (except future residential) for both average and RME exposure doses. Table 3-52 summarizes risks for current average exposure while Table 3-53 summarizes risks for current RME exposure. Table 3-54 summarizes risks for hypothetical future exposure using average exposure doses, and Table 3-55 summarize future risks using the RME scenario. The risk characterization results are discussed in Section 3.6.1.7.4.

The risk estimates were calculated separately for carcinogenic and noncarcinogenic effects. Carcinogenic risks are reported as an excess lifetime cancer risk (ELCR) and the noncarcinogenic risks are reported as a hazard index (HI). ELCRs are determined by multiplying the intake level, or exposure dose, with the CSF. These risks are probabilities that are generally expressed in scientific notation (e.g., 1×10^{-6} or 1E-6). An ELCR of 1×10^{-6} indicates that, as a plausible upper bound, an individual has a one in one million chance of developing cancer as a result of the site-related exposure to a carcinogen over a 70 year lifetime under the specific exposure conditions at a site.

Potential concern for noncarcinogenic effects of a single contaminant in a single medium is expressed as the hazard quotient (HQ) (or the ratio of the estimated intake derived from the contaminant concentration in a given medium to the contaminant’s RfD). By adding the HQs for all contaminants within a medium or across all media to which a given population may reasonably be exposed, the HI can be generated. The HI provides a useful reference point for gauging the potential significance of multiple contaminant exposures within a single medium or across media.

There are three notable exceptions to the risk assessment methodology described above. The first exception pertains to the evaluation of background concentrations of metals. Arsenic and beryllium were generally only detected at background levels but were identified as COCs because their naturally occurring concentration was greater than the USEPA Region IX PRGs. A discussion on the methodology for evaluating background metals concentrations is provided as Section 3.6.1.7.1. Secondly, the methodology used for calculating future residential risk was different from the methodology described above. The methodology for conducting the future residential risk assessment is discussed in Section 3.6.1.7.2. Lastly, because there are no toxicological values for lead, risks for lead exposure were evaluated differently. A discussion on the evaluation of exposure to lead is provided in Section 3.6.1.7.3.

3.6.1.7.1 Background Metals

Arsenic and beryllium were generally only detected at naturally occurring background levels and are likely not present as a results of Base activities. They were however, conservatively retained as COCs because their maximum detected concentrations exceeded the USEPA Region IX PRGs for unrestricted land use. Risks associated with average and reasonable maximum exposures to naturally occurring arsenic and beryllium in soil and arsenic in groundwater were calculated using the exposure assumptions for each applicable exposure pathway, the mean (for average exposures) and 95th percent upper tolerance limit (for RME) calculated for site-specific background samples, and appropriate toxicity data. These risks were subtracted from the total risks at each OU-1 PSC. The resulting risk is then considered to be the actual risk potentially related to activities at Luke AFB. The results of these calculations are shown on Tables 3-52 through 3-55.

Although several other metals detected in soil and groundwater at background concentrations were also carried through the risk assessment, only risks posed by potential exposure to naturally-occurring arsenic and beryllium were evaluated separately since arsenic and beryllium contribute most significantly to risks.

As shown on Tables 3-52 through 3-55, the actual risks attributable to Luke AFB activities (i.e. resulting risk after “background influences” are factored out of the equations) would be a negative number in several instances. This was because the “background influences” were calculated using the average concentrations of arsenic and beryllium in soil and arsenic in the groundwater as reported in the background data set. For several sites, arsenic and beryllium were detected at concentrations below the average of the background data set, but still at levels above the USEPA PRGs. Thus, arsenic and beryllium were retained as COCs. If no other COCs were present or if other COCs were present but did not contribute significantly to the risk level, a negative number would result if risks associated with average background levels were subtracted. Rather than reporting a negative number, the term “negligible” was used.

3.6.1.7.2 Future Residential Exposure

It is unlikely that the active portions of Luke AFB will ever be used for residential purposes in the future. Nevertheless, the regulatory agencies required an assessment of risks for hypothetical residential exposure at each of the PSCs. This evaluation was completed to determine whether the current conditions of the PSCs are suitable for unrestricted or residential land use at some time in the future. The evaluation of risks to potential future residents at each of the PSCs was presented in “Appendix J” of the *Base-wide Risk Assessment Report* (Geraghty & Miller, Inc., 1997).

Because the residential risk evaluation assesses hypothetical future exposures, default exposure assumptions must be used. Because those same default exposure assumptions are also used in the establishment of regulatory guidance levels, the FFA parties determined that future residential risks could be calculated using a ratio calculation (USEPA, 1995).

The ratio incorporates the EPC calculated for RME exposure to a COC in combined surface and subsurface soils in the top half of the equation and a risk-based regulatory cleanup level in the bottom half of the equation. Ratio calculations were conducted with each of the COCs detected at a site to provide both an ELCR and non-cancer hazard quotient (HQ). The individual ELCRs and HQs calculated for each of the COCs were then summed to provide a total ELCR and M at that site. A site was considered acceptable for residential land use if the total site ELCR was less than or equal to 1×10^{-6} and the HI was less than or equal to 1. Similar to the industrial risk assessment calculations, risks associated with exposure to background concentrations of arsenic and beryllium were calculated separately and then factored out of the total site risk.

Both the ADEQ proposed soil remediation levels (SRLs) and the USEPA Region IX PRGs were used in the residential exposure evaluation. As an initial step, the USEPA PRGs were used in the bottom half of the equation. Because the USEPA PRGs are not enforceable standards, they were only used to determine which sites required further evaluation. Sites that contained ELCRs or HIs over the guidance levels using the USEPA PRGs were further evaluated using the ADEQ SRLs during the second and final step of the residential risk assessment. A summary of the future residential risk calculations using the ADEQ SRLs are provided on Table 3-56.

3.6.1.7.3 Risk Characterization For Lead

Lead was identified as a COC in soils, sediment or surface water at PSCs RW-02, LF-03, DP-13, LF-25, LF-37, and SD-38. Lead was identified as a COC in groundwater in the monitoring wells at PSCs RW-02, SD-20, SD-21,DP-05,FT-06,FT-07E, and ST-18. Because RfDs or CSFs are not currently available for lead, it is not possible to evaluate the risks associated with lead exposure using conventional risk assessment methods. The USEPA Integrated Exposure Uptake Biokinetic (IEUBK) model (LEAD0.99) (USEPA, 1994a) was used as a conservative method to evaluate the potential for adverse health effects of a hypothetical population (children up to 7 years old) associated with exposure to lead in groundwater, soil, sediment and surface water at these PSCs . The results are shown in Tables 3-57 and 3-58 for exposure to surficiaI and combined surface and subsurface soil, respectively and in Table 3-59 for groundwater.

3.6.1.7.4 Risk Characterization Results

Risks for the exposure pathways identified in the Conceptual Site Model Section were calculated using the various methodologies described above. The risk characterization results are briefly summarized below. Detailed descriptions of the findings and conclusions are presented in *Remedial Investigation Report, Appendix A Base-wide Risk Assessment, Luke Air Force Base, Arizona*, (Geraghty & Miller, Inc., 1997b; AR#191,192).

3.6.1.7.4.1 Current and Future Exposure At Luke AFB

Current and hypothetical future risks calculated for exposure to the PSCs are summarized in Tables 3-52 through 3-55. Table 3-52 summarizes risks for current average exposure, while Table 3-53 summarizes risks for current RME exposure. Table 3-54 summarizes risks for hypothetical future exposure using average exposure doses, and Table 3-5 5 summarize future risks using the RME scenario.

With the exception of naturally occurring risks associated with a Base resident's exposure to production well water, all current and future risks associated with average exposures are within or below the USEPA risk-based general guidance goals (ELCR within or below the general guidance range of 10^{-4} to 10^{-6}; HI equal to or below 1.0) (USEPA, 1991b). The HI calculated for a Base resident average exposure to production welt water is 2. The elevated HI can be directly attributed to arsenic and fluoride detected in production well samples at background concentrations. After risks associated with background concentrations of arsenic are removed, the HI drops to 1.

All current and hypothetical future risks associated with RME type exposure are within or below the USEPA risk-based general guidance goals, with these exceptions. An elevated HI of 3 was calculated for an excavation worker's exposure to surface and subsurface soil at PSC LF-25. An elevated HI of 2 was calculated for a Base resident's exposure to groundwater at RW-02 and SD-20. Elevated HIs were calculated for future Base workers, Military Personal, and Base resident exposure to groundwater at PSC SS-42.

Antimony is the primary contributor to the elevated HI of 3 at PSC LF-25. Antimony was detected at a concentration of`368 mg/kg in the 2 foot bgs sample from Test Pit TP-11. All other antimony concentrations in the surface and subsurface soil samples from PSC LF-25 were below their respective detection limits. Metal shot, containing antimony, originating from the skeet range at OT-41 frequently lands at LF-25. The elevated detection of antimony in Test Pit TP-11 can likely be attributed to the metal shot. Without antimony, the RME HI for a hypothetical future excavation worker would be 0.08.

An HI of 2 was calculated for reasonable maximum exposure of a future Base resident to groundwater at PSCs RW-02 and SD-20. The elevated HI can be attributed to arsenic and fluoride which are present in the monitoring wells at background concentrations. After risks from background concentrations of arsenic are removed, the HIs become negligible (See Section 3.6.1.7.1 for use of the term ‘negligible’).

The HIs calculated for RME exposure of hypothetical future Base workers, military personnel, and Base residents to groundwater at PSC SS-42 are 8, 2, and 6, respectively. The HQ for chromium is the primary contributor to the risk. Sediment in one unfiltered sample most likely caused this elevated chromium EPC. That one particular sample was visibly turbid and contained sediment. Chromium was not detected in the paired sample that was filtered. When the one anomalous sample is removed from the calculations, the HI for each of the receptors is less than one.

3.6.1.7.4.2 Future Residential Exposure

Risk associated with hypothetical future residential exposure to combined surface and subsurface soil are shown on Table 3-56. All of the PSCs evaluated were determined to be suitable for unrestricted, or residential, land use with five exceptions (PSCs LF-03, FT-07E, DP-13, LF-14, and SD-38). PSCs LF-03, FT-07E, DP-13, LF-14, and SD-38 had elevated ELCRs ranging from of 2×10^{-6} to 3×10^{-5} DP-13 also had an elevated HI of 2.

Exposure to chromium in soils is the primary contributor to the elevated ELCR for PSC LF-03. Chromium was detected at concentrations of 349 and 386 mg/kg in an 8 foot bgs and a 7-8 foot bgs sample from test pit TP-5, respectively. Given these two detections, the EPC for chromium was 140 mg/kg. Chromium concentrations in the remaining nine subsurface soil samples were below 26.6 mg/kg. The EPC for chromium calculated without the samples from test pit TP-5 would have been 17 mg/kg, and the site would not have an elevated ELCR. When completing the residential risk evaluation, the SRL for hexavalent chrome was used; this was a highly conservative assumption since it is unlikely that all of the chromium present at LF-03 is actually present in the hexavalent state. Using the modified UCL as the EPC and the total chrome SRL, instead of the hexavalent chromium SRL, the ELCR for residential exposure drops from 5 x 10^{-6} to 8 x 10^{-9}.

Exposure to chromium in soils is the primary contributor to the elevated ELCR and M for PSC DP- 13. Chromium was detected at a concentration of 15,900 mg/kg in a 5 feet bgs sample from test pit TP-12. Chromium concentrations in the remaining 32 subsurface soil samples were below 25 mg/kg. The 95 percent UCL for chromium calculated without the sample from test pit TP-12 would have been 16 mg/kg. It should be noted that when completing the residential risk calculations, the SRL for hexavalent chrome was used; this was a highly conservative assumption since it is unlikely that all of the chromium present at DP-13 is actually present in the hexavalent state. Using the modified UCL as the EPC and the total chrome instead of the hexavalent chromium SRL, the ELCR for residential exposure drops from 3 x 10^{-5} to 8 x 10^{-9} and the HI drops from 2 to 0.3.

PCBs and chromium are the primary contributors to the elevated ELCR at LF-14. The UCL for PCBs was elevated due to a detected concentration of PCBs of 91 mg/kg in an 8 to 10 foot bgs sample from soil boring SB-8. Without this sample the maximum detected PCB concentration would be 37 mg/kg and the risks from exposure to PCBs at LF-14 would be significantly lower. The chromium UCL was elevated due to detected concentrations of chromium at from SB-2 and SB-5 of 108 mg/kg and 376 mg/kg, respectively. Without these two samples the maximum detected concentration of chromium at LF-14 would be 49.5 mg/kg and the risk from exposure to chromium would be lower.

TRPH was the contributor to the elevated HIs at both FT-07 and SD-38. Each of the PSCs had several samples elevated concentrations of TRPH in the subsurface. TRPH concentrations at FT-07 ranged from 10 to 27,000 mg/kg. Concentrations of TRPH at SD-38 ranged from 5.0 to 58,000 mg/kg.

3.6.1.7.4.3 Exposure To Lead

The USEPA has not established toxicity values for lead. Instead, blood lead concentration generally has been accepted as the best measure of the external dose of lead (NAS, 1980; USEPA, 1994b). The USEPA developed the IEUBK model (LEAD0.99) for predicting mean blood lead levels in a sensitive subpopulation, children up to 7 years old. Although exposure of young children to lead in soil or sediment at the any of the PSCs is unlikely, the IEUBK model was used as a conservative method to evaluate the potential for adverse health effects associated with exposure to lead in soil or sediment at PSCs RW-02, LF-03, DP-13, LF-25, LF-37, SD-38 and lead in groundwater at PSCs RW-02, FT-07E, SD-20, and SD-21.

The results of the IEUBK model (LEAD 0.99) run using the soil or sediment data for the PSCs and the monitoring well data for groundwater are shown in Tables 3-57 through 3-59, for surficial soil and combined surface and subsurface soil and groundwater exposures. Results of the model for each PSC are presented in detail in Section 4, Section 5, and Appendix F of the Base-wide Risk Assessment. Results of the model are summarized below.

Lead was a COC in surficial soil only at PSC LF-25. Therefore, this was the only site where the predicted geometric mean blood lead levels for the hypothetical population (children under 7 years old) exposed to surficial soils was evaluated. For PSC LF-25, the geometric mean blood lead levels are below the concern level 10 μg/dL for an average exposure scenario (USEPA, 1994b). However, the geometric mean blood lead level was 14.5 μg/dL for the RME scenario. This value exceeds the concern level of 10 μg/dL.

As noted in Section 3.5.19, lead was detected at a concentration of 10,100 mg/kg in one surficial sample at PSC LF-25. Lead concentrations in the other 16 surficial soil samples were below 66 mg/kg. The anomalously high concentration of lead in this one sample appears to be result of metal shot in the portion of the sample that was analyzed by the laboratory. Results of the shot recovery treatability study (ARCADIS Geraghty & Miller 1998d) show that if the metal shot is removed from the soil at PSC LF-25, expected residual lead concentrations would only be slightly elevated above background UCL of 22 mg/kg. Using the 66 mg/kg concentration as a representation of soil lead levels after metal shot is remove, the model indicates that 100 percent of the exposed population is expected to have a blood lead level below 10 μg/dL for both the average and RME scenarios.

The predicted geometric mean blood lead levels for the hypothetical population (children up to 7 years old) exposed to combined surface and subsurface soils is below the concern level of 10 μg/dL for all PSCs where it was evaluated except PSC DP-13 (USEPA, 1994b). Evaluation of lead in combined surface and subsurface soil is applicable for both the excavation worker and hypothetical future resident exposures.

As discussed in Section 3.5.10, lead was detected at a concentration of 36,000 mg/kg in a subsurface sample collected from Test Pit TP-12 at PSC DP-13, yielding a predicted blood lead level of 21.4 μg/dL. The high level of lead detected in the one sample from TP-12 may be associated paint residues buried in that area. Running the model without this one sample shows that 100 percent of the exposed population at DP-13 is predicted to have a blood lead level below 10 μg/dL for the average and RME scenarios.

The predicted geometric mean blood lead levels for the hypothetical population (children up to 7 years old) exposed to groundwater is below 10 μg/dL for all the PSCs evaluated.

3.6.1.8 Uncertainties In The Risk Assessment

The potential health risk estimates summarized in this report are conservative assessments of the risks associated with exposure to environmental media at the OU-1 PSCs. Uncertainty is inherent in the risk assessment process. Each of the three basic building blocks for risk assessment (monitoring data, exposure scenarios, and toxicity values) contribute uncertainties. Environmental sampling itself introduces uncertainty, largely because of the potential for uneven distribution of constituents in the environment.

This risk assessment is based on the assumption that the available monitoring data adequately describe the extent of constituents in soils, sediments, surface waters, ambient air, and groundwater. Environmental sampling itself introduces uncertainty. This source of uncertainty can be reduced through a well designed sampling plan, use of appropriate sampling techniques, and implementation of laboratory data validation and quality assurance/quality control (QA/QC). The data used in the Base-wide risk assessment meet QA/QC requirements and are appropriate for the Base-wide risk assessment.

Exposure scenarios and constituent transport models also contribute uncertainty to the risk assessment. Exposure doses for soils, sediments, surface waters, ambient air, and groundwater were calculated based on the assumption that the current conditions would remain stable throughout the exposure period. This simplifies reality because natural attenuation processes are expected to reduce COC concentrations in the environment. Exposure scenarios were developed based on site-specific information, USEPA exposure guidance documents, and professional judgment. Although uncertainty is inherent in the exposure assessment the exposure assumptions were chosen to err on the side of being health protective.

The toxicity values and other toxicologic (health effects) information used in this report are associated with significant uncertainty. Toxicity values are subject to change as now or better toxicity data become available or as the results of toxicity studies are re-evaluated. Many toxicity values are developed using results of studies in which laboratory animals are exposed to high doses. Although species differences in absorption, distribution, metabolism, excretion, and target organ sensitivity are well documented, available data are not sufficient to allow compensation for these differences. When human epidemiologic data are available, a different set of uncertainties is present. For instance, exposure dose is seldom well characterized in epidemiologic studies.

In conclusion, uncertainties do exist with the Base-wide risk assessment. However, every effort was made to reduce the inherent uncertainties and to err or the side of health protectiveness. The risk assessment was conducted using only data of defensible quality that were collected with stringent QA/QC procedures following USEPA guidance documents. Likewise, the toxicity values used in this risk assessment were the most recently available from the USEPA. As a matter of policy, the USEPA will always err on the side of health protectiveness to give an estimate of the risk or hazard that is overestimated.

3.6.2 Ecological Risk Assessmen

In addition to evaluating potential human health risks, an ecological risk assessment was also performed. The standard paradigm for predictive ecological risk assessment (ERA), as developed by the USEPA and others, was followed for the ecological risk assessment at Luke AFB (USEPA, 1989c,f, USEPA, 1992; USEPA, 1994a; Wentsel et al., 1996). Prior to completing the ecological risk assessment, a Base-wide ecological inventory (EI) was conducted to collect data on:

- biotic communities present on the Base;
- evidence of biological stress;
- pathways of potential exposure to impacted media; and
- the presence of species of special concern.

Luke AFB is in the lower Colorado River Valley of the Sonoran desert; however, little vegetation characteristics of this area were identified during the EI. Instead, flora was dominated by vegetation characteristic of urban, disturbed areas at similar elevations in the Sonoran Desert. This is consistent with current and past land use at the Base.

No species of special concern were observed during the EI. Animal species observed at the Base during the EI are more tolerant of urban and disturbed conditions. Because vegetative growth at the Base is sparse due to physical activities associated with normal base operations, the diversity and abundance of animals observed were less than that typical of more native conditions.

Potential risks to ecological receptors were quantitatively assessed by using the round-tailed ground squirrel, desert cottontail, western whiptail lizard and side-blotched lizard as indicator species. The desert cottontail was used to represent herbivorous primary consumers; the round-tailed ground squirrel to represent herbivorous/insectivorous primary consumers; and the western whiptail lizard and side-blotched lizard to represent insectivorous secondary consumers. HQs were calculated for the indicator species by comparing an estimated intake of site-related constituents of ecological concern (COECs) with a toxicity reference value derived for the specific indicator species and for the specific COEC. HQs were determined for the ingestion of food sources and for the incidental ingestion of soil where appropriate for the indicator species. The HQs were then added to obtain a HI for each PSC.

Based on previous investigations at Luke AFB and coordination with USEPA representatives, the following PSCs were determined to be representative of site conditions and were selected for study in the ecological risk assessment: PSCs LF-25; FT-07E; combined portions of SS-17 and LF-14; and SD-20. This selection was based on a combination of observations of ecosystems at the PSCs, detected COEC concentrations, and potential risks to higher trophic level organisms.

COECs evaluated in the ecological risk assessment included: polycyclic aromatic hydrocarbons (PAHs); TRPH; PCBs; and the metals antimony, cadmium, and lead. Data used to assess potential adverse effects to ecological receptors included chemical analysis of soil, plant tissue, and insect tissue.

Based on the results of the ecological assessment, it is unlikely that site-related COEC concentrations would pose a risk to ecological receptors at Luke AFB. HIs calculated for each indicator species at the representative PSCs did not exceed the risk threshold value of 1, with the exception of a HI of 3 for the desert cottontail rabbit at PSC LF-14. The elevated HI resulted from cadmium and lead concentrations detected in surficial soil at two sampling locations at this PSC. Due to limited habitat and food resources at PSC LF-14, it is likely that actual exposure by rabbits and other herbaceous primary consumers to soils and vegetation at this site would be less than that assumed for the purposes of this assessment. Therefore, it is unlikely that adverse effects would occur.

3.6.3 Risk Assessment Conclusions

Risks were calculated for both human and ecological receptors using the methods described above. Results of the ecological risk assessment indicate that none of the PSCs pose significant threats to ecological receptors. Results of the human health risk assessment indicated six OU-1 PSCs could potentially pose unacceptable levels of risk to human health under certain types of land usage. These six PSCs include: LF-03, FT-07E, DP-13, LF-14, LF-25, and SD-38. All of these, except for PSC LF-25, present an unacceptable risk to a hypothetical future resident. PSC LF-25 posed an unacceptable level of risks to a hypothetical future excavation worker.

A seventh site, PSC SS-42, showed that a risk to the underlying groundwater resources exists at this site. Results of the vadose zone transport model showed that COCs currently detected in the soil at PSC SS-42 could potentially leach to the groundwater table in the future.

Although conditions at PSC RW-02 do not pose risks to human health or the environment, the presence of the radioactive waste containment structure does represent a site condition that warrants additional evaluation. Currently, gamma logs and soil sample radiochemical analyses indicate that soils adjacent to the concrete containment structure do not contain radioactive materials in excess of naturally occurring levels. As long as conditions remain unchanged, there is no risk to human health.

3.7 REMEDIAL ACTION OBJECTIVES

Remedial Action Objectives (RAOs) are general descriptions of the goals established for protecting human health and the environment, and are accomplished through remedial actions. RAOs identify the medium of concern (air, soil, groundwater), chemicals of concern, potential exposure routes, potential receptors, and acceptable chemical concentrations for protecting human health and the environment. General Response Actions (GRAs) are the actions that will either alone or in combination satisfy the RAOs.

The RAOs and GRAs developed for the OU-1 PSCs at Luke AFB were based on the requirements of CERCLA, as amended by SARA. SARA mandated several overall objectives for remedial activities. These general mandates include the following:

- Preference is to be given to a remedy, "...which permanently and significantly reduces the volume, toxicity, or mobility of the hazardous substances, pollutants, and contaminants..." (Section 121 [b][1]).

- A remedial action "...shall attain a degree of cleanup of hazardous substances, pollutants, and contaminants released into the environment and of control of further release, at a minimum, which assures the protection of human health and the environment." (Section 121[d][1]).

- Remedial actions "...shall be developed that protect human health and the environment by recycling waste or by eliminating, reducing, and/or controlling the risks posed through each pathway by a site." (40 CFR 300.430 [e][2]).

These general mandates were the basis for determining the RAOs for the OU-1 PSCs at Luke AFB. The first step of the process for establishing RAOs is to identify the medium of concern, COCs, potential exposure routes, and potential receptors. This information has been summarized in the previous sections and on Tables 3-1 through 3-59 and Figures 3-22 through 3-39.

The second step of the process involves the identification of Applicable, Relevant, and Appropriate Requirements (ARARs). ARARS specify remedial action requirements and cleanup standards. Based on ARARs and the specific site conditions, RAOs are then developed to synthesize the goals and requirements of the remediation. At this point GRAs are established to satisfy the RAOs. The following sections present the identification of ARARs, RAOs, and the GRAs for the OU-1 PSCs at Luke Air Force Base.

3.7.1 <u>ARARs, To be Considered Requirements, and Waivers</u>

Section 12 1 (d)(2) of CERCLA, 42 USC Section 9621 (d)(2), requires the USEPA to ensure that cleanup actions conducted under CERCLA meet:

> "...any standard, requirement, criteria, or limitation under any Federal environmental law ... or any (more stringent) promulgated standard, requirement, criteria, or limitation under a State environmental or facility siting law ... which is legally applicable to the hazardous substance concerned or is relevant and appropriate under the circumstances of the release of such hazardous substance, pollutant, or contaminant..."

The USEPA refers to the standards, requirements, criteria, or limitations identified pursuant to this section as ARARs. ARARs are divided into applicable requirements or relevant and appropriate requirements, both of which require consideration under CERCLA.

"Only those state standards that are promulgated, are identified by the state in a timely manner, and are more stringent than federal requirements may be applicable or relevant and appropriate. For purposes of identification and notification of promulgated state standards, the term "promulgated" means that the standards are of general applicability and are legally enforceable.' (40 CFR§300.5).

ARARs are divided into three categories: chemical-specific, location-specific, and action-specific requirements. Because the NCP (40 CFR§300) includes detailed guidance on identification and application of ARARs, the following discussion adheres to the process specified in the NCP, except where state or local requirements may dictate a different result.

3.7.1.1 Applicable Requirements

Applicable requirements are federal and state laws or rules that legally apply to a hazardous substance, contaminant, remedial action, location, or other circumstance at a site. Applicable requirements are defined (40 CFR1§300.5) as those "...cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant contaminant, remedial action, location, or other circumstances..." For a requirement to be applicable, the action or the circumstances at the site must meet the jurisdictional prerequisites of that requirement.

3.7.1.2 Relevant and Appropriate Requirements

Relevant and appropriate requirements are defined as cleanup standards, standards of control, or other substantive requirements, criteria, or limitations promulgated under federal or state environmental or facility siting laws, that while not "applicable" to a hazardous substance, remedial action, location, or other circumstance at the site, address problems or situations sufficiently similar to those encountered at the site (relevant) so that utilization of these standards is warranted for the particular site (appropriate) (40 CFR§300.5). The NCP (40 CFR§300.400(g)(2)) specifies a number of factors for determining when a requirement may be relevant or appropriate. The factors include:

"(i) The purpose of the requirement and the purpose of the cleanup action;

(ii) The medium regulated by the requirement and the medium contaminated or affected at the site;

(iii) The substances regulated by the requirement and the substances found at the site;

(iv) The actions or activities regulated by the requirement and the remedial action contemplated at the site;

(v) Any variances, waivers, or exemptions of the requirement and their availability for the circumstances at the site;

(vi) The type and size of structure or facility regulated and the type and size of structure or facility affected by the release or contemplated by the cleanup action;

(vii) The type of place regulated and the type of place affected by the release or cleanup action; and

(viii) Any consideration of use or potential use of affected resources in the requirement and the use or potential use of the affected resource at the cleanup site."

In this light, relevant and appropriate requirements are those federal and state rules that do not legally apply but address situations sufficiently similar that they may warrant application to the remedial action. Although discretion is involved with this determination, once identified, a relevant and appropriate requirement must be complied with to the same extent as applicable requirements.

3.7.1.3 To Be Considered (TBC) Requirements

"In addition to applicable or relevant and appropriate requirements, the lead and support agencies may, as appropriate, identify other advisories, criteria, or guidance to be considered for a particular release. The "to be considered" (TBC) category consists of advisories, criteria, or guidance that were developed by the USEPA, other federal agencies, or states that may be useful in developing remedies." (40 CFR§300.5).

3.7.1.4 Waivers or Variance

It may be possible to select a remedial alternative that does not meet an ARAR that qualifies for a waiver or variance. These waivers apply only to the attainment of the ARAR; other statutory requirements, such as remedies must be protective of human health and the environment, cannot be waived (40 CFR§300.430 (f) (ii) (c)). The waivers provided are listed below:

- Interim Remedy: Measure/action that will not attain all applicable or relevant and appropriate requirements is an interim measure, which will be followed by a complete measure that will attain all ARARs.

- Equivalent Standard of Performance: Equivalent or better results can be obtained using a design or method different from that specified in the ARAR.

- Greater Risk: Compliance with an ARAR will cause greater risk to human health and the environment than noncompliance.

- Technical Impracticability: Achieving an ARAR(s) is impracticable from an engineering perspective.

- Inconsistent Application of State Requirements: Regarding a state standard, requirement, criterion, or limitation, the state has not consistently applied (or demonstrated the intention to apply consistently) the standard, requirement criterion, or limitation in similar circumstances at other remedial actions.

- Fund Balancing: The costs associated with meeting an ARAR to obtain an added degree of protection or reduction of risk would jeopardize the funds for remedial actions at other sites.

3.7.2 Chemical-Specific ARARs and TBCs

Chemical-specific ARARs are health-or risk-based concentrations set in state or federal statutes or rules regarding particular contaminants in soil, air, or water at a site. These limits establish the acceptable amount or concentration of a chemical that may be found in a media, or discharged to the ambient environment. Chemical-specific ARARs provide minimum requirements that CERCLA cleanup standards must meet.

For Luke AFB, chemical-specific ARARS include the remedial action criteria provided in Arizona Soil Remediation Standards (ARS 49-152), Arizona Water Quality Assurance Revolving Fund (WQARF) (ARS 49-282.06), and the federal Safe Drinking Water Act (SDWA) MCLs. The TBC chemical-specific information compiled for Luke AFB include the USEPA Region IX PRGs and Arizona GPLs. Chemical-specific ARARs for Luke AFB are described below and are summarized in Table 3-60 and 3-61.

3.7.2.1 Arizona Soil Remediation Standards

Arizona promulgated soil remediation standards on December 4, 1997. Because these state standards have been promulgated and are legally applicable to the Luke AFB Superfund investigation, the Arizona Soil Remediation Standards are identified as applicable chemical specific ARARs. The Arizona Soil Remediation Standards are based on the idea of "risk-based remediation," meaning that cleanup levels are based on the risk to human health and the environment posed by contaminated soil.

The Arizona Soil Remediation Standards are flexible and allow a party remediating soil to elect one of three acceptable contaminated soil remediation standards. The choices include: (1) the background remediation standards prescribed in A.A.C. R18-7-204, (2) the pre-determined remediation standards prescribed in A.A.C.R18-7-205, or (3) site-specific remediation standards prescribed in A.A.C.R-18-7-206.

The background remediation standards prescribed in A.A.C.R18-7-204 allows a site to be cleaned up to a level consistent with naturally occurring "background" conditions. This approach is called "cleaning up to background," and is based on site-specific information and statistically derived background concentrations using the 95th percentile UCL.

The pre-determined risk-based standards prescribed in A.A.C.R18-7-205, are an "off the shelf' or "one-size-fits-all" approach. The chemical specific standards are referred to as Soil Remediation Levels (SRLs). SRLs; are established for both residential and non-residential land uses. A person conducting soil remediation may elect either standard, however, a person who conducts an SRL-based remediation must remediate to the residential SRL on any property where there is residential use at the time the remediation is completed. Residential and Non-residential SRLs for the selected COCs detected at the OU-1 PSCs at Luke AFB are listed on Table 3-60.

As prescribed in A.A.C.R18-7-206, a party may also elect to remediate to a residential or non-residential site-specific remediation level derived from a site-specific human health risk assessment. This "customized" approach allows determination of a site-specific cleanup standard based on the concentration of a contaminant the health affects of that contaminant, and the potential for humans to come into contact with that contaminant. ne Base-wide risk assessment was conducted using a deterministic methodology that satisfies requirements prescribed in A.A.C. R18-7-206(b).

A party who conducts soil remediation based on the standards set forth in either A.A.C.R18-7-205 or R18-7-206, must remediate soil until contaminants remaining in the soil after the remediation do not:

> 1. Cause or threaten to cause a violation of Water Quality Standards prescribed in A.A.C. R18-11 et. seq. If the remediation level of a contaminate in the soil is not protective of aquifer water quality and surface water quality, that person shall remediate soil to an alternative soil remediation level that is protective of aquifer water quality and surface water quality.
>
> 2. Exhibit a hazardous waste characteristic of ignitability, corrosivity, or reactivity as defined in A.A.C. R-18-8-26(a). If the remediation level for a contaminant in the soil results in leaving soils that exhibit a hazardous waste characteristic other than toxicity, the person shall remediate soil "to an alternative soil remediation level such that the soil does not exhibit a hazardous waste characteristic other than toxicity.
>
> 3. Cause or threaten to cause an adverse impact to ecological receptors. If the ADEQ determines that the remediation level of a contaminant in soil may impact ecological receptors based on the existence of ecological receptors and complete exposure pathways, the person shall conduct an ecological risk assessment. If the ecological risk assessment indicates that any concentration of contaminants remaining in the soil after remediation causes or threatens to cause an adverse impact to ecological receptors, the person shall remediate soil to an alternative soil remediation level, derived from the ecological risk assessment, that is protective of ecological receptors.

Accordingly, depending upon the choice of remediation standards, the rule contains other requirements to ensure that the standard selected is fully effective in protecting human health and the environment. If a party elects to remediate to non-residential standards, they must, as detailed in A.R.S. 149-152 part B,

> "...record with the county recorder, in the county where the property is located, a voluntary environmental mitigation use restriction limiting, by legal description, the area necessary to protect public health and the environment to nonresidential uses if, after the approval by the Director pursuant to subsection A of this section, contamination remains on the property at or above either of the following:
>
> (1) Pre-determined risk based standards for other than residential exposure assumptions.
>
> (2) Concentrations resulting in a hazard index greater than one, indicating that there may exist an appreciable risk to human health from non-cancer health effects greater than the range of levels set forth in 40 CFR part 300.430(E)(2)(1)(A)(D[(e)(2)(1)(A)(2)]..."

With prior approval of the ADEQ, A.A.C.R18-7-206(D) also allows for the use of institutional and engineering controls to achieve the site specific remediation levels. The approval shall be based, in part, on the demonstration that the institutional and engineering controls will be properly maintained.

3.7.2.2 Arizona Aquifer Water Quality Standards

Numeric aquifer water quality standards for Arizona were created in 1986 by statute with the adoption of “primary drinking water maximum contaminant levels” established by the USEPA prior to August 13,1986 as drinking water aquifer water quality standards (ARS 49-223). Provisions were made for adoption by the ADEQ by rule of additional AWQS as additional MCLs were adopted by the USEPA. The statute also provided for adoption of a narrative standard. Current AWQS are provided in A.A.C. R18-11-401 et. seq.

The AWQS were not established as groundwater cleanup levels and hence, are not applicable to groundwater remedial actions. The statute requires the director of the ADEQ to adopt AWQS to “...preserve and protect the quality of these waters for all present and reasonably foreseeable future uses...” (ARS 49-221A). The rule adopted to guide the selection of remedial actions under WQARF (A.A.C. R18-7-109 A.2.) prior to the passage of SB1452, similarly refers to protection of uses of groundwater. The rules require that “...for remedial actions that may affect aquifers, the evaluation of beneficial use (of the groundwater) must include the protection of drinking water pursuant to ARS 49-223...” The AWQS are then relevant to the selection of groundwater clean up levels.

3.7.2.3 SDWA National Primary Drinking Water Regulations: MCLs

The SDWA establishes standards for maximum levels of contaminants in public drinking water sources (42 U.S.C.§300g). MCLs are federally enforceable limits for any contaminant that “may have an adverse effect on the health of persons and which is known or anticipated to occur in public water systems” (42 U.S.C.§300g-l[b][3][A]). MCLs are potentially relevant and appropriate during a cleanup involving the remediation of groundwater that is used currently or as may potentially be used as a source of drinking water.

The USEPA considers maximum contaminant level goals (MCLGs) established under the SDWA to be ARARs if the MCLG is greater than zero and if the groundwater is a potential drinking water source. If the MCLG for a contaminant is zero, then the MCL is considered to be the ARAR.

3.7.2.4 USEPA Region IX PRGs

The USEPA Region IX PRGs for soil and groundwater are predetermined risk-based criteria created for use as a screening toot to determine if pollutants are present in an environmental media, trigger additional investigation, and are initial cleanup goals. As such they fall in the TBC category for use in developing remedial alternatives. Exceedence of the PRG indicates that further evaluation of chemicals at a site may be necessary. The PRG calculations are based on RAGS Part B (USEPA, 1991) and the USEPA Soil Screening Guidance (USEPA, 1996b). PRGs have been developed for soil, groundwater, and ambient air. PRGs for selected chemicals are included in Table 3-60.

3.7.2.5 Arizona Groundwater Protection Limits (GPLs)

In September 1994, the ADEQ formed a Cleanup Standards Task Force to establish consistent remediation standards for all programs administered by the ADEQ. The Task Force's work lead to passage of legislation in 1995, A.R.S. 49-151 and 49-152, which mandated the development of consistent soil remediation standards based on the risk to human health and the environment. As described in Section 3.7.2.1, the ADEQ established these standards in rule on December 4, 1997.

Under the Arizona Soil Remediation Standards, a party conducting a soil remediation may use a risk based approach for determining the appropriate soil clean up standard, or they may elect to use the "off-the-shelf" SRLs as cleanup standards. No matter which approach is selected, the residual concentration of a contaminant in soil can not cause or threaten contamination of groundwater to exceed the AWQS at a program specific point of compliance.

In September 1996, the Leachability Working Group of the Cleanup Standards Task Force published "*A Screening Method To Determine Soil Concentrations Protective of Groundwater Quality*" (Leachability Working Group, 1996) as a guide for determining if residual contaminant concentrations in the soil could cause or threaten to cause contamination of groundwater. In order to provide a scientific basis for the screening process, the Task Force used a one-dimensional vadose zone transport model developed by the ADEQ. This model was developed specifically to determine the level of residual contaminant concentration in soil that would be protective of groundwater quality at a point of compliance in the underlying aquifer.

Based on the modeling results, Groundwater Protection Limits (GPLs), which are soil cleanup levels protective of groundwater quality, were developed for commonly occurring organic compounds with an AWQS. Three options for determining GPLs were developed. As an initial screening step, the COCs detected at a site can be compared with a "short list" of compounds with limited mobility in the subsurface. If any of the detected COCs are on the list, the threat to groundwater from that COC is considered negligible and the SRL or site-specific risk based cleanup level may serve as the cleanup standard. For other organic compounds with an AWQS, minimum GPLs are provided. The minimum GPLs are based on a “worst-case” scenario (where the whole soil profile is contaminated from surface to groundwater). The minimum GPL can be selected as the soil remediation level without detailed site-specific information.

The second and third options require site specific soil and contaminant characterization. The second screening step requires that the site-specific depth to groundwater and the vertical extent of contamination in the vadose zone be determined. This data is then compared to graphs developed by the Leachability Task Force Working group which provides Alternative GPLs for commonly occurring compounds with an AWQS. The graphs show Alternative GPLs based on the depth to groundwater and the depth of incorporation in soil of the contaminant of concern. These graphs depict the maximum soil concentrations that can remain in soil without potentially raising groundwater concentrations above the relevant AWQS at the default point-of-compliance. The third option allows GPLs to be determined by vadose zone and groundwater modeling using site-specific data collected and documented for the site in question.

Because the screening method for determining GPLs has not been promulgated under Arizona Law, the GPLs, themselves, can not be considered chemical-specific ARARs. Therefore, the screening method can only be considered as a TBC standard.

3.7.3 <u>Action-Specific ARARs and TBCs</u>

Action-specific requirements are technology- or activity-based requirements that regulate the specific containment, treatment, storage or disposal alternatives being considered for site cleanup. Because several different alternatives are evaluated during the course of a feasibility study, a wide range of action-specific standards could be applicable. Although 42 USC§9621(e) waives the requirement to obtain a state or federal permit, the substantive requirements must still be met. These standards provide guidelines for how a selected remedial action must be implemented.

The applicability of the requirements depends on the technologies and alternatives selected in the ROD. Action-specific ARARs are described below and are summarized in Table 3-61.

3.7.3.1 Federal Clean Air Act

The Clean Air Act established National Ambient Air Quality Standards (NAAQS) that may be applicable to remedial activities that would result in “major sources” of emissions (e.g., incineration). These requirements, although generally applicable, are superseded by state standards (42 USC§7401).

3.7.3.2 Arizona Clean Air Act

State ambient air quality standards supersede the NAAQS (ARS §49-401 through 516). These standards are anticipated to be applicable to activities that would result in "major sources"of emissions. Additional requirements include a review process for new sources of air emissions in which the toxic air pollutants are identified, the best available control technology is determined, the maximum ambient air concentration is estimated, and an acceptable ambient level is established. These additional rules are anticipated to apply to alternatives that involve “major sources.”

3.7.3.3 Facility Discharge Permits

State air pollution control statutes require the counties to establish air quality control programs; ARS §49-480 requires an installation permit for specified sources that may cause or contribute to air pollution or the use of which may eliminate, reduce, or control the emission of air pollutants. ARARs dealing with permit requirements for air pollution facility discharges might be applicable or relevant and appropriate for some work at the Luke AFB site.

3.7.3.4 County Air Pollution Control

The Arizona air quality statutes include a program for county air pollution control (ARS §49-471 et. seq.). The Maricopa County Bureau of Air Pollution Control Rules and Regulations (Regulation II, Rule Numbers 200, et seq., and Regulation III, Rule 300 et seq.) establish a permit system for new sources of air pollution, and establish criteria and requirements to limit emissions from these sources, respectively. Regulation III, Rule 300 et. seq. provides for the control of sources of fugitive dust and VOC emissions. The Maricopa County program has been approved and operates in lieu of the state program in Maricopa County. These rules are an applicable requirement for sources of emissions, such as excavations and treatment systems.

3.7.3.5 Wells: Permitting, Construction and Drilling Standards

State statutes and rules specify requirements for the permitting, drilling, construction, and abandonment of wells including monitoring, supply, and injection wells (ARS §45-591 through 45-604; A.A.C. R12-15-801 822). These rules apply to monitoring wells and groundwater withdrawal wells and are administered by the ADWR. These requirements are applicable for drilling and abandoning wells on-site.

3.7.3.6 Occupational Health Standards

The federal Occupational Safety and Health Act (OSHA) requirements for worker protection, training, and monitoring are applicable to the operation and maintenance of any treatment facilities, containment structures, or disposal facilities remaining on-site after the remedial action is completed (29 CFR 1910. et. seq.). The state has similar requirements (ARS §23-401 through 23-434).

OSHA regulates exposure of workers to a variety of chemicals in the workplace and specifies the training programs, health and environmental monitoring, and emergency procedures to be implemented at facilities dealing with hazardous waste and hazardous substances. The particular requirements of the OSHA rules that would relate to the Luke AFB site are dependent on the actions at the site.

The OSHA requirements to be implemented following site remedial actions (during long-term site maintenance) are dependent on the site remedial actions selected and the nature of the wastes or hazardous substances remaining on the site. Requirements other than those for hazardous waste sites may be applicable.

3.7.3.7 RCRA Hazardous Waste and Arizona Hazardous Waste Management Requirements

Both the USEPA and the state have comprehensive rules for the management of hazardous wastes (40 CFR§260 et. seq.; ARS §49-901 through 49-973). These rules could apply to any impacted soil excavated or groundwater withdrawn for treatment that contains a hazardous waste or exhibits a hazardous waste characteristic.

The treatment, storage and disposal (TSD) facility requirements of the hazardous waste programs will be applicable if such media are treated, stored, or disposed in the selected remedial action. The generator requirements, including waste characterization, record keeping, and manifesting, will also be applicable. If the groundwater is impacted with a hazardous waste or exhibits a hazardous waste characteristic, a hazardous waste permit could be required for groundwater treatment unless an exemption is granted. RCRA and state land disposal restrictions will also be applicable to any remedy that involves new land disposal of hazardous waste either on- site or off-site (40 CFR§268; A.A.C. R1 8-8-264[I]).

The treatment of hazardous wastes containing at least 10 parts per million (ppm) by weight of organic concentrations is subject to RCRA air emission standards for process vents (40 CFR§265, Subpart AA).

3.7.3.8 Hazardous Waste Transportation

Transportation of contaminated media constituting a hazardous waste to an off -site treatment or disposal facility is subject to federal and state hazardous materials transportation requirements (49 CFR Subchapter C; 10 CFR§71; 10 CFR§20.2006). These rules impose packaging and labeling requirements.

3.7.3.9 Aquifer Protection Permits

The Arizona Aquifer Protection Permit Program is established by statute (ARS 49-241 et. seq.) and requires that any facility that discharges a pollutant either directly to an aquifer or to the land surface above the vadose zone in such a manner that the pollutant has a reasonable probability to reach the aquifer must obtain an Aquifer Protection Permit from the ADEQ in accordance with A.A.C. R18-9-101. Discharging facilities that must comply with this requirement include the following: surface impoundments, solid wage disposal facilities, injection wells, land treatment facilities, facilities adding a pollutant to a salt dome, mine tailings pile and post, mine leaching operations, septic tank systems with a capacity greater than 2,000 gallons per day, underground water storage facilities, point source discharges to navigable waters, and sewage or wastewater treatment facilities. The substantive requirements of this permit program are applicable requirements for on-site land treatment facilities.

3.7.3.10 Groundwater Rights and Permits

Withdrawal of groundwater for remedial activities requires obtaining a right from an existing right holder or securing a permit from the ADWR (ARS §45-512). There are a number of rights and permits available. The ADWR may issue a permit for up to 35 years to withdraw poor-quality groundwater if the groundwater has no other beneficial use at the time and if the withdrawal is consistent with the Active Management Area Plan. This permit, called a “Poor Quality Groundwater Withdrawal Permit”(ARS §45-516), is the principal means of obtaining the right to withdraw groundwater for remedial actions. Groundwater rights or permits are an applicable action-specific requirement if groundwater extraction is considered a remedial alternative.

3.7.3.11 Solid Waste Management

State statutes and rules (ARS §49-701 et. seq., A.A.C. R-18-8-101 et. seq.) control the management of solid wastes, which area broad category of wastes other that hazardous wastes (ARS 49-701.01). Several "special" wastes are exempted from the definition of solid waste. These wastes include "...substances that remain on-site after being generated during on-site corrective actions..." undertaken pursuant to WQARF, RCRA or UST requirements (ARS 49-701.01.B12.). The statutes establish a management program for "special wastes," (ARS 49-851 et. seq.) and "Petroleum Contaminated Soils."

Petroleum Contaminated Soils are of particular interest for developing these ARARs. The ADEQ, under the authorities and responsibilities in A.A.C. R18-8-1601 et. seq., has established rules for management of Petroleum Contaminated Soils, that include the specific definitions, waste determination criteria, and treatment and disposal criteria. These rules are applicable for remedial actions involving excavation and on-site treatment of TRPH contaminated soils.

3.7.3.12 Radioactive Waste

Interim guidance has been established by the USAF for the disinterment of radioactive burial waste (USAF, 1989). According to this guidance, any removal actions at PSC RW-02 will be required to be performed by a licensed contractor operating under a Nuclear Regulatory Commission (NRC)-approved plan. USAF radioisotope committee approvals required prior to initiating contractual actions to perform the work.

Additional guidance has also been prepared regarding the management of low-level radioactive waste, specifically to storage (USAF, 1992). On-site storage of low-level radioactive waste must be conducted in accordance with good radiation practices as described in the NRC licensing agreement with the USAF. This includes site security to prevent unwanted theft and/or vandalism of the low- level radioactive wastes, placarding the area used for storage of these wastes, and controlling access to the storage area by designating a safety officer. The Arizona Radiation Regulatory Agency (ARRA) has no additional requirements beyond these NRC conditions. Additionally, the rules adopted by ARRA include exemptions for "electron tubes" and "self-luminous products" (A.A.C. R12-1-303B).

3.7.3.13 Treatment, Disposal and Storage of PCB-contaminated Soils

The treatment disposal, and storage of soils containing PCBs at concentrations of 50 ppm or above are regulated by 40 CFR 761. Disposal is defined as “spills and other uncontrolled discharges of PCBs at concentrations greater than 50 ppb...”

The “...PCBs resulting from the clean-up and removal of spills, leaks, or other uncontrolled discharges must be stored and disposed of in accordance with paragraph (a)...” (40 CFR 761.60[d]). Paragraph (a) provides in part that “...any non-liquid PCBs at concentrations of 50 ppm or greater in the form of contaminated soil... shall be disposed of.. (in) an incineration which complies with (40 CFR) 761.70, or a chemical wasteland fill which complies with (40 CFR) 761.75...” These rules are applicable requirements for remedial actions involving PCB-contaminated soil.

3.7.4 <u>Location-Specific ARARs and TBCs</u>

Location-specific ARARs are restrictions placed on concentrations of hazardous substances or the activities conducted at a location based solely on a site's geographical or physical location. These requirements may impose constraints on the type of remedial action allowed on-site. Location-specific ARARs are described below and are summarized in Table 3-61.

3.7.4.1 Luke AFB Clearances and Permits

Passes required for access to the Base are issued through security police squadron Pass ID Office. Access to runways; taxiways; aircraft storage/maintenance; other controlled area, such as the flight line restricted areas, requires an additional permit. These special permits are obtained through Air Field Management which is a division of the operations squadron. Air Field Management coordinates acceptable times and additional security needs for access to these controlled areas.

Prior to the beginning of any building project at Luke AFB, an Air Force Form 332 must be filed and approved. A copy of this form is included as Appendix D. As part of the approval process for AF Form 332, the BGP is reviewed to determine if any constraints exist. If constraints do exist, the project will not be approved or modifications will be required. The final approval of any building project resides with the Chief of Operations who is required to review the BGP and sign all AF Form 332s.

Conducting any type of soil excavation at the Base requires a utility clearance permit (Air Force Form 103). This permit must be obtained prior to ground-breaking at Luke AFB. To obtain a digging permit, an AF Form 103 must be filled out and submitted to the Base Civil Engineer Squadron for approval. A copy of AF Form 103 is provided in Appendix E.

3.7.4.2 Floodplain Management

Flood Insurance Rate Map Number 04013C1615F (FEMA, 1991) indicates that PSC RW-02 is located in an area of 500-year flood plain that is protected by levees from a 100-year flood. Therefore, the Base is potentially regarded as located within the 100-year floodplain of the Agua Fria River.

Executive Order 11988 directs federal agencies to evaluate the potential effects of actions they may take in a floodplain to avoid, to the extent possible, "... adverse effects associated with direct and indirect development of a floodplain..." The USEPA's Statement of Procedures on Floodplain Management and Wetlands Protection (40 CFR 6.302) requires USEPA programs to determine whether an action will be located in or will affect a floodplain. If so, the responsible official shall prepare a floodplain/wetlands assessment. The assessment will become part of the environmental assessment or environmental impact statement. The responsible official shall either avoid adverse impacts or minimize them if no practical alternative exists. Executive Order 11988 is an applicable requirement for excavation alternatives at PSC RW-02.

The state has established statutory authorities and responsibilities for county flood control districts (ARS 48-3601 et. seq.). The statutes, in part, direct the districts to adopt "...Rules for all development of land, construction of residential, commercial or industrial structures or uses of any kind which may divert, retard or obstruct floodwater and threaten public health or safety or the general welfare." (ARS 48-36093.1).

The Maricopa County Flood Control Districts rules on floodplain development are an applicable requirement for excavation alternatives at PSC RW-02.

3.7.4.3 Historical and Archaeological Artifacts

Remedial actions may result in alteration of terrain that threatens significant scientific, prehistoric, historic, or archaeological data. In such cases, federal and state requirements for actions by the respective agencies govern historical and archaeological discovery and preservation that must be adhered to during remedial action implementation (e.g., 36 CFR §65, 36 CFR §800, ARS 41-841 et. seq.). If artifacts are uncovered, the appropriate requirements governing their treatment and disposition are also ARARs.

3.7.5 RAOs and GRAs

Following the establishment of ARARS, RAOs were created to direct the development of remedial technologies for OU-1. All remedial technology considered for implementation, except for "no action," must satisfy the RAOs. The RAOs for OU-1 are presented below:

- **Exposure Prevention.** Prevent incidental ingestion, dermal contact, and inhalation by an at-risk receptor of soil that contains unacceptable concentrations of contaminants, as determined by the Base-wide risk assessment.

- **Protection of Groundwater.** Prevent the migration of COCs from unsaturated soils into groundwater or surface water to ensure that groundwater or surface water is protective of human health and the environment.

These objectives are protective of human health and the environment by preventing human contact with impacted material and by eliminating, reducing, or controlling the possible migration of COCs to other environmental media.

GRAs are general measures that could be implemented to achieve the RAOs. GRAs are developed to aid in the identification of remedial technologies that can minimize releases, threats of releases, or pathways of exposure to the soils. GRAs were developed for 1) soils to a depth of 16 feet bgs, and 2) soils with the potential to leach COCs to groundwater. The depth limit was established because exposure to soils deeper than 16 feet bgs is unlikely. This depth is greater than the maximum standard depth of excavation for a residential development and exceeds most depths of trenching for utility lines. The following GRAs were identified:

- **No action.** The site would remain as it currently exists. Monitoring may be conducted.

- **Institutional Controls.** Institutional action would be implemented to limit site access and land uses. Personal protective equipment may also be required during certain site activities.

- **Containment.** The relevant area would be physically contained.

- **Excavation and Disposal.** Selected soil volumes would be excavated for subsequent disposal off-site without treatment.

- **Excavation, Treatment, and Disposal.** Selected soil volumes would be removed for subsequent treatment and disposal either on or off-site.

- **In-situ Extraction.** Constituents would be removed from the subsurface soils and discharged at the surface for treatment.

- **In-situ Treatment.** Selected soil volumes would be treated using appropriate technologies applied in-situ.

Although GRAs are not detailed, they categorize technologies that may be pertinent for remediation of soils. It should be noted that GRAs were not developed for groundwater because the groundwater resources beneath the OU-1 PSCs were not impacted with COCs at concentrations above ARARs. GRAs developed for the soils also ensure that future impacts to groundwater would not occur at sites that showed the potential for COCs to leach to the groundwater.

3.8 DEVELOPMENT OF REMEDIAL ALTERNATIVES

Based on the establishment of ARARs, RAOs, and GRAs, remedial alternatives were developed for eight OU-1 PSCs (PSCs RW-02, LF-03, FT-07E, DP-13, LF-14, LF-25, SD-38, and SS-42). Remedial alternatives were developed for five sites (PSCs LF-03, FT-07E, DP-13, LF-14, and SD-38) because COCs detected in the soil exceed residential SRLs and the results of the Base-wide Risk Assessment showed that current soil conditions could potentially cause a risks to human health if the sites were developed for residential purposes. Remedial alternatives were developed for PSC LF-25 because COCs were detected in the soil at concentrations in excess of the non-residential SRLs and results of the Base-wide risk assessment showed that COCs in the soil could cause adverse health risks to hypothetical future excavation workers. Remedial alternatives were developed for PSC SS-42 because a site-specific vadose zone transport model showed COCs detected in the soil could potential impact the underlying groundwater. Remedial alternatives were developed for PSC RW-02 because the mere presence of low-level radioactive wastes at this site represent conditions that warranted additional evaluation.

It is important to note that although COCs in excess of the ADEQ residential and non-residential SRLs were detected at other sites, the results of the Base-wide risk assessment showed that the risks posed to human health and the environment from exposure to these COCs were within acceptable site-specific standards, even site-specific residential standards. As described in Section 3.7.2.1, the Arizona Soil Remediation Standards allow for the determination of site-specific standards via risk assessment. In compliance with ARARS, remedial alternatives were not developed for the air, surfacewater, or groundwater at Luke AFB or for the soils at 17 of the 25 OU-1PSCs. Remedial alternatives were only developed for the soils at the eight OU-1 PSCs listed below.

- Wastewater Treatment Annex Landfill (PSC RW-02).
- Outboard Runway Landfill (PSC LF-03).
- Eastern Portion of North Fire Training Area (PSC FT-07E).
- Drainage Ditch Disposal Area (PSC DP-13).
- Old Salvage Yard Burial Site (PSC LF-14).
- Northwest Landfill (PSC LF-25).
- Southwest Oil/Water Separator at the Auto Hobby Shop (SD-38).
- Bulk Fuels Storage (SS-42).

A large number of remedial technologies could be implemented to meet the RAOs and GRAs established for the eight “actionable” OU-1 PSCs. These technologies were identified and subsequently screened using three primary criteria: technical effectiveness, institutional implementability, and relative cost. Many potential technologies were eliminated during the screening process because of their prohibitively high costs or lack of successful implementation on a field scale. Logical combinations of those technologies retained for further evaluation were assembled into 12 remedial measures. These measures, designated S-1 through S-12, are summarized in general terms in the sections that follow.

The remedial alternatives described below can consist of a variety of remedial components, While the same remedial alternative can be considered for implementation at a number of sites, the specific remedial components that make up that alternative may not be the same for every site. The specific characteristics of the individual sites will dictate which remedial components would be necessary to adequately protect human health and the environment. For these reasons, the descriptions provided in the following sections are general in nature and are only intended to give the reader an overview of the types of remedial components that may be included in each remedial alternative. Section 3.10 of this ROD provides specific details of the remedial components that comprise the remedial alternatives selected for implementation at each of the sites.

3.8.1 S-1 - No Action

Remedial Alternative S-1 involves no remedial action; however, it may include monitoring of site conditions. The no action alternative serves as a reference base for comparison of the other possible remedial alternatives. This remedial alternative was considered at all OU-1 PSCs. In the unique situation of PSC RW-

02, the no action alternative included periodic geophysical monitoring of the site to ensure that the current level of protection is maintained. Similarly, groundwater monitoring was included with the no action alternative for PSC-SS-42, where protection of groundwater impact is the basis for inclusion in the FS.

- **Effectiveness.** This alternative is not effective in preventing occupational or residential exposure to impacted soils present at the PSCs. Depending on current and future potential hypothetical receptors, conditions at OU-1 PSCs may or may not represent an appreciable hazard to human health. Although the no action alternative may not be effective in meeting the current ADEQ benchmark remediation criteria for ELCRs (10^{-6}), this criterion is subject to regulatory change. Should these criteria be modified in the future, the no action alternative may be adequately protective and appropriate for implementation at that time.

  The ELCR and HI for exposure to soil at PSCs RW-02 and SS-42 were below both the ADEQ and USEPA's risk-based remediation benchmarks, For this reason, the no action alternative is effective in preventing significant human risk at PSC RW-02, while it is not effective at other PSCs. The no action alternative may not provide adequate protection of the environment at PSC SS-42 where the potential exists for COCs in the soil to migrate to the underlying groundwater resources.

- **Implementability.** The no action alternative is technically implementable at all PSCs. Administratively, the no action alternative is unlikely to be acceptable at all PSCs.

- **Cost.** No costs are generally associated with the no action alternative. When applicable, monitoring costs are incurred by Remedial Alternative S-1. These costs vary significantly with the site.

3.8.2 S-2 - Institutional Controls

Remedial Alternative S-2 encompasses several administrative and physical measures that restrict access and limit exposure to areas impacted with COCs above remediation standards. Remedial Alternative S-2 was considered at seven OU-1 PSCs (RW-02, LF-03, FT-07E, DP-13, LF-14, LF-25, and SD-38). Institutional controls were not considered for PSC SS-42 because they would not prevent the migration of contaminants from the soils to the underlying groundwater. Depending on the specific site conditions, a variety of remedial components may be needed to protect human health and the environment. These components include:

- Restriction of Land Usage to Non-Residential Purposes.
- Install/Maintain Perimeter Fencing (if necessary).
- Conduct Periodic Monitoring (if necessary).
- Regulate Work Practices (if necessary).
- Development and Maintenance of an Institutional Control Plan.

At a minimum for all sites, Remedial Alternative S-2 includes the implementation of procedures that place restrictions on the residential development of the site. Land use restrictions have been shown to be low-cost measures that are effective in ensuring against exposure to specific populations of receptors. The procedures for restricting residential development of a site consist of several parts as described below.

As required in the Arizona Soil Remediation Standards (see Section 3.7.2.1), a Voluntary Environmental Mitigation Use Restriction (VEMUR) must be recorded to restrict residential development of a site where soil contaminant levels exceed residential cleanup standards. A VEMUR is a written document signed by the property owner and the ADEQ and recorded with the county recorder on the chain-of-title for a particular parcel of real property, which indicates that a site has not been remediated to a level that meets residential standards and, unless subsequently canceled, that the owner agrees to restrict the property to non-residential usage.

The procedures for completing a VEMUR are detailed in A.A.C. R18-7-207. In general, recording a VEMUR requires that a VEMUR Notification form be filled out in a format that complies with the A.R.S.11-480. The format must also comply with any other specific requirements of the County Recorder of the jurisdiction. In the case of Luke AFB, the Maricopa County Recorder has jurisdiction. A copy of the VEMUR Notification form is included with this ROD as Appendix C.

In addition to completing a VEMUR Notification form, additional information must be compiled and submitted with the completed form. As stated in A.A.C. R18-7-208(A), the additional information will include the following:

1. A description of the actual activities, techniques, and technologies used to remediate soil at the site, including the legal mechanism in place to ensure that any institutional and engineering controls are maintained.

2. Documentation that requirements prescribed in A.A.C. Title 18, Chapter 7, Article 2, Section R18-7-203(A) and R-18-7-203(B)(1) and (2) have been satisfied.

3. Documentation that the requirements prescribed in A.A.C. Title 18, Chapter 7, Article 2, Section R18-7-203,(B)(3) have been satisfied.

4. Soil sampling analytical results which are representative of the area which has been remediated, including documentation that the laboratory analysis of samples has been performed by a laboratory licensed by the Arizona Department of Health Services under A.R.S. 36-495 et. seq. and A.A.C. Title 9, Chapter 14, Article 6.

5. A statement certifying the following: "I certify under penalty of law that this document and all attachments are, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of a fine and imprisonment for knowing violations."

The completed VEMUR Notification form and required additional information must be submitted to the ADEQ for review and verification. The ADEQ will evaluate the information to verify compliance with current policies, rules, and standards. An authorized Departmental representative will either request additional information or sign the VEMUR and return it by certified mail. The ADEQ may revoke or amend the VEMUR if any of the information submitted is inaccurate of if any condition was unknown to the ADEQ when the VEMUR was signed.

After verification and approval by the ADEQ, the VEMUR will be recorded in the County Recorder's office where the property is located within 30 calendar days of receipt, as evidenced by the return receipt.

In addition to a VEMUR, the Base General Plan (BGP) will be revised to place constraints on the residential development ofthe PSCs. The BGP is used to implement "zoning-like" requirements at Luke AFB, and it is the only comprehensive planning document required for Air Force installations. The BGP will serve as the mechanism that ensures the institutional and engineering controls are established and maintained.

Several sections of the BGP will be revised to establish the constraints against residential development of the PSCs. Language which clearly states that residential development of the PSC is prohibited will be added to the BGP in Section 4.2.2.4 - Installation Restoration Program Sites and Section 4.4.2 - Future Land Uses. Additionally, the locations of the PSCs at which residential development is prohibited will be added to Figure 4.1 - Environmental Constraints and Opportunities; Figure 4.7 Fuel Storage and Installation Restoration Program Sites; and Figure 4.19 - Future Land Use of the BGP.

The BGP's constraints against residential development will be enforced through procedures that are already in place at Luke AFB. Prior to the beginning of any building project at Luke AFB, an Air Force Form 332 must be filed and approved. A copy of this form is included as Appendix D. As part of the approval process for AF Form 332, the BGP is reviewed to determine if any constraints exist. If constraints do exist, the project will not be approved or modifications will be required. The final approval of any building project resides with the Chief of Operations who is required to review the BGP and sip all AF Form 332s.

Depending on particular site conditions, additional measures (in addition to restricting residential development) may be required to provide adequate protection of human health. At PSC RW-02, Remedial Alternative S-2 includes periodic monitoring and additional fencing to prevent exposure.

Monitoring an area or situation for hazardous conditions ensures the safbty of receptors, while risk of exposure remains at acceptable levels. It also provides a warning mechanism in the event that conditions change.

Perimeter fencing around an area is another institutional control that accomplishes two things. First, it establishes a physical barrier barring humans from direct exposure, and second, it prevents inadvertent disruption to an area, which may increase the potential of a release.

At PSCs DP-13 and LF-25, Remedial Alternative S-2 will also include administrative controls regulating excavation practices. At these two PSCs, COC concentrations could potentially pose a risk to future excavation workers. To mitigate this exposure, work policies requiring the use of personal protective equipment (PPE) by excavation workers will be implemented.

The requirement for the use of PPE while excavating will be added to the constraints detailed in Section 4.2.2.4 of the BGP. Figures 4.1 and 4.7 of the BGP will also be revised to clearly illustrate the areas that require the use of PPE while excavating.

The constraints will be implemented through the digging permit process. A digging permit must be obtained before breaking ground at any location of Luke AFB. To obtain a digging permit an AF Form 103 must be filled out and submitted to the Base Civil Engineer Squadron for approval. A copy of AF Form 103 is provided in Appendix E.

Currently, there is no requirement for the BGP to be referenced prior to the approval of a digging permit. Likewise the Chief of Environmental Engineering is not required to review all digging permit applications. To ensure the appropriate level of protection is maintained while digging at PSCs DP-13 and LF-25, the Luke AFB Commander wil I draft and enforce a policy letter that will amend the manner in which digging permits are reviewed.

The policy letter will require the Chief of Environmental Engineering to review all AF Form 103 permits submitted at Luke AFB. As part of the review, the BGP will be cross-referenced to determine if any constraints exist. If constraints do exist, the appropriate procedures to protect human health will be required.

In addition to the above described remedial components, Luke AFB will be required to develop and maintain an Institutional Control Plan (ICP). The ICP will facilitate training and education of personnel involved with the enforcement of the required institutional controls. The ICP will document all of the required institutional and engineering controls as well as detailing the procedures for any required monitoring programs. The ICP will also document procedures for the review of digging and building permits, establish procedures for ensuring regular checks and balances are in place, include provisions for annual review and updates of the BGP, and provide for inspection and enforcement measures to assure that the required institutional controls are correctly implemented and enforced. Additionally, the ICP will establish procedures that require the regulatory agencies be notified in the event any major change in land use is proposed.

- **Effectiveness.** This alternative is effective in the protection of human health and the environment. Land use restrictions would be placed on future residential development of the impacted PSCs, thus preventing residential exposure to soils. As noted in the risk assessment, prohibiting residential development will prevent significant risk to potential receptors at the PSCs under consideration. A perimeter fence and monitoring would be effective for the long term protection of the in-place waste at PSC RW-02.

  Because no treatment is included, this alternative will not actively reduce the concentrations of COCs in the soils.

- **Implementabity.** This alternative is readily implementable at all PSCs owned by Luke AFB. The BGP is a proper tool for implementation of Remedial Alternative S-2.

- **Cost.** The direct capital cost of this alternative is low and applies to the recording of a VEMUR, necessary revisions to the BGP, and development of an ICP. Operation and maintenance (O&M) costs of monitoring requirements and fence installation, if necessary, vary, but are typically lower than active remediation.

3.8.3 S-3 - Asphalt Cap with Institutional Controls

Remedial Alternative S-3 is a containment option. This remedial alternative was considered at PSC SS-42, the only site where potential impact to groundwater is a concern. Remedial components include:

- Constructing an asphalt cap over the impacted site to prevent human exposure, surface water infiltration, and potential migration of COCs in the soils.
- Grading areas surrounding the impacted area to promote surface-water runoff away from the cap.
- Implementing institutional controls to monitor groundwater quality and provide for continued preservation of the cap.

Asphalt capping was selected as the representative option for capping technology over concrete, because PSC SS42 does not support vehicular traffic. As a flexible and relatively impermeable surface, the asphalt cap would serve the function of reducing surface-water infiltration and downward migration of the contaminants. Surface controls, such as grading, are typically employed to control run-on and runoff in capped areas. These controls will minimize, but not eliminate, required maintenance of the caps. With regular maintenance, a cap can provide long-term prevention of soils exposure and infiltration control. Furthermore, preserving the cap is essential for continued effectiveness. This can be accomplished through a maintenance program and also through BGP land use restrictions requiring cap maintenance.

Following cap construction, groundwater monitoring will assist in determining if this alternative is achieving the intended result. Because the hydrocarbons will eventually degrade, soil or soil-gas sampling will indicate when the cap is no longer needed and maintenance requirements/land use restrictions may be removed.

- **Effectiveness.** This alternative is effective in protecting human health and the environment for both the short-term and the long-term. The cap would be effective in reducing surface-water infiltration through the soils and, therefore, reduce potential migration of COCs. An asphalt cap is not a permanent measure and requires periodic maintenance and repair. Constituent concentrations will not be actively reduced and may require an extended period of time to attenuate naturally. Monitoring will ensure effectiveness.

- **Implementability.** This alternative is implementable at PSC SS-42. The cap can be constructed in the area formerly occupied by the UST and in the bermed area containing the aboveground storage tanks. The alternative would be disruptive to operations during its construction and would limit ready access to the existing underground piping connecting the tanks to the distribution system. The cap could be maintained indefinitely.

- **Cost.** The capital cost of this alternative is moderate, consisting of design and installation expenses. O&M costs are relatively low.

3.8.4 S-4 - Institutional Controls and Ex-situ Physical Treatment/Metals Recovery

Remedial Alternative S-4 is an alternative developed specifically for PSC LF-25. An active skeet shooting range is located immediately east of the site. During past operations of the skeet range, metallic shot containing lead and antimony impacted the southern portion of PSC LF-25. Future operation of the skeet range will most likely continue to impact the site.

Remedial Alternative S-4 is unique in that it includes both active remediation and the establishment of institutional controls. Initially, ex-situ physical treatment/metals recovery (shot recovery) will be performed to remove the existing metal shot from the surficial soil of the site. It is anticipated that shot recovery will remediate the soils to levels acceptable for unrestricted land use. However, because the skeet range is still active and there are no plans to close the range, shot containing potentially hazardous metals (antimony and lead) will continue to impact the site into the foreseeable future. For this reason, institutional controls will be implemented to protect human health from potential future exposures.

As explained more fully in Appendix F, Remedial Alternative S-4 (as presented in this ROD) differs slightly from the version presented in the OU-1 FS and OU-1 Proposed Plan. There are two main differences between this version and the previous one. First, as a protective measure, Remedial Alternative S-4 now requires that a shot recovery process be performed prior to the closure of the skeet range. Secondly, procedures which restrict future land uses of the site to non-residential purposes will now be implemented as part of Remedial Alternative S-4.

Originally, Remedial Alternative S-4 called for the establishement of institutional controls prior to conducting the shot recovery process. Following closure of the, skeet range (at an undetermined point in the future), a shot recovery process would be conducted to clean the site to conditions acceptable for unrestricted land use. Because the site would meet residential standards at that time and the source of the impact would no longer be present, a land use restriction would not be required. Additionally, the previously imposed institutional controls would no longer be needed after the site cleanup.

Remedial Alternative S-4 now calls for conducting the shot recovery process prior to the closure of the skeet range. This is a highly protective measure designed to immediately minimize any potential threat to human health that could result from exposure to the accumulated metals. Because the skeet range will remain open and will continue to impact the site in the future, Remedial Alternative S-4 requires implementation of institutional controls after the initial cleanup process is complete. Although the extent and magnitude of the potential future impact can not be defined, it is conservatively assumed that it may be such that it could limit potential land uses of the site. As a result, Remedial Alternative S-4 now requires a land use restriction, as well as other institutional controls, to limit future exposure to the site.

The initial phase of Remedial Alternative S-4 now involves ex-situ physical treatment/metals; recovery. This is a multi-step process that will separate and remove the accumulated metallic shot from the surficial soil. Remedial components of the metals recovery process include:

- Determining the area of impacted soil which contains COCs (antimony and lead) in excess of evaluation criteria.
- Removing the surficial soil (0 to 2 feet bgs) which contains COCs at concentrations in excess of Arizona soil remediation standards.
- Removing metal shot from the excavated material using mechanical sifting methods and gravimetric separation.
- Recycling or disposing the recovered metal shot, depending on volume and value, at an off-site facility.
- Returning soil material to scraped surface area, following compliance sampling to ensure soil quality.

The first step of metals recovery process involves the delineation of the area impacted by the metal shot. Typically, the extent of impact from skeet shooting activities cover an area 300 yards in each direction from the shooting area. However, at PSC LF-25, shot may have been spread over a much greater area due to past surface grading and ground maintenance activities. Signs clearly indicating the extent of the impacted area will be installed and properly maintained for use in future institutional controls.

After the impacted area is delineated, a metals recovery process will be performed. The recovery equipment is typically mounted on a flat-bed truck which is driven across the impacted area. As the vehicle moves, surficial soil is scraped from the ground and fed into the metals recovery processor. The scraped soil is agitated to break up the soil clumps into finer grained pieces. Then, particle size separation is accomplished by a screen with openings smaller than the metal shot. Soil particles of medium-grained sand and finer will pass through this step and will be redeposited on the ground.

The retained soil and shot mixture is then subjected to gravimetric separation, during which the larger particles retained from the first step fall through a horizontal air current created by a fan. Due to the greater density of metals, particularly lead, relative to soil, shot retained by the first step will be less affected by the air current and will not be carried as far as the lighter soil particles. Therefore, the shot will be concentrated at a location upstream from where the soil accumulates. The processor then collects the retained shot and returns the soil particles to the ground. Compaction of the returned soil and make-up soil may or may not be required depending upon the future land uses planned for the site.

The metals recovery process will produce a usable amount of metal for recycling. Because the area of impact has yet to be delineated, it is not possible to provide an estimate of how much metal will be recovered, the economic value, if any, of the recovered metal, and/or the cost of disposal. Likewise, it is not possible to provide an accurate description of the implementation requirements, limitations, and costs at this time. These specific details: will be developed as part of the Remedial Design phase.

Although this process is used extensively at public skeet ranges to collect metal shot for recycling, it has not often been implemented as a method of environmental restoration. Performance data, therefore, are scarce. However, metals recovery offers the potential for comparable performance effectiveness at a significantly reduced cost, relative to other options. Based on the results of a shot recovery treatability study conducted at PSC LF-25 in March of 1998 (ARCADIS Geraghty & Miller, Inc. 1998d; AR# 210), it is anticipated that metals concentrations in the soil can be reduced to levels that will allow for unrestricted land usage of the site.

Application ofthis alternative is based on the assumption that residual metals, in non-metallic form or in fragments significantly smaller than initial shot size, are not present at concentrations greater than the evaluation criteria. This assumption is based on visual observation, soil conditions, and the nature ofthe skeet range. Because of the alkaline soil and low rainfall conditions at the site, it is unlikely that the shot, which is initially unoxidize, will be chemically altered. Furthermore, because the metal shot is projected upward and impacts the ground with relatively minimal force, fragmentation ofthe shot is unlikely. These factors strongly suggest that residual metals concentrations in the soils, due to the shot, are unlikely to be significant.

Because there are no plans to close the skeet shooting range in the foreseeable future, metallic shot containing antimony and lead will most likely continue to impact the site following this initial metals recovery process. Institutional controls will therefore be implemented to protect human health from future exposure to the site while the range continues operation. These institutional controls will consist of:

- Implementing administrative controls requiring PPE for excavation workers in the impacted area through revisions to the BGP.

- Restriction of future land usage to non-residential purposes through the recording of a VEMUR and revisions to the BGP.

- Development and maintenance of an Institutional Control Plan.

The requirement for the use of PPE while excavating in the impact area of PSC LF-25 will be added to the constraints detailed in Section 4.2.2.4 of the BGP. Figures 4.1 and 4.7 of the BGP will also be revised to clearly illustrate the impacted area that requires the use of PPE while excavating. These constraints will be implemented through the digging permit process. As previously noted, a digging permit must be obtained before breaking ground at any location of Luke AFB.

To obtain a digging permit, an AF Form 103 must be filled out and submitted to the Base Civil Engineer Squadron for approval. A copy of AF Form 103 is provided in Appendix E. Currently, there is no requirement for the BGP to be referenced prior to the approval of a digging permit. Likewise, the Chief of Environmental Engineering is not required to review all digging permit applications. To ensure the appropriate constraints on excavation are enforced at PSC LF-25, the Luke AFB Commander will draft and enforce a policy letter requiring the Chief of Environmental Engineering to review all AF Form 103 permits and review the BGP to see ifany constraints exist. The requirement for the use of PPE will be added to all digging permits issued for excavation work in the impacted area of PSC LF-25.

Remedial Alternative S-4 also includes the implementation of procedures that place restrictions on the residential development of the site. The procedures for restricting residential development of a site consist of two parts as described below.

- Recording a Voluntary Environmental Mitigation Use Restriction (VEMUR)
- Revising the Base General Plan

As described in detail in Section 3.8.2, a VEMUR is a written document, signed by the property owner and the ADEQ and recorded with the county recorder on the chain-of-title for a particular parcel of real property, which restricts the property to non-residential usage. The procedures for completing a VEMUR are summarized in Section 3.8.2 and detailed in A.A.C. R18-7-207.

The completed VEMUR must be submitted to the ADEQ for review and verification. The ADEQ will evaluate the information to verify compliance with current policies, rules, and standards. An authorized Departmental representative will either request additional information or sign the VEMUR and return it by certified mail. After verification and approval by the ADEQ, the VEMUR will be recorded in the County Recorder's office where the property is located within 30 calendar days of receipt as evidenced by the return receipt. In the case of Luke AFB, the Maricopa County Recorder has jurisdiction. A copy of the VEMUR Notification form is included with this ROD as Appendix C.

In addition to a VEMUR, the Base General Plan (BGP) will be revised to place constraints on the residential development of the impacted area of PSC LF-25. The BGP is used to implement "zoning-like" requirements at Luke AFB, and it is the only comprehensive planning document required for Air Force installations. The BGP will serve as the mechanism that ensures the required institutional and engineering controls are established and maintained.

Several sections of the BGP will be revised to establish the constraints against residential development of the impacted area of PSC LF-25. Language which clearly states that residential development of that portion of the site is prohibited will be added to the BGP in Section 4.2.2.4 - Installation Restoration Program Sites and Section 4.4.2 - Future Land Uses. Additionally, the location of the impacted area of PSC LF-25 will be added to Figure 4.1 - Environmental Constraints and Opportunities; Figure 4.7 Fuel Storage and Installation Restoration Program Sites; and Figure 4.19 - Future Land Use of the BGP.

The BGP's constraints against residential development will be enforced through procedures that are already in place at Luke AFB. Prior to the beginning of any building project at Luke AFB, an Air Force Form 332 must be filed and approved. A copy of this form is included as Appendix D. As part of the approval process for AF Form 332, the BGP is reviewed to determine if any constraints exist. If constraints do exist, the project will not be approved or modifications will be required. The final approval of any building project resides with the Chief of Operations who is required to review the BGP and sign all AF Form 332s.

In addition to the above described remedial components, Luke AFB will be required to develop and maintain an Institutional Control Plan (ICP) as part of Remedial Alternative S-4. The ICP will facilitate training and education of personnel involved with the enforcement of the required institutional controls. The ICP will document all of the required institutional and engineering controls. The ICP will also document procedures for the review of digging permits, establish procedures for ensuring regular checks and balances are in place, include provisions for annual review and updates of the BGP, and provide for inspection and enforcement measures to assure that the required institutional controls are correctly implemented and enforced.

- **Effectiveness.** This alternative is designed to be effective in both the short-term and the long-term. The removal of the particulate lead and antimony will effectively reduce concentrations in the soil. Institutional controls will effectively provide for long-term protection against dermal exposure to impacted soils.

- **Implementability.** This alternative is readily implementable. Technical implementability requires the appropriate device for the separation process, which is common technology.

- **Cost.** The combined capital and O&M cost of this alternative is low.

3.8.5 S-5- Excavation and Off-site Disposal

Remedial Alternative S-5 provides for the removal of the impacted soil and transportation off-site to an appropriate disposal facility without treatment. Remedial components include:

- Determining the area of concern or of impacted soils containing COCs in excess of evaluation criteria.
- Profile materials for disposal/obtain permits (as necessary).
- Excavate impacted area/soils.
- Collect excavation confirmation samples.
- Transport soils to disposal facility.
- Dispose of excavated soils in an appropriate off-site landfill without treatment.
- Backfill the excavation with clean, imported material.

This remedial alternative was considered at six PSCs: PSCs LF-03, FT-07E, DP-13, LF-14, and SD-38. Remedial Alternative S-5 is not considered at this time for PSC LF-25, where ongoing operations will provide a continuous source of contamination (fallout of metal shot from the active skeet range). Excavation and disposal of impacted soils from PSC SS-42 is not reasonably implementable due to the depth of impact.

Remedial Alternative S-5 provides for the excavation and off-site disposal of all soils impacted with COCs exceeding evaluation criteria detailed in the OU-1 FS. Confirmation samples would be collected at the extent of excavation to ensure that all impacted material has been removed. Soils may be eligible for disposal at either an industrial solid waste landfill or a hazardous waste (RCRA-permitted) landfill. The final disposal decision will be made based on the concentration of specific constituents in the excavated soils and applicable land disposal restrictions (LDRs).

At PSC RW-02, where removal of the concrete encasement will eliminate potential future release to the environment and will allow future obstruction-free development of the area, Remedial Alternative S-5 will be applied with several unique considerations. The transportation of the container of low-level radioactive waste will comply with all Nuclear Regulatory Commission (NRC) guidelines and, according to USAF policy, the potential wastes will then be disposed at a licensed DoD-approved commercial disposal site (USAF 1989).

- **Effectiveness.** This alternative would effectively satisfy the RAOs by removing the concrete encasement at PSC RW-02 and all impacted soils at the other PSCs. The disposal of impacted soils without treatment will not reduce the toxicity or volume of the impacted soils. An element of long-term liability is associated with off-site disposal of untreated wastes. A secure landfill, designed to minimize the potential of a release to the environment, would be selected.

- **Implementability.** Excavation of soils to the target depth of 16 feet bgs is implementable at each of the above-listed PSCs. Where present, above-ground or below-ground structures reduce the implementability of this remedy, requiring engineered support of the structures and/or demolition.

  Because of the current industrial land usage of Luke AFB, the excavation and off-site disposal alternative at the above-listed PSCs is not necessary at this time for protection of human health and the environment. For PSC SD-38, implementation of Remedial Alternative S-5 would not necessarily be done until after demolition of the overlying structures, and redevelopment of the PSC for residential occupation.

  Excavation and transportation of the impacted soils to the appropriate landfill are technically implementable at the PSCs under consideration. Classification of waste and acceptance by landfill operators are generally source-specific, but an appropriate landfill would be identified for impacted soils. Implementation would require coordination of construction, excavation, and operation activities so as not to interfere with Base operations.

  At PSC RW-02, minor interruption to operations at the DRMO yard would be incurred for a maximum of three days. Also, USAF regulations of radioactive waste disposal may restrict the volume of waste or the scheduling of disposal. Upon excavation, the concrete must be packaged appropriately for transportation.

- **Cost.** The capital cost of this alternative ranges from moderate to high, with no associated O&M cost. The primary variables affecting the costs are the volume and waste classification (i.e., hazardous/nonhazardous) of the soil, disposal restrictions, and relative case of excavation.

3.8.6 S-6 - Excavation, Off-site Incineration, and Disposal

Remedial Alternative S-6 is applicable to PSC LF-14 where soils are impacted by PCBs. This alternative has been identified by the USEPA as the presumptive treatment process for this classification of waste. Remedial components include:

- Determine area of impacted soils containing COCs in excess of evaluation criteria.
- Profile materials for disposal/obtain permits (as necessary).
- Excavate impacted soils.
- Transport soils to treatment/disposal facility.
- Treat excavated soils to reduce COC concentrations and/or mobility.
- Monitor the treated soils to confirm effectiveness.
- Dispose of treated soils in an appropriate off-site landfill.
- Backfill the excavation with clean, imported material.

Remedial Alternative S-6 consists of excavating soils with COCs above evaluation criteria to the depth of impact, or a maximum of 16 feet bgs. A 16-foot maximum depth of excavation is based on the expectation that human contact with soils below this depth is unlikely. Confirmation samples would be collected at the extent of the excavation to ensure that impacted material has been removed. The excavated soils are then brought to a facility where they are treated in a rotary kiln incinerator to destroy organic material in the soils.

Mobile incinerators are available to treat PCB-impacted soils; however, anticipated public opposition, treatment unit availability, and relative cost favor off-site incineration. Also, in the case of PSC LF-14, chromium impacts would still require off-site disposal following treatment; therefore, off-site incineration is selected as the representative process option. While incineration is effective for soils containing petroleum hydrocarbons, other alternatives that effectively treat hydrocarbons are applicable at a significantly lower cost.

Incineration generally provides greater than 99.99 percent destruction of organic contaminants and permanently reduces the toxicity, mobility, and volume of hazardous materials contaminated with organic compounds. The disadvantages of incineration typically are limited nationwide treatment capacity, strong public opposition to this technology, and the potential for concentration of inorganic constituents in the incinerator residue.

- **Effectiveness.** The Excavation, Off-site Incineration, and Disposal alternative incorporates proven technologies for the treatment of PCBs found at PSC LF-14.

- **Implementability.** This alternative is technically and administratively implementable.

- **Cost.** The combined capital and O&M cost of this alternative is moderate to high.

3.8.7 S-7 - Excavation, Off-site Thermal/Chemical Treatment, and Disposal

Remedial Alternative S-7 consists of excavation and treatment of the impacted soils off-site prior to its disposal. Remedial components include:

- Determine area of impacted soils containing COCs in excess of evaluation criteria.
- Conduct treatability testing (as necessary).
- Profile materials for disposal/obtain permits (as necessary).
- Excavate impacted soils.
- Transport soils to treatment/disposal facility.
- Treat excavated soils to reduce COC concentrations and/or mobility by thermal or chemical means.
- Monitor the treated soils to confirm effectiveness.
- Dispose of treated soils in an appropriate off-site landfill.
- Backfill the excavation with clean, imported material.

Remedial Alternative S-7 consists of excavating soils with COCs exceeding evaluation criteria to the depth of impact, or a maximum of 16 feet bgs. A 16-foot maximum depth of excavation is based on the expectation that human contact with soils below this depth is unlikely. Confirmation samples would be collected at the extent of excavation to ensure that impacted material has been sufficiently removed. The excavated soils are then brought to a facility where they are treated to reduce the concentration of COCs or reduce their mobility through stabilization.

Remedial Alternative S-7 is being considered at PSCs FT-07E and SD-38 (fuel hydrocarbons), LF-03 (chromium), and DP-13 (lead and chromium), the only sites where excavation is feasible and the COCs may be readily treated to reduce toxicity, mobility, or volume. In combining the ex-situ remedial technologies Thermal Treatment and Chemical Treatment, Remedial Alternative S-7 will be applied differently depending on the COCs present.

- Petroleum Hydrocarbons

  In the case of petroleum hydrocarbons, off-site low temperature thermal desorption (LTTD) has been selected as the representative treatment option. For this remedial process, the excavated soils are brought to a facility where they are subjected to mechanical agitation and elevated temperatures to reduce the TRPH concentrations through enhanced volatilization of the contaminants. The vapor pressure of the contaminants is effectively increased by this process. Prior to thermal treatment, the excavated soils may require screening or shredding to eliminate large rocks or foreign materials that may foul the thermal desorber.

The LTTD operation generation an off-gas stream containing water vapor, volatilized hydrocarbons, and fine particulates. Depending on the system utilized, the emissions from the desorber are controlled using an air pollution control (APC) system typically consisting of filtration, adsorption, scrubbing, oxidation, or a combination thereof to maintain compliance with applicable air regulations. Any residue or waste stream from the APC may require subsequent treatment. The treated soils would be monitored to confirm treatment effectiveness then taken to an off-site location for final disposal.

- Metals

Off-site ex-situ Solidification/Stabilization (S/S) has been selected as the representative chemical treatment option for lead-, chromium-, and antimony-impacted soils found at selected PSCs. With this process, the impacted soils are mixed with cementing agents and, possibly, proprietary additives to chemically bind the COCs, reducing their leachability. Because no reduction in metals concentrations occurs and the risk assessment conclusions are based on concentration, the treated soils are disposed off-site by this alternative. The primary disadvantages of treatment by ex-situ S/S are the leaching potential of stabilized soils and bulking of the soils, which contain both the treated soils and the stabilizing agent, resulting in a larger volume of material requiring management.

- **Effectiveness.** The Excavation, Off-site Thermal/Chemical Treatment and Disposal Alternative incorporates proven technologies for the treatment of individual COCs found at each of the PSCs.

- **Implementability.** This alternative is technically and administratively implementable at each of the above-described PSCs. In some cases, the implementability of the excavation component of the alternative is hampered by the position of an aboveground structure. Where current conditions do not pose an unacceptable risk to current land uses, this alternative is considered reasonable only after decommissioning of the structure for reasons other than remediation.

- **Cost.** The combined capital and O&M cost of this alternative is moderate to high.

3.8.8 S-8- Excavation, On-site Thermal/Chemical Treatment, and Disposal

The scope of this remedial alternative is similar to Remedial Alternative S-7, excepting the treatment of the material on the Base instead of at an off-site facility. Remedial components include:

- Determine area of impacted soils containing COCs in excess of evaluation criteria.
- Conduct treatability testing (as necessary).
- Excavate impacted soils.
- Treat impacted soils on-site by thermal or chemical means.
- Monitor the treated soils to confirm effectiveness.
- Return the treated soils to on-site location as fill material or transport soils off-site for landfill disposal.

Remedial Alternative S-8 consists of excavating soils with COCs exceeding evaluation criteria to the depth of impact or a maximum of 16 feet bgs, as described previously. The scope of this remedial alternative is similar to the scope of Remedial Alternative S-7, except for the on-site treatment of the material. Depending on the COC, treated soils may be returned as clean fill or, alternatively, transported off-site for landfill disposal. For petroleum hydrocarbons, treated soils will be disposed on-site. Post-treatment soils from metals-contaminated sites and from PSC LF-14, which contains PCBs and metals at concentrations greater than evaluation criteria, will be transported off-site for disposal. Off-site disposal of the metals is required because the treatment will not significantly reduce the concentrations of these metals driving the risk-based evaluation. Confirmation samples would be collected at the extent of excavation to ensure that impacted material has been removed.

Remedial Alternative S-8 is being considered at PSCs FT-07E and SD-38 (fuel hydrocarbons), LF-03 (chromium), DP-13 (lead and chromium), LF-14, (PCBs and chromium), and LF-25 (lead and antimony), the only sites where excavation is feasible and the COCs may be readily treated to reduce toxicity, mobility, or volume. As with Remedial Alternative S-7, the ex-situ remedial technologies Thermal Treatment and Chemical Treatment have been combined and Remedial Alternative S-8 will be applied differently depending on the COCs present.

- Petroleum Hydrocarbons and PCBs

In the case of petroleum hydrocarbons and PCBs, on-site LTTD has been selected as the representative thermal treatment option. For implementation of the LTTD process, a mobile thermal desorption unit is assembled on-site and the excavated soils are brought to the unit. The desorber mechanically agitates the soils and elevates temperatures to reduce the TRPH and PCB concentrations through enhanced volatilization of the contaminants. The vapor pressure of the contaminants is effectively increased by this process. Because of contaminant characteristics and permitting of equipment, separate desorption units are generally required to treat the two types of impact, TRPH and PCBs. Prior to thermal treatment, the excavated soils may require screening or shredding to eliminate large rocks or foreign materials that may foul the thermal desorber.

The LTTD operation generates an off-gas stream containing water vapor, volatilized hydrocarbons and fine particulates. Depending on the system utilized, the emissions from the desorber are controlled using an APC system typically consisting of filtration, adsorption, scrubbing, oxidation, or a combination thereof to maintain compliance with applicable air regulations. In the case of PCB treatment, oxidation would not be considered as an APC because of the potential for hydrogen chloride emissions. Any residue or waste stream from the APC may require subsequent treatment. The treated soils would be monitored to confirm treatment effectiveness then disposed on-site, or in the case of PSC LF-14, taken to an off-site location for final disposal.

- Metals

On-site S/S has been selected as the representative chemical treatment option for lead-, chromium-, and antimony-impacted soils found at selected PSCs. With this process, the impacted soils are mixed with cementing agents and, possibly, proprietary additives to chemically bind the COCs reducing their leachability. Because no reduction in metals concentrations occurs and the risk assessment conclusions are based on concentration, the treated soils are disposed off-site by this alternative. The primary disadvantages of treatment by S/S are the leaching potential of stabilized soils and bulking of the soils, which contain both the treated soils and the stabilizing agent, resulting in a larger volume of material requiring management.

- **Effectiveness.** The Excavation, On-site Thermal/Chemical Treatment, and Disposal Alternative incorporates proven technologies for the treatment of individual COCs found at each of the PSCs. In contrast to Remedial Alternative S-7, on-site treatment of the contaminated soils may result in increased exposure of Base workers during treatment of the soils, although engineering controls would be used to minimize potential exposure.

- **Implementability.** This alternative is technically and administratively implementable at each of the above-described PSCs. In some cases, the implementability of the excavation component of the alternative is hampered by the position of an aboveground structure within or adjacent to the impacted soils and adequate treatment capacity. Where current conditions do not pose an unacceptable risk to current land uses, this alternative is considered reasonable only after decommissioning of the structure for reasons other than remediation. On-site treatment of PCB-impacted soils may not be acceptable.

- **Cost.** The combined capital and O&M cost of this alternative is moderate to high.

3.8.9 S-9 - Excavation, On-site Biological Treatment, and Disposal

On-site aerobic biodegradation has been successfully performed at Luke AFB in the past. This alternative was considered at PSCs FT-07E and SD-38, the only sites where excavation is feasible and the COCs may be easily biodegraded. Remedial components include:

- Determine area of impacted soils containing COCs in excess of evaluation criteria.
- Conduct treatability testing (as necessary).
- Excavate impacted soils.
- Biologically treat excavated soils to reduce COC concentrations.
- Monitor the treated soils to confirm effectiveness.
- Return the effectively treated soils to on-site location as fill material.

Remedial Alternative S-9 consists of excavating soils with COCs above evaluation criteria to the depth of impact, a maximum of 16 feet bgs. Confirmation samples will be collected at the extent of excavation to ensure that all impacted material has been removed. The excavated soils will then be subjected to aerobic biological treatment to reduce the TRPH concentrations. On-site treatment was selected as the representative process option over off-site biological treatment because of slightly lower costs and demonstrated effectiveness. The method of biological treatment may be composting, during which the soils are spread across a surface and routinely aerated. Favorable conditions for biological degradation of the organic compounds will be developed by providing nutrients (i.e., phosphorus or nitrogen), oxygen, moisture, and/or cultured bacteria to the soils. Any air emission, residue, or leachate from the remedial process may require treatment. The treatment of these process by-products will be determined in design investigation studies; however, recycling of the by-products back into the treatment unit is a likely alternative. The treated soils will be monitored to confirm treatment effectiveness then placed at another on-site location for final disposal.

- **Effectiveness.** This alternative may be effective for reducing TRPH found in the soils at PSCs FT-07E and SD-38. This remedial alternative would be effective in the long-term in protecting human health by reducing COC concentrations.

- **Implementability.** This alternative is technically and administratively implementable at PSCs FT-07E and SD-38. At PSC SD-38, the implementability of the excavation component of the alternative is hampered by the position of an aboveground structure adjacent to the impacted soils. Because current conditions do not pose an unacceptable risk to current land uses, this alternative is considered reasonable at PSC SD-38 only after decommissioning of the structure for reasons other than remediation.

- **Cost.** This alternative has a low capital cost and moderate O&M cost.

3.8.10 S-10 - Excavation, On-site Thermoplastic Solidification, and Reuse

This Remedial alternative was considered for use only at PSC LF-14 where PCB and chromium impacted soils were found. Remedial components include:

- Determine area of impacted soils containing COCs in excess of evaluation criteria.
- Profile materials for disposal/obtain permits (as necessary).
- Conduct treatability testing (as necessary).
- Excavate impacted soil.
- Stabilize excavated soils to bind COCs and add structural properties.
- Incorporate stabilized soils as aggregate into an asphalt mix process.
- Monitor the treated soils to confirm effectiveness.
- Use asphalt product for conventional paving or resurfacing.
- Backfill the excavation with clean, imported material.

Remedial Alternative S-10 consists of excavating soil with COCs exceeding evaluation criteria to the depth of impact, or a maximum of 16 feet bgs. Confirmation samples would be collected at the extent of excavation to ensure that all impacted material has been removed. The excavated soils would first be stabilized using a cementing agent, then incorporated into an asphalt production process for reuse. As an innovative technology, performance data are not readily available; however this alternative has the potential for comparable performance at significantly reduced cost, relative to other PCB alternatives.

The stabilization process may generate small quantities of off-gas, which will be treated utilizing an APC system before being discharged to the atmosphere. If any, the residue from the APC may also require subsequent treatment, The asphalt produced would be suitable for use as pavement or resurfacing material either on-site or off-site.

- **Effectiveness.** This remedial alternative can be effective in reducing the mobility of the PCBs and other organic and inorganic contaminants in soils. While the process does not reduce the volume or toxicity of the contaminants, it produces a usable end-product that may be effective in preventing contaminant exposure. On-site treatment using this alternative would be monitored regularly to ensure treatment effectiveness. In the short-term, the on-site treatment of Remedial Alternative S-10 increases exposure of site occupants to impacted soils while treatment is being performed. Access restrictions and engineering controls (e.g., dust suppression) would be used to minimize this exposure.

- **Implementability.** This alternative is technically and administratively implementable. Mobile treatment units are available and treatment can be performed on-site. No disposal requirements apply because no waste is generated, except possibly for trace amounts of residue. The primary disadvantages of treatment by Thermoplastic Solidification are the uncertain leaching potential of stabilized soil and bulking of the soil, which contains both the treated soil and the stabilizing agent, resulting in a larger volume of material requiring management. Treatability testing would be required to verify performance of this alternative.

- **Cost.** The combined capital and O&M cost of this alternative is moderate.

3.8-11 S-11 - In-Situ Soil Vapor Extraction

Remedial Alternative S-11 consists of installing a network of extraction wells in the impacted soils and applying a vacuum to the network. The remedial components include:

- Install Soil Vapor Extraction (SVE) System.
- Monitor soil and groundwater (if necessary) to confirm effectiveness and potential migration of the COCs.

Remedial Alternative S-11 consists of installing a network of extraction wells in the impacted soils and applying a vacuum to the network. The vacuum induces a pressure gradient that propagates laterally, resulting in soil-gas migration toward the extraction well. The removal of impacted vapors and recharge from non-impacted soil areas results in volatilization of adsorbed organics. Extracted vapors are treated before being discharged to the atmosphere. Vapor-phase carbon adsorption and oxidation are potential vapor treatment systems. Vapor extraction systems require periodic maintenance to ensure efficient operation. The carbon would require periodic reactivation, which would occur off-site by the carbon provider. Oxidation systems typically require supplemental fuel to support combustion and regular maintenance.

This remedial alternative is being considered at PSCs FT-07E and SS-42, the only sites where the nature of the impact is conducive to SVE. At PSC SS-42, the source of impact, analytical results, and current performance data suggest the applicability of SVE to the site. At PSC FT-07E, analytical results also indicate the presence of BTEX. It is anticipated that SVE will address the lighter molecular-weight fraction of hydrocarbons that are present at PSC FT-07E.

- **Effectiveness.** This process has been applied to a range of organics and is capable of removing volatile range TRPH. This remedial alternative would be effective in the long-term in protecting human health and the environment by removing the impacts from the soil. This measure would not prevent contact with soils in the short-term if surface soils are exposed.

- **Implementability.** This alternative is technically and administratively implementable. Both vapor extraction and off-gas treatment systems are readily available as off-the-shelf items. These systems can be installed with subsurface piping to minimize disruption to ongoing site operations. Vapor extraction systems have been tested at both PSCs under consideration for this remedial alternative. An SVE system is currently in operation at PSC SS-42 as part of the ongoing biotreatability study.

- **Cost.** The capital cost of this alternative is low to moderate. O&M costs are also low to moderate.

3.8.12 S-12- In-Situ Aerobic Biodegradation

This remedial alternative consists of using indigenous or introduced aerobic bacteria to degrade organic compounds in soils. Remedial components include:

- Install injection or extraction system to foster in-situ bioremediation.
- Monitor soils and groundwater (if necessary) to confirm effectiveness and potential migration of the COCs.

This remedial alternative is being considered at PSCs FT-07E and SS-42, the only sites where the nature of the impact is conducive to biodegradation. The natural biodegradation process is typically enhanced by elevating oxygen levels within the impacted soils by injecting ambient air. Where conditions dictate, nutrients (generally phosphorous and/or nitrogen sources), moisture, or bacterial populations can be added to optimize degradation rates. Such injection would require a network of injection wells in the impacted areas.

The potential for enhanced aerobic degradation of the residual-phase hydrocarbons was tested at PSC SS-42 through a bioventing pilot study. This study determined that the natural conditions at the site were not conclusively favorable for this technology's successful application. Specifically, the degradation rates calculated for this area were very low. The low observed degradation rates were attributed to low moisture content in the soils and low hydrocarbon concentrations in the soil intervals containing the soil-gas monitoring points (Geraghty & Miller, Inc. 1996c; ARE # 178). At PSC SS-42, where potential impact to groundwater is a concern, groundwater monitoring would be conducted as a measure of this alternative's effectiveness.

- **Effectiveness.** In-situ bioremediation has been documented to be effective in treating TRPH impacted soils in a number of environmental settings. Despite this technology's performance at other sites, this remedial alternative was not documented to be effective under certain conditions found at Luke AFB. Uncertainty exists regarding the technology's effectiveness under conditions found at the noted PSCs

- **Implementability.** This alternative is technically and administratively implementable. The installation of this system would not be disruptive to ongoing activities at the base.

- **Cost.** The capital cost of this alternative is low, typically not requiring off-gas collection and treatment. O&M costs are low to moderate.

3.9 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

After the twelve remedial alternatives (S-1 through S-12) were established, a detailed analysis was conducted to determine which alternative is most appropriate for a given site. Because the types of environmental impacts vary form site to site, not every alternative was included in the detailed analysis for each site. Only those alternatives applicable to the individual site characteristics were used. Table 3-62 provides a matrix illustrating the remedial alternatives that were included in the detailed analysis of the eight sites.

The detailed analysis consisted of comparing the applicable remedial alternatives to the nine Superfund evaluation criteria listed below. The alternative which best satisfies these nine criteria was selected for implementation.

1. Overall Protection of Human Health and the Environment.
2. Compliance with Applicable or Relevant and Appropriate Requirements (ARARs).
3. Long-term Effectiveness and Permanence.
4. Short-term Effectiveness.
5. Reduction of Toxicity, Mobility, or Volume Through Treatment.
6. Implementability.
7. Costs.
8. State Acceptance.
9. Community Acceptance.

The first two criteria are considered threshold criteria and must be met of an alternative to be selected form implementation. Criteria 3 through 7 are considered primary balancing criteria and are used to rank alternatives that satisfy the threshold criteria. The final two criteria are considered modifying criteria and are considered after public comment period has ended.

Table 3-63 provides a matrix showing whether implementation of the remedial alternative will satisfy chemical-specific ARARs. Table 3-63 also shows which action- and location-specific ARARs will apply.

3.9.1 PSC RW-02

At PSC RW-02, Remedial Alternatives S-1 (No Action), S-2 (Institutional Controls), and S-5 (Excavation and Off-site Disposal) were considered. A comparison of each of the remedial measures with respect to the nine evaluation criteria is provided in the following sections.

3.9.1.1 Overall Protection of Human Health and the Environment

- Remedial Alternative S-5 is most protective of human health and environment by removing the potential source of risk and rendering the site essentially impact-free. The disposal site will be a facility designed to contain radioactive waste and will maintain a protective environment.

- Remedial Alternative S-2 is protective of human health and the environment and satisfies all regulatory standards of protection by preventing disruption to the concrete encasement.

- Remedial Alternative S-1 is adequately protective of human health and the environment but does not protect against disruption of the concrete encasement and a potential future impact.

3.9.1.2 Compliance With ARARs

- Remedial Alternative S-5 meets all location-specific ARARs. Action-specific ARARs regarding low-level radioactive material handling and disposal will be followed. There are no chemical-specific ARARS because radionuclides were not identified as COCs. By removing the source of potential contamination and preventing a future release on site, this alternative ensures future compliance with ARARs.

- Remedial Alternatives S-1 and S-2 meet location-specific ARARs. There are no chemical specific ARARS because radionuclides were not identified as COCs.

3.9.1.3 Long-term Effectiveness and Permanence

- Remedial Alternative S-5 provides the highest degree of long-term effectiveness because it removes the source of potential risk. It does transfer a minimal amount of risk to the disposal facility; however, the standard of protection at a licensed facility exceeds the level of the existing burial condition.
- Remedial Alternative S-2 provides long-term effectiveness for the prevention of contaminant exposure by preventing disruption to the buried waste and providing a monitoring system to detect releases.

- Remedial Alternative S-1 is also effective in the long term, although to a lesser degree than Remedial Alternatives S-2 and S-5.

3.9.1.4 Short-term Effectiveness

- Remedial Alternatives S-1 and S-2 provide equivalent short-term effectiveness. Neither alternative will result in disruption to the site and the Base-wide Risk Assessment has concluded that current conditions do not present unacceptable risk.

- Remedial Alternative S-5 is least effective in the short term because it involves excavation and handling of the material during transportation and disposal. This measure provides for the potential of increased exposure to radioactivity during implementation.

3.9.1.5 Reduction of Toxicity, Mobility, or Volume Through Treatment

- Remedial Alternative S-5 does not reduce toxicity or volume but does reduce potential mobility of radioactive material by containment in a controlled environment designed to prevent migration or release of radioactivity at a licensed/permitted off-site facility. While no active reduction in toxicity takes place, radioactivity inherently decays with time.

- While Remedial Alternatives S-1 and S-2 do not actively reduce toxicity, mobility, or volume, radioactivity inherently decays with time.

3.9.1.6 Implementability

- Remedial Alternative S-1 is the most implementable, requiring no effort and no disruption to Base activities. Because no risk exists at the site, this alternative may be the most administratively implementable.

- Remedial Alternative S-2 is only slightly less implementable than Remedial Alternative S-1, requiring minimal effort and disruption to Base activities. Periodic monitoring must be conducted as part of this alternative.

- Remedial Alternative S-5 is implementable from a technical standpoint. Qualified and properly licensed contractors must be identified to manage the excavation and disposal of the waste material. The waste must also be characterized, either through historical records or waste inspection, prior to arranging for disposal; however, these tasks do not limit the implementability of Remedial Alternative S-5.

3.9.1.7 Cost

The alternatives, ranked in order of increasing costs, are S-1, S-2, and S-5. The costs range from $93,000 for Remedial Alternative S-1, No Action (Monitoring only), to approximately $428,000, for Remedial Alternative S-5, Excavation and Off-site Disposal.

3.9.1.8 State Acceptance

- Based on preliminary discussions held during the development of the FS, Remedial Alternatives S-2 and S-5 are acceptable to the regulatory agencies.

- Remedial Alternative S-1 was not discussed specifically with the regulatory agencies, therefore, State Acceptance is uncertain.

3.9.1.9 Community Acceptance

- The RAB review of the Draft version of the OU-1 FS indicated that Remedial Alternative S-2 is acceptable to the community.

- While Remedial Alternatives S-1 and S-5 were not specifically addressed during the RAB meeting, no comments were received regarding these alternatives. Community Acceptance of these alternatives is not determined.

3.9.2 PSC LF-03

At PSC LF-03, Remedial Alternatives S-1 (No Action), S-2 (Institutional Controls), S-5 (Excavation and Off-site Disposal), S-7 (Excavation, Off-site Thermal/Chemical Treatment, and Disposal), and S-8 (Excavation, On-site Thermal/Chemical Treatment, and Disposal) are under consideration. A comparison of each of the remedial measures with respect to the nine evaluation criteria is provided in the following sections.

3.9.2.1 Overall Protection of Human Health and the Environment

- Remedial Alternatives S-7 and S-8 are equally protective of human health and environment since the contaminated soils are removed and treated aboveground. Excavated soils potentially containing hexavalent chromium are also stabilized, reducing the potential for additional migration of this COC.

- Remedial Alternative S-5 is slightly less protective of human health and the environment than Remedial Alternatives S-7 and S-8, because the impacted soil is disposed without treatment. Disposal, however, would only be conducted at a secure facility designed to prevent the migration of contaminants into the environment.

- Remedial Alternative S-2 is protective of human health and the environment to a lesser extent but satisfies all regulatory standards of protection by eliminating residential exposure.

- Remedial Alternative S-1 is not adequately protective of human health. However, with additional characterization of the soils to determine the chromium valence state, the No Action alternative may be adequately protective of human health and the environment.

3.9.2.2 Compliance With ARARs

- Remedial Alternatives S-5, S-7, and S-8 meet all chemical-specific ARARs. These alternatives incorporate location- and action-specific ARARs where necessary.
- Remedial Alternative S-2 meets the chemical-specific ARARs for non-residential land use.
- Remedial Alternative S-1 does not meet chemical-specific ARARs for residential land use based on the assumption of hexavalent chromium.

3.9.2.3 Long-term Effectiveness and Permanence

- The removal and/or treatment alternatives (S-5, S-7, and S-8) provide the highest degree of long-term effectiveness because they remove the impact or source of risk.
- Remedial Alternative S-2 provides long-term effectiveness for the prevention of contaminant exposure in that enforceable land use restrictions prohibiting residential development will remain with the property for the foreseeable future.
- Remedial Alternative S-1 does not provide long-term effectiveness.

3.9.2.4 Short-term Effectiveness

- Remedial Alternatives S-1 and S-2 provide the greatest short-term effectiveness in that they result in no disruption to the site, and the risk assessment indicates that current conditions do not present unacceptable risk.
- Remedial Alternatives S-5, S-7, and S-8 are less effective in the short term because they involve excavation and handling of the soil during treatment and/or transportation/disposal. These measures provide for increased exposure to the COCs during remediation. activity.

3.9.2.5 Reduction of Toxicity, Mobility, or Volume Through Treatment

- Remedial Alternatives S-7 and S-8 reduce the mobility of the COCs, although volume and toxicity are not affected.
- Remedial Alternative S-5 does not reduce toxicity or volume but does reduce mobility by containing impacted soil in a controlled landfill environment designed to prevent migration.
- Remedial Alternatives S-1 and S-2 do not reduce toxicity, mobility, or volume.

3.9.2.6 Implementability

- Remedial Alternative S-2 is the most implementable, requiring minimal effort and no disruption to Base activities.

- Remedial Alternatives S-5 and S-7 are technically implementable in that they both involve a single excavation, transportation, and backfill event and are very short in duration.

- Remedial Alternative S-8, which requires the siting or construction of an on-site treatment facility, would be most disruptive to ongoing activities.

- Remedial Alternative S-1 is unlikely to be administratively implementable because it is not adequately protective of human health and the environment.

3.9.2.7 Cost

The alternatives, ranked in order of increasing costs, are S-1, S-2, S-8, S-5, and S- The costs range from $0 for Remedial Alternatives S-1 and S-2 to approximately $25,415,000 for Remedial Alternative S-7.

3.9.2.8 State Acceptance

- Based on preliminary discussions held during the development of the FS, Remedial Alternatives S-2, S-5, S-7, and S-8 are acceptable to the regulatory agencies.

- Because of its inability to provide adequate protection of health, Remedial Alternative S-1 is unlikely to be acceptable to the regulatory agencies.

3.9.2.9 Community Acceptance

- The RAB review of the Draft version of the FS indicated that Remedial Alternative S-2 is acceptable to the community.

- While Remedial Alternatives S-5, S-7, and S-8 were not specifically addressed during the RAB meeting, no comments were received regarding these alternatives and Community Acceptance of these alternatives is not determined.

- While Remedial Alternative S-1 was not specifically discussed with or commented upon by the RAB, Community Acceptance of the No Action alternative is unlikely.

3.9.3 PSC FT-07E

At PSC FT-07E, Remedial Alternatives S-1 (No Action), S-2 (Institutional Controls), S-5 (Excavation and Off-site Disposal), S-7 (Excavation, Off-site Thermal/Chemical Treatment, and Disposal, S-8 (Excavation, On-site Thermal/Chemical Treatment, and Disposal), S-9 (Excavation, On-site Biological Treatment, and Disposal), S-11 (In-situ Soil Vapor Extraction), and S-12 (In-situ Aerobic Biodegradation) are under consideration. A comparison of each of the remedial measures with respect to the nine evaluation criteria is provided in the following sections.

3.9.3.1 Overall Protection of Human Health and the Environment

- Remedial Alternatives S-5, S-7, S-8, and S-9 are all equally protective of human health at the site. These options achieve the greatest level of protection by removal or aboveground treatment of contaminated soils, rendering the site essentially impact-free.

- Remedial Alternative S-11 provides the next highest degree of protection by removing or treating the contaminant in-situ through enhanced volatilization, thereby reducing the impact concentration to acceptable levels. As an in-situ measure, this alternative is less likely to achieve the degree of remediation realized in ex-situ actions.

- Remedial Alternative S-12 may provide protection equivalent to Remedial Alternative S-11; however, site-specific data obtained to-date do not conclusively support the viability of enhanced aerobic biodegradation.

- Remedial Alternative S-2 is protective of human health to a lesser extent and satisfies all regulatory standards of protection by eliminating the exposure pathway to an at-risk receptor.

- Remedial Alternative S-1 is not adequately protective of human health.

3.9-3.2 Compliance With ARARs

- Remedial Alternatives S-5, S-7, S-8, S-9, S-11, and S-12 meet all chemical-specific ARARs. Likewise, these alternatives incorporate location- and action-specific ARARs where necessary.

- Remedial Alternative S-2 meets chemical-specific ARARs for non-residential land uses.

- Remedial Alternative S-1 does not meet chemical-specific ARARs.

3.9.3.3 Long-term Effectiveness and Permanence

- The removal and/or treatment alternatives (S-5, S-7, S-8, S-9, S-11, and S-12) provide the highest degree of long-term effectiveness because they remove or reduce the contaminant or source of risk.

- Remedial Alternative S-2 provides long-term effectiveness for the prevention of contaminant exposure in that enforceable land use restrictions prohibiting residential development will remain with the property for the foreseeable future.

- Remedial Alternative S-1 does not provide long-term effectiveness.

3.9.3.4 Short-term Effectiveness

- Remedial Alternatives S-1 and S-2 provide the greatest short-term effectiveness in that they result in no disruption to the site, and the risk assessment indicates that current conditions do not present unacceptable risk.

- Remedial Alternatives S-11 and S-12 provide the next highest degree of short-term effectiveness because they impose only minimal potential exposure to the hydrocarbon impacts during system installation and operation.

- Remedial Alternatives S-5, S-7, S-8, and S-9 are less effective in the short-term because they involve excavation and handling of the soil during treatment and/or transportation/disposal. These measures provide for potentially increased exposure to the hydrocarbons during remediation activity.

3.9.3.5 Reduction of Toxicity, Mobility, or Volume Through Treatment

- Remedial Alternatives S-7, S-8, and S-9 reduce toxicity, mobility, and volume to the greatest extent by separating the contaminant from the soil and ultimately destroying or concentrating the recovered hydrocarbons.

- Remedial Alternative S-11 removes volatile hydrocarbons from the soil effectively. Higher molecular weight hydrocarbons may not be effectively treated using this technology, although aerobic biodegradation of the hydrocarbons may be enhanced as a result of elevated oxygen levels created by the SVE system.

- Remedial Alternative S-12 biodegrades the residual hydrocarbons. However, as an in-situ measure, it may not be capable of reducing concentrations as effectively as ex-situ methods and, therefore, may not reduce volume or toxicity to the same extent as other treatment alternatives.

- Remedial Alternative S-5 does not reduce toxicity or volume but does reduce potential hydrocarbon mobility by containing impacted soil in a controlled landfill environment designed to prevent migration.

- Remedial Alternatives S-1 and S-2 do not actively reduce toxicity, mobility, or volume of hydrocarbon concentrations.

3.9.3.6 Implementability

- Remedial Alternative S-2 is the most implementable, requiring minimal effort and no disruption to Base activities.

- In-situ treatment alternatives S-11 and S-12 are also easily implemented and involve only moderate activity at the site.

- Remedial Alternatives S-5 and S-7 are readily implementable in that they involve a single excavation, transportation, and backfill event and are very short in duration. No known aboveground or below-ground structures would reduce the implementability of these alternatives.

- Remedial Alternatives S-8 and S-9 require the siting or construction of an on-site treatment facility and would be most disruptive to Base activities.

- Remedial Alternative S-1 is unlikely to be administratively implementable because it is not adequately protective of human health.

3.9.3.7 Cost

The alternatives, ranked in order of increasing costs, are S-1, S-2, S-12, S-5, S-7, S-9, S-8, and S-11. The costs range from $0 for Remedial Alternatives S-1 and S-2 to approximately $106,000 for Remedial Alternative S-11, In-situ SVE.

3.9.3.8 State Acceptance

- Based on preliminary discussions held during the development of the FS, Remedial Alternatives S-2, S-5, S-7, S-8, S-9, S-11, and S-12 am acceptable to the regulatory agencies.

- It is unlikely that Remedial Alternative S-1 will be acceptable to the regulatory agencies because Remedial Alternative S-1 cannot provide adequate protection of human health.

3.9.3.9 Community Acceptance

- The RAB review of the Draft version of the FS indicated that Remedial Alternative S-2 is acceptable to the community.

- While Remedial Alternatives S-5, S-7, S-8, S-9, S-11, and S-12 were not specifically addressed during the RAB meeting, no comments were received regarding these alternatives and Community Acceptance of these alternatives is not determined.

- While Remedial Alternative S-1 was not specifically discussed with or commented upon by the RAB, Community Acceptance of the No Action alternative is unlikely.

3.9A PSC DP-13

At PSC DP-13, Remedial Alternatives S-1 (No Action), S-2 (Institutional Controls), S-5 (Excavation and Off-site Disposal), S-7 (Excavation, Off-site Thermal/Chemical Treatment, and Disposal), and S-8 (Excavation, On-site Thermal/Chemical Treatment, and Disposal) are under consideration. A comparison of each of the remedial measures with respect to the nine evaluation criteria is provided in the following sections.

3.9.4.1 Overall Protection of Human Health and the Environment

- Remedial Alternatives S-5, S-7, and S-8 are all equally protective of human health at the site. These options achieve the greatest level of protection by removal and disposal or aboveground treatment of contaminated soils, rendering the site essentially impact-free.

- Remedial Alternative S-2 is protective of human health and the environment to a lesser extent and satisfies all regulatory standards of protection by eliminating the exposure pathways.

- Remedial Alternative S-1 is not adequately protective of human health.

3.9.4.2 Compliance With ARARs

- Remedial Alternatives S-5, S-7, and S-8 meet all chemical-specific ARARs. Likewise, these alternatives incorporate location- and action-specific ARARs where necessary.

- While Remedial Alternative S-2 does not meet chemical-specific ARARs for non-residential land uses, institutional controls are proposed to protect at-risk receptors.

- Remedial Alternative S-1 does not meet chemical-specific ARARs.

3.9.4.3 Long-term Effectiveness and Permanence

- The removal and/or treatment alternatives (S-5, S-7, and S-8) provide the highest degree of long-term effectiveness because they remove the impact or source of risk.

- Remedial Alternative S-2 provides long-term effectiveness for the prevention of contaminant exposure for residential and non-residential land uses in that enforceable land use restrictions prohibiting residential development will remain with the property for the foreseeable future.

- Remedial Alternative S-1 does not provide long-term effectiveness.

3.9.4.4 Short-term Effectiveness

- Remedial Alternatives S-1 and S-2 provide the greatest short-term effectiveness in that they result in no disruption to the site, and the risk assessment indicates that current conditions do not present unacceptable risk.

- Remedial Alternatives S-5, S-7, and S-8 are less effective in the short-term because they involve excavation and handling of the soil during treatment and/or transportation/disposal. These measures provide for increased exposure to the COCs during remediation activity.

3.9.4.5 Reduction of Toxicity, Mobility, or Volume Through Treatment

- Remedial Alternatives S-7 and S-8 reduce the mobility of COCs, although volume and toxicity am not affected.

- Remedial Alternative S-5 does not reduce toxicity or volume but does reduce mobility by containing impacted soil in a controlled landfill environment designed to prevent migration.

- Remedial Alternatives S-1 and S-2 do not actively reduce toxicity, mobility, and volume, as they do not provide treatment measures

3.9.4.6 Implementability

- Remedial Alternative S-2 is the most implementable, requiring minimal effort and no disruption to Base activities.

- Remedial Alternatives S-5 and S-7 are readily implementable. Both involve a single excavation, transportation, and backfill event and are short in duration. No known above-ground or below-ground structures would reduce the implementability of these alternatives.

- Remedial Alternative S-8, which requires the siting or construction of an on-site treatment facility, would be most disruptive to Base activities.

- Remedial Alternative S-1 is unlikely to be administratively implementable because it is not adequately protective of human health.

3.9.4.7 Cost

The alternatives, ranked in order of increasing costs, are S-1, S-2, S-8, S-5, and S- The costs range from $0 for Remedial Alternatives S-1 and S-2 to approximately $497,000 for Remedial Alternative S-7, Excavation, Off-site Thermal/Chemical Treatment, and Disposal.

3.9.4.8 State Acceptance

- Based on preliminary discussions held during the development of the FS, Remedial Alternatives S-2, S-5, S-7, and S-8 are acceptable to the regulatory agencies.

- It is unlikely that Remedial Alternative S-1 will be acceptable to the regulatory agencies.

3.9.4.9 Community Acceptance

- The RAB review of the Draft version of the FS indicated that Remedial Alternative S-2 is acceptable to the community.

- While Remedial Alternatives S-5, S-7, and S-8 were not specifically addressed during the RAB meeting, no comments were received regarding these alternatives and Community Acceptance of these alternatives is not determined.

- While Remedial Alternative S-1 was not specifically discussed with or commented upon by the RAB, Community Acceptance of the No Action alternative is unlikely.

3.9.5 PSC LF-14

At PSC LF-14, Remedial Alternatives S-1 (No Action), S-2 (Institutional Controls), S-5 (Excavation and Off-site Disposal), S-6 (Excavation, Off-site Incineration, and Off-site Disposal), S-8 (Excavation, On-site

Thermal/Chemical Treatment, and Disposal), and S-10 (Excavation, On-site Thermoplastic Solidification, and Reuse) are under consideration. A comparison of remedial measures is provided in the following sections.

3.9.5.1 Overall Protection of Human Health and the Environment

- Remedial Alternatives S-5, S-6, S-8, and S-10 are all equally protective of human health and environment at the site. These options achieve the greatest level of protection by removal or aboveground treatment of contaminated soils, rendering the site essentially impact-free.

- Remedial Alternative S-2 is protective of human health and the environment to a lesser extent and satisfies all regulatory standards of protection by eliminating the exposure pathway.

- Remedial Alternative S-1 is not adequately protective of human health and the environment.

3.9.5.2 Compliance With ARARs

- Remedial Alternatives S-5, S-6, S-8, and S-10 meet all chemical-specific ARARs. Likewise, these alternatives incorporate location- and action-specific ARARs. where necessary.

- Remedial Alternative S-2 meets chemical-specific ARARs for non-residential land uses.

- Remedial Alternative S-1 does not meet chemical-specific ARARs for residential land uses.

3.9.5.3 Long-term Effectiveness and Permanence

- The removal and/or treatment alternatives (S-5, S-6, S-8, and S-10) provide the highest degree of long-term effectiveness because they remove or reduce the impact or source of risk.

- Remedial Alternative S-2 provides long-term effectiveness for the prevention of contaminant exposure in that enforceable land use restrictions prohibiting residential development will remain with the property for the foreseeable future.

- Remedial Alternative S-1 does not provide long-term effectiveness.

3.9.5.4 Short-term Effectiveness

- Remedial Alternatives S-1 and S-2 provide the greatest short-term effectiveness in that they result in no disruption to the site, and the current conditions do not present unacceptable risk.

- Remedial Alternatives S-5, S-6, S-8, and S-10 are less effective in the short term because they involve excavation and handling of the soil during treatment and/or transportation/disposal. These measures provide for increased exposure to the COCs during remediation activity.

3.9.5.5 Reduction of Toxicity, Mobility, or Volume Through Treatment

- Remedial Alternative S-6 reduces toxicity, mobility, and volume to the greatest extent by destroying the organic contaminants. Inorganic impact will remain in the treated soil, but migration will be controlled in an appropriate landfill.

- Remedial Alternative S-8 reduces toxicity, mobility, and volume to a lesser degree by separating the contaminant from the soil and ultimately destroying or concentrating the recovered organic compounds. Inorganic impact will remain in the treated soil, but migration will be controlled in an appropriate landfill.

- Remedial Alternatives S-5 and S-10 do not reduce toxicity or volume but do reduce potential mobility of COCs. Remedial Alternative S-5 contains impacted soil in a controlled landfill environment designed to prevent migration, while Remedial Alternative S-10 immobilizes impacted soil in an asphalt mix.

- Remedial Alternatives S-1 and S-2 do not actively reduce toxicity, mobility, and volume, of organic compound concentrations.

3.9.5.6 Implementability

- Remedial Alternative S-2 is the most implementable, requiring minimal effort and no disruption to Base activities.

- Remedial Alternatives S-5 and S-6 are readily implementable in that they both involve a single excavation, transportation, and backfill event and are very short in duration.

- Remedial Alternatives S-8 and S-10 which require the siting or construction of an on-site treatment facility, would be most disruptive to Base activities.

- Remedial Alternative S-1 is unlikely to be administratively implementable because it is not adequately protective of human health.

3.9.5.7 Cost

The alternatives, ranked in order of increasing costs, are S-1, S-2, S-10, S-5, S-8, and S-6. The costs range from $0 for Remedial Alternatives S-1 and S-2 to approximately $13,814,000 for Remedial Alternative S-6, Excavation, Off-site Incineration, and Disposal.

3.9.5.8 State Acceptance

- Based on preliminary discussions held during the development of the FS, Remedial Alternatives S-2, S-5, S-6, S-8, and S-10 are acceptable to the regulatory agencies.

- It is unlikely that Remedial Alternative S-1 will be acceptable to the regulatory agencies.

3.9.5.9 Community Acceptance

- The RAB review of the Draft version of the FS indicated that Remedial Alternative S-2 is acceptable to the community.

- While Remedial Alternatives S-5, S-6, S-8, and S-10 were not specifically addressed during the RAB meeting, no comments were received regarding these alternatives and Community Acceptance of these alternatives is not determined.

- While Remedial Alternative S-1 was not specifically discussed with or commented upon by the RAB, Community Acceptance of the No Action alternative is unlikely.

3.9.6 PSC LF-25

Remedial Alternatives S-1 (No Action), S-2 (Institutional Controls), S4 (Institutional Controls and Ex-situ Physical Treatmentt Metals Recovery), S-7 (Excavation, Off-site Thermal/Chemical Treatment, and Off-site Disposal), and S-8 (Excavation, On-site Thermal/Chemical Treatment, and Disposal) were considered for PSC LF-25. A comparison of each of the remedial measures with respect to the nine evaluation criteria is provided in the following sections.

3.9.6.1 Overall Protection of Human Health and the Environment

- Remedial Alternative S-4, institutional controls with ex-situ physical treatment/metals recovery, is the most protective of human health and the environment. This alternative satisfies all regulatory standards of protection by removing the existing contaminants from the soil. Additionally, institutional controls will limit future exposure to any contamination that may result from the continued operation of the skeet shooting range.

- Remedial Alternatives S-7 and S-8 are both equally protective of human health and environment but to a lesser extent than Remedial Alternative S4. These options both achieve protection of human health by removal and aboveground treatment of contaminated soils, rendering the site essentially impact-free immediately after the treatment components are implemented. However, neither of these alternatives protect against future exposure to contaminated soil that may result from continued operation of the adjacent skeet shooting range.

- Remedial Alternative S-2 is protective of human health to a lesser extent than Remedial Alternatives S-4, S-7, and S-8 because current levels of contamination are not eliminated or reduced. However, Remedial Alternative S-2 does satisfy all regulatory standards of protection by eliminating and/or managing exposure to the contaminated soil.

- Remedial Alternative S-1 is not adequately protective of human health and the environment.

3.9.6.2 Compliance With ARARs

- Remedial Alternatives S-4, S-7, and S-8 meet all chemical-specific ARARs. These alternatives incorporate location- and action-specific ARARs where necessary.

- Remedial Alternatives S-1 and S-2 do not meet chemical-specific ARARs for non-residential land uses.

3.9.6.3 Long-term Effectiveness and Permanence

- Remedial Alternative S-4 provides the highest degree of long-term effectiveness because it actively removes existing contaminants from the soil and provides mechanisms to prevent and/or manage future exposure to any contaminants that may result from continued operation of the adjacent skeet shooting range.

- The removal and/or treatment alternatives (S-7 and S-8) provide a high degree of long-term effectiveness because they remove the existing impact and source of risk, however, they do not provide mechanisms to prevent exposure to any future contamination that may result from continued operation of the adjacent skeet shooting range.

- Remedial Alternative S-2 provides long-term effectiveness in that enforceable regulations that limit future land usage and provide protection to potential future excavation workers will remain with the property. However, existing contaminant levels are not reduced or eliminated.

- Remedial Alternative S-1 is not effective for the protection of future excavation workers and, therefore, does not provide long-term effectiveness.

3.9.6.4 Short-term Effectiveness

- Remedial Alternatives S-2, S-4, S-7, and S-8 are all effective in the short term because they either provide for institutional controls that protect excavation workers or they physically remove the contaminants from the site. However, the excavation and handling of the soil during treatment and/or transportation/disposal provide for increased exposure to the COCs during remediation activity.

- Remedial Alternative S-1 is not effective for the protection of excavation workers and, therefore, does not provide short-term effectiveness.

3.9.6.5 Reduction of Toxicity, Mobility, or Volume Through Treatment

- Remedial Alternative S4 is most effective in reducing toxicity, mobility, and volume because it involves recycling the metals involved, which consist of shot containing lead and antimony.

- Remedial Alternatives S-7 and S-8 reduce the mobility of COCs, although volume and toxicity are not affected.

- Remedial Alternatives S-1 and S-2 do not actively reduce toxicity, mobility, and volume, as they do not provide treatment measures.

3.9.6.6 Implementability

- Remedial Alternatives S-4, and S-7 are readily implementable in that they both involve a single excavation, transportation/treatment, and backfill event and are very short in duration.

- Remedial Alternative S-8, which requires the siting or construction of an on-site treatment facility, would be most disruptive to Base activities.

- Remedial Alternative S-2 is technically implementable, but the administrative implementability is uncertain because of the potential risk to excavation workers.

- Remedial Alternative S-1 is unlikely to be administratively implementable because it is not adequately protective of human health.

3.9.6.7 Cost

The alternatives, ranked in order of increasing costs, are S-1 , S-2, S-4, S-8, and S-7. The costs range from $0 for Remedial Alternatives S-1 and S-2 to approximately $5,673,000 for Remedial Alternative S-7, Excavation, Off-site Thermal/Chemical Treatment, and Disposal.

3.9.6.8 State Acceptance

- Based on preliminary discussions held during the development of the FS, Remedial Alternatives S-4, S-7, and S-8 are acceptable to the regulatory agencies.

- Remedial Alternative S-2 was not discussed specifically with the regulatory agencies, therefore, State Acceptance is uncertain.

- It is unlikely that Remedial Alternative S-1 will be acceptable to the regulatory agencies.

3.9.6.9 Community Acceptance

- The RAB review of the Draft version of the FS indicated that Remedial Alternative S-4 is acceptable to the community.

- While Remedial Alternatives S-2, S-7, and S-8 were not specifically addressed during the RAB meeting, no comments were received regarding these alternatives and Community Acceptance of these alternatives is not determined.

- While Remedial Alternative S-1 was not specifically discussed with or commented upon by the RAB, Community Acceptance of the No Action alternative is unlikely.

3.9.7 PSC SD-38

At PSC SD-38, Remedial Alternatives S-1 (No Action), S-2 (Institutional Controls), S-5 (Excavation and Off-site Disposal), S-7 (Excavation, Off-site Thermal/Chemical Treatment, and Disposal), S-8 (Excavation, On-site Thermal/Chemical Treatment, and Disposal), and S-9 (Excavation, On-site Biological Treatment, and Disposal) are under consideration. A comparison of each of the remedial measures with respect to the nine evaluation criteria is provided in the following sections.

3.9.7.1 Overall Protection of Human Health and the Environment

- Remedial Alternatives S-5, S-7, S-8, and S-9 are all equally protective of human health at the site. These options achieve the greatest level of protection by removal or aboveground treatment of contaminated soils, rendering the site essentially impact-free.

- Remedial Alternative S-2 is protective of human health to a lesser extent and satisfies all regulatory standards of protection by eliminating the exposure pathway.

- Remedial Alternative S-1 is not adequately protective of human health.

3.9.7.2 Compliance With ARARs

- Remedial Alternatives S-5, S-7, S-8, and S-9 meet all chemical-specific ARARs. Likewise, these alternatives incorporate location- and action-specific ARARs where necessary.

- Remedial Alternative S-2 meets chemical-specific ARARs for non-residential land uses.

- Remedial Alternative S-1 does not meet chemical-specific ARARs for residential land uses.

3.9.7.3 Long-term Effectiveness and Permanence

- The removal and/or treatment alternatives (S-5, S-7, S-8, and S-9) provide the highest degree of long-term effectiveness because they remove or reduce the impact or source of risk.

- Remedial Alternative S-2 provides long-term effectiveness for the prevention of contaminant exposure in that enforceable land use restrictions prohibiting residential development will remain with the property for the foreseeable future.

- Remedial Alternative S-1 does not provide long-term effectiveness.

3.9.7.4 Short-term Effectiveness

- Remedial Alternatives S-1 and S-2 provide the greatest short-term effectiveness in that they result in no disruption to the site, and the risk assessment indicates that current conditions do not present unacceptable risk. These unintrusive alternatives result in no additional exposure, as long as existing conditions are maintained.

- Remedial Alternatives S-5, S-7, S-8, and S-9 are less effective in the short term because they involve excavation and handling of the soil during treatment and/or transportation/disposal. These measures provide for increased exposure to the hydrocarbons during remediation activity.

3.9.7.5 Reduction of Toxicity, Mobility, or Volume Through Treatment

- Remedial Alternatives S-7, S-8, and S-9 reduce toxicity, mobility, and volume to the greatest extent by separating the contaminants from the soil and destroying the hydrocarbons.

- Remedial Alternative S-5 does not reduce toxicity or volume but does reduce mobility by containing impacted soil in a controlled landfill environment designed to prevent migration.

- Remedial Alternatives S-1 and S-2 do not actively reduce toxicity, mobility, and volume, because they do not provide treatment measures.

3.9.7.6 Implementability

- Remedial Alternative S-2 is the most implementable, requiring minimal effort and no disruption to Base activities.

- Remedial Alternatives S-5 and S-7 are readily implementable in that they both involve a single excavation, transportation, and backfill event and are very short in duration.

- Remedial Alternatives S-8 and S-9, which require the siting or construction of an on-site treatment facility, would be most disruptive to Base activities.

- Remedial Alternative S-1 is unlikely to be administratively implementable because it is not adequately protective of human health.

3.9.7.7 Cost

The alternatives, ranked in order of increasing costs, am S-1, S-2, S-9, S-5, S-7, and S-8. The costs range from $0 for Remedial Alternatives S-1 and S-2 to approximately $122,000 for Remedial Alternative S-8, Excavation, On-site Thermal/Chemical Treatment, and Disposal.

3.9.7.8 State Acceptance

- Based on preliminary discussions held during the development of the FS, Remedial Alternatives S-2, S-5, S-7, S-8, and S-9 are acceptable to the regulatory agencies.

- It is unlikely that Remedial Alternative S-1 will be acceptable to the regulatory agencies.

3.9.7.9 Community Acceptance

- The RAB review of the Draft version of the FS indicated that Remedial Alternative S-2 is acceptable to the community.

- While Remedial Alternatives S-5, S-7, S-8, and S-9 were not specifically addressed during the RAB meeting, no comments were received regarding these alternatives and Community Acceptance of these alternatives is not determined.

- While Remedial Alternative S-1 was not specifically discussed with or commented upon by the RAB, Community Acceptance of the No Action alternative is unlikely.

3.9.8 PSC SS-42

At PSC SS-42, Remedial Alternatives S-1 (No Action), S-3 (Asphalt Cap and Institutional Controls), S-11 (In-situ Soil Vapor Extraction), and S-12 (In-situ Aerobic Biodegradation) are under consideration. A comparison of each of the remedial measures with respect to the nine evaluation criteria is provided in the following sections.

3.9.8.1 Overall Protection of Human Health and the Environment

- Remedial Alternative S-3 provides the highest level of protection by installing a barrier between the impacted soil and sources of infiltration.

- Remedial Alternative S-11 is protective of the environment by removing or treating the contaminant in-situ through volatilization, and potentially enhanced aerobic biodegradation, thereby reducing the impact concentration.

- As with Remedial Alternative S-11, Remedial Alternative S-12 may provide equivalent protection of the environment. The biodegradation potential of these residual hydrocarbons has not been conclusively supported by data collected to date.

- Remedial Alternative S-1 is also adequately protective of human health but may not provide adequate protection of the environment.

3.9.8.2 Compliance With ARARs

- All chemical-specific ARARs are currently met by Remedial Alternatives S-3, S-11, and S-12. Likewise, these alternatives incorporate location- and action-specific ARARs where necessary.

- Remedial Alternative S-1 may not be compliant with chemical-specific ARARs for groundwater protection.

3.9.8.3 Long-term Effectiveness and Permanence

- Treatment Remedial Alternatives, S-11 and S-12, provide the highest degree of long-term effectiveness because they remove or reduce the impact or source of risk.

- Remedial Alternative S-3 provides long-term effectiveness for the prevention of migration in that proper maintenance of an asphalt cap can effectively extend the life of the cap indefinitely. Also, enforceable land use restrictions will remain with the property for the foreseeable future.

- Remedial Alternative S-1 is less effective, as existing site soil conditions are protective of human health but possibly pose a threat to groundwater through leaching and migration.

3.9.8.4 Short-term Effectiveness

- Remedial Alternatives S-1 and S-2 provide the greatest short-term effectiveness in that they result in no disruption to the site and the risk assessment indicates that current conditions do not present unacceptable risk. The impact does not reside at the surface, and these unintrusive alternatives result in no additional exposure as long as existing conditions are maintained.

- In-situ Remedial Alternatives, S-11 and S-12, provide the next highest degree of short-term effectiveness because they impose only minimal potential exposure to the hydrocarbon impacts during system installation and operation.

3.9.8.5 Reduction of Toxicity, Mobility, or Volume Through Treatment

- SVE, Remedial Alternative S-11, removes volatile hydrocarbons from the soil effectively. Higher molecular weight hydrocarbons may not be effectively treated by enhanced volatilization, but may be subjected to enhanced aerobic biodegradation by the elevation of oxygen concentrations within the hydrocarbon-impacted soil.

- Remedial Alternative S-12, In-situ Biodegradation, reduces toxicity, mobility, and volume of hydrocarbons by employing micro-organisms to metabolize the hydrocarbons under favorable conditions. It is expected that a small portion of hydrocarbons may be biologically persistent.

- Remedial Alternatives S-1 and S-3 are least effective in reducing toxicity, mobility, or volume, as they do not provide treatment measures.

3.9.8.6 Implementability

- In-situ treatment Remedial Alternatives S-11 and S-12 are the most implementable and involve only moderate activity at the site. The duration of these alternatives may last from one to several years and require the installation and operation of suitable treatment units.

- Remedial Alternative S-1 is technically implementable, requiring no effort or disruption to Base activities. The administratively implementability of this alternative is uncertain because no current risk exists at the site and the potential threat to groundwater is not well-defined.

- The implementation of Remedial Alternative S-3 would require the clearing and preparation of a large surface area, which currently includes berms, an existing impermeable liner, aboveground piping, monitoring wells, and other structures. These features do not prohibit implementation; however, they would significantly interfere with the construction of an asphalt cap and potentially with future maintenance of the fuel distribution system at the site.

3.9.8.7 Cost

The alternatives, ranked in order of increasing costs, are S-12, S-1, S-11, and S-3. The costs range from approximately $423,000 for Remedial Alternative S-12, In-situ Aerobic Biodegradation to approximately $524,000 for Remedial Alternative S-3, Asphalt Cap and Institutional Controls. Groundwater monitoring costs, which are incurred for 30 years with Remedial Alternatives S-1 and S-3, and for 5 and 10 years with Remedial Alternatives S-11 and S-12, respectively, have a significant equalizing effect on these costs.

3.9.8.8 State Acceptance

- Based on preliminary discussions held during the development of the FS, Remedial Alternatives S-3, S-11, and S-12 are acceptable to the regulatory agencies.
- Remedial Alternative S-1 was not discussed specifically with the regulatory agencies, therefore, State Acceptance is uncertain.

3.9.8.9 Community Acceptance

- The RAB review of the Draft version of the FS indicated that Remedial Alternative S-11 is acceptable to the community.

- While Remedial Alternatives S-3 and S-12 were not specifically addressed during the RAB meeting, no comments were received regarding these alternatives and Community Acceptance of these alternatives is not determined.

- Based on preliminary discussions and RAB meetings held during the development of the FS, Remedial Alternative S-1 will not be acceptable to the public. PSC SS-42 is the only PSC presenting a potential threat to groundwater, and the community representatives expressed concern about this issue. Remedial Alternatives that do not address the threat to groundwater are unacceptable to the community.

3.10 SELECTED REMEDIAL ALTERNATIVES

The selected remedies for the eight “actionable” OU-1 PSCs (RW-02, LF-03, FT-07E, DP-13, LF-14, SD-38, LF-25, and SS-42) are described in detail in the following sections:

3.10.1 PSC RW-02 - S-2-Institutional Controls

Remedial Alternative S-2, Institutional Controls, was selected for implementation at PSC RW-02. Remedial Alternative S-2 is protective of human health and the environment by preventing exposure to the low-level radioactive wastes at the site. Remedial Alternative S-2 is the most cost-effective option which satisfies the evaluation criteria. The remedial components which will be implemented at PSC RW-02 as part of Remedial Alternative S-2 are listed below and detailed in the paragraphs that follow.

- A VEMUR will be executed and recorded to restrict land usage of the site to non-residential purposes.
- The Base General Plan will be modified to place constraints on future residential development of the site.
- A geophysical monitoring program will be designed and implemented to ensure the safety of potential receptors and to provide a warning mechanism in case subsurface conditions change. Specific requirements of the monitoring program will be developed as part of the Remedial Design process.
- Perimeter fencing will be installed around the low-level radioactive waste containment structure to provide a barrier preventing direct exposure and to prevent inadvertent disturbance of the area. The exact locations and dimensions of the fencing will be determined in the Remedial Design process.
- An Institutional Control Plan will be developed and maintained to document the required institutional controls at PSC RW-02. The ICP will also provide guidance to key personnel who are responsible for the implementation of this remedy.

The procedures for completing a VEMUR are detailed in Title 18, Chapter 7, Article 2, Section R18-7-207 of the Arizona Administrative Code. Recording a VEMUR requires that a VEMUR Notification form be filled out in a format that complies with A.R.S. 11-480. The format must also comply with any other specific requirements of the Maricopa County Recorder. In addition to completing a VEMUR Notification form, additional information will be compiled and submitted. The required additional information is detailed in A.A.C. Title 18, Chapter 7, Article 2, Section R18-7-208(A).

The completed VEMUR Notification form and the required additional information will be submitted to the ADEQ for review and verification within 60 days of the signing of this ROD. The ADEQ will evaluate the information to verify compliance with current policies, rules, and standards. An authorized Departmental representative will either request additional information or sign the VEMUR and return it by certified mail.

After verification and approval by the ADEQ, the VEMUR will be recorded in the Maricopa County Recorder's office within 30 calendar days of receipt, as evidenced by the return receipt.

Within 60 days of the signing of this ROD, the Base General Plan will be revised to place constraints on the residential development of the PSC RW-02. Language which clearly states that residential development of this PSC is prohibited will be added to the BGP in Section 4.2.2.4 - Installation Restoration Program Sites and Section 4.4.2 - Future Land Uses. Additionally, the location of PSC RW-02 will be added to Figure 4.1 Environmental Constraints and Opportunities; Figure 4.7 Fuel Storage and Installation Restoration Program Sites; and Figure 4.19 - Future Land Use of the BGP.

The BGP's constraints against residential development will be enforced through procedures that are already in place at Luke AFB. An AF Form 332 must be submitted prior to the beginning of any building project at the Base. The final approval of any building project resides with the Chief of Operations who is required to review the BGP and sign all AF Form 332s. In compliance with the constraints that are to be added to the BGP, the Chief of Operations for Luke AFB will not approve residential development of PSC RW-02.

As part of Remedial Alternative S-2 at PSC RW-02, a geophysical monitoring program will be developed and implemented to assess the integrity of the low-level radioactive waste containment structure. Monitoring will ensure the safety of potential receptors, while risk of exposure remains at acceptable levels. It also provides a warning mechanism in the event that conditions change. At a minimum, the monitoring program will consist of installing monitoring points at locations around the containment structure and geophysical monitoring of those points for a period of 30 years using field instrumentation. Specific details of the monitoring program, such as the locations and depths of the monitoring points, field instrumentation requirements, and monitoring frequency, will be developed during the Remedial Design process.

Perimeter fencing at the surface around the containment structure will also be required at PSC RW-02 as part of Remedial Alternative S-2. Perimeter fencing is another institutional control that accomplishes two things. First, it establishes a physical barrier barring humans from direct exposure, and second, it prevents inadvertent disruption to an area, which may increase the potential of a release. Specific details for the perimeter fencing, such as the location, height, and signage requirements, will be developed during the Remedial Design process.

In addition to the above described remedial components, Luke AFB will develop and maintain an Institutional Control Plan that will document all of the required institutional and engineering controls for PSC RW-02. The ICP will facilitate training and education of personnel involved with the enforcement of the required institutional controls. The ICP will also document procedures for the review of building permits, establish procedures for ensuring regular checks and balances are in place, include provisions for annual review and updates of the BGP, and provide for inspection and enforcement measures to assure that the required institutional controls are correctly implemented and enforced. The ICP will establish procedures that require the regulatory agencies be notified in the event any major change in land use is proposed.

These measures are protective of human health and the environment in the short term and conceivably in the long term, assuming maintained integrity of the concrete. The greater short-term effectiveness and significant cost savings between Remedial Alternatives S-2 and S-5 justify this selection. A cost summary for the selected remedy is presented in Table 3-64.

3.10.2 PSC LF-03 - S-2 Institutional Controls

Remedial Alternative S-2, Institutional Controls, was selected for implementation at PSC LF-03. Remedial Alternative S-2 is protective of human health and the environment by limiting exposure to the site. This alternative is also the most cost-effective option which satisfies the evaluation criteria. The remedial components which will be implemented at PSC LF-03 as part of Remedial Alternative S-2 are listed below and detailed in the paragraphs that follow.

- A VEMUR will be executed and recorded to restrict land usage of the site to non-residential purposes.
- The Base General Plan will be modified to place constraints on future residential development of the site.
- An Institutional Control Plan will be developed and maintained to document the required institutional controls at PSC LF-03. The ICP will also provide guidance to key personnel who are responsible for the implementation of this remedy.

The procedures for completing a VEMUR are detailed in Title 18, Chapter 7, Article 2, Section R18- 7-207 of the Arizona Administrative Code. Recording a VEMUR requires that a VEMUR Notification form be filled out in a format that complies with A.R.S. 11-480. The format must also comply with any other specific requirements of the Maricopa County Recorder. In addition to completing a VEMUR Notification form, additional information will be compiled and submitted. The required additional information is detailed in A.A.C. Title 18, Chapter 7, Article 2, Section R18-7-208(A).

The completed VEMUR Notification form and the required additional information will be submitted to the ADEQ for review and verification within 60 days of the signing of this ROD. The ADEQ will evaluate the information to verify compliance with current policies, rules, and standards. An authorized Departmental representative will either request additional information or sign the VEMUR and return it by certified mail. After verification and approval by the ADEQ, the VEMUR will be recorded in the Maricopa County Recorder's office within 30 calendar days of receipt, as evidenced by the return receipt.

In addition to a VEMUR, the Base General Plan will be revised within 60 days of the signing of this ROD to place constraints on the residential development of the PSC LF-03. Several sections of the BGP will be revised to establish the constraints against residential development of PSC LF-03. Language which clearly states that residential development of this PSC is prohibited will be added to the BGP in Section 4.2.2.4 - Installation Restoration Program Sites and Section 4.4.2 - Future Land Uses. Additionally, the location of PSC LF-03 will be added to Figure 4.1 - Environmental Constraints and Opportunities; Figure 4.7 Fuel Storage and Installation Restoration Program Sites; and Figure 4.19 - Future Land Use of the BGP.

The BGP's constraints against residential development will be enforced through procedures that are already in place at Luke AFB. An AF Form 332 must be submitted prior to the beginning of any building project at the Base. The final approval of any building project resides with the Chief of Operations who is required to review the BGP and sign all AF Form 332s. In compliance with the constraints that are to be added to the BGP, the Chief of Operations for Luke AFB will not approve residential development of PSC LF-03.

In addition to the above remedial components, Luke AFB will develop and maintain an Institutional Control Plan that will document all of the required institutional and engineering controls for PSC LF-03. The ICP will facilitate training and education of personnel involved with the enforcement of the required institutional controls. The ICP will also document procedures for the review of building permits, establish procedures for ensuring regular checks and balances are in place, include provisions for annual review and updates of the BGP, and provide for inspection and enforcement measures to assure that the required institutional controls are correctly implemented and enforced. Additionally, the ICP will establish procedures that require the regulatory agencies be notified in the event any major change in land use is proposed.

The institutional controls described above are a permanent measure that ensure protection of human health at this PSC. The risk assessment concluded that the site does not present unacceptable risk to Base or industrial-scenario workers in the area, although site conditions may present unacceptable risks to residential-scenario receptors. The site is currently on the Base adjacent to a runway with very limited human exposure. Given that it is unlikely for PSC LF-03 to be converted to residential usage (experiencing frequent, repeated contact with soil) in the future, Remedial Alternative S-2 maintains the current acceptable level of protection for current conditions and institutes a provision prohibiting the unexpected event of residential development. Other alternatives considered either did not satisfy the evaluation criteria or took excessive measures to protect a hypothetical receptor that has an extremely low probability of being exposed to the site. A cost summary for the selected remedy is presented in Table 3-65.

3.10.3 PSC FT-07E - S-2 Institutional Controls

Remedial Alternative S-2, Institutional Controls, was selected for implementation at PSC FT-07E. Remedial Alternative S-2 is protective of human health and the environment by limiting exposure to the site. This alternative is also the most cost-effective option which satisfies the evaluation criteria. The remedial components which will be implemented at PSC FT-07E as part of Remedial Alternative S-2 are listed below and detailed in the paragraphs that follow.

- A VEMUR will be executed and recorded to restrict land usage of the site to non-residential purposes.

- The Base General Plan will be modified to place constraints on future residential development of the site.

- An Institutional Control Plan will be developed and maintained to document the required institutional controls at PSC FT-07E. The ICP will also provide guidance to key personnel who are responsible for the implementation of this remedy.

The procedures for completing a VEMUR are detailed in Title 18, Chapter 7, Article 2, Section R18- -207 of the Arizona Administrative Code. Recording a VEMUR requires that a VEMUR Notification form be filled out in a format that complies with A.R.S. 11-A80. The format must also comply with any other specific requirements of the Maricopa County Recorder. In addition to completing a VEMUR Notification form, additional information will be compiled and submitted. The required additional information is detailed in A.A.C. Title 18, Chapter 7, Article 2, Section R18-7-208(A).

The completed VEMUR Notification form and the required additional information will be submitted to the ADEQ for review and verification within 60 days of the signing of this ROD. The ADEQ will evaluate the information to verify compliance with current policies, rules, and standards. An authorized Departmental representative will either request additional information or sign the VEMUR and return it by certified mail. After verification and approval by the ADEQ, the VEMUR will be recorded in the Maricopa County Recorder's office within 30 calendar days of receipt, as evidenced by the return receipt.

In addition to a VEMUR, the Base General Plan will be revised within 60 days of the signing of this ROD to place constraints on the residential development of the PSC FT-07E. Language which clearly states that residential development of this PSC is prohibited will be added to the BGP in Section 4.2.2.4- Installation Restoration Program Sites and Section 4.4.2 - Future Land Uses. Additionally, the location of PSC FT-07E will be added to Figure 4.1 - Environmental Constraints and Opportunities; Figure 4.7 Fuel Storage and Installation Restoration Program Sites; and Figure 4.19 - Future Land Use of the BGP.

The BGP's constraints against residential development will be enforced through procedures that are already in place at Luke AFB. An AF Form 332 must be submitted prior to the beginning of any building project at the Base. The final approval of any building project resides with the Chief of Operations who is required to review the BGP and sign all AF Form 332s. In compliance with the constraints that are to be added to the BGP, the Chief of Operations for Luke AFB will not approve residential development of PSC FT-07E.

In addition to the above described remedial components, Luke AFB will develop and maintain an Institutional Control Plan that will document all of the required institutional and engineering controls for PSC FT-07E. The ICP will facilitate training and education of personnel involved with the enforcement of the required institutional controls. The ICP will also document procedures for the review of building permits, establish procedures for ensuring regular checks and balances are in place, include provisions for annual review and updates of the BGP, and provide for inspection and enforcement measures to assure that the required institutional controls are correctly implemented and enforced. Additionally, the ICP will establish procedures that require the regulatory agencies be notified in the event any major change in land use is proposed.

The institutional controls described above are a permanent measure that ensure protection of human health at this PSC. The risk assessment concluded that the site does not present unacceptable risk to Base or industrial-scenario workers in the area, although site conditions may present unacceptable risks to residential-scenario receptors. Given that it is unlikely for PSC FT-07E to be converted to residential usage (experiencing frequent, repeated contact with soil) in the future, Remedial Alternative S-2 maintains the current, acceptable level of protection for current conditions and institutes a provision prohibiting the unexpected event of residential development in the future.

Other alternatives considered either did not satisfy the evaluation criteria or took excessive measures to protect a hypothetical receptor that has an extremely low probability of being exposed to the site. A cost summary for the selected remedy is presented in Table 3-66.

3.10.4 PSC DP-13 - S-2 Institutional Controls

Remedial Alternative S-2, Institutional Controls, was selected for implementation at PSC DP-13. Remedial Alternative S-2 is protective of human health and the environment by limiting exposure to the site and by requiring the use of PPE while excavating. This alternative is also the most cost-effective option which satisfies the evaluation criteria . The remedial components which will be implemented at PSC DP-13 as part of Remedial Alternative S-2 are listed below and detailed in the paragraphs that follow.

- A VEMUR will be executed and recorded to restrict land usage of the site to non-residential purposes.
- The Base General Plan will be modified to place constraints on future residential development of the site.
- Work practices will be regulated by requiring the use of PPE while excavating at the site. These constraints will added to the BGP and implemented through the digging permit process.
- An Institutional Control Plan will be developed and maintained to document the required institutional controls at PSC DP-13 The ICP will also provide guidance to key personnel who are responsible for the implementation of this remedy.

The procedures for completing a VEMUR are detailed in Title 18, Chapter 7, Article 2, Section R18-7-207 of the Arizona Administrative Code. Recording a VEMUR requires that a VEMUR Notification form be filled out in a format that complies with the A.R.S. 11-480. The format must also comply with any other specific requirements of the Maricopa County Recorder. In addition to completing a VEMUR Notification form, additional information will be compiled and submitted. The required additional information is detailed in A.A.C. Title 18, Chapter 7, Article 2, Section R18-7-208(A).

The completed VEMUR Notification form and the required additional information will be submitted to the ADEQ for review and verification within 60 days of the signing of this ROD. The ADEQ will evaluate the information to verify compliance with current policies, rules, and standards. An authorized Departmental representative will either request additional information or sign the VEMUR and return it by certified mail. After verification and approval by the ADEQ, the VEMUR will be recorded in the Maricopa County Recorder's office within 30 calendar days of receipt, as evidenced by the return receipt.

In addition to a VEMUR, the Base General Plan will be revised within 60 days of the signing of this ROD to place constraints on the residential development of the PSC DP-13. Language which clearly states that residential development of this PSC is prohibited will be added to the BGP in Section 4.2.2.4- Installation Restoration Program Sites and Section 4.4.2 - Future Land Uses. Additionally, the location of PSC DP- 13 will be added to Figure 4.1 - Environmental Constraints and Opportunities; Figure 4.7 Fuel Storage and Installation Restoration Program Sites; and Figure 4.19 - Future Land Use of the BGP.

The BGP's constraints against residential development will be enforced through procedures that are already in place at Luke AFB. An AF Form 332 must be submitted prior to the beginning of any building project at the Base. The final approval of any building project resides with the Chief of Operations who is required to review the BGP and sign all AF Form 332s. In compliance with the constraints that are to be added to the BGP, the Chief of Operations for Luke AFB will not approve residential development of PSC DP- 13.

At PSC DP-13, Remedial Alternative S-2 will also include administrative controls regulating excavation practices. At this site, COC concentrations could potentially pose a risk to future excavation workers. To mitigate this exposure, work policies requiring the use of personal protective equipment by excavation workers will be implemented.

The requirement for the use of PPE while excavating will be added to the constraints detailed in Section 4.2.2.4 of the BGP. Figures 4.1 and 4.7 of the BGP will also be revised to clearly illustrate the areas that require the use of PPE while excavating. The constraints will be implemented through the digging permit process. A digging permit must be obtained before breaking ground at any location of Luke AFB. To obtain a digging permit, an AF Form 103 must be filled out and submitted to the Base Civil Engineer Squadron for approval. Currently, there is no requirement for the BOP to be referenced prior to the approval of a digging permit. Likewise the Chief of Environmental Engineering is not required to review all digging permit applications. To ensure the appropriate level of protection is maintained while digging at PSC DP-13, the Luke AFB Commander will draft and enforce a policy letter that will amend the manner in which digging permits are reviewed. The policy letter will require the Chief of Environmental Engineering to review all AF Form 103 permits and review the BGP to see if any constraints exist. The Chief of Environmental Engineer will be required to enforce the use of PPE while excavating at PSC DP-13.

In addition to the above described remedial components, Luke AFB will develop and maintain an Institutional Control Plan that will document all of the required institutional and engineering controls for PSC DP-13. The ICP will facilitate training and education of personnel involved with the enforcement of the required institutional controls. The ICP will also document procedures for the review of building permits, establish procedures for ensuring regular checks and balances are in place, include provisions for annual review and updates of the BGP, and provide for inspection and enforcement measures to assure that the required institutional controls are correctly implemented and enforced. Additionally, the ICP will establish procedures that require the regulatory agencies be notified in the event any major change in land use is proposed.

The institutional controls described above are effectively a permanent measure that ensure protection of human health at this PSC. The risk assessment concluded that the site presents unacceptable risk to excavation workers in the area and to hypothetical future residential-scenario receptors. Regulations of excavation activities that require PPE will provide protection of excavation workers and land use restrictions will prevent exposure to future residential receptors. Given that it is unlikely for PSC DP-13 to be converted to residential usage (experiencing frequent repeated contact with soil) in the future, Remedial Alternative S-2 ensures an acceptable level of protection for current conditions, including excavation workers, and institutes a provision prohibiting the unexpected event of residential development in the future.

Other alternatives considered either did not satisfy the evaluation criteria or took excessive measures to protect a hypothetical receptor that has an extremely low probability of being exposed to the site. A cost summary for the selected remedy is presented in Table 3-67.

3.10.5 PSC LF-14 - S-2 Institutional Controls

Remedial Alternative S-2, Institutional Controls, was selected for implementation at PSC LF-14. Remedial Alternative S-2 is protective of human health and the environment by limiting exposure to the site. The remedial components which will be implemented at PSC LF-14 as part of Remedial Alternative S-2 are detailed below:

- A VEMUR will be executed and recorded to restrict land usage of the site to non-residential purposes.
- The Base General Plan will be modified to place constraints on future residential development of the site.
- An Institutional Control Plan will be developed and maintained to document the required institutional controls at PSC LF- 14. The ICP will also provide guidance to key personnel who are responsible for the implementation of this remedy.

The procedures for completing a VEMUR are detailed in Title 18, Chapter 7, Article 2, Section R18-7-207 of the Arizona Administrative Code. Recording a VENUM requires that a VEMUR Notification form be filled out in a format that complies with A.R.S. 11-480. The format must also comply with any other specific requirements of the Maricopa County Recorder. In addition to completing a VEMUR Notification form, additional information will be compiled and submitted. The required additional information is detailed in A.A.C. Title 18, Chapter 7, Article 2, Section RI 8-7-208(A).

The completed VEMUR Notification form and the required additional information will be submitted to the ADEQ for review and verification within 60 days of the signing of this ROD. The ADEQ will evaluate the information to verify compliance with current policies, rules, and standards. An authorized Departmental representative will either request additional information or sign the VEMUR and return it by certified mail. After verification and approval by the ADEQ, the VEMUR will be recorded in the Maricopa County Recorder's office within 30 calendar days of receipt, as evidenced by the return receipt.

In addition to a VEMUR, the Base General Plan will be revised within 60 days of the signing of this ROD to place constraints on the residential development of the PSC LF-14. Several sections of the BGP will be revised to establish the constraints against residential development of PSC LF- 14. Language which clearly states that residential development of this PSC is prohibited will be added to the BGP in Section 4.2.2.4 - Installation Restoration Program Sites and Section 4.4.2 - Future Land Uses. Additionally, the location of PSC

LF- 14 will be added to Figure 4.1 - Environmental Constraints and Opportunities; Figure 4.7 Fuel Storage and Installation Restoration Program Sites; and Figure 4.19 - Future Land Use of the BGP.

The BGP's constraints against residential development will be enforced through procedures that are already in place at Luke AFB. An AF Form 332 must be submitted prior to the beginning of any building project at the Base. The final approval of any building project resides with the Chief of Operations who is required to review the BGP and sign all AF Form 332s. In compliance with the constraints that are to be added to the BGP, the Chief of Operations for Luke AFB will not approve residential development of PSC LF-14.

In addition to the above described remedial components, Luke AFB will develop and maintain an Institutional Control Plan that will document all of the required institutional and engineering controls for PSC LF-14. The ICP will facilitate training and education of personnel involved with the enforcement of the required institutional controls. The ICP will also document procedures for the review of building permits, establish procedures for ensuring regular checks and balances are in place, include provisions for annual review and updates of the BGP, and provide for inspection and enforcement measures to assure that the required institutional controls are correctly implemented and enforced, Additionally, the ICP will establish procedures that require the regulatory agencies be notified in the event any major change in land use is proposed.

The institutional controls described above are effectively a permanent measure that ensure protection of human health at this PSC. The risk assessment concluded that the site does not present unacceptable risk to Base or industrial-scenario workers in the area, although site conditions may present unacceptable risks to residential-scenario receptors. Given that it is unlikely that PSC LF-14 would be converted to residential usage (experiencing frequent, repeated contact with soil) in the future, Remedial Alternative S-2 ensures the current, acceptable level of protection for current conditions, and institutes a provision prohibiting the unexpected event of residential development.

Other alternatives considered either did not satisfy the evaluation criteria or took excessive measures to protect a hypothetical receptor that has an extremely low probability of being exposed to the site. A cost summary for the selected remedy is presented in Table 3-68.

3.10.6 PSC LF-25 - S-4 Institutional Controls and Ex-situ Physical Treatment/Metals Recovery

Remedial Alternative S-4, institutional controls and ex-situ physical treatment/metals recovery, was selected for implementation at PSC LF-25. Of the alternatives that were evaluated, Remedial Alternative S-4 is the most protective of human health. Not only will implementation of this alternative remove existing levels of contaminants, but it will also provide a permanent mechanism for the control and management of exposure to future contamination that may occur due to continued operation of the adjacent skeet shooting range. Remedial Alternative S-4 is also one of the most cost-effective alternatives evaluated for the site. Other alternatives considered either did not satisfy all evaluation criteria, would be too disruptive to Base activities, or would not be as cost effective. A cost summary for the selected remedy is presented in Table 3-69.

As previously detailed, COCs at this site are lead and antimony, which are present in the form of metal shot that originated from the adjacent Base skeet shooting range. The Base-wide risk assessment concluded that dermal contact and ingestion of lead and antimony associated with the shot may present an unacceptable risk to human health. Remedial Alternative S-4 will reduce the existing concentrations of lead and antimony at the site to levels that will meet Arizona's Soil Remediation Standards for residential exposure. Because the skeet range will remain active into the foreseeable future, metal shot containing antimony and lead will continue to impact the site. For this reason, Remedial Alternative S-4 also requires that institutional controls be implemented to protect human health and the environement from potential future exposures.

Initially, ex-situ physical treatment/metals recovery (shot recovery) will be performed to remove the existing metal shot from the surficial soil of the site. The initial phase is a multi-step process that will separate and remove the accumulated metallic shot from the surficial soil. Remedial components of the metals recovery process include:

- Determining the area of impacted soil which containins COCs (antimony and lead) in excess of evaluation criteria.
- Removing the surficial soil (0 to 2 feet bgs) which contains COCs at concentrations in excess of Arizona soil remediation standards.
- Removing metal shot from the excavated material using mechanical sifting methods and gravimetric separation
- Recycling or disposing the recovered metal shot, depending on volume and value, at an off-site facility.
- Returning soil material to scraped surface area, following compliance sampling to ensure soil quality.

The first step of metals recovery process involves the delineation of the area impacted by the metal shot. Typically, the extent of impact from skeet shooting activities cover an area 300 yards in each direction from the shooting area. However, at PSC LF-25, shot may have been spread over a much greater area due to past surface grading and ground maintenance activities. Signs clearly indicating the extent of the impacted area will be installed and properly maintained for use in future institutional controls.

After the impacted area is delineated, a metals recovery process will be performed. The recovery equipment is typically mounted on a flat-bed truck which is driven across the impacted area. As the vehicle moves, surficial soil is scraped from the ground and fed into the metals recovery processor. The scraped soil is agitated to break up any soil clumps into finer grained pieces. Then, particle size separation is accomplished by a screen with openings smaller than the metal shot. Typically, soil particles of medium-grained sand and finer will pass through this step and will be redeposited on the ground.

The retained soil and shot mixture is then subjected to gravimetric separation, during which the larger particles retained from the first step fall through a horizontal air current created by a fan. Due to the greater density of metals, particularly lead, relative to soil, shot retained by the first step will be less affected by the air current and will not be carried as far as the lighter soil particles. Therefore, the shot will be concentrated at a location upstream from where the soil accumulates. The processor then collects the retained shot and returns the soil particles to the ground.

Because there are no plans to close the skeet shooting range in the foreseeable future, metallic shot containing antimony and lead will most likely continue to impact the site following this initial metals recovery process. Institutional controls will therefore be implemented to protect human health from future exposure to the site while the range continues operation. These institutional controls will consist of the following:

- A VEMUR will be executed and recorded to restrict land usage of the site to non-residential purposes.

- The Base General Plan will be modified to place constraints on future residential development of the site.

- Work practices will be regulated by requiring the use of PPE while excavating at the site. These constraints will added to the BGP and implemented through the digging permit process.

- An Institutional Control Plan will be developed and maintained to document the required institutional controls at PSC LF-25 The ICP will also provide guidance to key personnel who are responsible for the implementation of this remedy.

The procedures for completing a VEMUR are detailed in Title 18, Chapter 7, Article 2, Section R 18-7-207 of the Arizona Administrative Code. Recording a VEMUR requires that a VEMUR Notification form be filled out in a format that complies with the A.R.S. 11-480. The format must also comply with any other specific requirements of the Maricopa County Recorder. In addition to completing a VEMUR Notification form, additional information will be compiled and submitted. The required additional information is detailed in A.A.C. Title 18, Chapter 7, Article 2, Section RIS-7-208(A).

The completed VEMUR Notification form and die required additional information will be submitted to the ADEQ for review and verification within 60 days of the signing of this ROD. The ADEQ will evaluate the information to verify compliance with current policies, rules, and standards. An authorized Departmental representative will either request additional information or sip the VEMUR and return it by certified mail. After verification and approval by the ADEQ, the VEMUR will be recorded in the Maricopa County Recorder's office within 30 calendar days of receipt, as evidenced by the return receipt.

In addition to a VEMUR, the Base General Plan will be revised within 60 days of the signing of this ROD to place constraints on the residential development of the PSC LF-25. Language which clearly states that residential development of this PSC is prohibited will be added to the BGP in Section 4.2.2.4 - Installation Restoration Program Sites and Section 4.4.2 - Future Land Uses. Additionally, the location of PSC LF-25 will be added to Figure 4.1 - Environmental Constraints and Opportunities; Figure 4.7 Fuel Storage and Installation Restoration Program Sites; and Figure 4.19 - Future Land Use of the BGP.

The BGP's constraints against residential development will be enforced through procedures that are already in place at Luke AFB. An AF Form 332 must be submitted prior to the beginning of any building project at the Base. The final approval of any building project resides with the Chief of Operations who is required to review the BGP and sign all AF Form 332s. In compliance with the constraints that are to be added to the BGP, the Chief of Operations for Luke AFB will not approve residential development of PSC LF-25.

Administrative controls regulating excavation practices will also be implemented at PSC LF-25. At this site, COC concentrations could potentially pose a risk to future excavation workers. To mitigate this exposure, work policies requiring the use of personal protective equipment by excavation workers will be implemented.

The requirement for the use of PPE while excavating will be added to the constraints detailed in Section 4.2.2.4 of the BGP. Figures 4.1 and 4.7 of the BGP will also be revised to clearly illustrate the areas that require the use of PPE while excavating. The constraints will be implemented through the digging permit process. A digging permit must be obtained before breaking ground at any location of Luke AFB. To obtain a digging permit, an AF Form 103 must be filled out and submitted to the Base Civil Engineer Squadron for approval. Currently, there is no requirement for the BGP to be referenced prior to the approval of a digging permit. Likewise the Chief of Environmental Engineering is not required to review all digging permit applications. To ensure the appropriate level of protection is maintained while digging at PSC LF-25, the Luke AFB Commander will draft and enforce a policy letter that will amend the manner in which digging permits are reviewed. The policy letter will require the Chief of Environmental Engineering to review all AF Form 103 permits and review the BGP to see if any constraints exist. The Chief of Environmental Engineer will be required to enforce the use of PPE while excavating at PSC LF-25.

In addition to the above described remedial components, Luke AFB will develop and maintain an Institutional Control Plan that will document all of the required institutional and engineering controls for PSC PSC LF-25. The ICP will facilitate training and education of personnel involved with the enforcement of the required institutional controls. The ICP will also document procedures for the review of building permits, establish procedures for ensuring regular checks and balances are in place, include provisions for annual review and updates of the BGP, and provide for inspection and enforcement measures to assure that the required institutional controls are correctly implemented and enforced. Additionally, the ICP will establish procedures that require the regulatory agencies be notified in the event any major change in land use is proposed.

The institutional controls described above are effectively a permanent measure that ensure protection of human health at this PSC. The risk assessment concluded that the site presents unacceptable risk to excavation workers in the area and to hypothetical future residential-scenario receptors. Regulations of excavation activities that require PPE will provide protection of excavation workers and land use restrictions will prevent exposure to future residential receptors. Given that it is unlikely for PSC LF-25 to be converted to residential usage (experiencing frequent, repeated contact with soil) in the future, Remedial Alternative S-4 ensures an acceptable level of protection for current conditions, including excavation workers, and institutes a provision prohibiting the unexpected event of residential development in the future.

3.10.7 PSC SD-38 - S-2 Institutional Controls

Remedial Alternative S-2, Institutional Controls, was selected for implementation at PSC SD-38. Remedial Alternative S-2 is protective of human health and the environment by limiting exposure to the site. Remedial Alternative S-2 is also the most cost-effective option which satisfies the evaluation criteria. The remedial components which will be implemented at PSC SD-38 as part of Remedial Alternative S-2 are detailed below:

- A VEMUR will be executed and recorded to restrict land usage of the site to non-residential purposes.
- The Base General Plan will be modified to place constraints on future residential development of the site.
- An Institutional Control Plan will be developed and maintained to document the required institutional controls at PSC SD-38. The ICP will also provide guidance to key personnel who are responsible for the implementation of this remedy.

The procedures for completing a VEMUR are detailed in Title 18, Chapter 7, Article 2, Section R18-7-207 of the Arizona Administrative Code. Recording a VEMUR requires that a VEMUR Notification form be filled out in a format that complies with A.R.S. 11-480. The format must also comply with any other specific requirements of the Maricopa County Recorder. In addition to completing a VEMUR Notification form, additional information will be compiled and submitted. The required additional information is detailed in A.A.C. Title 18, Chapter 7, Article 2, Section R18-7-208(A).

The completed VEMUR Notification form and the required additional information will be submitted to the ADEQ for review and verification within 60 days of the signing of this ROD. The ADEQ will evaluate the information to verify compliance with current policies, rules, and standards. An authorized Departmental representative will either request additional information or sign the VEMUR and return it by certified mail. After verification and approval by the ADEQ, the VEMUR will be recorded in the Maricopa County Recorder’s office within 30 calendar days of receipt, as evidenced by the return receipt.

In addition to a VEMUR, the Base General Plan will be revised within 60 days of the signing of this ROD to place constraints on the residential development of the PSC SD-38. Several sections of the BGP will be revised to establish the constraints against residential development of PSC SD-38. Language which clearly states that residential development of this PSC is prohibited will be added to the BGP in Section 4.2.2.4 -

Installation Restoration Program Sites and Section 4.4.2 - Future Land Uses. Additionally, the location of PSC LF-03 will be added to Figure 4.1 - Environmental Constraints and Opportunities; Figure 4.7 Fuel Storage and Installation Restoration Program Sites; and Figure 4.19 - Future Land Use of the BGP.

The BGP's constraints against residential development will be enforced through procedures that are already in place at Luke AFB. An AF Form 332 must be submitted prior to the beginning of any building project at the Base. The final approval of any building project resides with the Chief of Operations who is required to review the BGP and sign all AF Form 332s. In compliance with the constraints that are to be added to the BGP, the Chief of Operations for Luke AFB will not approve residential development of PSC SD-38.

In addition to the above described remedial components, Luke AFB will develop and maintain an Institutional Control Plan that will document all of the required institutional and engineering controls for PSC SD-38 The ICP will facilitate training and education of personnel involved with the enforcement of the required institutional controls. The ICP will also document procedures for the review of building permits, establish procedures for ensuring regular checks and balances are in place, include provisions for annual review and updates of the BGP, and provide for inspection and enforcement measures to assure that the required institutional controls are correctly implemented and enforced. Additionally, the ICP will establish procedures that require the regulatory agencies be notified in the event any major change in land use is proposed.

The institutional controls described above are effectively a permanent measure that ensure protection of human health at this PSC. The risk assessment concluded that the site does not present unacceptable risk to Base or industrial-scenario workers in the area, although site conditions may present unacceptable risks to residential-scenario receptors. Given that it is unlikely for PSC SD-38 to be converted to residential usage (experiencing frequent, repeated contact with soil) in the future, Remedial Alternative S-2 maintains the current, acceptable level of protection for current conditions and institutes a provision prohibiting the unexpected event of residential development in the future.

Other alternatives considered either did not satisfy the evaluation criteria or took excessive measures to protect a hypothetical receptor that has an extremely low probability of being exposed to the site. A cost summary for the selected remedy is presented in Table 3-70.

3.10.8 PSC SS-42 - S-11 Soil Vapor Extraction

The Base-wide risk assessment concluded that direct exposure to the COCs detected in the soil at PSC SS-42 do not pose unacceptable risks to human health. However, a remedy was selected for PSC SS-42 because vadose zone modeling (see Section 3.6.1.4) has shown that residual concentrations of petroleum related contaminants (TPH and BTEX) in the soil could leach to the groundwater if left untreated.

Soil Vapor Extraction was selected as the remedial alternative for PSC SS-42 because of its ease of implementation, moderate cost, and long-term effectiveness. A cost summary for the selected remedy is presented in Table 3-71. Other alternatives considered do not remove the contaminants, are less easily implemented, or may not be sufficiently effective. The remedial components associated with Remedial Alternative S-11 include:

- Install Soil Vapor Extraction (SVE) System.
- Monitor soil and groundwater to confirm effectiveness and potential migration of the COCs.

Remedial Alternative S-11consists of installing a network of extraction wells in the impacted soils and applying a vacuum to the network. ne vacuum induces a pressure gradient that propagates laterally, resulting in soil-gas migration toward the extraction well. The removal of impacted vapors and recharge from non-impacted soil areas results in volatilization of adsorbed organic compounds, including BTEX and TPH.

Extracted vapors will be treated before being discharged to the atmosphere. Vapor-phase carbon adsorption and thermal oxidation are potential vapor treatment systems. Vapor extraction systems will also require periodic maintenance to ensure efficient operation. The SVE system configuration, off-gas treatment technology, operation and maintenance procedures, and monitoring requirements will be developed in the Remedial Design phase.

Remedial Alternative S-11 also includes a groundwater monitoring program. The analytical parameters, sampling protocols, and sampling frequency for the groundwater monitoring program will be developed in the remedial design phase. However, at a minimum, groundwater monitoring will be conducted at the site at least annually for 5 years after the completion of the soil cleanup. If petroleum related contaminants (TPH or BTEX) are not detectable above laboratory reporting limits after a period of 5 years of annual monitoring, no additional groundwater monitoring will be required. However, if conditions change during the monitoring period and petroleum related contaminants are detected at concentrations above chemical-specific ARARs for groundwater, the need for additional monitoring and its frequency will be re-examined and an alternative monitoring program will be developed. Chemical-specific ARARs for groundwater are the Arizona Aquifer Water Quality Standards prescribed in A.A.C. R 18-11-406.

Implementation of Remedial Alternative S-11 will continue until all chemical-specific ARARs are met. As described in Section 3.7.2.1, the chemical-specific ARARs for soil are the Arizona Soil Remediation Standards. These standards allow for the selection of either pre-determined SRLs as prescribed in A.A.C. R18-7-205 or site-specific remediation levels derived from a site-specific human health risk assessment as prescribed in A.A.C. R18-7-206. Additionally, residential or non-residential standards can be selected using either method.

As previously summarized in Section 3.5.25 (page 3-63), direct exposure to the COCs currently detectable in the soil at PSC SS-42 have already been shown not to pose an unacceptable threat to human health under both industrial and residential land use scenarios. As a result, compliance with this portion of the Arizona Soil Remediation Standards has already been achieved.

The Arizona Soil Remediation Standards also require that a party who conducts soil remediation based on the standards set forth in either A.A.C. R18-7-205 or R18-7-206 must continue remediation until contaminants remaining in the soil do not cause or threaten to cause a violation of Aquifer Water Quality Standards prescribed in A.A.C. R18-11-406 at a point of compliance.

The methods that will be used to determine whether post-remediation soil is protective of the groundwater are described in Section 3.7.2.5. As detailed in Section 3.7.2.5, ADEQ developed a Groundwater Protection Limit (GPL) screening model for use in determining whether residual contaminant concentrations in the soil could cause or threaten to cause contamination of groundwater at levels above the AWQSs at a point of compliance. For PSC SS-42, the point of compliance will be defined as the site boundaries, which at its closest point, is 40 feet from the point of release.

ADEQ's GPL screening model was used to calculate GPLs for PSC SS42. The GPLs calculated for PSC SS-42 are presented in Appendix G. As shown in Appendix G, the GPLs are dependant upon the vertical extent of the soil contamination (depth of incorporation) and the depth to groundwater at the site.

It is important to note that GPLs were calculated for BTEX but not for TPH. GPLs could not be calculated for TPH because there are no numeric water quality standards established for TPH. Additionally, TPH represents a broad class of petroleum related compounds and not just one specific constituent. GPLs can only be calculated for individual constituents with AWQSs. Of the petroleum related constituents with established AWQSs detected at PSC SS-42, BTEX compounds posed the greatest potential risk to human health. GPLs calculated for BTEX are, therefore, considered representative values established for the protection of groundwater from the petroleum release at PSC SS-42.

In summary, soil cleanup at PSC SS-42 will continue until all chemical specific ARARs are met. Post-remediation soil contaminant concentrations must not pose at threat to human health via direct exposure and must not pose a threat to groundwater quality. For PSC SS-42, a site-specific risk assessment has already shown that risks to human health via direct exposure are at an acceptable level for residential land usage. However, soil remediation must continue until BTEX concentrations detected in the soil are below the GPLs for their depth of incorporation. GPLs calculated for PSC SS-42 are presented in Appendix G.

3.11 STATUTORY DETERMINATIONS

This section describes how the selected remedy meets the statutory requirements of CERCLA section 121. The selected remedy must:

- Be protective of human health and the environment.
- Comply with ARARs (or justify an ARAR waiver).
- Be cost effective.
- Utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable (WP).
- Satisfy the preference for treatment that reduces toxicity, mobility, or volume as a principal element, or provide n explanation as to why this preference is not satisfied.

3.11.1 PSC RW-02

3.11.1.1 Protection of Human Health and the Environment

Remedial Alternative S-2 is protective of human health and the environment and satisfies all regulatory standards of protection by preventing disruption to the concrete encasement. The risk assessment concluded that existing site conditions do not present unacceptable risk to current receptors, and the selected remedial alternative manages the hazard to at-risk receptors of a potential future impact. Furthermore, the vadose zone transport model demonstrated that COCs will not migrate to groundwater.

3.11.1.2 Compliance With ARARs

The selected remedy will comply with all applicable or relevant and appropriate requirements. No waivers of ARARs are necessary.

3.11.1.3 Cost Effectiveness

Other alternatives considered either do not satisfy the evaluation criteria (S-1) or take excessive measures (S-5) to protect a hypothetical receptor that has an extremely low probability of being exposed to the site. Remedial Alternative S-2, Institutional Controls, was the most cost effective while satisfying all the evaluation criteria.

3.11.1.4 Utilize Permanent Solutions and Alternative Treatment Technologies to the MEP

The selected remedy utilizes permanent solutions and treatment technologies to the maximum extent practicable. The five primary balancing criteria were equally decisive factors in the selection decision. Remedial Alternative S-2 provides long-term and short term effectiveness for the prevention of contaminant exposure by preventing disruption to the buried waste and providing a monitoring system to detect releases.

None of the alternatives considered reduce the toxicity or volume but Remedial Alternative S-5 does reduce potential mobility of radioactive material by containment in a controlled environment designed to prevent the migration or release of radioactivity at a licensed/permitted off-site facility. While no active reduction in toxicity takes place, radioactivity inherently decays with time. All remedial alternatives evaluated were technically implementable without significant interference to site operations. Based on evaluation of the balancing criteria, the additional costs for implementation of Remedial Alternative S-5 to potentially reduce the mobility of the radioactive material were not justified.

Therefore, Remedial Alternative S-2 was selected as a cost-effective alternative that provided protection for human health and the environment. Remedial Alternatives S-2 was acceptable to the regulatory agencies and to the community.

3.11.1.5 Preference for Treatment as a Principal Element

The existing site conditions do not present unacceptable risk to current receptors, and the selected remedy manages the hazard to at-risk receptors of a potential future impact. Therefore, treatment is not necessary.

3.11.2 PSC LF-03

3.11.2.1 Protection of Human Health and the Environment

Except for Remedial Alternative S-1, No Action, all remedial alternatives considered for PSC LF-03 provide adequate protection of human health and the environment given the conservative assumption of a hexavalent state for the chromium, the COC contributing to an unacceptable risk level. The risk assessment concluded that existing site conditions do not present unacceptable risk to current receptors, and the alternatives considered, excluding Remedial Alternative S-1, remove either the hazard or the exposure mechanism for potential at-risk future receptors. Furthermore, the vadose zone transport model demonstrated that under typical conditions, COCs at the site will not migrate to groundwater.

3.11.2.2 Compliance With ARARS

All remedial alternatives considered for PSC LF-03, except for Remedial Alternative S-1, No Action, are ARAR-compliant.

3.11.2.3 Cost Effectiveness

Remedial Alternative S-2, Institutional Controls, was the most cost-effective option satisfying the evaluation criteria.

3.11.2.4. Utilize Permanent Solutions and Alternative Treatment Technologies to MEP

The selected remedy utilizes permanent solutions and treatment technologies to the maximum extent practicable. The five primary balancing criteria were equally decisive factors in the selection decision. Remedial Alternative S-2 provides long-term effectiveness for the prevention of-contaminant exposure in that enforceable land use restrictions prohibiting residential development will remain with the property for the foreseeable future.

Remedial Alternative S-2 provides the greatest short-term effectiveness in that it results in no disruption to the site, and the risk assessment indicates that current conditions do not present unacceptable risk. All remedial alternatives evaluated were technically implementable without significant interference to site operations. Based on evaluation of the balancing criteria, Remedial Alternative S-2 was selected as a cost-effective alternative that provides protection for human health and the environment. Remedial Alternatives S-2 was acceptable to the regulatory agencies and to the community.

3.11.2.5 Preference for Treatment as a Principal Element

The existing site conditions do not present unacceptable risk to current receptors, and the selected remedy removes the exposure mechanism for potential at-risk future receptors. Therefore, treatment is not necessary.

3.11.3 PSC FT-07E

3.113.1 Protection of Human Health and the Environment

Exception for Remedial Alternative S-1, No Action, all remedial alternatives considered for PSC FT-07E provide adequate protection of human health. All alternatives considered are adequately protective of the environment. The risk assessment concluded that existing site conditions do not present unacceptable risk to current receptors, and the alternatives considered, excluding Remedial Alternative S-1, remove either the hazard or the exposure mechanism for potential at-risk receptors. Furthermore, the vadose zone transport model demonstrated that COCs will not migrate to groundwater.

3.11.3.2 Compliance With ARARs

All remedial alternatives considered for PSC FT-07E, except for Remedial Alternative S-1, No Action, are ARAR-compliant.

3.11.3.3 Cost Effectiveness

Remedial Alternative S-2, Institutional Controls, was the most cost-effective option satisfying the evaluation criteria.

3.11.3.4 Utilize Permanent Solutions and Alternative Treatment Technologies to the MEP

The selected remedy utilizes permanent solutions and treatment technologies to the maximum extent practicable. The five primary balancing criteria were equally decisive factors in the selection decision. Though the removal and/or treatment alternatives (S-5, S-7, S-8, S-9, S-11, and S-12) provide a higher degree of long-term effectiveness, Remedial Alternative S-2 also provides long-term effectiveness in that enforceable land use restrictions prohibiting residential development will remain with the property for the foreseeable future.

The selected remedy (S-2) does not actively reduce toxicity, mobility, or volume like the other alternatives (S-5, S-7, S-8, S-9, S-11, and S-12), however, hydrocarbon concentrations will naturally decline with time through chemical and biological processes. Remedial Alternative S-2 provides the greatest short-term effectiveness in that it results in no disruption to the site, and the risk assessment indicates that current conditions do not present unacceptable risk. All remedial alternatives evaluated were technically implementable without significant interference to site operations. Based on evaluation of the balancing criteria, Remedial Alternative S-2 was selected as a cost-effective alternative that provides protection for human health and the environment. Remedial Alternatives S-2 was acceptable to the regulatory agencies and to the community.

3.11.3.5 Preference for Treatment as a Principal Element

The existing site conditions do not present unacceptable risk to current receptors. The selected remedy maintains the current, acceptable level of protection for current conditions and institutes a provision prohibiting the unexpected event of residential development in the future. Therefore, treatment is not necessary.

3.11.4 <u>PSC DP-13</u>

3.11.4.1 Protection of Human Health and the Environment

Except for Remedial Alternative S-1, No Action, all remedial alternatives considered for PSC DP-13 provide adequate protection of human health. All alternatives considered are adequately protective of the environment. The risk assessment concluded that existing site conditions present an unacceptable risk to excavation workers, and the alternatives considered, excluding Remedial Alternative S-1, remove either the hazard or the exposure mechanism for at-risk receptors. Furthermore, the vadose zone transport model demonstrated that COCs will not migrate to groundwater.

3.11.4.2 Compliance With ARARs

All remedial alternatives considered for PSC DP-13, except for Remedial Alternative S-1, No Action, are ARAR-compliant.

3.11.4.3 Cost Effectiveness

Remedial Alternative S-2, Institutional Controls, was the most cost-effective option satisfying the evaluation criteria.

3.11.4.4 Utilize Permanent Solutions and Alternative Treatment Technologies to the MEP

The selected remedy utilizes permanent solutions and treatment technologies to the maximum extent practicable. The five primary balancing criteria were equally decisive factors in the selection decision. Though the removal and/or treatment alternatives (S-5, S-7, and S-8) provide a higher degree of long-term effectiveness, Remedial Alternative S-2 also provides long-term effectiveness in that enforceable land use restrictions prohibiting residential development will remain with the property for the foreseeable future.

None of the remedies evaluated reduce the toxicity or volume of the impacted materials, though, Remedial Alternatives S-7 and S-8 reduce the mobility of COCs. Remedial Alternative S-2 provides the greatest short-term effectiveness in that it results in no disruption to the site, and the risk assessment indicates that current conditions do not present unacceptable risk. All remedial alternatives evaluated were technically implementable without significant interference to site operations. Based on evaluation of the balancing criteria, Remedial Alternative S-2 was selected as a cost-effective alternative that provides protection for human health and the environment. Remedial Alternatives S-2 was acceptable to the regulatory agencies and to the community.

3.11.4.5 Preference for Treatment as a Principal Element

The existing site conditions do not present unacceptable risk to current receptors. The selected remedy maintains the current, acceptable level of protection for current conditions, including excavation workers, and institutes a provision prohibiting the unexpected event of residential development in the future. Therefore, treatment is not necessary.

3.11.5 PSC LF-14

3.11.5.1 Protection of Human Health and the Environment

Except for Remedial Alternative S-1, No Action, all alternatives considered for PSC LF- 14 provide adequate protection of human health and the environment. The risk assessment concluded that existing site conditions do not present unacceptable risk to current receptors, and the alternatives considered, excluding Remedial Alternative S-1, remove either the hazard or the exposure mechanism for potential at-risk receptors. Furthermore, the vadose zone transport model demonstrated that COCs will not migrate to groundwater.

3.11.5.2 Compliance With ARARs

All remedial alternatives considered for PSC LF- 14, except for Remedial Alternative S-1, No Action, are ARAR-compliant.

3.11.5.3 Cost Effectiveness

Remedial Alternative S-2, Institutional Controls, was the most cost-effective option satisfying the evaluation criteria.

3.11.5.4 Utilize Permanent Solutions and Alternative Treatment Technologies to the MP

The selected remedy utilizes permanent solutions and treatment technologies to the maximum extent practicable. The five primary balancing criteria were equally decisive factors in the selection decision. Though the removal and/or treatment alternatives (S-5, S-6, S-8, and S-10) provide a higher degree of long-term effectiveness, Remedial Alternative S-2 also provides long-term effectiveness in that enforceable land use restrictions prohibiting residential development will remain with the property for the foreseeable future.

Remedial Alternative S-2 provides the greatest short-term effectiveness in that it results in no disruption to the site, and the risk assessment indicates that current conditions do not present unacceptable risk. All remedial alternatives evaluated were technically implementable without significant interference to site operations. Based on evaluation of the balancing criteria, Remedial Alternative S-2 was selected as a cost-effective alternative that provides protection for human health and the environment. Remedial Alternatives S-2 was acceptable to the regulatory agencies and to the community.

3.11.5.5 Preference for Treatment as a Principal Element

The existing site conditions do not present unacceptable risk to current receptors. The selected remedy maintains the current, acceptable level of protection for current conditions, and institutes a provision prohibiting the unexpected event of residential development in the future. Therefore, treatment is not necessary.

3.11.6 PSC LF-25

3.11.6.1 Protection of Human Health and the Environment

Except for Remedial Alternative S-1, No Action, all remedial alternatives considered for PSC LF-25 provide adequate protection of human health and the environment. The risk assessment concluded that existing site conditions present unacceptable risk to current excavation workers. The alternatives considered, excluding Remedial Alternative S-1, remove either the hazard or the exposure mechanism for potential at-risk receptors. Furthermore, the vadose zone transport model demonstrated that COCs will not migrate to groundwater.

3.11.6.2 Compliance With ARARs

All remedial alternatives considered for PSC LF-25, except for Remedial Alternative S-1, No Action, are ARAR-compliant.

3.11.6.3 Cost Effectiveness

Remedial Alternative S-4 was selected at PSC LF-25 as a cost-effective option satisfying all RAOs and adapted to the unique conditions of PSC LF-25.

3.11.6.4 Utilize Permanent Solutions and Alternative Treatment Technologies to the MEP

The selected remedy utilizes permanent solutions and treatment technologies to the maximum extent practicable. The five primary balancing criteria were equally decisive factors in the selection decision.

Remedial Alternative S-4, metals recovery, is more effective in the long term than the other excavation alternatives because it not only removes the existing contaminants, but establishes permanent mechanisms that will control and limit exposure to any future impact to the site that may result from continued use of the adjacent skeet shooting range.

Remedial Alternative S-4 is most effective in reducing toxicity, mobility, and volume because it involves recycling the metals involved, which consist of lead shot. All alternatives except S-1 are effective in the short term because they provide for institutional controls that protect excavation workers prior to closure of the skeet range. All remedial alternatives are technically implementable without significant interference to Base operations.

Based on evaluation of the balancing criteria, the selected remedy was Remedial Alternative S-4. The other alternatives considered either did not satisfy the evaluation criteria (S- 1), did not provide a desired level of protection (S-2), or provided comparable effectiveness at an increased cost (S-7 and S-8). Remedial Alternatives S-4 was acceptable to the regulatory agencies and to the community.

3.11.6.5 Preference for Treatment as a Principal Element

The statutory preference for treatment as a principal element is satisfied for PSC LF-25. Remedial Alternative S-4 will remove the metal shot from the soil and restore the site to conditions acceptable for unrestricted land use. Because the skeet range will remain operational after the initial cleanup is conducted, institutional controls will also be implemented. ADEQ regulations (ARS 49-151 [A]) allow the use of institutional controls to achieve non-residential site-specific remediation levels, proposed as second measure in Remedial Alternative S-4.

3.11.7 PSC SD-38

3.11.7.1 Protection of Human Health and the Environment

Except for Remedial Alternative S-1, No Action, all remedial alternatives considered for PSC SD-38 provide adequate protection of human health. All alternatives considered for this PSC were adequately protective of the environment. The risk assessment concluded that existing site conditions do not present unacceptable risk to current receptors, and the alternatives considered, excluding Remedial Alternative S-1, remove either the hazard or the exposure mechanism for potential at-risk receptors. The vadose zone transport model demonstrated COCs will not migrate to groundwater.

3.11.7.2 Compliance With ARARs

All remedial alternatives considered for PSC SD-38, except for Remedial Alternative S-1, No Action, are ARAR-compliant.

3.11.7.3 Cost Effectiveness

Remedial Alternative S-2, Institutional Controls, was the most cost-effective option satisfying the evaluation criteria.

3.11.7.4 Utilize Permanent Solutions and Alternative Treatment Technologies to the MEP

The selected remedy utilizes permanent solutions and treatment technologies to the maximum extent practicable. The five primary balancing criteria were equally decisive factors in the selection decision. Though the removal and/oi treatment alternatives (S-5, S-7, S-8, and S-9) provide a higher degree of long-term effectiveness, Remedial Alternative S-2 also provides long-term effectiveness in that enforceable land use restrictions prohibiting residential development will remain with the property for the foreseeable future.

While Remedial Alternative S-2 does not actively reduce toxicity, mobility, and volume, because it does not provide treatment measures, hydrocarbon concentrations will naturally decline with time through chemical and biological processes. Remedial Alternative S-2 provides the greatest short-term effectiveness in that it results in no disruption to the site, and the risk assessment indicates that current conditions do not present unacceptable risk. All remedial alternatives evaluated were technically implementable without significant interference to site operations.

Based on evaluation of the balancing criteria, Remedial Alternative S-2 was selected as a cost-effective alternative that provides protection for human health and the environment. Remedial Alternatives S-2 was acceptable to the regulatory agencies and to the community.

3.11.7.5 Preference for Treatment as a Principal Element

The existing site conditions do not present unacceptable risk to current receptors. The selected remedy maintains the current, acceptable level of protection for current conditions, and institutes a provision prohibiting the unexpected event of residential development in the future. Therefore, treatment is not necessary.

3.11.8 PSC SS-42

3.11.8.1 Protection of Human Health and the Environment

All remedial alternatives considered for PSC SS-42 provide adequate protection of human health. The risk assessment concluded that existing site conditions do not present unacceptable risk to current or future receptors. However, the vadose zone transport model, the comparison of detected BTEX concentrations in soils to the Arizona Groundwater Protection Limits (GPLs), and the groundwater concentrations of BTEX, all indicate that hydrocarbons in soils could migrate to groundwater but are unlikely to significantly impact groundwater quality at concentrations at or near Aquifer Water Quality Standards (AWQSs).

3.11.8.2 Compliance With ARARs

All remedial alternatives considered for PSC SS-42 are ARAR-compliant, except possibly for Remedial Alternative S-1, No Action. This site does not exceed acceptable risk levels but does present a potential threat to groundwater.

3.11.8.3 Cost Effectiveness

Remedial Alternative S-11 is recommended at PSC SS-42 because it satisfies all evaluation criteria at a moderate cost.

3.11.8.4 Utilize Permanent Solutions and Alternative Treatment Technologies to the MEP

The selected remedy utilizes permanent solutions and treatment technologies to the maximum extent practicable. The five primary balancing criteria were equally decisive factors in the selection decision. Selected remedial alternatives, S-11, provide the highest degree of long-term effectiveness because it removes the impact or source of risk, thereby, reducing the toxicity, mobility, and volume through treatment.

Remedial Alternative S-2 provides the greatest short-term effectiveness in that it results in no disruption to the site, and the risk assessment indicates that current conditions do not present unacceptable risk. However, the selected remedy, S-11, imposes only minimal potential exposure to the hydrocarbon impacts during system installation and operation. In-situ treatment Remedial Alternatives are the most implementable and involve only moderate activity at the site.

Based on evaluation of the balancing criteria, Remedial Alternative S-11 was selected due to its ease of implementation, moderate cost, and long-term effectiveness. Remedial Alternatives S-11 was acceptable to the regulatory agencies and to the community.

3.11.8.5 Preference for Treatment as a Principal Element

The statutory preference for treatment as a principal element is satisfied for PSC SS-42. PSC SS-42 is included in the FS because contaminated soils may pose a threat to groundwater.

4.0 RESPONSIVENESS SUMMARY

The Responsiveness Summary of the ROD summarizes all written and verbal comments received from the public during the Proposed Plan public comment period. This section also provides Luke AFB responses to those comments.

4.1 SUMMARY OF PUBLIC COMMENTS

As discussed in Section 3.3 of this document, *Highlights of Community Participation*, the public comment period on the Proposed Plan was from April 21, 1998 through May 21, 1998. In general, the only verbal comments received during the public comment period were in favor of the proposed remedial alternatives. Several members of the community commented that they believed Luke AFB was doing a good job with their environmental program and trusted the Base was making the correct decisions. Only one written comment was received during the public comment period. The only written comment was in the form of a letter written by a real estate developer/adjacent property owner. The concerns expressed in the letter include:

- Although they were essentially in agreement with the proposed alternatives, they were not necessarily in favor of institutional controls at six of the PSCs.
- They were opposed to the description of Luke AFB, in its entirety, as the CERCLA site. They believed that only the affected areas should be characterized as CERCLA sites. Additionally, they requested that when these sites are described on maps that they be distinguished between areas of surface and groundwater contamination.
- They suggested that the public be informed where their drinking water is coming from in relation to the sites to better illustrate that no impacts to their drinking water have occurred.
- They suggested that the Base provide a schedule of remedial activities to be conducted at the PSCs to provide a sense of closure for the environmental activities at the Base.

4.2 RESPONSE TO PUBLIC COMMENTS

This section of the Responsiveness Summary provides Luke AFB's response to the public comments. Because all of the verbal comments received during the public comment period were in favor of the recommended remedial alternatives, no response is necessary. Several points were raised in the only written comment received during the public comment period. The response to this written comment follows:

Although the use of institutional controls at six of the OU-1 PSCs was not the respondent's most favored alternative, no other remedial alternatives were offered as their preferred method. Luke AFB believes that the use of institutional controls at these six sites is protective of military personnel, Base workers, visitors, and local residents. Additionally, institutional controls are much more cost effective, saving tax payers money, while still protecting human health or the environment. Based on these considerations, Luke AFB believes that the use of institutional controls at six of the sites represents the best balance of all of the criteria used in the selection of remedial alternatives.

The description of Luke AFB as a Superfund site was necessary for several reasons. First, there were 25 PSCs included in the OU-1 investigation that were located across the Base. Secondly, the investigation of the air and groundwater resources encompassed the entire Base, not just the individual PSCs. Individual locations of the PSCs are included within the Proposed Plan and within the RI/FS reports. Differentiating these PSCs between surface and groundwater contaminations is not appropriate because groundwater contamination was not detected at any of the PSCs. Additionally, because groundwater resources have not been contaminated from Base activities, indicating where the public receives its groundwater in relation to the Luke AFB PSCs may create undue concerns.

Luke AFB has always encouraged public participation throughout the entire Superfund process and will continue to foster this process during the remedial action phase. After a ROD is signed, a schedule for the implementation of the selected remedial alternatives will be developed and presented to the public. Informing the public of this schedule is a requirement under Superfund law. When a schedule for the remedial actions has been developed, Luke AFB will inform the public through newsletters, announcements in local newspapers, and through their Web Site.

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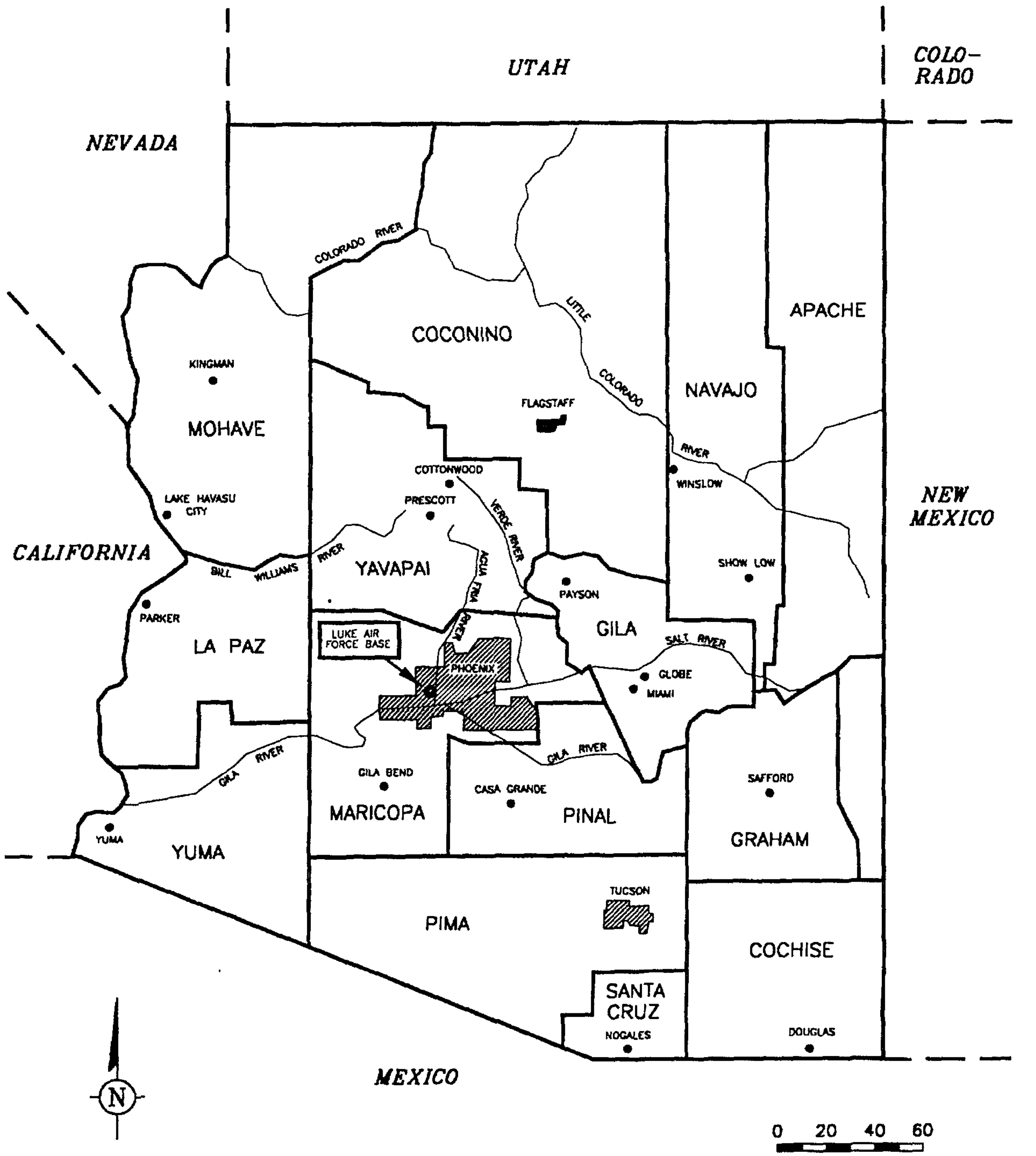

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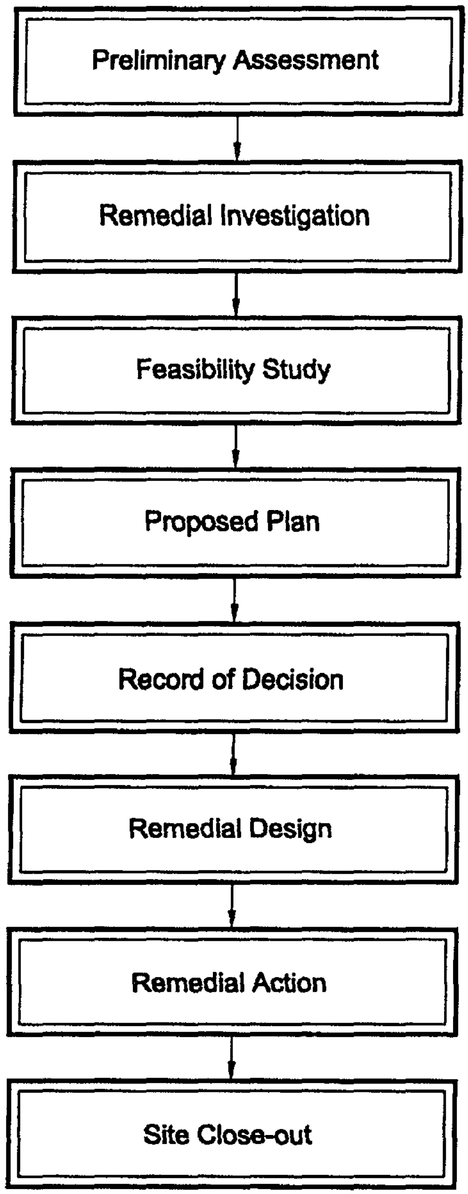
LOCATION OF LUKE AIR FORCE BASE, ARIZONA

OPERABLE UNIT No.1, RECORD OF DECISION
LUKE AIR FORCE BASE, ARIZONA

FIGURE **3-1**

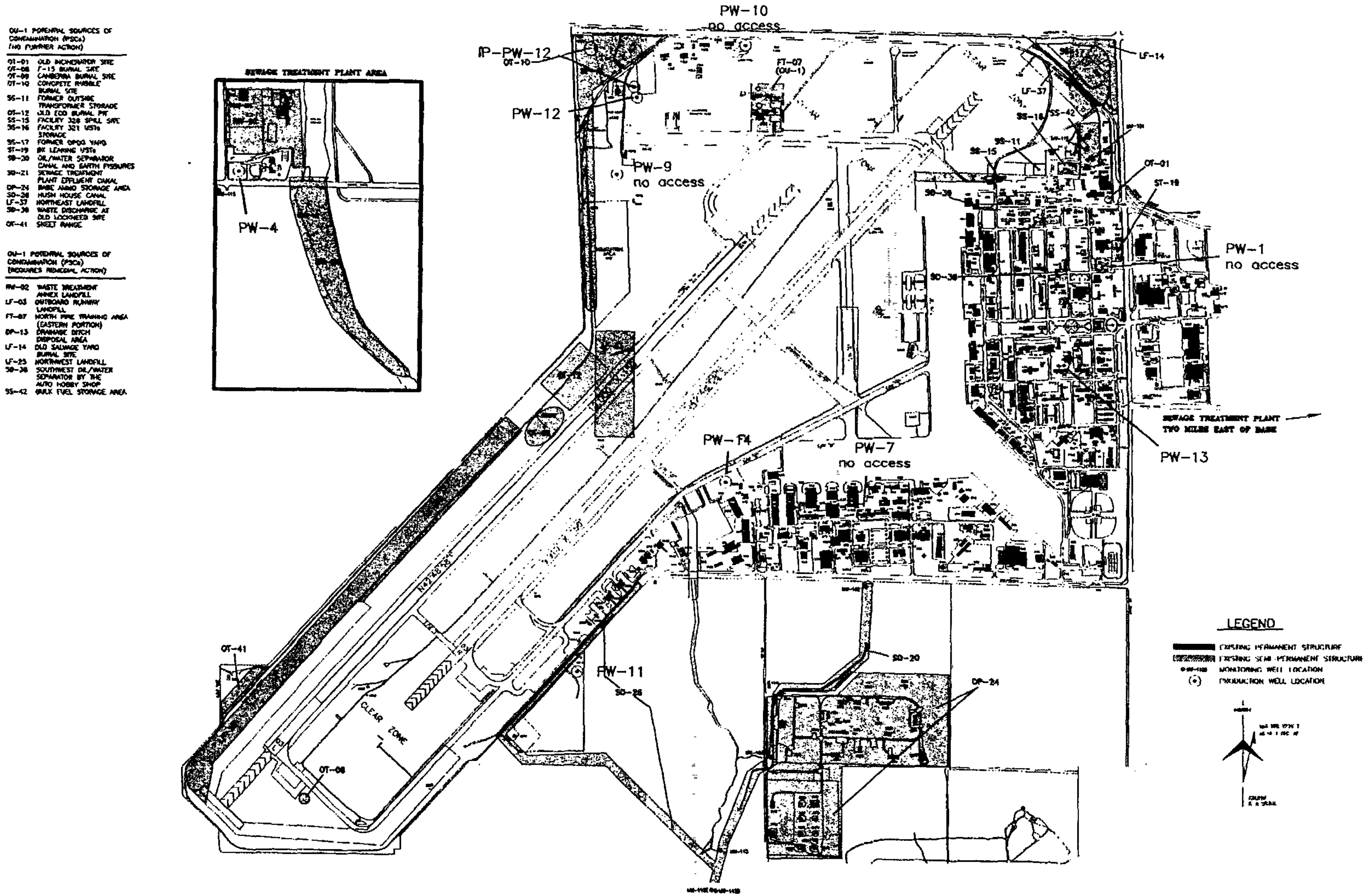


THE 8 STEPS OF THE SUPERFUND PROCESS

OPERABLE UNIT No.1, RECORD OF DECISION
LUKE AIR FORCE BASE, ARIZONA

FIGURE 3-2

DWG DATE: 11/09/1998 | PRJCT NO.: AZ0462.010 | FILE: ou-1rod\figures | DRAWING: FLOW-CHT | CHECKED: ARNOLD | APPROVED: JOHNSON | DRAFTER: STILES



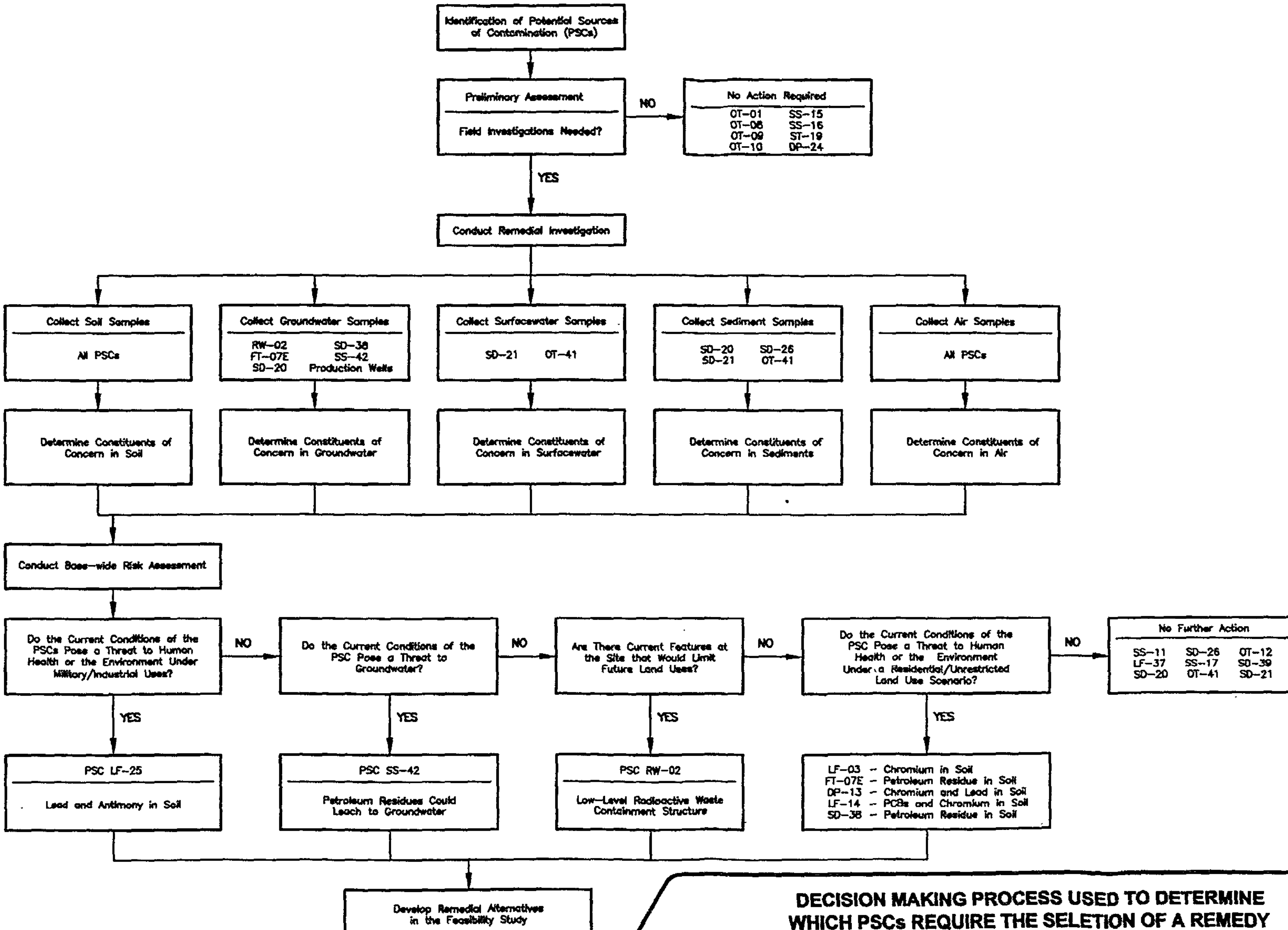
0 700 1400
Scale: 1 inch = 1400 feet

LOCATION OF OU-1 PSCs and MONITORING WELLS

OPERABLE UNIT No.1, RECORD OF DECISION
LUKE AIR FORCE BASE, ARIZONA

FIGURE
3-3

DATE: 01/19/1993 17:36 | PRJ#: AZ 423.011 | FILE: luke\ou-1rod\figures | DRAWING: LUKE-OU1 | CHECKED: SHERRILL | APPROVED: JOHNSON | DRAFTER: STILES

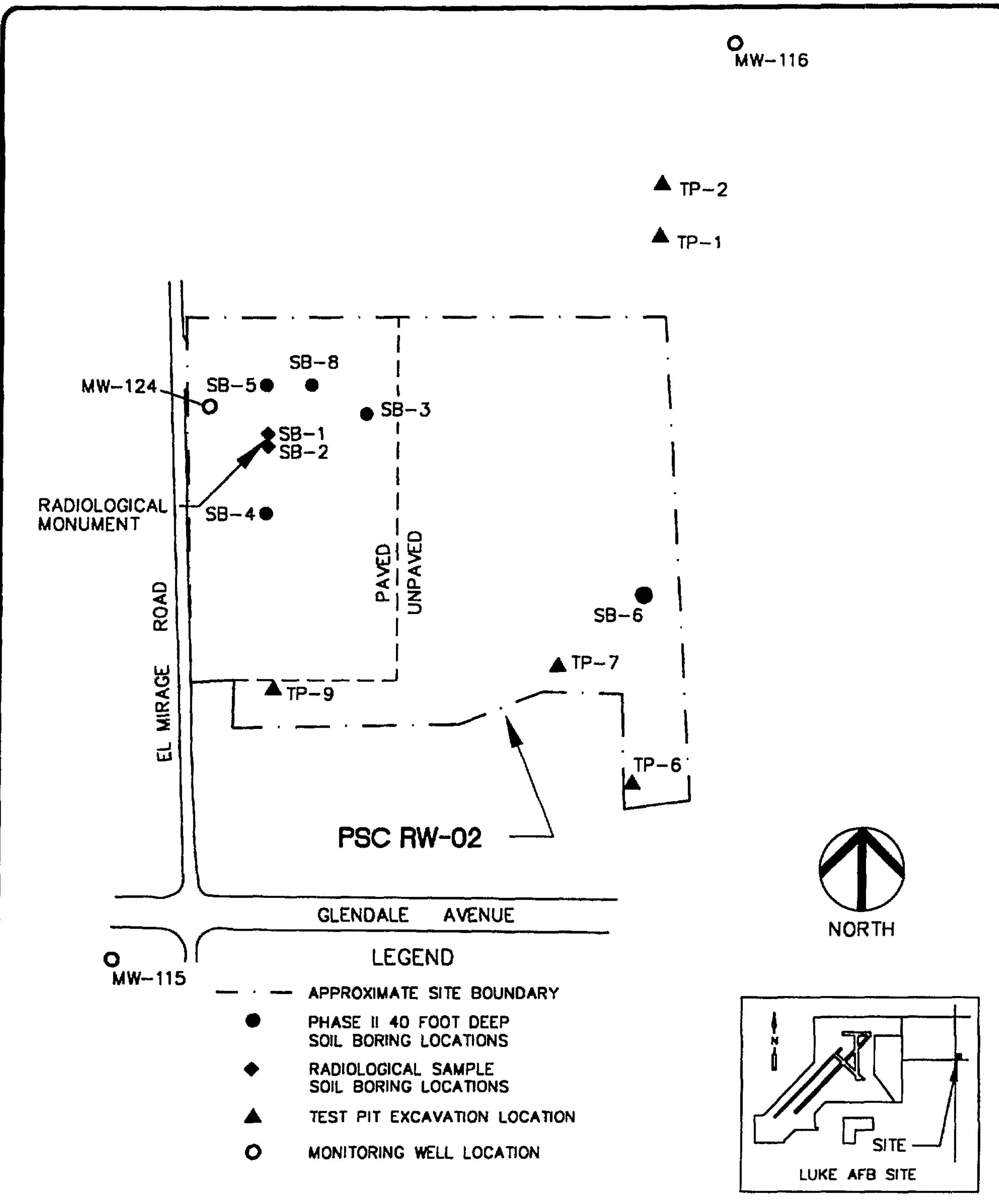


DECISION MAKING PROCESS USED TO DETERMINE WHICH PSCs REQUIRE THE SELETION OF A REMEDY

OPERABLE UNIT No.1, RECORD OF DECISION
LUKE AIR FORCE BASE, ARIZONA

FIGURE 3-4

DRAFTER: STILES | APPROVED: JOHNSON | CHECKED: JOHNSON | DRAWING: FLW-CHT2 | FILE: au-1rod\figures | PRJ#: AZ 423.012 | DATE: 11/06/1998 15:44



0 100 200 300

SCALE: 1" = 300 feet

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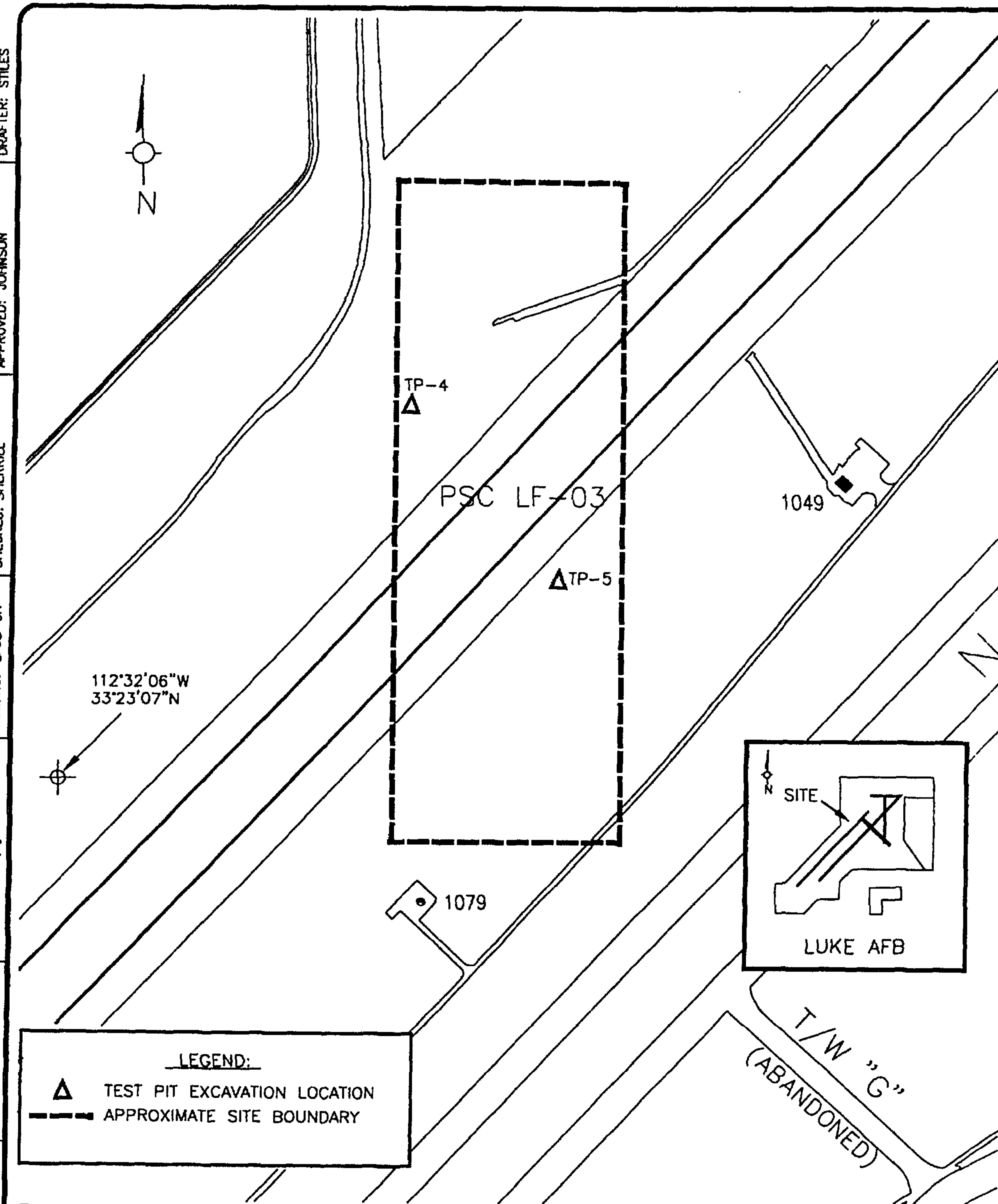
SITE DIAGRAM - PSC RW-02
LOCATION OF SAMPLES WITH CONSTITUENTS OF CONCERN
OPERABLE UNIT No.1, RECORD OF DECISION
LUKE AIR FORCE BASE, ARIZONA

FIGURE **3-5**

DWG DATE: 11/06/1998 | PRJCT NO.: LUKE | FILE: ou-1rod\figures | DRAWING: SL-RW02 | CHECKED: SHERRILL | APPROVED: JOHNSON | DRAFTER: STILES



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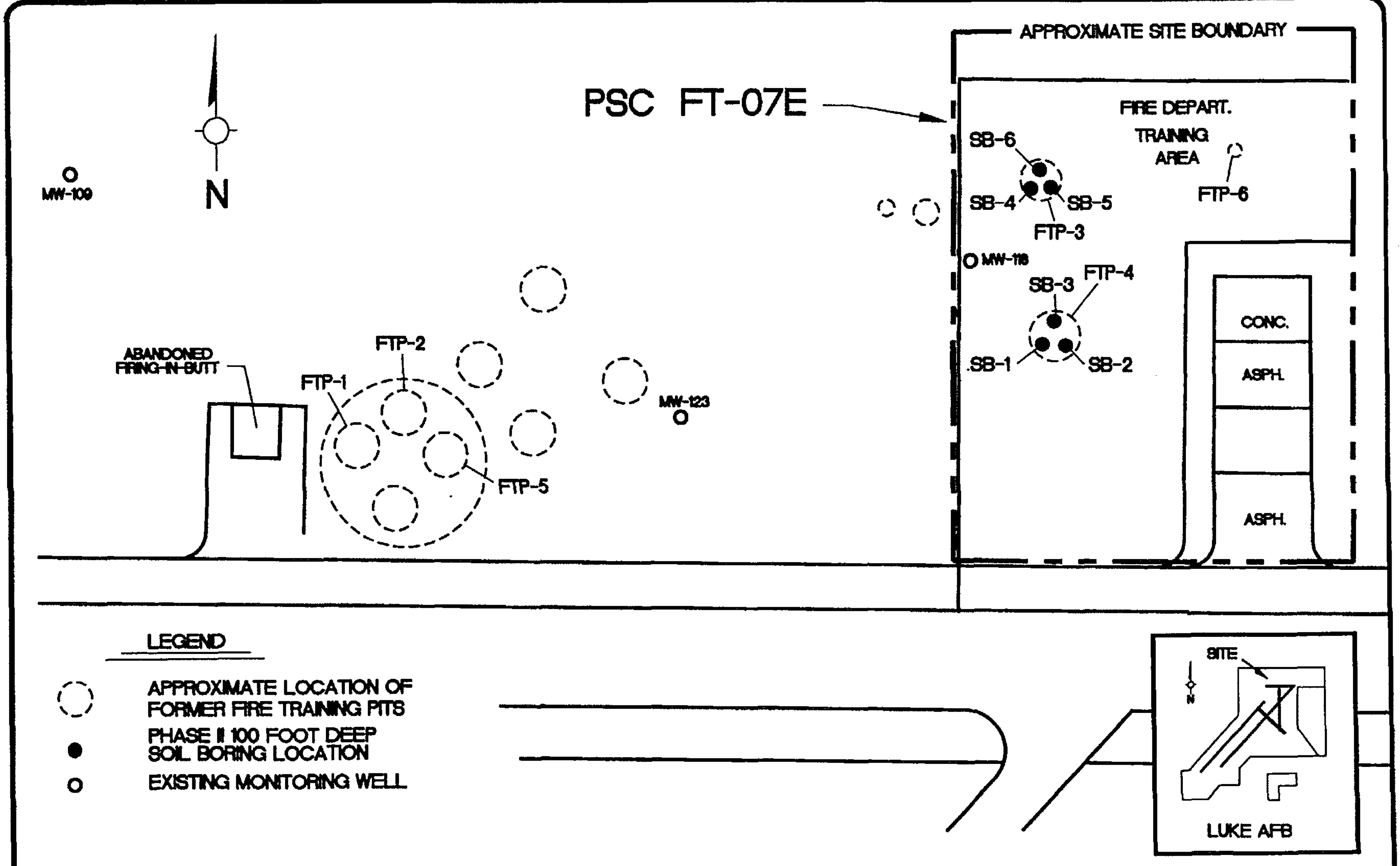
SITE DIAGRAM - PSC LF-03
LOCATION OF SAMPLES WITH CONSTITUENTS OF CONCERN
OPERABLE UNIT No.1, RECORD OF DECISION
LUKE AIR FORCE BASE, ARIZONA

FIGURE **3-6**

DWG DATE: 11/06/1998 | PRJCT NO.: LUKE | FILE: ou-1rod\figures | DRAWING: FT07-13A | CHECKED: SHERRILL | APPROVED: JOHNSON | DRAFTER: STILES

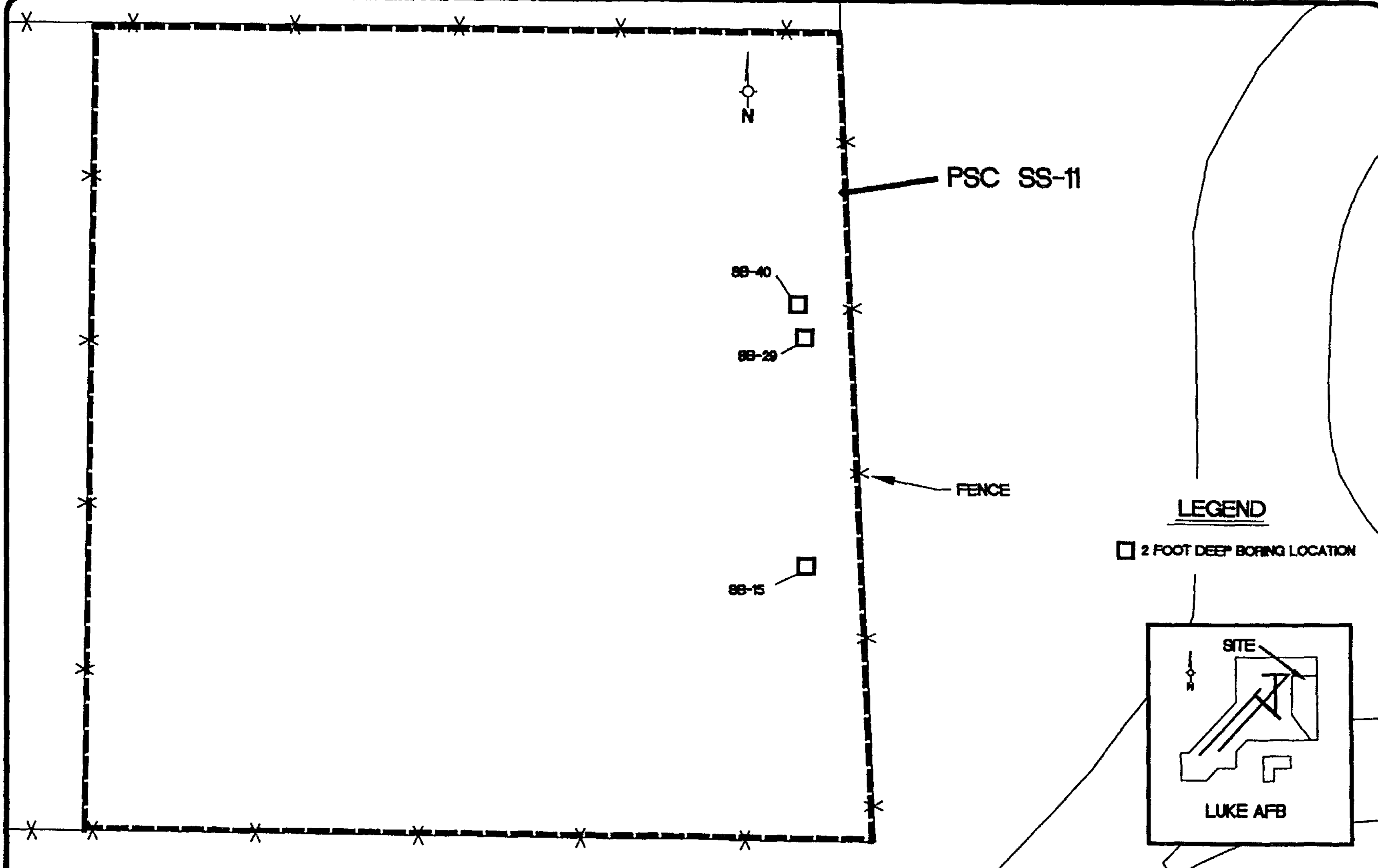


SITE DIAGRAM - EASTERN PORTION, PSC FT-07E
LOCATION OF SAMPLES WITH CONSTITUENTS OF CONCERN

OPERABLE UNIT No.1, RECORD OF DECISION
LUKE AIR FORCE BASE, ARIZONA

FIGURE 3-7

DWG DATE: 11/06/1998 | PRJCT NO.: AZ 0340.006 | FILE: ou-1rod\figures | DRAWING: SS11-B | CHECKED: KNIGHT | APPROVED: STEIN | DRAFTER: STILES



0 10 20 30

SCALE: 1" = 30 feet

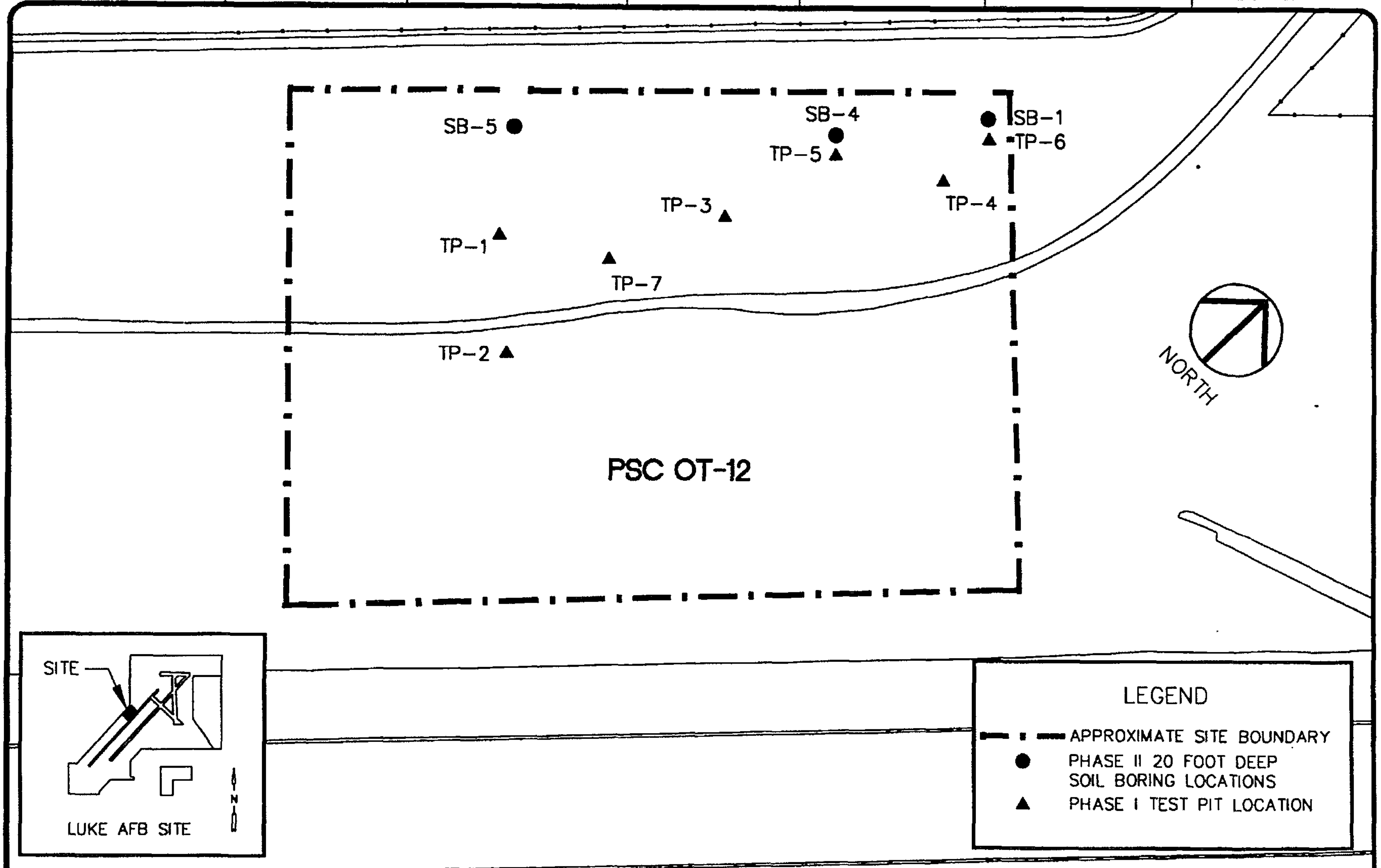
SITE DIAGRAM - PSC SS-11
LOCATIONS OF SAMPLES WITH CONSTITUENTS OF CONCERN

OPERABLE UNIT No.1, RECORD OF DECISION
LUKE AIR FORCE BASE, ARIZONA

FIGURE

3-8

DWG DATE: 11/06/1998 | PRJCT NO.: AZ 0340.006 | FILE: ou-1rod\figures | DRAWING: OT12-19A | CHECKED: KNIGHT | APPROVED: STEIN | DRAFTER: STILES



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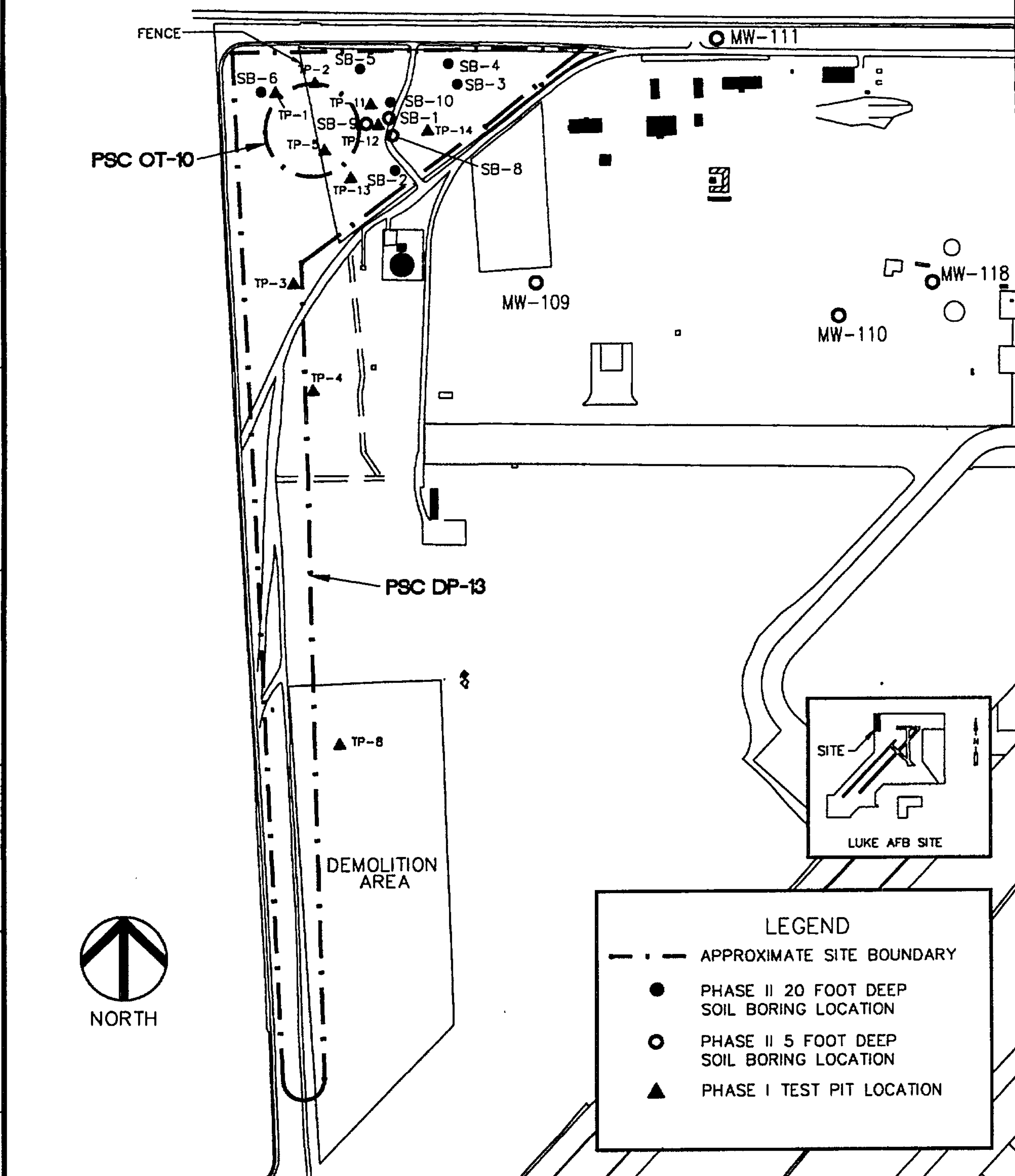
SITE DIAGRAM - PSC OT-12
LOCATIONS OF SAMPLES WITH CONSTITUENTS OF CONCERN

OPERABLE UNIT No.1
LUKE AIR FORCE BASE, ARIZONA

FIGURE 3-9



0 500

SCALE: 1" = 500 feet

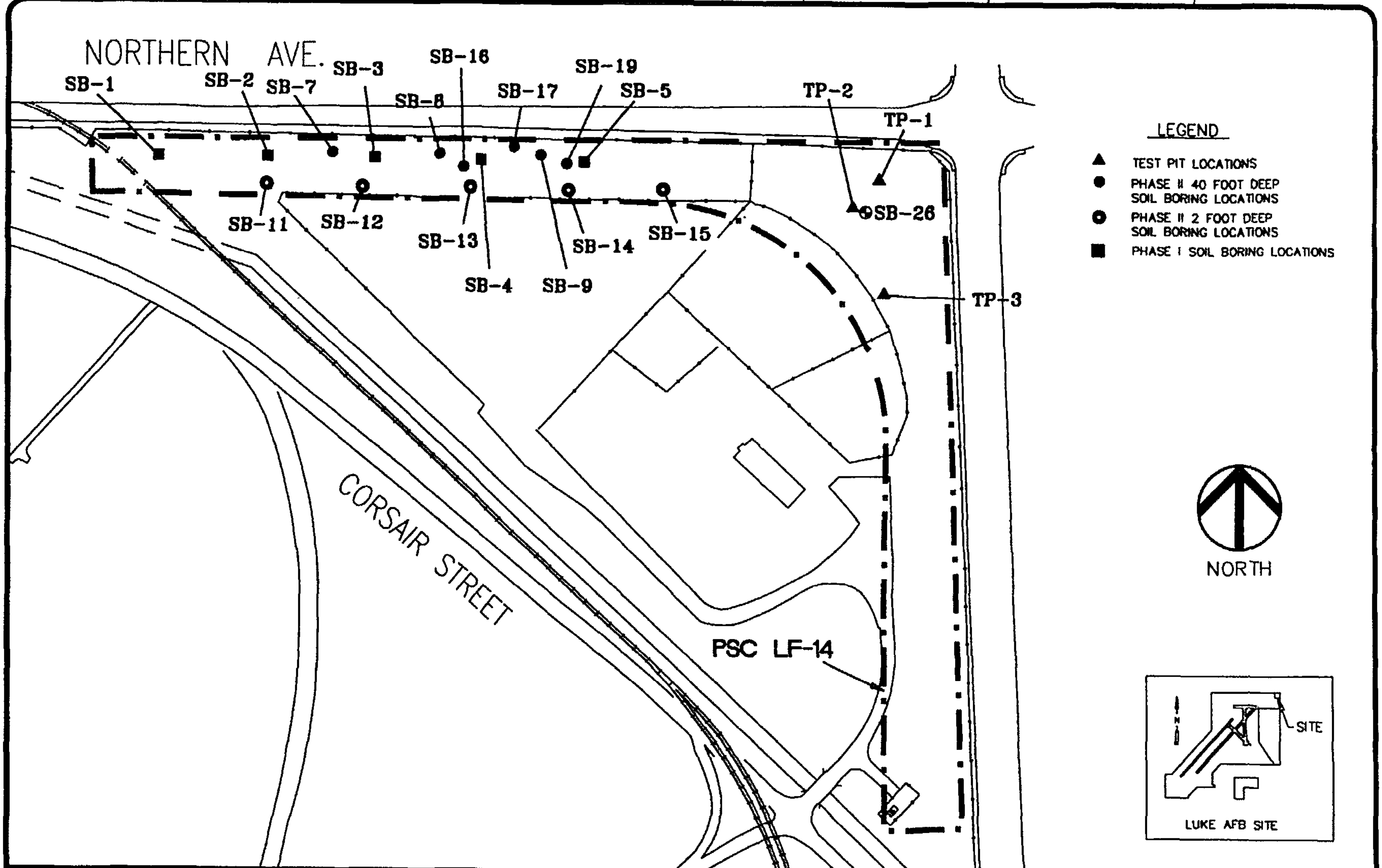
Geraghty & Miller, Inc.

SITE DIAGRAM - PSCs OT-10 and DP-13
LOCATIONS OF SAMPLES WITH CONSTITUENTS OF CONCERN
OPERABLE UNIT No.1, RECORD OF DECISION
LUKE AIR FORCE BASE, ARIZONA

FIGURE **3-10**

DWG DATE: 11/06/1998 | PRJCT NO.: AZ0340.006 | FILE: au-lrod\figures | DRAWING: DP13-20A | CHECKED: KNIGHT | APPROVED: JOHNSON | DRAFTER: STILES

DWG DATE: 06/18/1998	PRJCT NO.: AZ0436.022	FILE: ou-1rod\draft\jons\figs	DRAWING: LF14-21A	CHECKED: MARINO	APPROVED: JOHNSON	DRAFTER: STILES



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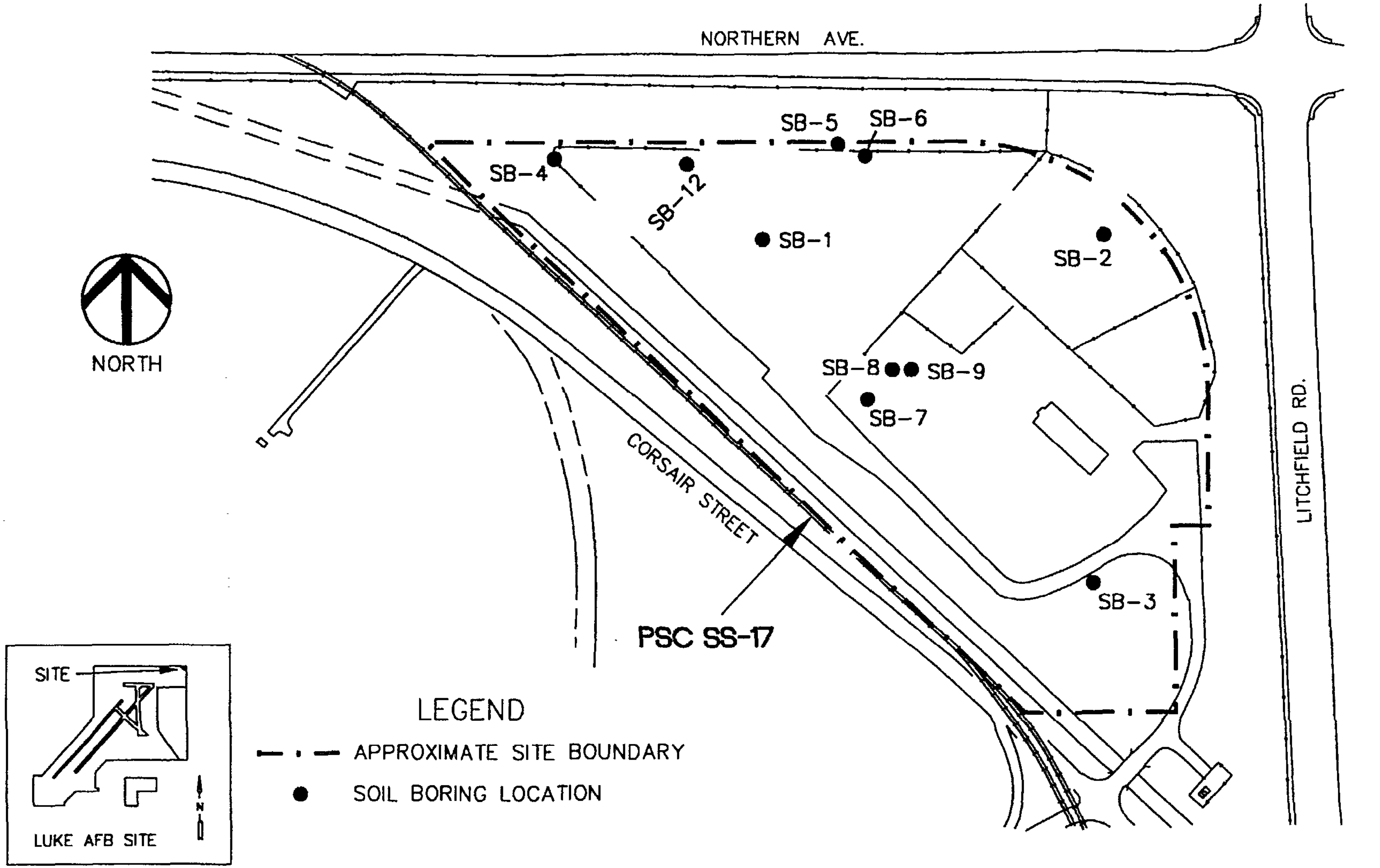
SITE DIAGRAM - PSC LF-14
LOCATIONS OF SAMPLES WITH CONSTITUENTS OF CONCERN

OPERABLE UNIT No.1, RECORD OF DECISION
LUKE AIR FORCE BASE, ARIZONA

FIGURE 3-11

DWG DATE: 11/06/1998	PRJCT NO.: AZ 0340.006	FILE: ou-1rod\figures	DRAWING: SS17-24A	CHECKED: SHERRILL	APPROVED: JOHNSON	DRAFTER: STILES



0 100 200

SCALE: 1" = 200 feet

GERAGHTY & MILLER INC.

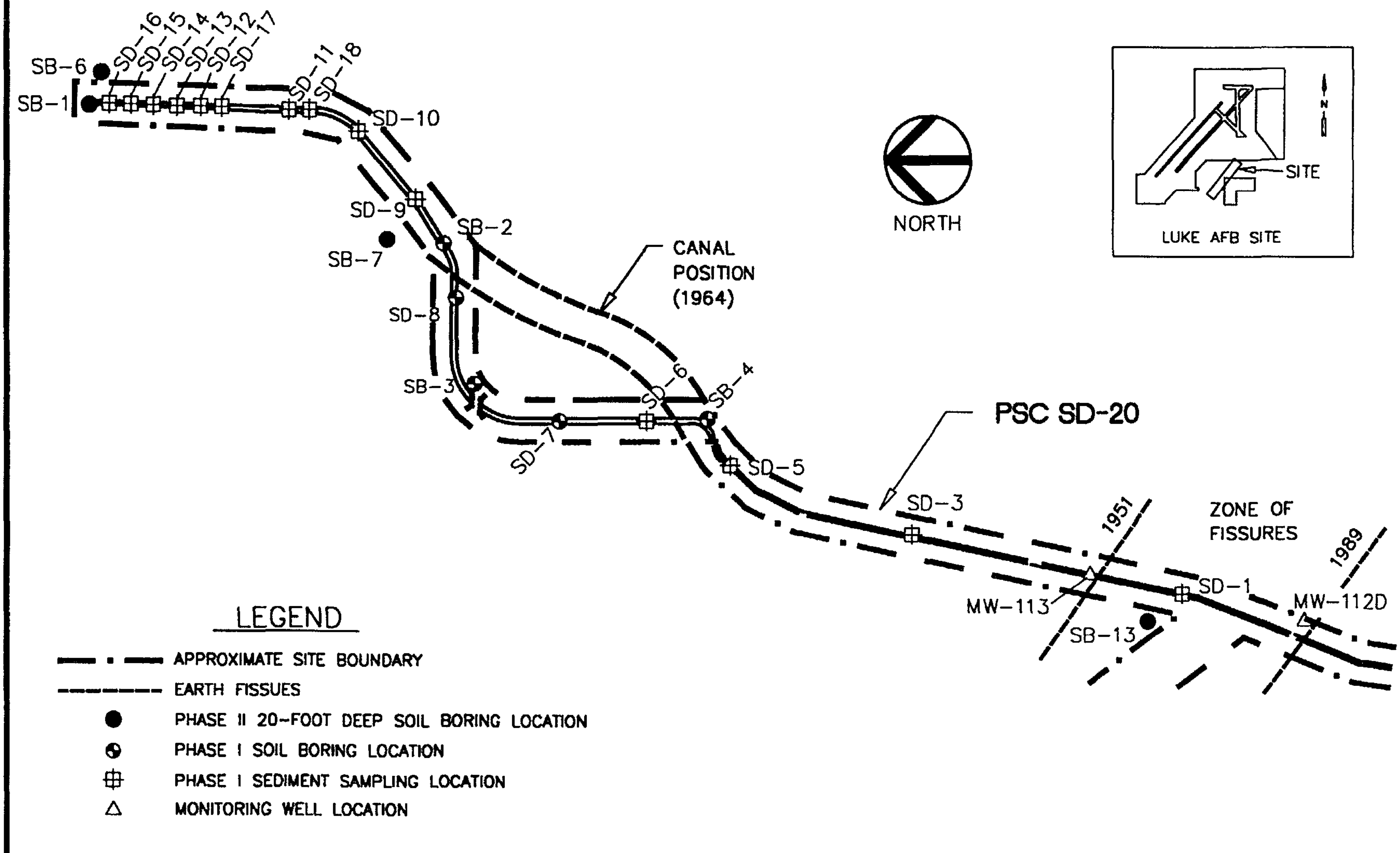
SITE DIAGRAM - PSC SS-17
LOCATIONS OF SAMPLES WITH CONSTITUENTS OF CONCERN

OPERABLE UNIT No.1, RECORD OF DECISION
LUKE AIR FORCE BASE, ARIZONA

FIGURE

3-12

DWG DATE: 11/06/1998 | PRJCT NO.: LUKE | FILE: ou-1rod\figures | DRAWING: SD20-27A | CHECKED: SHERRILL | APPROVED: JOHNSON | DRAFTER: STILES



0 600

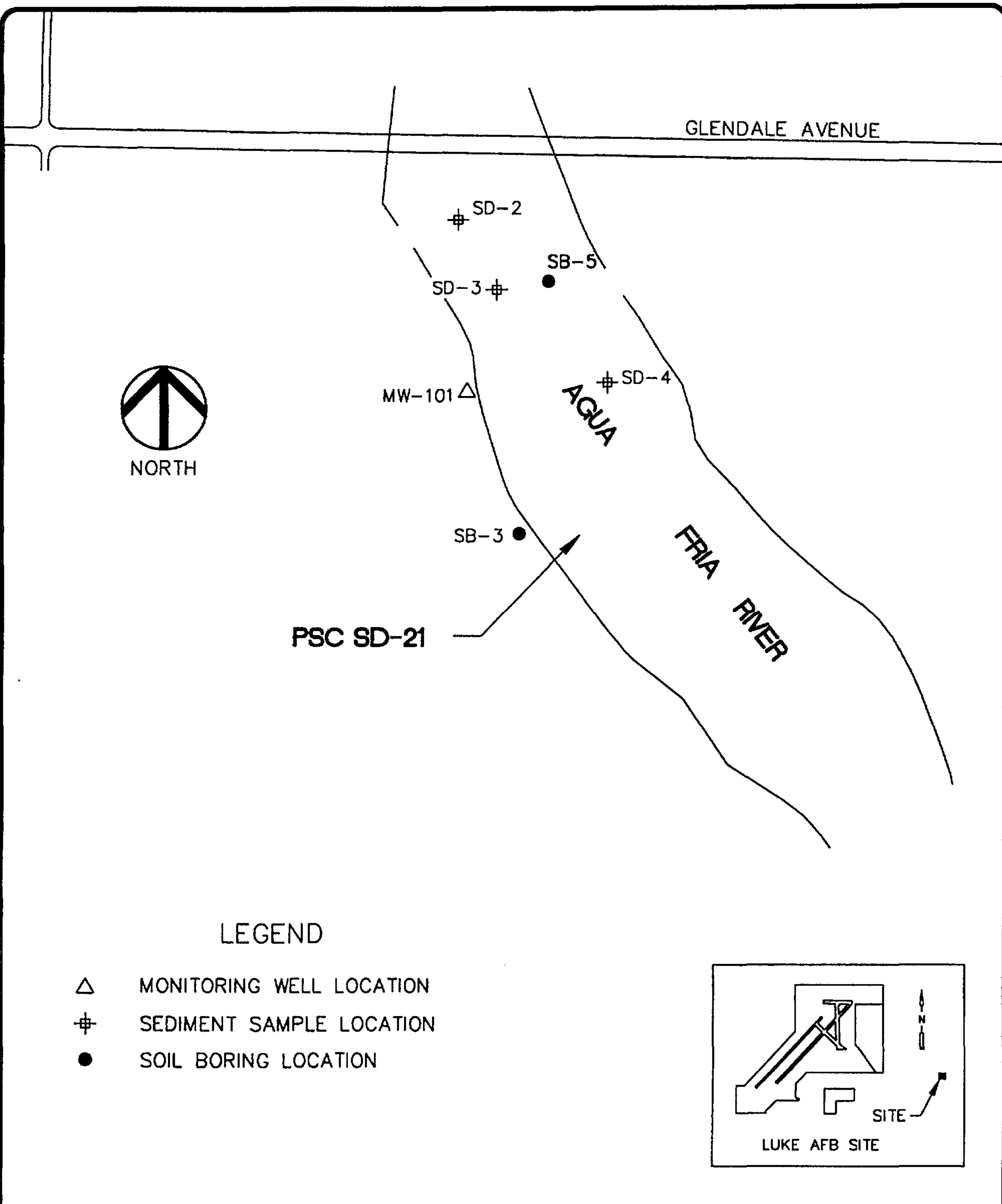
SCALE: 1" = 600 feet

GERAGHTY & MILLER INC.

SITE DIAGRAM - PSC SD-20
LOCATIONS OF SAMPLES WITH CONSTITUENTS OF CONCERN

OPERABLE UNIT No.1, RECORD OF DECISION
LUKE AIR FORCE BASE, ARIZONA

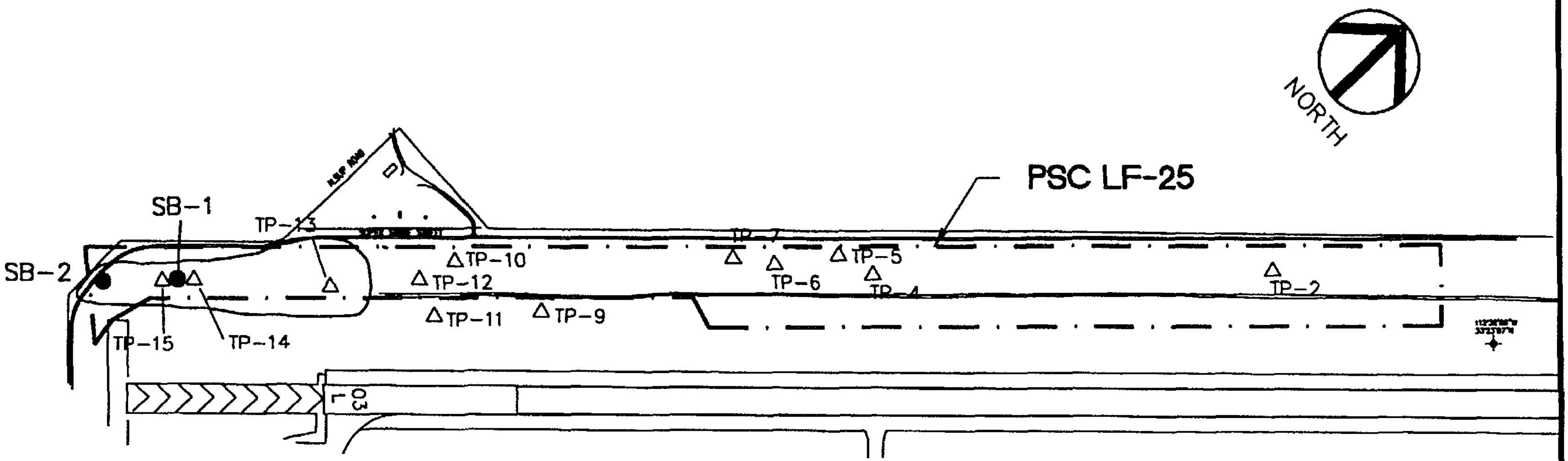
FIGURE 3-13

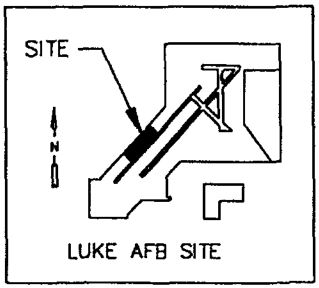


0 200 400 SCALE: 1" = 400 feet	**SITE DIAGRAM - PSC SD-21** **LOCATIONS OF SAMPLES WITH CONSTITUENTS OF CONCERN** OPERABLE UNIT No.1, RECORD OF DECISION LUKE AIR FORCE BASE, ARIZONA	FIGURE **3-14**
Geraghty & Miller, Inc.		

DRAFTER: STILES | APPROVED: JOHNSON | CHECKED: SHERRILL | DRAWING: SD21-28A | FILE: ou-1rod\figures | PRJCT NO.: LUKE | DWG DATE: 11/06/1998

DWG DATE: 11/06/1998 | PRJCT NO.: LUKE | FILE: ou-1rod\figures | DRAWING: LF25-32A | CHECKED: SHERRILL | APPROVED: JOHNSON | DRAFTER: STILES





LEGEND

APPROXIMATE SITE BOUNDARY

APPROXIMATE AREA OF EXCAVATION

PHASE II 20 FOOT DEEP SOIL BORING LOCATION

TEST PIT EXCAVATION LOCATION

0 1000

SCALE: 1" = 1000 feet

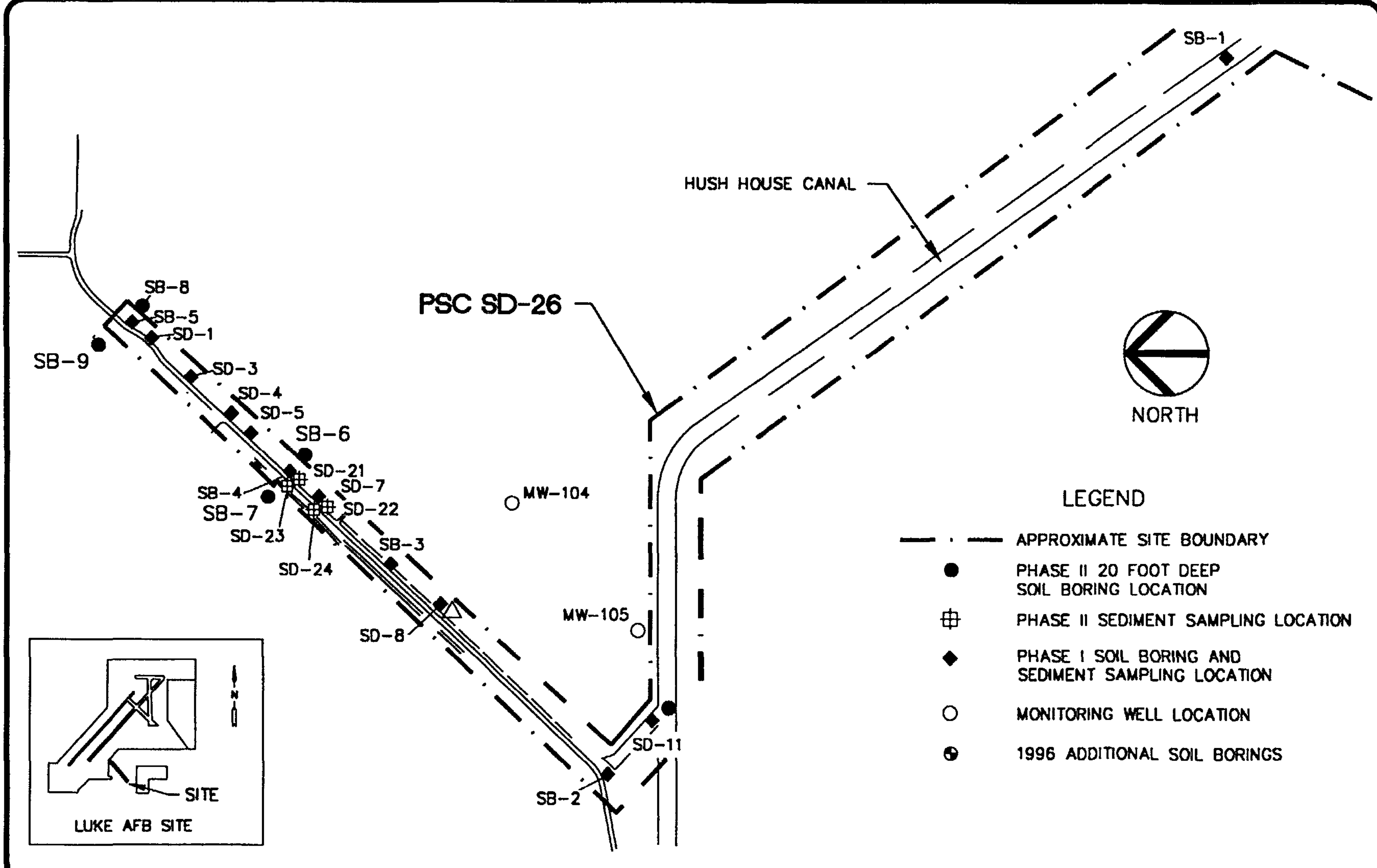
GERAGHTY & MILLER INC.

SITE DIAGRAM - PSC LF-25
LOCATIONS OF SAMPLES WITH CONSTITUENTS OF CONCERN

OPERABLE UNIT No.1, RECORD OF DECISION
LUKE AIR FORCE BASE, ARIZONA

FIGURE 3-15

DWG DATE: 11/06/1998 | PRJCT NO.: LUKE | FILE: ou-1rod\figures | DRAWING: SD26-33A | CHECKED: SHERRILL | APPROVED: JOHNSON | DRAFTER: STILES



0 600
SCALE: 1" = 600 feet

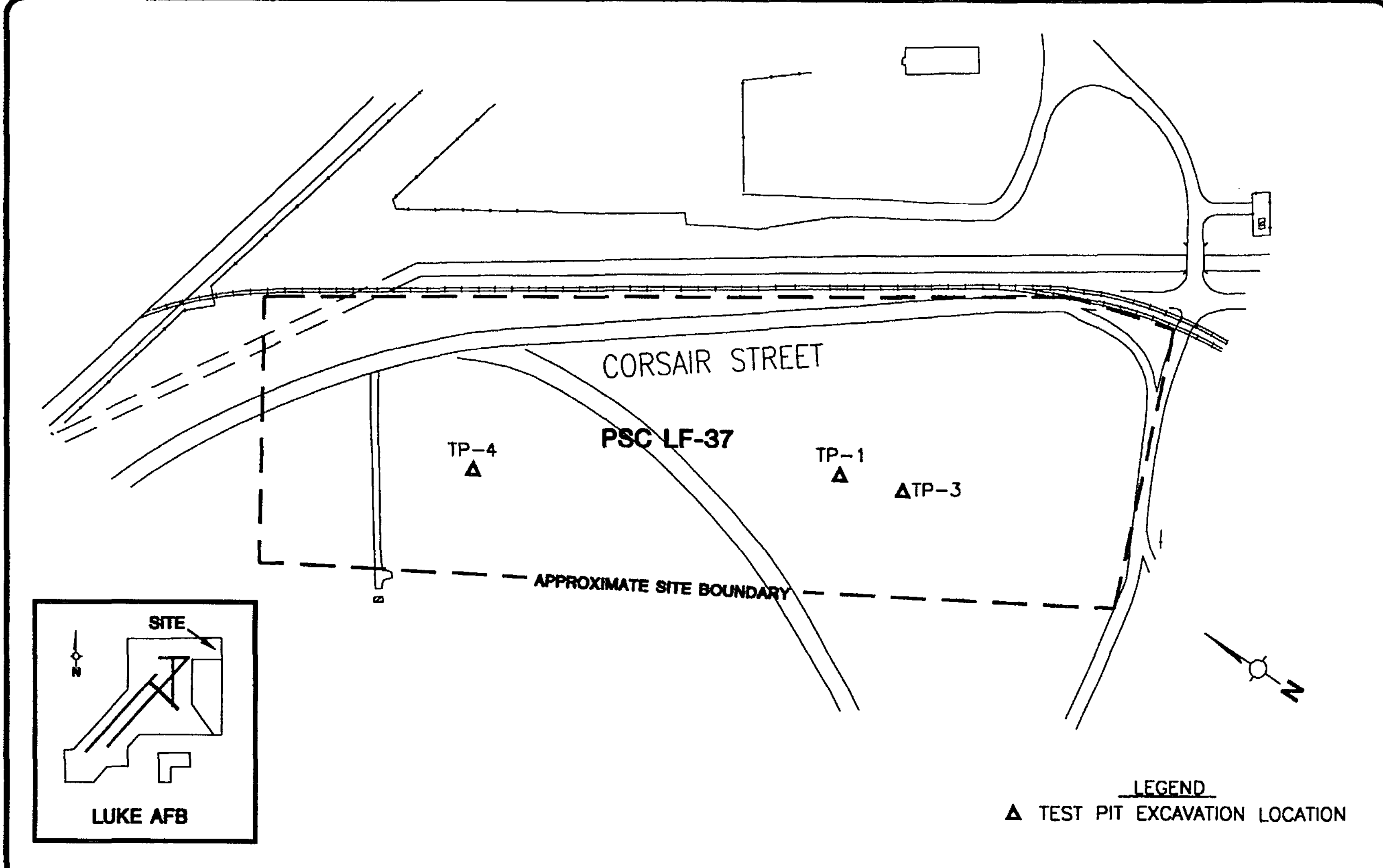
GERAGHTY & MILLER INC.

SITE DIAGRAM - PSC SD-26
LOCATIONS OF SAMPLES WITH CONSTITUENTS OF CONCERN

OPERABLE UNIT No.1, RECORD OF DECISION
LUKE AIR FORCE BASE, ARIZONA

FIGURE
3-16

DWG DATE: 11/06/1998 | PRJCT NO.: AZ 0340.006 | FILE: ou-lrod\figures | DRAWING: LF37-34A | CHECKED: SHERRILL | APPROVED: JOHNSON | DRAFTER: STILES



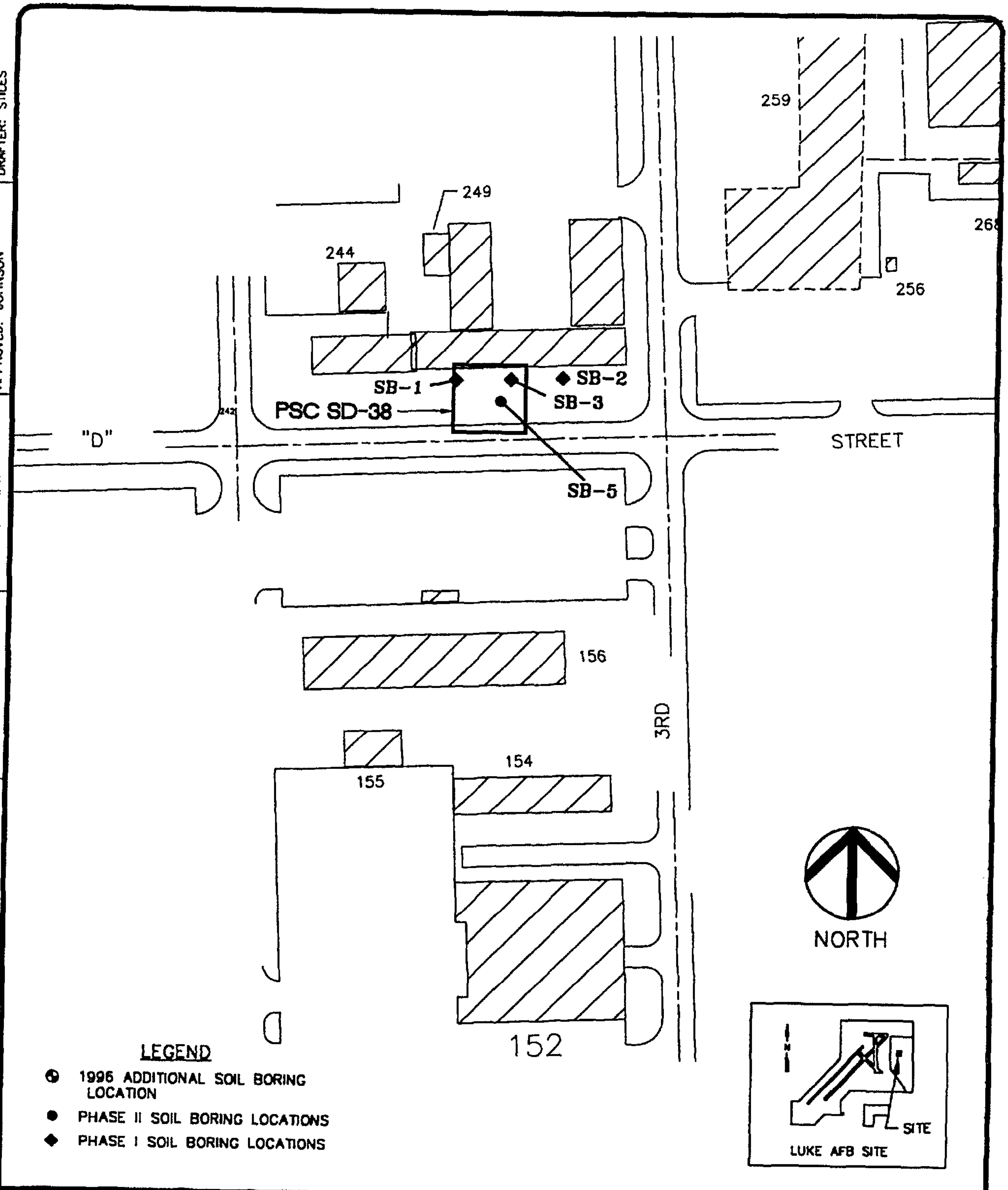
0 100 200

SCALE: 1" = 200 feet

SITE DIAGRAM - PSC LF-37
LOCATIONS OF SAMPLES WITH CONSTITUENTS OF CONCERN

OPERABLE UNIT No.1, RECORD OF DECISION
LUKE AIR FORCE BASE, ARIZONA

FIGURE 3-17



0 100
SCALE: 1" = 100 feet

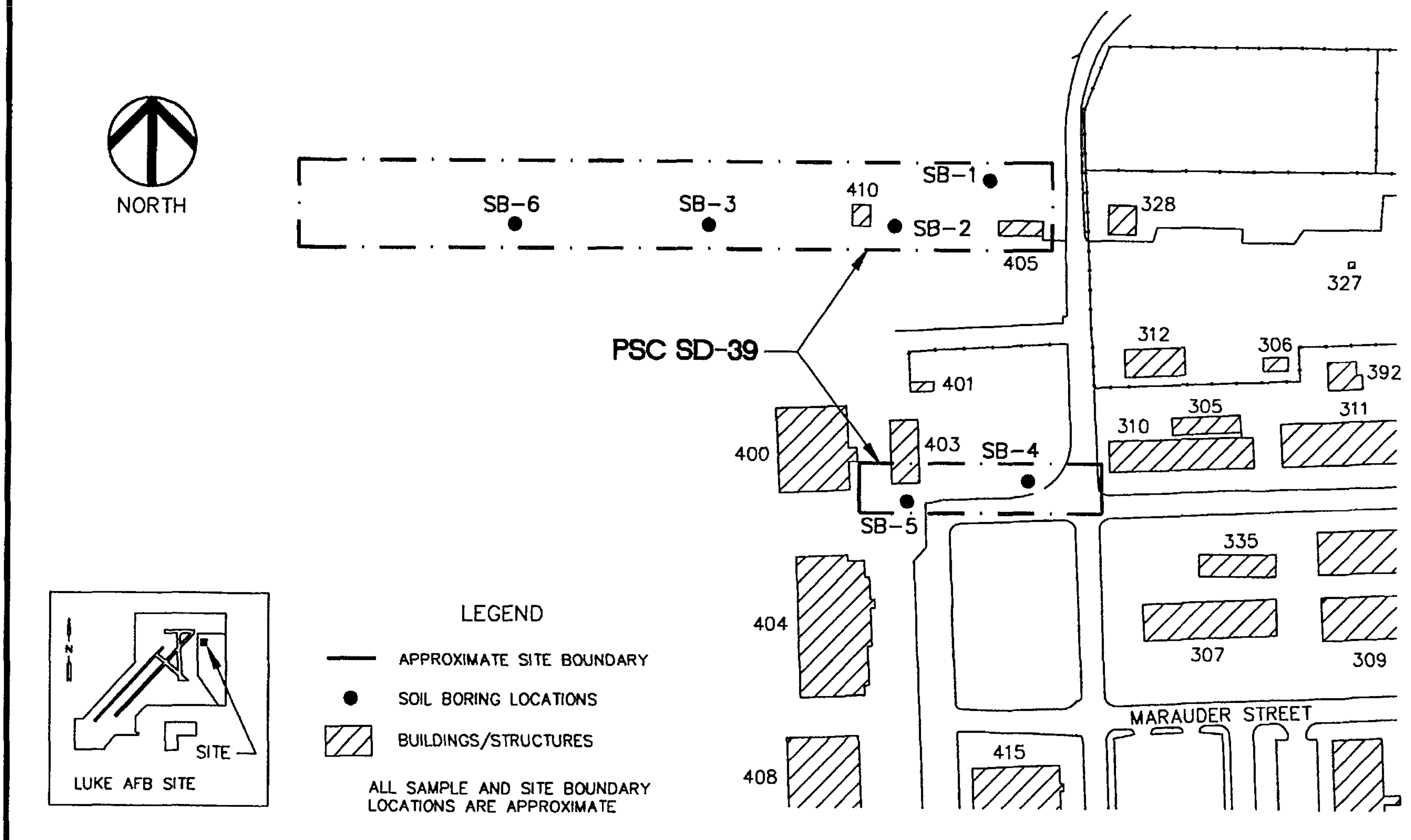
GERAGHTY & MILLER INC.

SITE DIAGRAM - PSC SD-38
LOCATIONS OF SAMPLES WITH CONSTITUENTS OF CONCERN
OPERABLE UNIT No.1, RECORD OF DECISION
LUKE AIR FORCE BASE, ARIZONA

FIGURE **3-18**

DWG DATE: 11/06/1998 | PRJCT NO.: AZ0374.001 | FILE: ou-1rod\figures | DRAWING: SD38-35A | CHECKED: KNIGHT | APPROVED: JOHNSON | DRAFTER: STILES

DWG DATE: 11/06/1998 | PRJCT NO.: AZ0374.001 | FILE: ou-1rod\figures | DRAWING: SD39-36A | CHECKED: KNIGHT | APPROVED: JOHNSON | DRAFTER: STILES



0 100 200

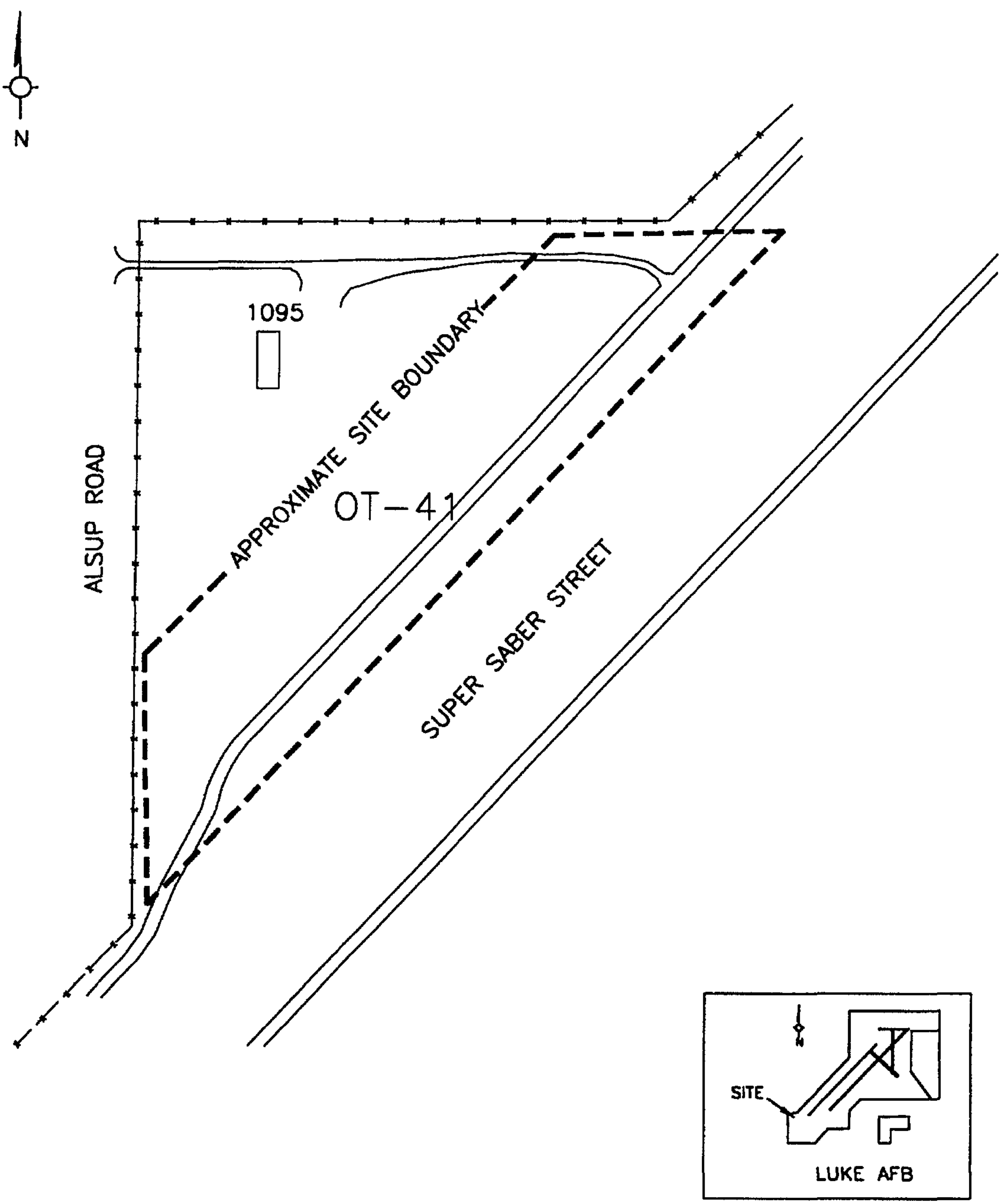
SCALE: 1" = 200 feet

GERAGHTY & MILLER INC.

SITE DIAGRAM - PSC SD-39
LOCATIONS OF SAMPLES WITH CONSTITUENTS OF CONCERN

OPERABLE UNIT No.1, RECORD OF DECISION
LUKE AIR FORCE BASE, ARIZONA

FIGURE
3-19



NOTE: NO COCs IN SOILS AT THIS SITE

0 100 200

SCALE: 1" = 200 feet

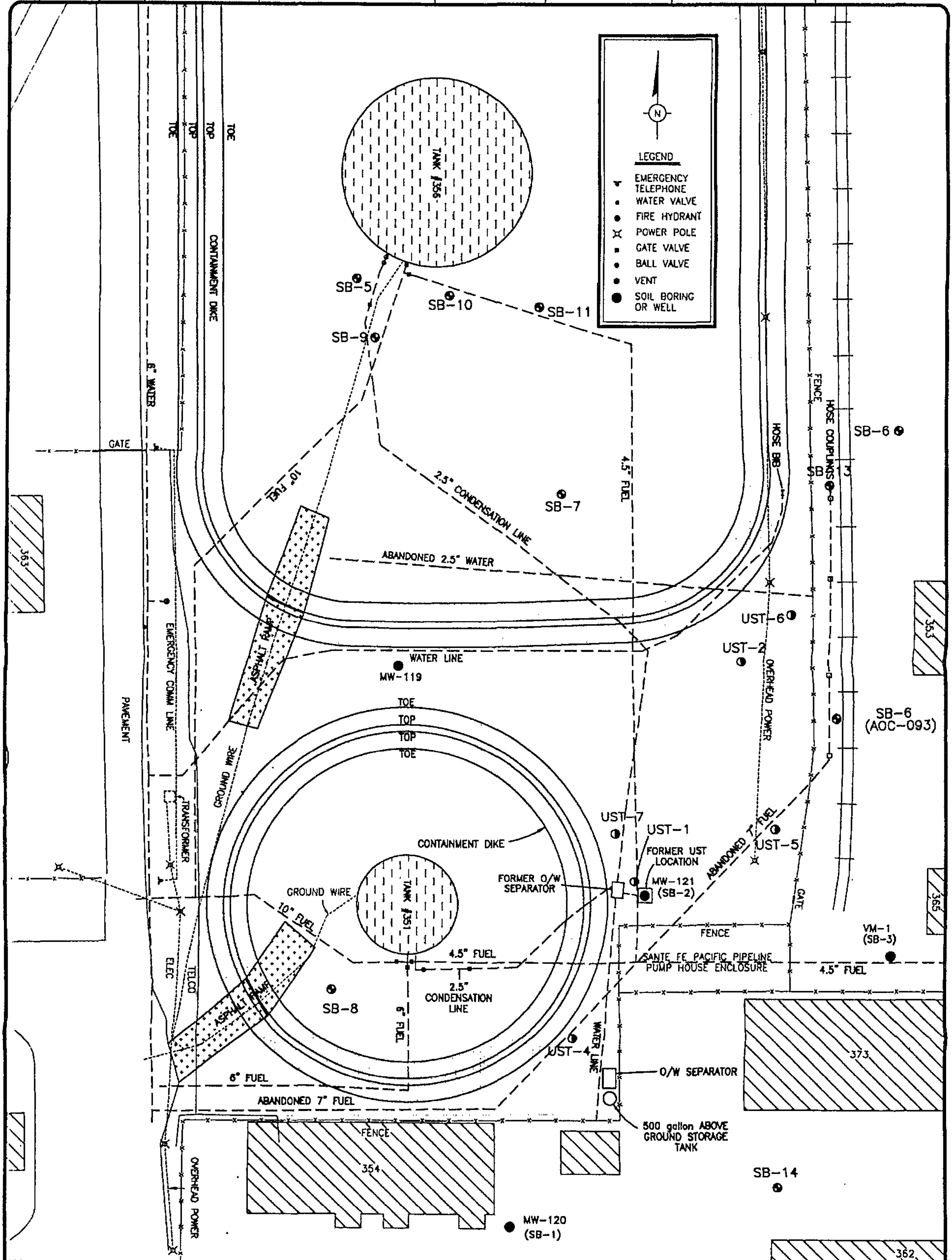
GERAGHTY & MILLER INC.

SITE DIAGRAM - PSC OT-41
LOCATIONS OF SAMPLES WITH CONSTITUENTS OF CONCERN
OPERABLE UNIT No.1, RECORD OF DECISION
LUKE AIR FORCE BASE, ARIZONA

FIGURE **3-20**

DRAFTER: STILES | APPROVED: JOHNSON | CHECKED: SHERRILL | DRAWING: OT41-B | FILE: ou-1rod\figures | PRJCT NO.: LUKE | DWG DATE: 11/06/1998

DWG DATE: 11/06/1996 | PRJCT NO.: LUKE | FILE: ou-1rod\figures | DRAWING: SS42-A | CHECKED: SHERRILL | APPROVED: JOHNSON | DRAFTER: STILES



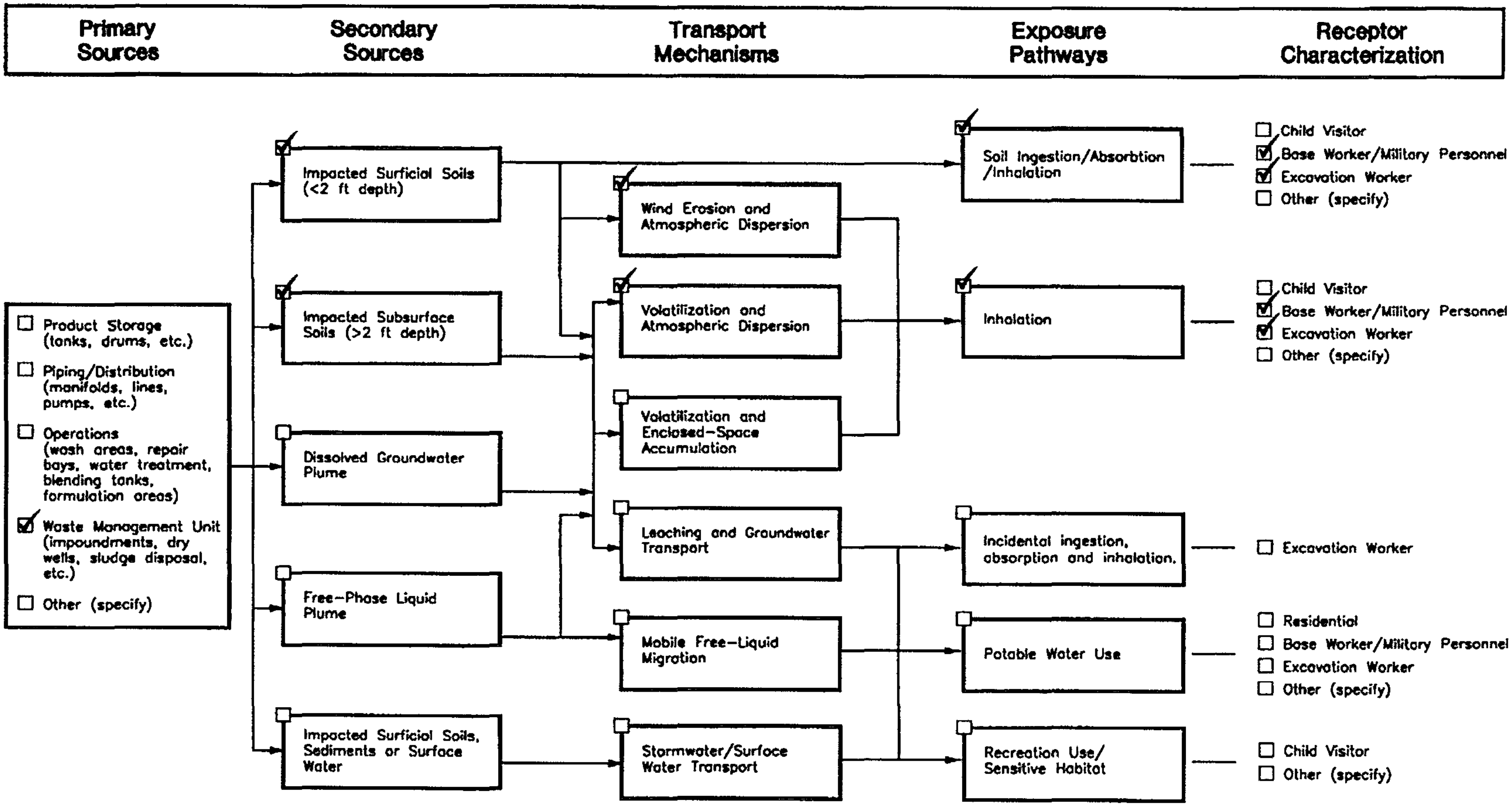
APPROX. SCALE
0 20 40
SCALE: 1 inch = 40 feet

GERAGHTY & MILLER, INC.

SITE DIAGRAM - PSC SS-42
LOCATIONS OF SAMPLES WITH CONSTITUENTS OF CONCERN

OPERABLE UNIT No.1, RECORD OF DECISION
LUKE AIR FORCE BASE, ARIZONA

FIGURE
3-21

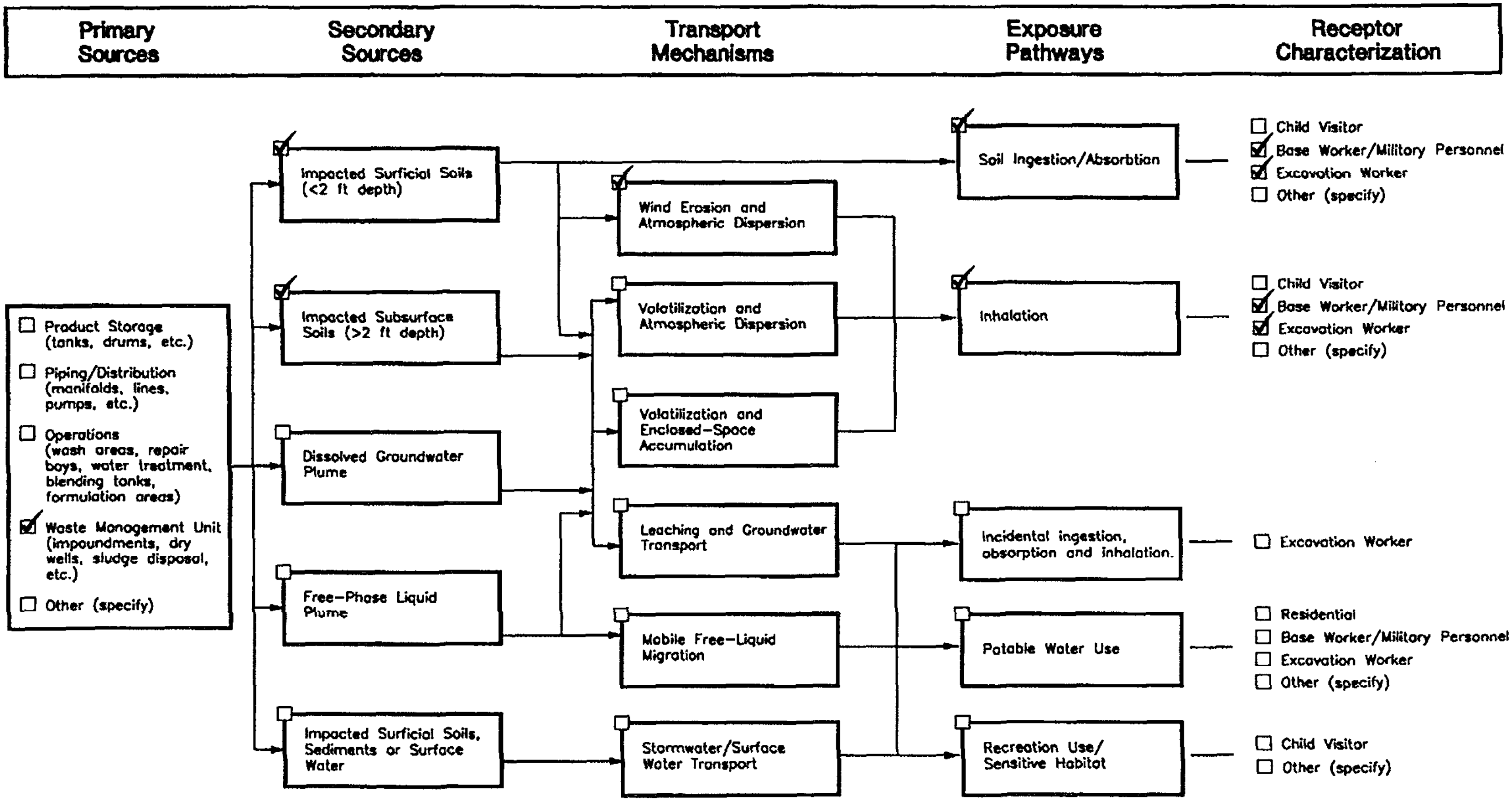


CONCEPTUAL SITE MODEL
PSC RW-02

OPERABLE UNIT No.1, RECORD OF DECISION
LUKE AIR FORCE BASE, ARIZONA

FIGURE 3-22

DWG DATE: 06/23/1998 PRJCT NO.: AZ 423.0011 | FILE: ou-1rod\figures | DRAWING: FC21 | CHECKED: BRADDY | APPROVED: JOHNSON | DRAFTER: STILES

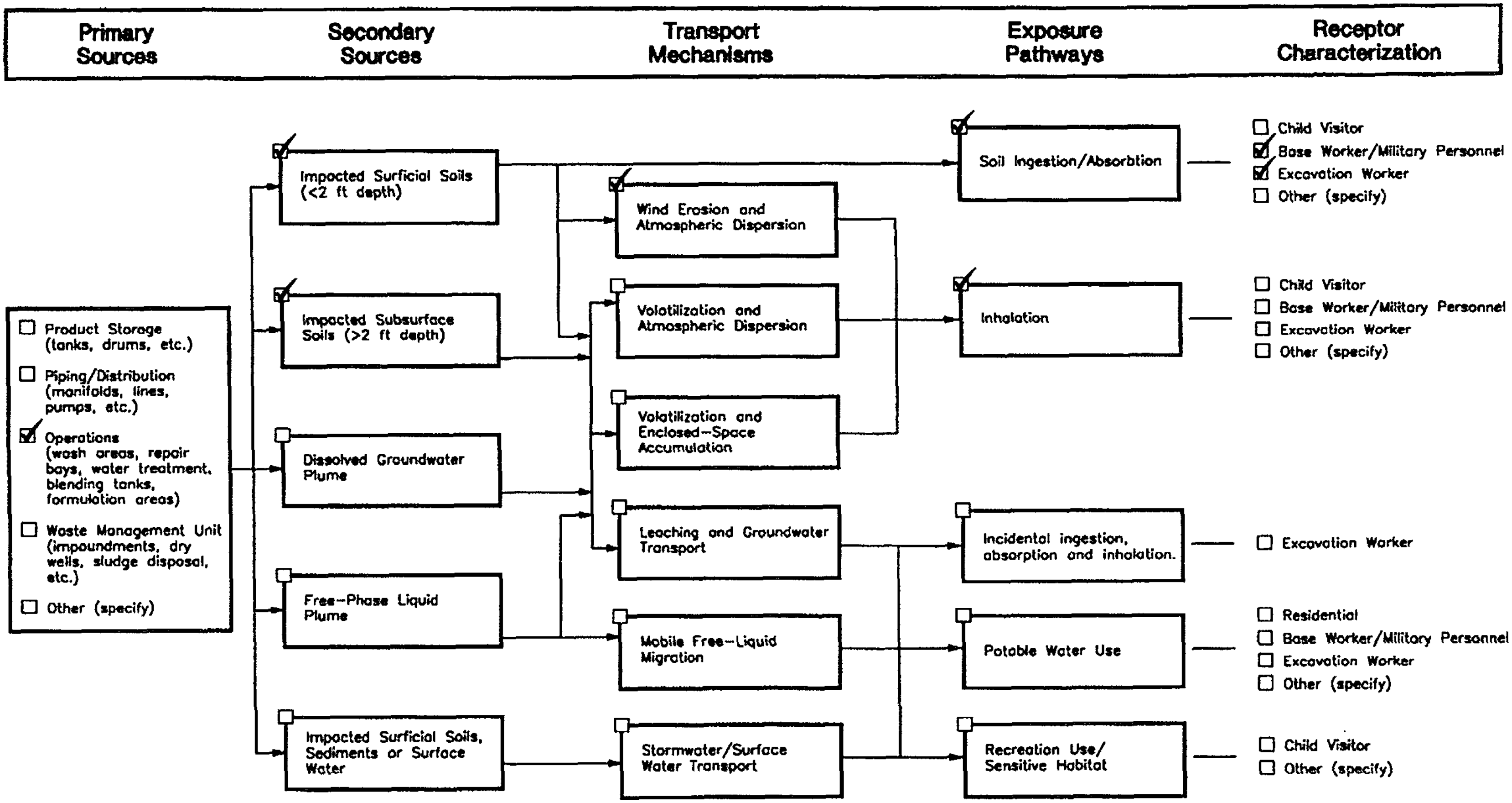


CONCEPTUAL SITE MODEL
PSC LF-03

OPERABLE UNIT No.1, RECORD OF DECISION
LUKE AIR FORCE BASE, ARIZONA

FIGURE 3-23

DWG DATE: 06/23/1998 PRJCT NO.: AZ 423.011 FILE: ou-1rod\figures DRAWING: FC22 CHECKED: BRADDY APPROVED: JOHNSON DRAFTER: STILES

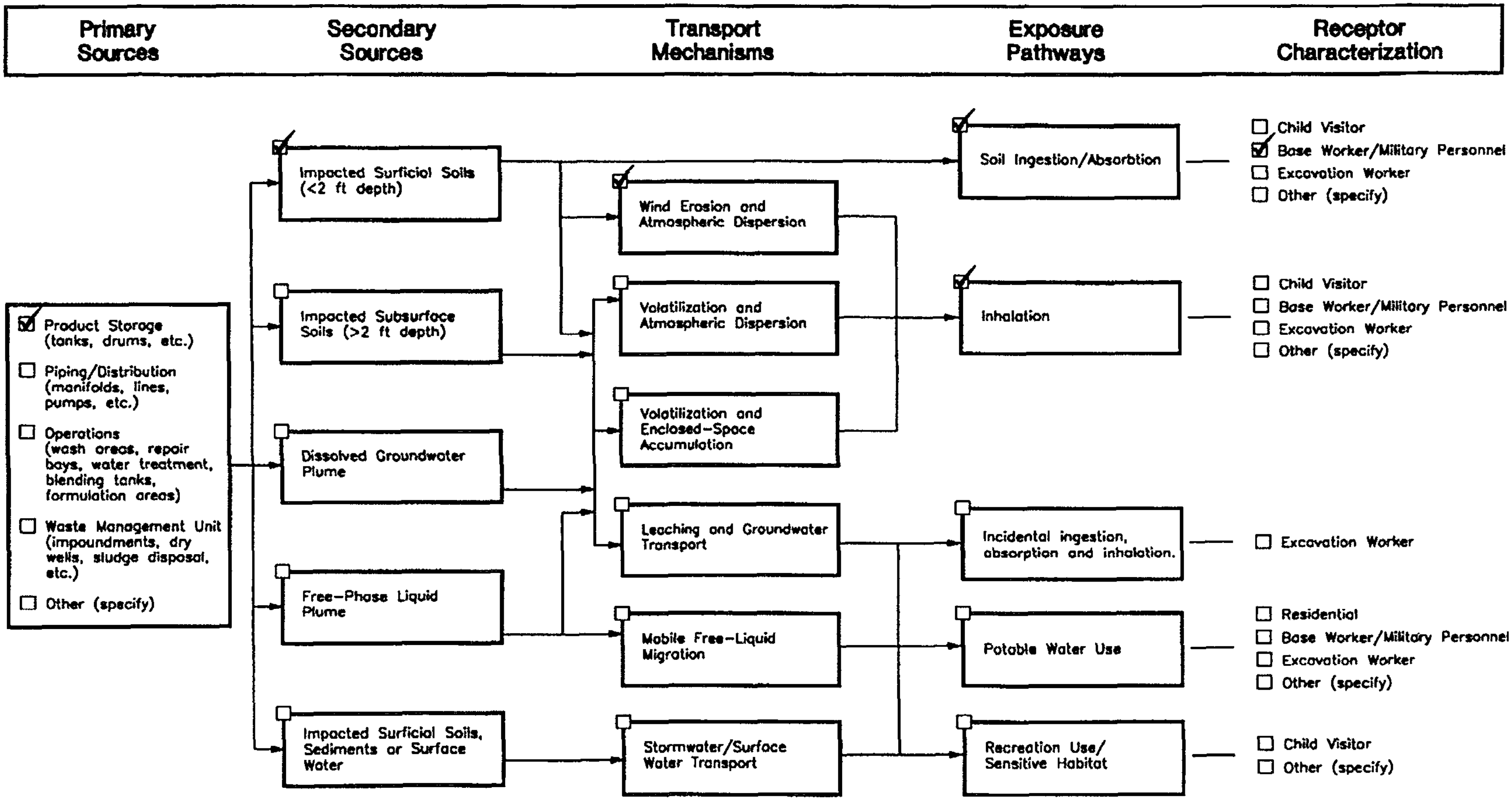


CONCEPTUAL SITE MODEL
PSC FT-07E

OPERABLE UNIT No.1, RECORD OF DECISION
LUKE AIR FORCE BASE, ARIZONA

FIGURE 3-24

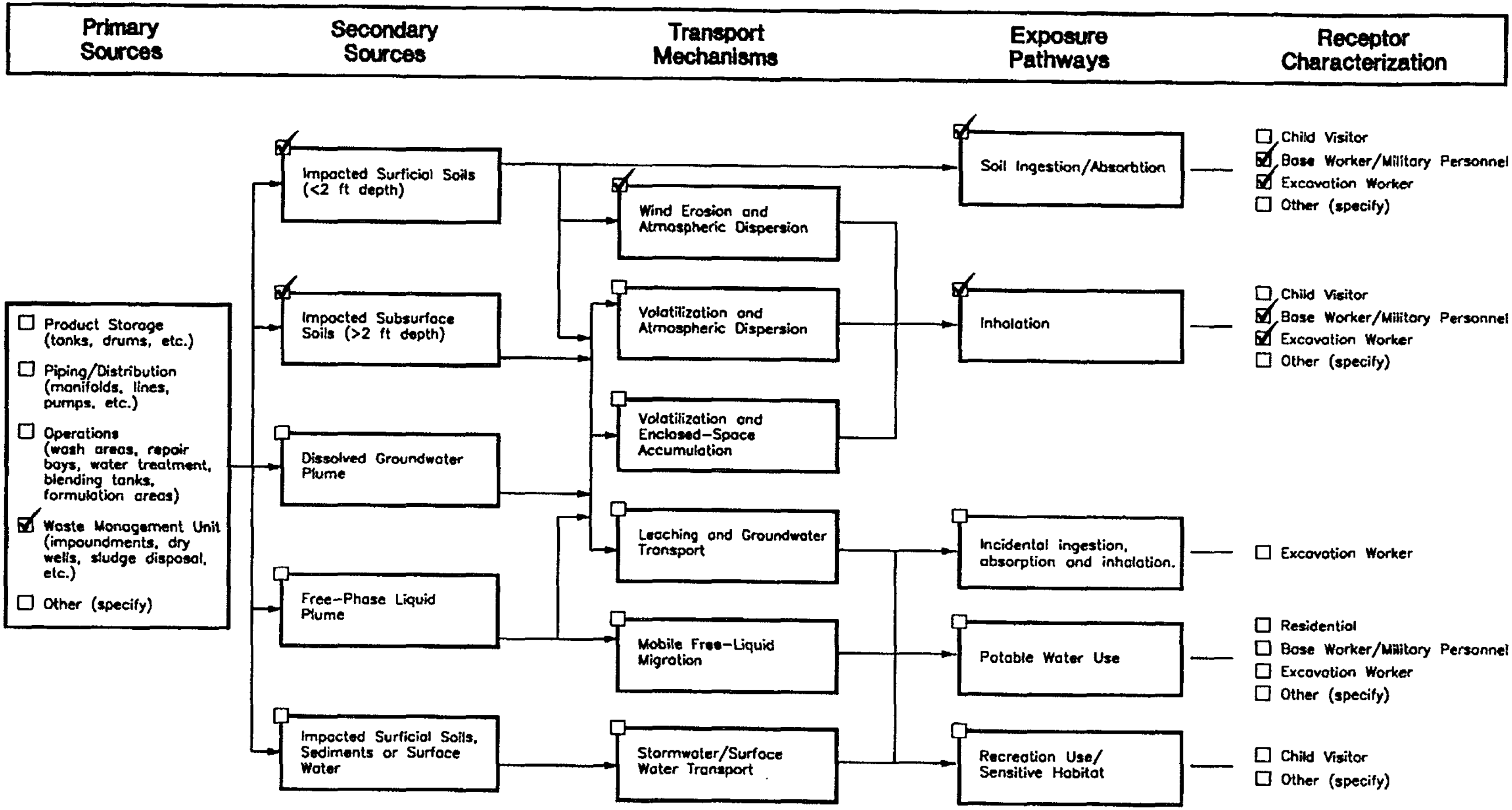
DWG DATE: 06/23/1998 PRJCT NO.: AZ 423.011 | FILE: ou-1rod\figures | DRAWING: FC22 | CHECKED: BRADDY | APPROVED: JOHNSON | DRAFTER: STILES



CONCEPTUAL SITE MODEL
PSC SS-11

OPERABLE UNIT No.1, RECORD OF DECISION
LUKE AIR FORCE BASE, ARIZONA

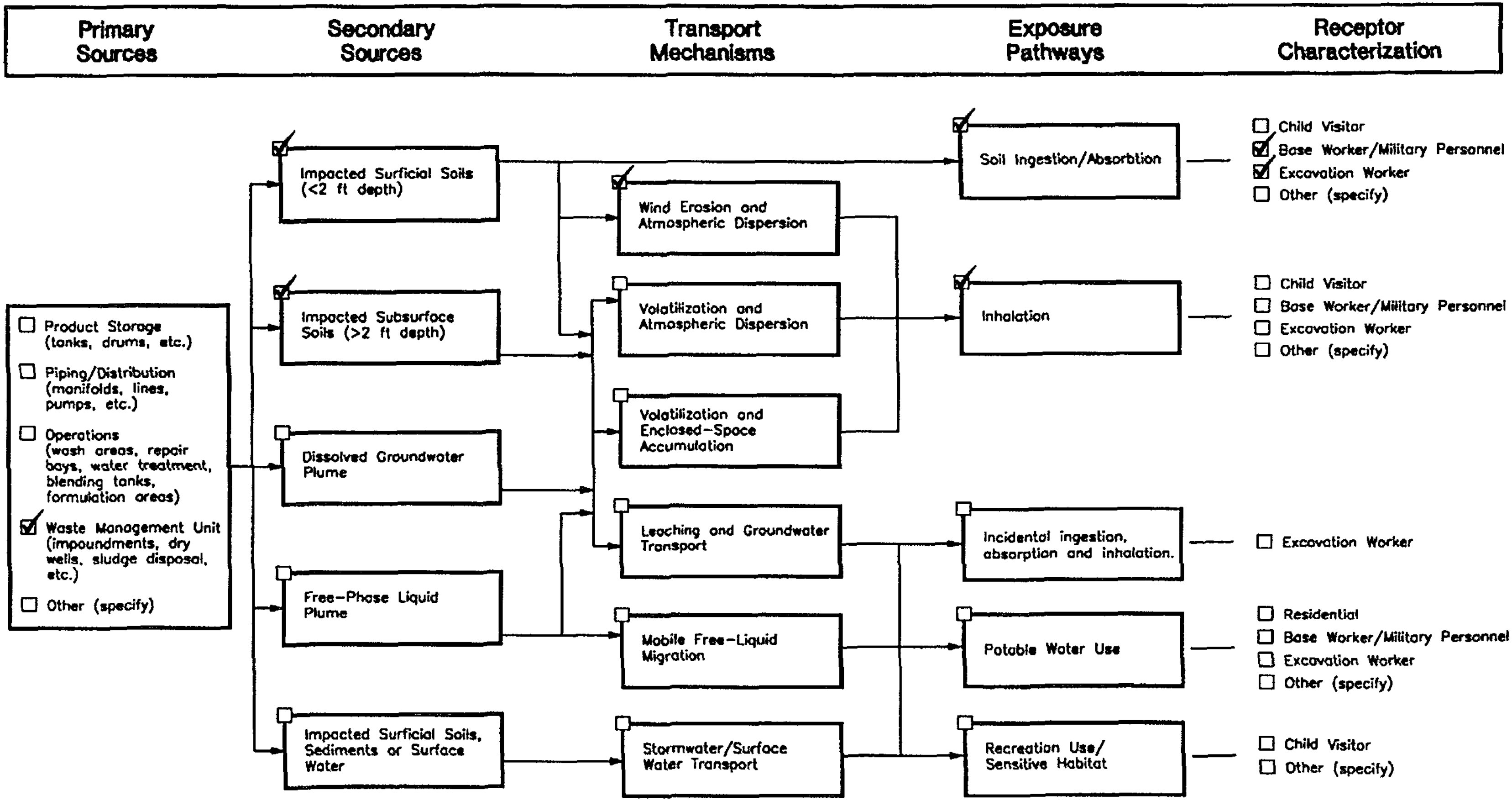
FIGURE 3-25



CONCEPTUAL SITE MODEL
PSC OT-12

OPERABLE UNIT No.1, RECORD OF DECISION
LUKE AIR FORCE BASE, ARIZONA

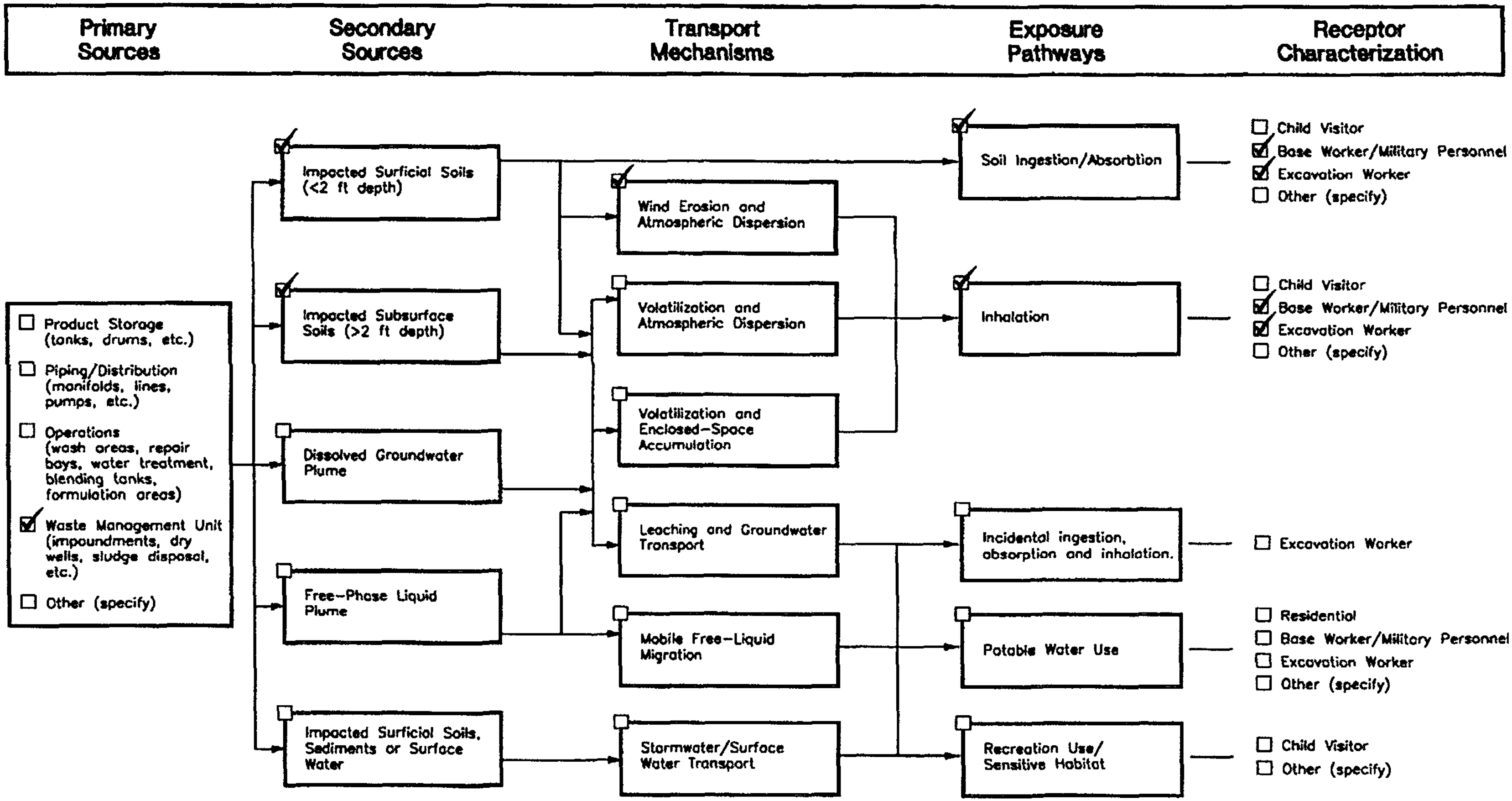
FIGURE
3-26



CONCEPTUAL SITE MODEL
PSC DP-13

OPERABLE UNIT No.1, RECORD OF DECISION
LUKE AIR FORCE BASE, ARIZONA

FIGURE 3-27

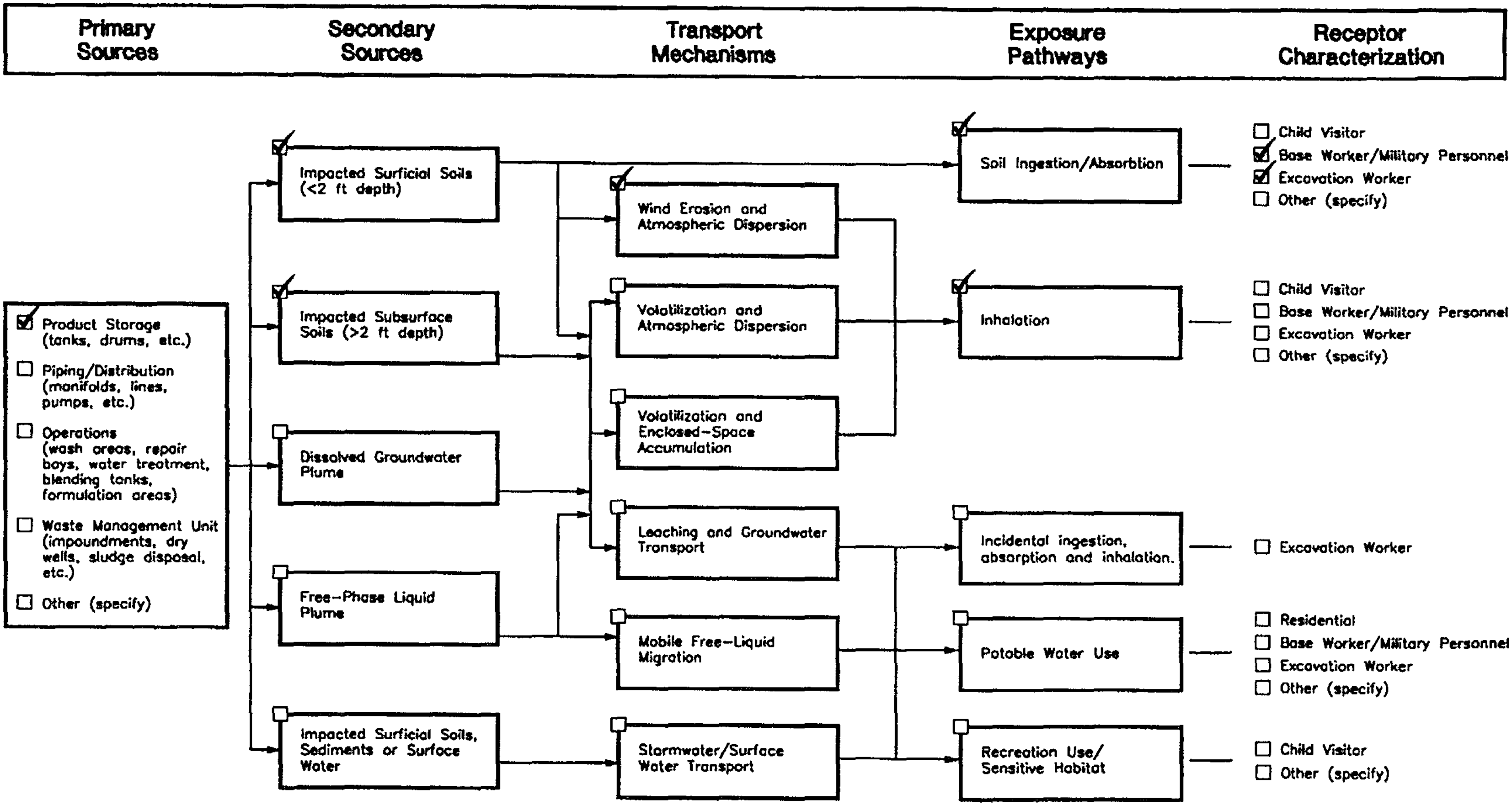


CONCEPTUAL SITE MODEL
PSC LF-14

OPERABLE UNIT No.1, RECORD OF DECISION
LUKE AIR FORCE BASE, ARIZONA

FIGURE 3-28

DWG DATE: 06/23/1998 PRJCT NO.: AZ 423.011 | FILE: ou-1rod\figures | DRAWING: FC22 | CHECKED: BRADDY | APPROVED: JOHNSON | DRAFTER: STILES

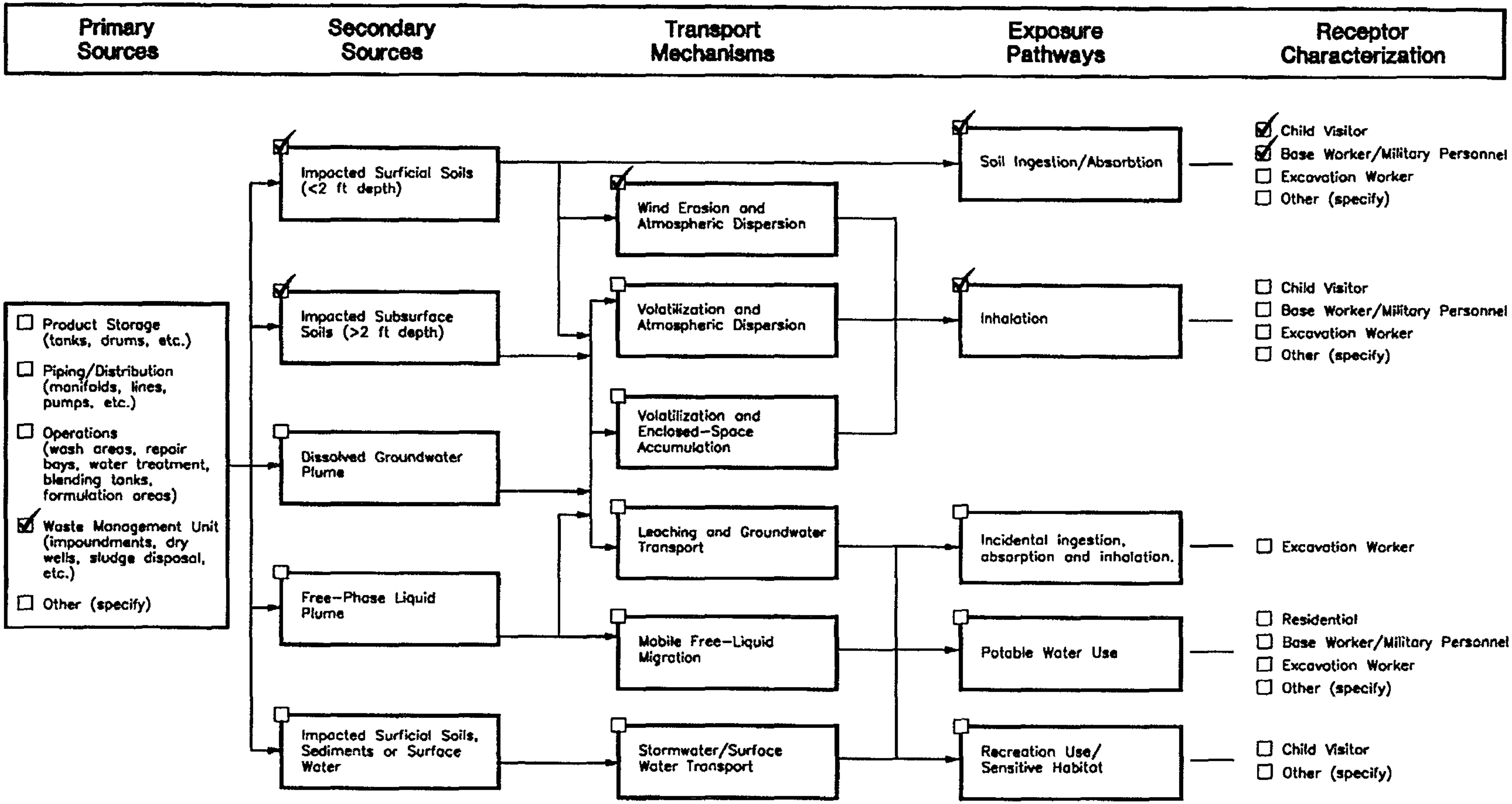


CONCEPTUAL SITE MODEL
PSC SS-17

OPERABLE UNIT No.1, RECORD OF DECISION
LUKE AIR FORCE BASE, ARIZONA

FIGURE 3-29

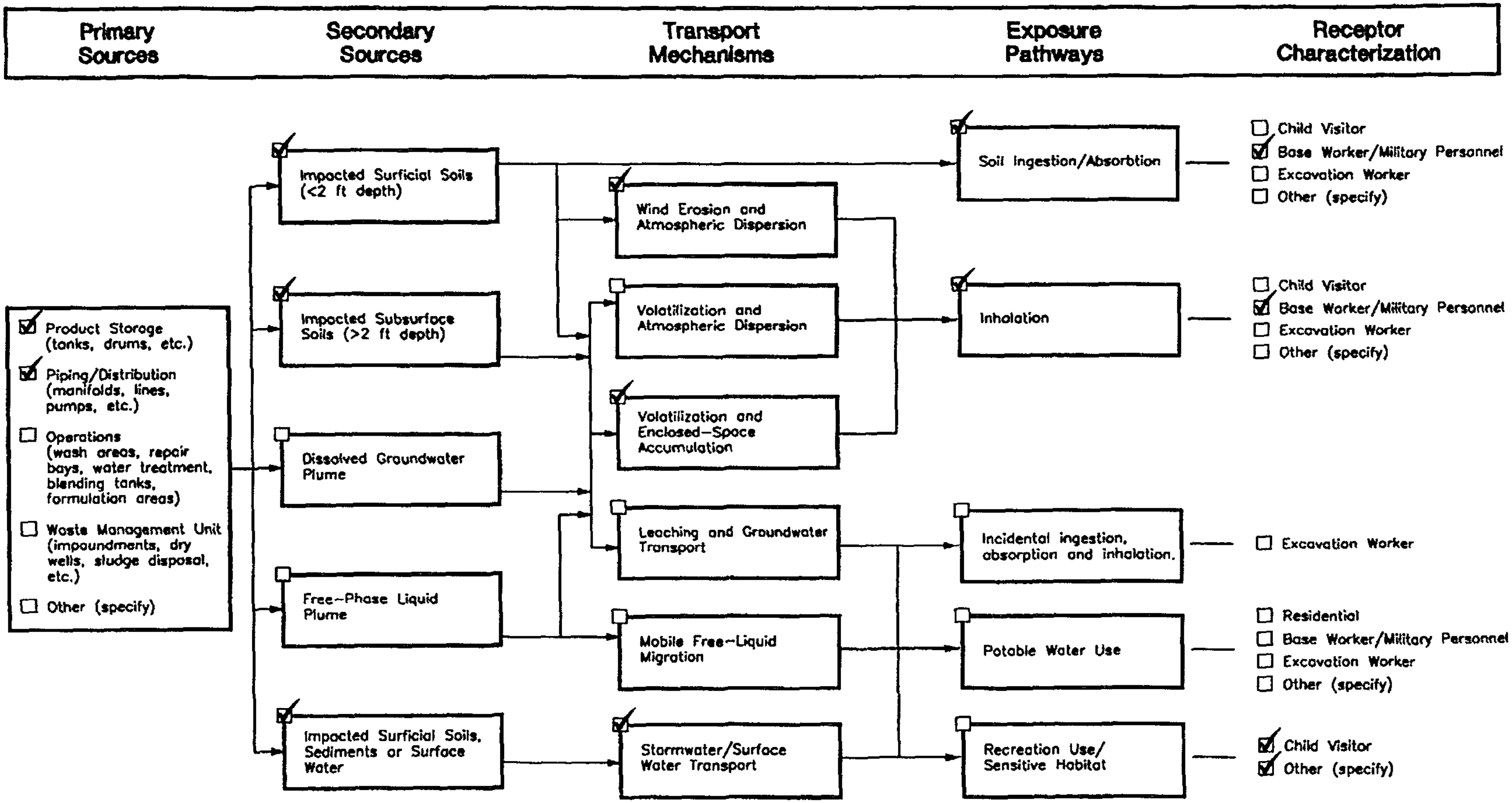
DWG DATE: 06/23/1998 | PRJCT NO.: AZ 423.011 | FILE: ou-1rod\figures | DRAWING: FC22 | CHECKED: BRADDY | APPROVED: JOHNSON | DRAFTER: STILES



CONCEPTUAL SITE MODEL
PSC SD-20

OPERABLE UNIT No.1, RECORD OF DECISION
LUKE AIR FORCE BASE, ARIZONA

FIGURE 3-30

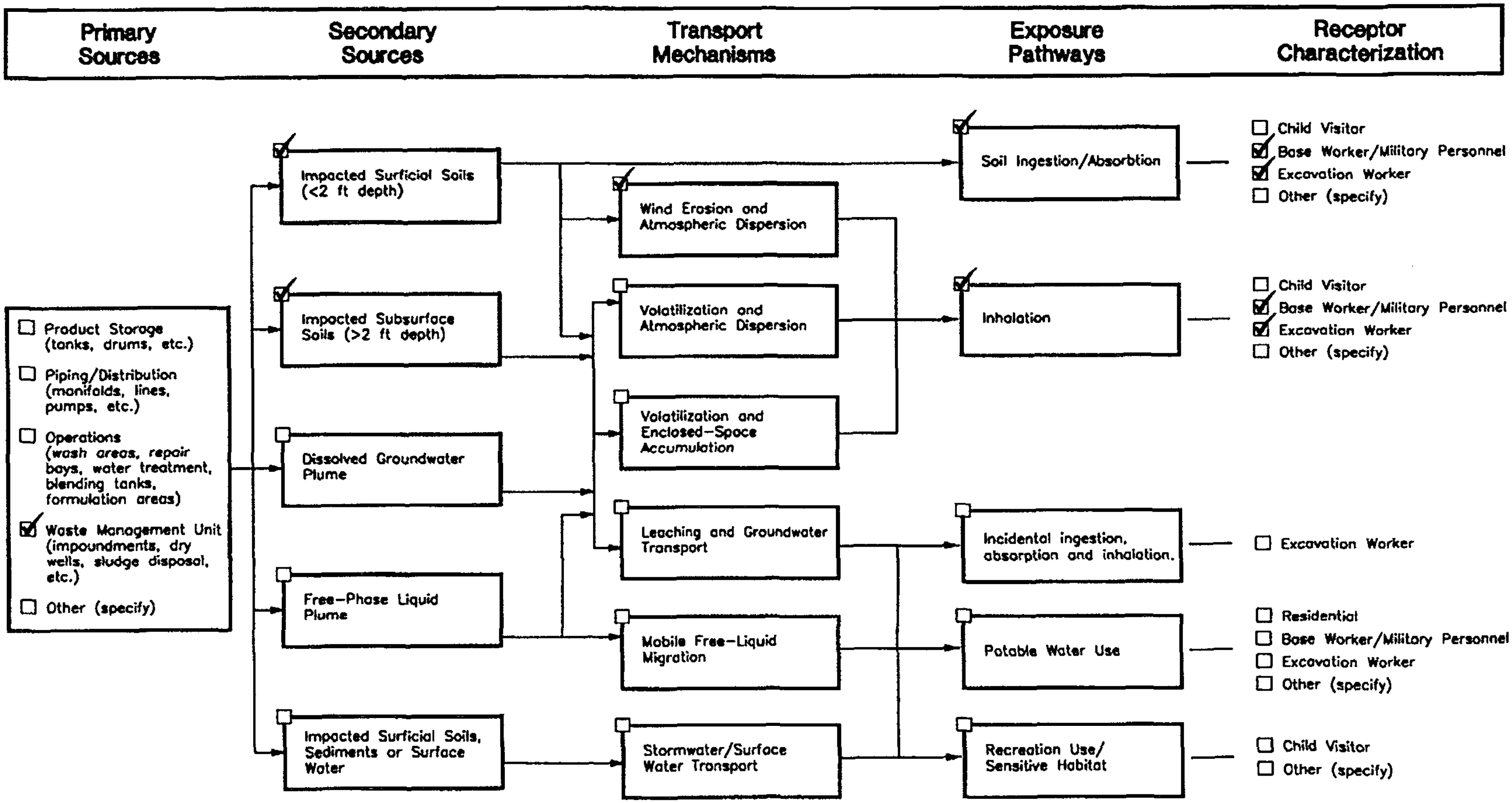


CONCEPTUAL SITE MODEL
PSC SD-21

OPERABLE UNIT No.1, RECORD OF DECISION
LUKE AIR FORCE BASE, ARIZONA

FIGURE 3-31

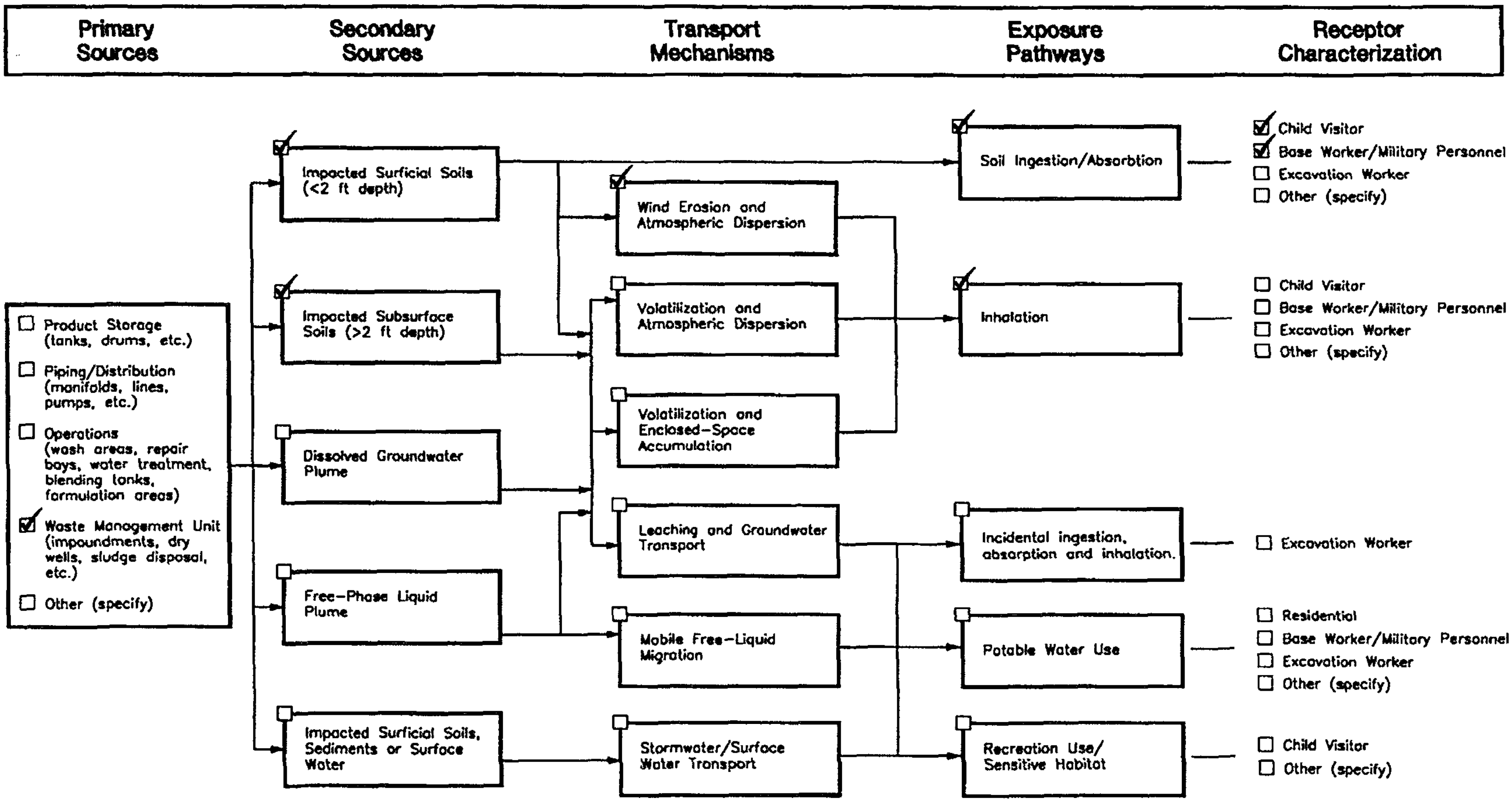
DWG DATE: 06/23/1998 | PRJCT NO.: AZ 423.0011 | FILE: ou-1rod\figures | DRAWING: FC21 | CHECKED: BRADDY | APPROVED: JOHNSON | DRAFTER: STILES



CONCEPTUAL SITE MODEL
PSC LF-25

OPERABLE UNIT No.1, RECORD OF DECISION
LUKE AIR FORCE BASE, ARIZONA

FIGURE 3-32

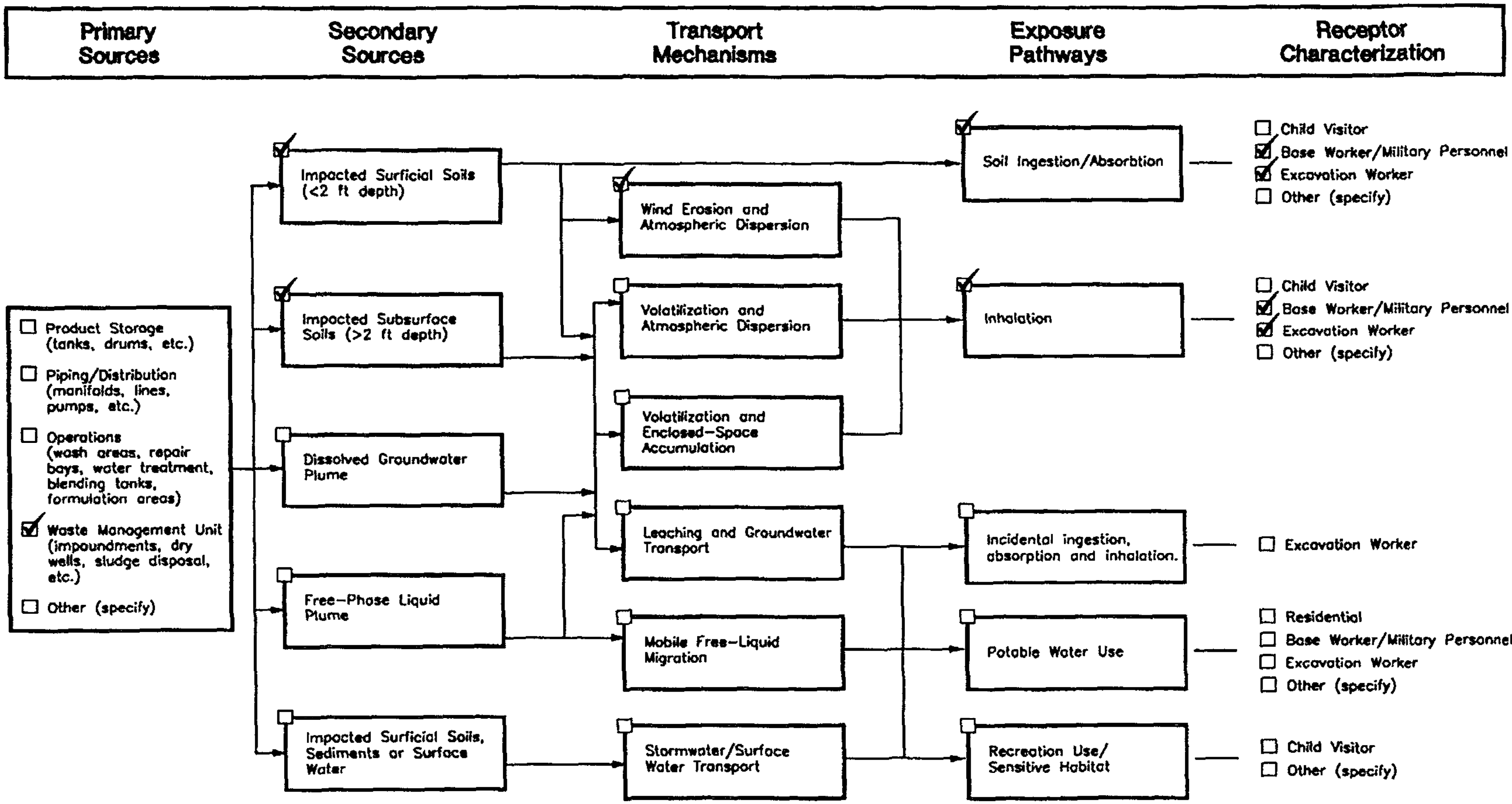


CONCEPTUAL SITE MODEL
PSC SD-26

OPERABLE UNIT No.1, RECORD OF DECISION
LUKE AIR FORCE BASE, ARIZONA

FIGURE 3-33

DWG DATE: 06/23/1998 PRJCT NO.: AZ 423.0011 | FILE: ou-1rod\figures | DRAWING: FC21 | CHECKED: BRADDY | APPROVED: JOHNSON | DRAFTER: STILES

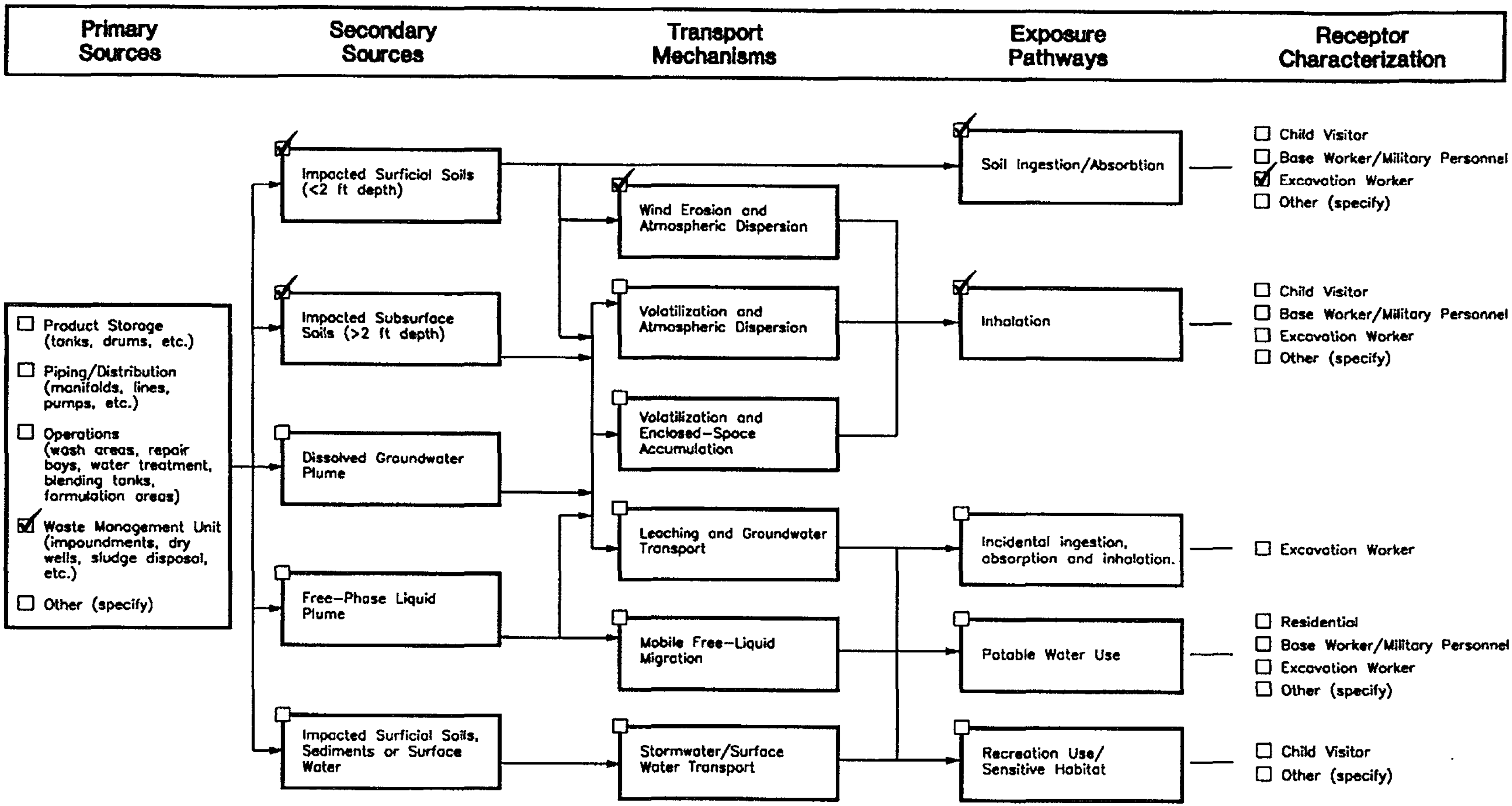


CONCEPTUAL SITE MODEL
PSC LF-37

OPERABLE UNIT No.1, RECORD OF DECISION
LUKE AIR FORCE BASE, ARIZONA

FIGURE 3-34

DWG DATE: 06/23/1998 | PRJCT NO.: AZ 423.011 | FILE: ou-1rod\figures | DRAWING: FC22 | CHECKED: BRADDY | APPROVED: JOHNSON | DRAFTER: STILES

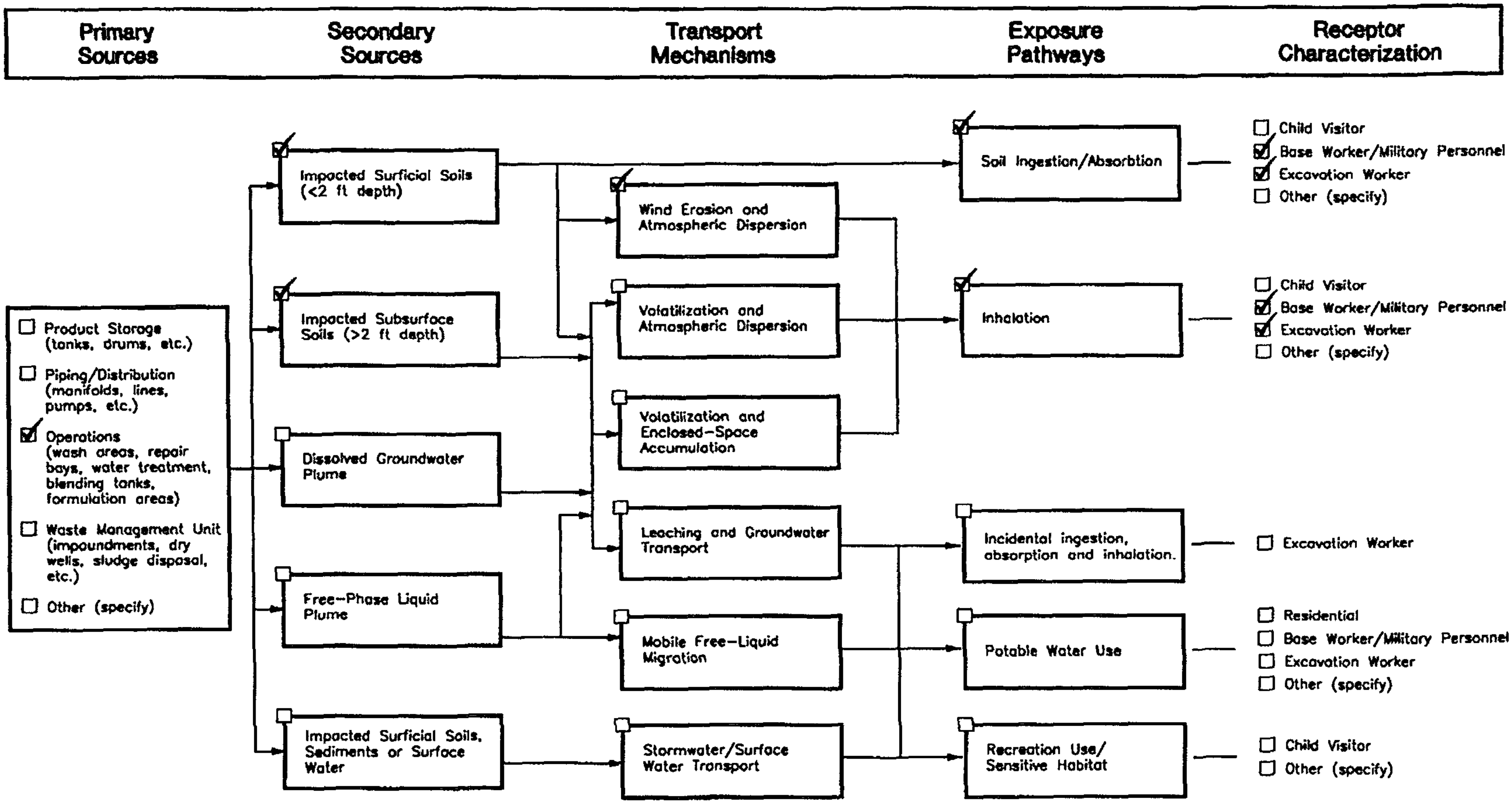


CONCEPTUAL SITE MODEL
PSC SD-38

OPERABLE UNIT No.1, RECORD OF DECISION
LUKE AIR FORCE BASE, ARIZONA

FIGURE 3-35

DWG DATE: 06/23/1998 | PRJCT NO.: AZ 423.0011 | FILE: ou-1rod\figures | DRAWING: FC21 | CHECKED: BRADDY | APPROVED: JOHNSON | DRAFTER: STILES

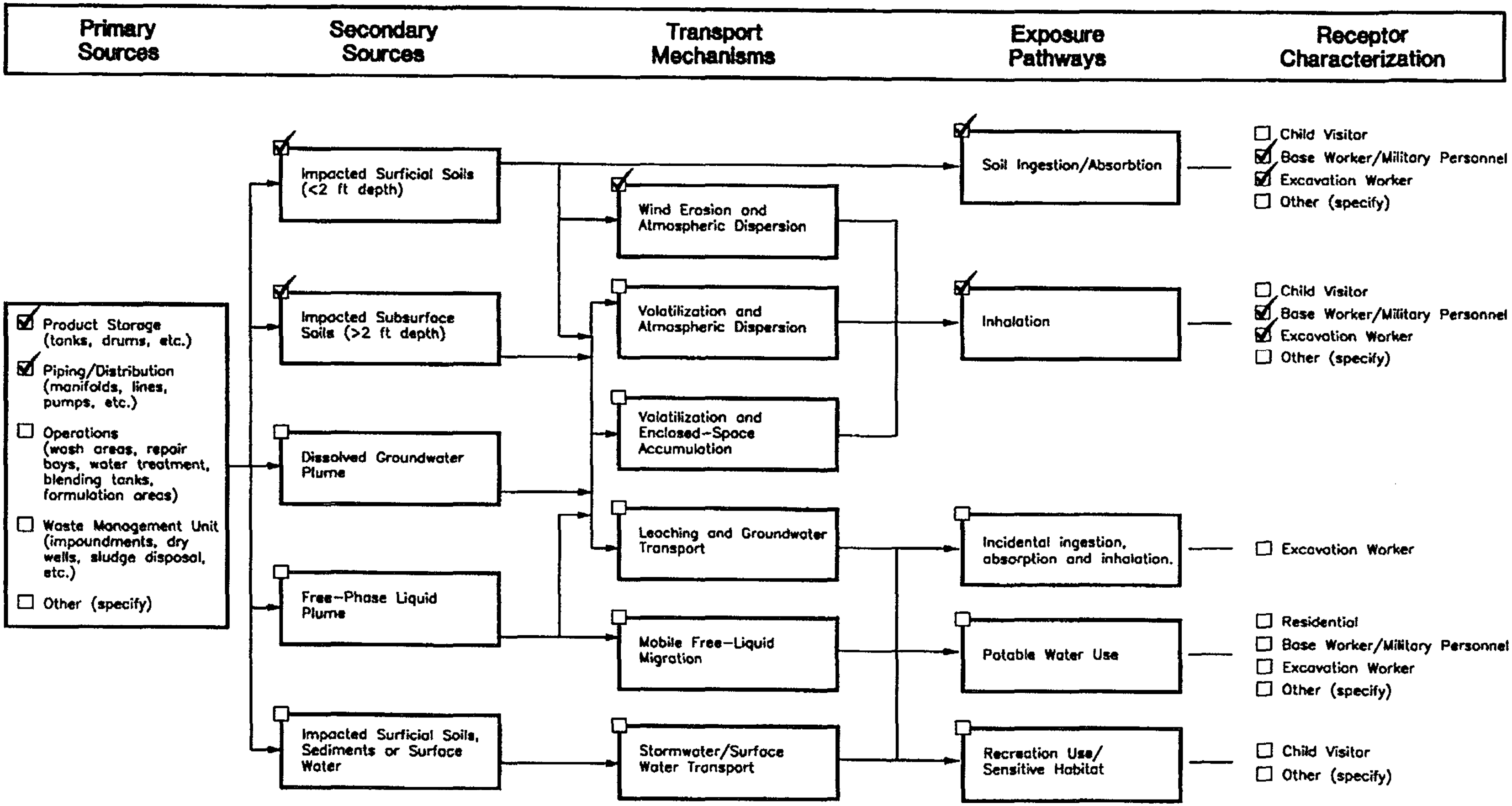


CONCEPTUAL SITE MODEL
PSC SD-39

OPERABLE UNIT No.1, RECORD OF DECISION
LUKE AIR FORCE BASE, ARIZONA

FIGURE 3-36

DWG DATE: 06/23/1998 | PRJCT NO.: AZ 423.0011 | FILE: ou-1rod\figures | DRAWING: FC21 | CHECKED: BRADDY | APPROVED: JOHNSON | DRAFTER: STILES

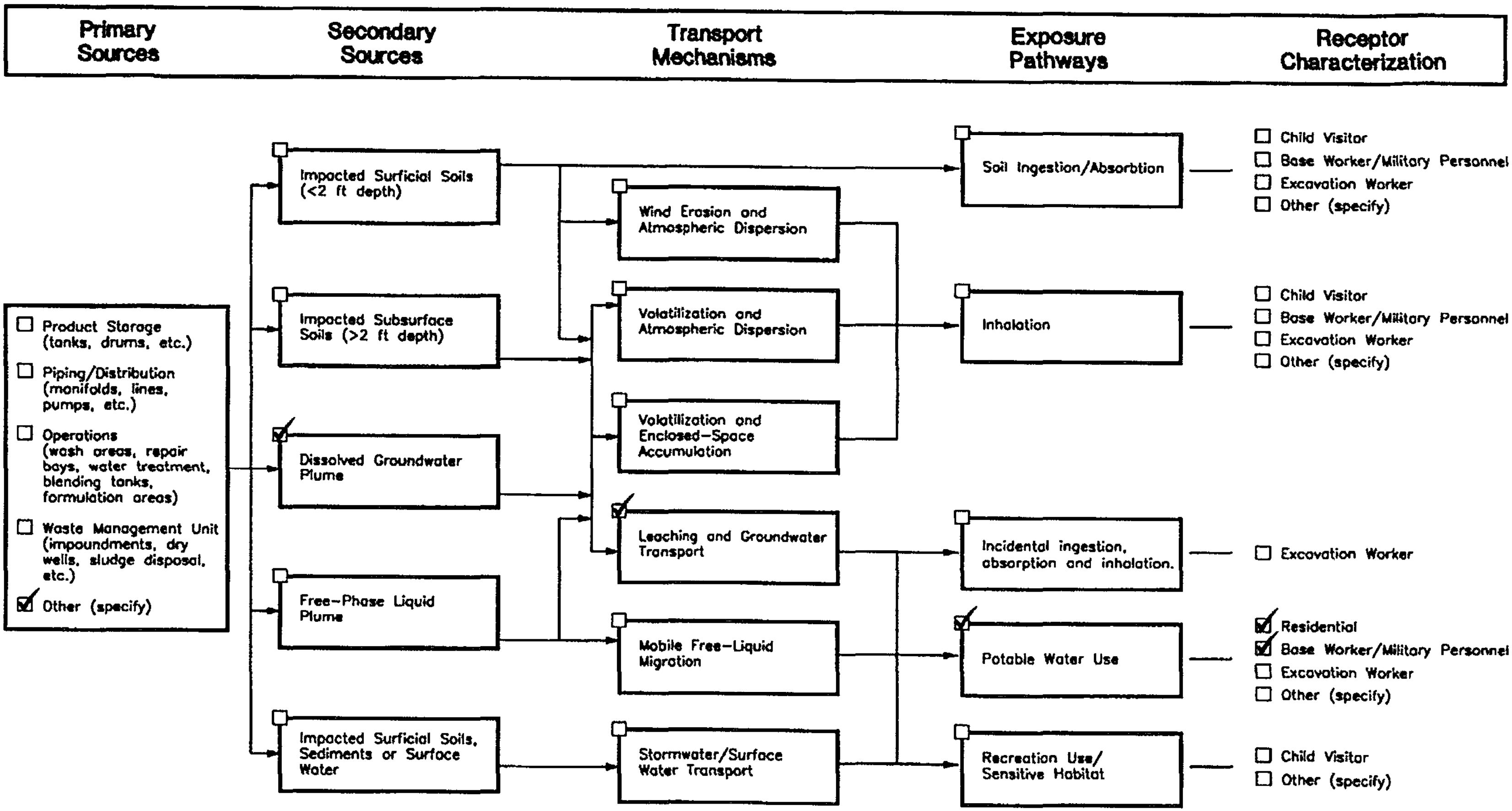


CONCEPTUAL SITE MODEL
PSC SS-42

OPERABLE UNIT No.1, RECORD OF DECISION
LUKE AIR FORCE BASE, ARIZONA

FIGURE 3-37

DWG DATE: 06/23/1998 PRJCT NO.: AZ 423.0011 | FILE: ou-1rod\figures | DRAWING: FC21 | CHECKED: BRADDY | APPROVED: JOHNSON | DRAFTER: STILES

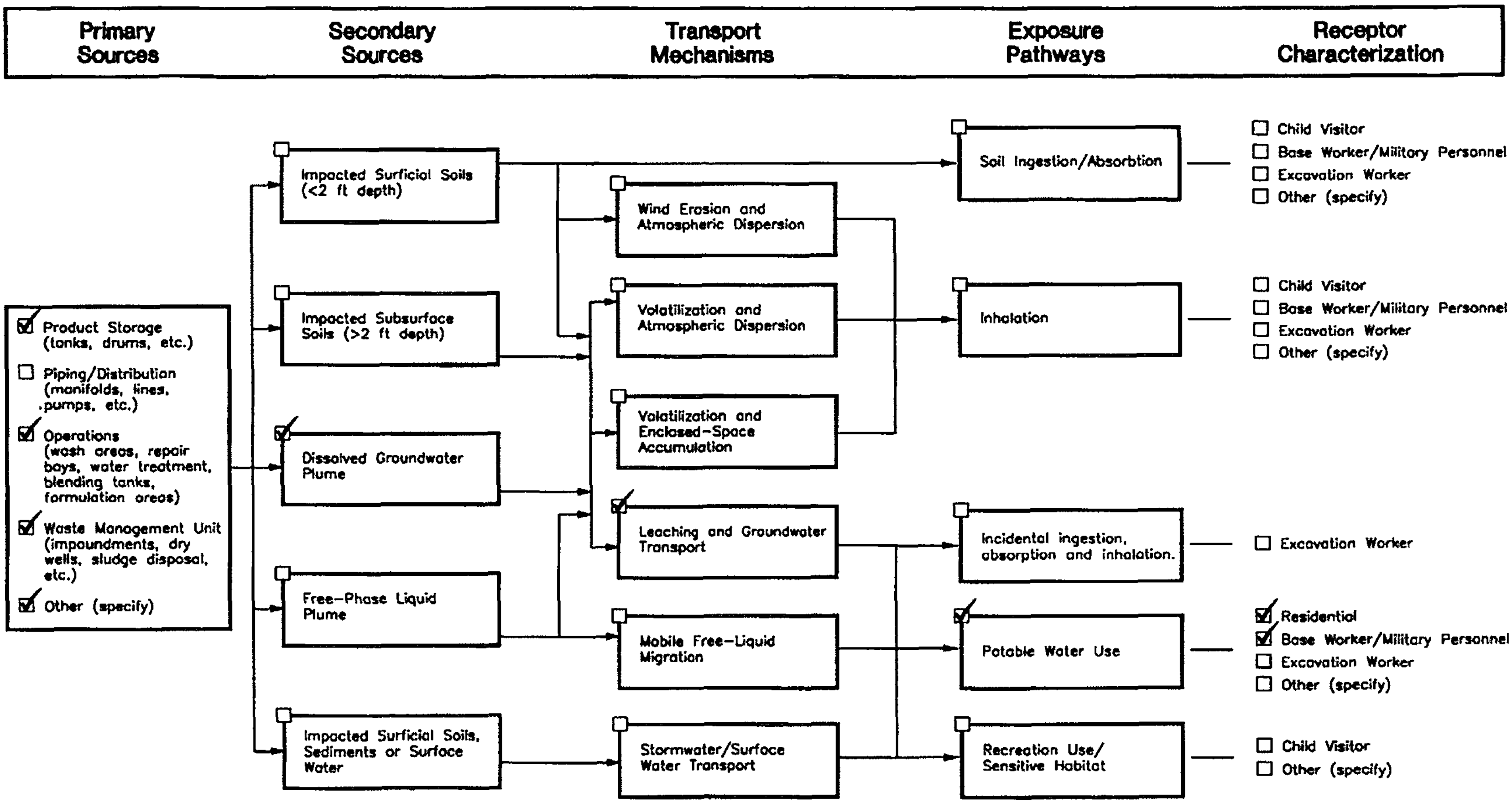


CONCEPTUAL SITE MODEL
PRODUCTION WELLS

OPERABLE UNIT No.1, RECORD OF DECISION
LUKE AIR FORCE BASE, ARIZONA

FIGURE 3-38

DWG DATE: 06/23/1998 | PRJCT NO.: AZ 423.0011 | FILE: ou-1rod\figures | DRAWING: FC21 | CHECKED: BRADDY | APPROVED: JOHNSON | DRAFTER: STILES



CONCEPTUAL SITE MODEL
MONITORING WELLS

OPERABLE UNIT No.1, RECORD OF DECISION
LUKE AIR FORCE BASE, ARIZONA

FIGURE 3-39

TABLE 3-1
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFICIAL SOIL SAMPLES AT
PSC RW-02
Luke Air Force Base, Arizona

Constituents	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRG		Maximum Exceeds PRG?
BNAs								
Benzo(a)anthracene	1 / 7	0.11	0.085 - .011	0.11	0.11	0.61		no
Benzo(a)pyrene	1 / 7	0.10	0.085 - 0.10	0.098	0.10	0.061		YES
Benzo(b)fluoranthene	1 / 7	0.11	0.085 - 0.11	0.11	0.11	0.61		no
Benzo(g,h,i)perylene	1 / 7	0.051	0.051 - 0.051	0.051	0.051	100	[a]	no
Benzo(k)fluoranthene	1 / 7	0.10	0.085 - 0.10	0.098	0.10	6.1		no
bis(2-Ethylhexyl)phthalate	1 / 7	0.071	0.024 - 0.071	0.064	0.077	32		no
Chrysene	1 / 7	0.12	0.085 - 0.12	0.12	0.12	7.2		no
Fluoranthene	1 / 7	0.18	0.085 - 0.18	0.17	0.19	2,600		no
Indeno(1,2,3-cd)pyrene	1 / 7	0.048	0.048 - 0.048	0.048	0.048	0.61		no
Phenanthracene	1 / 7	0.081	0.081 - 0.081	0.081	0.081	100	[a]	no
Pyrene	1 / 7	0.14	0.085 - 0.14	0.13	0.15	100		no
TRPH	9 / 13	20 - 1,000	5.0 - 1,000	180	330	110	[b]	YES
Metals								
Arsenic	4 / 13	6.0 - 9.0	2.5 - 9.0	4.0	5.3	0.38		YES
Barium	13 / 13	62 - 274	62 - 274	140	160	5,300		no
Cadmium	3 / 13	0.30 - 0.80	0.15 - 0.90	0.28	0.38	38		no
Chromium	13 / 13	6.7 - 24.3	6.7 - 24.3	18	20	210	[c]	no
Copper	13 / 13	12.9 - 32.2	12.9 - 32.2	22	25	2,800		no
Lead	13 / 13	6.0 - 117	6.0 - 117	22	36	400		no
Mercury	1 / 13	0.40	0.050 - 0.40	0.11	0.15	23	[d]	no
Nickel	13 / 13	12 - 22	12 - 22	17	18	1,500		no
Zinc	13 / 13	13.3- 109	23.3 - 109	44	55	23,000		no

Footnotes appear on Page 2

TABLE 3-1
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFICIAL SOIL SAMPLES AT
PSC RW-02
Luke Air Force Base, Arizona

Soil concentrations are given in milligrams per kilogram (mg/kg)

[a]	Pyrene is used as a surrogate for comparison to the Region IX PRG.
[b]	n-Hexane is used as a surrogate for comparison to the Region IX PRG.
[c]	Total chromium is used as a surrogate for comparison to the Region IX PRG.
[d]	Mercuric chloride is used as a surrogate for comparison to the Region IX PRG.
Average	Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
BNAs	Base-neutral and acid extractable compounds.
PRG	Preliminary Remediation Goal.
TRPH	Total recoverable petroleum hydrocarbon
UCL	95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.

TABLE 3-2
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFICIAL SOIL SAMPLES AT
PSC RW-02
Luke Air Force Base, Arizona

Constituents	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRG		Maximum Exceeds PRG?
BNAs								
2-Methylnaphthalene	1 / 21	0.32	0.085 - 0.32	0.16	0.18	240	[a]	no
Benzo(a)anthracene	1 / 21	0.11	0.085 - 0.11	0.10	0.11	0.61		no
Benzo(a)pyrene	1 / 21	0.10	0.085 - 0.10	0.10	0.10	0.061		YES
Benzo(b)fluoranthene	1 / 21	0.11	0.085 - 0.11	0.10	0.11	0.61		no
Benzo(g,h,i)perylene	1 / 21	0.051	0.051 - 0.051	0.51	0.051	100	[b]	no
Benzo(k)fluoranthene	1 / 21	0.10	0.085 - 0.10	0.95	0.098	6.1		No
Bis(2-ethylhexyl)phthalate	4 / 21	0.071	0.0235 - 5.1	0.43	0.85	32		no
Chrysene	1 / 21	0.12	0.085 - 0.12	0.11	0.11	7.2		no
Di-n-butyl phthalate	1 / 21	0.39	0.085 - 0.39	0.16	0.19	6,500		no
Di-n-octyl phthalate	2 / 21	0.25 - 0.52	0.085 - 0.52	0.17	0.21	1,300		no
Fluoranthene	1 / 21	0.18	0.085 - 0.18	0.15	0.16	2.600		no
Indeno(1,2,3-cd)pyrene	1 / 21	0.048	0.048 - 0.048	0.048	0.048	0.61		no
Phenanthrene	1 / 21	0.081	0.081 - 0.081	0.081	0.081	100	[b]	no
Pyrene	1 / 21	0.14	0.085 - 0.14	0.12	0.13	100		
TRPH	22 / 38	20 - 4,100	5.0 - 4,100	290	530	110	[c]	YES
Metals								
Arsenic	14 / 38	6.0 - 19	2.5 - 19	4.9	6.0	0.38		YES
Barium	38 / 38	35.1 - 357	35.1 - 357	140	160	5,300		no
Beryllium	3 / 38	0.50 - 0.70	0.15 - 0.70	0.24	0.27	0.14		YES
Cadmium	13 / 38	0.30 - 58	0.15 - 58	2.4	5.0	38		YES
Chromium	38 / 38	5.3 - 93	5.3 - 63	21	24	210	[d]	no
Copper	38 / 38	8.2 - 4,840	8.2 - 4,840	160	370	2,800		YES
Lead	37 / 38	6.0 - 680	2.5 - 680	56	91	400		YES
Mercury	2 / 38	0.40 - 0.64	0.05 - 0.64	0.12	0.15	23	[e]	no
Nickel	38 / 38	6.0 - 31	6.0 - 31	19	20	1,500		no

Footnotes appear on Page 2

TABLE 3-2
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFICIAL SOIL SAMPLES AT
PSC RW-02
Luke Air Force Base, Arizona

Constituents	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRG		Maximum Exceeds PRG?
Metals cont.								
Silver	5 / 38	1.0 - 12	0.25 - 12	0.82	1.3	380		no
Uranium	2 / 2	0.489 - 1.03	0.489 - 1.03	0.76	2.5	230	[f]	no
Zinc	38 / 38	17 - 3,660	17 - 3,660	200	360	23,000		no
Cyanide	1/ 38	0.50	0.25 - 0.50	0.26	0.27	1,300		no
Radionuclides								
Gross Alpha (pCi/g)	2 / 2	6.17 - 7.71	6.17 - 7.71	6.9	12.0	8.19	[g]	no
Gross Beta (pCi/g)	2 / 2	21.1 - 22.2	21.1 - 22.2	22	25	22.9	[g]	no
Radium-226 (pCi/g)	2 / 2	0.476 - 0.752	0.476 - 0.752	0.61	1.5	0.61	[g]	YES
Radium-228(pCi/g)	2 / 2	0.512 - 0.739	0.512 - 0.739	0.63	1.3	0.6025	[g]	YES

Soil concentrations are given in milligrams per Kilogram (mg/kg), except for the radionuclides which are given in picocuries per gram (pCi/g).

[a] Naphthalene is used as a surrogate for comparison to the Region IX PRG.
[b] Pyrene is used as a surrogate for comparison to the Region IX PRG.
[c] n-Hexane is used as a surrogate for comparison to the Region IX PRG.
[d] Total chromium is used as a surrogate for comparison to the Region IX PRG.
[e] Mercuric chloride is used as a surrogate for comparison the Region IX PRG.
[f] 1996 Region IX PRG is not available; 1994 Region IX PRG used for comparison purposes (USEPA, 1994c).
[g] Region IX PRG not available; value shown is average concentration in background samples MW-115 (10-12 feet below ground surface), and SB-11(10-12 feet below ground surface). Average detected compared to average background concentration.
Average Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
BNAs Base-neutral and acid extractable compounds.
PRG Preliminary Remediation Goal.
TRPH Total recoverable petroleum hydrocarbon.
UCL 95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.

TABLE 3-3
OCCURRENCE OF CONSTITUENTS DETECTED IN GROUNDWATER SAMPLES AT
PSC RW-02
Luke Air Force Base, Arizona

Constituents	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRG		Maximum Exceeds PRG?
Metal								
Arsenic	7 / 8	0.0060 - 0.017	0.0025 - 0.017	0.010	0.014	0.000045		YES
Barium	7 / 7	0.020 - 0.017	0.020 - 0.017	0.042	0.055	2.6		no
Chromium	8 / 8	0.013 - 0.058	0.013 - 0.058	0.022	0.032	0.18	[a]	no
Copper	3 / 8	0.013 - 0.276	0.0050 - 0.276	0.051	0.12	1.4		no
Lead	5 / 8	0.0031 - 0.018	0.0010 - 0.018	0.0066	0.011	0.004		YES
Nickel	2 / 8	0.029 - 0.042	0.010 - 0.042	0.016	0.025	0.73		no
Zinc	8 / 8	0.236 - 0.86	0.236 - 0.86	0.54	0.69	11		no

Groundwater concentrations are given in milligrams per liter (mg/L)

[a] Chromium VI is used as a surrogate for comparison tot he Region IX PRG.
Average Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
PRG Preliminary remediation goals.
UCL 95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.

TABLE 3-4
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFICIAL SOIL SAMPLES AT
PSC RW-02
Luke Air Force Base, Arizona

Constituents	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRG		Maximum Exceeds PRG?
Metals								
Arsenic	1 / 4	5.2	2.5 - 5.2	3.2	4.8	0.38		YES
Barium	4 / 4	81.7 - 181	81.7 - 181	130	180	5,300		no
Beryllium	2 / 4	0.70 - 0.70	0.25 - 0.70	0.48	0.78	0.14		YES
Cadmium	4 / 4	1.4 - 2.1	1.4 - 2.1	1.6	2.0	38		no
Chromium	4 / 4	10.6 - 20.1	10.6 - 20.1	16	21	210	[a]	no
Copper	4 / 4	10.7 - 32.9	10.7 - 32.9	21	33	2,800		no
Lead	4 / 4	7.2 - 13.5	7.2 - 13.5	10	14	400		no
Nickel	4 / 4	8.3 - 18.8	8.3 - 18.8	14	20	1,500		no
Zinc	4 / 4	22.3 - 45.6	22.3 - 45.6	36	49	23,000		no

Soil concentrations are given in milligrams per kilogram (mg/kg).

[a] Total chromium is used as a surrogate for comparison to the Region IX PRG.
Average Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
PRG Preliminary Remediation Goal.
UCL 95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.

TABLE 3-5
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFICIAL SOIL SAMPLES AT
PSC LF-03
Luke Air Force Base, Arizona

	Frequency	Range of Detects	Total Range					
Constituents	Detects / Total	Min - Max	Min - Max	Average	UCL	Region IX Residential PRG		Maximum Exceeds PRG?
TRPH	2 / 12	10 - 20	5.0 - 20	6.7	9.0	110	[a]	no
Metals								
Arsenic	4 / 12	5.2 - 15.9	2.5 - 15.9	4.7	6.9	0.38		YES
Barium	12 / 12	27 - 222	27 - 222	110	150	5,300		no
Beryllium	2 / 12	0.70	0.25 - 0.70	0.33	0.42	0.14		YES
Cadmium	11 / 12	0.70 - 7.8	0.25 - 7.8	2.4	3.6	38		no
Chromium	12 / 12	3.3 - 386	3.3 - 386	71	140	210	[b]	YES
Copper	12 / 12	5.2 - 4,700	5.2 - 4,700	450	1,100	2,800		YES
Lead	10 / 12	5.2 - 796	2.5 - 796	180	340	400		YES
Nickel	12 / 12	2.6 - 38.7	2.6 - 38.7	15	22	1,500		no
Silver	2 / 12	2.2 - 21	0.50 - 21	2.4	5.4	380		no
Zinc	12 / 12	8.5 - 867	8.5 - 867	200	370	23,000		no

Soil concentrations are given in milligrams per kilogram (mg/kg).

[a] n-Hexane is used as surrogate for comparison to the Region IX PRG.
[b] Total chromium is used as a surrogate for comparison to the Region IX PRG.
Average Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
PRG Preliminary Remediation Goal.
TRPH Total recoverable petroleum hydrocarbon.
UCL 95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.

TABLE 3-6
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFICIAL SOIL SAMPLES AT
PSC FT-07E
PRE-REMEDIATION
Luke Air Force Base, Arizona

Constituents	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRG		Maximum Exceeds PRG?
VOCs								
Acetone	7 / 8	0.023 - 0.104	0.023 - 0.104	0.063	0.084	2,100		no
Ethylbenzene	1 / 8	0.75	0.0025 - 0.75	0.96	0.27	230		no
Methylene chloride	6 / 8	0.0040 - 0.035	0.0025 - 0.035	0.014	0.023	7.8		no
Toluene	5 / 8	0.012 - 0.062	0.0025 - 0.062	0.030	0.047	790		no
Xylenes	1 / 8	3.75	0.0025 - 3.75	0.47	1.4	320		no
TRPH	2 / 8	24.3 -767	5.0 - 767	100	280	110	[a]	YES
Metals								
Chromium	8 / 8	7.4 - 2.12	7.4 - 21.2	15	17	210	[b]	no
Copper	8 / 8	17 - 23.2	17 - 23.2	20	21	2,800		no
Lead	8 / 8	2.1 - 18.7	2.1 - 18.7	9.9	13	400		no
Mercury	1 / 8	0.12	0.05 - 0.12	0.059	0.075	23	[c]	no
Nickel	8 / 8	11.4 - 20.8	11.4 - 20.8	17	18	1,500		no
Zinc	8 / 8	35.5 - 46.4	35.5 - 46.4	42	45	23,000		no

Soil concentrations are given in milligrams per kilogram (mg/kg).

[a] n-Hexane is used as surrogate for comparison to the Region IX PRG.
[b] Total chromium is used as a surrogate for comparison to the Region IX PRG.
Average Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
PRG Preliminary Remediation Goal.
TRPH Total recoverable petroleum hydrocarbon.
UCL 95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.
VOCs Volatile organic compounds.

TABLE 3-7
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFICIAL SOIL SAMPLES AT
PSC FT-07E
PRE-REMEDIATION
Luke Air Force Base, Arizona

Constituents	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRG		Maximum Exceeds PRG?
TRPH	6 / 6	160 - 2,000	160 - 2,000	920	1,600	110	[a]	YES
Metals								
Arsenic	4 / 6	6.0 - 9.0	2.5 - 9.0	5.7	7.9	0.38		YES
Barium	6 / 6	86.8 - 154	86.8 - 154	130	150	5,300		no
Chromium	6 / 6	9.4 - 32.1	9.4 - 32.1	21	28	210	[b]	no
Copper	6 / 6	15.5 - 27.7	15.5 - 27.7	21	25	2,800		no
Lead	6 / 6	8.0 - 73	8.0 - 73	21	42	400		no
Nickel	6 / 6	10.9 - 21	10.9 - 21	17	20	15,00		no
Zinc	6 / 6	31.1 - 112	31.1 - 112	58	85	23,000		no

Soil concentrations are given in milligrams per kilogram (mg/kg).

[a] n-Hexane is used as surrogate for comparison to the Region IX PRG.
[b] Total chromium is used as a surrogate for comparison to the Region IX PRG.
Average Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
PRG Preliminary Remediation Goal.
TRPH Total recoverable petroleum hydrocarbon.
UCL 95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.

TABLE 3-8
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFICIAL SOIL SAMPLES AT
PSC FT-07E
PRE-REMEDIATION
Luke Air Force Base, Arizona

Constituents	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRG		Maximum Exceeds PRG?
VOCs								
Acetone	24 / 32	0.010 - 0.28	0.010 - 0.28	0.13	0.17	2,100		no
Ethylbenzene	7 / 32	0.75 - 61	0.0025 - 61	3.7	7.2	230		no
Methylene chloride	20 / 32	0.0040 - 0.090	0.0025 - 0.090	0.033	0.044	7.8		no
Toluene	25 / 32	0.0050 - 97	0.0025 - 97	3.8	9.0	790		no
Xylenes	8 / 32	0.48 - 274	274	16	31	320		no
TRPH	7 / 32	20.1 - 1,380	5.0 - 1,380	100	190	110	[a	YES
Metals								
Arsenic	3 / 32	2.1 - 2.4	1.0 - 2.4	1.1	1.2	0.38		YES
Chromium	32 / 32	3.0 - 53.3	3.0 - 53.3	13	16	210	[b	no
Copper	32 / 32	6.5 - 26.7	6.5 - 26.7	16	17	2,800		no
Lead	32 / 32	2.1 - 18.7	2.1 - 18.7	7.5	8.5	400		no
Mercury	10 / 32	0.10 - 0.31	0.050 - 0.31	0.078	0.095	23	[c]	no
Nickel	32 / 32	4.6 - 23.6	4.6 - 23.6	13	14	1,500		no
Zinc	32 / 32	10.5 - 51	10.5 - 51	31	34	23,000		no

Soil concentrations are given in milligrams per kilogram (mg/kg).

[a]	n-Hexane is used as surrogate for comparison to the Region IX PRG.
[b]	Total chromium is used as a surrogate for comparison to the Region IX PRG.
[c]	Mercuric chloride is used as a surrogate for comparison to the Region IX PRG.
Average	Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
PRG	Preliminary Remediation Goal.
TRPH	Total recoverable petroleum hydrocarbon.
UCL	95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.
VOCs	Volatile organic compounds.

TABLE 3-9
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFACE AND SUBSURFACE SOIL SAMPLES AT
PSC FT-07
POST-REMEDIATION
Luke Air Force Base, Arizona

Constituents	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRG		Maximum Exceeds PRG?
VOCs								
Acetone	1 / 4	0.470 - 0.47	0.265 - 0.47	0.33	0.44	2,100		no
Ethylbenzene	1 / 4	0.98 - 1.0	0.13 - 1.0	0.34	0.84	230		no
Toluene	1 / 4	0.086 - 0.086	0.186 - 0.086	0.086	0.086	790		no
Xylenes	1 / 4	8.6 - 8.6	0.13 - 8.6	2.2	7.2	320		no
TRPH	10 / 14	10.0 - 27,000	5.0 - 27,000	3,900	7,500	110	[a]	YES
Metals								
Arsenic	5 / 14	6.0 - 9.0	2.5 - 9.0	4.1	5.2	0.38		YES
Barium	14 / 14	68.5 - 209	68.5 - 209	140	160	5,300		no
Chromium	14 / 14	5.6 - 32.1	5.6 - 32.1	17	21	210	[b]	no
Copper	14 / 14	8.1 - 27.7	8.1 - 27.7	18	20	2,800		no
Lead	12 / 14	6.0 - 73	2.5 - 73	13	22	400		no
Nickel	14 / 14	4.7 - 21	4.7 - 21	14	17	1,500		no
Zinc	14 / 14	13.8 - 112	13.8 - 112	41	54	23,000		no

Soil concentrations are given in milligrams per kilogram (mg/kg).

[a] n-Hexane is used as a surrogate for comparison to the Region IX PRG.
[b] Total chromium is used as a surrogate for comparison to the Region IX PRG.
Average Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
PRG Preliminary Remediation Goal.
TRPH Total recoverable petroleum hydrocarbon.
UCL 95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.
VOCS Volatile organic compounds.

TABLE 3-10
OCCURRENCE OF CONSTITUENTS DETECTED IN GROUNDWATER SAMPLES AT
PSC FT-07E
Luke Air Force Base, Arizona

	Frequency	Range of Detects	Total Range					
Constituents	**Detects / Total**	**Min - Max**	**Min - Max**	**Average**	**UCL**	**Region IX Residential PRG**		**Maximum Exceeds PRG?**
Metals								
Barium	10 / 11	0.044 - 0.32	0.044 - 0.32	0.18	0.22	2.6		no
Chromium	10 / 11	0.011 - 0.024	0.0050 - 0.024	0.016	0.019	0.18	[a]	no
Copper	6 / 11	0.010 - 0.032	0.0050 - 0.032	0.013	0.018	1.4		no
Lead	10 / 11	0.0020 - 0.0080	0.0010 - 0.0080	0.0039	0.0051	0.004		YES
Zinc	11 / 11	0.284 - 1.07	0.284 - 1.07	0.60	0.74	11		no

Groundwater concentrations are given in milligrams per kilogram (mg/L).

[a] Chromium VI is used as a surrogate for comparison to the Region IX PRG.
Average Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
PRG Preliminary remedial goals.
UCL 95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.

TABLE 3-11
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFICIAL SOIL SAMPLES AT
PSC SS-11
Luke Air Force Base, Arizona

Constituents	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRG	Maximum Exceeds PRG?
PCBs	3 / 84	0.060 - 0.22	0.0125 - 0.22	0.026	0.033	0.066	YES

Soil concentrations are given in milligrams per kilogram (mg/kg).

Average	Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
PCBS	Polychlorinated biphenyls.
PRG	Preliminary Remediation Goal.
UCL	95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.

TABLE 3-12
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFACE AND SUBSURFACE SOIL SAMPLES AT PSC OT-12
Luke Air Force Base, Arizona

Constituents	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRG		Maximum Exceeds PRG?
BNAs								
Acenaphthylene	1 / 3	0.046	0.046 - 0.046	0.046	0.046	100	[a]	no
Anthracene	1 / 3	0.083	0.083 - 0.083	0.083	0.083	5.7		no
Benzo(a)anthracene	1 / 3	0.66	0.17 - 0.66	0.33	0.81	0.61		YES
Benzo(a)pyrene	1 / 3	0.87	0.17 - 0.87	0.40	1.1	0.061		YES
Benzo(b)fluoranthene	2 / 3	0.036 - 0.97	0.036 - 0.97	0.39	1.2	0.061		YES
Benzo(g,h,i)perylene	1 / 3	0.48	0.17 - 0.48	0.27	0.58	100	[a]	no
Benzo(k)fluoranthene	2 / 3	0.042 - 0.69	0.042 - 0.69	0.30	0.88	6.1		no
Carbazole	1 / 3	0.13	0.13 - 0.13	0.13	0.13	22		no
Chrysene	2 / 3	0.048 - 1.1	0.048 - 1.1	0.44	1.4	7.2		no
Dibenza(a,h)anthracene	1 / 3	0.20	0.17 - 0.20	0.18	0.21	0.061		YES
Fluoranthene	2 / 3	0.085 - 1.1	0.085 - 1.1	0.45	1.4	2,600		no
Indeno(1,2,3-c,d)pyrene	1 / 3	0.47	0.17 - 0.47	0.27	0.56	0.61		no
Pentachlorophenol	1 / 3	0.045	0.045 - 0.045	0.045	0.045	2.5		no
Phenanthrene	2 / 3	0.037 - 0.43	0.037 - 0.43	0.21	0.55	100	[a]	no
Pyrene	2 / 3	0.061 - 1.4	0.061 - 1.4	0.54	0.8	100		no
TRPH	4 / 7	30 - 1,400	5.0 - 1,400	430	840	110	[b]	YES
Metals								
Arsenic	3 / 7	5.0 - 9.0	2.5 - 9.0	4.4	6.4	0.38		YES
Barium	7 / 7	90.1 - 148	90.1 - 148	120	140	5,300		no
Beryllium	3 / 7	0.40 - 0.60	0.15 - 0.60	0.33	0.46	0.14		YES
Cadmium	3 / 7	0.30 - 0.90	0.15 - 0.90	0.40	0.65	38		no
Chromium	7 / 7	11.6 - 33	11.6 - 33	18	23	210	[c]	no

Footnotes appear on Page 2.

TABLE 3-12
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFICIAL SOIL SAMPLES AT
PSC OT-12
Luke Air Force Base, Arizona

Constituents	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRG	Maximum Exceeds PRG
Copper	7 / 7	15.7 - 29.7	15.7 - 29.7	22	25	2,800	no
Lead	7 / 7	9.0 - 330	9.0 - 330	72	160	400	no
Nickel	7 / 7	11.8 - 17.1	11.8 - 17.1	14	15	1,500	no
Zinc	7 / 7	35.3 - 76.3	35.3 - 76.3	46	56	23,100	no

Sol concentrations are given in milligrams per kilogram (mg/kg).

[a] Pyrene is used as a surrogate for comparison to the Region IX PRG.
[b] n-Hexane is used as a surrogate for comparison to the Region IX PRG.
[c] Total chromium is used as a surrogate for comparison to the Region IX PRG.
Average Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
BNAs Base-neutral and acid extractable compounds.
PRG Preliminary Remediation Goal.
TRPH Total recoverable petroleum hydrocarbon.
UCL 95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.

TABLE 3-13
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFACE AND SUBSURFACE SOIL SAMPLES AT PSC OT-12
Luke Air Force Base, Arizona

Constituents	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRGs		Maximum Exceeds PRG?
BNAs								
Acentaphthylene	1 / 6	0.046	0.046 - 0.046	0.046	0.046	100	[a	no
Anthracene	1 / 6	0.083	0.083 - 0.083	0.083	0.083	5.7		no
Benzo(a)anthracene	1 / 6	0.66	0.17 - 0.66	0.26	0.42	0.61		YES
Benzo(a)pyrene	1 / 6	0.87	0.17 - 0.87	0.29	0.52	0.061		YES
Benzo(b)fluoranthene	2 / 6	0.036 - 0.97	0.036 - 0.97	0.28	0.56	0.61		YES
Benzo(g,h,i)perylene	1 / 6	0.48	0.17 - 0.48	0.23	0.33	100	[a	no
Benzo(k)fluoranthene	2 / 6	0.042 - 0.69	0.042 - 0.69	0.24	0.43	6.1		no
Carbazole	1 / 6	0.13	0.13 - 0.13	0.13	0.13	22		no
Chrysene	2 / 6	0.048 - 1.1	0.048 - 1.1	0.31	0.63	7.2		no
Dibenz(a,h)anthracene	1 / 6	0.20	0.17 - 0.20	0.18	0.19	0.061		YES
Fluoranthene	2 / 6	0.085 - 1.1	0.085 - 1.1	0.31	0.63	2,600		no
Indeno(1,2,3,-c,d)pyrene	1 / 6	0.47	0.17 - 0.47	0.22	0.32	0.61		no
Pentachlorophenol	1 / 6	0.045	0.045 - 0.045	0.045	0.045	2.5		no
Phenanthrene	2 / 6	0.037 - 0.43	0.037 - 0.43	0.19	0.30	100	[a	no
Pyrene	2 / 6	0.061 - 1.4	0.061 - 1.4	0.36	0.78	100		no
TRPH	15 / 24	20 - 1,400	5.0 - 1,400	170	290	110	[b	YES
Metals								
Arsenic	6 / 24	5.0 - 11	2.5 - 11	4.0	4.9	0.38		YES
Barium	24 / 24	90.1 - 276	90.1 - 276	140	160	5,300		no
Beryllium	7 / 24	0.40 - 0.70	0.15 - 0.70	0.31	0.37	0.14		YES
Cadmium	5 / 24	0.30 - 1.0	0.15 - 1.0	0.31	0.40	38		no
Chromium	24 / 24	9.9 - 33	9.9 - 33	16	18	210	[c]	no
Copper	24 / 24	11.1 - 29.7	11.1 - 29.7	19	20	2,800		no
Lead	23 / 24	8.0 - 330	2.5 - 330	38	64	400		no
Nickel	24 / 24	8.8 - 17.1	8.8 - 17.1	14	15	1,500		no
Zinc	24 /24	24.9 - 76.3	24.9 - 76.3	42	46	23,000		no
Cyanide	1 / 24	2.0	0.25 - 2.0	0.32	0.45	1,300		no

Footnotes appear on Page 2.

TABLE 3-13
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFACE AND SUBSURFACE SOIL SAMPLES AT
PSC OT-12
Luke Air Force Base, Arizona

Soil concentrations are given in milligrams per kilogram (mg/kg).

[a]	Pyrene is used as a surrogate for comparison to the Region IX PRG.
[b]	n-Hexane is used as a surrogate for comparison to the Region IX PRG.
[c]	Total chromium is used as a surrogate for comparison to the Region IX PRG.
Average	Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
PRG	Preliminary remediation goal.
TRPH	Total recoverable petroleum hydrocarbon.
UCL	95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.

TABLE 3-14
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFICIAL SOIL SAMPLES AT PSC DP-13
Luke Air Force Base, Arizona

Constituents	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRG		Maximum Exceeds PRG?
TRPH	13 / 20	10 / 2,20	5.0 - 2,200	300	530	110	[a]	YES
Metals								
Arsenic	5 / 20	9.0 - 17	25.7 - 17	4.7	6.3	0.38		YES
Barium	20 / 20	98.1 - 484	98.1 - 484	170	200	5,300		no
Beryllium	7 / 20	0.50 - 0.80	0.15 - 0.80	0.38	0.47	0.14		YES
Cadmium	1 / 20	0.40	0.15 - 0.40	0.21	0.24	38		no
Chromium	20 / 20	9.3 - 29.7	9.3 - 29.7	17	19	210	[b]	no
Copper	20 / 20	14.5 - 25	14.5 - 25	19	21	2,800		no
Lead	20 / 20	8.0 139	8.0 - 139	21	32	400		no
Mercury	1 / 20	0.10	0.050 - 0.10	0.095	0.10	23	[c]	no
Nickel	20 / 20	12 - 20.8	12 - 20.8	16	17	1,500		no
Zinc	20 / 20	27.5 - 64.8	27.5 - 64.8	42	47	23,000		no

Soil concentrations are given in milligrams per kilogram (mg/kg)

[a] n-Hexane is used as a surrogate for comparison to the Region IX PRG.
[b] Total chromium is used as a surrogate for comparison to the Region IX PRG.
[c] Mecuric chloride is used as a surrogate for comparison to the Region IX PRG.
Average Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
PRG Preliminary Remediation Goal
TRPH Total recoverable petroleum hydrocarbon.
UCL 95 percent upper confifence limit (one-tailed) on the mean, assuming a normal distribution.

TABLE 3-15
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFICIAL SOIL SAMPLES AT
PSC DP-13
Luke Air Force Base, Arizona

Constituents	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRG		Maximum Exceeds PRG?
Acenaphthalene	1 / 12	0.13	0.085 - 0.13	0.12	0.13	110		no
Anthracene	2 / 12	0.055 - 0.19	0.055 - 0.19	0.14	0.17	5.7		no
Benzo(a)anthracene	3 / 12	0.085 - 0.64	0.085 - 0.64	0.24	0.33	0.61		YES
Benzo(a)pyrene	3 / 12	0.085 - 0.56	0.085 - 0.56	0.23	0.32	0.061		YES
Benzo(b)fluoranthene	3 / 12	0.38 - 0.63	0.085 - 0.63	0.27	0.36	0.61		YES
Benzo(g,h,i)perylene	2 / 12	0.16 - 0.22	0.085 - 0.22	0.15	0.18	100	[a	no
Benzo(k)fluoranthene	2 / 12	0.42 - 0.63	0.085 - 0.63	0.24	0.34	6.1		no
Bis(2-Ethylhexyl)phthalate	1 / 12	0.036	0.031 - 0.036	0.035	0.036	32		no
Carbazole	2 / 7	0.051 - 0.25	0.051 - 0.25	0.14	0.19	22		no
Chrysene	3 / 12	0.085 - 0.67	0.085 - 0.67	0.24	0.35	7.2		no
Dibenz(a,h)anthracene	2 / 12	0.076 - 0.11	0.076 - 0.11	0.099	0.11	0.061		YES
Dibenzofuran	1 / 12	0.040	0.040 - 0.040	0.040	0.040	140		no
Fluoranthene	3 / 12	0.085 - 1.8	0.085 - 1.8	0.36	0.62	2,600		no
Fluorene	1 / 12	0.078	0.078 - 0.078	0.078	0.078	90		no
Indeno(1,2,3-c,d)pyrene	2 / 12	0.18 - 0.25	0.085 - 0.25	0.16	0.20	0.61		no
Phenathrene	2 / 12	0.33 - 0.96	0.085 - 0.96	0.26	0.40	100	[a	no
Pyrene	3 / 12	0.085 - 1.5	0.085 - 1.5	0.34	0.55	100		no
<u>TRPH</u>	33 / 53	10 - 12,000	5.0 - 12,000	410	790	110	[b	YES
<u>Metals</u>								
Antimony	1 / 53	7.0	0.25 - 7.0	1.8	2.1	31		no
Arsenic	11 / 53	5.0 - 19	0.25 - 19	4.2	5.1	0.38		YES
Barium	53 / 53	34 - 484	34 - 484	140	160	5,300		no
Beryllium	15 / 53	0.40 - 0.80	0.15 - 0.80	0.35	0.39	0.14		YES

Footnotes appear on page 2.

TABLE 3-15
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFICIAL SOIL SAMPLES AT
PSC DP-13
Luke Air Force Base, Arizona

Constituents	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRG		Maximum Exceeds PRG?
Metals (continued)								
Cadmium	3 / 53	0.40 - 28.6	0.15 - 28.6	0.79	1.7	38		no
Chromium	53 / 53	2.9 - 15,900	2.9 - 15,900	310	820	210	[c]	YES
Copper	53 / 53	6.1 - 3,900	6.1 - 3,900	120	250	2,800		YES
Lead	51 / 53	6.0 - 36,000	2.5 - 36,000	700	1,800	400		YES
Mercury	1 / 53	0.10	0.50 - 0.10	0.091	0.095	23	[d	no
Nickel	53 / 53	4.0 - 22	4.0 - 22	14	15	1,500		no
Zinc	53 / 53	11.4 - 183	11.4- 183	44	50	23,000		no
Cyanide	1 / 50	2.0	0.025 - 2.0	0.29	0.34	1,300		no

Soil concentrations are given in milligrams per kilogram (mg/kg).

[a]	Pyrene is used as a surrogate for comparison to the Region IX PRG.
[b]	n-Hexane is used as a surrogate for comparison to the Region IX PRG.
[c]	Total chromium is used as a surrogate for comparison to the Region IX PRG.
[d]	Mecuric chloride is used as a surrogate for comparison to the Region IX PRG.
Average	Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
BNAs	Base-neutral and acid extractable compounds.
PRG	Preliminary Remediation Goal.
TRPH	Total recoverable petroleum hydrocarbon.
UCL	95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.

TABLE 3-16
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFICIAL SOIL SAMPLES AT
PSC LF-14
Luke Air Force Base, Arizona

Constituents	Frequency of Detects	Range of Detects	Total Range	Average	UCL	Region IX Residential PRG		Maximum Exceeds PRG?
	Detects / Total	Min - Max	Min - Max					
BNAs								
Benzo(a)anthracene	2 / 12	0.085 - 0.20	0.085 - 0.20	0.13	0.16	0.61		no
Benzo(a)pyrene	2 / 12	0.042 - 0.30	0.042 - 0.30	0.12	0.15	0.061		YES
Benzo(b)fluoranthene	3 / 12	0.042 - 0.50	0.042 - 0.50	0.17	0.24	0.61		no
Benzo(g,h,i)perylene	1 / 12	0.20	0.085 - 0.20	0.13	0.16	100	[a]	no
Benzo(k)fluoranthene	2 / 12	0.048 - 0.085	0.048 - 0.085	0.082	0.087	6.1		no
Butylbenzylphthalate	1 / 12	0.19	0.085 - 0.19	0.13	0.15	930		no
Chrysene	3/ 12	0.039 - 0.20	0.039 - 0.20	0.12	0.15	7.2		no
Fluoranthene	3 / 12	0.045 - 0.27	0.045 - 0.27	0.13	0.17	2,600		no
Indeno(1,2,3-c,d)pyrene	2 / 12	0.085 - 0.30	0.085 - 0.30	0.15	0.20	0.61		no
Phenanthrene	1 / 12	0.019	0.085 - 0.19	0.13	0.15	100	[a]	no
Pyrene	2 / 12	0.040 - 0.21	0.040 - 0.21	0.12	0.15	100		no
PCBs	16 / 34	0.030 - 37	0.0125 - 37	1.7	3.6	0.066		YES
TRPH	6 / 8	30 - 2,400	5.0 - 2,400	540	1,100	110	[b]	YES
Metals								
Arsenic	4 / 13	5.4 - 14	2.4 - 14	4.1	5.8	0.38		YES
Barium	13 / 13	67.4 - 331	67.4 - 331	130	170	5,300		no
Berylium	5 / 13	0.50 - 1.5	0.15 - 1.5	0.44	0.62	0.14		YES
Cadmium	11 / 13	0.50 - 2.6	0.15 - 2.6	1.3	1.7	38		no
Chromium	13 / 13	10.7 - 376	10.7 - 376	51	100	210	[c]	YES
Copper	13 / 13	12.2 - 35.8	12.2 - 35.8	22	25	2,800		no
Lead	13 / 13	7.5 - 88	7.5 - 88	46	61	400		no

Footnotes appear on page 2

TABLE 3-16
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFICIAL SOIL SAMPLES AT
PSC LF-14
Luke Air Force Base, Arizona

Constituents	Frequency of Detects Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRG	Maximum Exceeds PRG?
Metals (continuted)							
Nickel	13 / 13	10.5 - 17.8	10.5 - 17.8	14	15	1,500	no
Silver	4 / 13	1.8 - 4.8	0.25 - 4.8	1.2	1.8	380	no
Zinc	13 / 13	24.2 - 737	24.2 - 737	120	210	23,000	no
Cyanide	1 / 13	0.20	0.25 - 2.0	0.38	0.62	1,300	no

Soil concentrations are given in milligrams per kilogram (mg/kg).

[a] Pyrene is used as a surrogate for comparison to the Region IX PRG.
[b] n-Hexane is used as a surrogate for comparison to the Region IX PRG.
[c] Total chromium is used as a surrogate for comparison to the Region IX PRG.
Average Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
BNAs Base-neutral and acid extractable compounds.
PCBS Polychlorinate biphenyls.
PRG Preliminary Remediation Goal.
TRPH Total recoverable petroleum hydrocarbon.
UCL 95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.

TABLE 3-17
OCCURRENCE OF CONSTITUENTS DETECTED IN SUBSURFACE SOIL SAMPLES AT
PSC LF-14
Luke Air Force Base, Arizona

Constituents	Frequency of Detects	Range of Detects	Total Range	Average	UCL	Region IX Residential PRG		Maximum Exceeds PRG?
	Detects / Total	Min - Max	Min - Max					
VOC								
Xyenes (total)	1 / 18	0.24	0.025 - 0.24	0.043	0.07	320		no
BNAs								
Benzo(a)anthracene	3 / 22	0.085 - 0.20	0.085 - 0.20	0.12	0.46	0.61		no
Benzo(a)pyrene	3 / 22	0.042 - 0.30	0.042 - 0.30	0.13	0.16	0.061		YES
Benzo(b)fluoranthene	4 / 22	0.042 - 0.50	0.042 - 0.50	0.16	0.21	0.61		no
Benzo(g,h,i)perylene	2 / 22	0.085 - 0.20	0.085 - 0.20	0.12	0.14	100	[a]	no
Benzo(k)fluoranthene	2 / 22	0.048 - 0.085	0.048 - 0.085	0.083	0.086	6.1		no
Butyl benzyl phthalate	2 / 22	0.190 - 23	0.085 - 23	1.2	3.0	930		no
Chrysene	4 / 22	0.039 - 0.20	0.039 - 0.20	0.11	0.13	7.2		no
Fluoranthene	4 / 22	0.045 - 0.27	0.045 - 0.27	0.14	0.16	2,600		no
Indeno(1,2,3-c,d)pyrene	3 / 22	0.085 - 0.30	0.085 - 0.30	0.14	0.17	0.61		no
Phenanthracene	1 / 22	0.019	0.085 - 0.19	0.12	0.14	100	[a]	no
Pyrene	3 / 22	0.040 - 0.21	0.040 - 0.21	0.11	0.13	100		no
PCBs	22 / 60	0.030 - 37	0.0125 - 37	1.0	2.1	0.066		YES
TRPH	8 / 16	30 - 2,400	5.0 - 2,400	280	570	110	[b]	YES
Metals								
Arsenic	10 / 26	5.0 - 14.0	2.5 - 14.0	4.4	5.4	0.38		YES
Barium	26 / 26	67.4 - 331	67.4 - 331	150	170	5,300		no
Berylium	11 / 26	0.50 - 1.5	0.15 - 1.5	0.34	0.53	0.14		YES
Cadmium	19 / 26	0.50 - 5.7	0.15 - 5.7	1.2	1.6	38		no
Chromium	24 / 24	10.7 - 49.5	10.7 - 49.5	18	21	210	[c]	YES
Copper	26 / 26	12.2 - 38.8	12.2 - 38.8	21	24	2,800		no
Lead	26 / 26	7.0 - 88	7.0 - 88	30	39	400		no
Nickel	26 / 26	10.5 - 19.6	10.5 - 19.6	14	15	1,500		no
Silver	5 / 26	1.0 - 4.8	0.25 -4.8	0.82	1.2	380		no
Zinc	26 / 26	24.2 - 737	24.2 - 737	80	130	23,000		no
Cyanide	1 / 20	2	0.25 - 2	0.34	0.49	1,300		no

Footnotes appear on page 2

TABLE 3-17
OCCURRENCE OF CONSTITUENTS DETECTED IN SUBSURFACE SOIL SAMPLES AT
PSC LF-14
Luke Air Force Base, Arizona

Soil concentrations are given in milligrams per kilogram (mg/kg).

[a]	Pyrene is used as a surrogate for comparison to the Region IX PRG.
[b]	n-Hexane is used as a surrogate for comparison to the Region IX PRG.
[c]	Total chromium is used as a surrogate for comparison to the Region IX PRG.
Average	Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
BNAs	Base-neutral and acid extractable compounds.
PCBS	Polychlorinate biphenyls.
PRG	Preliminary Remediation Goal.
TRPH	Total recoverable petroleum hydrocarbon.
UCL	95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.
VOC	Volatile organic compound.

TABLE 3-18
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFICIAL SOIL SAMPLES AT
PSC SS-17
Luke Air Force Base, Arizona

	Frequency of Detects	Range of Detects	Total Range					
Constituents	Detects / Total	Min - Max	Min - Max	Average	UCL	Region IX Residential PRG		Maximum Exceeds PRG?
BNAs								
Chrysene	1 / 3	0.20	0.20 - 0.20	0.20	0.20	7.2		no
Fluoranthene	1 / 3	0.23	0.23 - 0.23	0.23	0.23	2,600		no
Pyrene	1 / 3	1.18	0.18 - 0.18	0.18	0.18	100		no
PCBs	6 / 12	0.05 - 0.30	0.013 - 0.30	0.079	0.13	0.066		YES
TRPH	4 / 6	20 - 7,000	5.0 - 7,000	1,600	4,000	110	[a]	YES
Metals								
Arsenic	1 / 6	6.0	0.25 - 6.0	3.1	4.3	0.38		YES
Barium	6 / 6	90.2 - 148	90.2 - 148	110	130	5,300		no
Berylium	1 / 6	2.3	0.25 - 2.3	0.59	1.3	0.14		YES
Cadmium	3 / 6	0.70 - 24.6	0.25 - 24.6	4.5	13	38		no
Chromium	6 / 6	6.3 - 28.4	6.3 - 28.4	15	21	210	[b]	no
Copper	6 / 6	14.3 - 189	1.43 - 189	48	110	2,800		no
Lead	6 / 6	9.0 - 169	9.0 - 169	45	95	400		no
Nickel	6 / 6	11 - 19	11 - 19	16	18	1,500		no
Silver	2 / 6	1.0 - 2.0	0.50 - 2.0	0.83	1.3	380		no
Zinc	6 / 6	32.1 - 366	32.1 - 366	100	210	23,000		no
Cyanide	1 / 6	0.50	0.25 - 0.50	0.29	0.38	1,300		no

Soil concentrations are given in milligrams per kilogram (mg/kg).

[a] Pyrene is used as a surrogate for comparison to the Region IX PRG.
[b] n-Hexane is used as a surrogate for comparison to the Region IX PRG.
Average Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
BNAs Base-neutral and acid extractable compounds.
PCBS Polychlorinate biphenyls.
PRG Preliminary Remediation Goal.
TRPH Total recoverable petroleum hydrocarbon.
UCL 95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.

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TABLE 3-19
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFACE AND SUBSURFACE SOIL SAMPLES AT
PSC SS-17
Luke Air Force Base, Arizona

Constituents	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRG		Maximum Exceeds PRG?
BNAs								
Chrysene	1 / 4	0.20	0.18 - 0.20	0.19	0.21	7.2		No
Di-n-octyl phthalate	1 / 5	0.17	0.17 - 0.17	0.17	0.17	1,300		no
Fluoranthene	1 / 4	0.23	0.175 - 0.23	0.22	0.25	2,600		no
Pyrene	1 / 4	0.18	0.175 - 0.18	0.18	0.18	100		no
PCBs	6 / 12	0.05 - 0.30	0.013 - 0.30	0.079	0.13	0.066		YES
TRPH	13 / 18	10 - 7,000	5.0 - 7,000	640	1,300	110	[a]	YES
Metals								
Arsenic	5 / 18	6.0 - 12.4	2.5 - 12.4	4.0	5.1	0.38		YES
Barium	18 / 18	86.1 - 230	86.1 - 230	140	150	5,300		no
Beryllium	3 / 18	0.60 - 2.6	0.25 - 2.6	0.51	0.81	0.14		YES
Cadmium	7 / 18	0.70 - 24.6	0.25 - 24.6	2.4	4.9	38		no
Chromium	18 / 18	6.3 - 28.4	6.3 - 28.4	14	16	210	[b]	no
Copper	18 / 18	14.3 - 189	14.3 - 189	35	53	2,800		no
Lead	18 / 18	7.0 - 169	7.0 - 169	28	43	400		no
Nickel	18 / 18	9.0 - 20	9.0 - 20	15	16	1,500		no
Silver	2 / 18	1.0 - 2.0	0.50 - 2.0	0.61	0.76	380		no
Zinc	18 / 18	31.5 - 366	31.5 - 366	74	110	23,000		no
Cyanide	2 / 18	0.50 - 2.5	0.25 - 2.5	0.39	0.61	1,300		no

Soil concentrations are given in milligrams per kilogram (mg/kg).

[a] n-Hexane is used as a surrogate for comparison to the Region IX PRG.
[b] Total chromium is used as a surrogate for comparison to the Region IX PRG.
Average Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
BNAs Base-neutral and acid extractable compounds.
PCBs Polychlorinated biphenyls.
PRG Preliminary Remediation Goal.
TRPH Total recoverable petroleum hydrocarbon.
UCL 95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.

TABLE 3-20
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFICIAL SOIL SAMPLES AT
PSC SD-20
Luke Air Force Base, Arizona

Constituents	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRG		Maximum Exceeds PRG?
VOC								
Toluene	3 / 22	0.050 - 0.10	0.050 - 0.10	0.052	0.056	790		no
BNAs								
Benzo(a)anthracene	2 / 27	0.24 - 0.30	0.17 - 0.30	0.20	0.21	0.61		no
Benzo(a)pyrene	2 / 27	0.18 - 0.30	0.17 - 0.30	0.19	0.21	0.061		YES
Benzo(b)fluoranthene	3 / 27	0.24 - 0.32	0.17 - 0.32	0.20	0.22	0.61		no
Benzo(g,h,i)perylene	1 / 27	0.22	0.17 - 0.22	0.18	0.19	100	[a]	no
Bis(2-ethylhexyl)phthalate	1 / 27	0.54	0.17 - 0.54	0.21	0.24	32		no
Chrysene	3 / 27	0.15 - 0.41	0.15 - 0.41	0.20	0.22	7.2		No
Di-n-octylphthalate	1 / 27	0.18	0.085 - 0.18	0.10	0.11	1,300		no
Fluoranthene	3 / 27	0.19 - 0.65	0.17 - 0.65	0.22	0.26	2,600		no
Indeno(1,2,3-c,d)pyrene	1 / 27	0.20	0.17 - 0.20	0.18	0.18	0.61		no
Phenathracene	2 / 27	0.20 - 0.32	0.17 - 0.32	0.20	0.22	100	[a]	no
Pyrene	3 / 27	0.19 - 0.64	0.17 - 0.64	0.22	0.25	100		no
TRPH	28 / 41	10 - 3,700	5.0 - 3,700	320	530	110	[b]	YES
Metals								
Antimony	1 / 39	0.60	0.25 - 0.60	0.26	0.27	31		no
Arsenic	8 / 39	5.0 - 10.9	2.5 - 10.9	3.3	3.8	0.38		YES
Barium	39 / 39	43.9 - 501	43.9 - 501	170	190	5,300		no
Beryllium	13 / 39	0.50 - 0.90	0.15 - 0.90	0.41	0.48	0.14		YES
Cadmium	35 / 39	0.50 - 4.3	0.25 - 4.3	1.5	1.8	38		no

Footnotes appear on page 2.

TABLE 3-20
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFICIAL SOIL SAMPLES AT
PSC SD-20
Luke Air Force Base, Arizona

Constituents	Frequency of Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRG		Maximum Exceeds PRG?
Metals (continued)								
Chromium	39 / 39	3.1 - 81.5	3.1 - 81.5	29	33	210	[c]	no
Copper	39 / 39	6.5 - 36.2	6.5 - 36.2	20	23	2,800		no
Lead	36 / 39	5.8 - 118	2.5 - 118	21	27	400		no
Nickel	39 / 39	5.1 - 24.9	5.1 - 24.9	14	15	1,500		no
Zinc	38 / 39	11.9 - 157	11.9 - 157	45	53	23,000		no

Soil concentrations are given in milligrams per kilogram (mg/kg).

[a] Pyrene is used as a surrogate for comparison to the Region IX PRG.
[b] n-Hexane is used as a surrogate for comparison to the Region IX PRG.
[c] Total chromium is used as a surrogate for comparison to the Region IX PRG.
Average Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
BNAs Base-neutral and acid extractable compounds.
PRGs Preliminary Remediation Goal.
TRPH Total recoverable petroleum hydrocarbon.
UCL 95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.
VOC Volatile organic compound

TABLE 3-21
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFACE AND SUBSURFACE SOIL SAMPLES AT
PSC SD-20
Luke Air Force Base, Arizona

Constituents	Frequency of Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRG		Maximum Exceeds PRG?
VOC								
Toluene	6 / 30	0.050 - 0.10	0.050 - 0.10	0.052	0.054	790		no
BNAs								
Benzo(a)anthracene	2 / 35	0.24 - 0.30	0.085 - 0.30	0.17	0.19	0.61		No
Benzo(a)pyrene	2 / 35	0.18 - 0.30	0.085 - 0.30	0.17	0.19	0.061		YES
Benzo(b)fluoranthene	4 / 35	0.085 - 0.32	0.085 - 0.32	0.17	0.19	0.61		no
Benzo(g,h,i)perylene	1 / 35	0.22	0.085 - 0.22	0.16	0.17	100	[a]	no
Bis(2-ethylhexyl)phthalate	1 / 35	0.54	0.085 - 0.54	0.18	0.21	32		no
Chrysene	3 / 35	0.15 - 0.41	0.085 - 0.41	0.17	0.2	7.2		no
Di-n-octylphthalate	1 / 35	0.18	0.085 - 0.18	0.10	0.11	1,300		no
Fluoranthene	3 / 35	0.19 - 0.65	0.085 - 0.65	0.19	0.22	2,600		no
Indeno(1,2,3-c,d)pyrene	1 / 35	0.20	0.085 - 0.20	0.16	0.17	0.61		no
Phenanthrene	2 / 35	0.20 - 0.32	0.085 - 0.32	0.17	0.19	100	[a]	no
Pyrene	3 / 35	0.19 - 0.64	0.085 - 0.64	0.19	0.22	100		no
TRPH	36 / 63	10 - 3,700	5.0 - 3,700	210	360	110	[b]	YES
Metals								
Antimony	1 / 63	0.60	0.25 - 0.60	0.3	0.33	31		no
Arsenic	19 / 63	5.0 - 26	2.5 - 26	4.9	5.9	0.38		YES
Barium	63 / 63	38.5 - 532	38.5 - 532	170	190	5,300		no
Beryllium	13 / 63	0.50 - 0.90	0.15 - 0.90	0.32	0.37	0.14		YES
Cadmium	43 / 63	0.50 - 4.3	0.15 - 4.3	1.2	1.4	38		no

Footnotes appear on page 2.

TABLE 3-21
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFACE AND SUBSURFACE SOIL SAMPLES AT
PSC SD-20
Luke Air Force Base, Arizona

Constituents	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRG		Maximum Exceeds PRG?
Metals (continued)								
Chromium	63 / 63	3.1 - 81.5	3.1 - 81.5	27	30	210	[c]	no
Copper	63 / 63	6.3 - 36.2	6.3 - 36.2	18	20	2,800		no
Lead	59 / 63	5.0 - 118	2.5 - 118	16	20	400		no
Nickel	63 / 63	4.3 - 26.3	4.3 - 26.3	13	14	1,500		no
Zinc	62 / 63	11.2 - 157	11.2 - 157	40	45	23,000		no

Soil concentrations are given in milligrams per kilogram (mg/kg).

[a] Pyrene is used as a surrogate for comparison to the Region IX PRG.
[b] n-Hexane is used as a surrogate for comparison to the Region IX PRG.
[c] Total chromium is used as a surrogate for comparison to the Region IX PRG.
Average Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
BNAs Base-neutral and acid extractable compounds.
PRG Preliminary Remediation Goal.
TRPH Total recoverable petroleum hydrocarbon.
UCL 95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.
VOC Volatile organic compound

TABLE 3-22
OCCURRENCE OF CONSTITUENTS DETECTED IN GROUNDWATER SAMPLES AT
PSC SD-20
Luke Air Force Base, Arizona

Constituents	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Tap Water PRG		Maximum Exceeds PRG?
Inorganics								
Arsenic	26 / 26	0.0070 - 0.026	0.0070 - 0.026	0.014	0.016	0.000045		YES
Barium	26 / 26	0.014 - 0.47	0.014 - 0.47	0.091	0.13	2.6		no
Boron	5 / 16	0.19 - 0.23	0.0025 - 0.23	0.10	0.13	3.3		no
Chromium	26 / 26	0.010 - 0.11	0.010 - 0.011	0.028	0.034	0.18	[a]	no
Copper	12 / 26	0.011 - 0.17	0.0050 - 0.17	0.024	0.037	1.4		no
Lead	19 / 26	0.0020 - 0.048	0.0010 - 0.018	0.0067	0.010	0.004		YES
Nickel	2 / 26	0.035 - 0.071	0.010 - 0.071	0.013	0.018	0.73		no
Zinc	26 / 26	0.022 - 1.66	0.022 - 1.66	0.33	0.44	11		no

Groundwater concentrations are given in milligrams per liter (mg/L).

[a] Chromium VI is used as a surrogate for comparison tot he Region IX PRG.
Average Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
PRG Preliminary remediation goals.
UCL 95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.

TABLE 3-23
OCCURRENCE OD CONSTITUENTS DETECTED IN SURFICIAL SOIL SAMPLES AT
PSC SD-21
Luke Air Force Base, Arizona

Constituents	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRGs		Maximum Exceeds PRG?
BNAs								
Anthracene	1 / 3	0.085	0.085 - 0.085	0.085	0.085	5.7		no
Benzo(a)anthracene	1 / 3	0.48	0.085 - 0.48	0.22	0.60	0.61		no
Benzo(b)fluoranthene	1 / 3	1.5	0.085 - 1.5	0.56	1.9	0.61		YES
Benzo(k)fluoranthene	1 / 3	1.4	0.085 - 1.4	0.52	1.8	6.1		no
Benzo(g,h,i)perylene	1 / 3	0.42	0.085 - 0.42	0.20	0.52	100	[a]	no
Benzo(a)pyrene	1 / 3	0.59	0.085 - 0.59	0.25	0.74	0.061		YES
Chrysene	1 / 3	0.67	0.085 - 0.67	0.28	0.85	7.2		no
Dibenzo(a,h)anthracene	1 / 3	0.085	0.085 - 0.085	0.085	0.085	0.061		YES
Fluoranthene	1 / 3	0.97	0.085 - 0.97	0.38	1.2	2,600		no
Indeno(1,2,3-c,d)pyrene	1 / 3	0.57	0.085 - 0.57	0.25	0.72	0.61		no
Phenanthrene	1 / 3	0.40	0.085 - 0.40	0.19	0.50	100	[a]	no
Pyrene	1 / 3	0.88	0.085 - 0.88	0.35	1.1	100		no
TRPH	1 / 9	10	5.0 - 10	5.6	6.6	110	[b]	no
Metals								
Arsenic	3 / 9	5.0 - 8.2	2.5 - 8.2	3.9	5.3	0.38		YES
Barium	9 / 9	48 - 125	49 - 125	75	93	5,300		no
Beryllium	1 / 9	0.60	0.15 - 0.6	0.28	0.36	0.14		YES
Cadmium	3 / 9	0.70 - 1.2	0.15 - 1.2	0.48	0.72	38		no
Chromium	9 / 9	5.7 - 19.4	5.7 - 19.4	11	14	210	[c]	no
Copper	9 / 9	8.8 - 32.7	8.8 - 32.7	17	21	2,800		no
Lead	5 / 9	7.0 - 16	2.5 - 16	6.3	9.0	400		no
Nickel	9 / 9	8.8 - 18.8	8.8 - 18.8	13	16	1,500		no
Silver	1 / 9	2.0	0.25 - 2.0	0.64	0.96	380		no
Zinc	9 / 9	18.6 - 65.6	18.6 - 65.6	31	41	23,000		no

Footnotes appear on page 2.

TABLE 3-23
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFICIAL SOIL SAMPLES AT
PSC SD-21
Luke Air Force Base, Arizona

Soil Concentrations are given in milligrams per kilogram (mg/kg).

[a]	Pyrene is used as a surrogate for comparison to Region IX PRG.
[b]	n-Hexane is used as a surrogate for comparison to Region IX PRG.
[c]	Total chromium is used as a surrogate for comparison to Region IX PRG.
Average	Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
BNA	Base-neutral acid extractable compounds.
PRG	Preliminary Remediation Goal.
TRPH	Total recovery petroleum hydrocarbon.
UCL	95 percent upper confidence limit (one-tailed) on the means, assuming a normal distribution.

TABLE 3-24
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFACE AND SUBSURFACE SOIL SAMPLES AT PSC SD-21
Luke Air Force Base, Arizona

Constituents	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRGs		Maximum Exceeds PRG?
BNAs								
Anthracene	1 / 6	0.085	0.085 - 0.085	0.085	0.085	5.7		no
Benzo(a)anthracene	1 / 6	0.48	0.085 - 0.48	0.15	0.28	0.61		no
Benzo(b)fluoranthene	1 / 6	1.5	0.085 - 1.5	0.32	0.80	0.61		YES
Benzo(k)fluoranthene	1 / 6	1.4	0.085 - 1.4	0.30	0.75	6.1		no
Benzo(g,h,i)perylene	1 / 6	0.42	0.085 - 0.42	0.14	0.25	100	[a]	no
Benzo(a)pyrene	1 / 6	0.59	0.085 - 0.59	0.17	0.34	0.061		YES
Chrysene	1 / 6	0.67	0.085 - 0.67	0.18	0.38	7.2		no
Dibenzo(a,h)anthrancene	1 / 6	0.085	0.085 - 0.085	0.085	0.085	0.061		YES
Fluoranthene	1 / 6	0.97	0.085 - 0.97	0.23	0.53	2,600		no
Indeno(1,2,3-c,d)pyrene	1 / 6	0.57	0.085 - 0.57	0.17	0.33	0.61		no
Phenanthrene	1 / 6	0.40	0.085 - 0.40	0.14	0.24	100	[a]	no
Pyrene	1 / 6	0.88	0.085 - 0.88	0.22	0.48	100		no
TRPH	1 / 1	10	10 - 10	10	#N/A	100	[b]	no
Metals								
Arsenic	5 / 19	5.0 - 8.2	2.5 - 8.2	3.6	4.4	0.38		YES
Barium	19 / 19	49 - 148	49 - 148	79	92	5,300		no
Beryllium	1 / 19	0.60	0.15- 0.60	0.26	0.30	0.14		YES
Cadmium	3 / 19	0.70 - 1.2	0.15 - 1.2	0.36	0.47	38		no
Chromium	19 / 19	5.5 - 19.4	5.5 - 19.4	11	12	210	[c]	no
Copper	19 / 19	8.8 - 32.7	8.8 - 32.7	17	19	2,800		no
Lead	10 / 19	7.0 - 16	2.5 - 16	6.0	7.6	400		no
Nickel	19 / 19	8.8 - 20	8.8 - 20	14	16	1,500		no
Silver	1 / 19	2.0	0.25 - 2.0	0.57	0.71	380		no
Zinc	19 / 19	16.6 - 69.5	16.6 - 69.5	31	38	23,000		no

Footnotes appear on page 2.

TABLE 3-24
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFACE AND SUBSURFACE SOIL SAMPLES AT
PSC SD-21
Luke Air Force Base, Arizona

Soil concentrations are given in milligrams per kilogram (mg/kg).

[a]	Pyrene is used as a surrogate for comparison to Region IX PRG.
[b]	n-Hexane is used as a surrogate for comparison to Region IX PRG.
[c]	Total chromium is used as a surrogate for comparison to Region IX PRG.
Average	Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
BNA	Base-neutral acid extractable compounds
PRG	Preliminary Remediation Goal.
TRPH	Total recoverable petroleum hydrocarbon.
UCL	95 percent upper confidence limit (one-tailed) on the assuming a normal distribution.
#N/A	Not applicable; UCL cannot be calculated for one data point.

TABLE 3-25
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFICIAL SOIL SAMPLES AT
PSC SD-21
Luke Air Force Base, Arizona

Constituents	Frequency Detects Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRG		Maximum Exceeds PRG?
<u>Metals</u>								
Arsenic	4 / 8	6.0 - 24	2.5 - 24	9.2	15	0.38	[a]	YES
Barium	8 / 8	25.4 - 283	25.4 - 283	120	180	5.300	[a]	no
Beryllium	1 / 8	0.80	0.05 - 0.8	0.44	0.65	0.14	[a]	YES
Cadmium	3 / 8	1.0 - 3.0	0.05 - 3	0.94	1.7	38	[a]	no
Chromium	8 / 8	5.6 - 60.3	5.6 - 60.3	25	37	210	[a,b]	no
Copper	8 / 8	10.5 - 81.4	10.5 - 81.4	42	59	2,800	[a]	no
Lead	8 / 8	7.0 - 48	7 - 48	23	33	400	[a]	no
Nickel	8 / 8	9.0 - 32	9 - 32	20	25	1,500	[a]	no
Silver	5 / 8	3.0 - 30	0.5 - 30	8.3	16	380	[a]	no
Zinc	8 / 8	20.8 - 166	20.8 - 166	79	110	23,000	[a]	no

Sediment concentrations are given in milligrams per kilogram (mg/kg).

[a] Sediment PRG not available; Residential Soil PRG used for comparison purposes.
[b] Total chromium is used as a surrogate for comparison to the Region IX PRG.
Average Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
PRG Preliminary Remediation Goal.
UCL 95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.

TABLE 3-26
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFACE-WATER SAMPLES AT
PSC SD-21
Luke Air Force Base, Arizona

Constituents	Frequency Detects Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRG		Maximum Exceeds PRG?
Metals								
Arsenic	3 / 3	0.013 - 0.059	0.013 - 0.059	0.029	0.073	0.000045	[a]	Yes
Barium	3 / 3	0.015 - 0.72	0.015 - 0.72	0.27	0.93	2.6	[a]	no
Chromium	3 / 3	0.012 - 0.163	0.012 - 0.163	0.067	0.21	0.180	[a,b]	no
Copper	3 / 3	0.020 - 0.202	0.020 - 0.202	0.088	0.26	1.40	[a]	no
Lead	3 / 3	0.0020 - 0.078	0.0020 - 0.078	0.031	0.10	0.004	[a]	Yes
Mercury	1 / 3	0.0010	0.00010 - 0.001	0.00040	0.0013	0.011	[a,c]	no
Nickel	1 / 3	0.084	0.010 - 0.084	0.035	0.11	0.730	[a]	no
Silver	1 / 3	0.071	0.0050 - 0.071	0.027	0.091	0.180	[a]	no
Zinc	3 / 3	0.030 - 0.47	0.030 - 0.47	0.20	0.60	11.0	[a]	no

Concentrations are given in milligrams per liter (mg/L).

[a] Surface water PRG not available; Tap Water PRG used for comparison purposes.
[b] Chromium VI is used as a surrogate for comparison to the Region IX PRG.
[c] Mercuric chloride is used as a surrogate for comparison to the Region IX PRG.
Average Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
PRG Preliminary Remediation Goal.
UCL 95 percent upper confidence limit (one-tailed) on the means, assuming a normal distribution.

TABLE 3-27
OCCURRENCE OF CONSTITUENTS DETECTED IN GROUNDWATER SAMPLES AT
PSC SD-21
Luke Air Force Base, Arizona

Constituents	Frequency Detects Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRG	Maximum Exceeds PRG?
<u>Inorganics</u>							
Arsenic	1 / 5	0.011	0.0025 - 0.011	0.0042	0.0078	0.000045	YES
Barium	5 / 5	0.089 - 0.117	0.089 - 0.117	0.10	0.12	2.6	no
Boron	1 / 3	0.25	0.050 - 0.25	0.12	0.31	3.3	no
Copper	3 / 5	0.012 - 0.092	0.0050 - 0.092	0.030	0.065	1.4	no
Lead	2 / 5	0.0050 - 0.0070	0.0010 - 0.007	0.0030	0.0057	0.0040	YES
Zinc	5 / 5	0.184 - 0.50	0.184 - 0.50	0.27	0.39	11	no

Groundwater concentrations are given in milligrams per liter (mg/L).

Average — Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
PRG — Preliminary remediation goals.
UCL — 95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.

TABLE 3-28
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFICIAL SOIL SAMPLES AT
PSC LF-25
Luke Air Force Base, Arizona

Constituents	Frequency Detects Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRG		Maximum Exceeds PRG?
TRPH	12 / 17	20 - 290	5.0 - 290	71	110	110	[a]	YES
Metals								
Antimony	1 / 17	368	0.25 - 368	24	61	31		YES
Arsenic	2 / 17	6.0 - 16	2.5 - 16	3.5	4.9	0.38		YES
Barium	17 / 17	99.6 - 163	99.6 - 163	140	140	5,300		no
Beryllium	8 / 17	0.70 - 7.6	0.15 - 7.6	1.4	2.3	0.14		YES
Cadmium	4 / 17	0.50 - 0.6	0.15 - 0.60	0.30	0.36	38		no
Chromium	17 / 17	8.6 - 22.1	8.6 - 22.1	15	16	210	[b]	no
Copper	17 / 17	16.1 - 36.9	16.1 - 36.9	22	24	2,800		no
Lead	17 / 17	10 - 10,100	10 - 10,100	610	1,600	400		YES
Nickel	17 / 17	11 - 21	11 - 21	15	17	1,500		no
Silver	1 / 17	2.0	0.25 - 2.0	0.54	0.71	380		no
Zinc	17 / 17	31.7 - 63	31.7 - 63	46	50	23,000		no
Cyanide	1 / 17	1.0	0.25 - 1.0	0.29	0.37	1,300		no

Soil concentrations are given in milligrams per kilogram (mg/kg)

[a]	n-Hexane is used as a surrogate for comparison to the Region IX PRG.
[b]	Total chromium is used as a surrogate for comparison to the Region IX PRG.
Average	Arithmetic average of the total number of samples, using proxy concentrations for non-detectes.
PRG	Preliminary Remediation Goal.
TRPH	Total recoverable petroleum hydrocarbon.
UCL	95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.

TABLE 3-29
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFACE AND SUBSURFACE SOIL SAMPLES AT
PSC LF-25
Luke Air Force Base, Arizona

Constituents	Frequency Detects Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRG		Maximum Exceeds PRG?
VOC								
Xylenes (total)	1 / 2	0.14	0.135 - 0.14	0.14	0.15	320		no
BNAs								
Benzo(a)anthracene	1 / 7	0.12	0.12 - 0.12	0.12	0.12	0.61		no
Benzo(a)pyrene	1 / 7	0.10	0.10 - 0.10	0.10	0.10	0.061		YES
Benzo(b)fluoranthene	1 / 7	0.21	0.19 - 0.21	0.21	0.21	0.61		no
Benzo(k)fluoranthene	1 / 7	0.15	0.15 - 0.15	0.15	0.15	6.1		no
Chrysene	1 / 7	0.21	0.19 - 0.21	0.21	0.21	7.2		no
Fluoranthene	1 / 7	0.20	0.19 - 0.20	0.20	0.20	2,600		no
Pyrene	1 / 7	0.22	0.19 - 0.22	0.22	0.22	100		no
TRPH	15 / 36	10 - 290	0.5 - 290	43	64	110	[a]	YES
Metals								
Antimony	1 / 36	368	0.25 - 368	12	29	31		YES
Arsenic	2 / 36	6.0 - 16	2.5 - 16	3.0	3.6	0.38		YES
Barium	36 / 36	39 - 179	39 - 179	130	140	5,300		no
Beryllium	16 / 36	0.60 - 7.6	0.15 - 7.6	1.0	1.5	0.14		YES
Cadmium	7 / 36	0.50 - 0.60	0.15 - 0.60	0.29	0.32	38		no
Chromium	36 / 36	2.8 - 24.8	2.8 - 24.8	13	15	210	[b]	no
Copper	36 / 36	8.7 - 36.9	8.7 - 36.9	19	21	2,800		no
Lead	35 / 36	6.0 - 10,100	2.5 - 10,100	290	770	400		YES
Nickel	36 / 36	5.0 - 21	5.0 - 21	14	15	1,500		no
Silver	1 / 36	2.0	0.25 - 2.0	0.50	0.58	380		no
Zinc	36 / 36	14 - 63	14 - 63	41	45	23,000		no
Cyanide	2 / 35	0.75 - 1	0.25 - 1	0.29	0.33	1,300		no

Footnotes appear on Page 2.

TABLE 3-29
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFICIAL SOIL SAMPLES AT
PSC LF-25
Luke Air Force Base, Arizona

Soil concentrations are given in milligrams per kilogram (mg/kg).

[a]	n-Hexane is used as a surrogate for comparison to the Region IX PRG.
[b]	Total chromium is used as a surrogate for comparison to the Region IX PRG.
Average	Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
BNA	Base-neutral and acid extractable compounds.
PRG	Preliminary Remediation Goal.
TRPH	Total recoverable petroleum hydrocarbon.
UCL	95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.
VOC	Volatile organic compound.

TABLE 3-30
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFICIAL SOIL SAMPLES AT
PSC SD-26
Luke Air Force Base, Arizona

Constituents	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRG	Maximum Exceeds PRG?
VOCs							
Ethylbenzene	2 / 45	0.25 - 4.0	0.025 - 4.0	0.12	0.27	230	no
Toluene	1 / 45	3.0	0.050 - 3.0	0.12	0.23	790	no
Xylenes (total)	1 / 45	1.0 - 18	0.025 - 18	0.45	1.1	320	no
BNAs							
2-Methylnaphthalene	1 / 48	6.5	0.085 - 6.5	0.23	0.45	240	no
Benzo(a)anthracene	2 / 48	0.085 - 0.097	0.085 - 0.097	0.086	0.086	0.61	no
Benzo(a)pyrene	2 / 48	0.085 - 0.11	0.085 - 0.11	0.087	0.088	0.061	YES
Benzo(b)fluoranthene	4 / 48	0.042 - 0.18	0.042 - 0.18	0.089	0.094	0.61	no
Benzo(g,h,i)pyrene	1 / 48	0.066	0.066 - 0.066	0.066	0.066	100	no
Benzo(k)fluoranthene	1 / 48	0.086	0.085 - 0.086	0.085	0.085	6.1	no
bis(2-Ethylhexyl)phthalate	2 / 48	0.40 - 1.7	0.085 - 1.7	0.13	0.19	32	no
Chrysene	2 / 48	0.085 - 0.14	0.085 - 0.14	0.088	0.092	7.2	no
Di-n-butylphthalate	1 / 48	7.3	0.085 - 7.3	0.24	0.49	6,500	no
Fluoranthene	3 / 48	0.085 - 0.23	0.085 - 0.23	0.095	0.10	2,600	no
Indeno(1, 2, 3-cd)pyrene	1 / 48	0.053	0.053 - 0.053	0.053	0.053	0.61	no
Naphthalene	1 / 48	1.7	0.085 - 1.7	0.13	0.18	240	no
Phenanthrene	2 / 48	0.059 -0.085	0.059 - 0.085	0.084	0.085	100	no
Pyrene	4 / 48	0.047 - 0.23	0.047 - 0.23	0.092	0.10	100	no
TRPH	17 / 49	10 - 19,000	5.0 - 19,000	460	1,100	110	YES
Metals							
Arsenic	13 / 47	5.0 -15	2.5 - 15	431	4.9	0.38	YES
Barium	47 / 47	86.5 - 742	86.5 - 742	190	220	5,300	no
Beryllium	11 / 47	0.40 - 0.80	0.25 - 0.80	0.34	0.38	0.14	YES

Footnotes appear on Page 2.

TABLE 3-30
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFICIAL SOIL SAMPLES AT
PSC SD-26
Luke Air Force Base, Arizona

Constituents	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRG	Maximum Exceeds PRG?
Metals (continued)							
Cadmium	25 / 47	0.60 - 3.7	0.15 - 3.7	0.86	1.1	38	no
Chromium	47 / 47	10.6 - 35	10.6 - 35	18	19	210	no
Copper	47 / 47	11.5 - 30.7	11.5 - 30.7	21	22	2,800	no
Lead	46 / 47	5.2 - 20	2.5 - 20	11	12	400	no
Nickel	47 / 47	8.6 - 21	8.6 - 21	15	16	1,500	no
Silver	1 / 47	1.3	0.25 - 1.3	0.51	0.54	380	no
Zinc	47 / 47	23.9 - 199	23.9 - 199	50	57	23,000	no

Soil concentrations are given in milligrams per kilogram (mg/kg).

[a]	Naphthalene is used as a surrogate for comparison to the Region IX PRG.
[b]	Pyrene is used as a surrogate for comparison to the Region IX PRG.
[c]	n-Hexane is used as a surrogate for comparison to the Region IX PRG.
[d]	Total chromium is used as a surrogate for comparison to the Region IX PRG.
Average	Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
BNAs	Base-neutral and acid extractable compounds.
PRG	Preliminary Remediation Goal.
TRPH	Total recoverable petroleum hydrocarbon.
UCL	95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.
VOCs	Volatile organic compounds.

TABLE 3-31
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFICIAL SOIL SAMPLES AT
PSC SD-26
Luke Air Force Base, Arizona

Constituents	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRG	Maximum Exceeds PRG?
VOCs							
Ethylbenzene	3 / 53	0.25 - 4.0	0.025 - 4.0	0.13	0.26	230	no
Toluene	1 / 53	3.0	0.050 - 3.0	0.12	0.21	790	no
Xylenes (total)	3 / 53	1.0 - 18	0.025 - 18	0.43	1.0	320	no
BNAs							
2-Methylnaphthalene	2 / 56	0.91 - 6.5	0.085 - 6.5	0.22	0.42	240	no
Benzo(a)anthracene	3 / 56	0.085 - 0.097	0.085 - 0.097	0.086	0.087	0.61	no
Benzo(a)pyrene	3 / 56	0.085 - 0.11	0.085 - 0.11	0.087	0.089	0.061	YES
Benzo(b)fluoranthene	5 / 56	0.042 - 0.18	0.042 - 0.18	0.092	0.098	0.61	no
Benzo(g,h,i)pyrene	1 / 56	0.066	0.066 - 0.066	0.066	0.066	100	no
Benzo(k)fluoranthene	1 / 56	0.086	0.085 - 0.086	0.085	0.085	6.1	no
bis(2-Ethylhexyl)phthalate	2 / 56	0.40 - 1.7	0.085 - 1.7	0.13	0.18	32	no
Chrysene	3 / 56	0.085 - 0.14	0.085 - 0.14	0.09	0.093	7.2	no
Di-n-butylphthalate	1 / 56	7.3	0.085 - 7.3	0.22	0.44	6,500	no
Fluoranthene	4 / 56	0.085 - 0.23	0.085 - 0.23	0.097	0.11	2,600	no
Indeno(1, 2, 3-cd)pyrene	1 / 56	0.053	0.053 - 0.053	0.053	0.053	0.61	no
Naphthalene	2 / 56	0.33 - 1.7	0.085 - 1.7	0.13	0.18	240	no
Phenanthrene	2 / 56	0.059 -0.085	0.059 - 0.085	0.085	0.085	100	no
Pyrene	5 / 56	0.047 - 0.23	0.047 - 0.23	0.095	0.10	100	no
TRPH	26 / 64	10 - 19,000	5.0 - 19,000	370	870	110	YES
Metals							
Arsenic	20 / 62	5.0 -15	2.5 - 20	4.5	5.3	0.38	YES
Barium	62 / 62	55.9 - 742	55.9 - 742	190	210	5,300	no
Beryllium	11 / 62	0.40 - 0.80	0.15 - 0.80	0.30	0.34	0.14	YES

Footnotes appear on Page 2.

TABLE 3-31
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFICIAL SOIL SAMPLES AT
PSC SD-26
Luke Air Force Base, Arizona

Constituents	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRG		Maximum Exceeds PRG?
Metals (continued)								
Cadmium	31 / 62	0.60 - 3.7	0.15 - 3.7	0.94	1.1	38		no
Chromium	62 / 62	10.3 - 41.6	10.3 - 41.6	18	20	210	[d]	no
Copper	62 / 62	5.5 - 35.1	5.5 - 35.1	20	21	2,800		no
Lead	57 / 62	2.5 - 20	2.5 - 20	10	11	400		no
Nickel	62 / 62	3.5 - 21	3.5 - 21	15	16	1,500		no
Silver	3 / 62	1.0 - 1.4	0.25 - 1.4	0.49	0.53	380		no
Zinc	62 / 62	10.6 - 199	10.6 - 199	49	56	23,000		no

Soil concentrations are given in milligrams per kilogram (mg/kg).

[a]	Naphthalene is used as a surrogate for comparison to the Region IX PRG.
[b]	Pyrene is used as a surrogate for comparison to the Region IX PRG.
[c]	n-Hexane is used as a surrogate for comparison to the Region IX PRG.
[d]	Total chromium is used as a surrogate for comparison to the Region IX PRG.
Average	Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
BNAs	Base-neutral and acid extractable compounds.
PRG	Preliminary Remediation Goal.
TRPH	Total recoverable petroleum hydrocarbon.
UCL	95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.
VOCS	Volatile organic compounds.

TABLE 3-32
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFICIAL SOIL SAMPLES AT
PSC LF-37
Luke Air Force Base, Arizona

	Frequency	Range of Detects	Total Range					
Constituents	Detects / Total	Min - Max	Min - Max	Average	UCL	Region IX Residential PRG		Maximum Exceeds PRG?
BNAs								
Benzo(a)anthracene	1 / 5	0.039	0.039 - 0.039	0.039	0.039	0.61		no
Benzo(a)pyrene	2 / 5	0.057 - 0.425	0.057 - 0.425	0.15	0.30	0.061		YES
Benzo(b)fluoranthene	2 / 5	0.076 - 0.425	0.076 - 0.425	0.15	0.30	0.61		no
Benzo(g,h,i)perylene	2 / 5	0.037 - 0.425	0.037 - 0.425	0.14	0.29	100	[a]	no
Benzo(k)fluoranthene	2 / 5	0.07 - 0.425	0.070 - 0.425	0.15	0.30	6.1		no
Bis(2-ethylhexyl)phthalate	1 / 5	0.425	0.085 - 0.425	0.17	0.31	32		no
Butylbenzylphthalate	1 / 5	1.2	0.085 - 1.2	0.33	0.79	930		no
Chrysene	1 / 5	0.06	0.060 - 0.06	0.06	0.06	7.2		no
Fluoranthene	2 / 5	0.067 - 0.425	0.067 - 0.425	0.15	0.30	2,600		no
pyrene	2 / 5	0.064 - 0.425	0.064 - 0.425	0.15	0.30	100		no
TRPH	1 / 4	540	5.0 - 540	140	450	110	[b]	YES
Metals								
Arsenic	1 / 4	9.6	2.5 - 9.6	4.3	8.5	0.38		YES
Barium	4 / 4	60.8 - 159	60.8 - 159	120	160	5,300		no
Beryllium	2 / 4	0.50 - 0.60	0.25 - 0.60	0.40	0.61	0.14		YES
Cadmium	4 / 4	0.80 - 1.1	0.80 - 1.1	0.93	1.1	38		no
Chromium	4 / 4	12.5 - 25.3	12.5 - 25.3	16	23	210	[c]	no
Copper	4 / 4	14.9 - 17.9	14.9 - 17.9	16	18	2,800		no
Lead	4 / 4	8.5 - 109	8.5 - 109	34	93	400		no
Nickel	4 / 4	9.4 - 13.6	9.4 - 13.6	12	14	1,500		no
Zinc	4 / 4	28.3 - 34.4	28.3 - 34.4	32	35	23,000		no

Soil concentrations are given in milligrams per kilogram (mg/kg).

[a] Pyrene is used as a surrogate for comparison to the Region IX PRG.
[b] n-Hexane is used as a surrogate for comparison to the Region IX PRG.
[c] Total chromium is used as a surrogate for comparison to the Region IX PRG.
Average Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
BNAs Base-neutral acid extractable compounds.
PRG Preliminary Remediation Goal.
TRPH Total recoverable petroleum hydrocarbon.
UCL 95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.

TABLE 3-33
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFICIAL SOIL AND SUBSURFACE SOIL SAMPLES AT
PSC LF-37
Luke Air Force Base, Arizona

Constituents	Frequency	Range of Detects	Total Range	Average	UCL	Region IX		Maximum
	Detects / Total	Min - Max	Min - Max			Residential PRG		Exceeds PRG?
<u>BNAs</u>								
Benzo(a)anthracene	2 / 14	0.039 - 0.054	0.039 - 0.054	0.053	0.055	0.61		no
Benzo(a)pyrene	3 / 14	0.053 - 0.425	0.053 - 0.425	0.11	0.15	0.061		YES
Benzo(b)fluoranthene	3 / 14	0.066 - 0.425	0.066 - 0.425	0.11	0.15	0.61		no
Benzo(g,h,i)perylene	3 / 14	0.037 - 0.425	0.037 - 0.425	0.10	0.15	100	[a]	no
Benzo(k)fluoranthene	3 / 14	0.057 - 0.425	0.057 - 0.425	0.11	0.15	6.1		no
bis(2-ethylhexyl)phthalate	1 / 14	0.425	0.085 - 0.425	0.12	0.17	32		no
Butyl benzyl phthalate	1 / 14	1.2	0.085 - 1.2	0.18	0.32	930		no
Chrysene	2 / 14	0.06 - 0.062	0.06 - 0.062	0.062	0.062	7.2		no
Fluoranthene	3 / 14	0.067 - 0.425	0.067 - 0.425	0.11	0.15	2,600		no
pyrene	3 / 14	0.054 - 0.425	0.054 - 0.425	0.11	0.15	100		no
<u>TRPH</u>	3 / 12	15 - 540	5.0 - 540	52	130	110	[b]	YES
<u>Metals</u>								
Arsenic	7 / 12	5.0 - 9.6	2.5 - 9.6	5.4	6.9	0.38		YES
Barium	12 / 12	60.8 - 334	60.8 - 334	190	220	5,300		no
Beryllium	8 / 12	0.50 - 0.80	0.25 - 0.80	0.51	0.62	0.14		YES
Cadmium	12 / 12	0.80 - 29.5	0.80 - 29.5	3.5	7.8	38		no
Chromium	12 / 12	12.5 - 28.2	12.5 - 28.2	18	20	210	[c]	no
Copper	12 / 12	14.9 - 561	14.9 - 561	65	150	2,800		no
Lead	12 / 12	7.1 - 597	7.1 - 597	70	160	400		YES
Nickel	12 / 12	9.4 - 58.5	9.4 - 58.5	18	25	1,500		no
Silver	1 / 12	3.4	0.50 - 3.4	0.74	1.2	380		no
Zinc	12 / 12	28.3 - 2,270	28.3 - 2,270	230	560	23,000		no

Footnotes appear on Page 2.

TABLE 3-33
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFICIAL SOIL SAMPLES AT
PSC LF-37
Luke Air Force Base, Arizona

Soil concentrations are given in milligrams per kilogram (mg/kg).

[a]	Pyrene is used as surrogate for comparison to the Region IX PRG.
[b]	n-Hexane is used as surrogate for comparison to the Region IX PRG.
[c]	Total chromium is used as surrogate for comparison to the Region IX PRG.
Average	Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
BNAs	Base-neutral acid extractable compounds.
PRG	Preliminary Remediation Goals.
TRPH	Total recoverable petroleum hydrocarbon.
UCL	95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.

TABLE 3-34
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFICIAL SOIL SAMPLES AT
PSC SD-37
Luke Air Force Base, Arizona

Constituents	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRG		Maximum Exceeds PRG?
TRPH	2 / 3	80 - 90	5.0 - 90	58	140	110	[a]	no
Metals								
Arsenic	2 / 3	10 - 11	2.5 - 11	7.8	16	0.38		YES
Barium	3 / 3	173 - 188	173 - 188	180	190	5,300		no
Beryllium	1 / 3	1.0	0.15 - 1.0	0.47	1.2	0.14		YES
Cadmium	1 / 3	0.50	0.15 - 0.50	0.30	0.60	38		no
Chromium	3 / 3	13.1 - 19.3	13.1 - 19.3	17	23	210	[b]	no
Copper	3 / 3	21 - 29.2	21 - 29.2	25	32	2,800		no
Lead	3 / 3	9.0 - 30	9.0 - 30	21	39	400		no
Nickel	3 / 3	17 - 21	17 - 21	19	22	1,500		no
Zinc	3 / 3	39.3 - 58.1	39.3 - 58.1	48	64	23,000		no

Soil concentrations are given in milligrams per kilogram (mg/kg).

[a] n-Hexane is used as a surrogate for comparison to the Region IX PRG.
[b] Total chromium is used as a surrogate for comparison to the Region IX PRG.
Average Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
PRG Preliminary Remediation Goal.
TRPH Total recoverable petroleum hydrocarbon.
UCL 95 percent upper confidence limit (one-tailed) on the means, assuming a normal distribution.

TABLE 3-35
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFICIAL SOIL SAMPLES AT
PSC SD-38
Luke Air Force Base, Arizona

Constituents	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRG		Maximum Exceeds PRG?
TRPH	8 / 13	10 - 58,000	5.0 - 58,000	7,700	16,000	110	[a]	YES
Metals								
Antimony	1 / 13	0.80	0.25 - 0.80	0.29	0.37	31		no
Arsenic	7 / 13	5.0 - 14	2.5 - 14	5.8	7.8	0.38		YES
Barium	13 / 13	93 - 264	93 - 264	180	200	5,300		no
Beryllium	1 / 13	1.0	0.15 - 1.0	0.26	0.37	0.14		YES
Cadmium	4 / 13	0.5 - 2.1	0.15 - 2.1	0.45	0.72	38		no
Chromium	13 / 13	12.6 - 41.5	12.6 - 41.5	18	22	210	[b]	no
Copper	13 / 13	12.4 - 36.5	12.4 - 36.5	21	25	2,800		no
Lead	13 / 13	6.0 - 470	6.0 - 470	54	120	400		YES
Nickel	13 / 13	10 - 23	10 - 23	16	18	1,500		no
Zinc	13 / 13	21.5 - 321	21.5 - 321	61	100	23,000		no

Soil concentrations are given in milligrams per kilogram (mg/kg).

[a] n-Hexane is used as a surrogate for comparison to the Region IX PRG.
[b] Total chromium is used as a surrogate for comparison to the Region IX PRG.
Average Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
PRG Preliminary Remediation Goal.
TRPH Total recoverable petroleum hydrocarbon.
UCL 95 percent upper confidence limit (one-tailed) on the means, assuming a normal distribution.

TABLE 3-36
OCCURRENCE OF CONSTITUENTS DETECTED IN GROUNDWATER SAMPLES AT
PSC SD-38
Luke Air Force Base, Arizona

Constituents	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Tap Water PRG	Maximum Exceeds PRG?
Metals							
Barium	1 / 1	0.146	0.146 - 0.146	0.15	NAP	2.6	no
Copper	1 / 1	0.012	0.012 - 0.012	0.012	NAP	1.4	no
Lead	1 / 1	0.003	0.003 - 0.003	0.0030	NAP	0.004	no
Zinc	1 / 1	0.378	0.378 - 0.378	0.38	NAP	11	no

Groundwater concentrations are given in milligrams per liter (mg/L).

Average	Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
NAP	Not applicable.
PRG	Preliminary remediatiion goals.
UCL	95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.

TABLE 3-37
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFICIAL SOIL SAMPLES AT
PSC SD-39
Luke Air Force Base, Arizona

Constituents	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRG		Maximum Exceeds PRG?
TRPH	7 / 7	20 - 2,000	20 - 2,000	420	950	110	[a]	YES
Metals								
Arsenic	6 / 7	7.0 - 10	2.5 - 10	7.4	9.2	0.38		YES
Barium	7 / 7	93.7 - 179	93.7 - 179	140	160	5,300		no
Cadmium	4 / 7	0.60 - 1.6	0.25 - 1.6	0.64	1.0	38		no
Chromium	7 / 7	9.2 - 19.9	9.2 - 19.9	14	17	210	[b]	no
Copper	7 / 7	14.2 - 40.1	14.2 - 40.1	26	32	2,800		no
Lead	7 / 7	10 - 125	10 - 125	48	85	400		no
Nickel	7 / 7	11 - 20	11 - 20	16	18	1,500		no
Zinc	7 / 7	27 - 58.8	27 - 58.8	42	49	23,000		no

Soil concentrations are given in milligrams per kilogram (mg/kg).

[a]	n-Hexane is used as a surrogate for comparison to the Region IX PRG.
[b]	Total chromium is used as a surrogate for comparison to the Region IX PRG.
Average	Arithmetic average of the total of number of samples, using proxy concentrations for non-detects.
PRG	Preliminary Remediation Goal.
TRPH	Total recoverable petroleum hydrocarbon.
UCL	95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.

TABLE 3-38
OCCURRENCE OF CONSTITUENTS DETECTED IN SUBSURFICIAL SOIL SAMPLES AT
PSC SD-39
Luke Air Force Base, Arizona

Constituents	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRG		Maximum Exceeds PRG?
BNA								
Diethyl phthalate	1 / 6	0.042	0.042 - 0.042	0.042	0.042	52,000		no
TRPH	11 / 21	10 - 2,000	5.0 - 2,000	150	310	110	[a]	YES
Metals								
Arsenic	17 / 21	5.0 - 14	2.5 - 14	8.0	9.3	0.38		YES
Barium	21 / 21	66.2 - 220	66.2 - 220	150	170	5,300		no
Cadmium	5 / 21	0.60 - 1.6	0.25 - 1.6	0.40	0.52	38		no
Chromium	21 / 21	5.6 - 22.5	5.6 - 22.5	13	15	210	[b]	no
Copper	21 / 21	11.3 - 40.1	11.3 - 40.1	21	24	2,800		no
Lead	20 / 21	7.0 - 125	2.5 - 125	22	35	400		no
Nickel	21 / 21	8.0 - 25	8.0 - 25	15	17	1,500		no
Zinc	21 / 21	18.9 - 62.8	18.9 - 62.8	39	43	23,000		no

Soil concentrations are given in milligram per kilogram (mg/kg).

[a]	n-Hexane is used as a surrogate for comparison to the Region IX PRG.
[b]	Total chromium is used as a surrogate for comparison to the Region IX PRG.
Average	Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
BNA	Base-neutral acid extractable compound.
PRG	Preliminary Remediation Goal.
TRPH	Total recoverable petroleum hydrocarbon.
UCL	95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.

TABLE 3-39
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFICIAL SOIL SAMPLES AT
PSC OT-41
Luke Air Force Base, Arizona

Constituents	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRG	Maximum Exceeds PRG?
<u>Metals</u>							
Lead	20 / 20	7.0 - 22	7.0 - 22	13	15	400	no

Soil concentration are given in milligrams per kilogram (mg/kg).

Average Arithmetic average of the total number of samples, Using proxy concentrations for non-detects.
PRG Preliminary Remediation Goal.
UCL 95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.

TABLE 3-40
OCCURRENCE OF CONSTITUENTS DETECTED IN SEDIMENT SAMPLES AT
PSC OT-41
Luke Air Force Base, Arizona

Constituents	Frequency	Range of Detects	Total Range	Average	UCL	Region IX Residential PRG	Maximum Exceeds PRG?
	Detects / Total	Min - Max	Min - Max				
Metals							
Lead	12 / 12	14 - 33	14 - 33	23	27	400	no

Sediment concentration are given in milligrams per kilogram (mg/kg).

Average Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
PRG Preliminary Remediation Goal.
UCL 95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.

TABLE 3-41
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFICIAL SOIL SAMPLES AT
PSC SS-42
Luke Air Force Base, Arizona

Constituents	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRG		Maximum Exceeds PRG?
BNAs								
Benzo(a)anthracene	1 / 4	0.52	0.26 - 0.52	0.33	0.48	0.61		no
Benzo(b)fluoranthene	1 / 4	1.4	1.04 - 1.43	1.1	1.4	0.61		YES
bis(2-Ethylhexyl)phthalate	4 / 4	0.23 - 1.5	0.23 - 1.48	0.61	1.3	32		no
Chrysene	1 / 4	0.85	0.26 - 0.85	0.41	0.75	7.2		no
Di-n-butylphthalate	4 / 4	0.39 - 1.0	0.39 - 1.03	0.63	0.96	6,500		no
Fluoranthene	1 / 4	0.47	0.26 - 0.47	0.32	0.44	2,600		no
Pyrene	1 / 4	0.43	0.16 - 0.43	0.23	0.38	100		no
TPH	9 / 14	24 - 9,000	2.5 - 9,000	680	1,800	110	[a]	YES
Metals								
Lead	13 / 14	7.0 - 144	2.5 - 144	27	44	400		no

Soil concentrations are given in milligrams per kilogram (mg/kg).

[a]	n-Hexane is used as a surrogate for comparison to Region IX PRG.
Average	Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
BNAs	Base-neutral and acid extractable compounds.
PRGs	Preliminary Remediation Goal.
TPH	Total petroleum hydrocarbons by EPA Method 8015 (modified).
UCL	95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.

TABLE 3-42
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFICIAL SOIL SAMPLES AT
PSC SS-42
Luke Air Force Base, Arizona

Constituents	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRG		Maximum Exceeds PRG?
VOCs								
Xylenes	1 / 7	0.96	0.00165 - 0.96	0.14	0.4	320		no
BNAs								
Benzo(a)anthracene	1 / 4	0.516	0.261 - 0.516	0.33	0.48	0.61		no
Benzo(b)fluoranthene	1 / 4	1.43	1.04 - 1.43	1.1	1.4	0.61		YES
Bis(2-ethylhexyl)phthalate	4 / 4	0.227 - 1.48	0.227 - 1.48	0.61	1.3	32		no
Chrysene	1 / 4	0.848	0.261 - 0.848	0.41	0.75	7.2		no
Di-n-butylphthalate	4 / 4	0.393 - 1.03	0.393 - 1.03	0.63	0.96	6,500		no
Fluoranthene	1 / 4	0.472	0.261 - 0.472	0.32	0.44	2,600		no
Pyrene	1 / 4	0.427	0.157 - 0.427	0.23	0.38	100		no
TPH	14 / 33	6 - 9,000	6 - 9,000	780	1,500	110	[a]	YES
Metals								
Lead	32 / 33	5.0 - 144	2.5 - 144	17	25	400		no

Soil concentrations are given in milligrams per kilogram (mg/kg).

[a] n-Hexane is used as a surrogate for comparison to Region IX PRG.
Average Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
BNAs Base-neutral and acid extractable compounds.
PRGs Preliminary Remediation Goal.
TPH Total petroleum hydrocarbons by EPA Method 8015 (modified).
UCL 95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.

TABLE 3-43
OCCURRENCE OF CONSTITUENTS DETECTED IN SURFICIAL SOIL SAMPLES AT
PSC SS-42
Luke Air Force Base, Arizona

Constituents	Frequency	Range of Detects	Total Range	Average	UCL	Region IX Residential PRG		Maximum Exceeds PRG?
	Detects / Total	Min - Max	Min - Max					
Metals								
Arsenic	1 / 7	0.0070 - 0.0070	0.0025 - 0.0070	0.0031	0.0044	0.000045		YES
Barium	7 / 7	0.077 - 0.139	0.077 - 0.139	0.099	0.12	2.6		no
Chromium	7 / 7	0.026 - 3.84	0.026 - 3.84	0.61	1.7	0.18	[a]	YES
Copper	2 / 7	0.019 - 0.036	0.0050 - 0.036	0.011	0.020	1.4		no
Nickel	5 / 7	0.071 - 0.254	0.010 - 0.254	0.098	0.16	0.73		no
Selenium	3 / 7	0.0050 - 0.0080	0.0025 - 0.0080	0.0041	0.0058	0.18		no
Zinc	7 / 7	0.64 - 3.09	0.64 - 3.09	2.0	2.5	11		no

Soil concentrations are given in milligrams per kilogram (mg/kg).

[a] Chromium VI is used as a surrogate for comparison to the Region IX PRG.
Average Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
PRGs Preliminary Remediation Goal.
UCL 95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.

TABLE 3-44
OCCURRENCE OF CONSTITUENTS DETECTED IN PRODUCTION WELL SAMPLES
Luke Air Force Base, Arizona

Constituents	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRG		Maximum Exceeds PRG?
VOCs								
Bromoform	8 / 20	0.0008 - 0.011	0.00025 - 0.011	0.0021	0.0033	0.008		YES
Bromodichloromethane	4 / 20	0.0008 - 0.0031	0.00025 - 0.0031	0.00054	0.00081	0.00018		YES
Chloroform	1 / 20	0.0012	0.00025 - 0.0012	0.00030	0.00038	0.00016		YES
Dibromochloromethane	6 / 17	0.001 - 0.0056	0.00025 - 0.0056	0.0013	0.0021	0.0010		YES
Dichlorodifluoromethane	2 / 20	0.005 - 0.0012	0.0025 - 0.0012	0.0031	0.00040	0.39		no
TTHM	2 / 6	0.0011 - 0.0063	0.00025 - 0.0063	0.0014	0.0034	0.1000	[a]	no
Inorganics								
Arsenic	5 / 5	0.006 - 0.013	0.006 - 0.013	0.0094	0.012	0.000045		YES
Barium	5 / 5	0.04 - 0.14	0.04 - 0.14	0.070	0.11	2.6		no
Calcium	5 / 5	20 - 72	20 - 72	36	58	NA		NA
Chromium	4 / 5	0.013 - 0.018	0.005 - 0.02	0.014	0.019	0.18	[b]	no
Chloride	5 / 5	13 - 104	13 - 104	56	90	250	[c]	no
Copper	1 / 5	0.02 - 0.02	0.005 - 0.02	0.0080	0.014	1.4		no
Fluoride	6 / 6	0.05 - 2.50	0.5 - 2.5	1.4	2.2	2.2	[d]	YES
Iron	5 / 5	0.01 - 0.15	0.01 - 0.15	0.070	0.13	0.3	[c]	no
Magnesium	5 / 5	9.00 - 30	9 - 30	16	24	NA		NA
Manganese	1 / 5	0.01	0.005 - 0.010	0.0060	0.0081	1.7		no
Nitrate	11 / 11	0.61 - 4.4	0.61 - 4.4	2.1	2.9	58		no
Nitrite	1 / 6	0.21 - 0.21	0.005 - 0.21	0.058	0.12	3.7		no
Nitrogen (total)	5 / 5	0.61 - 1.70	0.61 - 1.7	0.97	1.4	3.7		no
Sodium	5 / 5	48 - 90	48 - 90	70	89	NA		NA
Sulfate	3 / 5	32.00 - 48	32 - 48	43	50	400	[a]	no
Zinc	3 / 5	0.02 - 0.13	0.005 - 0.13	0.042	0.092	11		no

Footnotes on page 2

TABLE 3-44
OCCURRENCE OF CONSTITUENTS DETECTED IN
PRODUCTION WELL SAMPLES
Luke Air Force Base, Arizona

Constituents	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Average	UCL	Region IX Residential PRG	Maximum Exceeds PRG?
Pesticides							
Aldicarb	1 / 15	0.0050	0.00025 - 0.0050	0.0021	0.0027	0.037	no
Aldicarb sulfone	1 / 15	0.0050	0.00040 - 0.0050	0.0021	0.0027	0.037	no
Aldicarb sulfoxide	1 / 15	0.0050	0.00025 - 0.0050	0.0021	0.0027	0.037	no

Groundwater concentrations are given in milligrams per kilogram (mg/kg).

[a]	Region IX PRG not available, primary MCL used for comparison purposes.
[b]	Chromium VI is used as a surrogate for comparison to the Region IX PRG.
[c]	Region IX PRG not available, secondary MCL used for comparison purposes.
[d]	Fluorine is used as a surrogate for comparison to the Region IX PRG.
Average	Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
MCL	Maximum contaminant level.
NA	Not available.
PRGs	Preliminary Remediation Goal.
TTHM	Total trihalomethanes.
UCL	95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.

TABLE 3-45
COMPARISON OF UPWIND AND DOWNWIND CONCENTRATIONS
AT THE MAIN BASE
Luke Air Force Base, Arizona

	Downwind*					Upwind*				
	Range of Detects		COC on Other	Region IX	Maximum	Range of Detects		COC on Other	Region IX	Maximum
Constituent	Min - Max	Mean	Media? [a]	Ambient Air PRG[b]	Exceeds PRG?	Min - Max	Mean	Media? [a]	Ambient Air PRG[b]	Exceeds PRG?
VOCs										
Acetone	8.8 - 242	76	no	–	–	1.3 - 117	40	no	–	–
Benzene	0.64 - 3.2	1.6	no	–	–	0.56 - 3.1	1.2	no	–	–
Bromodichloromethane	0.85	0.85	no	–	–	ND	<0.93	–	–	–
2-Butanone	2.8	2.8	no	–	–	3.1 - 4.2	1.8	no	–	–
Carbon disulfide	0.52 - 18	4.5	no	–	–	0.91 - 4.9	1.8	no	–	–
Carbon tetrachloride	0.49 - 0.85	0.67	no	–	–	ND	<0.93	–	–	–
Chlorobenzene	0.85	0.85	no	–	–	ND	<0.93	–	–	–
Chloroethane	0.85	0.85	no	–	–	ND	<56	–	–	–
Chloroform	0.85	0.85	no	–	–	ND	<0.93	–	–	–
Chloromethane	0.69 - 45	12	no	–	–	1.2 - 21	6.8	no	–	–
1,2-Dichloroethane	0.85	0.85	no	–	–	ND	<0.93	–	–	–
1,2-Dichloroethene (total)	0.85	0.85	no	–	–	ND	<0.93	–	–	–
Ethylbenzene	0.66 - 11	3.0	no	–	–	0.63 - 4.2	1.3	no	–	–
2-Hexanone	2.8 - 2.8	2.8	no	–	–	ND	<3.1	–	–	–
Methylene chloride	224 - 1,072	630	no	–	–	201 - 919	520	no	–	–
4-Methyl-2-pentanone	2.8	2.8	no	–	–	ND	<3.1	–	–	–
Styrene	1.54 - 14	5.8	no	–	–	ND	<0.93	–	–	–
1,1,2,2-Tetrachloroethane	0.85	0.85	no	–	–	ND	<0.93	–	–	–
Tetrachloroethene	0.73 - 5.4	2.0	no	–	–	1.1 - 19	2.0	no	–	–
Toluene	0.86 - 197	17	no	–	–	0.88 - 27	5.6	no	–	–
1,1,1-Trichloroethane	0.79 - 2.2	1.4	no	–	–	0.78 - 3.1	1.3	no	–	–
Trichloroethene	0.085 - 25	5.8	no	–	–	2.9 - 15	3.1	no	–	–
Vinyl chloride	0.85	0.85	no	–	–	ND	<0.93	–	–	–
Xylenes	0.86 - 38	7.2	no	–	–	0.66 - 13	4.4	no	–	–
								–		
Semi-VOCs								–		
Acenaphthene	0.69	0.69	no	–	–	ND	<0.67	–	–	–
Benzoic acid	0.071 - 0.49	0.22	no	–	–	0.14 - 0.47	0.41	no	–	–
Benzyl alcohol	0.063 - 0.28	0.17	no	–	–	0.064 - 0.14	0.12	no	–	–
Bis(2-ethylhexyl)phthalate	0.19 - 5.2	1.6	no	–	–	0.071 - 4.3	0.87	no	–	–
Butylbenzylphthalate	0.058 - 0.19	0.10	no	–	–	0.071 - 0.13	0.12	no	–	–
4-Chlorophenyl-phenylether	0.69	0.69	no	–	–	ND	<0.67	–	–	–
Di-n-butylphthalate	0.1 - 2.2	0.35	no	–	–	0.072 - 1.5	0.42	no	–	–
Dibenzofuran	0.69	0.69	no	–	–	ND	<0.67	–	–	–
Diethylphthalate	0.065 - 0.42	0.18	no	–	–	0.13 - 0.33	0.27	no	–	–
Dimethylphthalate	ND	<0.068	no	–	–	0.068	0.068	no	–	–
2,4-Dinitrophenol	3.5	3.5	no	–	–	ND	<3.4	–	–	–
2,4-Dinitrotoluene	0.69	0.69	no	–	–	ND	<0.67	–	–	–

Footnotes appear on Page 2

TABLE 3-45
COMPARISON OF UPWIND AND DOWNWIND CONCENTRATIONS
AT THE MAIN BASE
Luke Air Force Base, Arizona

	Downwind*					Upwind*				
	Range of Detects					Range of Detects				
Constituent	Min - Max	Mean	COC on Other Media? [a]	Region IX Ambient Air PRG[b]	Maximum Exceeds PRG?	Min - Max	Mean	COC on Other Media? [a]	Region IX Ambient Air PRG[b]	Maximum Exceeds PRG?
Semi-VOCs (continued)										
Di-n-octylphthalate	1.2 - 1.8	1.5	no	–	–	0.60 - 0.71	0.39	no	–	–
Hexachlorobutadiene	ND	<0.13	no	–	–	0.13 - 0.71	0.13	no	–	–
2-Methylnaphthalene	0.065 - 0.33	0.17	no	–	–	0.133 - 0.71	0.35	no	–	–
Naphthalene	0.065 - 0.28	0.21	no	–	–	0.064 - 0.28	0.22	no	–	–
4-Nitrophenol	3.5	3.5	no	–	–	ND	<3.4	–	–	–
Phenanthracene	0.068	0.068	no	–	–	0.064 - 0.14	0.13	no	–	–
Phenol	0.058 - 0.33	0.13	no	–	–	0.066 - 0.14	0.10	no	–	–
Inorganics										
Aluminum	0.61 - 3.0	1.3	no	–	–	0.80 - 1.5	1.0	no	–	–
Boron	0.50 - 0.59	0.54	no	–	–	0.59 - 0.60	0.17	no	NAP	–
Copper	0.091 - 0.13	0.11	YES	NAP	–	0.092 - 0.16	0.052	YES	–	–
Iron	0.42 - 2.9	1.1	no	–	–	0.56 - 1.4	0.99	no	–	–
Lead	0.015 - 0.12	0.031	no	–	–	0.011 - 0.027	0.013	no	–	–
Manganese	0.044 - 0.084	0.066	no	–	–	0.041	0.016	no	–	–
Mercury	0.00040 - 00.0014	0.00070	no	–	–	0.0040 - 0.0021	0.0007	no	–	–
Zinc	0.0683 - 0.10	0.087	no	–	–	0.067 - 0.075	0.031	no	–	–
Particulate matter	28 - 122	64	no[c]	150[d]	–	40 - 95	62	no[c]	[d]	no

Concentrations are reported in micrograms per cublic meter ($\mu g/m^3$).

[a] Other media includes soil, sediment, and surface water.
[b] Comparison to Region IX PRGs completed only for those constituents also present in soil, surface water, or sediment.
[c] Not analyzed for in soil, sediment, or surface water; comparison to Region IX PRG will be completed.
[d] Ambient Air PRG not available; 24-hour ambient air quality PM-10 standard used for comparison purposes.
* Concentrations reported are from Appendix H, Tables 6 through 11 (particulates and metals), 15 through 20 (semi-VOCs), and 24 through 28 (VOCs).
Mean Arithmetic average of the total number of samples, using one-half the concentrations for non-detects. If a constituent was never detected, the average of the detection limit is presented.
NAP Not applicable.
ND Not detected.

TABLE 3-46
COMPARISON OF UPWIND AND DOWNWIND CONCENTRATIONS
AT THE MAIN BASE
Luke Air Force Base, Arizona

Constituent	Downwind* Range of Detects Min - Max	Downwind* Mean	Downwind* COC on Other Media? [a]	Downwind* Region IX Ambient Air PRG[b]	Downwind* Maximum Exceeds PRG?	Upwind* Range of Detects Min - Max	Upwind* Mean	Upwind* COC on Other Media? [a]	Upwind* Region IX Ambient Air PRG[b]	Upwind* Maximum Exceeds PRG?
VOCs										
Acetone	5.5 - 117	45	no	–	–	3.0	2.2	no	–	–
Benzene	1.5 - 3.7	2.3	no	–	–	2.0 - 8.7	4.3	no	–	–
Carbon tetrachloride	0.74	0.74	no	–	–	ND	<1.02	no	–	–
Methylene chloride	18 - 1105	440	no	–	–	12 - 878	310	no	–	–
Tetrachloroethene	2.7	2.7	no	–	–	4.1	1.4	no	–	–
Toluene	1.7 - 11	4.9	no	–	–	2.5 - 13	8.1	no	–	–
1,1,1-Trichloroethane	1.2 - 2.1	1.7	no	–	–	1.0 - 2.1	1.3	no	–	–
Trichloroethene	3.9	3.9	no	–	–	12.1	3.4	no	–	–
Xylenes	1.33 - 2.93	2.3	no	–	–	1.8 - 2.5	1.3	no	–	–
Semi-VOCs										
Benzoic acid	0.14	0.14	no	–	–	0.20	1.2	no	–	–
Bis(2-ethylhexyl)phthalate	0.68 - 1.5	1.1	no	–	–	0.20 - 2.5	1.1	no	–	–
Butylbenzylphthalate	0.066	0.066	no	–	–	ND	<0.69	no	–	–
Di-n-butylphthalate	0.26	0.26	no	–	–	0.067 - 0.07	0.080	no	–	–
Diethylphthalate	0.070 - 0.14	0.094	no	–	–	0.20	0.20	no	–	–
2-Methylnaphthalene	0.070 - 0.081	0.073	no	–	–	0.069 - 0.07	0.070	no	–	–
Naphthalene	0.070 - 0.14	0.11	no	–	–	0.067 - 0.15	0.12	no	–	–
Phenol	0.14 - 0.23	0.16	no	–	–	0.13 - 0.20	0.18	no	–	–
Inorganics										
Aluminum	1.1 - 2.7	2.0	no	–	–	1.1 - 2.1	1.6	no	–	–
Copper	0.093 - 0.10	0.097	no	–	–	ND	<0.035	no	–	–
Iron	1.12 - 2.7	2.1	no	–	–	1.27 - 2.1	1.6	no	–	–
Lead	0.014 - 0.021	0.017	no	–	–	0.014 - 0.015	0.015	no	–	–
Manganese	0.053 - 0.063	0.059	no	–	–	0.049	0.027	no	–	–
Mercury	0.00010 - 0.0010	0.00050	no	–	–	0.00040	0.00020	no	–	–
Zinc	0.067 - 0.11	0.087	no	–	–	0.068 - 0.075	0.055	no	–	–
Particulate matter	66 - 163	110	no[c]	150[c]	YES	77 - 101	87	no[c]	150[d]	no

Footnotes appear on Page 2

TABLE 3-46
COMPARISON OF UPWIND AND DOWNWIND CONCENTRATIONS
AT THE MAIN BASE
Luke Air Force Base, Arizona

Concentrations are reported in micrograms per cublic meter ($\mu g/m^3$).

[a]	Other media includes soil, sediment, and surface water.
[b]	Comparison to Region IX PRGs completed only for those constituents detected in soil sediment, and surface water
[c]	Not analyzed for in soil, sediment, or surface water; comparison to Region IX PRG will be completed.
[d]	Ambient Air PRG not available; 24-hour ambient air quality PM-10 standard used for comparison purposes.
C	Concentrations reported are from Appendix H, Tables 12 through 14 (particulates and metals), 21 through 23 (semi-VOCs), and 29 through 32 (VOCs).
Mean	Arithmetic average of the total number of samples, using one-half the concentrations for non-detects. If a constituent was never detected, the average of the detection limit is presented.
ND	Not detected.
PRG	Preliminary Remediation Goal.
Semi-VOC	Semi-volatile organic compound.
VOC	Volatile organic compound.

TABLE 3-47
DERMAL AND ORAL ABSORPTION EFFICIENCIES
FOR CONSTITUENTS OF CONCERN
Luke Air Force Base, Arizona

Constituents	Absorption Efficiencies Dermal		Oral	
VOCs	0.1	a	1.00	b
BNAs				
Benzo(a)anthracene	0.03	c	0.85	c
Benzo(b)fluoranthene	0.03	c	0.85	c
Benzo(a)pyrene	0.03	c	0.85	c
Dibenzo(a,h)anthracene	0.03	c	0.85	c
OCDD[a]	0.03	a	0.87	d
PCBs	0.06	e	0.95	f
TRPHs[b]	0.10	a	1.00	b
Metals				
Antimony	0.01	a	0.01	g
Arsenic	0.01	a	0.95	h
Beryllium	0.001	a	0.009	i
Cadmium	0.018	j	0.02	j
Chromium	0.01	a	0.02	k
Copper	0.01	a	0.60	l
Fluoride	0.01	a	0.96	m
Lead	0.006	n	0.15	n

[a] TCDD is used as a surrogate for OCDD
[b] n-Hexane is used as a surrogate for total recoverable petroleum hydrocarbons (TRPHs).
a USEPA, 1996 (Region IX PRGs).
b Assumed.
c ATSDR (1990b).
d ASTDR, 1990c.
e USEPA (1992).
f Owen (1990).
g ATSDR (1990a).
h ATSDR (1991b).
i ATSDR (1991c).
j ATSDR (1991d).
k ATSDR (1991e).
l ATSDR (1989b).
m ATSDR (1990d).
n ATSDR (1991f).

TABLE 3-48
REFERENCE DOSES, TARGET SITES, AND CONFIDENCE LEVELS
FOR CONSTITUENTS OF CONCERN
Luke Air Force Base, Arizona

Constituents	RfDo (mg/kg/day)		RfDi (mg/kg/day)		Target Sites		Confidence Level/ Uncertainty Factor
	Subchronic	Chronic	Subchronic	Chronic	Oral	Inhalation	
VOCs							
Bromodichloromethane	2.0E-02	2.0E-02	NA	NA	kidney	NA	medium/1000
bromoform	2.0E-02	2.0E-02	2.0E-02*	2.0E-02*	liver	NA	medium/1000
Chloroform	1.0E-02	1.0E-02	1.0E-02*	1.0E-02*	liver	NA	medium/1000
Dibromochloromethane	2.0E-02	2.0E-02	2.0E-01*	2.0E-02*	liver	NA	medium/1000
1,2-Dichloropropane	3.7E-03*	1.1E-03*	3.7E-03	1.1E-03	NA	nasal mucosa	medium/300
BNAs							
Benzo(a)anthracene [a]	3.0E-01	3.0E-02	3.0E-01*	3.0E-02*	kidney	NA	low/3000
Benzo(b)fluoranthene[a]	3.0E-01	3.0E-02	3.0E-01*	3.0E-02*	kidney	NA	low/3000
Benzo(a)pyrene [a]	3.0E-01	3.0E-02	3.0E-01*	3.0E-02*	kidney	NA	low/3000
Dibenzo(a,h)anthracene[a]	3.0E-01	3.0E-02	3.0E-01*	3.0E-02*	kidney	NA	low/3000
OCDD	NA	NA	NA	NA	NA	NA	low/3000
PCBs (Arolcor 1254)	5.0E-05	2.0E-05	5.0E-05*	2.0-05*	immune system	NA	NA
TRPHs	6.0E-01	6.0E-02	5.7E-02	5.7E-02	CNS,testicles	CNS	Medium/300
Metals							
Antimony	4.0E-04	4.0E-04	NA	NA	increased mortality	NA	low/1000
Arsenic	3.0E-04	3.0E-04	NA	NA	skin	NA	medium/3
Beryllium	5.0E-03	5.0E-03	NA	NA	none	NA	low/100
Cadmium	5.0E-04*	5.0E-04*	NA	5.7E-05*	kidney	NA	high/10
Chromium VI	2.0E-02	5.0E-03	NA	NA	NA	NA	low/500
Copper	3.7E-02	3.7E-02	NA	NA	gastrointestinal tract	NA	NA
Fluoride	6.0E-02	6.0E-02	NA	NA	teeth	NA	high/1
Lead	NA	NA	NA	NA	CNS	CNS	NA

References: IRIS, 1996; USEPA, 1996 (Region IX PRG tables); USEPA, 1995 (HEAST)

C Following USEPA Region IX guidance, route-to route extrapolation was assumed when route-specific values were not available.
[a] Pyrene is used as a surrogate for polycyclic aromatic hydrocarbons (PAHs).
[b] n-Hexane is used as a surrogate for total recoverable petroleum hydrocarbons (TRPHs).
[c] Based on current drinking water standard.
CNS Central nervous system.
Mg/kg/day Milligrams per kilogram per day.
NA Not available.
OCDD Octachloro-dibenzo-para-dioxion.
RfDo Inhalation reference dose.
RfDo Oral reference dose.

TABLE 3-49
CANCER SLOPE FACTORS, TUMOR SITES, AND USEPA CANCER CLASSIFICATIONS
FOR CONSTITUENTS OF CONCERN
Luke Air Force Base, Arizona

Constituents	CSF (mg/kg/day)		Tumor site		USEPA Classification
	Oral	Inhalation Chronic	Oral	Inhalation	
VOCs					
Bromodichloromethane	6.2E-02	NA	large intestine/kidney	NA	B2
Bromoform	7.9E-03	3.9E-03	large intestine	large intestine	B2
Chloroform	6.1E-03	8.1E-02	kidney	liver	B2
Dibromochloromethane	8.4E-02	8.4E-02*	liver	NA	C
1,2-Dichloropropane	6.8E-02	NA	liver	NA	B2
BNAs					
Benzo(a)anthracene [a]	7.3E-01	7.3E-01*	stomach	respiratory tract	B2
Benzo(b)fluoranthene [a]	7.3E-01	7.3E-01*	stomach	respiratory tract	B2
Benzo(a)pyrene [a]	7.3E+00	7.3E+00*	stomach	respiratory tract	B2
Dibenzo(a,h)anthracene [a]	7.3E+00	7.3E+00*	stomach	respiratory tract	B2
OCDD [b]	1.5E+02	1.5E+02	liver	respiratory tract	B2
PCBs	7.7E+00	7.7E+00*	liver	NA	B2
Metals					
Arsenic	1.5E+00	1.5E+01	skin	respiratory tract	A
Beryllium	4.3E+00	8.4E+00	total tumors	lung	B2
Cadmium	NAP	6.3E+00	NA	respiratory tract	B1
Chromium (Total)	NAP	4.1E++01	NA	lung	A
Lead	NA	NA	NA	NA	B2

Footnotes appear on Page 2.

TABLE 3-49
CANCER SLOPE FACTORS, TUMOR SITES, AND USEPA CANCER CLASSIFICATIONS
FOR CONSTITUENTS OF CONCERN
Luke Air Force Base, Arizona

References:	ATSDR, 1991b; IRIS, 1996; USEPA, 1996 (Region IX PRG tables); USEPA, 1992 (Dermal Risk Assessment Supplemental Guidance).
C	Following USEPA Region IX guidance, route-to extrapolation was assumed when route-specific values were not available.
[a]	CSFs for the carcinogenic PAHs were calculated using the CSFs for Benzo(a)pyrene and the following toxicity equivalence factors (TEFs) recommended by USEPA (USEPA, 1993):

PAH	TEF
Benzo(a) anthracene	0.1
Benzo(b)fluoranthene	0.1
Benzo(a)pyrene	1.0
Dibenzo(a,h)anthracene	1.0

[b]	CSFs for OCDD was calculated using the CSFs for TCDD and a TEF of (0.001).
BNA	Base-neutral and acid extractable compounds.
CSF	Cancer slope factor.
kg-day/mg	Kilograms-day per milligram.
NA	Not available.
OCDD	Octachloro-dibenzo-para-dioxion.
PAH	Polycyclic aromatic hydrocarbon.
TCDD	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD).
TEF	Toxicity equivalence factor.
VOCs	Volatile Organic Compounds.

TABLE 3-50
EXPOSURE ASSUMPTIONS FOR AVERAGE AND REASONABLE MAXIMUM SOIL EXPOSURE SCENARIOS
Luke Air Force Base, Arizona.

	Base Worker		Military Personnel		Future Excavation Worker		Child Visitor	
	Average	RME	Average	RME	Average	RME	Average	RME
AP (carcinogens; days/lifetime)	25,550	25,550	25,550	25,550	25,550	25,550	25,550	25,550
AP (non-carcinogens; days/lifetime)	2,190	9,125	1,095	1,825	42	84	3,285	3,285
BR (m^3/he\r)	2.5[a]	2.5[a]	2.5[a]	2.5[a]	2.5[a]	2.5[a]	3[i]	3[i]
BW (kg)	70[a]	70[a]	70[a]	70[a]	70[a]	70[a]	30[i]	30[i]
C_s (mg/kg)	b	c	b	c	d	e	b	c
ED (years)	6[f]	25[a]	3[f]	5[f]	1[g]	1[g]	9[g]	9[g]
EF (hours/day)	12[g]	24[g]	250[a]	250[a]	30[g]	72[g]	12[g]	24[g]
ET (hours/day)	2[g]	4[g]	8[a]	8[a]	8[a]	8[a]	2[g]	4[g]
IR (mg/day)	50[a]	50[a]	50[a]	50[a]	100[g]	480[a]	100[a]	100[a]
SAR (mg/cm^2-day)	0.2[h]	1[h]	0.2[h]	1[h]	0.2[h]	1[h]	0.2[h]	1[h]
SSA (cm^2)	3,160[h]	3,160[h]	990[i]	990[i]	3,160[i]	3,160[i]	3,700[i]	3,700[i]

a	USEPA (1991a).	Cm^2	Square centimeters.
b	Average Concentration in surficial soils (for PSC DP-13 this includes soils from 0 to 6 feet below ground surface).	C_a	Soil concentration.
		ED	Exposure duration.
c	Lesser of maximum concentration or 95 percent UCL on the arithmetic average for surficial soils (for PSC DP-13 this includes soils from 0 to 6 feet below ground surface).	EF	Exposure frequency.
		ET	Exposure time.
		IR	Soil ingestion rate.
d	Average concentration in surface and subsurface soils combined.	kg	Kilograms.
e	Lesser of maximum concentration or 95 percent UCL on the arithmetic average for surface and subsurface soils combined.	m^3/hr	Cubic meters per hour.
		mg	Milligrams.
f	Information from Luke AFB (Geraghty & Miller, 1992).	mg/day	Milligrams per day.
g	Professional judgment based on available information.	mg/cm^2-day	Milligram per square centimeter per day.
h	USEPA (1992).	PSC	Potential source of contamination.
i	USEPA (1989c).	RME	Reasonable maximum exposure.
AP	Averaging period.	SAR	Skin adherence rate.
BR	Breathing rate.	SSA	Skin surface area.
BW	Body weight.	UCL	Upper confidence limit.

TABLE 3-51
EXPOSURE ASSUMPTIONS FOR AVERAGE AND REASONABLE MAXIMUM SOIL EXPOSURE SCENARIOS
Luke Air Force Base, Arizona.

	Base Worker		Military Personnel		Base Resident	
	Average	RME	Average	RME	Average	RME
AP (carcinogens)(days/lifetime)	25,550	25,550	25,550	25,550	25,550	25,550
AP (non-corcinogens)(days/lifetime)	2,190	9,125	1,095	1,825	1,095	1,825
BW (kg)	70[a]	70[a]	70[a]	70[a]	70[a]	70[a]
Cgw (mg/kg)	b	c	b	c	b	c
ED (years)	6[d]	25[a]	3[d]	5[d]	3[d]	5[d]
EF (days/year)	250[a]	250[a]	250[a]	250[a]	350[a]	350[a]
ET (minutes/day)	8[e,f]	16[e,g]	2[e,h]	4[e,i]	10[e,l]	20[e,k]
IR (L/day)	1[a]	1[a]	1[a]	1[a]	2[a]	2[a]
SSA (cm^2)	1,980[i,m]	1,980[i,m]	840[i,n]	840[i,n]	15,520[i,a]	15,520[i,a]

a	USEPA (1991a).
b	Average concentration in groundwater.
c	Lesser of maimum conentration or 95 percent UCL on the arithmetic average.
d	Information from Luke AFB (Geraghty & Miller, 1992).
e	Professional judgment based on available information.
f	Assumes 4 events/day x 2 minutes/event.
g	Assumes 8 events/day x 2 minutes/event.
h	Assumes 4 events/day x 0.5 minutes/event.
i	Assumes 8 events/day x 0.5 minutes/event.
j	Assumes 1 event/day x 10 minutes/event.
k	Assumes 1 event/day x 20 minutes/event.
l	USEPA (1992).
m	Skin surface area of hands and forearms.
n	Skin surface area of hands.
o	Eighty percent of total body surface area
AP	Averaging period.
BW	Body weight.
cm^2	Square centimeters.
Cgw	Groundwater concentration.
ED	Exposure duration.
EF	Exopsure frequency.
ET	Exposure time.
IR	Groundwater ingestion rate.
kg	Kilograms.
mg	Milligrams
L/day	Liters per day.
SSA	Skin surface area.
UCL	Upper confidence limit.

TABLE 3-52
CURRENT TOTAL SITE HUMAN-HEALTH RISK SUMMARY
FOR AVERAGE EXPOSURE
Luke Air Force Base, Arizona

Operable Unit	PSC	Media	Receptor: Potential Current Base Worker ELCR	Potential Current Base Worker HI	Potential Current Military Personnel ELCR	Potential Current Military Personnel HI	Potential Current Child Visitor ELCR	Potential Current Child Visitor HI	Potential Current Base Resident ELCR	Potential Current Base Resident HI
OU-1	RW-02									
		Groundwater [a]	1E-05	0.5	6E-06	0.5	- -	- -	2E-05	2
		+ Soil	2E-108	0.0004	2E-07	0.007	- -	- -	- -	- -
		Total Risks*	1E-05	0.5	6E-06	0.5		- -	2E-05	2
		Arsenic in Groundwater	1E-05	0.3	5E-06	0.3	- -	- -	1E-05	0.7
		*Arsenic in Soil**	1E-08	0.0003	1E-07	0.006	- -	- -	- -	- -
		- *Beryllium in Soil**	ND	ND	ND	ND	- -	- -	- -	- -
		Total Risks**	1E-08	0.2	1E-06	0.2	- -	- -	1E-05	1
OU-1	LF-03									
		Groundwater [a]	1E-05	0.5	6E-06	0.5	- -	- -	2E-05	2
		+ Soil	2E-08	0.0003	- -	- -	- -	- -	- -	- -
		Total Risks*	1E-05	0.5	6E-06	0.5	- -	- -	2E-05	2
		Arsenic in Groundwater	1E-05	0.3	5E-06	0.3	- -	- -	1E-05	0.7
		*Arsenic in Soil**	1E-08	0.0003	- -	- -	- -	- -	- -	- -
		- *Beryllium in Soil**	8E-09	0.000005	- -	- -	- -	- -	- -	- -
		Total Risks**	2E-09	0.2	1E-06	0.2	- -	- -	1E-05	1
OU-1	FT-07	(Pre-Remediation)								
		Groundwater[a]	1E-05	0.5	6E-06	0.5	- -	- -	2E-05	2
		+ Soil [b]	NC	0.000009	- -	- -	- -	- -	- -	- -
		Total Risks*	1E-05	0.5	6E-06	0.5	- -	- -	2E-05	2
		Arsenic in Groundwater	1E-05	0.3	5E-06	0.3	- -	- -	1E-05	0.7
		*Arsenic in Soil**	ND	ND	- -	- -	- -	- -	- -	- -
		- *Beryllium in Soil**	ND	ND	- -	- -	- -	- -	- -	- -
		Total Risks**	NEG	0.2	1E-06	0.2	- -	- -	1E-05	1

Footnotes appear on Page 7.

TABLE 3-52
CURRENT TOTAL SITE HUMAN-HEALTH RISK SUMMARY
FOR AVERAGE EXPOSURE
Luke Air Force Base, Arizona

Operable Unit	PSC		Media	Receptor: Potential Current Base Worker ELCR	Potential Current Base Worker HI	Potential Current Military Personnel ELCR	Potential Current Military Personnel HI	Potential Current Child Visitor ELCR	Potential Current Child Visitor HI	Potential Current Base Resident ELCR	Potential Current Base Resident HI
OU-1	FT-07		(Post-Remediation)								
			Groundwater [a]	1E-05	0.5	6E-06	0.5	- -	- -	2E-05	2
		+	Soil [c]	2E-08	0.0006	- -	- -	- -	- -	- -	- -
			Total Risks*	1E-05	0.5	6E-06	0.5	- -	- -	2E-05	2
			Arsenic in Groundwater	1E-05	0.3	5E-06	0.3	- -	- -	1E-05	0.7
			*Arsenic in Soil**	1E-08	0.0003	- -	- -	- -	- -	- -	- -
		-	*Beryllium in Soil**	ND	ND	- -	- -	- -	- -	- -	- -
			Total Risks**	1E-08	0.2	1E-06	0.2	- -	- -	1E-05	1
OU-1	SS-11										
			Groundwater [a]	1E-05	0.5	6E-06	0.5	- -	- -	2E-05	2
		+	Soil	7E-05	0.00002	- -	- -	- -	- -	- -	- -
			Total Risks*	1E-05	0.5	6E-06	0.5	- -	- -	2E-05	2
			Arsenic in Groundwater	1E-05	0.3	5E-06	0.3	- -	- -	1E-05	0.7
			*Arsenic in Soil**	- -	- -	- -	- -	- -	- -	- -	- -
		-	*Beryllium in Soil**	- -	- -	- -	- -	- -	- -	- -	- -
			Total Risks**	7E-10	0.2	1E-06	0.2	- -	- -	1E-05	1
OU-1	OT-12										
			Groundwater [a]	1E-05	0.5	6E-06	0.5	- -	- -	2E-05	2
		+	Soil	4E-08	0.0004	- -	- -	- -	- -	- -	- -
			Total Risks*	1E-05	0.5	6E-06	0.5	- -	- -	2E-05	2
			Arsenic in Groundwater	1E-05	0.3	5E-06	0.3	- -	- -	1E-05	0.7
			*Arsenic in Soil**	1E-08	0.0003	- -	- -	- -	- -	- -	- -
		-	*Beryllium in Soil**	8E-09	0.000005	- -	- -	- -	- -	- -	- -
			Total Risks**	2E-08	0.2	1E-06	0.2	- -	- -	1E-05	1

Footnotes appear on Page 7.

TABLE 3-52
CURRENT TOTAL SITE HUMAN-HEALTH RISK SUMMARY
FOR AVERAGE EXPOSURE
Luke Air Force Base, Arizona

Operable Unit	PSC		Media	Potential Current Base Worker ELCR	Potential Current Base Worker HI	Potential Current Military Personnel ELCR	Potential Current Military Personnel HI	Potential Current Child Visitor ELCR	Potential Current Child Visitor HI	Potential Current Base Resident ELCR	Potential Current Base Resident HI
OU-1	DP-13										
			Groundwater [a]	1E-05	0.50.5	6E-06	0.5	- -	- -	2E-05	2
		+	Soil	2E-08	0.0004	2E-6	0.05	- -	- -	- -	- -
			Total Risks*	1E-05	0.5	8E-06	0.6	- -	- -	2E-05	2
			Arsenic in Groundwater	1E-05	0.3	5E-06	0.3	- -	- -	1E-05	0.7
			*Arsenic in Soil**	1E-08	0.0003	1E-07	0.006	- -	- -	- -	- -
		-	*Beryllium in Soil**	8E-09	0.000005	5E-08	0.00006	- -	- -	- -	- -
			Total Risks**	2E-09	0.2	3E-06	0.2	- -	- -	1E-05	1
OU-1	LF-14										
			Groundwater [a]	1E-05	0.5	6E-06	0.5	- -	- -	2E-05	2
		+	Soil	8E-08	0.002	- -	0.05	- -	- -	- -	- -
			Total Risks*	1E-05	0.5	6E-06	0.6	- -	- -	2E-05	2
			Arsenic in Groundwater	1E-05	0.3	5E-06	0.3	- -	- -	1E-05	0.7
			*Arsenic in Soil**	1E-08	0.0003	- -	--	- -	- -	- -	- -
		-	*Beryllium in Soil**	8E-09	0.000005	- -	--	- -	- -	- -	- -
			Total Risks**	6E-08	0.2	1E-06	0.2	- -	- -	1E-05	1
OU-1	SS-17										
			Groundwater[a]	1E-05	0.5	6E-06	0.5	- -	- -	2E-05	2
		+	Soil	3E-08	0.0005	- -	- -	- -	- -	- -	- -
			Total Risks*	1E-05	0.5	6E-06	0.5	- -	- -	2E-05	2
			Arsenic in Groundwater	1E-05	0.3	5E-06	0.3	- -	- -	1E-05	0.7
			*Arsenic in Soil**	1E-08	0.0003	- -	- -	- -	- -	- -	- -
		-	*Beryllium in Soil**	8E-09	0.000005	- -	- -	- -	- -	- -	- -
			Total Risks**	1E-08	0.2	1E-06	0.2	- -	- -	1E-05	1

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TABLE 3-52
CURRENT TOTAL SITE HUMAN-HEALTH RISK SUMMARY
FOR AVERAGE EXPOSURE
Luke Air Force Base, Arizona

Operable Unit	PSC		Media	Potential Current Base Worker ELCR	Potential Current Base Worker HI	Potential Current Military Personnel ELCR	Potential Current Military Personnel HI	Potential Current Child Visitor ELCR	Potential Current Child Visitor HI	Potential Current Base Resident ELCR	Potential Current Base Resident HI
OU-1	SD-20										
			Groundwater [a]	1E-05	0.5	6E-06	0.5	--	--	2E-05	2
		+	Soil	2E-08	0.0003	--	--	1E-07	0.002	--	--
			Total Risks*	1E-05	0.5	6E-06	0.5	1E-07	0.002	2E-05	2
			Arsenic in Groundwater	1E-05	0.3	5E-06	0.3	--	--	1E-05	0.7
			*Arsenic in Soil**	1E-08	0.0003	--	--	8E-08	0.001	--	--
		-	*Beryllium in Soil**	8E-09	0.000005	--	--	4E-08	0.00002	--	--
			Total Risks**	2E-09	0.2	1E-06	0.2	NEG	0.001	1E-05	1
OU-1	SD-21										
			Groundwater [a]	1E-05	0.3	6E-06	0.5	--	--	2E-05	2
			Soil	3E-08	0.0003	--	--	2E-07	0.002	--	--
		+	Surface Water and/or Sediment	4E-08	0.001	--	--	1E-07	0.002	--	--
			Total Risks*	1E-05	0.5	6E-06	0.5	3E-07	0.004	2E-05	2
			Arsenic in Groundwater	1E-05	0.3	5E-06	0.3	--	--	1E-05	0.7
			*Arsenic in Soil**	1E-08	0.0003	--	--	8E-08	0.001	--	--
		-	*Beryllium in Soil**	8E-09	0.000005	--	--	4E-08	0.00002	--	--
			Total Risks**	5E-08	0.2	1E-06	0.2	2E-07	0.003	1E-05	1
OU-1	LF-25										
			Groundwater[a]	1E-05	0.5	6E-06	0.5	--	--	2E-05	2
		+	Soil]	4E-08	0.02	--	--	--	--	--	--
			Total Risks*	1E-05	0.5	6E-06	0.5	--	--	2E-05	2
			Arsenic in Groundwater	1E-05	0.3	5E-06	0.3	--	--	1E-05	0.7
			*Arsenic in Soil**	1E-08	0.0003	--	--	--	--	--	--
		-	*Beryllium in Soil**	8E-09	0.000005	--	--	--	--	--	--
			Total Risks**	2E-08	0.2	1E-06	0.2	--	--	1E-05	1

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TABLE 3-52
CURRENT TOTAL SITE HUMAN-HEALTH RISK SUMMARY
FOR AVERAGE EXPOSURE
Luke Air Force Base, Arizona

				Receptor						
			Potential Current Base Worker		Potential Current Military Personnel		Potential Current Child Visitor		Potential Current Base Resident	
Operable Unit	PSC	Media	ELCR	HI	ELCR	HI	ELCR	HI	ELCR	HI
OU-1	SD-26									
		Groundwater [a]	1E-05	0.5	6E-06	0.5	--	--	2E-05	2
		+ Soil	2E-08	0.0004	--	--	1E-07	0.003	--	--
		Total Risks*	1E-05	0.5	6E-06	0.5	1E-07	0.003	2E-05	2
		Arsenic in Groundwater	1E-05	0.3	5E-06	0.3	--	--	1E-05	0.7
		*Arsenic in Soil**	1E-08	0.0003	--	--	8E-08	0.001	--	--
		- *Beryllium in Soil**	8E-09	0.000005	--	--	4E-08	0.00002	--	--
		Total Risks**	2E-09	0.2	1E-06	0.2	NEG	0.002	1E-05	1
OU-1	LF-37									
		Groundwater [a]	1E-05	0.5	6E-06	0.5	--	--	2E-05	2
		+ Soil	3E-08	0.0004	--	--	--	--	--	--
		Total Risks*	1E-05	0.5	6E-06	0.5	--	--	2E-05	2
		Arsenic in Groundwater	1E-05	0.3	5E-06	0.3	--	--	1E-05	0.7
		*Arsenic in Soil**	1E-08	0.0003	--	--	--	--	--	--
		- *Beryllium in Soil**	8E-09	0.000005	--	--	--	--	--	--
		Total Risks**	1E-08	0.2	1E-06	0.2	--	--	1E-05	1
OU-1	SD-38									
		Groundwater[a]	1E-05	0.5	6E-06	0.5	--	--	2E-05	2
		+ Soil	--	--	--	--	--	--	--	--
		Total Risks*	1E-05	0.5	6E-06	0.5	--	--	2E-05	2
		Arsenic in Groundwater	1E-05	0.3	5E-06	0.3	--	--	1E-05	0.7
		*Arsenic in Soil**	--	--	--	--	--	--	--	--
		- *Beryllium in Soil**	--	--	--	--	--	--	--	--
		Total Risks**	NEG	0.2	1E-06	0.2	--	--	1E-05	1

Footnotes appear on Page 7.

TABLE 3-52
CURRENT TOTAL SITE HUMAN-HEALTH RISK SUMMARY
FOR AVERAGE EXPOSURE
Luke Air Force Base, Arizona

Operable Unit	PSC		Media	Receptor: Potential Current Base Worker ECLR	HI	Potential Current Military Personnel ECLR	HI	Potential Current Child Visitor ECLR	HI	Potential Current Base Resident ECLR	HI
OU-1	SD-39										
			Groundwater [a]	1E-05	0.5	6E-06	0.5	--	--	2E-05	2
		+	Soil	3E-08	0.001	3E-07	0.01	--	--	--	--
			Total Risks*	1E-05	0.5	6E-06	0.5	--	--	2E-05	2
			Arsenic in Groundwater	1E-05	0.3	5E-06	0.3	--	--	1E-05	0.7
			*Arsenic in Soil**	1E-08	0.0003	1E-07	0.006	--	--	--	--
		-	*Beryllium in Soil**	ND	ND	ND	ND	--	--	--	--
			Total Risks**	2E-08	0.2	1E-06	0.2	--	--	1E-05	1
OU-1	OT-41										
			Groundwater [a]	1E-05	0.5	6E-06	0.5	--	--	2E-05	2
		+	Sediment	--	--	--	--	--	--	--	--
			Total Risks*	1E-05	0.5	6E-06	0.5	--	--	2E-05	2
			Arsenic in Groundwater	1E-05	0.3	5E-06	0.3	--	--	1E-05	0.7
			*Arsenic in Soil**	--	--	--	--	--	--	--	--
		-	*Beryllium in Soil**	--	--	--	--	--	--	--	--
			Total Risks**	NEG	0.2	1E-06	0.2	--	--	1E-05	1
OU-1	SS-42										
			Groundwater [a]	1E-05	0.5	6E-06	0.5	--	--	2E-05	2
		+	Soil	2E-09	0.00006	2E-08	0.0008	--	--	--	--
			Total Risks*	1E-05	0.5	6E-06	0.5	--	--	2E-05	2
			Arsenic in Groundwater	1E-05	0.3	5E-06	0.3	--	--	1E-05	0.7
			*Arsenic in Soil**	--	--	--	--	--	--	--	--
		-	*Beryllium in Soil**	--	--	--	--	--	--	--	--
			Total Risks**	2E-09	0.2	1E-06	0.2	--	--	1E-05	1

Footnotes appear on Page 7.

TABLE 3-52
CURRENT TOTAL SITE HUMAN-HEALTH RISK SUMMARY
FOR AVERAGE EXPOSURE
OPERABLE UNITS 1 AND 2
Luke Air Force Base, Arizona

Italics	Indicate risks from background concentrations.
*	Total risk calculation is the sum of risk from groundwater and soil.
**	Total risk calculation is the total PSC risk from groundwater and soil minus risks from background concentrations of arsenic in groundwater and soil, and beryllium in soil.
[a]	Current ground-water risk calculated using production well data.
[b]	Risk calculated using pre-remediation data.
[c]	Risks calculated using post-remediation data.
--	Not quantitatively evaluated.
Average	Reasonable average exposure.
ELCR	Excess lifetime cancer risk.
HI	Hazard index.
NA	Nat available.
NC	No carcinogenic constituents of concern.
ND	Constituent riot detected at PSC.
NEG	Negligible; total PSC risk without risks from background concentrations is negligible, either below regulatory guideline (ELCR < 1E-6, HI < 1) or value is < or = 0.
PSC	Potential source of contamination.
OU	Operable unit

TABLE 3-53
CURRENT TOTAL SITE HUMAN-HEALTH RISK SUMMARY
FOR REASONABLE MAXIMUM EXPOSURE
Luke Air Force Base, Arizona

Operable Unit	PSC	Media	Receptor							
			Potential Current Base Worker		Potential Current Military Personnel		Potential Current Child Visitor		Potential Current Base Resident	
			ECLR	HI	ECLR	HI	ECLR	HI	ECLR	HI
OU-1	RW-02									
		Groundwater [a]	7E-05	0.8	2E-05	0.8	--	--	4E-05	2
		+ Soil	3E-07	0.003	4E-07	0.01	--	--	--	--
		Total Risks*	7E-05	0.8	2E-05	0.8	--	--	4E-05	2
		Arsenic in Groundwater	3E-04	2	5E-05	2	--	--	1E-04	5
		*Arsenic in Soil**	3E-07	0.002	5E-07	0.02	--	--	--	--
		- *Beryllium in Soil**	ND	ND	ND	ND	--	--	--	--
		Total Risks**	NEG	NEG	NEG	NEG	--	--	NEG	1
OU-1	LF-03									
		Groundwater [a]	7E-05	0.8	2E-05	0.8	--	--	4E-05	2
		+ Soil	6E-07	0.001	--	--	--	--	--	--
		Total Risks*	7E-05	0.8	2E-05	0.8	--	--	4E-05	2
		Arsenic in Groundwater	3E-04	2	5E-05	2	--	--	1E-04	5
		*Arsenic in Soil**	3E-07	0.002	--	--	--	--	--	--
		- *Beryllium in Soil**	6E-07	0.00008	--	--	--	--	--	--
		Total Risks**	NEG	NEG	NEG	NEG	--	--	NEG	1
OU-1	FT-07	(Pre-Remediation)								
		Groundwater [a]	7E-05	0.8	2E-05	0.8	--	--	4E-05	2
		+ Soil [b]	NC	0.002	--	--	--	--	--	--
		Total Risks*	7E-05	0.8	2E-05	0.8	--	--	4E-05	2
		Arsenic in Groundwater	3E-04	2	5E-05	2	--	--	1E-04	5
		*Arsenic in Soil**	ND	ND	--	--	--	--	--	--
		- *Beryllium in Soil**	ND	ND	--	--	--	--	--	--
		Total Risks**	NEG	NEG	NEG	NEG	--	--	NEG	1

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TABLE 3-53
CURRENT TOTAL SITE HUMAN-HEALTH RISK SUMMARY
FOR REASONABLE MAXIMUM EXPOSURE
Luke Air Force Base, Arizona

Operable Unit	PSC		Media	Potential Current Base Worker ECLR	Potential Current Base Worker HI	Potential Current Military Personnel ECLR	Potential Current Military Personnel HI	Potential Current Child Visitor ECLR	Potential Current Child Visitor HI	Potential Current Base Resident ECLR	Potential Current Base Resident HI
OU-1	FT-07		(Post-Remediation)								
			Groundwater [a]	7E-05	0.8	2E-05	0.8	--	--	4E-05	2
		+	Soil [c]	3E-07	0.01	--	--	--	--	--	--
			Total Risks*	7E-05	0.8	2E-05	0.8	--	--	4E-05	2
			Arsenic in Groundwater	3E-04	2	5E-05	2	--	--	1E-04	5
			*Arsenic in Soil**	3E-07	0.002	--	--	--	--	--	--
		-	*Beryllium in Soil**	ND	ND	--	--	--	--	--	--
			Total Risks**	NEG	NEG	NEG	NEG	--	--	NEG	1
OU-1	SS-11										
			Groundwater [a]	7E-05	0.8	2E-05	0.8	--	--	4E-05	2
		+	Soil	2E-08	0.0004	--	--	--	--	--	--
			Total Risks*	7E-05	0.8	2E-05	0.8	--	--	4E-05	2
			Arsenic in Groundwater	3E-04	2	5E-05	2	--	--	1E-04	5
			*Arsenic in Soil**	--	--	--	--	--	--	--	--
		-	*Beryllium in Soil**	--	--	--	--	--	--	--	--
			Total Risks**	NEG	NEG	NEG	NEG	--	--	NEG	1
OU-1	OT-12										
			Groundwater [a]	7E-05	0.8	2E-05	0.8	--	--	4E-05	2
		+	Soil	1E-06	0.007	--	--	--	--	--	--
			Total Risks*	7E-05	0.8	2E-05	0.8	--	--	4E-05	2
			Arsenic in Groundwater	3E-04	2	5E-05	2	--	--	1E-04	5
			*Arsenic in Soil**	3E-07	0.002	--	--	--	--	--	--
		-	*Beryllium in Soil**	6E-07	0.00008	--	--	--	--	--	--
			Total Risks**	NEG	NEG	NEG	NEG	--	--	NEG	1

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TABLE 3-53
CURRENT TOTAL SITE HUMAN-HEALTH RISK SUMMARY
FOR REASONABLE MAXIMUM EXPOSURE
Luke Air Force Base, Arizona

Operable Unit	PSC		Media	Receptor: Potential Current Base Worker ECLR	Potential Current Base Worker HI	Potential Current Military Personnel ECLR	Potential Current Military Personnel HI	Potential Current Child Visitor ECLR	Potential Current Child Visitor HI	Potential Current Base Resident ECLR	Potential Current Base Resident HI
OU-1	DP-13										
			Groundwater [a]	7E-05	0.8	2E-05	0.8	–	–	4E-05	2
		+	Soil	5E-07	0.005	8E-06	0.4	--	--	--	--
			Total Risks*	7E-05	0.8	3E-05	1	--	--	4E-05	2
			Arsenic in Groundwater	3E-04	2	5E-05	2	--	--	1E-04	5
			*Arsenic in Soil**	3E-07	0.002	5E-07	0.02	--	--	--	--
		-	*Beryllium in Soil**	6E-07	0.00008	5E-07	0.0003	--	--	--	--
			Total Risks**	NEG	NEG	8E-06	NEG	--	--	NEG	1
OU-1	LF-14										
			Groundwater [a]	7E-05	0.8	2E-05	0.8	--	--	4E-05	2
		+	Soil	3E-06	0.08	--	--	--	--	--	--
			Total Risks*	7E-05	0.9	2E-05	0.8	--	--	4E-05	2
			Arsenic in Groundwater	3E-04	2	5E-05	2	--	--	1E-04	5
			*Arsenic in Soil**	3E-07	0.002	--	--	--	--	--	--
		-	*Beryllium in Soil**	6E-07	0.00008	--	--	--	--	--	--
			Total Risks**	5E-06	NEG	NEG	NEG	--	--	NEG	1
OU-1	SS-17										
			Groundwater [a]	7E-05	0.8	2E-05	0.8	--	--	4E-05	2
		+	Soil	1E-06	0.03	--	--	--	--	--	--
			Total Risks*	7E-05	0.8	2E-05	0.8	--	--	4E-05	2
			Arsenic in Groundwater	3E-04	2	5E-05	2	--	--	1E-04	5
			*Arsenic in Soil**	3E-07	0.002	--	--	--	--	--	--
		-	*Beryllium in Soil**	6E-07	0.00008	--	--	--	--	--	--
			Total Risks**	NEG	NEG	NEG	NEG	--	--	NEG	1

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TABLE 3-53
CURRENT TOTAL SITE HUMAN-HEALTH RISK SUMMARY
FOR REASONABLE MAXIMUM EXPOSURE
Luke Air Force Base, Arizona

Operable Unit	PSC		Media	Potential Current Base Worker ECLR	Potential Current Base Worker HI	Potential Current Military Personnel ECLR	Potential Current Military Personnel HI	Potential Current Child Visitor ECLR	Potential Current Child Visitor HI	Potential Current Base Resident ECLR	Potential Current Base Resident HI
OU-1	SD-20										
			Groundwater [a]	7E-05	0.8	2E-05	0.8	--	--	4E-05	2
		+	Soil	5E-07	0.004	--	--	6E-07	0.01	--	--
			Total Risks*	7E-05	0.8	2E-05	0.8	6E-07	0.01	4E-05	2
			Arsenic in Groundwater	3E-04	2	5E-05	2	--	--	1E-04	5
			*Arsenic in Soil**	3E-07	0.002	--	--	5E-07	0.008	--	--
		-	*Beryllium in Soil**	6E-07	0.00008	--	--	6E-07	0.0002	--	--
			Total Risks**	NEG	NEG	NEG	NEG	NEG	0.002	NEG	1
OU-1	SD-21										
			Groundwater [a]	7E-05	0.8	2E-05	0.8	--	--	4E-05	2
			Soil	8E-07	0.001	--	--	9E-07	0.005	--	--
		+	Surface Water and/or Sediment	1E-06	0.004	--	--	1E-08	0.02	--	--
			Total Risks*	7E-05	0.8	2E-05	0.8	2E-06	0.03	4E-05	2
			Arsenic in Groundwater	3E-04	2	5E-05	2	--	--	1E-04	5
			*Arsenic in Soil**	3E-07	0.002	--	--	5E-07	0.008	--	--
		-	*Beryllium in Soil**	6E-07	0.00008	--	--	6E-07	0.0002	--	--
			Total Risks**	NEG	NEG	NEG	NEG	8E-07	0.02	NEG	1
OU-1	LF-25										
			Groundwater [a]	7E-05	0.8	2E-05	0.8	--	--	4E-05	2
		+	Soil	2E-06	0.5	--	--	--	--	--	--
			Total Risks*	7E-05	1	2E-05	0.8	--	--	4E-05	2
			Arsenic in Groundwater	3E-04	2	5E-05	2	--	--	1E-04	5
			*Arsenic in Soil**	3E-07	0.002	--	--	--	--	--	--
		-	*Beryllium in Soil**	6E-07	0.00008	--	--	--	--	--	--
			Total Risks**	NEG	NEG	NEG	NEG	--	--	NEG	1

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TABLE 3-53
CURRENT TOTAL SITE HUMAN-HEALTH RISK SUMMARY
FOR REASONABLE MAXIMUM EXPOSURE
Luke Air Force Base, Arizona

Operable Unit	PSC		Media	Receptor: Potential Current Base Worker ECLR	Potential Current Base Worker HI	Potential Current Military Personnel ECLR	Potential Current Military Personnel HI	Potential Current Child Visitor ECLR	Potential Current Child Visitor HI	Potential Current Base Resident ECLR	Potential Current Base Resident HI
OU-1	SD-26										
			Groundwater [a]	7E-05	0.8	2E-05	0.8	--	--	4E-05	2
		+	Soil	5E-07	0.008	--	--	6E-07	0.02	--	--
			Total Risks*	7E-05	0.8	2E-05	0.8	6E-07	0.02	4E-05	2
			Arsenic in Groundwater	3E-04	2	5E-05	2	--	--	1E-04	5
			*Arsenic in Soil**	3E-07	0.002	--	--	5E-07	0.008	--	--
		-	*Beryllium in Soil**	6E-07	0.00008	--	--	6E-07	0.0002	--	--
			Total Risks**	NEG	NEG	NEG	NEG	NEG	0.01	NEG	1
OU-1	LF-37										
			Groundwater [a]	7E-05	0.8	2E-05	0.8	–	--	4E-05	2
		+	Soil	8E-07	0.005	--	--	--	--	--	--
			Total Risks*	7E-05	0.8	2E-05	0.8	--	--	4E-05	2
			Arsenic in Groundwater	3E-04	2	5E-05	2	--	--	1E-04	5
			*Arsenic in Soil**	3E-07	0.002	--	--	--	--	--	--
		-	*Beryllium in Soil**	6E-07	0.00008	--	--	--	--	--	--
			Total Risks**	NEG	NEG	NEG	NEG	--	--	NEG	1
OU-1	SD-38										
			Groundwater [a]	7E-05	0.8	2E-05	0.8	--	--	4E-05	2
		+	Soil	--	--	--	--	--	--	--	--
			Total Risks*	7E-05	0.8	2E-05	0.8	--	--	4E-05	2
			Arsenic in Groundwater	3E-04	2	5E-05	2	--	--	1E-04	5
			*Arsenic in Soil**	--	--	--	--	--	--	--	--
		-	*Beryllium in Soil**	--	--	--	--	--	--	--	--
			Total Risks**	NEG	NEG	NEG	NEG	--	--	NEG	1

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TABLE 3-53
CURRENT TOTAL SITE HUMAN-HEALTH RISK SUMMARY
FOR REASONABLE MAXIMUM EXPOSURE
Luke Air Force Base, Arizona

Operable Unit	PSC		Media	Potential Current Base Worker ECLR	Potential Current Base Worker HI	Potential Current Military Personnel ECLR	Potential Current Military Personnel HI	Potential Current Child Visitor ECLR	Potential Current Child Visitor HI	Potential Current Base Resident ECLR	Potential Current Base Resident HI
OU-1	SD-39										
			Groundwater [a]	7E-05	0.8	2E-05	0.8	–	–	4E-05	2
		+	Soil	4E-07	0.008	6E-07	0.02	--	--	--	--
			Total Risks*	7E-05	0.8	2E-05	0.8	--	--	4E-05	2
			Arsenic in Groundwater	3E-04	2	5E-05	2	--	--	1E-04	5
			*Arsenic in Soil**	3E-07	0.002	5E-07	0.02	--	--	--	--
		-	*Beryllium in Soil**	ND	ND	ND	ND	--	--	--	--
			Total Risks**	NEG	NEG	NEG	NEG	--	--	NEG	1
OU-1	OT-41										
			Groundwater [a]	7E-05	0.8	2E-05	0.8	--	--	4E-05	2
			Soil	--	--	--	--	--	--	--	--
		+	Sediment	--	--	--	--	--	--	--	--
			Total Risks*	7E-05	0.8	2E-05	0.8	--	--	4E-05	2
			Arsenic in Groundwater	3E-04	2	5E-05	2	--	--	1E-04	5
			*Arsenic in Soil**	--	--	--	--	--	--	--	--
		-	*Beryllium in Soil**	--	--	--	--	--	--	--	--
			Total Risks**	NEG	NEG	NEG	NEG	--	--	NEG	1
OU-1	SS-42										
			Groundwater [a]	7E-05	0.8	2E-05	0.8	--	--	4E-05	2
		+	Soil	6E-08	0.01	6E-08	0.004	--	--	--	--
			Total Risks*	7E-05	0.8	2E-05	0.8	--	--	4E-05	2
			Arsenic in Groundwater	3E-04	2	5E-05	2	--	--	1E-04	5
			*Arsenic in Soil**	--	--	--	--	--	--	--	--
		-	*Beryllium in Soil**	--	--	--	--	--	--	--	--
			Total Risks**	NEG	NEG	NEG	NEG	--	--	NEG	1

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TABLE 3-53
CURRENT TOTAL SITE HUMAN-HEALTH RISK SUMMARY
FOR REASONABLE MAXIMUM EXPOSURE
OPERABLE UNITS 1 AND 2
Luke Air Fome Base, Arizona

Italics	Indicate risks from background concentrations.
*	Total risk calculation is the sum of risk from groundwater and soil.
**	Total risk calculation is the total PSC risk from groundwater and soil minus risks from background concentrations of arsenic in groundwater and soil, and beryllium in soil.
[a]	Current ground-water risk calculated using production well data.
[b]	Risks calculated using pre-remediation data.
[c]	Risks calculated using post-remediation data.
- -	Not quantitatively evaluated.
Average	Reasonable average exposure.
ELCR	Excess lifetime cancer risk.
HI	Hazard index.
NA	Not available.
NC	No carcinogenic constituents of concern.
ND	Constituent not detected at PSC.
NEG	Negligible; total PSC risk without risks from background concentrations is negligible, either below regulatory guideline (ELCR < 1 E-6, HI < 1) or value is < or = 0.
PSC	Potential source of contamination.
OU	Operable unit

TABLE 3-54
HYPOTHETICAL FUTURE TOTAL SITE HUMAN-HEALTH RISK SUMMARY
FOR AVERAGE EXPOSURE
OPERABLE UNITS 1 AND 2
Luke Air Force Base, Arizona

Operable Unit	PSC		Media	Receptor							
				Potential Current Base Worker		Potential Current Military Personnel		Potential Current Child Visitor		Potential Current Base Resident	
				ECLR	HI	ECLR	HI	ECLR	HI	ECLR	HI
OU-1	RW-02										
			Groundwater [a]	1E-05	0.3	6E-06	0.3	--	--	2E-05	0.9
		+	Soil	2E-08	0.0004	2E-07	0.007	2E-08	0.06	--	--
			Total Risks*	1E-05	0.3	6E-06	0.3	2E-08	0.06	2E-05	0.9
			Arsenic in Groundwater	1E-05	0.3	5E-06	0.3	--	--	1E-05	0.7
			*Arsenic in Soil**	1E-08	0.0003	1E-07	0.006	1E-08	0.01	--	--
		-	*Beryllium in Soil**	ND	ND	ND	ND	4E-09	0.0001	--	--
			Total Risks**	1E-08	0.0001	1E-06	0.001	6E-09	0.05	1E-05	0.2
OU-1	LF-03										
			Groundwater [a]	--	--	--	--	--	--	--	--
		+	Soil	2E-08	0.0003	--	--	3E-08	0.05	--	--
			Total Risks*	2E-08	0.0003	--	--	3E-08	0.05	--	--
			Arsenic in Groundwater	--	--	--		--	--	--	--
			*Arsenic in Soil**	1E-08	0.0003	--	--	1E-08	0.01	--	--
		-	*Beryllium in Soil**	8E-09	0.000005	--	--	4E-09	0.0001	--	--
			Total Risks**	2E-09	NEG	--	--	2E-08	0.04	--	--
OU-1	FT-07		(Pre-Remediation)								
			Groundwater [a]	2E-07	0.007	8E-08	0.007	--	--	2E-07	0.02
		+	Soil [b]	NC	0.000009	--	--	3E-09	0.004	--	--
			Total Risks*	2E-07	0.007	8E-08	0.007	3E-09	0.004	2E-07	0.02
			Arsenic in Groundwater	ND	ND	ND	ND	--	--	ND	ND
			*Arsenic in Soil**	ND	ND	--	--	1E-08	0.01	--	--
		-	*Beryllium in Soil**	ND	ND	--	--	ND	ND	--	--
			Total Risks**	2E-07	0.007	8E-08	0.007	NEG	NEG	2E-07	0.02

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TABLE 3-54
HYPOTHETICAL FUTURE TOTAL SITE HUMAN-HEALTH RISK SUMMARY
FOR AVERAGE EXPOSURE
OPERABLE UNITS 1 AND 2
Luke Air Force Base, Arizona

			Receptor							
Operable Unit	**PSC**	**Media**	**Hypothetical Future Base Worker**		**Hypothetical Future Military Personnel**		**Hypothetical Future Excavation Worker**		**Hypothetical Future Base Resident**	
			ECLR	**HI**	**ECLR**	**HI**	**ECLR**	**HI**	**ECLR**	**HI**
OU-1	FT-07	(Post -Remediation)								
		Groundwater	2E-07	0.007	8E-08	0.007	--	--	2E-07	0.02
		+ Soil	2E-08	0.0006	--	--	1E-08	0.03	--	--
		Total Risks*	2E-07	0.008	8E-08	0.007	1E-08	0.03	2E-07	0.02
		Arsenic in Groundwater	ND	ND	ND	ND	--	--	ND	ND
		*Arsenic in Soil**	1E-08	0.0003	--	--	1E-08	0.01	--	--
		- *Beryllium in Soil**	ND	ND	--	--	ND	ND	--	--
		Total Risks**	2E-07	0.007	8E-08	0.007	NEG	0.02	2E-07	0.02
OU-1	SS-11									
		Groundwater [a]	--	--	--	--	--	--	--	--
		+ Soil	7E-10	0.00002	--	--	--	--	--	--
		Total Risks*	7E-10	0.00002	--	--	--	--	--	--
		Arsenic in Groundwater	--	--	--	--	--	--	--	--
		*Arsenic in Soil**	--	--	--	--	--	--	--	--
		- *Beryllium in Soil**	--	--	--	--	--	--	--	--
		Total Risks**	7E-10	0.00002	--	--	--	--	--	--
OU-1	OT-12									
		Groundwater [a]	--	--	--	–	--	--	--	--
		+ Soil	4E-08	0.0004	--	--	2E-08	0.02	--	--
		Total Risks*	4E-08	0.0004	--	--	2E-08	0.02	--	--
		Arsenic in Groundwater	--	--	--	--	--	--	--	--
		*Arsenic in Soil**	1E-08	0.0003	--	--	1E-08	0.01	--	--
		- *Beryllium in Soil**	8E-09	0.000005	--	--	4E-09	0.0001	--	--
		Total Risks**	2E-08	0.0001	--	--	6E-09	0.01	--	--

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TABLE 3-54
HYPOTHETICAL FUTURE TOTAL SITE HUMAN-HEALTH RISK SUMMARY
FOR AVERAGE EXPOSURE
OPERABLE UNITS 1 AND 2
Luke Air Force Base, Arizona

				Receptor						
Operable Unit	**PSC**		**Media**	**Hypothetical Future Base Worker**		**Hypothetical Future Military Personnel**		**Hypothetical Future Excavation Worker**		**Hypothetical Future Base Resident**	
				ECLR	**HI**	**ECLR**	**HI**	**ECLR**	**HI**	**ECLR**	**HI**
OU-1	DP-13										
			Groundwater	--	--	--	--	--	--	--	--
		+	Soil	2E-08	0.0004	2E-06	0.05	6E-08	0.09	--	--
			Total Risks*	2E-08	0.0004	2E-06	0.05	6E-08	0.09	--	--
			Arsenic in Groundwater	--	--	--	--	--	--	--	--
			*Arsenic in Soil**	1E-08	0.0003	1E-07	0.006	1E-08	0.01	--	--
		-	*Beryllium in Soil**	8E-09	0.000005	5E-08	0.00006	4E-09	0.0001	--	--
			Total Risks**	2E-09	0.0001	2E-06	0.04	5E-08	0.08	--	--
OU-1	LF-14										
			Groundwater [a]	--	--	--	--	--	--	--	--
		+	Soil	8E-08	0.002	--	--	7E-08	0.1	--	--
			Total Risks*	8E-08	0.002	--	--	7E-08	0.1	--	--
			Arsenic in Groundwater	--	--	--	--	--	--	--	--
			*Arsenic in Soil**	1E-08	0.0003	--	--	1E-08	0.01	--	--
		-	*Beryllium in Soil**	8E-08	0.000005	--	--	4E-09	0.0001	--	--
			Total Risks**	6E-08	0.002	--	--	6E-08	0.09	--	--
OU-1	SS-17										
			Groundwater [a]	--	--	--	--	--	--	--	--
		+	Soil	3E-08	0.0005	--	--	2E-08	0.02	--	--
			Total Risks*	3E-08	0.0005	--	--	2E-08	0.02	--	--
			Arsenic in Groundwater	--	--	--	--	--	--	--	--
			*Arsenic in Soil**	1E-08	0.0003	--	--	1E-08	0.01	--	--
		-	*Beryllium in Soil**	8E-09	0.000005	--	--	4E-09	0.0001	--	--
			Total Risks**	1E-08	0.0002	--	--	6E-09	0.01	--	--

Footnotes appear on Page 7.

TABLE 3-54
HYPOTHETICAL FUTURE TOTAL SITE HUMAN-HEALTH RISK SUMMARY
FOR AVERAGE EXPOSURE
OPERABLE UNITS 1 AND 2
Luke Air Force Base, Arizona

Operable Unit	PSC		Media	Hypothetical Future Base Worker ECLR	Hypothetical Future Base Worker HI	Hypothetical Future Military Personnel ECLR	Hypothetical Future Military Personnel HI	Hypothetical Future Excavation Worker ECLR	Hypothetical Future Excavation Worker HI	Hypothetical Future Base Resident ECLR	Hypothetical Future Base Resident HI
OU-1	SD-20										
			Groundwater	2E-05	0.5	9E-06	0.5	--	--	2E-05	1
		+	Soil	2E-08	0.0003	--	--	--	--	--	--
			Total Risks*	2E-05	0.5	9E-06	0.5	--	--	2E-05	1
			Arsenic in Groundwater	1E-05	0.3	5E-06	0.3	--	--	1E-05	0.7
			*Arsenic in Soil**	1E-08	0.0003	--	--	--	--	--	--
		-	*Beryllium in Soil**	8E-09	0.000005	--	--	--	--	--	--
			Total Risks**	1E-05	0.2	4E-06	0.2	--	--	1E-05	0.3
OU-1	SD-21										
			Groundwater [a]	5E-06	0.1	3E-06	0.1	--	--	7E-06	0.4
			Soil	3E-08	0.0003	--	--	--	--	--	--
		+	Surface Water and/or Sediment	4E-08	0.001	--	--	--	--	--	--
			Total Risks*	5E-06	0.1	3E-06	0.1	--	--	7E-06	0.4
			Arsenic in Groundwater	1E-05	0.3	5E-06	0.3	--	--	1E-05	0.7
			*Arsenic in Soil**	1E-08	0.0003	--	--	--	--	--	--
		-	*Beryllium in Soil**	8E-09	0.000005	--	--	--	--	--	--
			Total Risks**	NEG	NEG	NEG	NEG	--	--	NEG	NEG
OU-1	LF-25										
			Groundwater [a]	--	--	--	–	--	--	--	--
		+	Soil	4E-08	0.02	--	--	2E-08	0.2	--	--
			Total Risks*	4E-08	0.02	--	--	2E-08	0.2	--	--
			Arsenic in Groundwater	--	--	--	--	--	--	--	--
			*Arsenic in Soil**	1E-08	0.0003	--	--	1E-08	0.01	--	--
		-	*Beryllium in Soil**	8E-09	0.000005	--	--	4E-09	0.0001	--	--
			Total Risks**	2E-08	0.02	--	--	6E-09	0.2	--	--

TABLE 3-54
HYPOTHETICAL FUTURE TOTAL SITE HUMAN-HEALTH RISK SUMMARY
FOR AVERAGE EXPOSURE
OPERABLE UNITS 1 AND 2
Luke Air Force Base, Arizona

Operable Unit	PSC		Media	Receptor: Hypothetical Future Base Worker ECLR	HI	Hypothetical Future Military Personnel ECLR	HI	Hypothetical Future Excavation Worker ECLR	HI	Hypothetical Future Base Resident ECLR	HI
Footnotes appear on Page 7.											
OU-1	SD-26										
			Groundwater	--	--	--	--	--	--	--	--
		+	Soil	2E-08	0.0004	--	--	--	--	--	--
			Total Risks*	2E-08	0.0004	--	--	--	--	--	--
			Arsenic in Groundwater	--	--	--	--	--	--	--	--
			*Arsenic in Soil**	1E-08	0.0003	--	--	--	--	--	--
		-	*Beryllium in Soil**	8E-09	0.000005	--	--	--	--	--	--
			Total Risks**	2E-09	0.0001	--	--	--	--	--	--
OU-1	LF-37										
			Groundwater [a]	--	--	--	--	--	--	--	--
		+	Soil	3E-08	0.0004	--	--	2E-08	0.02	--	--
			Total Risks*	3E-08	0.0004	--	--	2E-08	0.02	--	--
			Arsenic in Groundwater	--	--	--	--	--	--	--	--
			*Arsenic in Soil**	1E-08	0.0003	--	--	1E-08	0.01	--	--
		-	*Beryllium in Soil**	8E-09	0.000005	--	--	4E-09	0.0001	--	--
			Total Risks**	1E-08	0.0001	--	--	6E-09	0.01	--	--
OU-1	SD-38										
			Groundwater [a]	--	--	--	--	--	--	--	--
		+	Soil	--	--	--	--	2E-08	0.04	--	--
			Total Risks*	--	--	--	--	2E-08	0.04	--	--
			Arsenic in Groundwater	--	--	--	--	--	--	--	--
			*Arsenic in Soil**	--	--	--	--	1E-08	0.01	--	--
		-	*Beryllium in Soil**	--	--	--	--	4E-09	0.0001	--	--
			Total Risks**	--	--	--	--	6E-09	0.03	--	--

TABLE 3-54
HYPOTHETICAL FUTURE TOTAL SITE HUMAN-HEALTH RISK SUMMARY
FOR AVERAGE EXPOSURE
OPERABLE UNITS 1 AND 2
Luke Air Force Base, Arizona

Operable Unit	PSC		Media	Hypothetical Future Base Worker ECLR	Hypothetical Future Base Worker HI	Hypothetical Future Military Personnel ECLR	Hypothetical Future Military Personnel HI	Hypothetical Future Excavation Worker ECLR	Hypothetical Future Excavation Worker HI	Hypothetical Future Base Resident ECLR	Hypothetical Future Base Resident HI
Footnotes appear on Page 7.											
OU-1	SD-39										
			Groundwater	--	--	--	--	--	--	--	--
		+	Soil	3E-08	0.001	3E-07	0.01	2E-08	0.03	--	--
			Total Risks*	3E-07	0.001	3E-07	0.01	2E-08	0.03	--	0.02
			Arsenic in Groundwater	--	--	--	--	--	--	--	--
			*Arsenic in Soil**	1E-08	0.0003	1E-07	0.006	1E-08	0.01	--	--
		-	*Beryllium in Soil**	ND	ND	ND	ND	ND	ND	--	--
			Total Risks**	2E-08	0.0007	2E-07	0.004	1E-08	0.02	--	--
OU-1	OT-41										
			Groundwater [a]	--	--	--	--	--	--	--	--
		+	Soil	--	--	--	--	--	--	--	--
			Total Risks*	--	--	--	--	--	--	--	--
			Arsenic in Groundwater	--	--	--	--	--	--	--	--
			*Arsenic in Soil**	--	--	--	--	--	--	--	--
		-	*Beryllium in Soil**	--	--	--	--	--	--	--	--
			Total Risks**	--	--	--	--	--	--	--	--
OU-1	SS-42										
			Groundwater [a]	4E-06	0.3	2E-06	0.3	--	--	5E-06	1
		+	Soil	2E-09	0.00006	2E-08	0.0008	2E-09	0.002	--	--
			Total Risks*	4E-06	0.3	2E-06	0.3	2E-09	0.002	5E-06	1
			Arsenic in Groundwater	1E-05	0.3	5E-06	0.3	--	--	1E-05	0.7
			*Arsenic in Soil**	--	--	--	--	--	--	--	--
		-	*Beryllium in Soil**	--	--	--	--	--	--	--	--
			Total Risks**	NEG	0.00006	NEG	0.0008	2E-09	0.002	NEG	0.7

TABLE 3-54
HYPOTHETICAL FUTURE TOTAL SITE HUMAN-HEALTH RISK SUMMARY
FOR AVERAGE EXPOSURE
OPERABLE UNITS 1 AND 2
Luke Air Force Base, Arizona

			Receptor							
Operable Unit	PSC	Media	Potential Current Base Worker		Potential Current Military Personnel		Potential Current Child Visitor		Potential Current Base Resident	
			ECLR	HI	ECLR	HI	ECLR	HI	ECLR	HI

Footnotes appear on Page 7.

TABLE 3-54
HYPOTHETICAL FUTURE TOTAL SITE HUMAN-HEALTH RISK SUMMARY
FOR AVERAGE EXPOSURE
OPERABLE UNITS 1 AND 2
Luke Air Force Base, Arizona

Italics	Indicate risks from background concentrations.
*	Total risk calculation is the sum of risk from groundwater and soil.
**	Total risk calculation is the total PSC risk from groundwater and soil minus risks from background concentrations of arsenic in groundwater and soil, and beryllium in soil.
[a]	Hypothetical future groundwater calculated using monitoring well data, where available.
[b]	Risks calculated using pre-remediation data.
[c]	Risks calculated using post-remediation data.
--	Not quantitatively evaluated.
Average	Reasonable average exposure.
ELCR	Excess lifetime cancer risk
HI	Hazard index.
NA	Not available.
NC	No carcinogenic constituents of concern.
ND	Constituent not detected as PSC.
NEG	Negligible; total PSC risk without risks from background concentrations is negligible, either below regulatory guideline (ELCR < 1E-6, HI<1) or value is <or=0.
PSC	Potential source of contamination.
OU	Operable unit.

TABLE 3-55
HYPOTHETICAL FUTURE TOTAL SITE HUMAN-HEALTH RISK SUMMARY
FOR REASONABLE MAXIMUM EXPOSURE
OPERABLE UNITS 1 AND 2
Luke Air Force Base, Arizona

Operable Unit	PSC	Media	Receptor							
			Potential Current Base Worker		Potential Current Military Personnel		Potential Current Child Visitor		Potential Current Base Resident	
			ECLR	HI	ECLR	HI	ECLR	HI	ECLR	HI
OU-1	RW-02									
		Groundwater [a]	9E-05	0.6	2E-05	0.6	--	--	5E-05	2
		+ Soil	3E-07	0.003	4E-07	0.01	2E-07	0.6	--	--
		Total Risks*	9E-05	0.6	2E-05	0.6	2E-07	0.6	5E-05	2
		Arsenic in Groundwater	3E-04	2	5E-05	2	--	--	1E-04	5
		*Arsenic in Soil**	3E-07	0.002	5E-07	0.02	3E-07	0.2	--	--
		- *Beryllium in Soil**	ND	ND	ND	ND	1E-07	0.002	--	--
		Total Risks**	NEG	NEG	NEG	NEG	NEG	0.4	NEG	NEG
OU-1	LF-03									
		Groundwater [a]	--	--	--	--	--	--	--	--
		+ Soil	6E-07	0.001	--	--	3E-07	0.5	--	--
		Total Risks*	6E-07	0.001	--	--	3E-07	0.5	--	--
		Arsenic in Groundwater	3E-07	--	--	--	--	--	--	--
		*Arsenic in Soil**	6E-07	0.002	--	--	3E-07	0.2	--	--
		- *Beryllium in Soil**	NEG	0.00008	--	--	1E-07	0.002	--	--
		Total Risks**			--	--	NEG	0.3	--	--
OU-1	FT-07 (Pre-Remediation)									
		Groundwater [a]	--	--	--	--	--	--	--	--
		+ Soil [b]	NC	0.002	--	--	4E-08	0.03	--	--
		Total Risks*	--	0.002	--	--	4E-08	0.03	--	--
		Arsenic in Groundwater	--	ND	--	--	--	--	--	--
		*Arsenic in Soil**	ND	ND	--	--	3E-07	0.2	--	--
		- *Beryllium in Soil**	ND	ND	--	--	ND	ND	--	--
		Total Risks**	--	0.002	--	--	NEG	NEG	--	--

Footnotes appear on Page 7.

TABLE 3-55
HYPOTHETICAL FUTURE TOTAL SITE HUMAN-HEALTH RISK SUMMARY
FOR REASONABLE MAXIMUM EXPOSURE
OPERABLE UNITS 1 AND 2
Luke Air Force Base, Arizona

Operable Unit	PSC	Media	Receptor: Potential Current Base Worker ECLR	Potential Current Base Worker HI	Potential Current Military Personnel ECLR	Potential Current Military Personnel HI	Potential Current Child Visitor ECLR	Potential Current Child Visitor HI	Potential Current Base Resident ECLR	Potential Current Base Resident HI
OU-1	FT-07 (Post Remediation)									
		Groundwater [a]	--	–	--	--	--	--	--	--
		+ Soil [c]	3E-07	0.01	--	--	2E-07	0.2	--	--
		Total Risks*	3E-07	0.01	--	--	2E-07	0.2	--	--
		Arsenic in Groundwater	--	--	--	--	--	--	--	--
		*Arsenic in Soil**	3E-07	0.002	--	--	3E-07	0.2	--	--
		- *Beryllium in Soil**	ND	ND	--	--	ND	ND	--	--
		Total Risks**	NEG	0.01	--	--	NEG	NEG	--	--
OU-1	SS-11									
		Groundwater [a]	--	--	--	--	--	--	--	--
		+ Soil	2E-08	0.004	--	--	--	--	--	--
		Total Risks*	2E-08	0.004	--	--	--	--	--	--
		Arsenic in Groundwater	--	--	--	--	--	--	--	--
		*Arsenic in Soil**	--	--	--	--	--	--	--	--
		- *Beryllium in Soil**		--	--	--	--	--	--	--
		Total Risks**	2E-08	0.0004	--	--	--	--	--	--
OU-1	OT-12									
		Groundwater [a]	--	--	--	--	--	--	--	--
		+ Soil [b]	1E-06	0.007	--	--	3E-07	0.1	--	--
		Total Risks*	1E-06	0.007	--	--	3E-07	0.1	--	--
		Arsenic in Groundwater	--	--	--	--	--	--	--	--
		*Arsenic in Soil**	3E-07	0.002	--	--	3E-07	0.2	--	--
		- *Beryllium in Soil**	6E-07	0.00008	--	--	1E-07	0.002	--	--
		Total Risks**	1E-07	00.005	--	--	NEG	NEG	--	--

Footnotes appear on Page 7

TABLE 3-55
HYPOTHETICAL FUTURE TOTAL SITE HUMAN-HEALTH RISK SUMMARY
FOR REASONABLE MAXIMUM EXPOSURE
OPERABLE UNITS 1 AND 2
Luke Air Force Base, Arizona

Operable Unit	PSC	Media	Receptor: Potential Current Base Worker ECLR	Potential Current Base Worker HI	Potential Current Military Personnel ECLR	Potential Current Military Personnel HI	Potential Current Child Visitor ECLR	Potential Current Child Visitor HI	Potential Current Base Resident ECLR	Potential Current Base Resident HI
OU-1	DP-13									
		Groundwater [a]	--	--	--	--	--	- -	--	--
		+ Soil [c]	5E-07	0.005	8E-06	0.4	6E-07	1	--	--
		Total Risks*	5E-07	0.005	8E-06	0.4	6E-07	1	--	--
		Arsenic in Groundwater	--	--	--	--	--	- -	--	--
		*Arsenic in Soil**	3E-07	0.002	5E-07	0.02	3E-07	0.2	--	--
		- *Beryllium in Soil**	6E-07	0.00008	5E-07	0.0003	1E-07	0.002	--	--
		Total Risks**	NEG	0.003	7E-06	0.4	2E-07	1	--	--
OU-1	LF-14									
		Groundwater [a]	--	--	--	--	--	- -	--	--
		+ Soil	3E-06	0.08	--	--	1E-06	1	--	--
		Total Risks*	3E-06	0.08	--	--	1E-06	1	--	--
		Arsenic in Groundwater	--	--	--	--	- -	- -	--	--
		*Arsenic in Soil**	3E-07	0.02	--	--	3E-07	0.2	--	--
		- *Beryllium in Soil**	6E-07	0.0008	--	--	1E-07	0.002	--	--
		Total Risks**	2E-06	0.08	--	--	6E-07	1	--	--
OU-1	SS-17									
		Groundwater [a]	--	--	--	--	- -	- -	--	--
		+ Soil [b]	1E-06	0.03	--	--	3E-07	0.2	--	--
		Total Risks*	1E-06	0.03	--	--	3E-07	0.2	--	--
		Arsenic in Groundwater	--	--	--	--	- -	- -	--	--
		*Arsenic in Soil**	3E-07	0.002	--	--	3E-07	0.2	--	--
		- *Beryllium in Soil**	6E-07	0.0008	--	--	1E-07	0.002	--	--
		Total Risks**	1E-07	0.03	--	--	NEG	NEG	--	--

Footnotes appear on Page 7.

TABLE 3-55
HYPOTHETICAL FUTURE TOTAL SITE HUMAN-HEALTH RISK SUMMARY
FOR REASONABLE MAXIMUM EXPOSURE
OPERABLE UNITS 1 AND 2
Luke Air Force Base, Arizona

Operable Unit	PSC		Media	Hypothetical Future Base Worker		Hypothetical Future Military Personnel		Hypothetical Future Child Visitor		Hypothetical Future Base Resident	
				ECLR	HI	ECLR	HI	ECLR	HI	ECLR	HI
OU-1	SD-20										
		+	Groundwater [a]	1E-04	0.8	3E-05	0.8	- -	- -	8E-05	2
			Soil	5E-07	0.004	- -	- -	- -	- -	- -	- -
			Total Risks*	1E-04	0.8	3E-05	0.8	- -	- -	8E-05	2
			Arsenic in Groundwater	3E-04	2	5E-05	2	- -	- -	1E-04	5
			*Arsenic in Soil**	3E-07	0.002	- -	- -	- -	- -	- -	- -
		-	*Beryllium in Soil**	6E-07	0.00008	- -	- -	- -	- -	- -	- -
			Total Risks**	NEG	NEG	NEG	NEG	- -	- -	NEG	NEG
OU-1	SD-21										
			Groundwater [a]	6E-05	0.4	1E-05	0.4	- -	- -	3E-05	1
			Soil	8E-07	0.001	- -	- -	- -	- -	- -	- -
		+	Surface Water and/or Sediment	1E-06	0.004	- -	- -	- -	- -	- -	- -
			Total Risks*	6E-05	0.4	1E-05	0.4	- -	- -	3E-05	1
			Arsenic in Groundwater	3E-04	2	5E-05	2	- -	- -	1E-04	5
			*Arsenic in Soil**	3E-07	0.002	- -	- -	- -	- -	- -	- -
		-	*Beryllium in Soil**	6E-07	0.00008	- -	- -	- -	- -	- -	- -
			Total Risks*	NEG	NEG	NEG	NEG	- -	- -	NEG	NEG
OU-1	LF-25										
			Groundwater [a]	- -	- -	- -	- -	- -	- -	- -	- -
		+	Soil	2E-06	0.5	- -	- -	3E-07	3	- -	- -
			Total Risks*	2E-06	0.5	- -	- -	3E-07	3	- -	- -
			Arsenic in Groundwater	- -	- -	- -	- -	- -	- -	- -	- -
			*Arsenic in Soil**	3E-07	0.002	- -	- -	3E-07	0.2	- -	- -
		-	*Beryllium in Soil*	6E-07	0.00008	- -	- -	1E-07	0.002	- -	- -
			Total Risks**	1E-06	0.5	- -	- -	NEG	3	- -	- -

Receptor (spans all receptor columns)

Footnotes appear on Page 7.

TABLE 3-55
HYPOTHETICAL FUTURE TOTAL SITE HUMAN-HEALTH RISK SUMMARY
FOR REASONABLE MAXIMUM EXPOSURE
OPERABLE UNITS 1 AND 2
Luke Air Force Base, Arizona

Operable Unit	PSC		Media	Hypothetical Future Base Worker ECLR	Hypothetical Future Base Worker HI	Hypothetical Future Military Personnel ECLR	Hypothetical Future Military Personnel HI	Hypothetical Future Child Visitor ECLR	Hypothetical Future Child Visitor HI	Hypothetical Future Base Resident ECLR	Hypothetical Future Base Resident HI
OU-1	SD-26										
		+	Groundwater [a]	- -	- -	- -	- -	- -	- -	- -	- -
			Soil	5E-07	0.008	- -	- -	- -	- -	- -	- -
			Total Risks*	5E-07	0.008	- -	- -	- -	- -	- -	- -
			Arsenic in Groundwater	- -							
			*Arsenic in Soil**	3E-07	0.002	- -	- -	- -	- -	- -	- -
		-	*Beryllium in Soil**	6E-07	0.00008	- -	- -	- -	- -	- -	- -
			Total Risks**	NEG	0.006	- -	- -	- -	- -	- -	- -
OU-1	LF-37										
			Groundwater [a]	- -	- -	- -	- -	- -	- -	- -	- -
		+	Soil	8E-07	0.005	- -	- -	3E-07	0.1	- -	- -
			Total Risks*	8E-07	0.005	- -	- -	3E-07	0.1	- -	- -
			Arsenic in Groundwater	- -	- -	- -	- -	- -	--	- -	- -
			*Arsenic in Soil**	3E-07	0.002	- -	- -	3E-07	0.02	- -	- -
		-	*Beryllium in Soil**	6E-07	0.00008	- -	- -	1E-07	0.002	- -	- -
			Total Risks**	NEG	0.003	- -	- -	NEG	NEG	- -	- -
OU-1	SD-38										
			Groundwater [a]	- -	- -	- -	- -	- -	--	- -	- -
		+	Soil	- -	- -	- -	- -	3E-07	0.4	- -	- -
			Total Risks*	- -	- -	- -	- -	3E-07	0.4	- -	- -
			Arsenic in Groundwater	- -	- -	- -	- -	- -	- -	- -	- -
			Arsenic in Soil	- -	- -	- -	- -	3E-07	0.2	- -	- -
		-	*Beryllium in Soil*	- -	- -	- -	- -	1E-07	0.002	- -	- -
			Total Risks**	- -	- -	- -	- -	NEG	0.2	- -	- -

Footnotes appear on Page 7.

TABLE 3-55
HYPOTHETICAL FUTURE TOTAL SITE HUMAN-HEALTH RISK SUMMARY
FOR REASONABLE MAXIMUM EXPOSURE
OPERABLE UNIT 1 AND 2
Luke Air Force Base, Arizona

Operable Unit	PSC		Media	Receptor: Hypothetical Future Base Worker ECLR	HI	Hypothetical Future Military Personnel ECLR	HI	Hypothetical Future Child Visitor ECLR	HI	Hypothetical Future Base Resident ECLR	HI
OU-1	SD-39										
		+	Groundwater [a]	- -	- -	- -	- -	- -	- -	- -	- -
			Soil	4E-07	0.008	6E-07	0.02	3E-07	0.2	- -	- -
			Total Risks*	4E-07	0.008	6E-07	0.02	3E-07	0.2	- -	- -
			Arsenic in Groundwater	- -	- -	- -	- -	- -	- -	- -	- -
			*Arsenic in Soil**	3E-07	0.002	5E-07	0.02	3E-07	0.2	- -	- -
		-	*Beryllium in Soil**	ND	ND	ND	ND	ND	ND	- -	- -
			Total Risks**	1E-07	0.006	1E-07	NEG	NEG	NEG	- -	- -
OU-1	OT-41										
			Groundwater [a]	- -	- -	- -	- -	- -	- -	- -	- -
			Soil	- -	- -	- -	- -	- -	- -	- -	- -
		+	Stediment	- -	- -	- -	- -	- -	- -	- -	- -
			Total Risks*	- -	- -	- -	- -	- -	- -	- -	- -
			Arsenic in Groundwater	- -	- -	- -	- -	- -	- -	- -	- -
			*Arsenic in Soil**	- -	- -	- -	- -	- -	- -	- -	- -
		-	*Beryllium in Soil**	- -	- -	- -	- -	- -	- -	- -	- -
			Total Risks**	- -	- -	- -	- -	- -	- -	- -	- -
OU-1	SS-42										
			Groundwater [a]	4E-05	8	7E-06	2	- -	- -	2E-05	6
		+	Soil	6E-08	0.01	6E-08	0.004	2E-08	0.02	- -	- -
			Total Risks*	4E-05	8	7E-08	2	2E-08	0.02	2E-05	6
			Arsenic in Groundwater	3E-04	2	5E-05	2	- -	- -	1E-04	5
			*Arsenic in Soil**	- -	- -	- -	- -	- -	- -	- -	- -
		-	*Beryllium in Soil**	- -	- -	- -	- -	- -	- -	- -	- -
			Total Risks**	NEG	8	NEG	2	2E-08	0.02	NEG	5

Footnotes appear on Page 7.

TABLE 3-55
HYPOTHETICAL FUTURE TOTAL SITE HUMAN-HEALTH RISK SUMMARY
FOR REASONABLE MAXIMUM EXPOSURE
OPERABLE UNITS 1 AND 2
Luke Air Force Base, Arizona

Italics	Indicate risks from background concentrations.
*	Total risk calculations is the sum of the risk from groundwater and soils.
**	Total risk calculation is the total PSC risk from soil and groundwater minus risks from background concentrations of arsenic in groundwater and soil, and beryllium in soil.
[a]	Hypothetical future groundwater risk calculated using monitoring well data, where available.
[b]	Risks calculated using pre-remediation data
[c]	Risks calculated using post-remediation data.
- -	Not quantitatively evaluated.
Average	Reasonable average exposure.
ELCR	Excess lifetime cancer risk.
HI	Hazard index.
NA	Not available
NC	No carcinogenic constituents of concern
ND	Constituent not detected at PSC.
NEG	Negligible; total PSC risk without risks from background concentrations is negligible, either below regulatory (ELCR < 1E-6, HI<1) or values is < or = 0.
PSC	Potential source of contamination.
OU	Operable unit.

Table 3-56
Summary Of Risk Calculations for Hypothetical Future Residential Exposure to Surface and Subsurface Soil at Luke Air Force Base, Arizona

	SRL Ration Calculation [a,d,c]	
PSC	ELCR	HI
RW-02	3E-07	0.3
LF-03	5E-06	1
FT-07	2E-06	NEG
SS-11	[d]	[d]
OT-12	1E-06	NEG
DP-13	3E-05	2
LF-14	1E-05	0.2
SS-17	5E-07	NEG
SD-20	4E-07	NEG
SD-21	8E-07	NEG
LF-25	2E-07	1
SD-26	4E-07	NEG
LF-37	3E-07	NEG
SD-38	4E-06	NEG
SD-39	9E-07	0.01
OT-41	[d]	[d]
SS-42	6E-07	NA

The ELCR is calculated using a target cancer risk of 1E-06. The HQ is calculated using a target hazard index of 1.

[a] Carcinogenic and Noncarcinogenoc SRL used in ratio taken from ADEQ SRL calculation for Residential Land Use.
[b] ELCR and HI are the total PSC risk from soil minus risks from background concentrations of arsenic and beryllium in soil.
[c] PSC deemed suitable for Unrestricted Land Use if ELCR is at or below 1E-06 and the HI is at or below 1.
[d] SRL ration not calculated; ration calculated using USEPA Region IX PRGs showed ELCR at or below 1E-06 and the HI at or below 1; PSC deemed suitable for Unrestricted Land Use.

ADEQ Arizona Department of Environmental Quality.
ELCR Excess lifetime cancer risk.
HI Hazard index (sum of the Hqs).
mg/kg Milligrams per kilogram.
NA Not available. There are no non-carcinogenic COCs, therefore, a HI could not be calculated.
NEG Negligible; total PSC risk without risks from background is negligible (< or = 0).
PRG Preliminary Remediation Goal.
PSC Potential Source of Contamination.
SRL Soil remediation level.
USEPA United States Environmental Protection Agency.

TABLE 3-57
BLOOD LEAD LEVELS FOR EXPOSURE TO SURFICIAL SOIL
Luke Air Force Base, Arizona

PSC	Exposure Scenario	Lead Surface Cs (mg/kg)	Lead Groundwater Cgw (mg/L)	Blood Lead Level Geometric Mean (µg/dL)	Blood Lead Level Percent Below 10(µg/dL)
LF-25	average	610	a	7.0	79
	RME	1,600	a	13.5	30

Blood lead levels were calculated using the USEPA model "LEAD0.99."
The default value for air (0.1 µg/m^3) was used in determining blood lead levels. The default value is higher than the mean concentrations detected in upwind or downwind ambient air and approximately equal to the maximum detected concentration.

a Ground-water samples were not collected from this PSC. The average and 95 percent UCL lead concentrations detected in groundwater at PSC RW-02 (0.007 mg/L and 0.011 mg/L, respectively) were used as the exposure concentrations for groundwater.

Cgw Lead concentration in groundwater,

COC Constituent of potential concern.

Cs Lead concentration in soil.

mg/kg Milligrams per kilogram,

mg/L Milligrams per liter.

µg/dL Micrograms per deciliter.

PSC Potential source of contamination.

RME. Reasonable maximum exposure

TABLE 3-58
BLOOD LEAD LEVELS FOR EXPOSURE TO SURFACE AND SUBSURFACE SOIL
Luke Air Force Base, Arizona

PSC	Exposure Scenario	Lead Surface and Subsurface Cs (mg/kg)	Lead Groundwater Cgw (mg/L)	Blood Lead Level	
				Geometric Mean (µg/dL)	Percent Below 10(µg/dL)
RW-02	average	56	0.007	2.3	100
	RME	91	0.011	3.0	100
LF-03	average	180	a	3.5	93
	RME	340	a	5.1	93
DP-13	average	700	a	7.6	73
	RME	1,800	a	14.5	24
DP-13	average	1,200	a	11	45
(0 TO 6 FT bgs.)	RME	3,300	a	21.4	7.4
LF-25	average	290	a	4.4	96
	RME	770	a	8.3	68
LF-37	average	70	a	2.5	100
	RME	160	a	3.6	99
SD-38	average	54	0.003	2.0	100
	RME	120	0.003	2.6	100

Blood lead levels were calculated using the USEPA model "LEAD 0.99d."
The default lead concentration for air (0.1 µg/m^3) was used in determining blood lead levels. The default lead concentration is higher than the mean concentrations detected in upwind or downwind ambient air and approximately equal to the maximum detected concentration.

a Ground-water samples were not collected from this PSC. The average and 95 percent UCL lead concentrations detected in groundwater at PSC RW-02 (0.007 mg/L and 0.011 mg/L, respectively) were used as the exposure concentrations for groundwater.
Cgw Lead concentration in groundwater,
COC Constituent of potential concern.
Cs Lead concentration in soil.
mg/kg Milligrams per kilogram,
mg/L Milligrams per liter.
µg/dL Micrograms per deciliter.
PSC Potential source of contamination.
RME. Reasonable maximum exposure

TABLE 3-59
BLOOD LEAD LEVELS FOR EXPOSURE TO GROUNDWATER
Luke Air Force Base, Arizona

PSC	Exposure Scenario	Lead Groundwater Cgw (mg/L)	Lead Surface Cs (mg/kg)	Blood Lead Level: Geometric Mean (µg/dL)	Blood Lead Level: Percent Below 10(µg/dL)	Lead Surface and Subsurface Cs (mg/kg)	Blood Lead Level: Geometric Mean (µg/dL)	Blood Lead Level: Percent Below 10(µg/dL)
RW-02	average	0.007	22	2.0	100	56	2.3	100
	RME	0.011	36	2.5	100	91	3.0	100
SD-20	average	0.007	21	2.0	100	16	2.0	100
	RME	0.010	27	2.3	100	20	2.2	100
SD-21**	average	0.034	23	4.1	97	23	4.1	97
	RME	0.084	23	7.5	75	23	7.5	75

Blood lead levels were calculated using the USEPA model "LEAD 0.99d." The default lead concentration for air (0.1 µg/m^3) was used in determining blood lead levels. The default lead concentration is higher than the mean concentrations detected in upwind or downwind ambient air and approximately equal to the maximum detected concentration.

*	For completeness, surface soil concentrations and combined surface and subsurface soil concentrations were used to calculate the blood lead level at the PSCs where lead exceeded the residential Region IX PRG; however, the residential Region IX PRG was not exceeded for soils at these PSCs, with the exception of RW-02.
**	Concentrations of lead in sediment; lead is a COC in surface water only and the sediment concentrations are higher than soil concentrations. To be conservative, the lead concentration in sediment is used for the surficial and subsurface soil concentration and the groundwater and surface water concentration were added together to provide the groundwater concentration.
Cgw	Lead concentration in groundwater.
Cs	Lead concentration in soil.
mg/kg	Milligrams per kilogram.
mg/L	Milligrams per liter.
µg/dL	Micrograms per deciliter
PSC	Potential source of contamination.

Table 3-60
Chemical-Specific ARARs and TCBs for Soils and Groundwater
OU-1 Record of Decision, Luke Air Force Base, Arizona

COC	Soil ARARs		Soil TBCs	Groundwater ARARs	
	ADEQ Pre-Determined Residential SRL (mg/kg)	ADEQ Industrial SRL (mg/kg)	USEPA Region IX Residential PRG (mg/kg)	Arizona Aquifer Water Quality Standards (mg/L)	Federal Primary Maximum Contaminate Level (mg/L)
VOCs*					
Benzene	0.62	1.4	0.63	0.005	0.005
Toluene	790	2,700	790	1	1
Ethyl benzene	1,500	2,700	230	0.7	0.7
Xylenes	2,800	2,800	320	10	10
PCBs	2.5	13	0.066	0.0005	0.0005
TRPH	4100 [c]	18000 [c]	110 [a]	NA	NA
Inorganics					
Antimony and compounds	31	680	31	0.006	0.006
Antimony pentoxide	38	850			
Antimony potassium tartrate	69	1,500			
Antimony tetroxide	31	680			
Antimony trioxide	31	680			
Chromium, Total (1/6 ratio Cr VI	2,100	4,500	30 [b]	0.1	0.1
Chromium III	77,000	1,000,000			
Chromium IV	30	64			
Lead	400	2,000	400	0.05	TB

Notes:
* Benzene, toluene, ethylbenzene, and xylenes were not COCs in OU-1; however, they are included in this table of ARARs and TBCs for completeness.
** - Chemical has limited mobility and GPL is equivalent to SRL or site-specific remediation standard.
[a] n-hexane is used as representative for TRPH.
[b] Value is for soil and is for hexavalent chromium.
[c] Value is for soil and for hydrocarbons C_{10} to C_{12}.

ARARs Applicable or Relevant and Appropriate Requirements.
TBC To- be- considered.
COC Constituents of concern.
ADEQ Arizona Department of Environmental Quality.
mg/L milligrams per liter.
NS No Standard
mg/kg Milligrams per kilogram.
USEPA United States Environmental Protection Agency.
PRG Preliminary Remediation Goal.
SRL Soil Remediation Level.
VOCs Volatile organic compounds.
PCBs Polychlorinated biphenyls.
TB Treatment Based Standard

Table 3-61 Potential Chemical-Specific, Location-Specific, and Action-Specific Applicable or Relevant and Appropriate Requirements (ARARs) and To-Be-Considered (TBCs) Materials for Soil and Groundwater, Luke Air Force Base.

Standard, Requirement, Criteria, Limitation	Citation	Description	Comments
Chemical-Specific ARARs and TBCs			
Arizona Soil Remediation Standards	AAC R18-7-201 thru R18-7-209	Specifies remediation levels for soils.	Applicable for soil remediation
Arizona Aquifer Water Quality Standards	AAC R18-11-406	The aquifer water quality standards apply to aquifers that are classified for drinking water protected use. Soil cleanups most continue until there is no longer a threat that contaminants in the soil will leach to the groundwater and cause groundwater quality to be impacted above the AWQS at a point of compliance.	Applicable for soil and groundwater remediation goals.
SDWA National Primary Drinking Water Maximum Contaminant Level	40 CFR Part 141, Subpart B	Specifies Federal drinking water standards expressed as maximum contaminant levels (MCLs)	Requirements, although generally applicable, are superseded by state standards.
USEPA Region IX PRGs	RAGS part B, USEPA Soil Screening Guidance	Predetermined risk-based criteria used as screening tool to determine the presence of pollutants, trigger investigation and initial cleanup goals.	TBC, used to determine if further evaluation is necessary.
Arizona Groundwater Protection Limits (GPLs)	"A Screening method to Determine Soil Concentrations Protective of Groundwater Quality"	Outlines soil cleanup standards that will adequately protect groundwater.	TBC applicable for petroleum contaminated soils.
Action-Specific ARARs and TBCs			
Federal Clean Air Act	42 USC § 7401	Established National Ambient Air Quality Standards (NAAQS) that may be applicable to remedial activities which would result in "major sources" of emissions: incineration.	Requirements, although generally applicable, are superseded by state standards.
Arizona Clean Air Act	ARS §§ 49-401 thru 49-516	State ambient air quality standards supersede the NAAQS. These standards are anticipated to be applicable to activities which would result in "major sources" of emissions.	Implementation shared with Maricopa County
Facility Discharge Permits	ARS § 49-480	Requires an installation permit to alter machinery which may cause or contribute to air pollution or the use of which may eliminate or reduce or control the emission of air pollutants.	
County Air Pollution Control	ARS § 49-4717 et. seq. Maricopa County Bureau of Air Pollution Control Regulation II, Rule Numbers 200,210, 220, 320 and 330.	Regulations which control air emissions of fugitive dust, volatile organic compounds and gaseous contaminants.	Applicable for excavation and treatment alternatives.

Table 3-61 Potential Chemical-Specific, Location-Specific, and Action-Specific Applicable or Relevant and Appropriate Requirements (ARARs) and To-Be-Considered (TBCs) Materials for Soil and Groundwater, Luke Air Force Base.

Standard, Requirement, Criteria, Limitation	Citation	Description	Comments
Wells Permitting, Construction and Drilling Standards	ARS §§ 45-591 thru 45-604 AAC R12-15-801 thru 822	Specify requirements for the permitting, drilling, construction and abandonment of wells including monitoring, supply, and injection wells.	Applicable for construction and maintenance of wells at the site.
Occupational Safety and Health Act (OSHA)	29 CFR § 1910 SARA Sec. 126	Requires that on-site workers engaged in hazardous waste operations complete 40-hour health and safety training.	Worker protection standards that are applicable to workers on CERCLA sites.
RCRA Hazardous Waste and Arizona Hazardous Waste Management Requirements	40 CFR § 260, ARS §§ 49-901 thru 49-973	Apply to any impacted soil excavated or groundwater withdrawn for treatment that contains hazardous waste	Sites at which hazardous waste would be handled
Hazardous Waste Transportation	49 CFR Subchapter C; 10 CFR §7, 10 CFR § 20.006	Transportation of contaminated media constituting a hazardous waste to an off-site treatment or disposal facility is subject to federal and state hazardous materials transportation requirements.	
Arizona Aquifer Protection Permits	ARS §§ 49-241 thru 49-248	Requires a permit to discharge a pollutant either directly into an aquifer, or to the land surface above the vadose zone in such a manner that there is a potential for the pollutant to reach the aquifer.	Applicable for land treatment alternatives.
Groundwater Rights and Permits	ARS §§ 45-512 thru 45-516	Withdrawal for groundwater for remedial activities requires procurement existing right or permit from ADW.	Applicable for groundwater extraction alternatives.
Solid Waste Management	ARS §§ 49-701 thru 49-881	These state rules would apply to the disposal of contaminated solid waste on-site or off-site that did not constitute a hazardous waste.	Applicable for solid waste and TRPH contaminated soils.
Radioactive Waste Management	USAF guidelines	Guidance for disenterment and storage of buried wastes.	TBC for excavation alternative at PSC RW-02.
PCB Contaminated Soils	CFR 761 et. seq.	Specifies treatment and disposal technologies and criteria.	Applicable to soils containing >50ppm PCBs.
Location-Specific ARARs and TCBs			
Luke AFB Civil Engineering Clearance	Air Force Form 103 and Form 332	Requires a permit from the base civil engineering department to conduct excavation.	Applicable on-site.
Luke AFB Operations Permit	AETC Form 401	Requires permit to access runways, taxiways, aircraft	Applicable on-site.

Table 3-61 Potential Chemical-Specific, Location-Specific, and Action-Specific Applicable or Relevant and Appropriate Requirements (ARARs) and To-Be-Considered (TBCs) Materials for Soil and Groundwater, Luke Air Force Base.

		storage/maintenance, and other controlled areas such as the flight line.	
Standard, Requirement, Criteria, Limitation	**Citation**	**Description**	**Comments**
Luke AFB Vehicle and Personnel Permits	General Air Force Instruction 13213; Luke-specific instruction 24301	Passes required for access to the base	Applicable on-site.
Floodplain Management	40 CFR § 6., Appendix A; ARS §§ 48-3609	Action must be taken to avoid adverse effects, minimize potential harm, restore and preserve natural and beneficial value.	Only RW-02 is within a designated floodplain.
Historical Landmarks and Archaeological Arfifacts	36 CFR § 6.30, ARS §§ 41-841 thru 41-847	Governs archaeological and historical discovery and preservation in the event that artifacts are uncovered	State law applies to state land and agency actions.

Table 3-62. Remedial Alternative Matrix for OU-1 PSCs, Luke Air Force Base, Arizona

	No Action	Institutional Controls	Asphalt Cap and Institutional Controls	Institutional Controls and Ex Situ Physical Treatment/Metals Recovery	Excavation and Off-Site Disposal	Excavation, Off-Site Incineration, and Disposal	Excavation, Off-Site Thermal/Chemical treatment, and Disposal	Excavtion, On-Site Thermal/Chemical Treatment, and Disposal	Excavation, On-Site Biological Treatment, nas Disposal	Excavation, On-Site Thermoplastic Solidification, and Reuse	In-Situ Soil Vapor Extraction	In-Situ Aerobic Biodegradation
PSC	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-`0	S-11	S-12
RW-01	x	**X**			x							
LF-03	x	**X**			x		x	x			x	x
FT-07E	x	**X**			x		x	x	x			
DP-13	x	**X**			x		x	x				
LF-14	x	**X**			x	x		x		x		
LF-25	x			**X**			x	x				
SD-38	x	**X**			x		x	x	x			
SS-42	x		x								**X**	x

"X" indicates that the Remediation Alternative is the recommended alternative.
To address the corresponding PSC
"x" indicates that the Remediation Alternative is selected as an alternative
under consideration at the corresponding PSC.

TABLE 3-63: Matrix Showing Chemical-Specific ARARs That Would Be Met and Action-, Location-Specific ARARs That Apply to Each of the Remedial Alternatives Evaluated in the OU-1 Feasibility Study

PBC Identification	Remedial Alternative		Are Chemical-Specific ARARs met by implementing This Remedial Alternative?				Do Location Specific ARARs Apply To This Remedial Alternative?			Do Action Specific ARARs Apply to this Remedial Alternative?												
			Site-Specific Industrial SRLs	Site-Specific Residential SRLs	USEPA MCLs	Arizona AWQS	Luke AFB Permits	Floodplain Management	Historical/ Archeol. Artifacts	Federal Clean Air Act	Arizona Clean Air Act	Facility Discharge Permits	County Air Pollution Control	Well Install Permits	OSHA Standards	State/Federal RCRA Requirements	Hazardous Waste Transport	Aquifer Protection Permit	Groundwater Withdraw Rights	Solid Waste Management	Radioactive Waste	TSD of PCB-Soils
RW-02	S-1	No Action	NA	NA	NA	NA	-	X	-	-	-	-	-	-	X	-	-	-	-	-	X	-
	S-2	**Institutional Controls**	**NA**	**NA**	**NA**	**NA**	**X**	**X**	**-**	**-**	**-**	**-**	**-**	**-**	**X**	**-**	**-**	**-**	**-**	**-**	**X**	**-**
	S-5	Excavation and Off-site Disposal	NA	NA	NA	NA	X	X	X	X	X	X	X	-	X	X	X	-	-	X	X	-
LF-03	S-1	No Action	YES	NO	YES	YES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	S-2	**Institutional Controls**	**YES**	**NO**	**YES**	**YES**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	S-7	Excavation, Off-site Thermal/Chemical Treatment, and Disposal	YES	YES	YES	YES	X	-	X	X	X	X	X	-	X	X	X	-	-	X	-	-
	S-8	Excavation, On-site Thermal/Chemical Treatment, and Disposal	YES	YES	YES	YES	X	-	X	X	X	X	X	-	X	X	X	-	-	X	-	-
FT-07E	S-1	No Action	YES	NO	YES	YES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	S-2	**Institutional Controls**	**YES**	**NO**	**YES**	**YES**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	S-5	Excavation and Off-site Disposal	YES	YES	YES	YES	X	-	X	X	X	X	X	-	X	X	-	-	-	X	-	-
	S-7	Excavation, Off-site Thermal/Chemical Treatment, and Disposal	YES	YES	YES	YES	X	-	X	X	X	X	X	-	X	X	-	-	-	X	-	-
	S-8	Excavation, On-site Thermal/Chemical Treatment, and Disposal	YES	YES	YES	YES	X	-	X	X	X	X	X	-	X	X	-	-	-	X	-	-
	S-9	Excavation, On-site Biological Treatment, and Disposal	YES	YES	YES	YES	X	-	X	X	X	X	X	-	X	X	-	-	-	X	-	-
	S-11	In-situ Soli Vapor Extraction	YES	YES	YES	YES	X	-	X	X	X	X	X	X	X	-	-	-	-	-	-	-
	S-12	In Situ Aerobic Biodegradation	YES	YES	YES	YES	X	-	X	X	X	X	X	X	X	-	-	-	-	-	-	-
DP-13	S-1	No Action	YES	NO	YES	YES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	S-2	**Institutional Controls**	**YES**	**NO**	**YES**	**YES**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**X**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	S-5	Excavation and Off-site Disposal	YES	YES	YES	YES	X	-	X	X	X	X	X	-	X	X	X	-	-	X	-	-
	S-7	Excavation, Off-site Thermal/Chemical Treatment, and Disposal	YES	YES	YES	YES	X	-	X	X	X	X	X	-	X	X	X	-	-	X	-	-
	S-8	Excavation, On-site Thermal/Chemical Treatment, and Disposal	YES	YES	YES	YES	X	-	X	X	X	X	X	-	X	X	X	-	-	X	-	-
LF-14	S-1	No Action	YES	NO	YES	YES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	S-2	**Institutional Controls**	**YES**	**NO**	**YES**	**YES**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**X**
	S-5	Excavation and Off-site Disposal	YES	YES	YES	YES	X	-	X	X	X	X	X	-	X	X	X	-	-	X	-	X
	S-6	Excavation, off-site incineration, and Off-site Disposal	YES	YES	YES	YES	X	-	X	X	X	X	X	-	X	X	X	-	-	X	-	X
	S-8	Excavation, On-site Thermal/Chemical Treatment, and Disposal	YES	YES	YES	YES	X	-	X	X	X	X	X	-	X	X	X	-	-	X	-	X
	S-10	Excavation, On-site Thermoplastic Solidification, and Reuse	YES	YES	YES	YES	X	-	X	X	X	X	X	-	X	X	-	-	-	X	-	X
LF-25	S-1	No Action	NO	NO	YES	YES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	S-2	**Institutional Controls**	**NO**	**NO**	**YES**	**YES**	**X**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**X**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	S-4	Institutional Controls and Ex-situ Physical Treatment/Metals Recovery	YES	YES	YES	YES	X	-	X	X	X	X	X	-	X	X	-	-	-	X	-	-
	S-7	Excavation, Off-site Thermal/Chemical Treatment, and Disposal	YES	YES	YES	YES	X	-	X	X	X	X	X	-	X	X	X	-	-	X	-	-
	S-8	Excavation, On-site Thermal/Chemical Treatment, and Disposal	YES	YES	YES	YES	X	-	X	X	X	X	X	-	X	X	X	-	-	X	-	-
SD-38	S-1	No Action	YES	NO	YES	YES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	S-2	**Institutional Controls**	**YES**	**NO**	**YES**	**YES**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	S-5	Excavation and Off-site Disposal	YES	YES	YES	YES	X	-	X	X	X	X	X	-	X	X	X	-	-	X	-	-
	S-7	Excavation, Off-site Thermal/Chemical Treatment, and Disposal	YES	YES	YES	YES	X	-	X	X	X	X	X	-	X	X	X	-	-	X	-	-
	S-8	Excavation, On-site Thermal/Chemical Treatment, and Disposal	YES	YES	YES	YES	X	-	X	X	X	X	X	-	X	X	X	-	-	X	-	-
	S-9	Excavation, On-site Biological Treatment, and Disposal	YES	YES	YES	YES	X	-	X	X	X	X	X	-	X	X	X	-	-	X	-	-
SD-42	S-1	No Action	YES	YES	NO	NO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	S-3	Asphalt Cap and Institutional Controls	YES	YES	YES	YES	X	-	X	X	X	X	X	-	-	-	-	X	-	-	-	-
	S-11	**In-situ Soli Vapor Extraction**	**YES**	**YES**	**YES**	**YES**	**X**	**-**	**X**	**X**	**X**	**X**	**X**	**X**	**-**	**-**	**-**	**X**	**-**	**-**	**-**	**-**
	S-12	In-situ Aerobic Biodegredation	YES	YES	YES	YES	X	-	X	X	X	X	X	X	-	-	-	X	-	-	-	-

NOTES:

ARAR	Applicable Relevant and Appropriat Requirement	NA	Not applicable for PSC and/or remedial alternative under evaluation
PSC	Potential Source of Contamination	X	ARAR applicable for PSC and/or remedial alternatives under evaluation
SRL	Soil Remediation level	-	ARAR not applicable for PSC and/or remedial alternatives under evaluation
MCL	Maximum Contaminant level	PCB	Polychlorinated biphenyls
S-11	**Bold text denotes selected remedial alternative for each PSC**	TSD	Treatment, Storage, or Disposal
AWQS	Aquifer Water Quality Standard		

TABLE 3-64
Cost Summary for the Selected Remedy
PSC RW-02
Luke Air Force Base, Phoenix, Arizona

Selected Remediation Alternative **S-2** **Institutional Controls**

Alternative Components:	**Quantity**	**Unit**	**Unit Cost**	**Capital Cost:**	**Annual Operating Cost:**
Fencing	80	lf	$ 36	$ 2,853	
Monitoring System Installation	20,000	LS	$ 1	$ 20,000	
Annual Monitoring ($/year)				$ -	$ 3,064
Land Use Restriction				$ -	
Contingencies				$ 13,992	
Project Management				$ 12,593	
Total				**$ 49,437**	**$ 3,064**
Project Duration				**30**	**year**
Present Worth*				**$ 96,543**	

Note: a sensitivity analysis was not done for this PSC. The volume of waste is based on documentation.
*Present worth values are based on 5% interest and no inflation or salvage value.
Modifications to Base Master Plan (BMP) imposing land use restrictions will be done in-house by Air Force environmental professionals and legal counsel, whose costs are not included in the cost estimate.
lf - linear foot
LS - Lump sum

TABLE 3-65
Cost Summary for the Selected Alternative
PSC LF-03
Luke Air Force Base, Phoenix, Arizona

Alternative Remediation Alternative:	**S-2**	**Institutional Controls**

Alternative Components:	**Quantity**	**Unit**	**Unit Cost**	**Cost:**
Land Use Restriction	1	LS	$ -	$ -
Total				$ -

Note:
Modifications to Base Master Plan (BMP) imposing land use restrictions will be done in-house by environmental professionals and legal counsel, whose costs are not included in the cost estimate.
LS - Lump sum

TABLE 3-66
Cost Summary for the Selected Alternative
PSC FT-07E
Luke Air Force Base, Phoenix, Arizona

Alternative Remediation Alternative:	**S-2**	**Institutional Controls**

Alternative Components:	**Quantity**	**Unit**	**Unit Cost**	**Cost:**
Land Use Restriction	1	LS	$ -	$ -
Total				$ -

Note:
Modifications to Base Master Plan (BMP) imposing land use restrictions will be done in-house by environmental professionals and legal counsel, whose costs are not included in the cost estimate.
LS - Lump sum

TABLE 3-67
Cost Summary for the Selected Alternative
PSC DP-13
Luke Air Force Base, Phoenix, Arizona

Alternative Remediation Alternative:	**S-2**	**Institutional Controls**

Alternative Components:	**Quantity**	**Unit**	**Unit Cost**	**Cost:**
Land Use Restriction	1	LS	$ -	$ -
Total				$ -

Note:
Modifications to Base Master Plan (BMP) imposing land use restrictions will be done in-house by environmental professionals and legal counsel, whose costs are not included in the cost estimate.
LS - Lump sum

TABLE 3-68
Cost Summary for the Selected Alternative
PSC LF-14
Luke Air Force Base, Phoenix, Arizona

Alternative Remediation Alternative:	**S-2**	**Institutional Controls**

Alternative Components:	**Quantity**	**Unit**	**Unit Cost**	**Cost:**
Land Use Restriction	1	LS	$ -	$ -
Total				$ -

Note:
Modifications to Base Master Plan (BMP) imposing land use restrictions will be done in-house by environmental professionals and legal counsel, whose costs are not included in the cost estimate.
LS - Lump sum

TABLE 3-69
Cost Summary for the Selected Alternative
PSC LF-25
Luke Air Force Base, Phoenix, Arizona

Alternative Remediation Alternative: **S-4** **Institutional Controls and Metals Recovery**

Alternative Components:	**Quantity**	**Unit**	**Unit Cost**	**Cost:**	**Minimum Cost**	**Maximum Cost**
Institutional Controls	1	LS	$ 3,000.00	$ 3,000	$ 3,000	$ 3,000
Excavation/Separation						
Mob/Demob	1	LS	$ 50,000	$ 5,000		
Excavation/Separation	112,255	Sq. Ft.	$ 0.21	$ 23,253		
				$ 28,253	$ 7,341	$ 508,368
Sampling and Analysis						
6000/7000 Series metal (total)	20	each	$ 145.00	$ 2,900		
6000/7000 series metals (TCLP)	20	each	$ 235.00	$ 4,700		
				$ 7,600	$ 765	$ 164,522
Contingencies				$ 7,771	$ 2,068	$ 102,274
Project Management				$ 6,994	$ 1,861	$ 92,046
Total				**$ 53,617**	**$ 15,326**	**$ 932,729**
Present Worth				**$ 53,617**	**$ 15,326**	**$ 932,729**

Note:
LS - Lump sum

TABLE 3-70
Cost Summary for the Selected Alternative
PSC SD-38
Luke Air Force Base, Phoenix, Arizona

Alternative Remediation Alternative:	**S-2**	**Institutional Controls**

Alternative Components:	**Quantity**	**Unit**	**Unit Cost**	**Cost:**
Land Use Restriction	1	LS	$ -	$ -
Total				$ -

Note:
Modifications to Base Master Plan (BMP) imposing land use restrictions will be done in-house by environmental professionals and legal counsel, whose costs are not included in the cost estimate.
LS - Lump sum

TABLE 3-71
Cost Summary for the Selected Alternative
PSC SS-42
Luke Air Force Base, Phoenix, Arizona

Alternative Remediation Alternative:	**S-4**	**Institutional Controls and Metals Recovery**

Alternative Components:	**Quantity**	**Unit**	**Unit Cost**		**Cost:**		**Minimum Cost**		**Maximum Cost**
Well Installation									
2" PVC Schedule 40, well casing	50	LF	6	$	293				
2" PVC Schedule 40, well screen	50	LF	12	$	579				
Mud drilling, 6" diameter borehole	300	LF	24	$	7,107				
				$	10,610	$	10,610	$	10,610
System Installation				$	67,896	$	67,896	$	67,896
0 SCFM Vapor Extraction Blower/Controls	1	LS	6,000	$	6,000				
Knockout drum	1	LS	53	$	53				
Install/assemble rental blower	4	day	400	$	1,600				
4" PVC schedule 40 piping manifold	30	LF	8	$	243				
Catalytic Oxidizer	1	LS	60,000	$	60,000				
				$	67,896	$	67,896	$	67,896
Treatment (5 years)	5	year	8,880	$	38,446	$	38,446	$	38,446
Sampling and Analysis (5 years)	5	year	24,938	$	107,968	$	66,375	$	129,562
System Dissembly									
Well abandonment and System breakdown	1	LS	3,429	$	3,429				
Hollow-stem auger, 8" o.d. for 2" well	350	LF	26	$	9,211				
				$	12,639	$	12,639	$	12,639
Groundwater Monitoring (5 years)	5	years	20,133	$	87,165	$	83,702	$	90,629
Contingencies				$	64,945	$	59,933	$	69,956
Project Management				$	58,450	$	53,940	$	62,961
Total				**$**	**448,120**	**$**	**413,641**	**$**	**482,699**
Present Worth				**$**	**448,120**	**$**	**413,6-+41**	**$**	**482,699**

Note:
*Present worth values are based on 5% interest and no inflation ar salvage value.
LF - linear foot
LS - Lump sum

APPENDIX A

LOCATION OF INFORMATION REPOSITORIES

LOCATIONS OF INFORMATION REPOSITORIES

The information repositories listed below have been chosen for their proximity and accessibility to the affected publics, hours of operation, and facilities for the handicapped.

The Glendale Public Library	Hours:	
5959 West Brown Avenue	Monday - Thursday	9 a.m. to 9 p.m.
Glendale, AZ 85302	Friday and Saturday	9 a.m. to 9 p.m.
Telephone: (602)435-4900		

Luke AFB Library	Hours:	
Building 700	Monday - Thursday	9 a.m. to 8 p.m.
Like AFB, AZ 85309	Friday	9 a.m. to 5 p.m.
Telephone: (602) 856-7191	Saturday and Sunday	11 a.m. to 2 p.m.

Peoria Public Library	Hours:	
8463 West Monroe Avenue	Monday - Wednesday	10 a.m. to 9 p.m.
Peoria, AZ 85340	Thursday - Saturday	10 a.m. to 6 p.m.
Telephone: (602) 412-7556	Sunday	1 p.m. to 5 p.m.

APPENDIX B

CONSENSUS STATEMENT AMONG THE LUKE AFB NPL FEDERAL FACILITY AGREEMENT PROJECT MANAGERS

CONSENSUS STATEMENT AMONG THE LUKE AIR FORCE BASE
NPL FEDERAL FACILITY AGREEMENT PROJECT MANAGERS

Pursuant to the Luke Air Force Base National Priorities List (NPL) Federal Facility Agreement (FPA) under CERCLA Section 120 (EPA Administrative Docket Number 90-20), the Project managers agree no further remedial investigations are needed at the following Areas of Concern (AOC), 1) OT-1 Old Incinerator Site; 2) OT-08 F-15 Burial Site; OT-09 Canberra Burial Site; and OT-10 which is a subset of and wholly contained in DP-13 Outboard Runway Landfill. This will formalizes the intent of the Project managers as indicated in the Project Manager Meeting Minutes of July 24, 1990 and August 21, 1990.

The Project managers also agree no further remedial investigations are needed at the following Areas of Concern: 1) SS-15 Facility 328 Spill Site; 2) SS-14 Facility 321 UST's Storage: 3) ST-19 BX Leaking UST's; and 4) DP-24 Base Arnmo Storage Area. This formalizes the intent of the Air Force, as stated in the Project Manager Meeting Minutes of October 11, 1990, to remove SS-15, SS-16, and ST-19 from the NPL process and place them under the jurisdiction of the State of Arizona Underground Storage Tank Program for any and all remedial activities. In addition, DP-24 was identified as a clerical error that occurred in the compilation of the list of PSC's. It is agreed to strike DP-24 from Attachment A Section A of the FFA and included DP-24 in Attachment A Section B of the FFA.

It is further agreed that the findings to support no further investigations will be documented in the in the remedial investigation report and noted in the applicable Operable Unit Record of Decision (ROD).

In addition to the above agreement the Project managers concur to strike PSC's SS-11 Former Outside Transformer Storage and SD-21 Sewage Treatment Plant Effluent Canal from Attachment A Section B of the FFA and included SS-11 and SD-21 in Attachment A Section A of the FFA. These two PSC's are continuing to be investigated under the NPL program. The amendments will ensure consistence between the FFA and documents in the Administrative Record File.

The signatures of the Project Managers below shall constitute approval of this Consensus Statement. This Consensus Statement may be executed and delivered in any number of counterparts, each of which when executed and delivered shall be deemed to be an original, but such counterparts shall together constitute one and the same document.

5-19-93

JEFF ROTHROCK
Luke AFB

~~WILLIAM LOPP~~ Michelle Schutz
EPA, Region IX

TIM STEELE
AZ Dept of Environmental Quality

4 Aug-93

DAVID ANNIS
AZ Dept of Water Resources

APPENDIX C

NOTICE OF VOLUNTARY ENVIRONMENTAL MITIGATION USE RESTRICTION

When recorded, mail to:

NOTICE OF VOLUNTARY ENVIRONMENTAL MITIGATION USE RESTRICTION BY OWNER(S)

Pursuant to A.R.S.§49-152(B), the owner(s)
____of the following described property:
(Please Print)

(Insert legal description of entire parcel)

has (have) remediated a portion of the above-described property, which remediated portion is described as follows:

(Insert legal description of remediated portion, the source of the release, and the remaining contaminants)

The date when the remediation was completed is:____

The undersigned owner voluntarily agrees to limit and restrict the use of the remediated portion of the property to non-residential uses, as defined in A.R.S. §49-151(A).

No property rights, including, in particular, any restrictive covenants, are being created in favor of or behalf of the state or any other party, by filing of the voluntary environmental mitigation use restriction (VEMUR) notice.

Any formal restrictive covenants which may be necessary due to the property transfer will be filed separately, with the federal government as the owner of the dominant estate.

The state's approval of the VEMUR notice is to verify the propriety of the format of the notification, and the accuracy of the assertion that the cleanup conducted is protective for non-residential use.

Approved:

____
Signature of owner(s)

____
(ADEQ official)

STATE OF ARIZONA

County of _________________

This instrument was acknowledged before me this _______ day of _____________, ____
by_________________________

____
Notary Public

My commission expires: __________

____
Signature of owner(s)

STATE OF ARIZONA

County of _________________

This instrument was acknowledged before me this _______ day of _____________, _______
by _______________________________________

____
Notary Public

My commission expires: _____________

Please make no marks below this line

When recorded, mail to:

CANCELLATION OF VOLUNTARY ENVIRONMENTAL MITIGATION USE RESTRICTION BY OWNER(S)

Pursuant to A.R.S. §49-152(B), the owner(s)
____ of the following described property:
(Please Print)

(insert legal description of entire parcel)

recorded a Notice of Voluntary Mitigation Use Restriction By Owner(s) in the Office of the County Recorder of ____________ County, Arizona on the _____ day of ________, ____ in Document/Docket _______ at Page ______, affecting the following portion of the above-described property:

(insert legal description of remediated portion)

The undersigned owner(s) has (have) remediated the above-described portion of the property pursuant to the levels prescribed in A.R.S. §49-152(C). Accordingly the above-described property may now be used for any lawful purpose. The date when the remediation was completed is:

____.

________________________________ ________________________________
Signature of owner(s) Signature of owner(s)

Pursuant to A.R.S. §49-152(C), the undersigned hereby cancel(s) the above-described notice and declare(s) said notice to be of no further force and effect as of this _______ day of _________, _____

The state's approval of the Cancellation of VEMUR notice is to verify the propriety of the format of the notification, and the accuracy of the assertion that the cleanup conducted is protective for residential uses.

____
(ADEQ official)

STATE OF ARIZONA

County of ________________

This instrument was acknowledged before me this _______ day of ______________, _______

____

by ________________________________

____
Notary Public

My commission expires: ________________

STATE OF ARIZONA

County of ________________

This instrument was acknowledged before me this _______ day of ______________, _______

____

by ________________________________

____
Notary Public

My commission expires: ________________

Please make no marks below this line

APPENDIX D

AIR FORCE FORM 332

BASE CIVIL ENGINEER WORK REQUEST *(See Reverse for Instructions)*	Form Approved OMB No. 0704-0188

SECTION I - TO BE COMPLETED BY REQUESTER

1. FROM *(Organization)*	2. OFFICE SYMBOL	3. DATE OF REQUEST	4. WORK REQUEST NO. *(For BCE Use)*

5. NAME AND PHONE NO. OF REQUESTER	6. REQUIRED COMPLETION DATE	7. BUILDING, FACILITY OR STREET ADDRESS WHERE WORK IS TO BE ACCOMPLISHED 1132

8. DESCRIPTION OF WORK TO BE ACCOMPLISHED *(Include Sketch or Plan, when appropriate)*

9. BRIEF JUSTIFICATION FOR WORK TO BE ACCOMPLISHED *(Not required for maintenance and repair)*

10. DONATED RESOURCES NONE

								X	
	FUNDS		LABOR		MATERIAL		CONTRACT BY REQUESTER	X	NONE

11. NAME OF REQUESTER	12. GRADE OF REQUESTER	13. SIGNATURE OF REQUESTER *(See Reverse of Form)*

14. COORDINATION

SECTION II - FOR BASE CIVIL ENGINEER USE

15. WORK ORDER *(Place an "X" in the appropriate box.)*

	IN-SERVICE		SELF-HELP		CONTRACT		SABER

16. DIRECT SCHEDULED WORK *(Place an "X" in the appropriate box.)*

	EMERGENCY		URGENT		ROUTINE		SELF-HELP		M/C

17. SELF-HELP *(Place an "X" in the appropriate box.)*

	BRIEFING REQUIRED		ADEQUATE COORDINATION		INSPECTION REQUIRED

SECTION III - COMPLETE ONLY IF WORK IS TO BE ACCOMPLISHED BY WORK ORDER

18. WORK CLASS	19. PRIORITY	20. ESTIMATED HOURS	21. ESTIMATED FUNDED COST	22. ESTIMATED TOTAL COST

	23. THERE IS NO NEED FOR AN ENVIRONMENTAL ASSESSMENT (AFR 19-2)		24. A WRITTEN ASSESSMENT IS BEING/HAS BEEN PROCESSED		25. APPROVED		26. DISAPPROVED

27. REMARKS

SECTION IV - APPROVING AUTHORITY

28. NAME AND GRADE *(Please Type or Print)*	29. SIGNATURE	30. DATE

BASE CIVIL ENGINEER WORK REQUEST

(See Reverse for Instructions)

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average .3 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to the Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project 0704-0188, Washington DC 20503. Please DO NOT RETURN your form to either of these addresses. Send your completed form to HQ AFESC/DEMG.

SECTION I - TO BE COMPLETED BY REQUESTER

1. FROM *(Organization)*	2. OFFICE SYMBOL	3. DATE OF REQUEST	4. WORK REQUEST NO. *(For BCE Use)*

5. NAME AND PHONE NO. OF REQUESTER	6. REQUIRED COMPLETION DATE	7. BUILDING, FACILITY OR STREET ADDRESS WHERE WORK IS TO BE ACCOMPLISHED
		1132

8. DESCRIPTION OF WORK TO BE ACCOMPLISHED *(Include Sketch or Plan, when appropriate)*

9. BRIEF JUSTIFICATION FOR WORK TO BE ACCOMPLISHED *(Not required for maintenance and repair)*

10. DONATED RESOURCES NONE

	FUNDS		LABOR		MATERIAL		CONTRACT BY REQUESTER	X	NONE

11. NAME OF REQUESTER	12. GRADE OF REQUESTER	13. SIGNATURE OF REQUESTER *(See Reverse of Form)*

14. COORDINATION

SECTION II - FOR BASE CIVIL ENGINEER USE

15. WORK ORDER *(Place an "X" in the appropriate box.)*

	IN-SERVICE		SELF-HELP		CONTRACT		SABER

16. DIRECT SCHEDULED WORK *(Place an "X" in the appropriate box.)*

	EMERGENCY		URGENT		ROUTINE		SELF-HELP		M/C

17. SELF-HELP *(Place an "X" in the appropriate box.)*

	BRIEFING REQUIRED		ADEQUATE COORDINATION		INSPECTION REQUIRED

SECTION III - COMPLETE ONLY IF WORK IS TO BE ACCOMPLISHED BY WORK ORDER

18. WORK CLASS	19. PRIORITY	20. ESTIMATED HOURS	21. ESTIMATED FUNDED COST	22. ESTIMATED TOTAL COST

	23. THERE IS NO NEED FOR AN ENVIRONMENTAL ASSESSMENT (AFR 19-2)		24. A WRITTEN ASSESSMENT IS BEING/HAS BEEN PROCESSED		25. APPROVED		26. DISAPPROVED

27. REMARKS

SECTION IV - APPROVING AUTHORITY

28. NAME AND GRADE *(Please Type or Print)*	29. SIGNATURE	30. DATE

BASE CIVIL ENGINEER WORK REQUEST *(See Reverse for Instructions)*	Form Approved OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average .3 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to the Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project 0704-0188, Washington DC 20503. Please DO NOT RETURN your form to either of these addresses. Send your completed form to HQ AFESC/DEMG.

SECTION I - TO BE COMPLETED BY REQUESTER

1. FROM *(Organization)*	2. OFFICE SYMBOL	3. DATE OF REQUEST	4. WORK REQUEST NO. *(For BCE Use)*

5. NAME AND PHONE NO. OF REQUESTER	6. REQUIRED COMPLETION DATE	7. BUILDING, FACILITY OR STREET ADDRESS WHERE WORK IS TO BE ACCOMPLISHED 1132

8. DESCRIPTION OF WORK TO BE ACCOMPLISHED *(Include Sketch or Plan, when appropriate)*

9. BRIEF JUSTIFICATION FOR WORK TO BE ACCOMPLISHED *(Not required for maintenance and repair)*

10. DONATED RESOURCES NONE

	FUNDS		LABOR		MATERIAL		CONTRACT BY REQUESTER	X	NONE

11. NAME OF REQUESTER	12. GRADE OF REQUESTER	13. SIGNATURE OF REQUESTER *(See Reverse of Form)*

14. COORDINATION

SECTION II - FOR BASE CIVIL ENGINEER USE

15. WORK ORDER *(Place an "X" in the appropriate box.)*

	IN-SERVICE		SELF-HELP		CONTRACT		SABER

16. DIRECT SCHEDULED WORK *(Place an "X" in the appropriate box.)*

	EMERGENCY		URGENT		ROUTINE		SELF-HELP		M/C

17. SELF-HELP *(Place an "X" in the appropriate box.)*

	BRIEFING REQUIRED		ADEQUATE COORDINATION		INSPECTION REQUIRED

SECTION III - COMPLETE ONLY IF WORK IS TO BE ACCOMPLISHED BY WORK ORDER

18. WORK CLASS	19. PRIORITY	20. ESTIMATED HOURS	21. ESTIMATED FUNDED COST	22. ESTIMATED TOTAL COST

	23. THERE IS NO NEED FOR AN ENVIRONMENTAL ASSESSMENT (AFR 19-2)		24. A WRITTEN ASSESSMENT IS BEING/HAS BEEN PROCESSED		25. APPROVED		26. DISAPPROVED

27. REMARKS

SECTION IV - APPROVING AUTHORITY

28. NAME AND GRADE *(Please Type or Print)*	29. SIGNATURE	30. DATE

<u>APPENDIX E</u>

AIR FORCE FORM 103

BASE CIVIL ENGINEERING WORK CLEARANCE REQUEST

DATE PREPARED

Clearance is requested to proceed with work at ______________________________

on Work Order/Job No. ______________, Contract No. ________________, involving excavation or utility disturbance per attached sketch. The area involved ☐ Has ☐ Has not been staked or clearly marked.

TYPE OF FACILITY/WORK INVOLVED

A. PAVEMENTS	B. DRAINAGE SYSTEMS	C. RAILROAD TRACKS	D. FIRE DETECTION AND PROTECTION SYSTEMS	E. UTILITY ☐ OVERHEAD ☐ UNDERGROUND
F. COMM. ☐ OVERHEAD ☐ UNDERGROUND	G. AIRCRAFT OR VEHICULAR TRAFFIC FLOW	H. SECURITY	I. OTHER *(Specify)*	

INSTRUCTIONS: The BCE work clearance request is used for any work (contract or in house) that may disrupt aircraft or vehicular traffic flow, base utility services, protection provided by fire and intrusion alarm system, or routine activities of the installation. This form is used to coordinate the required work with key base activities and keep customer inconvenience to a minimum. It is also used to identify potentially hazardous work conditions in an attempt to prevent accidents. The work clearance request is processed just prior to the start of work. If delays are encountered and the conditions at the job site change (or may have changed) this work clearance request must be reprocessed.

DATE CLEARANCE REQUIRED	5. DATE CLEARANCE TERMINATED

REQUESTING OFFICIAL *(Signature)*	7. PHONE NO.	8. ORGANIZATION

CLEARANCE REVIEW

ORGANIZATION	REMARKS	REVIEWER'S NAME AND INITIALS
9. A. ELECTRICAL DISTRIBUTION		
B. STEAM DISTRIBUTION		
C. WATER DISTRIBUTION		
D. POL DISTRIBUTION		
E. SEWER LINES		
F. DRAINAGE SYSTEMS		
G. PAVEMENTS, GROUNDS, RAILROADS		
H. FIRE DEPARTMENT		
I. ENGINEERING & ENVIRONMENTAL PLANNING		
J. CATHODIC PROTECTION		
K. OTHER		
SECURITY POLICE		
SAFETY		
COMMUNICATIONS		
BASE OPERATIONS		
COMMERCIAL UTILITY COMPANY *(Telephone, Gas, Electrical, etc.)*		
OTHER *(Specify)*		

FORM 103 JUL 82 PREVIOUS EDITION WILL BE USED.

APPENDIX F

PRE-ROD SIGNIFICANT CHANGES

PRE-ROD SIGNIFICANT CHANGES

After the public comment period ends, a final remedial alternative is selected for adoption in the ROD. The remedy is selected based on the analysis of comments provided by the public and support agencies on the Proposed Plan and the RI/FS reports, as well as any other new and significant information received or generated. The lead agency may re-evaluate the preferred alternative in light of this information and may change a component of the preferred remedy or choose to implement a remedy other than the preferred alternative.

If a change is made, according to CERCLA section117(b), the lead agency must determine whether the modifications are "significant." When a lead agency makes a significant change, these changes must be explained in the ROD. This appendix presents an explanation of the significant changes between the proposed and final remedial alternatives selected for implementation at OU-1 of Luke AFB. This appendix presents the general framework used for categorizing significant changes made to the proposed alternatives after they were issued for public comment. Documentation and notification activities that are required to communicate these changes are also specified. Finally, a detailed explanation and summary of the changes are presented.

CATEGORIE5 OF SIGNIFICANT CHANGE

According to USEPA guidance (USEPA, 1989a), modifying a selected alternative or changing from the preferred alternative to another alternative are examples of significant changes. Once it has been determined that a significant change is necessary, the lead agency should decide whether the change warrants only documentation in the ROD or additional public comment. To make this assessment, the lead agency decides which of two categories the significant change belongs: (1) changes that are a logical outgrowth of the information and analysis already presented to the public; or (2) changes that the public could not have reasonably anticipated, based on information available during the public comment period. If the lead agency determines that the significant changes are a logical outgrowth, the changes should be documented in the ROD Decision Summary. In those limited situations in which the public could not have reasonably anticipated the changes, the lead agency should issue a revised Proposed Plan for public comment.

Significant Changes that are Considered Logical Outgrowths of Information Available to the Public

In analyzing significant changes, three broad scenarios of changes are likely to be classified as logical outgrowths of the information on which the public had the opportunity to comment. The significant changes in each of these scenarios would only have to be explained in the ROD; additional public, comment is not necessary. The three scenarios are as follows:

(1) A Change to a Comment of the Selected Alternative. The lead agency may make a change to a component of the selected remedy (e.g., a change in cost, timing, level of performance, or ARARs) that may result in a significant alteration to the scope, performance, or cost of the remedy, while the overall waste management approach represented by the alternative remains the same. If the significant change to a component of the alternative could have been reasonably anticipated by the public, taking into consideration inherent uncertainties associated with the waste management/engineering process, the lead agency need only document the significant change in the ROD Decision Summary.

(2) Selection of a Remedy Other that the one Selected in the Proposed Plan. The lead agency may determine, based on information received during the comment period that the preferred alternative in the Proposed Plan no longer provides the most appropriate balance of tradeoffs among the alternatives with respect to the evaluation criteria. Information available to the lead agency may suggest that another alternative from the Proposed Plan provides the best balance of tradeoffs, and the lead agency may select the other alternative. Such a change requires only documentation in the ROD because the public has been apprised previously that another alternative might be selected as the remedy; thus, the public had adequate opportunity to review and comment on it.

(3) Combining Components of Alternatives. In some instances, Proposed Plans may recommend two or more alternatives (or a combination of alternatives) for addressing different pathways at a site. For example, two alternatives could be developed for a site, one to address contaminated soils and another to remediate the groundwater. If the lead agency chooses to retain the preferred alternative for the groundwater, but rejects the preferred soil remediation alternative and chooses a different alternative form among those presented in the Proposed Plan, the new selection would be considered a logical outgrowth of the information on which the public already had the opportunity comment. In this instance, a new comment period would not be required. The change, however, must be documenting within the ROD Decision Summary along with the reasons for the change.

Significant Changes that are not Considered Logical Outgrowths of Information Available to the Public

Changes that are not logical outgrowths of the information presented in the Proposed Plan should be documented by the lead agency in a revised Proposed Plan and a new public comment period should be held. When issuing a revised Proposed Plan to document a significant change that was not a logical outgrowth, the revised document should be prepared in accordance with the requirements of bother CERCLA section 117 and the NCP. Two changes that require additional public comment are listed below.

(1) Selection of a New Alternative that was Not Previously Analyzed. The lead agency may determine that an alternative that was not presented in the Proposed Plan or detailed analysis phase of the FS report should be selected as the remedy. In this case, the public could not have reasonably anticipated the lead agency making such a selection; therefore, the lead agency should issue a revised Proposed Plan presenting the new preferred alternative and provide appropriate supporting information for public comment.

(2) Significant Change to a Component of the Selected Alternative. A change to a component of the selected alternative requires additional public comment if making the change will radically alter the overall remedy with regards to its scope, performance, or cost in a manner that the public could not have reasonably anticipated. Such changes could radically alter the volume of waste managed or the physical scope of action, as estimated in the Proposed Plan.

SIGNIFICANT CHANGES TO THE SELECTED ALTERNATIVES FOR OU-1 AT LUKE AFB

Remedial Alternative S-4 (institutional controls and ex-situ physical treatment/metals recovery) was selected for implementation at PSC LF-25. Remedial Alternative S-4 (as presented in this ROD) differs slightly from the version presented in the OU-1 FS and OU-1 Proposed Plan. There are two main differences between this version and the previous one. First, as a protective measure, Remedial Alternative S-4 now requires that a shot recovery process be performed prior to the closure of the skeet range. Secondly, procedures which restrict future land uses of the site to non-residential purposes will now be implemented as part of Remedial Alternative S-4.

Originally, Remedial Alternative S-4 called for the establishment of institutional controls prior to conducting the shot recovery process. Following closure of the skeet range (at an undetermined point in the future), a shot recovery process would be conducted to clean the site to conditions acceptable for unrestricted land use. Because the site would meet residential standards at that time and the source of the impact would no longer be present, a land use restriction would not be required. Additionally, the previously imposed institutional controls would no longer be needed after the site cleanup.

Remedial Alternative S-4 now calls for conducting the shot recovery process prior to the closure of the skeet range. This is a highly protective measure designed to immediately minimize any potential threat to human health that could result from exposure to the accumulated metals. Because the skeet range will remain open and will continue to impact the site in the future, Remedial Alternative S-4 now requires implementation of institutional controls after the cleanup process is complete. Although the extent and magnitude of the potential future impact can not be defined, it is conservatively assumed that it may be such that it could limit potential land uses of the site. As a result, Remedial Alternative S-4 now requires a land use restriction, as well as other institutional controls, to limit future exposure to the site.

SUMMARY

A significant change has occurred with Remedial Alternative S-4, which was selected for implementation at PSC LF-25. There are two main differences between Remedial Alternative S-4 (as presented in this ROD) and the original alternative presented in the OU-1 FS and OU-1 Proposed Plan. First, as a protective measure, Remedial Alternative S-4 now requires that a shot recovery process be performed prior to the closure of the skeet range. Secondly, procedures which restrict future land uses of the site to non-residential purposes will now be implemented as part of Remedial Alternative S-4.

Based on USEPA guidance (USEPA, 1989a), the USAF has determined that this significant Pre-ROD change could have been a logical outgrowth of the information already available to the public. The overall waste management approach remains the same as the alternative presented in the Proposed Plan. The changes with Remedial Alternative S-4 only pertain to the timing of the implementation of metals recovery process and the establishment of institutional controls.

Because the changes to the selected alternatives could have been reasonably anticipated by the public, a new Proposed Plan and additional public comment are not required. However, as per CERCLA requirements, these changes have been documented in the OU-1 ROD.

Site specific depth to groundwater (97.5 meters), distance to the compliance point (12 meters), and depth of incorporation (55 meters) were incorporated into the model. All other input parameters were the same as those used by the ADEQ in the default model which was used to develop the "Alternative GPL" graphs. These default input parameters were determined "reasonable" by the Working Group to establish a vadose zone base-case scenario.

After establishing model input parameters, GPLs were calculated for each of the BTEX compounds. Modeling results are summarized in Table 5. Model output data are provided in Attachments A through D.

The GPL calculated for benzene was 154,100 mg/kg (milligrams per kilogram). Modeling results for toluene, ethylbenzene, and xylenes resulted in the GPL calculation exceeding 100% saturation. The resultant model output denotes "Groundwater Not Threatened (GW NT)" when the GPL value is beyond the model's capacity to yield a theoretical concentration.

As shown in Table 5 and in Attachments A through D, several model runs were conducted using varying depths of incorporation and varying depths to groundwater. These additional runs were conducted so that GPLs could be established for a variety of potential site conditions in the event confirmation sampling at PSC SS-42 yields a different depth of incorporation and depth to groundwater than indicated by previously collected site characterization data. The results of the additional modeling runs are summarized below.

- GPLs calculated for benzene ranged from 8,685 mg/kg (55m depth of incorporation and 90m depth to groundwater) to 400,600 mg/kg (55m depth of incorporation and 100m depth to groundwater).

- GPLs calculated for the ethylbenzene ranged from 679 mg/kg (55m depth of incorporation and 70m depth to groundwater) to GWNT at variable depths.

- GPLs calculated for toluene ranged from 35,310 mg/kg (55m depth of incorporation and 70m depth to groundwater) to GWNT at variable depths.

- GPLs calculated for xylenes ranged from 23,580 mg/kg (55m depth of incorporation and 70m depth to groundwater) to GWNT at variable depths.

APPENDIX G

GROUNDWATER PROTECTION LIMITS FOR PSC SS-42

GROUNDWATER PROTECTION LIMITS FOR PSC SS-42

INTRODUCTION

Arizona's Soil Remediation Standards requires soil cleanup continue until contaminants remaining in the soil do not cause or threaten to cause a violation of Aquifer Water Quality Standards (AWQS) at a point of compliance. Fortunately, the ADEQ developed a screening model for use in determining whether a soil cleanup level adequately protects groundwater. The screening model was presented in “A Screening Method to Determine Soil Concentrations Protective of Groundwater Quality,” (ADEQ, 1996). This ADEQ screening model was used to calculate Groundwater Protection Limits (GPLS) for PSC SS-42.

The ADEQ's screening model contains three options for determining GPLs. As an initial screening step, the organic chemical compounds detected at a site can be compared with a “short list” of compounds with limited mobility in the subsurface. If the contaminants detected at a site are on the “short list”, the threat to groundwater from that compound is considered negligible and the pre-determined soil remediation levels (SRLs) or site-specific risk based cleanup levels can serve as the cleanup standard. For other organic compounds, “Minimum GPLs” are provided. The “Minimum GPLs” are based on a worst-case scenario (where the whole soil profile is contaminated from surface to groundwater). The “Minimum GPL” can be selected as the soil remediation level without detailed site-specific information.

The second screening step requires that the site-specific depth to groundwater and the vertical extent of contamination in the vadose zone be determined. This data is then compared to graphs developed by the ADEQ which provide “Alternative GPLs”. The graphs show “Alternative GPLs” based on the depth to groundwater and the maximum vertical extent of soil contamination (depth of incorporation). “Alternative GPLs” represent the maximum contaminant concentration that can remain in soil without threatening to cause groundwater contamination above the relevant AWQS at a default point-of-compliance.

The third option provided in the ADEQ screening model allows for the determination of a GPL based on site-specific characteristics. This option entails collecting and documenting site-specific data and calculation a soil cleanup level using a vadose and saturated zone contaminant fate-and-transport model. Although use of the ADEQ model is not required, it is recommended. If other contaminant fate-and-transport models are selected for use they must be pre-approved by the ADEQ.

BACKGROUND AND SITE-SPECIFIC DATA

As detailed in Section 3.6.1.4 of the OU-1 ROD, vadose zone fate-and-transport modeling was previously conducted at PSC SS-42 during the OU-1 remedial investigation. Results of this modeling indicate that petroleum related compounds (i.e. TPH and BTEX) could eventually leach to the groundwater. However, the vadose zone modeling results conducted as part of the OU-1 remedial investigation did not predict whether these petroleum related compounds could threaten to cause a violation of the AWQS at a point of compliance. As a result, GPLs have not been previously established for PSC SS-42.

Although previous fate-and-transport modeling has shown that petroleum related contaminants (TPH and BTEX) could eventually leach to the groundwater, GPLs can not be calculated for TPH. GPLs could not be calculated for TPH because there are no numeric water quality standards established for T?H. Additionally, TPH represents a broad class of petroleum related compounds and not just one specific constituent. GPLs can only be calculated for individual constituents with AWQSs. Of the petroleum related constituents with established AWQSs detected at PSC SS-42, BTFX compounds posed the greatest potential risk to human health. GPLs calculated for BTEX are, therefore, considered representative values established for the protection of groundwater from the petroleum release at PSC SS-42.

Other site-specific data of importance needed to calculate GPLs for SS-42 include the point of compliance, depth to groundwater, and depth of incorporation. The site boundaries were identified as the point of compliance for PSC SS-42. The minimum distance between the site boundaries and the point of the release at SS-42 is 40 feet (12 meters). Site-specific data collected during the OU-1 remedial investigation indicates that the depth to groundwater at PSC SS-42 is approximately 310 feet bgs (97.5 meters). Additionally, the deepest detection of BTEX compounds (depth of incorporation) have been determined to be 180 feet bgs (55 meters).

DETERMINATION OF GROUNDWATER PROTECTION LIMITS FOR PSC SS-42

STEP 1: Initial Screening and Comparison to Minimum GPLs

As an initial screening step, organic chemical compounds of interest at a site are compared to a "short list" of soil contaminants with limited mobility in the vadose zone. The "short list, of soil contaminants with limited mobility in the vadose zone include: Chlordane, Heptachlor, Heptachlor Epoxide, Methoxychlor, Polychlorinated Biphenyls, and Toxaphene. Because the organic chemical compounds of concern at PSC SS42 (BTEX) are not on the "short list," additional evaluation was necessary and the second part of Step 1 was conducted.

The second part of Step 1 involved comparing the BTEX concentrations detected at PSC SS-42 to “Minimum GPLs” developed by the ADEQ. The “Minimum GPLs” represent soil concentrations protective of groundwater quality in a worst-case scenario where the whole soil profile is contaminated from surface to groundwater. “Minimum GPLs” for BTEX are listed on Table 3-60 of the Luke AFB OU-1 ROD. Comparison of site specific data collected during the OU-1 remedial investigation of PSC SS-42 to the “Minimum GPLs” indicates that the detected concentrations of BTEX exceed the “Minimum GPLs.” Therefore, additional evaluation was required and Step 2 of the ADEQ model was conducted to determine GPLs for PSC SS-42.

STEP 2: Alternative GPL Determination

Step 2 can only be used if the site is adequately characterized for depth to groundwater and maximum vertical extent of soil of contamination. Because PSC SS-42 was adequately characterized as part of the OU-1 remedial investigation, Step 2 could be used to determine GPLs. As previously described, the site-specific depth to groundwater has been identified as 97.5 meters and the depth of incorporation has been defined as 55 meters.

Base on numerous model runs, the ADEQ developed a series of graphs for common organic contaminants (BTEX, TCE, and PCE). From these graphs an “Alternative GPL” can be determined based on the site-specific depth to groundwater and the depth of contaminant incorporation. A default point of compliance (33 meters) from the point of the release was used in the model calculations. If the concentration of a contaminant at the site is below the “Alternative GPL” determined from the graph, the soil contaminant concentration is considered protective of groundwater.

The graphs of “Alternative GPLs” developed by the ADEQ for BTEX are included as Tables 1 through 4. As shown on Tables 1 though 4, the “Alternative GPL” values developed by the ADEQ were limited to a depth of incorporation of 50 meters. Unfortunately, site specific data for PSC SS42 indicates that the depth incorporation for BTEX of 55 meters. Therefore, GPLs could not be determined for PSC SS-42 using Step 2 of the ADEQ screening model.

STEP 3: Site Specific Modeling

As a consequence of the limited depth of incorporation range presented in the ADEQ “Alternative GPL” tables (Tables 1 through 4), a site-specific model had to be used to determine GPLs for PSC SS-42. The ADEQ screening model was selected for use in this evaluation.

BASE CIVIL ENGINEER WORK REQUEST *(See Reverse for Instructions)*	Form Approved OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average .3 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to the Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project 0704-0188, Washington DC 20503. Please DO NOT RETURN your form to either of these addresses. Send your completed form to HQ AFESC/DEMG.

SECTION I - TO BE COMPLETED BY REQUESTER

1. FROM *(Organization)*	2. OFFICE SYMBOL	3. DATE OF REQUEST	4. WORK REQUEST NO. *(For BCE Use)*
5. NAME AND PHONE NO. OF REQUESTER		6. REQUIRED COMPLETION DATE	7. BUILDING, FACILITY OR STREET ADDRESS WHERE WORK IS TO BE ACCOMPLISHED 1132

8. DESCRIPTION OF WORK TO BE ACCOMPLISHED *(Include Sketch or Plan, when appropriate)*

9. BRIEF JUSTIFICATION FOR WORK TO BE ACCOMPLISHED *(Not required for maintenance and repair)*

10. DONATED RESOURCES NONE

	FUNDS		LABOR		MATERIAL		CONTRACT BY REQUESTER	X	NONE

11. NAME OF REQUESTER	12. GRADE OF REQUESTER	13. SIGNATURE OF REQUESTER *(See Reverse of Form)*

14. COORDINATION

SECTION II - FOR BASE CIVIL ENGINEER USE

15. WORK ORDER *(Place an "X" in the appropriate box.)*

	IN-SERVICE		SELF-HELP		CONTRACT		SABER

16. DIRECT SCHEDULED WORK *(Place an "X" in the appropriate box.)*

	EMERGENCY		URGENT		ROUTINE		SELF-HELP		M/C

17. SELF-HELP *(Place an "X" in the appropriate box.)*

	BRIEFING REQUIRED		ADEQUATE COORDINATION		INSPECTION REQUIRED

SECTION III - COMPLETE ONLY IF WORK IS TO BE ACCOMPLISHED BY WORK ORDER

18. WORK CLASS	19. PRIORITY	20. ESTIMATED HOURS	21. ESTIMATED FUNDED COST	22. ESTIMATED TOTAL COST

	23. THERE IS NO NEED FOR AN ENVIRONMENTAL ASSESSMENT (AFR 19-2)		24. A WRITTEN ASSESSMENT IS BEING/HAS BEEN PROCESSED		25. APPROVED		26. DISAPPROVED

27. REMARKS

SECTION IV - APPROVING AUTHORITY

28. NAME AND GRADE *(Please Type or Print)*	29. SIGNATURE	30. DATE

INSTRUCTIONS FOR COMPLETING AF FORM 332

1. The AF Form 332 set consists of a Master File Copy, a Suspense Copy, a Status Copy, and a Customer's Copy. Retain the Status Copy for your organizational files.

2. All requirements for a single facility may be included on the same AF Form 332.

3. The requester completes the following items on the AF Form 332. If there is any question, contact the Civil Engineering Customer Service Unit or the Self-Help Center for assistance:

Item

1. *Enter the organization assignment of requester.*

2. *Enter the organization office symbol of requester.*

3. *Self-explanatory.*

4. *For internal BCE use only.*

5. *Self-explanatory.*

6. *Enter the date that requested work should be completed. If the proposed work is new work, modification or minor construction, the required completion date should also be explained in item 9.*

7. *Enter the number of the building or facility on which the work is requested.*

8. *Enter a clear and concise description of the desired work, supported by sketches, plans, diagrams, specifications, photographs, and any other data or information that provide a complete description of the location and scope of work requested.*

9. *Complete only if the work requested is new work, modification, or minor construction. The justification should be factual and indicate the urgency of the request. List any related projects and impact if delayed (item 6). It should be written so reviewers and approving authorities can understand it though they may not have access to any referenced documents/directives.*

10. *Indicate the resources that the requester/requesting organization proposes to donate/furnish. Include any details known (amount, quantities, contract/contractor, etc.) on the resources in item 8.*

11 thru 13. *If the requested work is new work, modification, or minor construction, the organization's commander should sign the request. Otherwise, the signature of the building manager or requester suffices. This signature indicates the work is essential and not prohibited by any directives the requester is aware of.*

14. *When coordination of another agency/section is needed (medical, safety, security, fire protection, etc.), the requester can expedite processing of this form by obtaining the coordination prior to its submittal. If the requester/requesting organization is a contractor or proposes to donate contract resources, this form requires the coordination of the appropriate base contracting office. This coordination indicates that proposed work to be done is within the provisions of the existing contract, or the proposed contracting is appropriate. If the work is to be accomplished by self-help, the form is then routed to the Self-Help Center after coordination is complete.*

15 thru 30. *For Base Civil Engineer Use.*

Table 1

Alternative GPLs for BENZENE						
(Numbers in table are GPLs in mg/kg)						
Depth to Water (m)						
	Depth of Incorporation (m)					
	5m	**10m**	**20m**	**30m**	**40m**	**50m**
0m						
10m	10	0.070				
20m	678	74.8	0.707			
30m	35,930	4,095	74.3	0.707		
40m	1,751,000	202,000	4,033	74.3	0.707	
50m			197,000	4,033	75.2	0.707
60m				197,000	4,033	84.0
70m					197,000	4,032
80m						197,000
90m						
100m						
Half-life = 1000 days						

Table 2

Alternative GPLs for Toluene						
(Numbers in table are GPLs in mg/kg)						
Depth to Water (m)	**Depth of Incorporation (m)**					
	5m	**10m**	**20m**	**30m**	**40m**	**50m**
0m						
10m	10480	402				
20m	2,534,000	159,800	402			
30m		32,140,000	162,700	402		
40m			32,040,000	219,100	402	
50m				32,030,000	371,000	402
60m					33,090,000	711,900
70m						41,620,000
80m						
90m						
100m						
Half-life = 1000 days						

Table 3

Alternative GPLs for ETHYLBENZENE						
(Numbers in table are GPLs in mg/kg)						
Depth to Water (m)						
	Depth of Incorporation (m)					
	5m	**10m**	**20m**	**30m**	**40m**	**50m**
0m						
10m	1,731	124				
20m	117,100	12,900	124			
30m	6,183,000	704,200	12,820	124		
40m			693,200	12,890	124	
50m				693,200	14,640	124
60m					693,100	18,730
70m						693,200
80m						
90m						
100m						
Half-life = 1000 days						

Table 4

Alternative GPLs for o-XYLENE						
(Numbers in table are GPLs in mg/kg)						
Depth to Water (m)						
	Depth of Incorporation (m)					
	5m	**10m**	**20m**	**30m**	**40m**	**50m**
0m						
10m	36,570	2,161				
20m	3,642,000	341,000	261			
30m		27,720,000	339,800	2,161		
40m				348,000	2,161	
50m					420,800	2,161
60m						577,400
70m						
80m						
90m						
100m						
Half-life = 1000 days						

GNT = Groundwater Not Threatened

Table 5: Groundwater Protection Limits (GPLs) for PSC SS-42

Benzene GPLs (mg/kg), PSC SS-42					
Depth to GW Meters	Depth of Incorporation (meters)				
	40	50	55	60	65
80	59170				
90		59190	8685		
97.5			154100		
100			400600	59180	
105					59190

Ethylbenzene GPLs (mg/kg), PCS SS-42			
Depth to GW (Meters)	Depth of Incorporation (meters)		
	50	55	60
70		679	
80	213000	30700	
85		213000	
90		GW NT	
97.5		GW NT	
100			GW NT

Toluene GPLs (mg/kg), PSC SS-42			
Depth to GW (Meters)	Depth of Incorporation (meters)		
	50	55	60
70		35310	
75		282100	
80	GW NT	GW NT	
97.5		GW NT	
100		GW NT	GW NT

Xylene GPLs (mg/kg), PSC SS-42			
Depth to GW (Meters)	Depth of Incorporation (meters)		
	50	55	60
70		23580	
75		170900	
80	GW NT	GW NT	
97.5		GW NT	
100			GW NT

Notes:
GW NT = Ground Water Not Threatened
Distance to compliance point = 12.0 meters

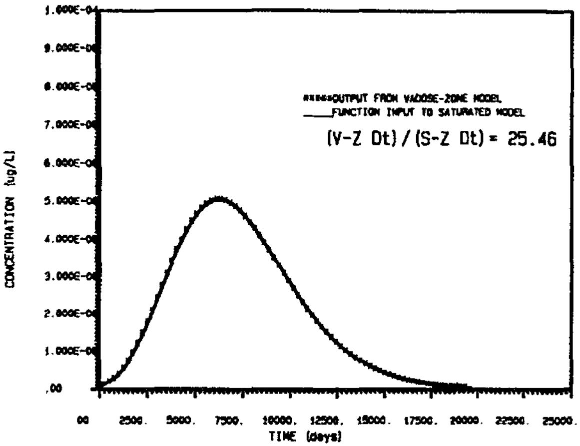
ATTACHMENT A

GPL Model Runs for Benzene

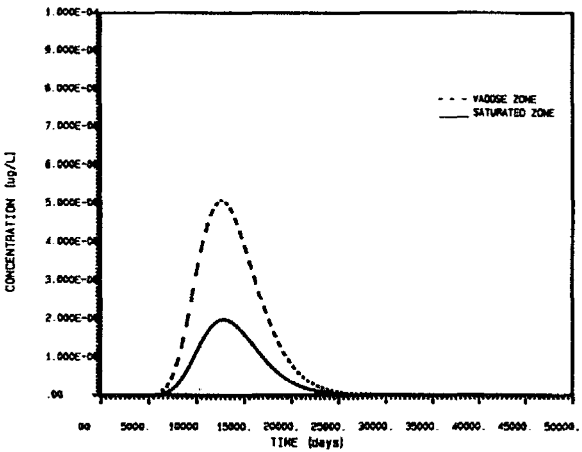
ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

GROUNDWATER PROTECTION LEVEL MODEL

SITE NAME / ID ______________________



LIQUID PHASE CONCENTRATION VS TIME (CORRECTED TO INITIAL BREAKTHROUGH)



LIQUID PHASE CONCENTRATION VS TIME FOR VADOSE-ZONE AND SATURATED ZONE MODELS

benzene

KOC = .6450E+02 cm^3/g
KH = .2210E+00
HALF-LIFE (IN VADOSE ZONE) = .10E+04 days
HALF-LIFE (IN SATURATED ZONE) = .10E+04 days
GROUNDWATER STANDARD = 5.0000 ug/L
SOIL HEALTH-BASED GUIDANCE LEVEL = 47.00 mg/kg

DEPTH TO GROUNDWATER = 97.5 m
AQUIFER MIXING-CELL FACTOR = 1.0
DISTANCE TO COMPLIANCE POINT = 12.0 m
BULK DENSITY = 1.50 g/cm^3
POROSITY = .25
SOIL FOC = .0010
AQUIFER FOC = .0010
SOIL MOISTURE CONTENT = .15
MOISTURE FLUX THROUGH WASTE CELL= .70E-02 cm/day
MOISTURE FLUX OUTSIDE WASTE CELL= .70E-02 cm/day
GROUNDWATER VELOCITY = 10.00 cm/day
DIFFUSION LAYER THICKNESS = .50 cm
DEPTH OF INCORPORATION = 55.000 m
RELEASE WIDTH = 10.0 m
AIR DIFFUSION COEF. = .7000E+04 cm^2/day
WATER DIFFUSION COEF. = .7000E+00 cm^2/day
INITIAL CONTAMINANT CONCENTRATION IN SOIL = 1 ug/cm^3

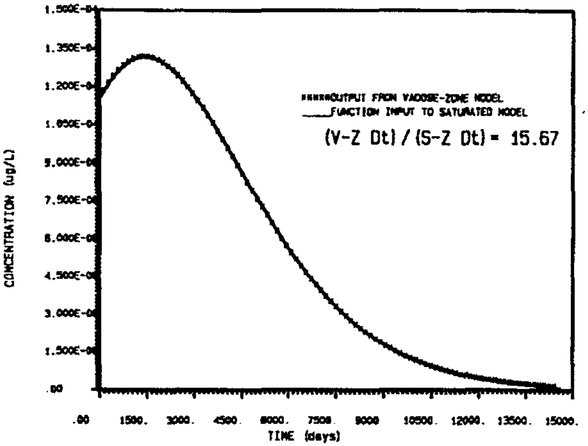
VADOSE-ZONE TIME TO PEAK = .1274E+05 days
VADOSE-ZONE PEAK CONCENTRATION = .5056E-04 ug/L
SATURATED-ZONE TIME TO PEAK = .1291E+05 days
SATURATED-ZONE PEAK CONCENTRATION = .1966E-04 ug/L
CELL THICKNESS AT COMPLIANCE POINT = 6.2 cm
CELL GPL = .1541E+06 mg/kg

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

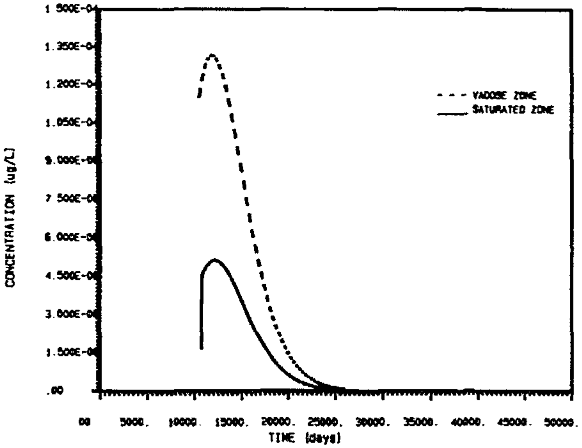
GROUNDWATER PROTECTION LEVEL MODEL

SITE NAME / ID ____________________

benzene



LIQUID PHASE CONCENTRATION VS TIME (CORRECTED TO INITIAL BREAKTHROUGH)



LIQUID PHASE CONCENTRATION VS TIME FOR VADOSE-ZONE AND SATURATED ZONE MODELS

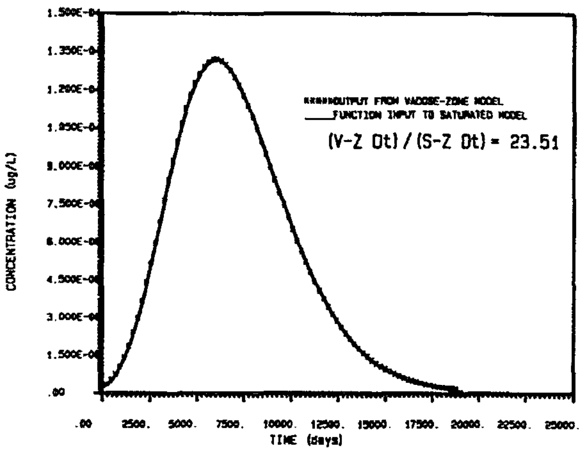
KOC = .6450E+02 cm^3/g
KH = .2210E+00
HALF-LIFE (IN VADOSE ZONE) = .10E+04 days
HALF-LIFE (IN SATURATED ZONE) = .10E+04 days
GROUNDWATER STANDARD = 5.0000 ug/L
SOIL HEALTH-BASED GUIDANCE LEVEL = 47.00 mg/kg

DEPTH TO GROUNDWATER = 80.0 m
AQUIFER MIXING-CELL FACTOR = 1.0
DISTANCE TO COMPLIANCE POINT = 12.0 m
BULK DENSITY = 1.50 g/cm^3
POROSITY = .25
SOIL FOC = .0010
AQUIFER FOC = .0010
SOIL MOISTURE CONTENT = .15
MOISTURE FLUX THROUGH WASTE CELL= .70E-02 cm/day
MOISTURE FLUX OUTSIDE WASTE CELL= .70E-02 cm/day
GROUNDWATER VELOCITY = 10.00 cm/day
DIFFUSION LAYER THICKNESS = .50 cm
DEPTH OF INCORPORATION = 40.000 m
RELEASE WIDTH = 10.0 m
AIR DIFFUSION COEF. = .7000E+04 cm^2/day
WATER DIFFUSION COEF. = .7000E+00 cm^2/day
INITIAL CONTAMINANT CONCENTRATION IN SOIL = 1 ug/cm^3

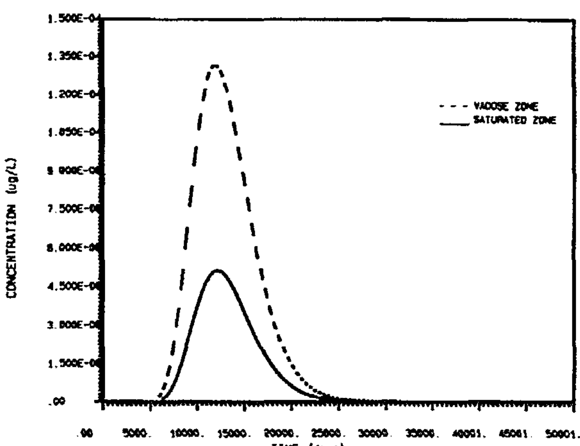
VADOSE-ZONE TIME TO PEAK = .1187E+05 days
VADOSE-ZONE PEAK CONCENTRATION = .1317E-03 ug/L
SATURATED-ZONE TIME TO PEAK = .1213E+05 days
SATURATED-ZONE PEAK CONCENTRATION = .5121E-04 ug/L
CELL THICKNESS AT COMPLIANCE POINT = 6.2 cm
CELL GPL = .5917E+05 mg/kg

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

GROUNDWATER PROTECTION LEVEL MODEL



LIQUID PHASE CONCENTRATION VS TIME (CORRECTED TO INITIAL BREAKTHROUGH)



LIQUID PHASE CONCENTRATION VS TIME FOR VADOSE-ZONE AND SATURATED ZONE MODELS

SITE NAME / ID ______________________

benzene

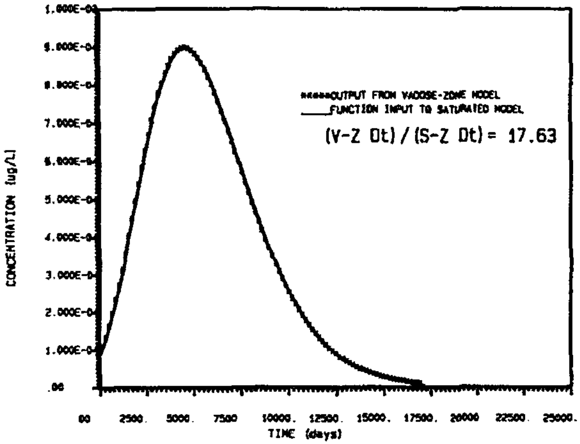
KOC = .6450E+02 cm³/g
KH = .2210E+00
HALF-LIFE (IN VADOSE ZONE) = .10E+04 days
HALF-LIFE (IN SATURATED ZONE) = .10E+04 days
GROUNDWATER STANDARD = 5.0000 ug/L
SOIL HEALTH-BASED GUIDANCE LEVEL = 47.00 mg/kg

DEPTH TO GROUNDWATER = 90.0 m
AQUIFER MIXING-CELL FACTOR = 1.0
DISTANCE TO COMPLIANCE POINT = 12.0 m
BULK DENSITY = 1.50 g/cm³
POROSITY = .25
SOIL FOC = .0010
AQUIFER FOC = .0010
SOIL MOISTURE CONTENT = .15
MOISTURE FLUX THROUGH WASTE CELL= .70E-02 cm/day
MOISTURE FLUX OUTSIDE WASTE CELL= .70E-02 cm/day
GROUNDWATER VELOCITY = 10.00 cm/day
DIFFUSION LAYER THICKNESS = .50 cm
DEPTH OF INCORPORATION = 50.000 m
RELEASE WIDTH = 10.0 m
AIR DIFFUSION COEF. = .7000E+04 cm²/day
WATER DIFFUSION COEF. = .7000E+00 cm²/day
INITIAL CONTAMINANT CONCENTRATION IN SOIL = 1 ug/cm³

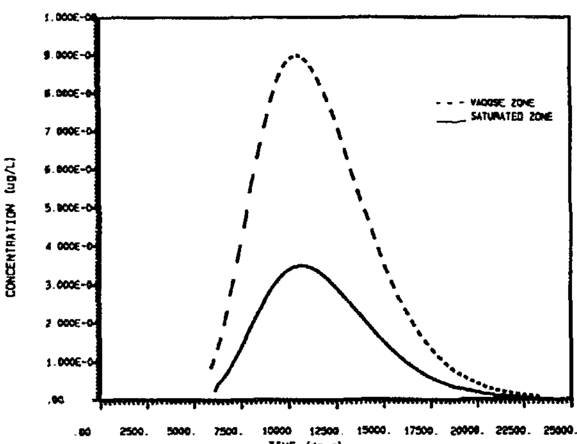
VADOSE-ZONE TIME TO PEAK = .1200E+05 days
VADOSE-ZONE PEAK CONCENTRATION = .1317E-03 ug/L
SATURATED-ZONE TIME TO PEAK = .1217E+05 days
SATURATED-ZONE PEAK CONCENTRATION = .5120E-04 ug/L
CELL THICKNESS AT COMPLIANCE POINT = 6.2 cm
CELL GPL = .5919E+05 mg/kg

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

GROUNDWATER PROTECTION LEVEL MODEL



LIQUID PHASE CONCENTRATION VS TIME (CORRECTED TO INITIAL BREAKTHROUGH)



LIQUID PHASE CONCENTRATION VS TIME FOR VADOSE-ZONE AND SATURATED ZONE MODELS

SITE NAME / ID ______________________

benzene

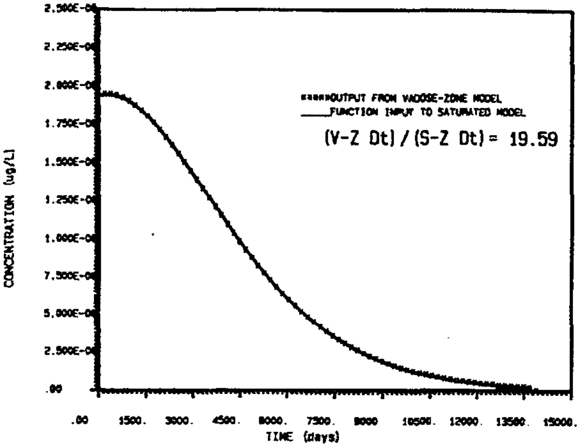
KOC = .6450E+02 cm³/g
KH = .2210E+00
HALF-LIFE (IN VADOSE ZONE) = .10E+04 days
HALF-LIFE (IN SATURATED ZONE) = .10E+04 days
GROUNDWATER STANDARD = 5.0000 ug/L
SOIL HEALTH-BASED GUIDANCE LEVEL = 47.00 mg/kg

DEPTH TO GROUNDWATER = 90.0 m
AQUIFER MIXING-CELL FACTOR = 1.0
DISTANCE TO COMPLIANCE POINT = 12.0 m
BULK DENSITY = 1.50 g/cm³
POROSITY = .25
SOIL FOC = .0010
AQUIFER FOC = .0010
SOIL MOISTURE CONTENT = .15
MOISTURE FLUX THROUGH WASTE CELL= .70E-02 cm/day
MOISTURE FLUX OUTSIDE WASTE CELL= .70E-02 cm/day
GROUNDWATER VELOCITY = 10.00 cm/day
DIFFUSION LAYER THICKNESS = .50 cm
DEPTH OF INCORPORATION = 55.000 m
RELEASE WIDTH = 10.0 m
AIR DIFFUSION COEF. = .7000E+04 cm²/day
WATER DIFFUSION COEF. = .7000E+00 cm²/day
INITIAL CONTAMINANT CONCENTRATION IN SOIL = 1 ug/cm³

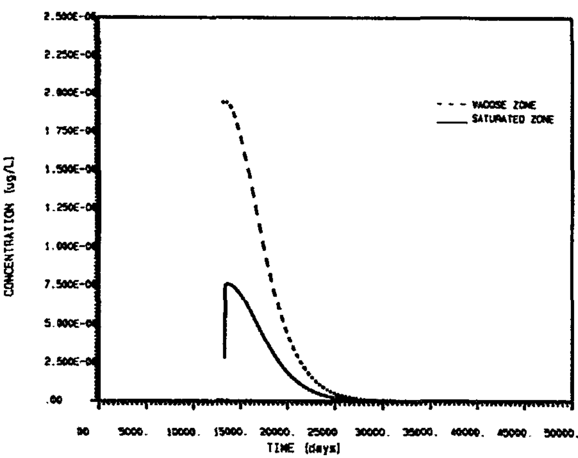
VADOSE-ZONE TIME TO PEAK = .1047E+05 days
VADOSE-ZONE PEAK CONCENTRATION = .8976E-03 ug/L
SATURATED-ZONE TIME TO PEAK = .1069E+05 days
SATURATED-ZONE PEAK CONCENTRATION = .3489E-03 ug/L
CELL THICKNESS AT COMPLIANCE POINT = 6.2 cm
CELL GPL = .8685E+04 mg/kg

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

GROUNDWATER PROTECTION LEVEL MODEL



LIQUID PHASE CONCENTRATION VS TIME (CORRECTED TO INITIAL BREAKTHROUGH)



LIQUID PHASE CONCENTRATION VS TIME FOR VADOSE-ZONE AND SATURATED ZONE MODELS

SITE NAME / ID ______________________

benzene

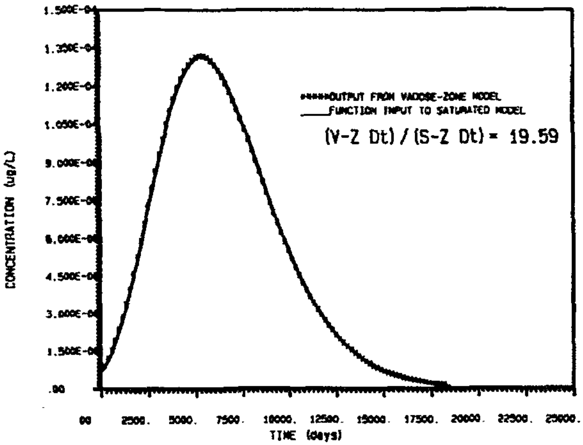
KOC = .6450E+02 cm^3/g
KH = .2210E+00
HALF-LIFE (IN VADOSE ZONE) = .10E+04 days
HALF-LIFE (IN SATURATED ZONE) = .10E+04 days
GROUNDWATER STANDARD = 5.0000 ug/L
SOIL HEALTH-BASED GUIDANCE LEVEL = 47.00 mg/kg

DEPTH TO GROUNDWATER = 100.0 m
AQUIFER MIXING-CELL FACTOR = 1.0
DISTANCE TO COMPLIANCE POINT = 12.0 m
BULK DENSITY = 1.50 g/cm^3
POROSITY = .25
SOIL FOC = .0010
AQUIFER FOC = .0010
SOIL MOISTURE CONTENT = .15
MOISTURE FLUX THROUGH WASTE CELL= .70E-02 cm/day
MOISTURE FLUX OUTSIDE WASTE CELL= .70E-02 cm/day
GROUNDWATER VELOCITY = 10.00 cm/day
DIFFUSION LAYER THICKNESS = .50 cm
DEPTH OF INCORPORATION = 55.000 m
RELEASE WIDTH = 10.0 m
AIR DIFFUSION COEF. = .7000E+04 cm^2/day
WATER DIFFUSION COEF. = .7000E+00 cm^2/day
INITIAL CONTAMINANT CONCENTRATION IN SOIL = 1 ug/cm^3

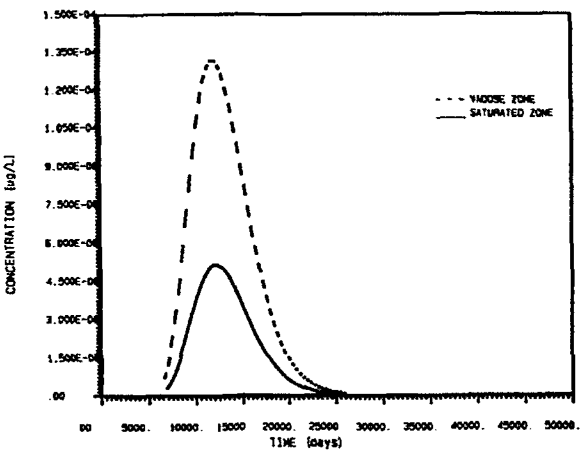
VADOSE-ZONE TIME TO PEAK = .1326E+05 days
VADOSE-ZONE PEAK CONCENTRATION = .1945E-04 ug/L
SATURATED-ZONE TIME TO PEAK = .1357E+05 days
SATURATED-ZONE PEAK CONCENTRATION = .7564E-05 ug/L
CELL THICKNESS AT COMPLIANCE POINT = 6.2 cm
CELL GPL = .4006E+06 mg/kg

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

GROUNDWATER PROTECTION LEVEL MODEL



LIQUID PHASE CONCENTRATION VS TIME (CORRECTED TO INITIAL BREAKTHROUGH)



LIQUID PHASE CONCENTRATION VS TIME FOR VADOSE-ZONE AND SATURATED ZONE MODELS

SITE NAME / ID ____________________

benzene

KOC = .6450E+02 cm^3/g
KH = .2210E+00
HALF-LIFE (IN VADOSE ZONE) = .10E+04 days
HALF-LIFE (IN SATURATED ZONE) = .10E+04 days
GROUNDWATER STANDARD = 5.0000 ug/L
SOIL HEALTH-BASED GUIDANCE LEVEL = 47.00 mg/kg

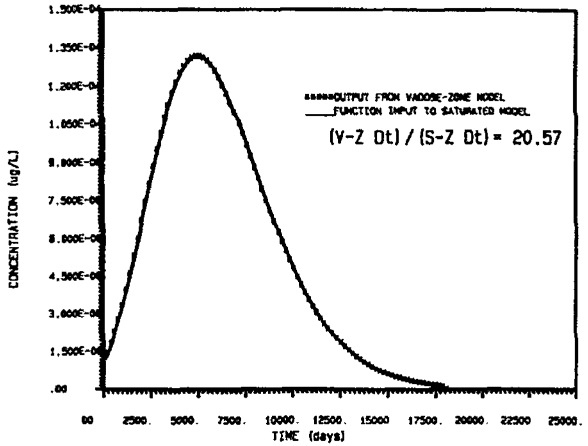
DEPTH TO GROUNDWATER = 100.0 m
AQUIFER MIXING-CELL FACTOR = 1.0
DISTANCE TO COMPLIANCE POINT = 12.0 m
BULK DENSITY = 1.50 g/cm^3
POROSITY = .25
SOIL FOC = .0010
AQUIFER FOC = .0010
SOIL MOISTURE CONTENT = .15
MOISTURE FLUX THROUGH WASTE CELL= .70E-02 cm/day
MOISTURE FLUX OUTSIDE WASTE CELL= .70E-02 cm/day
GROUNDWATER VELOCITY = 10.00 cm/day
DIFFUSION LAYER THICKNESS = .50 cm
DEPTH OF INCORPORATION = 60.000 m
RELEASE WIDTH = 10.0 m
AIR DIFFUSION COEF. = .7000E+04 cm^2/day
WATER DIFFUSION COEF. = .7000E+00 cm^2/day
INITIAL CONTAMINANT CONCENTRATION IN SOIL = 1 ug/cm^3

VADOSE-ZONE TIME TO PEAK = .1183E+05 days
VADOSE-ZONE PEAK CONCENTRATION = .1317E-03 ug/L
SATURATED-ZONE TIME TO PEAK = .1212E+05 days
SATURATED-ZONE PEAK CONCENTRATION = .5120E-04 ug/L
CELL THICKNESS AT COMPLIANCE POINT = 6.2 cm
CELL GPL = .5918E+05 mg/kg

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

GROUNDWATER PROTECTION LEVEL MODEL

SITE NAME / ID ______________________

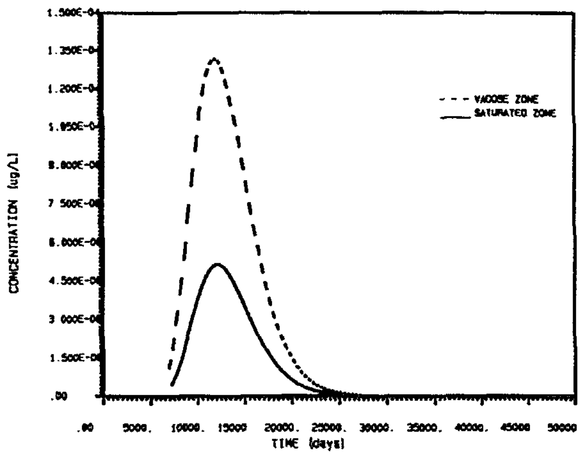


LIQUID PHASE CONCENTRATION VS TIME (CORRECTED TO INITIAL BREAKTHROUGH)

benzene

KOC = .6450E+02 cm^3/g
KH = .2210E+00
HALF-LIFE (IN VADOSE ZONE) = .10E+04 days
HALF-LIFE (IN SATURATED ZONE) = .10E+04 days
GROUNDWATER STANDARD = 5.0000 ug/L
SOIL HEALTH-BASED GUIDANCE LEVEL = 47.00 mg/kg

DEPTH TO GROUNDWATER = 105.0 m
AQUIFER MIXING-CELL FACTOR = 1.0
DISTANCE TO COMPLIANCE POINT = 12.0 m
BULK DENSITY = 1.50 g/cm^3
POROSITY = .25
SOIL FOC = .0010
AQUIFER FOC = .0010
SOIL MOISTURE CONTENT = .15
MOISTURE FLUX THROUGH WASTE CELL= .70E-02 cm/day
MOISTURE FLUX OUTSIDE WASTE CELL= .70E-02 cm/day
GROUNDWATER VELOCITY = 10.00 cm/day
DIFFUSION LAYER THICKNESS = .50 cm
DEPTH OF INCORPORATION = 65.000 m
RELEASE WIDTH = 10.0 m
AIR DIFFUSION COEF. = .7000E+04 cm^2/day
WATER DIFFUSION COEF. = .7000E+00 cm^2/day
INITIAL CONTAMINANT CONCENTRATION IN SOIL = 1 ug/cm^3



LIQUID PHASE CONCENTRATION VS TIME FOR VADOSE-ZONE AND SATURATED ZONE MODELS

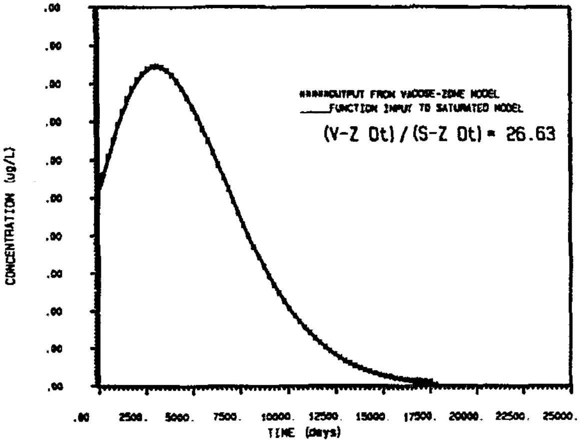
VADOSE-ZONE TIME TO PEAK = .1201E+05 days
VADOSE-ZONE PEAK CONCENTRATION = .1317E-03 ug/L
SATURATED-ZONE TIME TO PEAK = .1216E+05 days
SATURATED-ZONE PEAK CONCENTRATION = .5120E-04 ug/L
CELL THICKNESS AT COMPLIANCE POINT = 6.2 cm
CELL GPL = .5919E+05 mg/kg

ATTACHMENT B

GPL Model Runs for Toluene

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

GROUNDWATER PROTECTION LEVEL MODEL



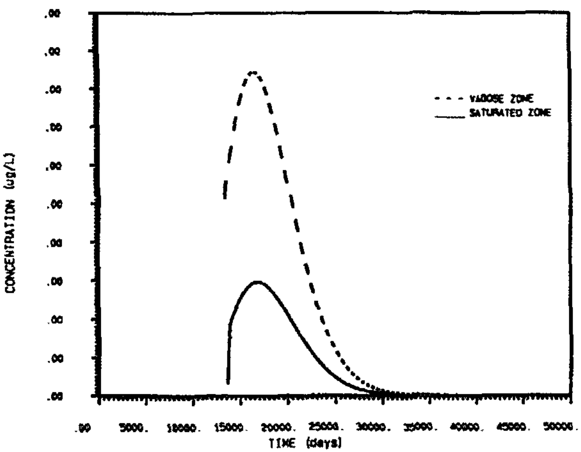
LIQUID PHASE CONCENTRATION VS TIME (CORRECTED TO INITIAL BREAKTHROUGH)

SITE NAME / ID ____________________

toluene

KOC = .2570E+03 cm³/g
KH = .2690E+00
HALF-LIFE (IN VADOSE ZONE) = .10E+04 days
HALF-LIFE (IN SATURATED ZONE) = .10E+04 days
GROUNDWATER STANDARD = 1000.0000 ug/L
SOIL HEALTH-BASED GUIDANCE LEVEL = 23000.00 mg/kg

DEPTH TO GROUNDWATER = 97.5 m
AQUIFER MIXING-CELL FACTOR = 1.0
DISTANCE TO COMPLIANCE POINT = 12.0 m
BULK DENSITY = 1.50 g/cm³
POROSITY = .25
SOIL FOC = .0010
AQUIFER FOC = .0010
SOIL MOISTURE CONTENT = .15
MOISTURE FLUX THROUGH WASTE CELL= .70E-02 cm/day
MOISTURE FLUX OUTSIDE WASTE CELL= .70E-02 cm/day
GROUNDWATER VELOCITY = 10.00 cm/day
DIFFUSION LAYER THICKNESS = .50 cm
DEPTH OF INCORPORATION = 55.000 m
RELEASE WIDTH = 10.0 m
AIR DIFFUSION COEF. = .7000E+04 cm²/day
WATER DIFFUSION COEF. = .7000E+00 cm²/day
INITIAL CONTAMINANT CONCENTRATION IN SOIL = 1 ug/cm³

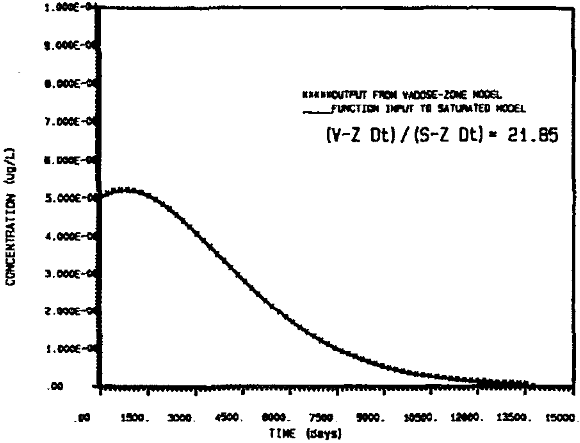


LIQUID PHASE CONCENTRATION VS TIME FOR VADOSE-ZONE AND SATURATED ZONE MODELS

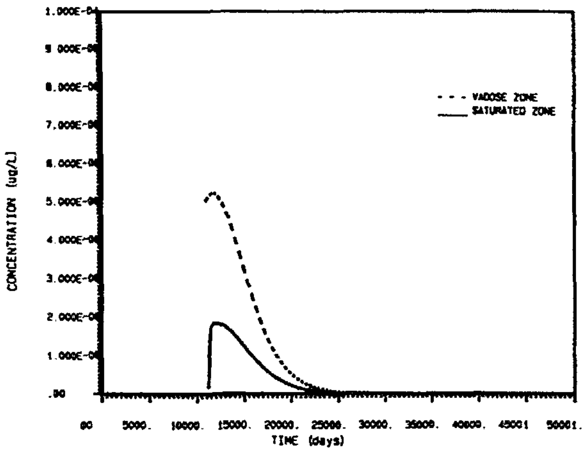
VADOSE-ZONE TIME TO PEAK = .1652E+05 days
VADOSE-ZONE PEAK CONCENTRATION = .8447E-07 ug/L
SATURATED-ZONE TIME TO PEAK = .1684E+05 days
SATURATED-ZONE PEAK CONCENTRATION = .2960E-07 ug/L
CELL THICKNESS AT COMPLIANCE POINT = 6.2 cm
CELL GPL NOT CALCULATED: GROUNDWATER NOT THREATENED

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

GROUNDWATER PROTECTION LEVEL MODEL



LIQUID PHASE CONCENTRATION VS TIME (CORRECTED TO INITIAL BREAKTHROUGH)



LIQUID PHASE CONCENTRATION VS TIME FOR VADOSE-ZONE AND SATURATED ZONE MODELS

SITE NAME / ID ____________________

toluene

KOC = .2570E+03 cm^3/g
KH = .2690E+00
HALF-LIFE (IN VADOSE ZONE) = .10E+04 days
HALF-LIFE (IN SATURATED ZONE) = .10E+04 days
GROUNDWATER STANDARD = 1000.0000 ug/L
SOIL HEALTH-BASED GUIDANCE LEVEL = 23000.00 mg/kg

DEPTH TO GROUNDWATER = 80.0 m
AQUIFER MIXING-CELL FACTOR = 1.0
DISTANCE TO COMPLIANCE POINT = 12.0 m
BULK DENSITY = 1.50 g/cm^3
POROSITY = .25
SOIL FOC = .0010
AQUIFER FOC = .0010
SOIL MOISTURE CONTENT = .15
MOISTURE FLUX THROUGH WASTE CELL= .70E-02 cm/day
MOISTURE FLUX OUTSIDE WASTE CELL= .70E-02 cm/day
GROUNDWATER VELOCITY = 10.00 cm/day
DIFFUSION LAYER THICKNESS = .50 cm
DEPTH OF INCORPORATION = 50.000 m
RELEASE WIDTH = 10.0 m
AIR DIFFUSION COEF. = .7000E+04 cm^2/day
WATER DIFFUSION COEF. = .7000E+00 cm^2/day
INITIAL CONTAMINANT CONCENTRATION IN SOIL = 1 ug/cm^3

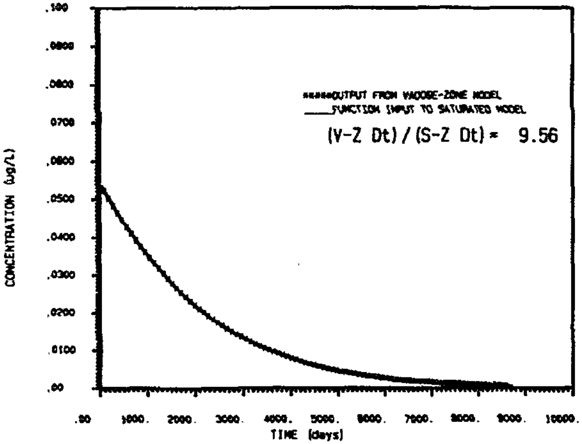
VADOSE-ZONE TIME TO PEAK = .1181E+05 days
VADOSE-ZONE PEAK CONCENTRATION = .5218E-04 ug/L
SATURATED-ZONE TIME TO PEAK = .1210E+05 days
SATURATED-ZONE PEAK CONCENTRATION = .1829E-04 ug/L
CELL THICKNESS AT COMPLIANCE POINT = 6.2 cm
CELL GPL NOT CALCULATED: GROUNDWATER NOT THREATENED

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

GROUNDWATER PROTECTION LEVEL MODEL

SITE NAME / ID ______________________

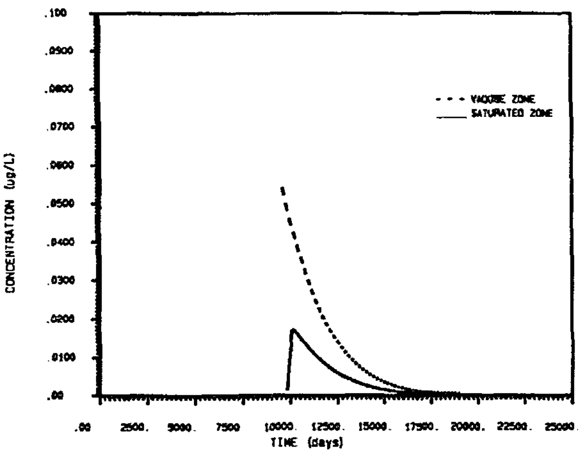
toluene



LIQUID PHASE CONCENTRATION VS TIME (CORRECTED TO INITIAL BREAKTHROUGH)

KOC = .2570E+03 cm^3/g
KH = .2690E+00
HALF-LIFE (IN VADOSE ZONE) = .10E+04 days
HALF-LIFE (IN SATURATED ZONE) = .10E+04 days
GROUNDWATER STANDARD = 1000.0000 ug/L
SOIL HEALTH-BASED GUIDANCE LEVEL = 23000.00 mg/kg

DEPTH TO GROUNDWATER = 70.0 m
AQUIFER MIXING-CELL FACTOR = 1.0
DISTANCE TO COMPLIANCE POINT = 12.0 m
BULK DENSITY = 1.50 g/cm^3
POROSITY = .25
SOIL FOC = .0010
AQUIFER FOC = .0010
SOIL MOISTURE CONTENT = .15
MOISTURE FLUX THROUGH WASTE CELL= .70E-02 cm/day
MOISTURE FLUX OUTSIDE WASTE CELL= .70E-02 cm/day
GROUNDWATER VELOCITY = 10.00 cm/day
DIFFUSION LAYER THICKNESS = .50 cm
DEPTH OF INCORPORATION = 55.000 m
RELEASE WIDTH = 10.0 m
AIR DIFFUSION COEF. = .7000E+04 cm^2/day
WATER DIFFUSION COEF. = .7000E+00 cm^2/day
INITIAL CONTAMINANT CONCENTRATION IN SOIL = 1 ug/cm^3

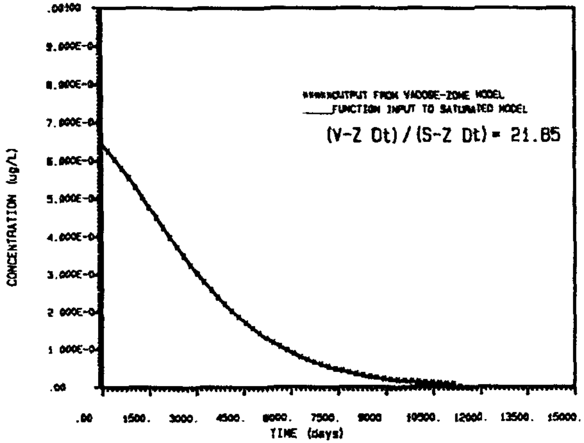


LIQUID PHASE CONCENTRATION VS TIME FOR VADOSE-ZONE AND SATURATED ZONE MODELS

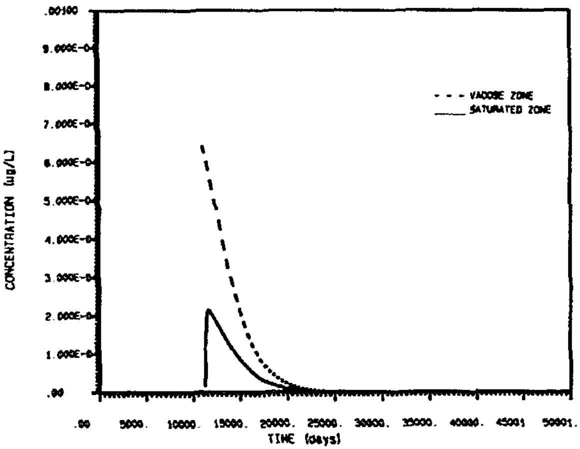
VADOSE-ZONE TIME TO PEAK = .9571E+04 days
VADOSE-ZONE PEAK CONCENTRATION = .5415E-01 ug/L
SATURATED-ZONE TIME TO PEAK = .1015E+05 days
SATURATED-ZONE PEAK CONCENTRATION = .1717E-01 ug/L
CELL THICKNESS AT COMPLIANCE POINT = 6.2 cm
CELL GPL = .3531E+05 mg/kg

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

GROUNDWATER PROTECTION LEVEL MODEL



LIQUID PHASE CONCENTRATION VS TIME (CORRECTED TO INITIAL BREAKTHROUGH)



LIQUID PHASE CONCENTRATION VS TIME FOR VADOSE-ZONE AND SATURATED ZONE MODELS

SITE NAME / ID ____________________

toluene

KOC = .2570E+03 cm^3/g
KH = .2690E+00
HALF-LIFE (IN VADOSE ZONE) = .10E+04 days
HALF-LIFE (IN SATURATED ZONE) = .10E+04 days
GROUNDWATER STANDARD = 1000.0000 ug/L
SOIL HEALTH-BASED GUIDANCE LEVEL = 23000.00 mg/kg

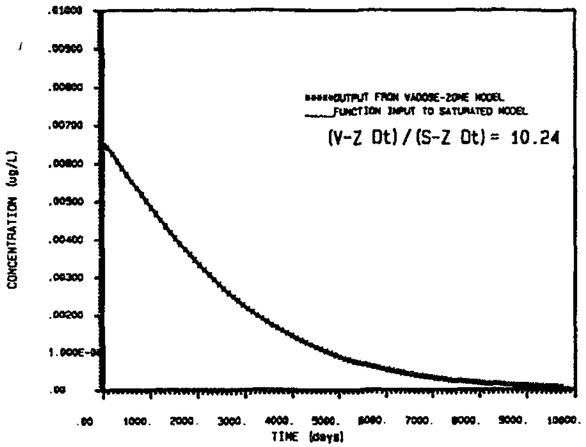
DEPTH TO GROUNDWATER = 80.0 m
AQUIFER MIXING-CELL FACTOR = 1.0
DISTANCE TO COMPLIANCE POINT = 12.0 m
BULK DENSITY = 1.50 g/cm^3
POROSITY = .25
SOIL FOC = .0010
AQUIFER FOC = .0010
SOIL MOISTURE CONTENT = .15
MOISTURE FLUX THROUGH WASTE CELL= .70E-02 cm/day
MOISTURE FLUX OUTSIDE WASTE CELL= .70E-02 cm/day
GROUNDWATER VELOCITY = 10.00 cm/day
DIFFUSION LAYER THICKNESS = .50 cm
DEPTH OF INCORPORATION = 55.000 m
RELEASE WIDTH = 10.0 m
AIR DIFFUSION COEF. = .7000E+04 cm^2/day
WATER DIFFUSION COEF. = .7000E+00 cm^2/day
INITIAL CONTAMINANT CONCENTRATION IN SOIL = 1 ug/cm^3

VADOSE-ZONE TIME TO PEAK = .1094E+05 days
VADOSE-ZONE PEAK CONCENTRATION = .6437E-03 ug/L
SATURATED-ZONE TIME TO PEAK = .1156E+05 days
SATURATED-ZONE PEAK CONCENTRATION = .2166E-03 ug/L
CELL THICKNESS AT COMPLIANCE POINT = 6.2 cm
CELL GPL NOT CALCULATED: GROUNDWATER NOT THREATENED

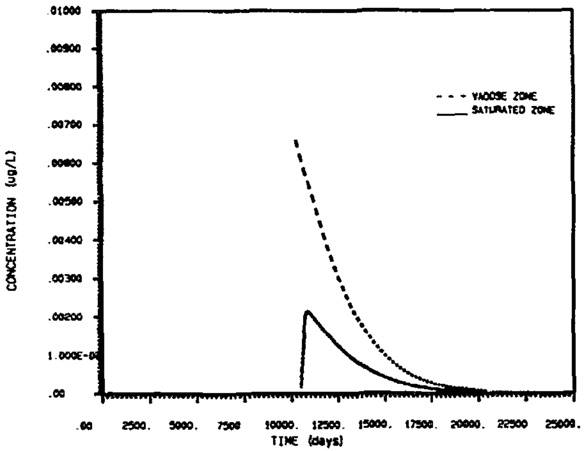
ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

GROUNDWATER PROTECTION LEVEL MODEL

SITE NAME / ID ______________________



LIQUID PHASE CONCENTRATION VS TIME (CORRECTED TO INITIAL BREAKTHROUGH)



LIQUID PHASE CONCENTRATION VS TIME FOR VADOSE-ZONE AND SATURATED ZONE MODELS

toluene

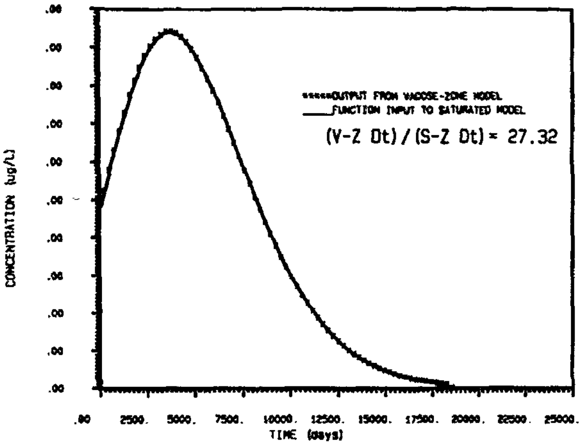
KOC = .2570E+03 cm^3/g
KH = .2690E+00
HALF-LIFE (IN VADOSE ZONE) = .10E+04 days
HALF-LIFE (IN SATURATED ZONE) = .10E+04 days
GROUNDWATER STANDARD = 1000.0000 ug/L
SOIL HEALTH-BASED GUIDANCE LEVEL = 23000.00 mg/kg

DEPTH TO GROUNDWATER = 75.0 m
AQUIFER MIXING-CELL FACTOR = 1.0
DISTANCE TO COMPLIANCE POINT = 12.0 m
BULK DENSITY = 1.50 g/cm^3
POROSITY = .25
SOIL FOC = .0010
AQUIFER FOC = .0010
SOIL MOISTURE CONTENT = .15
MOISTURE FLUX THROUGH WASTE CELL= .70E-02 cm/day
MOISTURE FLUX OUTSIDE WASTE CELL= .70E-02 cm/day
GROUNDWATER VELOCITY = 10.00 cm/day
DIFFUSION LAYER THICKNESS = .50 cm
DEPTH OF INCORPORATION = 55.000 m
RELEASE WIDTH = 10.0 m
AIR DIFFUSION COEF. = .7000E+04 cm^2/day
WATER DIFFUSION COEF. = .7000E+00 cm^2/day
INITIAL CONTAMINANT CONCENTRATION IN SOIL = 1 ug/cm^3

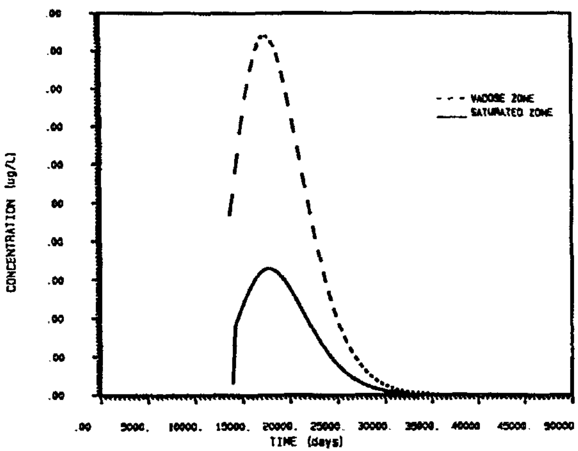
VADOSE-ZONE TIME TO PEAK = .1025E+05 days
VADOSE-ZONE PEAK CONCENTRATION = .6591E-02 ug/L
SATURATED-ZONE TIME TO PEAK = .1084E+05 days
SATURATED-ZONE PEAK CONCENTRATION = .2148E-02 ug/L
CELL THICKNESS AT COMPLIANCE POINT = 6.2 cm
CELL GPL = .2821E+06 mg/kg

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

GROUNDWATER PROTECTION LEVEL MODEL



LIQUID PHASE CONCENTRATION VS TIME (CORRECTED TO INITIAL BREAKTHROUGH)



LIQUID PHASE CONCENTRATION VS TIME FOR VADOSE-ZONE AND SATURATED ZONE MODELS

SITE NAME / ID ______________________

toluene

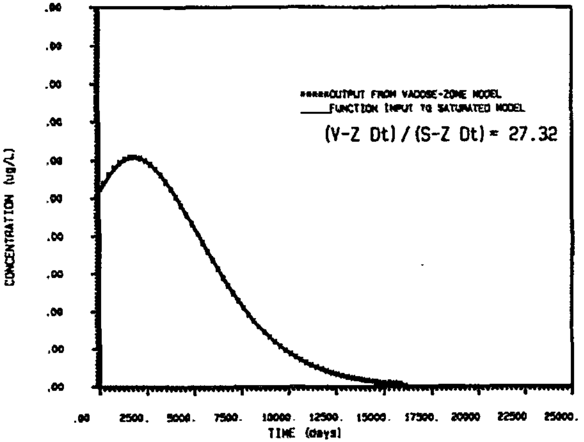
KOC = .2570E+03 cm^3/g
KH = .2690E+00
HALF-LIFE (IN VADOSE ZONE) = .10E+04 days
HALF-LIFE (IN SATURATED ZONE) = .10E+04 days
GROUNDWATER STANDARD = 1000.0000 ug/L
SOIL HEALTH-BASED GUIDANCE LEVEL = 23000.00 mg/kg

DEPTH TO GROUNDWATER = 100.0 m
AQUIFER MIXING-CELL FACTOR = 1.0
DISTANCE TO COMPLIANCE POINT = 12.0 m
BULK DENSITY = 1.50 g/cm^3
POROSITY = .25
SOIL FOC = .0010
AQUIFER FOC = .0010
SOIL MOISTURE CONTENT = .15
MOISTURE FLUX THROUGH WASTE CELL= .70E-02 cm/day
MOISTURE FLUX OUTSIDE WASTE CELL= .70E-02 cm/day
GROUNDWATER VELOCITY = 10.00 cm/day
DIFFUSION LAYER THICKNESS = .50 cm
DEPTH OF INCORPORATION = 55.000 m
RELEASE WIDTH = 10.0 m
AIR DIFFUSION COEF. = .7000E+04 cm^2/day
WATER DIFFUSION COEF. = .7000E+00 cm^2/day
INITIAL CONTAMINANT CONCENTRATION IN SOIL = 1 ug/cm^3

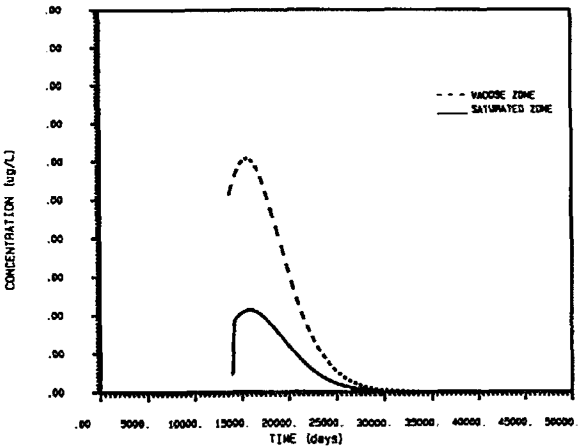
VADOSE-ZONE TIME TO PEAK = .1749E+05 days
VADOSE-ZONE PEAK CONCENTRATION = .2349E-07 ug/L
SATURATED-ZONE TIME TO PEAK = .1779E+05 days
SATURATED-ZONE PEAK CONCENTRATION = .8230E-08 ug/L
CELL THICKNESS AT COMPLIANCE POINT = 6.2 cm
CELL GPL NOT CALCULATED: GROUNDWATER NOT THREATENED

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

GROUNDWATER PROTECTION LEVEL MODEL



LIQUID PHASE CONCENTRATION VS TIME (CORRECTED TO INITIAL BREAKTHROUGH)



LIQUID PHASE CONCENTRATION VS TIME FOR VADOSE-ZONE AND SATURATED ZONE MODELS

SITE NAME / ID ______________________

toluene

KOC = .2570E+03 cm^3/g
KH = .2690E+00
HALF-LIFE (IN VADOSE ZONE) = .10E+04 days
HALF-LIFE (IN SATURATED ZONE) = .10E+04 days
GROUNDWATER STANDARD = 1000.0000 ug/L
SOIL HEALTH-BASED GUIDANCE LEVEL = 23000.00 mg/kg

DEPTH TO GROUNDWATER = 100.0 m
AQUIFER MIXING-CELL FACTOR = 1.0
DISTANCE TO COMPLIANCE POINT = 12.0 m
BULK DENSITY = 1.50 g/cm^3
POROSITY = .25
SOIL FOC = .0010
AQUIFER FOC = .0010
SOIL MOISTURE CONTENT = .15
MOISTURE FLUX THROUGH WASTE CELL= .70E-02 cm/day
MOISTURE FLUX OUTSIDE WASTE CELL= .70E-02 cm/day
GROUNDWATER VELOCITY = 10.00 cm/day
DIFFUSION LAYER THICKNESS = .50 cm
DEPTH OF INCORPORATION = 60.000 m
RELEASE WIDTH = 10.0 m
AIR DIFFUSION COEF. = .7000E+04 cm^2/day
WATER DIFFUSION COEF. = .7000E+00 cm^2/day
INITIAL CONTAMINANT CONCENTRATION IN SOIL = 1 ug/cm^3

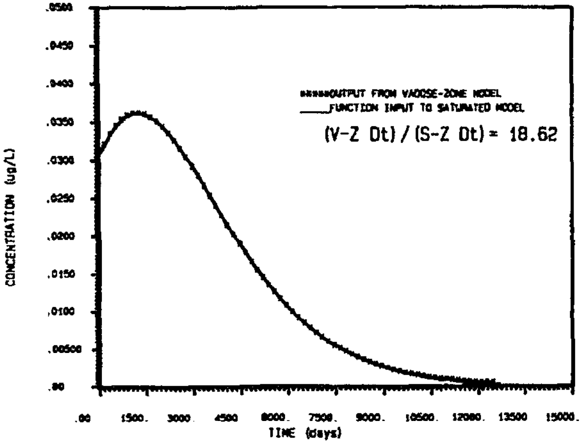
VADOSE-ZONE TIME TO PEAK = .1558E+05 days
VADOSE-ZONE PEAK CONCENTRATION = .3042E-06 ug/L
SATURATED-ZONE TIME TO PEAK = .1589E+05 days
SATURATED-ZONE PEAK CONCENTRATION = .1066E-06 ug/L
CELL THICKNESS AT COMPLIANCE POINT = 6.2 cm
CELL GPL NOT CALCULATED: GROUNDWATER NOT THREATENED

ATTACHMENT C

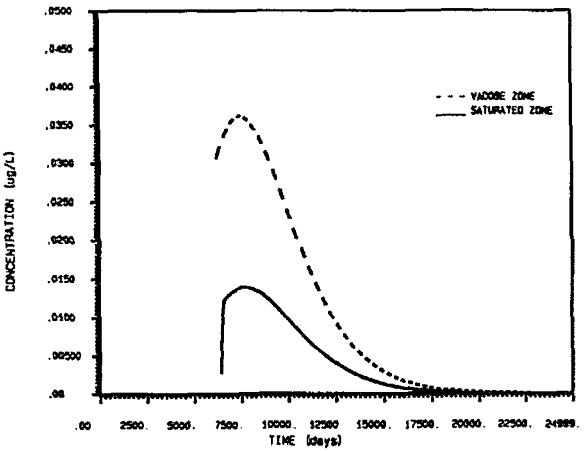
GPL Model Runs for Ethylbenzene

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

GROUNDWATER PROTECTION LEVEL MODEL



LIQUID PHASE CONCENTRATION VS TIME (CORRECTED TO INITIAL BREAKTHROUGH)



LIQUID PHASE CONCENTRATION VS TIME FOR VADOSE-ZONE AND SATURATED ZONE MODELS

SITE NAME / ID ______________________

ethylbenzene

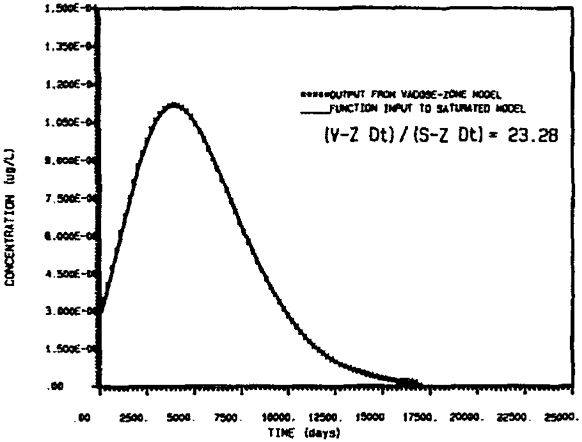
KOC = .9500E+02 cm^3/g
KH = .2700E+00
HALF-LIFE (IN VADOSE ZONE) = .10E+04 days
HALF-LIFE (IN SATURATED ZONE) = .10E+04 days
GROUNDWATER STANDARD = 700.0000 ug/L
SOIL HEALTH-BASED GUIDANCE LEVEL = 12000.00 mg/kg

DEPTH TO GROUNDWATER = 80.0 m
AQUIFER MIXING-CELL FACTOR = 1.0
DISTANCE TO COMPLIANCE POINT = 12.0 m
BULK DENSITY = 1.50 g/cm^3
POROSITY = .25
SOIL FOC = .0010
AQUIFER FOC = .0010
SOIL MOISTURE CONTENT = .15
MOISTURE FLUX THROUGH WASTE CELL= .70E-02 cm/day
MOISTURE FLUX OUTSIDE WASTE CELL= .70E-02 cm/day
GROUNDWATER VELOCITY = 10.00 cm/day
DIFFUSION LAYER THICKNESS = .50 cm
DEPTH OF INCORPORATION = 55.000 m
RELEASE WIDTH = 10.0 m
AIR DIFFUSION COEF. = .7000E+04 cm^2/day
WATER DIFFUSION COEF. = .7000E+00 cm^2/day
INITIAL CONTAMINANT CONCENTRATION IN SOIL = 1 ug/cm^3

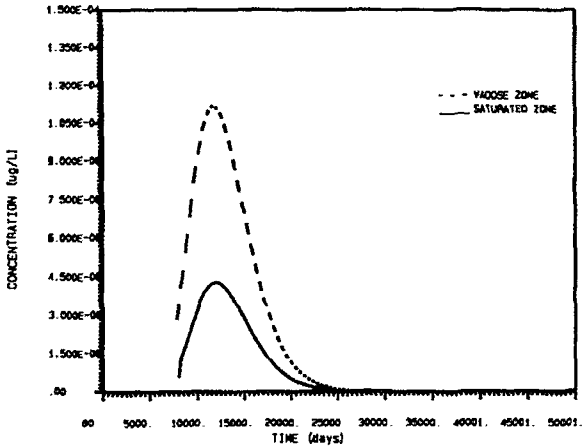
VADOSE-ZONE TIME TO PEAK = .7521E+04 days
VADOSE-ZONE PEAK CONCENTRATION = .3614E-01 ug/L
SATURATED-ZONE TIME TO PEAK = .7727E+04 days
SATURATED-ZONE PEAK CONCENTRATION = .1382E-01 ug/L
CELL THICKNESS AT COMPLIANCE POINT = 6.2 cm
CELL GPL = .3070E+05 mg/kg

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

GROUNDWATER PROTECTION LEVEL MODEL



LIQUID PHASE CONCENTRATION VS TIME (CORRECTED TO INITIAL BREAKTHROUGH)



LIQUID PHASE CONCENTRATION VS TIME FOR VADOSE-ZONE AND SATURATED ZONE MODELS

SITE NAME / ID ____________________

ethylbenzene

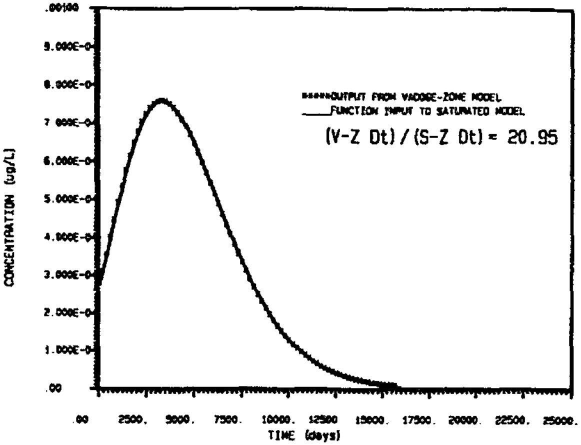
KOC = .9500E+02 cm^3/g
KH = .2700E+00
HALF-LIFE (IN VADOSE ZONE) = .10E+04 days
HALF-LIFE (IN SATURATED ZONE) = .10E+04 days
GROUNDWATER STANDARD = 700.0000 ug/L
SOIL HEALTH-BASED GUIDANCE LEVEL = 12000.00 mg/kg

DEPTH TO GROUNDWATER = 100.0 m
AQUIFER MIXING-CELL FACTOR = 1.0
DISTANCE TO COMPLIANCE POINT = 12.0 m
BULK DENSITY = 1.50 g/cm^3
POROSITY = .25
SOIL FOC = .0010
AQUIFER FOC = .0010
SOIL MOISTURE CONTENT = .15
MOISTURE FLUX THROUGH WASTE CELL= .70E-02 cm/day
MOISTURE FLUX OUTSIDE WASTE CELL= .70E-02 cm/day
GROUNDWATER VELOCITY = 10.00 cm/day
DIFFUSION LAYER THICKNESS = .50 cm
DEPTH OF INCORPORATION = 60.000 m
RELEASE WIDTH = 10.0 m
AIR DIFFUSION COEF. = .7000E+04 cm^2/day
WATER DIFFUSION COEF. = .7000E+00 cm^2/day
INITIAL CONTAMINANT CONCENTRATION IN SOIL = 1 ug/cm^3

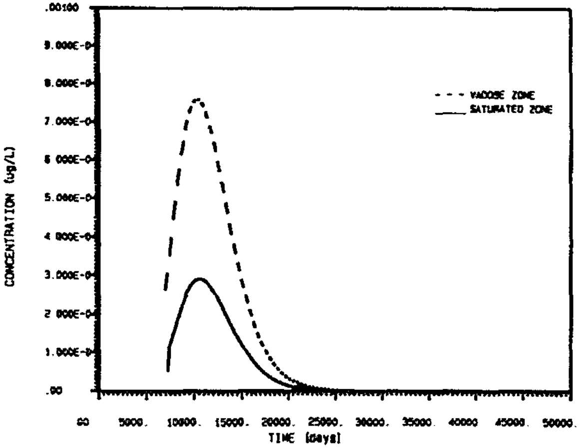
VADOSE-ZONE TIME TO PEAK = .1173E+05 days
VADOSE-ZONE PEAK CONCENTRATION = .1117E-03 ug/L
SATURATED-ZONE TIME TO PEAK = .1199E+05 days
SATURATED-ZONE PEAK CONCENTRATION = .4270E-04 ug/L
CELL THICKNESS AT COMPLIANCE POINT = 6.2 cm
CELL GPL NOT CALCULATED: GROUNDWATER NOT THREATENED

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

GROUNDWATER PROTECTION LEVEL MODEL



LIQUID PHASE CONCENTRATION VS TIME (CORRECTED TO INITIAL BREAKTHROUGH)



LIQUID PHASE CONCENTRATION VS TIME FOR VADOSE-ZONE AND SATURATED ZONE MODELS

SITE NAME / ID ______________________

ethylbenzene

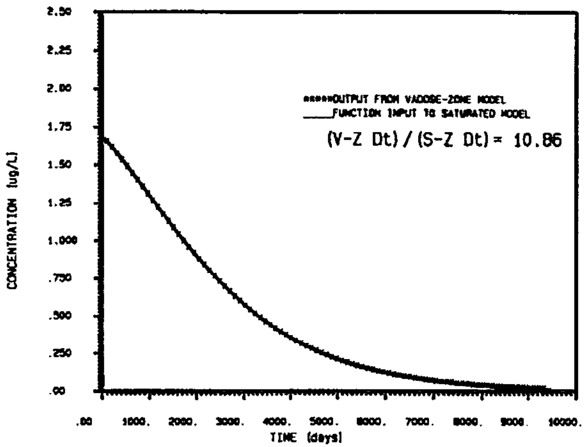
KOC = .9500E+02 cm^3/g
KH = .2700E+00
HALF-LIFE (IN VADOSE ZONE) = .10E+04 days
HALF-LIFE (IN SATURATED ZONE) = .10E+04 days
GROUNDWATER STANDARD = 700.0000 ug/L
SOIL HEALTH-BASED GUIDANCE LEVEL = 12000.00 mg/kg

DEPTH TO GROUNDWATER = 90.0 m
AQUIFER MIXING-CELL FACTOR = 1.0
DISTANCE TO COMPLIANCE POINT = 12.0 m
BULK DENSITY = 1.50 g/cm^3
POROSITY = .25
SOIL FOC = .0010
AQUIFER FOC = .0010
SOIL MOISTURE CONTENT = .15
MOISTURE FLUX THROUGH WASTE CELL= .70E-02 cm/day
MOISTURE FLUX OUTSIDE WASTE CELL= .70E-02 cm/day
GROUNDWATER VELOCITY = 10.00 cm/day
DIFFUSION LAYER THICKNESS = .50 cm
DEPTH OF INCORPORATION = 55.000 m
RELEASE WIDTH = 10.0 m
AIR DIFFUSION COEF. = .7000E+04 cm^2/day
WATER DIFFUSION COEF. = .7000E+00 cm^2/day
INITIAL CONTAMINANT CONCENTRATION IN SOIL = 1 ug/cm^3

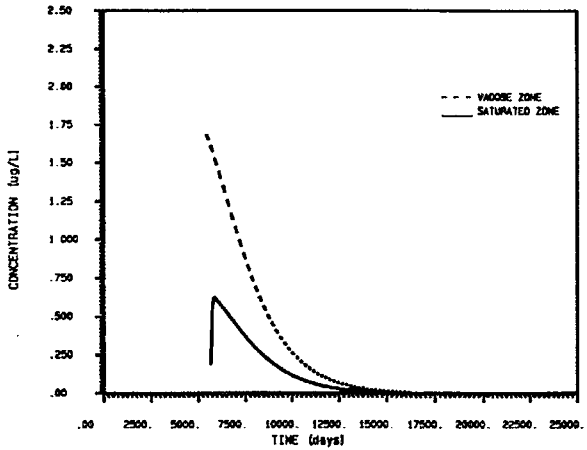
VADOSE-ZONE TIME TO PEAK = .1035E+05 days
VADOSE-ZONE PEAK CONCENTRATION = .7597E-03 ug/L
SATURATED-ZONE TIME TO PEAK = .1058E+05 days
SATURATED-ZONE PEAK CONCENTRATION = .2905E-03 ug/L
CELL THICKNESS AT COMPLIANCE POINT = 6.2 cm
CELL GPL NOT CALCULATED: GROUNDWATER NOT THREATENED

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

GROUNDWATER PROTECTION LEVEL MODEL



LIQUID PHASE CONCENTRATION VS TIME (CORRECTED TO INITIAL BREAKTHROUGH)



LIQUID PHASE CONCENTRATION VS TIME FOR VADOSE-ZONE AND SATURATED ZONE MODELS

SITE NAME / ID ____________________

ethylbenzene

KOC = .9500E+02 cm^3/g
KH = .2700E+00
HALF-LIFE (IN VADOSE ZONE) = .10E+04 days
HALF-LIFE (IN SATURATED ZONE) = .10E+04 days
GROUNDWATER STANDARD = 700.0000 ug/L
SOIL HEALTH-BASED GUIDANCE LEVEL = 12000.00 mg/kg

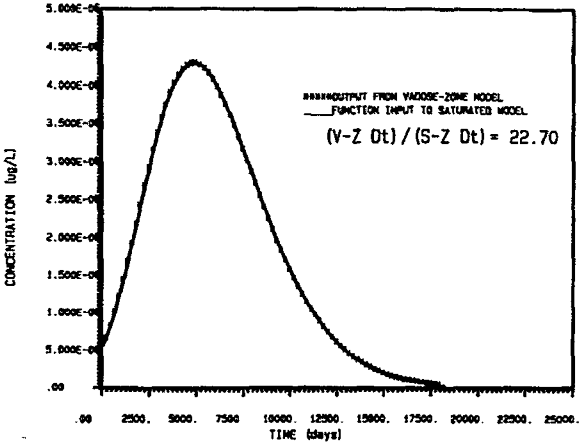
DEPTH TO GROUNDWATER = 70.0 m
AQUIFER MIXING-CELL FACTOR = 1.0
DISTANCE TO COMPLIANCE POINT = 12.0 m
BULK DENSITY = 1.50 g/cm^3
POROSITY = .25
SOIL FOC = .0010
AQUIFER FOC = .0010
SOIL MOISTURE CONTENT = .15
MOISTURE FLUX THROUGH WASTE CELL= .70E-02 cm/day
MOISTURE FLUX OUTSIDE WASTE CELL= .70E-02 cm/day
GROUNDWATER VELOCITY = 10.00 cm/day
DIFFUSION LAYER THICKNESS = .50 cm
DEPTH OF INCORPORATION = 55.000 m
RELEASE WIDTH = 10.0 m
AIR DIFFUSION COEF. = .7000E+04 cm^2/day
WATER DIFFUSION COEF. = .7000E+00 cm^2/day
INITIAL CONTAMINANT CONCENTRATION IN SOIL = 1 ug/cm^3

VADOSE-ZONE TIME TO PEAK = .5442E+04 days
VADOSE-ZONE PEAK CONCENTRATION = .1686E+01 ug/L
SATURATED-ZONE TIME TO PEAK = .5832E+04 days
SATURATED-ZONE PEAK CONCENTRATION = .6246E+00 ug/L
CELL THICKNESS AT COMPLIANCE POINT = 6.2 cm
CELL GPL = .6793E+03 mg/kg

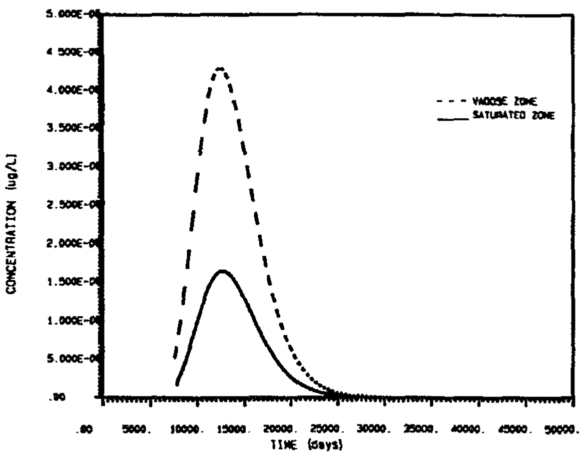
GPL = .2205E+06 mg/kg
(adjusted for .200E+02m perforated interval

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

GROUNDWATER PROTECTION LEVEL MODEL



LIQUID PHASE CONCENTRATION VS TIME (CORRECTED TO INITIAL BREAKTHROUGH)



LIQUID PHASE CONCENTRATION VS TIME FOR VADOSE-ZONE AND SATURATED ZONE MODELS

SITE NAME / ID ______________________

ethylbenzene

KOC = .9500E+02 cm^3/g
KH = .2700E+00
HALF-LIFE (IN VADOSE ZONE) = .10E+04 days
HALF-LIFE (IN SATURATED ZONE) = .10E+04 days
GROUNDWATER STANDARD = 700.0000 ug/L
SOIL HEALTH-BASED GUIDANCE LEVEL = 12000.00 mg/kg

DEPTH TO GROUNDWATER = 97.5 m
AQUIFER MIXING-CELL FACTOR = 1.0
DISTANCE TO COMPLIANCE POINT = 12.0 m
BULK DENSITY = 1.50 g/cm^3
POROSITY = .25
SOIL FOC = .0010
AQUIFER FOC = .0010
SOIL MOISTURE CONTENT = .15
MOISTURE FLUX THROUGH WASTE CELL= .70E-02 cm/day
MOISTURE FLUX OUTSIDE WASTE CELL= .70E-02 cm/day
GROUNDWATER VELOCITY = 10.00 cm/day
DIFFUSION LAYER THICKNESS = .50 cm
DEPTH OF INCORPORATION = 55.000 m
RELEASE WIDTH = 10.0 m
AIR DIFFUSION COEF. = .7000E+04 cm^2/day
WATER DIFFUSION COEF. = .7000E+00 cm^2/day
INITIAL CONTAMINANT CONCENTRATION IN SOIL = 1 ug/cm^3

VADOSE-ZONE TIME TO PEAK = .1257E+05 days
VADOSE-ZONE PEAK CONCENTRATION = .4291E-04 ug/L
SATURATED-ZONE TIME TO PEAK = .1275E+05 days
SATURATED-ZONE PEAK CONCENTRATION = .1641E-04 ug/L
CELL THICKNESS AT COMPLIANCE POINT = 6.2 cm
CELL GPL NOT CALCULATED: GROUNDWATER NOT THREATENED

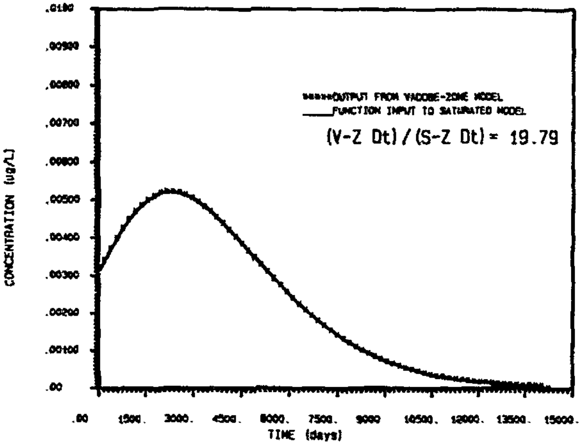
ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

GROUNDWATER PROTECTION LEVEL MODEL

SITE NAME / ID ______________________

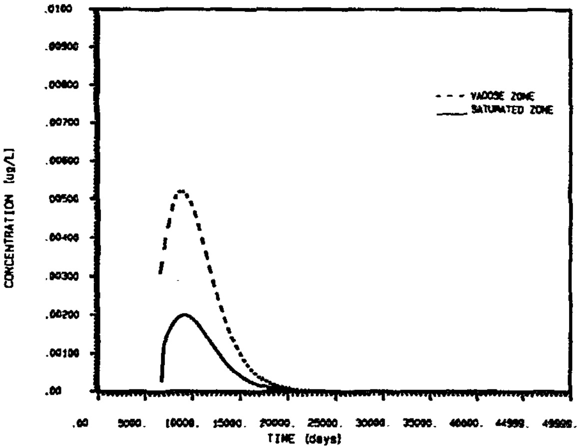
ethylbenzene

KOC = .9500E+02 cm^3/g
KH = .2700E+00
HALF-LIFE (IN VADOSE ZONE) = .10E+04 days
HALF-LIFE (IN SATURATED ZONE) = .10E+04 days
GROUNDWATER STANDARD = 700.0000 ug/L
SOIL HEALTH-BASED GUIDANCE LEVEL = 12000.00 mg/kg



LIQUID PHASE CONCENTRATION VS TIME (CORRECTED TO INITIAL BREAKTHROUGH)

DEPTH TO GROUNDWATER = 85.0 m
AQUIFER MIXING-CELL FACTOR = 1.0
DISTANCE TO COMPLIANCE POINT = 12.0 m
BULK DENSITY = 1.50 g/cm^3
POROSITY = .25
SOIL FOC = .0010
AQUIFER FOC = .0010
SOIL MOISTURE CONTENT = .15
MOISTURE FLUX THROUGH WASTE CELL= .70E-02 cm/day
MOISTURE FLUX OUTSIDE WASTE CELL= .70E-02 cm/day
GROUNDWATER VELOCITY = 10.00 cm/day
DIFFUSION LAYER THICKNESS = .50 cm
DEPTH OF INCORPORATION = 55.000 m
RELEASE WIDTH = 10.0 m
AIR DIFFUSION COEF. = .7000E+04 cm^2/day
WATER DIFFUSION COEF. = .7000E+00 cm^2/day
INITIAL CONTAMINANT CONCENTRATION IN SOIL = 1 ug/cm^3



LIQUID PHASE CONCENTRATION VS TIME FOR VADOSE-ZONE AND SATURATED ZONE MODELS

VADOSE-ZONE TIME TO PEAK = .8980E+04 days
VADOSE-ZONE PEAK CONCENTRATION = .5209E-02 ug/L
SATURATED-ZONE TIME TO PEAK = .9165E+04 days
SATURATED-ZONE PEAK CONCENTRATION = .1992E-02 ug/L
CELL THICKNESS AT COMPLIANCE POINT = 6.2 cm
CELL GPL = .2130E+06 mg/kg

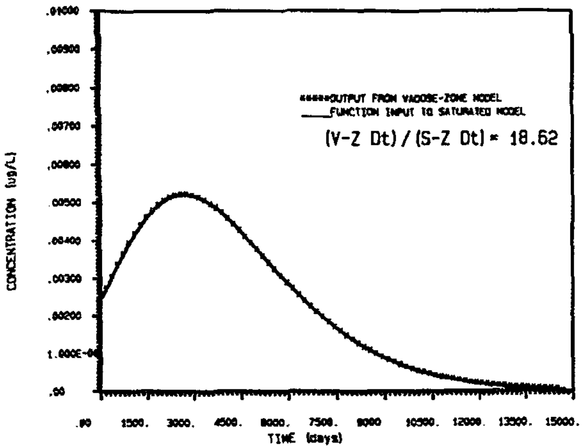
ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

GROUNDWATER PROTECTION LEVEL MODEL

SITE NAME / ID ______________________

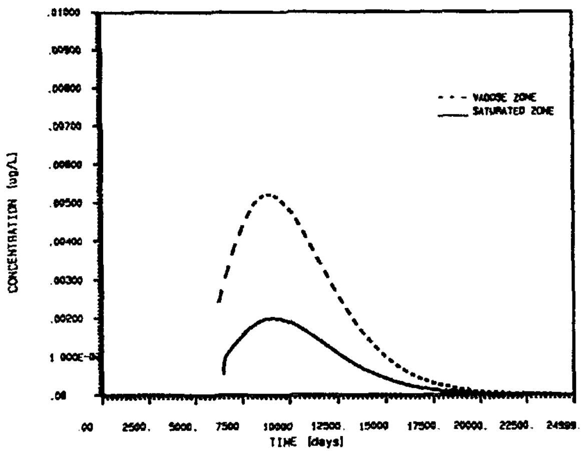
ethylbenzene

KOC = .9500E+02 cm³/g
KH = .2700E+00
HALF-LIFE (IN VADOSE ZONE) = .10E+04 days
HALF-LIFE (IN SATURATED ZONE) = .10E+04 days
GROUNDWATER STANDARD = 700.0000 ug/L
SOIL HEALTH-BASED GUIDANCE LEVEL = 12000.00 mg/kg



LIQUID PHASE CONCENTRATION VS TIME (CORRECTED TO INITIAL BREAKTHROUGH)

DEPTH TO GROUNDWATER = 80.0 m
AQUIFER MIXING-CELL FACTOR = 1.0
DISTANCE TO COMPLIANCE POINT = 12.0 m
BULK DENSITY = 1.50 g/cm³
POROSITY = .25
SOIL FOC = .0010
AQUIFER FOC = .0010
SOIL MOISTURE CONTENT = .15
MOISTURE FLUX THROUGH WASTE CELL= .70E-02 cm/day
MOISTURE FLUX OUTSIDE WASTE CELL= .70E-02 cm/day
GROUNDWATER VELOCITY = 10.00 cm/day
DIFFUSION LAYER THICKNESS = .50 cm
DEPTH OF INCORPORATION = 50.000 m
RELEASE WIDTH = 10.0 m
AIR DIFFUSION COEF. = .7000E+04 cm²/day
WATER DIFFUSION COEF. = .7000E+00 cm²/day
INITIAL CONTAMINANT CONCENTRATION IN SOIL = 1 ug/cm³



LIQUID PHASE CONCENTRATION VS TIME FOR VADOSE-ZONE AND SATURATED ZONE MODELS

VADOSE-ZONE TIME TO PEAK = .8825E+04 days
VADOSE-ZONE PEAK CONCENTRATION = .5209E-02 ug/L
SATURATED-ZONE TIME TO PEAK = .9147E+04 days
SATURATED-ZONE PEAK CONCENTRATION = .1992E-02 ug/L
CELL THICKNESS AT COMPLIANCE POINT = 6.2 cm
CELL GPL = .2130E+06 mg/kg

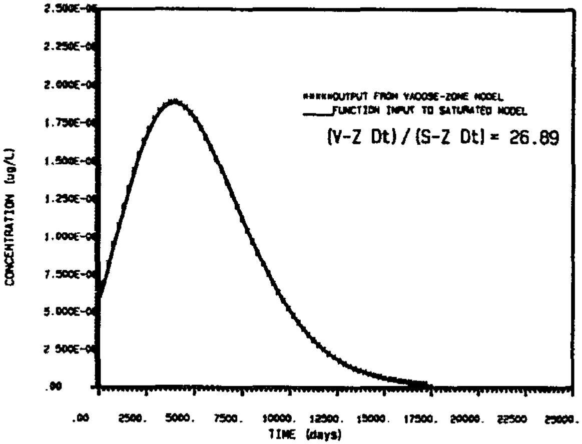
ATTACHMENT D

GPL Model Runs for Xylenes

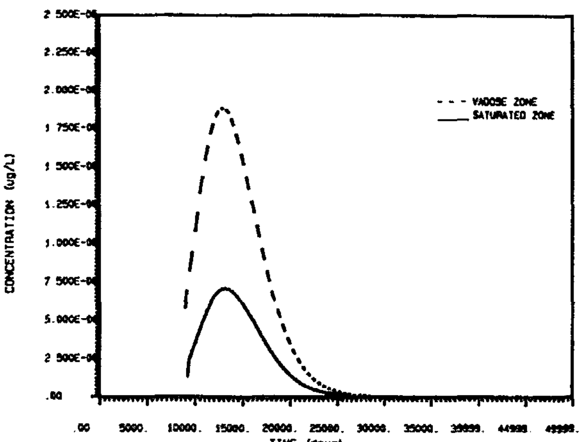
ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

GROUNDWATER PROTECTION LEVEL MODEL

SITE NAME / ID ______________________



LIQUID PHASE CONCENTRATION VS TIME (CORRECTED TO INITIAL BREAKTHROUGH)



LIQUID PHASE CONCENTRATION VS TIME FOR VADOSE-ZONE AND SATURATED ZONE MODELS

o-xylene

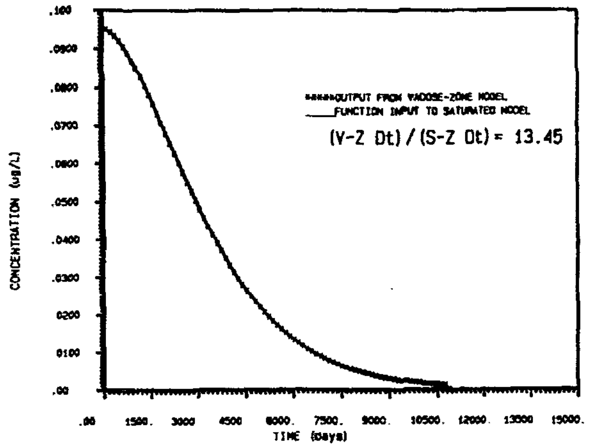
KOC = .1290E+03 cm³/g
KH (CALCULATED AS SVD/CS) = .2560E+00
SATURATED VAPOR DENSITY = .3840E-04 g/c
CHEMICAL SOLUBILITY ³= .1500E-03 g/cm
HALF-LIFE (IN VADOSE ZONE) = .10E+04 days
HALF-LIFE (IN SATURATED ZONE) = .10E+04 days
GROUNDWATER STANDARD = 10000.0000 ug/L
SOIL HEALTH-BASED GUIDANCE LEVEL = 230000.00 mg/kg

DEPTH TO GROUNDWATER = 100.0 m
AQUIFER MIXING-CELL FACTOR = 1.0
DISTANCE TO COMPLIANCE POINT = 12.0 m
BULK DENSITY = 1.50 g/cm³
POROSITY = .25
SOIL FOC = .0010
AQUIFER FOC = .0010
SOIL MOISTURE CONTENT = .15
MOISTURE FLUX THROUGH WASTE CELL= .70E-02 cm/day
MOISTURE FLUX OUTSIDE WASTE CELL= .70E-02 cm/day
GROUNDWATER VELOCITY = 10.00 cm/day
DIFFUSION LAYER THICKNESS = .50 cm
DEPTH OF INCORPORATION = 60.000 m
RELEASE WIDTH = 10.0 m
AIR DIFFUSION COEF. = .7000E+04 cm²/day
WATER DIFFUSION COEF. = .7000E+00 cm²/day
INITIAL CONTAMINANT CONCENTRATION IN SOIL = 1 ug/cm³

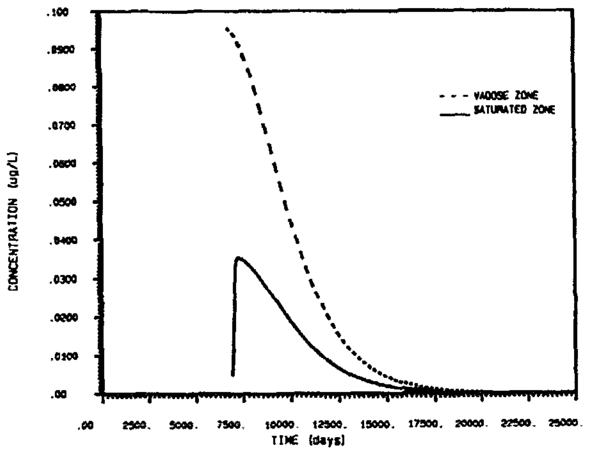
VADOSE-ZONE TIME TO PEAK = .1301E+05 days
VADOSE-ZONE PEAK CONCENTRATION = .1884E-04 ug/L
SATURATED-ZONE TIME TO PEAK = .1323E+05 days
SATURATED-ZONE PEAK CONCENTRATION = .7073E-05 ug/L
CELL THICKNESS AT COMPLIANCE POINT = 6.2 cm
CELL GPL NOT CALCULATED: GROUNDWATER NOT THREATENED

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

GROUNDWATER PROTECTION LEVEL MODEL



LIQUID PHASE CONCENTRATION VS TIME (CORRECTED TO INITIAL BREAKTHROUGH)



LIQUID PHASE CONCENTRATION VS TIME FOR VADOSE-ZONE AND SATURATED ZONE MODELS

SITE NAME / ID ______________________

o-xylene

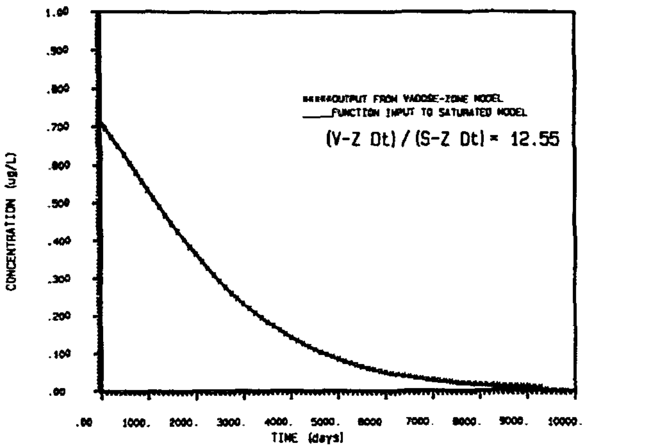
KOC = .1290E+03 cm^3/g
KH (CALCULATED AS SVD/CS) =.2560E+00
SATURATED VAPOR DENSITY = .3840E-04 g/c
CHEMICAL SOLUBILITY = .1500E-03 g/cm
HALF-LIFE (IN VADOSE ZONE) = .10E+04 days
HALF-LIFE (IN SATURATED ZONE) = .10E+04 days
GROUNDWATER STANDARD = 10000.0000 ug/L
SOIL HEALTH-BASED GUIDANCE LEVEL = 230000.00 mg/kg

DEPTH TO GROUNDWATER = 75.0 m
AQUIFER MIXING-CELL FACTOR = 1.0
DISTANCE TO COMPLIANCE POINT = 12.0 m
BULK DENSITY = 1.50 g/cm^3
POROSITY = .25
SOIL FOC = .0010
AQUIFER FOC = .0010
SOIL MOISTURE CONTENT = .15
MOISTURE FLUX THROUGH WASTE CELL= .70E-02 cm/day
MOISTURE FLUX OUTSIDE WASTE CELL= .70E-02 cm/day
GROUNDWATER VELOCITY = 10.00 cm/day
DIFFUSION LAYER THICKNESS = .50 cm
DEPTH OF INCORPORATION = 55.000 m
RELEASE WIDTH = 10.0 m
AIR DIFFUSION COEF. = .7000E+04 cm^2/day
WATER DIFFUSION COEF. = .7000E+00 cm^2/day
INITIAL CONTAMINANT CONCENTRATION IN SOIL = 1 ug/cm^3

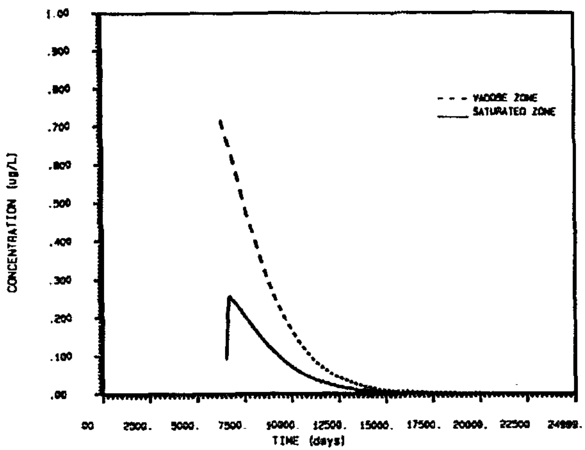
VADOSE-ZONE TIME TO PEAK = .6733E+04 days
VADOSE-ZONE PEAK CONCENTRATION = .9526E-01 ug/L
SATURATED-ZONE TIME TO PEAK = .7203E+04 days
SATURATED-ZONE PEAK CONCENTRATION = .3545E-01 ug/L
CELL THICKNESS AT COMPLIANCE POINT = 6.2 cm
CELL GPL = .1709E+06 mg/kg

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

GROUNDWATER PROTECTION LEVEL MODEL



LIQUID PHASE CONCENTRATION VS TIME (CORRECTED TO INITIAL BREAKTHROUGH)



LIQUID PHASE CONCENTRATION VS TIME FOR VADOSE-ZONE AND SATURATED ZONE MODELS

SITE NAME / ID ____________________

o-xylene

KOC = .1290E+03 cm^3/g
KH (CALCULATED AS SVD/CS) =.2560E+00
SATURATED VAPOR DENSITY = .3840E-04 g/c
CHEMICAL SOLUBILITY = .1500E-03 g/cm
HALF-LIFE (IN VADOSE ZONE) = .10E+04 days
HALF-LIFE (IN SATURATED ZONE) = .10E+04 days
GROUNDWATER STANDARD = 10000.0000 ug/L
SOIL HEALTH-BASED GUIDANCE LEVEL = 230000.00 mg/kg

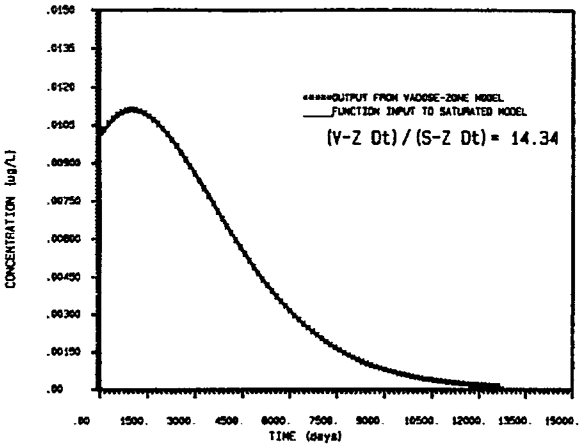
DEPTH TO GROUNDWATER = 70.0 m
AQUIFER MIXING-CELL FACTOR = 1.0
DISTANCE TO COMPLIANCE POINT = 12.0 m
BULK DENSITY = 1.50 g/cm^3
POROSITY = .25
SOIL FOC = .0010
AQUIFER FOC = .0010
SOIL MOISTURE CONTENT = .15
MOISTURE FLUX THROUGH WASTE CELL= .70E-02 cm/day
MOISTURE FLUX OUTSIDE WASTE CELL= .70E-02 cm/day
GROUNDWATER VELOCITY = 10.00 cm/day
DIFFUSION LAYER THICKNESS = .50 cm
DEPTH OF INCORPORATION = 55.000 m
RELEASE WIDTH = 10.0 m
AIR DIFFUSION COEF. = .7000E+04 cm^2/day
WATER DIFFUSION COEF. = .7000E+00 cm^2/day
INITIAL CONTAMINANT CONCENTRATION IN SOIL = 1 ug/cm^3

VADOSE-ZONE TIME TO PEAK = .6285E+04 days
VADOSE-ZONE PEAK CONCENTRATION = .7156E+00 ug/L
SATURATED-ZONE TIME TO PEAK = .6715E+04 days
SATURATED-ZONE PEAK CONCENTRATION = .2570E+00 ug/L
CELL THICKNESS AT COMPLIANCE POINT = 6.2 cm
CELL GPL = .2358E+05 mg/kg

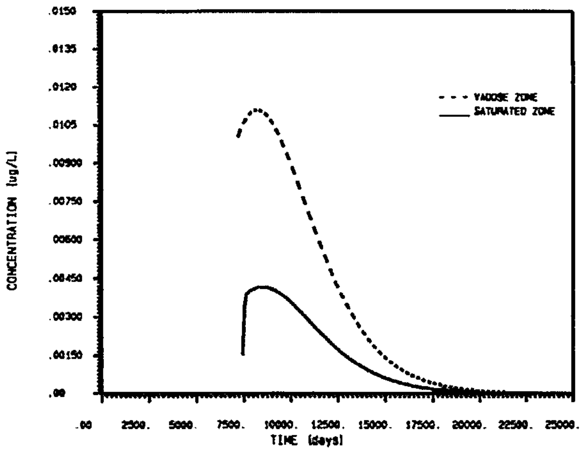
ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

GROUNDWATER PROTECTION LEVEL MODEL

SITE NAME / ID ______________________



LIQUID PHASE CONCENTRATION VS TIME (CORRECTED TO INITIAL BREAKTHROUGH)



LIQUID PHASE CONCENTRATION VS TIME FOR VADOSE-ZONE AND SATURATED ZONE MODELS

o-xylene

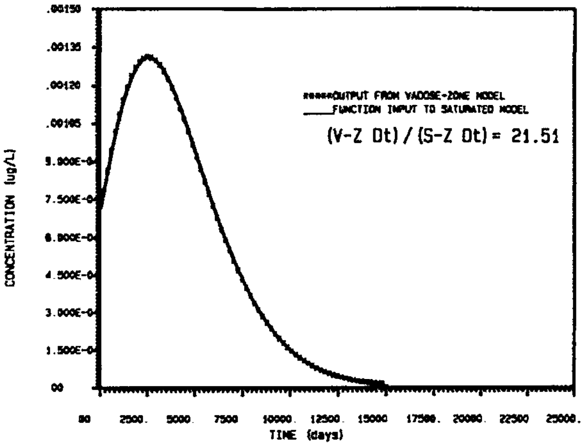
KOC = .1290E+03 cm^3/g
KH (CALCULATED AS SVD/CS) =.2560E+00
SATURATED VAPOR DENSITY = .3840E-04 g/c
CHEMICAL SOLUBILITY ^{3}= .1500E-03 g/cm
HALF-LIFE (IN VADOSE ZONE) = .10E+04 days
HALF-LIFE (IN SATURATED ZONE) = .10E+04 days
GROUNDWATER STANDARD = 10000.0000 ug/L
SOIL HEALTH-BASED GUIDANCE LEVEL = 230000.00 mg/kg

DEPTH TO GROUNDWATER = 80.0 m
AQUIFER MIXING-CELL FACTOR = 1.0
DISTANCE TO COMPLIANCE POINT = 12.0 m
BULK DENSITY = 1.50 g/cm^3
POROSITY = .25
SOIL FOC = .0010
AQUIFER FOC = .0010
SOIL MOISTURE CONTENT = .15
MOISTURE FLUX THROUGH WASTE CELL= .70E-02 cm/day
MOISTURE FLUX OUTSIDE WASTE CELL= .70E-02 cm/day
GROUNDWATER VELOCITY = 10.00 cm/day
DIFFUSION LAYER THICKNESS = .50 cm
DEPTH OF INCORPORATION = 55.000 m
RELEASE WIDTH = 10.0 m
AIR DIFFUSION COEF. = .7000E+04 cm^2/day
WATER DIFFUSION COEF. = .7000E+00 cm^2/day
INITIAL CONTAMINANT CONCENTRATION IN SOIL = 1 ug/cm^3

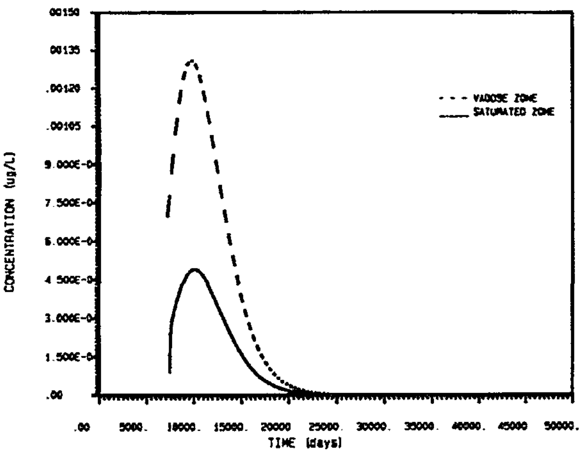
VADOSE-ZONE TIME TO PEAK = .8185E+04 days
VADOSE-ZONE PEAK CONCENTRATION = .1109E-01 ug/L
SATURATED-ZONE TIME TO PEAK = .8491E+04 days
SATURATED-ZONE PEAK CONCENTRATION = .4161E-02 ug/L
CELL THICKNESS AT COMPLIANCE POINT = 6.2 cm
CELL GPL NOT CALCULATED: GROUNDWATER NOT THREATENED

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

GROUNDWATER PROTECTION LEVEL MODEL



LIQUID PHASE CONCENTRATION VS TIME (CORRECTED TO INITIAL BREAKTHROUGH)



LIQUID PHASE CONCENTRATION VS TIME FOR VADOSE-ZONE AND SATURATED ZONE MODELS

SITE NAME / ID ____________________

o-xylene

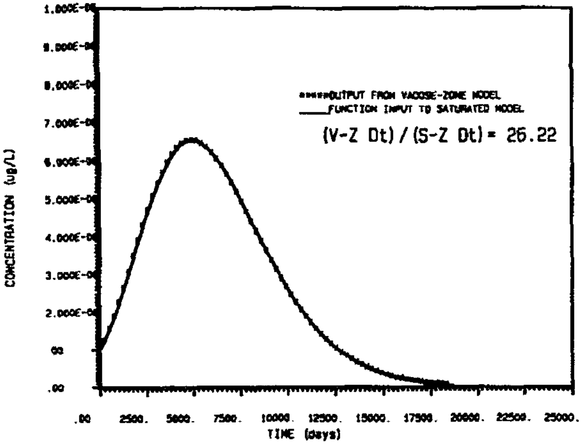
KOC = .1290E+03 cm^3/g
KH (CALCULATED AS SVD/CS) = .2560E+00
SATURATED VAPOR DENSITY = .3840E-04 g/c
CHEMICAL SOLUBILITY ^{3}= .1500E-03 g/cm
HALF-LIFE (IN VADOSE ZONE) = .10E+04 days
HALF-LIFE (IN SATURATED ZONE) = .10E+04 days
GROUNDWATER STANDARD = 10000.0000 ug/L
SOIL HEALTH-BASED GUIDANCE LEVEL = 230000.00 mg/kg

DEPTH TO GROUNDWATER = 80.0 m
AQUIFER MIXING-CELL FACTOR = 1.0
DISTANCE TO COMPLIANCE POINT = 12.0 m
BULK DENSITY = 1.50 g/cm^3
POROSITY = .25
SOIL FOC = .0010
AQUIFER FOC = .0010
SOIL MOISTURE CONTENT = .15
MOISTURE FLUX THROUGH WASTE CELL= .70E-02 cm/day
MOISTURE FLUX OUTSIDE WASTE CELL= .70E-02 cm/day
GROUNDWATER VELOCITY = 10.00 cm/day
DIFFUSION LAYER THICKNESS = .50 cm
DEPTH OF INCORPORATION = 50.000 m
RELEASE WIDTH = 10.0 m
AIR DIFFUSION COEF. = .7000E+04 cm^2/day
WATER DIFFUSION COEF. = .7000E+00 cm^2/day
INITIAL CONTAMINANT CONCENTRATION IN SOIL = 1 ug/cm^3

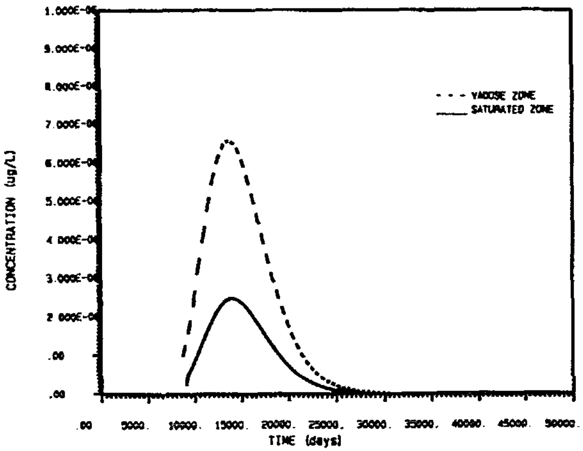
VADOSE-ZONE TIME TO PEAK = .9763E+04 days
VADOSE-ZONE PEAK CONCENTRATION = .1309E-02 ug/L
SATURATED-ZONE TIME TO PEAK = .1005E+05 days
SATURATED-ZONE PEAK CONCENTRATION = .4914E-03 ug/L
CELL THICKNESS AT COMPLIANCE POINT = 6.2 cm
CELL GPL NOT CALCULATED: GROUNDWATER NOT THREATENED

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

GROUNDWATER PROTECTION LEVEL MODEL



LIQUID PHASE CONCENTRATION VS TIME (CORRECTED TO INITIAL BREAKTHROUGH)



LIQUID PHASE CONCENTRATION VS TIME FOR VADOSE-ZONE AND SATURATED ZONE MODELS

SITE NAME / ID ______________________

o-xylene

KOC = .1290E+03 cm^3/g
KH (CALCULATED AS SVD/CS) = .2560E+00
SATURATED VAPOR DENSITY = .3840E-04 g/c
CHEMICAL SOLUBILITY = .1500E-03 g/cm^3
HALF-LIFE (IN VADOSE ZONE) = .10E+04 days
HALF-LIFE (IN SATURATED ZONE) = .10E+04 days
GROUNDWATER STANDARD = 10000.0000 ug/L
SOIL HEALTH-BASED GUIDANCE LEVEL = 230000.00 mg/kg

DEPTH TO GROUNDWATER = 97.5 m
AQUIFER MIXING-CELL FACTOR = 1.0
DISTANCE TO COMPLIANCE POINT = 12.0 m
BULK DENSITY = 1.50 g/cm^3
POROSITY = .25
SOIL FOC = .0010
AQUIFER FOC = .0010
SOIL MOISTURE CONTENT = .15
MOISTURE FLUX THROUGH WASTE CELL= .70E-02 cm/day
MOISTURE FLUX OUTSIDE WASTE CELL= .70E-02 cm/day
GROUNDWATER VELOCITY = 10.00 cm/day
DIFFUSION LAYER THICKNESS = .50 cm
DEPTH OF INCORPORATION = 55.000 m
RELEASE WIDTH = 10.0 m
AIR DIFFUSION COEF. = .7000E+04 cm^2/day
WATER DIFFUSION COEF. = .7000E+00 cm^2/day
INITIAL CONTAMINANT CONCENTRATION IN SOIL = 1 ug/cm^3

VADOSE-ZONE TIME TO PEAK = .1373E+05 days
VADOSE-ZONE PEAK CONCENTRATION = .6559E-05 ug/L
SATURATED-ZONE TIME TO PEAK = .1400E+05 days
SATURATED-ZONE PEAK CONCENTRATION = .2462E-05 ug/L
CELL THICKNESS AT COMPLIANCE POINT = 6.2 cm
CELL GPL NOT CALCULATED: GROUNDWATER NOT THREATENED