AD-A120 953 INSTALLATION RESTORATION PROGRAM RECORDS SEARCH FOR LUKE AIR FORCE BASE ARIZONA(U) CH2M HILL GAINESVILLE FL JUN 82 F08637-80-G-0010

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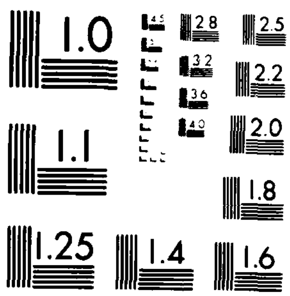

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INSTALLATION RESTORATION PROGRAM RECORDS SEARCH

For
Luke Air Force Base, Arizona

CH2M HILL

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Prepared for

AIR FORCE ENGINEERING AND SERVICES CENTER
DIRECTORATE OF ENVIRONMENTAL PLANNING
TYNDALL AIR FORCE BASE, FLORIDA 32403

JUNE 1982

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NOTICE

This report has been prepared for the United States Air Force by CH2M HILL SOUTHEAST, INC., for the purpose of aiding in the implementation of the Air Force Installation Restoration Program. It is not an endorsement of any product. The views expressed herein are those of the contractor and do not necessarily reflect the official views of the publishing agency, the United States Air Force, or the Department of Defense.

INSTALLATION RESTORATION
PROGRAM RECORDS SEARCH

For

LUKE AIR FORCE BASE, ARIZONA

Prepared for

AIR FORCE ENGINEERING AND SERVICES CENTER
DIRECTORATE OF ENVIRONMENTAL PLANNING
TYNDALL AIR FORCE BASE, FLORIDA 32403

By

CH2M HILL
Gainesville, Florida

~~February~~ 1982

Contract No. F0863780 G0010 0007

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FOREWORD

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LIST OF ACRONYMS, ABBREVIATIONS, AND SYMBOLS USED IN THE TEXT

LIST OF ACRONYMS, ABBREVIATIONS, AND SYMBOLS USED IN THE TEXT

AAA	Aircraft Aerial Attack
ACM	Air Combat Maneuvering
ACMR	Air Combat Maneuvering Range
AFAF	Air Force Auxiliary Field
AFB	Air Force Base
AFESC	Air Force Engineering and Services Center
AFFF	Aqueous Film-Forming Foam
AFRES	Air Force Reserve
AFTEC	Air Force Test and Evaluation Center
AGE	Aerospace Ground Equipment
AGL	Above Ground Level
AGS	Aircraft Generation Squadron
AUX	Auxiliary
AVGAS	Aviation Gasoline
Bldg.	Building
CE	Civl Engineering
CES	Civil Engineering Squadron
cm/s	centimeters per second
CRS	Component Repair Squadron
CSG	Combat Support Group
DEQPPM	Defense Environmental Quality Program Policy Memorandum
DoD	Department of Defense
DPDO	Defense Property Disposal Office
ECM	Electronic Counter Measures
EMS	Equipment Maintenance Squadron
EOD	Explosive Ordnance Disposal
EPA	Environmental Protection Agency
EW	Electronic Warfare
FAA	Federal Aviation Administration
FAC	Facility
ft/min	feet per minute
gal/mo	gallons per month
GAT	Ground Attack Tactical
gpm	gallons per minute
gpy	gallons per year
IRP	Installation Restoration Program
JP	Jet Petroleum
LAAMBn	Light Anti-Aircraft Missile Battalion
LAS	Lockheed Aircraft Service
lb/yr	pounds per year
MCAS	Marine Corp Air Station
MEK	Methyl ethyl ketone
mg/l	milligrams per liter
MOGAS	Motor gasoline
NDI	Non-Destructive Inspection
NM	Nautical mile
No.	Number

NORAD	North American Air Defense
NTACRg	North Tactical Range
OEHL	Occupational and Environmental Health Laboratory
OPS	Operations
ppm	parts per million
PCB	Polychlorinated Biphenyl
PMEL	Precision Measurement Equipment Laboratory
POL	Petroleum, oil, and lubricants
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RTO	Range Training Officer
RWR	Radar Warning Receiver
SAM	Surface to Air Missile
sf	square foot (feet)
STACRg	South Tactical Range
TAC	Tactical Air Command
TCE	Trichloroethylene
TDS	Total dissolved solids
TTL	Tactical Training Luke
TTS	Tactical Training Squadron
TTW	Tactical Training Wing
UHF	Ultra-high frequency
USAF	United States Air Force
USMC	United States Marine Corp
USN	United States Navy
WCACMR	West Coast Air Combat Maneuvering Range

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

A. INTRODUCTION

1. CH2M HILL was retained by the Air Force Engineering and Services Center (AFESC), using funding provided by the Tactical Air Command (TAC), on August 27, 1981 to conduct the Luke Air Force Base (Luke AFB) records search under Contract No. F08637-80-G0010-0007.

2. Department of Defense (DoD) policy was directed by Defense Environmental Quality Program Policy Memorandum 81-5 dated 11 December 1981 and implemented by Air Force message dated 21 January 1982 as a positive action to ensure compliance of military installations with existing environmental regulations. DEQPPM 81-5 reissued and amplified all previous directives and memoranda on the Installation Restoration Program. The purpose of DoD policy is to identify and full evaluate suspected problems associated with past hazardous material disposal sites on DoD facilities, control the migration of hazardous contamination from such facilities, and control hazards to health and welfare that may have resulted from these past operations.

3. To implement the DoD policy, a four-phase Installation Restoration Program has been directed. Phase I, the records search, is the identification of potential problems. Phase II (not part of this contract) consists of follow-on field work as determined from Phase I. Phase IIa. consists of a preliminary survey to confirm or rule out the presence and/or migration of contaminants. If the Phase IIa. work confirms the presence and/or migration of contaminants, then Phase IIb. field work would be conducted to determine the extent and magnitude of the contaminant migration. Phase III (not part of this contract) consists of a technology base development study to support the development of project plans for controlling migration or restoring the installation. Phase IV (not part of this contract) includes those efforts which are required to control identified hazardous conditions.

4. The Luke AFB records search included a detailed review of pertinent installation records, contacts with 18 government agencies for documents and information relevant to the records search effort, and an onsite base visit conducted by CH2M HILL during the week of October 26 through October 30,

1981. Activities conducted during the onsite base visit included interviews with 35 past and present base employees, ground tours of base facilities, and a helicopter overflight to identify past disposal areas. Installations addressed in the Records Search include Luke Air Force Base, Gila Bend Air Force Auxiliary Field, Luke Air Force Range, Fort Tuthill Recreation Annex, Air Force Auxiliary Field No. 1, Sanitary Landfill Annex, Waste Treatment Annex, Holbrook Radar Bomb Scoring Range, and Humbolt Mountain Radar Site.

B. MAJOR FINDINGS

1. The major industrial operations at Luke AFB involving hazardous ~~chemicals~~ and wastes have been in existence since reactivation of the base in 1951 and include aircraft corrosion control, pneudraulics repair, AGE inspection and repair, the Transportation Division vehicle maintenance shops, and Lockheed Aircraft Services. During the early years of the base, 1941 to 1946, industrial operations and related wastes were comparatively small. Since no large-scale industrial operations have been conducted at Luke AFB, the quantities of waste oils, solvents, paint residues, and thinners generated have been small. The standard procedure for disposition of the majority of waste oils and solvents in the past has been (1) fire department training exercises (1941-1946); (2) road oiling (1951-1970); (3) shallow disposal trenches (1970-1972); (4) collection in Facility 993 storage tanks and sale to recycling contractors (1972-1980); and (5) since 1980, segregation of POL wastes and sale to recycling contractors (salvageable wastes) or contractor disposal to an approved offbase site (unsalvageable wastes).

2. Interviews with 35 past and present base employees resulted in the identification of 16 past disposal or spill sites and the approximate dates that these sites were used. These sites include one former incinerator site, two former landfills; two former POL waste disposal sites; two former fire department training areas; two aircraft burial sites; three burial sites for concrete rubble, scrap lumber, and old parts; two fuel spill sites; and one former EOD burial site. A former out-of-service transformer storage area was also identified.

3. In general, the landfills were used for disposal of non-putrescible base generated refuse. A small quantity of low level radioactive electron tubes was also disposed of at one of the landfills. The

POL waste disposal areas included surface application to the perimeter road around the runway at the western portion of the base, and disposal into shallow trenches in a triangular area in the southern portion of the base. Although the majority of the POL waste consisted of contaminated JP-4, some waste solvents from the industrial operations were also disposed of in the above areas and may have included (unconfirmed) methyl ethyl ketone (MEK), trichloroethane, trichloroethylene (TCE), toluene, acetone, cresylic acid, o-dichlorobenzene, phenolic paint strippers, and paint residues and thinners. Leaded tank sludge from the cleaning of AVGAS storage tanks were also disposed of in the above areas.

4. The presence of subsidence fissures in the area surrounding Luke AFB provides a possible direct pathway from the surface to the water table. However, the subsidence fissures are remote from the identified disposal sites and, therefore, do not contribute to the potential for migration of contaminants from these sites. The major concerns related to subsidence fissure pathways are the base drainage ditches that flow through this area.

5. Interviews with past and present base employees resulted in the identification of three past landfill sites at Gila Bend Air Force Auxiliary Field (Gila Bend AFAF), and 24 known past and present expended ordnance disposal sites at Luke Air Force Range (Luke AFR).

C. CONCLUSIONS

1. No direct evidence indicates migration of hazardous contamination beyond Luke AFB properties.

2. The potential for migration of hazardous contaminants at Luke AFB is low because of (1) low ground-water table, (2) extremely low precipitation, (3) extremely high evapotranspiration, and (4) presence of a ground-water table depression below the base which would tend to prevent migration of contaminants beyond the base. Although low, the potential for migration does exist because of (1) moderate permeability of the soil, and (2) the absence of continuous impermeable confining strata in the unsaturated zone above the water table.

3. As a result of large-scale off-base agricultural withdrawals, a large cone of depression has formed around the Luke AFB area. Consequently, ground water flows toward Luke AFB from all directions.

4. Although no high priority sites were identified, the following disposal sites were designated as areas showing the most significant potential (relative to other Luke AFB sites) for contaminant migration.

   o <u>Site No. 4 (Perimeter Road POL Waste Application Site) and Site No. 5 (POL Waste Disposal Trench Site)</u>

     The above sites (shown on Figure 15) were used for disposal of the majority of the base POL wastes from 1951 until 1972, including leaded tank sludge from AVGAS storage tank cleaning operations and waste solvents from the industrial areas. Of particular concern are the waste solvents, especially chlorinated solvents, which would tend to persist and may possibly be migrating through the unsaturated zone above the water table. Site No. 5 has a higher potential for contaminant migration than Site No. 4 since the POL wastes at Site No. 5 were concentrated in a small area (trenches) relative to Site No. 4 (perimeter road). Site No. 5 also contained a shallow lagoon for POL waste disposal which was located very close (less than 200 feet) to Luke AFB drinking water supply Well No. 11.

5. Other environmental concerns include the base drainage ditch effluents (subsidence fissures) and the base sewage treatment plant effluent (discharge to the Agua Fria River). Based on a review of industrial operations at the base, the potential for significant concentrations of hazardous contaminants being present in the drainage ditch effluents or the treated effluent from the sewage treatment plant appears to be low. However, this needs to be verified.

6. The records search did not indicate any significant potential for migration of hazardous contaminants from any of the identified disposal sites at Gila Bend AFAF or Luke AFR. However, some of the treated sewage in the Gila Bend AFAF treatment lagoons may potentially migrate to the water table by percolation. Based on a review of industrial operations, the potential for significant concentrations of hazardous contaminants being present in the treated effluent appears to be low. However, this needs to be verified.

7. The remaining sites identified at Luke AFB and the auxiliary installations are not considered to pose a contaminant migration problem.

D. RECOMMENDATIONS

1. Phase II Program

To verify that hazardous contaminant migration is not a problem at Luke AFB Site No. 5, a limited Phase II program is advisable. The recommended program includes the following:

a. Soil sampling is recommended at Site No. 5, the POL Waste Disposal Trench Site, to determine if contaminant migration is occurring in the unsaturated zone above the water table. Three 200-foot soil borings should be made at the northeast corner of the site, and five soil samples from each boring location (total of 15 samples) should be analyzed for COD, TOC, oil and grease, lead, phenols, and volatile organic compounds (including trichloroethane, TCE, toluene, o-dichlorobenzene and carbon tetrachloride).

b. Details of the program outlined above, including the exact location of the soil sampling points, should be finalized as part of the Phase II program.

c. In the event that contaminants are detected in the soil samples, a more extensive field survey program should be implemented to determine the extent of contaminant migration. The Phase II contractor should be responsible for evaluating the results of the program outlined above and for recommending additional monitoring, as appropriate.

~~2.~~ In-House Environmental Monitoring Program

To verify that hazardous contaminant migration is not a problem with the Luke AFB drainage ditches, the Luke AFB sewage treatment plant effluent, and the Gila Bend AFAF sewage treatment lagoons, the following routine monitoring should be conducted by the base.

a. The base should continue its program of comprehensive sampling and analysis of active drinking water wells, including wells at Luke AFB and Gila Bend AFAF. It is recommended that a volatile organic compound analysis be included in addition to the analyses currently performed. This monitoring is recommended as a precautionary measure to determine if a long-term contaminant migration potential exists.

b. The treated effluents from the Luke AFB sewage treatment plant and the Gila Bend AFAF treatment lagoons should be sampled and analyzed to establish a baseline for heavy metals, phenols, and volatile organic compounds. This monitoring is recommended as a precautionary measure to ensure that the above effluents do not contain hazardous contaminants which could migrate to the Agua Fria River (Luke AFB) or to the water table (Gila Bend AFAF). Monitoring should be continued periodically.

c. A waste sludge sample from the Luke AFB sewage treatment plant should be collected and analyzed for hazardous contaminants.

d. The base drainage ditch effluents should be monitored to establish a baseline for heavy metals, volatile organic compounds, phenols, COD, TOC, and oil and grease to ensure that the drainage ditch effluents do not contain hazardous contaminants which could possibly migrate to the water table through subsidence fissures. Monitoring should be continued periodically after rainfall events.

e. In the event that hazardous contaminants are detected in the routine monitoring conducted by the base, a risk assessment should be made to determine follow-on action.

3. Since no imminent hazard has been determined, there is no immediate urgency to conduct the above program, which can be implemented as financial resources become available.

I. INTRODUCTION

I. INTRODUCTION

A. Background

The primary legislation governing the management and disposal of solid waste is the Resource Conservation and Recovery Act (RCRA) of 1976. Regulations and implementing instructions for the Act are continuing to be developed by EPA. Under RCRA Section 3012 (Public Law 96-482, October 21, 1981) each state is required to inventory all past and present hazardous waste disposal sites. Section 6003 of RCRA requires Federal agencies to assist EPA and make available all requested information on past disposal practices. It is the intent of the Department of Defense (DoD) to comply fully in these as well as other requirements of RCRA. Simultaneous to the passage of RCRA, the DoD devised a comprehensive Installation Restoration Program (IRP). The purpose of the IRP is to identify, report, and correct environmental deficiencies from past disposal practices that could result in ground-water contamination and probable migration of contaminants beyond DoD installation boundaries. In response to RCRA and in anticipation of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, the DoD issued Defense Environmental Quality Program Policy Memorandum 81-5 (DEQPPM 81-5) on 11 December 1981 which was implemented by Air Force message dated 21 January 1982. DEQPPM 81-5 reissued and amplified all previous directives and memoranda on the Installation Restoration Program.

To conduct the Installation Restoration Program records search for Luke AFB, the AFESC retained CH2M HILL on August 27, 1981 under Contract No. F08637-80-G0010-0007. Funding for the project was provided by the Tactical Air Command. The installations included in the records search are Luke AFB and several offsite facilities which are supported by Luke AFB (Figure 1) as follows:

1. Gila Bend Air Force Auxiliary Field
2. Luke Air Force Range
3. Fort Tuthill Recreation Annex
4. Air Force Auxiliary Field No. 1
5. Sanitary Landfill Annex
6. Waste Treatment Annex
7. Holbrook Radar Bomb Scoring Range
8. Humbolt Mountain Radar Site

The records search comprises Phase I of the Department of Defense (DoD) Installation Restoration Program and is intended to review installation records to identify possible hazardous waste contaminated sites and potential problems that may result in contaminant migration from the installation. Phase II (not part of this contract) consists of follow-on field work as determined from Phase I. Phase IIa. consists of a preliminary survey to confirm or rule out the presence and/or migration of contaminants. If the Phase IIa. work confirms the presence and/or migration of contaminants, then Phase IIb. field work would be conducted to determine the extent and magnitude of the contaminant migration. Phase III (not part of this contract) consists of a technology base development study to support the development of project plans for controlling migration or restoring the installation. Phase IV (not part of this contract) includes those efforts which are required to control identified hazardous conditions.

B. <u>Authority</u>

The identification of hazardous waste disposal sites at military installations was directed by Defense Environmental Quality Program Policy Memorandum 81-5 (DEQPPM 81-5) dated 11 December 1981, and implemented by Air Force message dated 21 January 1982 as a positive action to ensure compliance of military installations with existing environmental regulations.

C. <u>Purpose of the Records Search</u>

DoD policy is to identify and fully evaluate suspected problems associated with past hazardous material disposal sites on DoD facilities, control the migration of hazardous contamination from such facilities, and control hazards to health or welfare that may have resulted from those past operations. The potential for adverse impact was evaluated at Luke AFB by reviewing the existing information and conducting a detailed analysis of installation records. Pertinent information involves the history of operations, the geological and hydrogeological conditions which may contribute to the migration of contaminants off the installation, and the ecological settings which indicate sensitive habitats or evidence of environmental stress resulting from contaminants.

D. <u>Scope</u>

The records search consisted of a pre-performance meeting, a preliminary coordination meeting, an onsite base visit, a review and analysis of the information obtained, and preparation of this report.

The pre-performance meeting was held at Nellis AFB, Nevada on August 17, 1981. Attendees at this meeting included representatives of AFESC, USAF OEHL, Tactical Air Command

(TAC), Luke AFB, and CH2M HILL. The purpose of the pre-performance meeting was to provide detailed project instructions for the records search, to provide clarification and technical guidance by AFESC, and to define the responsibilities of all parties participating in the Luke AFB records search.

A CH2M HILL representative conducted a preliminary visit to Luke AFB on October 13 and 14, 1981 to become familiar with the installation and to effect coordination for the records search team onsite base visit.

The onsite base visit was conducted by CH2M HILL from October 26 through October 30, 1981. Activities performed during the onsite visit included a detailed search of installation records, ground and aerial tours of the installation, and interviews with 35 former and present base personnel. At the conclusion of the onsite base visit, an outbriefing was held with the Commander of the 832nd Combat Support Group and members of his staff to discuss preliminary findings. The following individuals comprised the CH2M HILL Records Search team:

1. Mr. Norman Hatch, Project Manager (M.S. Chemistry, 1972; M.S. Environmental Engineering, 1973)

2. Mr. Ken Cable, Assistant Project Manager (M.E. Civil Engineering, 1980)

3. Mr. Gary Eichler, Hydrogeologist (M.S. Engineering Geology, 1974)

4. Mr. Brian Winchester (B.S. Wildlife Ecology, 1973)

Resumes of these team members are included in Appendix A.

Eighteen government agencies were contacted for documents and information relevant to the records search effort. Appendix B lists the agencies contacted during the records search.

Individuals from the Air Force who assisted in the Luke AFB records search included the following:

1. Mr. Bernard Lindenberg, AFESC, Program Manager, Phase I

2. Mr. Myron Anderson, AFESC, Environmental Engineer

3. Mr. Gil Burnet, TAC, Command Representative, Phase I

4. Mr. John Forrest, Luke AFB, Environmental Coordinator

5. Major Gary Fishburn, USAF OEHL, Program Manager, Phase II

6. Capt. Dennis Brownley, Luke AFB, Chief of Bioenvironmental Engineering.

E. Methodology

The methodology utilized in the Luke AFB records search is shown graphically on Figure 2. First, a review of past and present industrial operations is conducted at the base. Information is obtained from available records such as shop files and real property files, as well as interviews with past and present base employees from the various operating areas of the base. A list of the type of interviewees from Luke AFB (total of 35 interviewees), including areas of knowledge and years of employment, is given in Appendix C.

The next step in the activity review process is to determine the past management practices regarding the use, storage, treatment, and disposal of hazardous materials from the various industrial operations on the base. Included in this part of the activity review is the identification of all past landfill sites and burial sites; as well as any other possible sources of contamination such as major PCB or solvent spills, or fuel-saturated areas resulting from large fuel spills or leaks.

A helicopter overflight and a general ground tour of identified sites are then made by the records search team to gather site-specific information including evidence of environmental stress and the presence of nearby drainage ditches or surface-water bodies, and to visually inspect these water bodies for any obvious signs of contamination or leachate migration.

A decision is then made, based on all of the above information, whether a potential exists for hazardous material contamination in any of the identified sites. If not, the site is deleted from further consideration. If minor operations and maintenance deficiencies are noted during the investigations, the condition is reported to the Base Environmental Coordinator for remedial action.

For those sites where a potential for contamination is identified, a determination of the potential for migration of the contamination off the installation boundaries is made by considering site-specific soil and ground-water conditions. If there is potential for on-base contaminant migration or other environmental concerns, the site is referred to the base environmental monitoring program for further action. If no further environmental concerns are identified, the site is deleted from further consideration. If the potential for contaminant migration is considered significant, then the site is rated and prioritized using the site rating methodology described in Appendix L "Site Hazard Evaluation Methodology."

The site rating indicates the relative potential for environmental impact at each site. For those sites showing a high potential, recommendations are made to quantify the potential contaminant migration problem under Phase II of the Installation Restoration Program. For those sites showing a medium potential, a limited Phase II program may be advisable to confirm that a serious contaminant migration problem does not exist. For those sites showing a low potential, no Phase II work would be recommended.

II. INSTALLATION DESCRIPTION

II. INSTALLATION DESCRIPTION

A. LOCATION

Luke Air Force Base is located on 4,198 acres of land in Maricopa County, Arizona, 13 miles west of downtown Phoenix. The cities of Sun City, Sun City West, and Litchfield Park are located northeast, north, and south, respectively, of the base; and the White Tank Mountains are located west of the base. Luke Air Force Base also supports the following offsite facilities:

1. Gila Bend Air Force Auxiliary Field
2. Luke Air Force Range
3. Auxiliary Field No. 1 (now closed)
4. Holbrook Radar Bomb Scoring Range
5. Fort Tuthill Recreation Annex
6. Sanitary Landfill Annex
7. Waste Treatment Annex
8. Humbolt Mountain Radar Site

The locations of these facilities are shown on Figure 1.

B. ORGANIZATION AND MISSION

Construction of Luke AFB began in March of 1941 after the land had been acquired from the City of Phoenix. Occupation of the base took place in June of 1941 with the primary purpose of providing advanced flight training to fighter pilots. In November of 1946 the base was deactivated after having trained 17,000 pilots over a 5-year period. The Gila Bend Gunnery Range, a major part of the training operation, remained open but was operated by Williams AFB near Chandler, Arizona. With the onset of the Korean War, Luke AFB was reopened in February, 1951, again to provide advanced flight training. The base was transferred from Air Training Command (ATC) to Tactical Air Command (TAC) in July, 1958.

In December of 1980, the 832nd Air Division replaced Tactical Training Luke (TTL) to become the current host of Luke AFB. The primary mission of the unit today is to provide command supervision of the F-4 and and F-104 training programs of the 58th Tactical Training Wing and of the F-15 and F-5 programs of the 405th Tactical Training Wing.

A more detailed description of the base history is included in Appendix D.

III. ENVIRONMENTAL SETTING

III. ENVIRONMENTAL SETTING

A. METEOROLOGY

Luke Air Force Base is located in the western portion of the Salt River Valley, a desert area with hot, dry summers and mild winters. Temperature extremes range from winter night-time lows of below freezing to highs well above 100°F throughout most of the summer. The average frost-free growing season is 270 days; however, many frost-hardy species are grown throughout the winter months. Mild winds from the west and southwest predominate, with occasional gusts from the east during the thunderstorm season. These mild winds, coupled with rapid night-time cooling, frequently create surface-based inversions during the longer winter nights. Rapid heating and slightly more intense daytime winds result in good dispersion throughout most of the year. Hot, dry winds from the west are responsible for low relative humidity and predominantly clear skies.

Rainfall in the Luke AFB area averages about 7 inches per year. There are two main seasons during which precipitation is likely to occur. The period from November through March is characterized by occasional storm systems from the southwest. Although it is classified as a rainy season, extended periods of drought are not unusual. From July through August, widespread thunderstorm activity occurs throughout the State. Snowfall is rare and seldom accumulates in depths greater than .05 inches. Lake evaporation amounts to about 60 inches per year and is approximately equal to the evapotranspiration rate in the area. Actual evapotranspiration rates over land areas may be greater or less than this value, depending on vegetative cover type. The annual evapotranspiration rate exceeds the annual precipitation rate by about 53 inches per year. Climatological data for Luke AFB is summarized in Table 1.

B. GEOLOGY

Luke AFB is located within the Sonoran Desert section of the Basin and Range physiographic province (see Figure 3). The province, in general, is characterized by north to northwest-trending isolated mountain ranges separated by desert plains. The Sonoran Desert section, in particular, consists of more desert plain than mountains, and the ranges are generally lower and narrower, making up less than one-fourth of the area of this section. Luke AFB lies approximately 8 miles east of the White Tank Mountains, which are typical of mountain ranges common to the Sonoran Desert section. The base itself rests on a broad alluvium-filled valley and is partly surrounded, on three sides, north, south, and west by highland bedrock (mountain ranges). The White Tank Mountains, as mentioned above, lie west of Luke AFB; while the Sierra Estrella lie 12 miles to the

Table 1
CLIMATOLOGICAL DATA FOR LUKE AIR FORCE BASE

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Ann.
Temperature (°F)													
Record High	85	91	95	102	112	118	118	116	112	105	93	87	118
Record Low	21	25	28	35	43	53	60	60	50	32	30	23	21
Normal Maximum	65	69	74	83	92	101	105	102	98	87	74	66	85
Normal Minimum	39	42	47	53	61	70	79	77	69	57	46	40	57
Normal Mean	52	56	61	68	77	85	92	90	84	72	60	53	71
Precipitation (inches)													
Record Maximum	2.9	2.1	2.4	1.8	0.6	0.8	2.6	8.4	4.0	2.1	1.9	4.5	8.4
Record Minimum	0.0	0.0	0.0	0.0	0.0	0.0	Trace	Trace	0.0	0.0	0.0	0.0	0.0
Normal Mean	0.7	0.6	0.6	0.3	0.1	0.1	0.7	1.2	0.8	0.5	0.5	0.9	7.0
Wind													
Mean Velocity (MPH)	4.6	4.6	5.8	6.9	6.9	6.9	6.9	5.8	4.6	4.6	4.6	3.5	5.5
Prevailing Direction	N	N	N	SW	SW	SW	SW	SW	N	N	N	N	N

Source: AWS Climatic Brief, prepared by USAFETAC.
Period of Record: December 1941-July 1972.

south, and the Hieroglyphic Mountains lie approximately 15 miles to the north. Elevations of the mountains are approximately 4,000 to 4,500 feet above mean sea level. Elevations at Luke AFB, located on the desert plain, range from 1,110 feet above mean sea level (msl) at the northwest corner to 1,075 feet above msl at the southeast corner of the base (see Figure 4). The ground surface generally slopes uniformly downward from northwest to southeast at 25 feet per mile.

Rivers near the base include the Agua Fria, the Salt, and the Gila Rivers. The Agua Fria, flowing north to south, lies approximately 2 miles east of the main portion of Luke AFB. The base Waste Treatment Annex is located on the bank of the Agua Fria River, and the treatment plant discharges to this river. The Salt River, into which the Agua Fria discharges, flows from east to west and lies approximately 6.5 miles south of the base. The Salt River discharges into the Gila River, which flows east to west, discharging to the Colorado River. The Gila River is located approximately 7 miles south of Luke AFB.

The low amount and irregularity of rainfall in the Arizona desert result in erratic natural flows in these rivers. To better utilize the surface-water resources associated with those river basins, dams and reservoirs have been constructed. As a result, these rivers, as are many in the desert southwest area, are dry most of the year and flow only during and immediately following storms. To further optimize surface-water resources and, at the same time, prevent flood damage from infrequent but sometimes severe storms, many drainage ditches/canals have been constructed. One, in particular, cuts across and provides drainage for the north end of the base discharging to the Agua Fria River.

The most significant soil associations occurring at Luke AFB (to a depth of approximately 60 inches) consist of deep, well-drained soils on valley plains and low stream terraces. These soils were formed in recent alluvium derived from a wide mixture of rock type, including andesite, basalt, schist, rhyolite, and granite-gneiss. Approximately 60 percent of the base, mostly the runway/taxiway areas, is covered with this soil type, referred to as the Gilman series (see Figure 5). Permeability of this soil is moderate (5×10^{-4} cm/sec or 0.001 ft/min.), runoff is slow, and erosion hazard is slight to moderate.

Other soil associations occurring at Luke AFB are the Laveen series, the Mohall series, the Pinal series, and the Anano series. These soils occur, for the most part, under the developed portion (buildings) of the base.

The Laveen series consists of deep, well-drained soils that have a large concentration of calcium carbonate in the lower portion (50 to 60 inches in depth). The soils were formed in alluvium on old alluvial fans and old valley plains, and were originally derived from granite, granite-gneiss, schist, andesite, basalt, and limestone. Permeability is moderate (same as Gilman series), runoff is moderate, and erosion hazard is moderate.

The Mohall series consists of deep, well drained-soils that have visible amounts of calcium carbonate at a moderate depth (30 to 40 inches). These soils were formed on old alluvial fans and valley plains derived from granite, rhyolite, schist, and limestone. Permeability is moderately low (1×10^{-4} cm/sec or 2.0×10^{-4} ft/min), runoff rate is moderate, and erosion hazard is slight.

The Pinal series consists of shallow, well-drained soils that are less than 20 inches deep over a silica-lime cemented layer. These soils were formed in old, gravelly or cobbly valley-fill material derived from mixed rock types on old alluvial fans and stream terraces. Permeability is moderate (same as Gilman series) down to the silica-lime cemented layer, which is nearly impermeable. Runoff is moderate, and erosion potential is slight to moderate.

The Antho series consists of deep, well-drained soils which were formed in recent alluvium deposited on alluvial fans and stream terraces, derived primarily from granite. Permeability is moderately high (3×10^{-3} cm/sec or 6×10^{-3} ft/min), runoff is slow, and erosion potential is slight.

Geologically, Luke AFB lies within an alluvium-filled basin, partially surrounded by basement (crystalline) mountain ranges (see Figure 6). In general, the source for the alluvium is the crystalline rock, granite, granite-gneiss, anyolite, schist, andesite, basalt, and limestone, which eroded from the mountains, and were transported by wind and water. These deposits are, for the most part, unconsolidated sediments of variable thickness which were deposited during Pliocene and Quaternary time (less than 10 million years ago). Their thickness varies from a few feet at the periphery of the basin adjacent to the mountains to an estimated maximum of 10,000 feet at Litchfield Park, just south of Luke AFB. These unconsolidated sediments are deposited on top of basement rock which is probably of the same composition as the nearby mountain ranges.

No wells have penetrated the entire thickness of the alluvium to bedrock except at the periphery of the basin. The deepest well in the Luke AFB vicinity is 4,500 feet deep and is located at the salt processing operation approximately 1 mile east of the base. This well is a brine injection/

recovery well completed into a salt dome known as the Luke Salt Body. This operation is a commercial salt product facility which operates by injecting freshwater into the salt body to dissolve the mineral halite (salt). The saturated solution is then pumped to solar evaporation ponds from which salt is recovered. The salt body, other geologic and hydrogeologic processes, and man-induced hydrologic changes significantly affect conditions at Luke AFB, land subsidence being the most obvious. This will be discussed in Section III.C. "Hydrology."

At Luke AFB, the upper 1,000 feet of unconsolidated sediments are of importance to water supply and pollutant migration. Figure 7 illustrates the geologic log and well construction details of a typical water supply well at Luke AFB. The log illustrates the variable nature of the alluvial deposition in the Luke AFB vicinity. The sediments, as mentioned above, were all derived from crystalline rock. In general, most of the deposit was emplaced by running water which eroded the parent rock, transported the sediments away from the uplands, and deposited them in the lowland basin. The finer-grained materials, such as silts and clays, were deposited at low velocity during flood stage where rivers overflowed their banks. These materials were deposited on the adjacent terrace or at the river mouth where alluvial fans were being built. Coarser materials, i.e., sands and gravels, were deposited within the stream bed itself. These deposits were distributed laterally by the ever-changing stream course. The great thickness of unconsolidated and therefore compressible sediments occurring at Luke AFB and the immediate vicinity is another contributing factor to the relatively rapid land subsidence common to the area.

C. HYDROLOGY

A low precipitation rate (7 inches/year) together with a high evaporation rate (60 inches/year-lake surface) are common to the Luke AFB area. Surface streams and rivers near Luke AFB, including the Agua Fria, Salt, and Gila Rivers, are dry most of the time, and convey water only during and immediately following storms. All of the streams/rivers in the Luke AFB vicinity begin in the upland, mountainous region of the Colorado Plateau and flow south to the Colorado River, discharging to the Gulf of California. The Agua Fria River, located approximately 2 miles east of Luke AFB, is dammed upstream within the Hieroglyphic Mountains to the north. 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 prevention. The Beardsley Canal conveys water from Lake Pleasant Reservoir to agricultural lands within the Maricopa County Municipal Water Conservation District No. 1, just north, west, and south of Luke AFB. The Salt and Gila Rivers are also dammed for irrigation and flood prevention. The Buckeye Canal diverts water from the Gila River for use by the Buckeye Water Conservation District located north and south of Luke AFB.

Luke AFB derives all of its water supply from ground water. Figure 8 illustrates potable water supply wells at Luke AFB.

Ground water occurs within the unconsolidated alluvial deposits consisting of interfingering sand, gravel, silt, and clay of the basin lowlands. The saturated thickness of these sediments is extremely variable (200 to 10,000 feet). The sediments are thin toward the mountains and thicken toward the center of the basin. Therefore, in the vicinity of Luke AFB, near the center of the basin, the unconsolidated sediments are thought to be approximately 10,000 feet thick. Since ground water occurs within the void space of these unconsolidated materials, the thicker the deposit, the greater its saturated section. The saturated thickness of these deposits is rapidly decreasing due to demand from irrigation withdrawals.

In general, the unconsolidated alluvium can be divided into three hydrologic units, referred to as the upper alluvial unit, the middle fine-grained unit, and the lower conglomerate unit (see Figure 9).

The upper alluvial unit is the major source of ground water in the Luke AFB vicinity and is the unit into which base wells are completed. The base wells are completed at a depth of 800 to 1,000 feet. The deposits within this hydrologic unit are generally unconsolidated, and ground water occurs under unconfined or water table conditions. There are areas where the occurrence of locally extensive clay layers results in a perched or confined ground-water condition. However, under the influence of long-term ground-water withdrawals, aquifer response is more unconfined as a unit than confined. The upper alluvial unit ranges in thickness from a few feet at the periphery of the basin to over 1,200 feet near Luke AFB. Well yields within this unit are high, ranging from 500 to 3,000 gallons per minute (gpm), with variations resulting from differences in well construction, well depth, and local hydrogeologic conditions.

The middle fine-grained unit occurs below the upper unit and consists of sedimentary deposits of low permeability, primarily clay and silt in the upper section, and gypsum and salt in the lower section. The gypsum and salt deposits impede the downward flow of ground water. Some ground water does occur in the lower section, within limited sand and gravel deposits. Where it does occur, it is under artesian or confined conditions. This unit ranges in thickness from a few feet at the edge of the basin to over 1,500 in the vicinity of Luke AFB. In some parts of the basin edges, this unit is absent. Wells are never completed in this unit exclusively; however, some are open to both the upper alluvial unit and the middle fine-grained unit and draw water from both.

The occurrence of evaporites, i.e., gypsum (calcium sulfate) and halite (sodium chloride) in this unit has a significant effect on ground-water quality. The Luke Salt Body, described above, occurs within this unit. Water quality will be discussed below in more detail.

The lower conglomerate unit consists of a heterogeneous mixture of sand, gravel, and some clay. Ground water generally occurs under artesian conditions confined by the middle fine-grain unit above. The exception is in those areas at the periphery of the basin where the middle unit is absent and the upper alluvial unit rests directly on top of the lower conglomerate unit. In those areas, the two units are hydrologically the same. In those areas where the middle unit is absent, the upper unit recharges the lower unit. The lower conglomerate unit ranges in thickness from a few feet near the edge of the basin to greater than 3,000 feet in the vicinity of Luke AFB. Wells penetrating this unit are generally located along the basin edge and withdraw water from both the upper and lower units. Well yields are high and are generally greater than 1,000 gpm within this unit.

In the vicinity of Luke AFB, the upper alluvial unit is the primary source of water and is the only unit which could potentially be contaminated. The discussion of ground water will be focused on this upper unit.

Ground-water withdrawals in the vicinity of Luke AFB have increased significantly over the past 20 years. More than 90 percent of the withdrawn ground water is used for agricultural irrigation. The increased use of ground water in the Luke AFB area has caused a number of significant changes in the hydrogeologic/geologic regime. Figure 10 illustrates the elevation of the ground water as it was in 1977. Currently, and for the past several years, ground-water levels have been declining approximately 5 feet per year. Consequently, in 1981 the elevation of the ground water is approximately 20 feet lower than the elevations depicted on Figure 10. To illustrate the point of declining water levels even more dramatically, Figure 11 shows the change in water level which has occurred during the period 1923 to 1977. During this time the ground-water level has declined over 300 feet in the vicinity of Luke AFB.

The reason water levels are declining so rapidly is that ground-water withdrawals are significantly higher than recharge; thus water is being "mined" from storage in the aquifer and not being replaced by recharge. Also, the effects of ground-water pumpage are more pronounced because the area immediately around Luke AFB is lower in permeability than the surrounding area. Presently, the primary source of recharge is percolation from excess irrigation water and seepage losses from irrigation canals such as Beardsley and Buckeye Canals. In the past, prior to large-scale agricultural irrigation and the construction of dams and reservoirs along rivers such as the Agua Fria, infiltration from river beds was the principal source of recharge. Today, most of the rivers and streams in the area are dry most of the time, flowing and contributing recharge only during and after storm events.

This change in hydrologic conditions, i.e., increased pumpage and decreased surface-water flow, has caused a significant change in the subsurface ground-water flow patterns in the basin. Historically, ground water flowed southwesterly from recharge areas at the base of mountains following the channels of the Agua Fria and the Gila Rivers, both of which contributed recharge to the aquifer. Flow out of the ground-water basin occurred under the Gila River bed south of the White Tank Mountains. Today, as a result of large-scale off-base agricultural withdrawals, a large cone of depression has formed around the Luke AFB area. As a result, the ground water no longer flows southwesterly but instead flows toward Luke AFB from all directions. This condition is evident from area maps depicting water level elevations. Figure 10 illustrates the water level elevations in the area immediately surrounding Luke AFB. A larger-scale map would indicate a closed contour surrounding the Luke AFB area with the lowest point just south of the base. Furthermore, little recharge occurs through river beds such as the Agua Fria. Very little, if any, ground-water now leaves the basin as underflow. Recharge in the Luke AFB area now occurs almost entirely as excess irrigation water. This recharge, however, probably has yet to reach the water table. In the Luke AFB area, water levels are approximately 380-390 feet below land surface. Downward flow rates in unsaturated materials are estimated at 10 to 20 feet per year. Therefore, it would take 20 to 40 years for irrigation water applied at the surface to reach the water table, which is declining at the rate of 5 feet per year. Vertical migration in unirrigated areas would take even longer. This is significant not only from the standpoint of recharge but also from the standpoint of contaminant migration. For example, Luke AFB has been in existence from 1941 to the present, a period of 40 years. A migrating contaminant on the surface during the first year of base operation probably has not yet reached the water table.

Ground-water depletion is not the only significant change in the geologic/hydrogeologic regime caused or aggravated by large-scale ground-water withdrawals. Under normal conditions, in saturated unconsolidated materials, the void space is filled with water, which tends to reduce the weight of the solid material due to the buoyancy effect. Because of the large ground-water withdrawals in the area, this buoyancy effect has decreased. Consequently, the overlying sediments effectively weigh more and begin to settle by compaction. Figure 12 illustrates the area around Luke AFB most affected by subsidence.

Geologic conditions in the Luke AFB area are such that land subsidence causes fissures or cracks to occur in the land surface. Most of these fissures are tensional with no vertical displacement. The occurrence of compressible strata such as salt also contributes to the formation of fissures. Salt becomes plastic and quite mobile under pressure, and the increased weight of overburden causes it to compress which, in turn, causes the overlying sediments to settle.

Existing, known earth fissures are plotted on Figure 12. Unpublished geologic data indicate that these fissures may be quite deep vertically, possibly down to the water table. Surface drainage, such as the discharge from the south end of the base, could enter the fissure and, therefore the aquifer, quite rapidly.

Ground-water quality at Luke AFB is dependent on several factors, including depth of well, proximity to the Luke Salt Body, pumping rate, screen setting, and perhaps most important, time. Historically, naturally occurring high concentrations of fluorides, dissolved solids, and hardness have been water quality concerns in the Luke AFB area, especially in the area south of the base. Natural contaminants are the result of the quality of surface-water recharge. Surface-water quality is in turn affected by the occurrence of natural salts and soluble minerals in the soil within the upper watershed. Natural ground-water contaminants are also derived from salts and/or soluble minerals within the aquifer/ formation either in the recharge area or downgradient.

Fluoride concentrations in excess of 1.0 milligram per liter (mg/l) are common in the Luke AFB area (see Figure 13). In fact, as Table 2 illustrates, fluorides have been measured as high as 4.0 mg/l (Well No. 9) at Luke AFB. Fluoride minerals are associated with the mountain regions; therefore, recharge at the range front contributes to high fluoride concentrations. Also, fluoride is derived from the middle fine-grained unit; therefore, concentrations in the upper alluvial unit increase with depth. It should be noted that Well No. 9 produces from 800 to 1,002 feet below land surface, close to the top of the middle unit. This would explain the high fluoride concentrations (4.0 mg/l) reported for Well No. 9.

Table 2
WATER QUALITY CHARACTERISTICS FROM SELECTED WELLS AT LUKE AFB

Parameter[a]	Well No. 9[b]	Well No. 4[b]
Total Depth (ft)	1,007	596
Perforated Section (ft)	800 to 1,002	359 to 588
Arsenic	0.013	0.017
Barium	<1	<1
Cadmium	<0.01	<0.01
Chromium	<0.05	<0.05
Lead	<0.02	<0.02
Mercury	<0.002	<0.002
Selenium	<0.01	<0.01
Silver	<0.01	<0.01
Copper	0.25	0.25
Iron	4.2	0.1
Manganese	0.05	<0.05
Zinc	<0.05	<0.05
Calcium as Ca	9.9	28.2
Magnesium as Mg	4.0	12.3
Potassium	2.2	2.5
Sodium	97.4	64.6
Alkalinity, total as $CaCO_3$	123	134
Chloride	44	80
Hardness as $CaCO_3$	41	137
Residue, Filtrable (TDS)	297	349
Residue, Non-Filtrable (SS)	5	4
Residue	302	353
Specific Conductance (μmhos/cm)	470	490
Sulfate as SO_4	15	32
Nitrate as N	0.6	2.9
Fluoride	4.0	1.2
Turbidity, JTU	7	<1
TCE Solvent	ND[c] <0.0005	ND[c] <0.0005

Source: USAF OEHL, Brooks AFB, Texas.

[a]Parameters are in mg/l unless otherwise noted.

[b]Sampled March - April, 1981.

[c]ND = None detected.

Nitrate concentrations generally increase from north to south in the Luke AFB area. Nitrate is derived from the upper soil horizon and is associated with agricultural operations.

Total dissolved solids, primarily chlorides, increase north to south (see Figure 14). This is due to the historically high total dissolved solids (TDS) and chloride concentrations of the Gila River, which was once a primary source of recharge. As noted above, ground-water flow in the past was from north to southwest. This flow pattern south of Luke AFB has been reversed, and the flow is now toward the pumping depression centered on the base. As pumping continues, flow from the naturally poor water quality areas associated with the Gila River will increase and water quality will become progressively worse.

D. Environmentally Sensitive Conditions

1. Biotic Communities

According to Turner (1974), three plant communities naturally occur in close proximity to Luke Air Force Base. The desert saltbush (Atriplex polycarpa) community, which also includes species such as chamiso (Atriplex canescens) and mesquite (Prosopis juliflora), formerly occurred over much of the fine-grained alluvium in the lower portions of the valleys, especially along the Agua Fria, Gila, and Salt Rivers. Its natural occurrence in the vicinity of Luke AFB is south and east of the base. However, much of this community throughout the Phoenix area has been lost to agriculture or urban development.

The creosotebush (Larrea tridentata) community occurs on more upland soils than the desert saltbush community. Typical co-dominant species are white bursage (Franseria dumosa) and big galleta (Hilaria rigida), with paloverde (Cercidium spp.) occurring in moister areas around washes. Much of this community has also been eliminated by agricultural and residential developments. Its natural occurrence in the vicinity of Luke AFB is north and west of the base.

Narrow reaches of deciduous riparian forest occur along some of the washes to the south and southeast of Luke AFB. Typical plant species include mesquite, salt cedar (Tamarix pentandra), seepwillow (Baccharis glutinosa), blue paloverde, and various other shrubs and small trees.

The diversity and density of desert wildlife species in the vicinity of Luke AFB varies from one plant community to another and also with the degree of human disturbance. The richest wildlife habitats occur in the riparian forest community. In the vicinity of Luke AFB, wildlife is limited primarily to desert-adapted reptiles and amphibians; birds, such as gambrel quail, mourning dove, white-winged dove, roadrunners, and various songbirds; and small mammals of which most are rodents.

2. Threatened Species

No Federally or State-listed endangered or threatened species are known to occur on Luke AFB (Kurtz, 1981; Butterwick, 1981), although some have been recorded for the Phoenix area. The peregrine falcon (Falco peregrinus), which is Federally listed as endangered, has been occasionally reported in downtown Phoenix, where it feeds on the abundant pigeon populations (Kurtz, 1981). The Yuma clapper rail (Rallus longirostris yumanensis), classified as endangered by the U.S. Fish and Wildlife Service, was reported along the Gila and Agua Fria Rivers in the early and mid 1970's (Maricopa County, 1980). However, recent flooding has temporarily destroyed the suitable rail habitat along these rivers.

3. Environmental Stress

No evidence of present biological stress related to hazardous wastes or materials was noted during site visits to Luke AFB. Although stresses have occurred on Luke AFB vegetation in the past, there was no indication of persistent adverse effects.

IV. FINDINGS

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A. ACTIVITY REVIEW

1. Summary of Industrial Waste Disposal Practices

The quantities of waste oils, solvents, paint residues, and thinners that are generated at Luke AFB are relatively small. Generally the quantity of wastes produced ranges from 10 to 1,000 gallons per year depending upon the type of waste, (see Table 3). Information gathered in the records search and interviews indicated that no chemical landfills have existed on Luke AFB or any of its properties.

The industrial operations at Luke have been in existence since 1941. During the war years, from 1941 to 1946, industrial operations and related wastes were comparatively small. The base was deactivated from 1946 to 1951. In the 1950's, after the reactivation of the base, larger quantities of wastes were generated as a result of expanded maintenance requirements for the new jet aircraft assigned to the base. Major industrial operations included the pneudraulics shop, corrosion control, AGE Inspection and Repair, Nonpowered AGE, PMEL, metals processing, structural repair, and weapon control systems. These operations generated varying quantities of waste oils, solvents, fuels, and cleaners. Past disposal practices minimized the problem of indiscriminate dumping into base landfills.

Standard procedures for past and present waste disposal practices at Luke AFB are as follows:

- 1941 to 1946: POL wastes included small amounts of fuels, oils, solvents, tank sludge, and cleaners. These wastes were collected periodically from the shop locations and were then used in fire department training exercises.

- 1951 to 1970: POL wastes including solvents, paint residues, tank sludge, and thinners were disposed of in one of two ways. A small quantity of the waste was used in fire department training activities. The majority of the waste was used for road oiling on the perimeter road located at the southwest end of the runway.

- 1968: Facility 993 was constructed for storage of all POL waste from the base. Storage facilities include two 10,000-gallon tanks used for storage of contaminated JP-4 and one 5,000-gallon tank used for storage of contaminated JP-4, oils, and solvents. This facility was used as a principal storage site prior to removal for road oiling. The facility is presently used for storage prior to removal by contractor for recycling.

- 1970-1972: POL wastes and solvents were primarily disposed of in narrow trenches south of the base. These trenches were approximately 1-1/2 feet deep and 40 feet long. The waste mixture was dumped into a shallow trench, allowed to weather for several weeks, and then covered with soil. A shallow lagoon in the area near the trenches was also used for disposal of the POL waste.

- 1972 to Present: The DPDO began to sell the waste that was stored in Facility 993 to private contractors for recycling. Facility 993 has two 10,000-gallon tanks used to store contaminated JP-4 and AVGAS and one 5,000-gallon tank used to store a mixture of waste oils and solvents. Currently, only waste oils and contaminated fuels are stored at Facility 993. Other wastes, including waste paint, thinners, and solvents, are segregated into 55-gallon drums. These drums are stored at the individual shops in selected areas. The CE hazardous waste storage Facility 364 was established in 1980 as a central storage area for all hazardous waste drums prior to contractor disposal or recycling. The DPDO storage facility at the Waste Treatment Annex is also used for drum storage. Final disposition of the segregated wastes is handled by the DPDO. Salvageable wastes are sold to private contractors for recycling, while non-salvageable wastes are contracted for disposal at an approved hazardous waste disposal site.

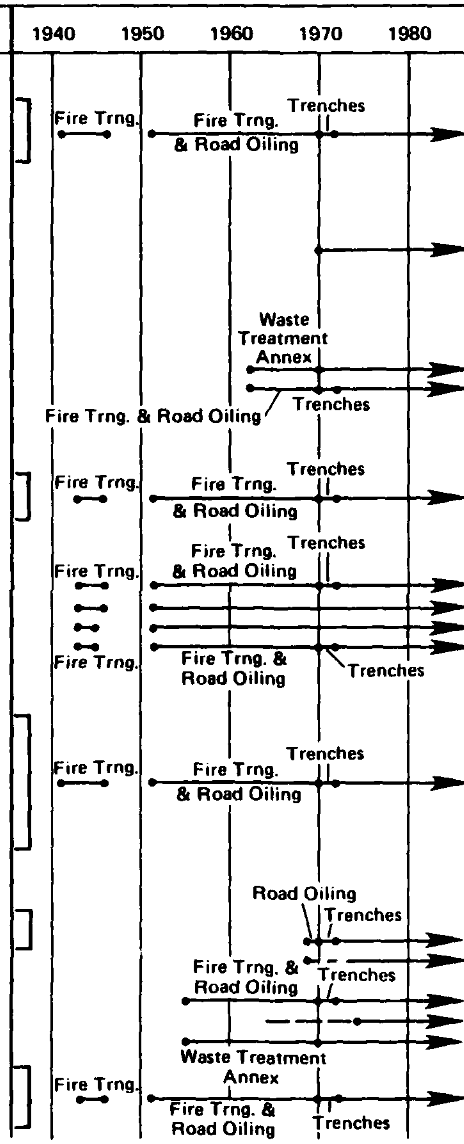
2. Industrial Operations

The industrial operations at Luke AFB are primarily involved in the routine maintenance of assigned F-4, F-104, and F-15 aircraft. Appendix E contains a master list of the industrial shops.

The industrial operations which generate the majority of hazardous wastes on-base were identified by a review of base records and interviews with shop personnel. Table 3 summarizes the major industrial operations and includes the estimated quantity of waste generated as well as the past and present disposal practices for the waste, i.e., treatment, storage, and disposal. A description of the major industrial activities follows:

Table 3
MAJOR INDUSTRIAL OPERATIONS SUMMARY

Shop Name	Location	Waste Material	Waste Quantity	Disposal
58 CRS/405 CRS				
Pneudraulics	931	Trichloroethylene[a] (TCE)	50 gpy	FAC 993–DPDO
		PD 680	40 gpy	
		Carbon Remover	40 gpy	
58 CRS				
Weapons Control System	917	1, 1, 1,–Trichloroethane	Consumed	To Glendale Landfill
		Electron tubes (radioactive)	Small variable quantity	
Metals Processing	915	Methyl ethyl ketone (MEK)	Consumed	
		Carbon tetrachloride	Consumed	
Structural Repair	915	Adhesive	1 gal/mo.	To Glendale Landfill
		MEK	10 gal/mo.	To Bldg. 922 disposal area
		TCE	Consumed	
58 EMS				
Non-Powered AGE	480	Oil	550 gal/mo.	DPDO
		PD-680	800 gal/mo.	
		WD-40	Consumed	
		Paint	Consumed	
AGE Inspection and Repair	480	Oil	400 gal/mo.	DPDO via 55-gal drums
		PD-680	900 gal/mo.	To oil/water separator
		Cleaning compound	220 gal/mo.	To sanitary sewer
		PD-680	600 gal/mo.	Waste oil tank–DPDO
58 EMS/405 EMS				
Corrosion Control	922	MEK	74 gpy	DPDO via 55-gal drums
		Thinner	32 gpy	
		Acetone	10 gpy	
		Epoxy remover	50 gpy	
		Toluene	18 gpy	
		Denatured alcohol	--	
		PD-680	--	
405 CRS				
NDI	931	TCE	60 gpy	DPDO
		Zyglo	100 gpy	To sanitary sewer
		Penetrant/emulsifier/developer	--	
PMEL	417	H-2620 (contains TCE)	12 gpy	DPDO
		Mercury	15 lbs/yr.	DPDO
		Radioactive electron tubes	3 lb/yr.	Glendale Landfill
F-100 Engine Shop	930A	JP-4	780 gpy	FAC 993–DPDO
		7808 oil	1,560 gpy	DPDO via 55-gal drums
		PD-680	520 gpy	DPDO via 55-gal drums



[a]Used in ultrasonic cleaner.

Table 3–Continued

Shop Name	Location	Waste Material	Waste Quantity	1940 1950 1960 1970 1980	
405 EMS					
AGE Inspection and Repair	480	Oil	400 gal/mo.	Fire Trng. / Fire Trng. & Road Oiling / Trenches	DPDO via 55-gal drums
		Hydraulic fluid	600 gal/mo.		
		Cleaning compound	220 gal/mo.		To floor drain
		PD-680	900 gal/mo.		To oil/water separator
		Thinners	850 gpy		DPDO
Fuel Systems Repair	984	MEK	55 gpy	Fire Trng. / Fire Trng. & Road Oiling / Trenches	DPDO via 55-gal drums
		PD-680	5 gpy		Floor drain
		Toluene	12 gpy		DPDO via 55-gal drums
Tire and Dart	985	PD-680	65 gal/mo.	Fire Trng. / Fire Trng. & Road Oiling / Trenches	FAC 993–DPDO
832 CES					
Entomology	354	Diazinon	Consumed		Empty container to dumpsters
		Dursban	Consumed		
		Malathion	Consumed		
		Ficam W	Consumed		
832 MWR					
Auto Hobby Shop	248	PD-680	2-4 gal/mo.	Fire Trng. & Road Oiling / Trenches	DPDO
		Cleaning compound	55 gal/mo.		Sanitary sewer
Photo Hobby Shop	242	Developing solutions	--		Silver recovery effluent to sanitary sewer
832 Supply					
Fuels Lab & QC	328	Petroleum ether	20 gal/mo.	Fire Trng. & Road Oiling / Trenches	DPDO
		Cleaning compound	20 gal/mo.		Washrack drain
		Solvent	20 gal/mo.		Washrack drain
Fuels Distribution	331	Cleaning compound			Washrack drain
		TCE	Consumed		
Liquid Oxygen	992	Trichloroethylene	Consumed		
832 Transportation					
Tanker Repair	353	Oil	25 gal/mo.	Fire Trng. & Road Oiling / Trenches	Bldg. 353–DPDO
		Antifreeze	15 gal/mo.		Sanitary sewer
		JP4	25 gal/mo.		DPDO
Fire Truck Maintenance	444	Hydraulic Fluid	18 gal/mo.	Fire Trng. & Road Oiling / Trenches	DPDO
		Engine oil	55 gal/mo.		
Minor Maintenance	335	Lube oils	60 gal/mo.	Fire Trng. / Fire Trng. & Road Oiling / Trenches	55-gal drums to DPDO
		Transmission/hydraulic fluid	120 gal/mo.		
		PD-680	20 gal/mo.		
		Antifreeze	120 gal/mo.		Sanitary sewer
Tire and Battery Shop	297	Waste acid	Varies		To sanitary sewer after neutralization
Heavy Equipment Repair	346	PD-680	25 gal/mo.		DPDO

Table 3–Continued

Shop Name	Location	Waste Material	Waste Quantity	1940 1950 1960 1970 1980	
Vehicle Maintenance	336	Oil Antifreeze Auto/hydraulic/brake fluid PD-680 Thinner	200 gal/mo. 40 gal/mo. 25 gal/mo. 200 gal/mo. 5 gal/mo.	Fire Trng. / Fire Trng. & Road Oiling / Trenches	DPDO via 55-gal drums Sanitary sewer DPDO
U.S.A.F. Hospital Lake					
Hospital Lab	1130	Iodine 125 from nuclear medical lab	Small		
Histopathology	1130	Small amounts of waste	Small		Glendale Landfill
Medical/dental x-ray	1130	Developers and fixers	..		Silver recovery effluent to sanitary sewer
832 CSS Gila Bend					
Power Production	2079	TCE Sulfuric acid	Consumed 200 gal/mo.		Neutralized to sanitary sewer
Vehicle Maintenance	3110	Antifreeze Cleaning compound Oil PD-680 Thinner Paint	60 gal/mo. 40 gal/mo. 120 gal/mo. 10 gal/mo. Consumed Consumed		Sanitary sewer DPDO via 55-gal drums
Battery Shop		Sulfuric acid	Varies		Neutralized to sanitary sewer
832 Combat Support Group	583	Developer Formaldehyde	12 gal/mo. 10 gal/mo.		To sanitary sewer
Graphic Division	583	Developer Cleaner	42 gal/mo. Varies		To sanitary sewer
302 Special OPS Squadron					
Weapons Shop	999	PD-680	15 gal/mo.	Trenches	FAC 993–DPDO
58 AGS					
310 AMU	913	Hydraulic fluid Oil Contaminated JP4	10 gal/mo. 38 gal/mo. 30,000 gpy	Fire Trng. / Fire Trng. & Road Oiling / Trenches	FAC 993–DPDO
Lockheed Aircraft Services					
Shops RPC AGE Washrack MoGas storage NDI Field Maintenance Weapons Maintenance/Welding Paint Dope Storage Electronics Engine Test Cells Fuel Cell Repair/NDI Trim Pad	 303 400 403 405 407 408 409 413 415 968, 988 1,024 LAS-12	For all shops combined MEK MEK Solvents Thinners Toluene TCE Oils	 350 gpy 1,000 gpy 1,200 gpy Consumed Consumed Consumed 2,400 gpy		To Lockheed contractor disposal

a. Pneudraulics

The pneudraulics shop has been located in Facility 931 since 1969. From 1964 to 1969 it was located in Facility 483. Prior to 1964 base pneudraulics shop operations were conducted in Facility 408. The primary purpose of this shop is to service and repair all aircraft pneumatic and hydraulic equipment. Wastes generated by this operation are trichloroethylene (50 gpy), PD 680 (40 gpy), and carbon remover (40 gpy). Within the past year these wastes have been collected in 55-gallon drums and sent either to the CE hazardous waste storage yard or to the DPDO storage yard. The non-recoverable wastes, such as trichloroethylene (TCE) or carbon cleaner, are contracted by DPDO for proper disposal at an approved hazardous waste disposal site. Salvageable wastes, such as PD 680, are sold through the DPDO to a contractor for recycling. From 1972 to 1980 all wastes from this area were taken to Facility 993 where they were sold through the DPDO to a private contractor for recycling. Prior to 1972, all wastes were used for road oiling, fire department training, or disposal in waste POL trenches.

b. Corrosion Control

The corrosion control operation has been located in Facility 922 since 1962. Prior to 1962 this shop was located in Facilities 303 and 408. Corrosion control operations include sanding, wiping, priming, repainting, and stenciling of aircraft and some aerospace ground equipment (AGE). Repainting consists primarily of reapplication of the top coat. Some stripping of parts is conducted for the inspection of a structure; however, stripping of an entire aircraft is done only infrequently. Wastes generated by corrosion control operations include methyl ethyl ketone (74 gpy), thinner (32 gpy), acetone (10 gpy), toluene (18 gpy), epoxy remover (50 gpy), and small quantities of other chemicals. The wastes are currently stored in drums and are disposed of by a private contractor through the DPDO. Prior to 1972, wastes were sent to Facility 993, collected with other POL wastes, and disposed of in trenches or in road oiling, or discharged to the sanitary sewer.

c. AGE Inspection and Repair and Nonpowered AGE, and Washrack

AGE Inspection and Repair and Nonpowered AGE operations have been located in Facility 480 since 1943. The responsibility of AGE Inspection and Repair is to repair, maintain, and periodically inspect all powered aerospace ground equipment. The Nonpowered AGE shop repairs and maintains all nonpowered aerospace ground equipment. Included in these maintenance operations is a washrack used for aircraft as well as for all powered and nonpowered AGE. Wastes generated from these operations include oils (950 gal/mo), cleaning compounds (220 gal/mo), hydraulic fluid (600 gal/mo), PD 680 (1,700 gal/mo), and small quantities of paint. The waste oil is collected in 55-gallon drums and sent to either the CE hazardous waste storage area or to the DPDO storage yard. All cleaning compounds go down the washrack drain to the waste treatment plant. Hydraulic fluid is stored in a waste oil tank prior to removal by a contractor for recycling.

d. NDI and PME Laboratories

Since 1969 the NDI lab has been located in Facility 935. Nondestructive testing methods using X-ray, magnaflux, ultrasound, and other tests are performed in this area. X-ray film development is also conducted on a limited basis. Small amounts of trichloroethylene (TCE) and Zyglo are used in this area. All the material is consumed and no waste is generated.

The Precision Measurement Equipment Laboratory (PMEL) has been located in Facility 417 since 1955. This laboratory calibrates all measuring equipment. Solvent H-2620, used in small quantities for cleaning equipment in this area, contains TCE; however, no wastes are generated. Approximately 15 pounds of waste mercury is generated per year and sent to the DPDO for sale or proper contractor disposal.

e. Fuels Quality Control Lab and Fuels Distribution

The Fuels Quality Control Lab is located in Facility 328. This lab performs quality control testing of fuels used in aircraft. Petroleum ether, cleaning compounds, and solvent wastes are generated in small quantities. Petroleum ether from this area goes to a holding tank, which is periodically cleaned by a contractor. Small quantities of waste solvent and cleaning compounds are disposed of to the sanitary sewer.

Fuels distribution in Facility 331 uses small quantities of cleaning compound and TCE for parts cleaning. These solvents are consumed in the process, and no wastes are generated.

f. Transportation Division

The Transportation Division is involved in the repair and maintenance of heavy equipment, fire trucks, and automobiles on the base. Fire truck maintenance is located in Facility 444 and has been there since 1952. Their work involves repairing and maintaining fire protection equipment and refueling vehicles. Some solvents are used and there is a limited amount of painting. Oils, solvents, and other wastes are disposed of by a contractor through the DPDO. Prior to 1972 these wastes were used for fire department training activities, road oiling, or disposed of in trenches.

Located in Facility 346 since 1966, the heavy equipment repair shop repairs and maintains dump trucks, road graders, forklifts, farm tractors, aircraft tugs, and wreckers. PD 680 (25 gal/mo) is the waste generated from this operation. This waste is stored in 55-gallon drums prior to disposal by a contractor. Previous to 1972 the waste was used for road oiling, fire department training activities, or disposed of in trenches.

Vehicle maintenance has been located in Facility 336 since 1942. Minor maintenance and major overhaul of gasoline powered vehicles is performed. Oils (200 gal/mo), antifreeze (40 gal/mo), hydraulic fluid (25 gal/mo), and dry cleaning solvent (200 gal/mo) wastes are generated in the shop and disposed of by a private contractor through the DPDO. Prior to 1972 these wastes were used in fire department training exercises, road oiling, or disposed of in trenches.

The tire and battery shop is located in Facility 297. Located here since 1942, the primary responsibility of the shop is to maintain and repair lead-acid batteries. Waste acid is neutralized with sodium bicarbonate and disposed of down the sanitary sewer drain. Unserviceable batteries are sold by the DPDO for recycling.

The minor maintenance shop in Facility 335 and tanker repair in Facility 353 generate waste oil (85 gal/mo), antifreeze (135 gal/mo), transmission fluid (120 gal/mo), PD 680 (20 gal/mo), and contaminated JP-4 (25 gal/mo). All waste oils and fluids from minor maintenance are stored in drums and sent to the DPDO storage yard for sale to a recycling contractor. Waste oils from tanker repair are sent to Facility 993 for sale to a recycling contractor. All antifreeze is disposed of down the sanitary drain. Previous to 1972, all wastes from these areas were used in fire department training exercises, road oiling, or disposed of in trenches.

g. <u>Lockheed Aircraft Services</u>

Lockheed Aircraft Services (LAS) is a private contractor involved in the repair and maintenance of the F-104 aircraft, which are used by the German Air Force. Present on-base since 1964, LAS operates its own shops and also uses some of the Air Force shop facilities on Luke AFB. The following shops are operated independently by LAS: AGE maintenance, an aircraft washrack, PMEL, a welding shop, MOGAS storage, an NDI lab, field and weapons maintenance, an electronics shop, engine test cells, a fuel cell repair area, and a test cell. Their wastes have been stored and collected by a private contractor since they commenced operations in 1964. The quantity generated is small and so all wastes are combined prior to disposal. This combined waste consists mainly of oil (200 gal/mo), MEK (30 gal/mo), strippers (80 gal/mo), and solvents (100 gal/mo). TCE and toluene are used but no waste is generated. Current plans call for all LAS operation to be phased out by 1983.

h. Plating Operations

There are currently no plating operations conducted at Luke AFB. A small-scale cadmium plating operation was conducted in the past in Building 915. The plating operation was a 30-minute process conducted about twice a week, and consisted of cadmium plating of hand tools and small parts from F-4 aircraft. The operation was conducted in three 75-gallon tanks including caustic cleaning, hot water dip, and cadmium plating using a cyanide process. It is believed that the plating solution was wasted infrequently, approximately every 2 to 3 years. Disposition of the small quantity of wasted plating solution is unknown, but it was probably discharged to the sanitary sewer. The plating operation was conducted in Building 915 from 1964 until 1974 and previously in Building 409 from approximately 1960 until 1964. Because of the small quantities and infrequent discharge of plating solution, the impact of discharge to the sewage treatment plant would have been minimal.

i. Other

There are several industrial shops which generate small amounts of waste or which use hazarous materials that are consumed in-process. Weapons Control Systems, Metals Processing, and Structural Repair are areas in the 58th CRS Division which use various organic solvents with little or no waste generated. The tire and dart shop generates PD 680 (65 gal/mo), which is stored in Facility 993 and pumped out by a private contractor. The liquid oxygen area uses TCE but no waste is generated. The auto hobby shop generates waste PD 680 (20 gal/mo) and cleaning compound (55 gal/mo). This waste is collected in drums and sent to the DPDO storage area. The photo hobby shop has developer wastes which are sent to the sanitary sewer after the silver is recovered. The graphics shop sends developer (42 gal/mo) to the sanitary drain. The Fuel Systems Repair shop generates MEK (4 gal/mo), toluene (1 gal/mo), and PD 680 (1 gal/mo). The wastes are collected in drums and sent to the DPDO storage area. Prior to 1972 all POL type wastes, including solvents, were used for fire department training activities, road oiling, or disposed of in trenches.

The Entomology Shop is involved in all pesticide usage on the base. Empty containers are the only wastes generated from this area. A more detailed discussion is presented in Section A.7.

3. Fuels

Fuels handling, storage, and distribution is a major industrial operation at Luke AFB. Fuels are stored in the following locations:

- Facility 351 and 356 are the main storage areas for JP-4. Facility 351 has a 420,000-gallon storage tank and Facility 356 has a 1,680,000-gallon storage tank. These tanks are above ground and are diked.

- In the 305 area there are twenty eight 5,000-gallon tanks used for refueling vehicles. These tanks are above ground with no dikes. Two small tanks for MOGAS and diesel are also present.

- Facility 321 has six 50,000-gallon tanks used for storage of MOGAS, diesel, and JP-4. All tanks are below ground.

- The Base Exchange and Base Service stations together store 72,000 gallons of MOGAS in underground tanks.

- In Facility 405, Lockheed Aircraft Services has several storage tanks both above and below ground used to store JP-4 and MOGAS.

A complete inventory of fuel storage tanks is included in Appendix F. This list includes location, capacity, and type of fuel stored. No major problems with leaky tanks or major spills were found. There were no suspected fuel-saturated areas near the storage tanks.

Minor spills were found to have occurred in the past. Spills occur infrequently at Facility 321 as a result of overtopping tanks. A minor spill was reported to have occurred near Facility 321 when the connection was made from underground lines to above-ground lines in 1964.

In the major fuel storage areas (Facility 351 and 356) the storage tanks are cleaned approximately every 5 years. The tanks are inspected yearly and if the sludge layer is greater than 1/8-inch then the tank is cleaned. Since 1972 this sludge has been taken to Facility 993 for storage prior to collection by the contractor for disposal. Prior to 1972 the tank sludge was treated as POL waste and used for road oiling or disposed of in waste disposal trenches.

4. Abandoned Tanks

There are four known abandoned storage tanks on Luke AFB. The location and size of these tanks are summarized in Appendix G. One of the interviewees indicated (unconfirmed), that the four abandoned tanks may still be full. The base should make an effort to locate these tanks and determine the quantity and nature of their contents.

5. Fire Department Training Activities

Fire department training activities have been common since the initial activation of the base. These fire department training activities now take place at Facility 1356, which was constructed in 1973. Contaminated JP-4 is used for fire department training exercises and is stored at Facility 1355 in a 5,000-gallon above-ground tank.

Prior to construction of the new facility, two older fire department training areas existed. From 1941 to 1963, an area near Facility 999 on the west end of "N" Street was used for fire department training. In 1963 the fire department training area was moved to a location just west of the new Facility 1356.

Fire department training exercises were at one time held monthly but are now held quarterly. In early fire department training exercises, waste POL quantities of up to 1,000 gallons were dumped into a diked area to be used in the exercise. Water was routinely sprayed on the ground prior to dumping the fuel in order to keep the fuel at the surface. Present practice involves spraying the contaminated fuel from nozzles and burning it in this vaporized form. This method limits the amount of fuel required for a fire department training activity to about 300 gallons. The practice of saturating the bermed fire department training area with water prior to the fire department training exercises would have minimized fuel accumulation into the soil.

6. Polychlorinated Biphenyls (PCBs)

Polychlorinated biphenyls (PCBs) are among the most chemically and thermally stable organic compounds known to man. Until the mid-1960's, PCBs were considered nontoxic; however, further testing demonstrated that PCBs were high-risk chronic toxicants. Current knowledge indicates that PCBs accumulate in animal fatty organs and tissues, especially in fish and poultry, and that they can cause human liver and kidney damage through ingestion or direct contact. Because of their stability, PCBs, once introduced into the environment, persist for long periods of time and are not readily destroyed.

Electrical transformers and capacitors are the possible sources of PCBs at Luke AFB. Presently all transformers which have been removed from service are being tested for their PCB concentrations. These transformers are being stored at Facility 376 on an asphalt surface in a secured, fenced area awaiting proper contractor disposal through the DPDO. Of the 145 suspected transformers which have been tested at Luke, only ten have been found to contain PCBs. The out-of-service transformer storage area was located across the road from the present location near Facility 356. This facility was used until June, 1981.

The records search did not indicate any PCB spills from leaking transformers, or past disposal of PCB-containing transformers and capacitors, or oil from PCB-containing transformers to base landfills. PCB contamination was not found to be a problem at Luke AFB.

7. Pesticides

Luke AFB commonly uses herbicides and other pesticides for weed and pest control. The Entomology Shop controls the use and handling of all the pesticides and herbicides. These materials are used to control mosquitos, flies, roaches, rats, ants, and subterranean termites, as well as weeds and overgrowth.

Major pesticides found on the base are: Malathion, Dursban M, Diazinon, Baygon, Divalyl, Paradichlorobenzene, Pyrethrum, Dibrom 14, Baygon, Diquat, Weedone LV4, Ficam W, Phytax 60, and Pramitol. All pesticides are EPA-registered chemicals. Proper preparation and application procedures are followed. Empty containers are triple rinsed, punched with holes, and crushed prior to landfill disposal. There was no indication of inadequate disposal of residual pesticides. Appendix H lists the type and frequency of pesticides used.

There were no reports of banned or restricted pesticides currently used on-base. DDT was used commonly in the past but was discontinued in the 1960's. A small quantity of the herbicide 2,4-D was used on one occasion in the 1950's for weed control. An over-application of the 2,4-D resulted in some damage to adjacent cotton fields.

The quantities of waste pesticides resulting from rinsing empty containers and application equipment from past operations are judged to be small. The records search did not uncover any significant contamination problems from past pesticide usage.

8. Wastewater Treatment

Wastewater from Luke AFB is treated at the Waste Treatment Annex in a treatment plant built in the early 1940's. The plant processes include a comminutor, two primary sedimentation units, two trickling filters, a secondary clarifier, and a chlorine contact chamber. Two anaerobic digestors are used to digest the sludge, which is then dewatered on sludge drying beds. The design capacity of the plant is 0.9375 mgd with a peak flow of 3.15 mgd. Presently the plant is operating at 0.6 to 0.7 mgd. The majority of this flow consists of domestic sewage. Industrial wastewater is estimated to comprise less than 5 percent of the total average daily flow. The industrial wastewater is pretreated in 14 oil/water separators prior to discharge to the sanitary sewer system.

The effluent from the plant discharges directly to the Agua Fria River. The treated effluent is routinely monitored as required by the EPA for conventional parameters including BOD, COD, oil and grease, TSS, and pH. Recent results indicate treated effluent quality in compliance with existing NPDES permit regulations.

The sludge is digested in the two anaerobic digesters and then dewatered on sludge drying beds. Up until 1970, the dewatered sludge was disposed of at the base landfill and, from 1970 to 1979, at the Glendale landfill. Since 1979 it has been stockpiled in an area at the Waste Treatment Annex.

Recent test results indicate good treated effluent quality. However, no test results were available for indicators of toxic contaminants, e.g., heavy metals or volatile organic compounds.

9. Other Activities

The review of the records and information obtained in the interviews indicated no past or present usage of biological or chemical warfare agents at Luke AFB.

Radioactive waste has been disposed of at Luke AFB in the past. Electronic tubes were buried in 1956 at the Waste Treatment Annex. These tubes were buried 12 feet deep with a 4-foot concrete cover and 6 feet of earth cover. The site is marked, and the area is monitored annually. Results show no significant levels above background. The Weapons Control System Shop generates a small quantity of low-level radioactive electron tubes (about 3 pounds per year) which are disposed of in dumpsters as generated. This is an acceptable disposal practice.

No explosive ordnance disposal activities are currently being conducted at Luke AFB. There was an explosive ordnance demolition facility constructed in 1962, but the facility was seldom used. This facility has since been removed. Presently, any unexploded ordnance from Luke AFB is taken to the Luke Air Force Range for safe demolition and disposal.

The hospital at Luke AFB has a surgical lab, a dental lab, a histopathology lab, and a medical and dental X-ray lab. The base also has two Precision Measurement Equipment Labs (PMEL), a fuels testing lab, two photo labs, and two nondestructive inspection (NDI) labs.

The PMEL, NDI, and fuels testing labs have been discussed earlier. The remaining labs dispose of small quantities of common laboratory chemical solutions to the sanitary sewer; the photo lab practices silver recovery. Old chemicals which have exceeded their useful shelf life are sent to DPDO for disposition.

No significant hazards from past or present disposal methods were found in these areas.

10. Available Water Quality Data

The Bioenvironmental Engineering staff at Luke AFB performs periodic testing of all potable water wells on base.

Luke AFB obtains potable water from seven wells on-base. One well, located at the Waste Treatment Annex, provides water to the DPDO Storage Area, the stables, and the waste treatment plant. The location of these wells is shown on Figure 8. The water wells are periodically tested for pesticides, metals, trichloroethylene (TCE), trihalomethanes, and typical safe drinking water parameters (i.e., turbidity, alkalinity, chloride, nitrates, etc.). Periodic testing of the water wells indicates that there are presently no contamination problems with the base's drinking water supply.

The base stormwater drainage ditches are not routinely sampled since they are dry the majority of the time.

B. DISPOSAL SITES IDENTIFICATION AND EVALUATION

1. Disposal Site Identification

Interviews with 35 past and present base personnel (Appendix C) resulted in the identification of 16 disposal sites at Luke AFB. The approximate locations of these sites are shown on Figure 15. Disposal sites at the off-base installations included in the records search, with the exception of the Waste Treatment Annex, are discussed in Section VII and VIII of this report. A summary of the approximate dates that the major sites were in use is given on Figure 16.

- Site No. 1, referred to as the Old Incinerator Site, is the former site of a 15-ton-per-day capacity incinerator located near the North Gate. Incineration was the main method of disposal of base 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, at which time it was abandoned because of maintenance problems. The incinerator facility was demolished in 1972. No known or suspected hazardous wastes were disposed of at this site; therefore, this site was not rated. Ash from the incinerator was probably sent to Site No. 2 (described below) for disposal.

- Site No. 2, referred to as the Waste Treatment Annex Site, is located on Glendale Avenue 2 miles east of the main base and is adjacent to the Luke AFB sewage treatment plant. The site was used as the main landfill site for disposal of general refuse from approximately 1953 until 1970. Since 1970, all general refuse from Luke AFB has gone to the City of Glendale landfills. The site may also have been used intermittently from 1941 until deactivation of the base in 1946. Mess hall wastes were sold to area hog farmers and were not disposed of in this landfill. The site is now occupied by the horse stable and riding area and the newly constructed DPDO office, warehouse, and asphalt paved storage yard. Soil borings taken during the construction of the DPDO facilities encountered an assortment of buried general refuse including paper and old tires. Installation of a new sewer line to the DPDO facility was hampered due to numerous old tires encountered during the sewer line trench excavations. The landfill operation consisted of narrow trenches approximately 10 feet deep. The refuse was placed in the trench, burned, and then covered on a daily basis. When the trench was filled, it received a final 3 to 4 feet of cover, and a new trench was excavated beside it to receive additional waste. The total area included in this landfill operation was approximately 58 acres. A small quantity of low-level radioactive electron tubes was buried at this site in 1956. The material, believed to be encased in concrete, was disposed of in a pit 12 feet deep with 4 feet of concrete cover and 6 feet of earth cover. The radioactive burial site is located in the current DPDO storage yard and is designated by a small concrete marker approximately 1 foot square and 1 foot high with a radioactive warning sign. A recent radiological survey showed no measurable radiation above background at the surface of the site. Since small quantities of hazardous wastes may have been disposed of at this site, it was rated using the Air Force site rating methodology.

- Site No. 3, referred to as the Outboard Runway Landfill Site, was used from 1951 until 1953 for disposal of general refuse from the base. The operation consisted of narrow trenches where refuse was burned and covered on a daily basis, similar to the operation of Site No. 2. Landfill operations were discontinued at this site in 1953 when the Outboard Runway was constructed. All general refuse from the base was then sent to Site No. 2 for disposal. No known or suspected industrial type wastes or hazardous wastes were disposed of at this site; therefore this site was not rated.

POL wastes were not sent to landfills in the past but were used in fire training exercises, application to dirt roads, or disposed of in shallow trenches. Currently, POL wastes are segregated and sold through the DPDO for reuse. Past POL waste disposal sites are described below.

- Site No. 4, referred to as the Perimeter Road POL Waste Application Site, was used from 1951 until approximately 1970 for the disposal of most of the POL wastes from the main base. The POL waste was collected on a weekly basis. A 5,000-gallon tanker truck collected the waste from various holding tanks and drum storage areas located throughout the base. The tanker truck then spread the POL waste on the dirt perimeter road around the runway at the western portion of the base. This "road oiling" procedure served to dispose of the POL waste and to control excessive road dust. Prior to 1954, the total volume of POL waste from the base was relatively small and was disposed of in fire department training exercises. After 1954, the total volume of

POL waste increased significantly, due mainly to contaminated JP-4 from F-104 and F-4 jet aircraft. One of the interviewees indicated that up to 50,000 gallons per year of POL waste was disposed of on the perimeter road. The majority of this POL waste consisted of contaminated JP-4, but some AVGAS, MOGAS, diesel fuel, waste engine oils, and waste solvents were also included. Other wastes disposed of in this manner included wastes from the Facility 912 oil/water separator, and tank sludge from the periodic cleaning of fuel storage tanks. Some of the tank sludge contained lead from cleaning of AVGAS storage tanks. The surface application of the POL waste on the perimeter road and the high evaporation rate in this area of the country (approximately 60 inches per year) would have resulted in the majority of the JP-4 and other volatile POL wastes being evaporated into the atmosphere. Some of the waste may also have penetrated into the ground, where the biodegradable components would be degraded and assimilated by soil bacteria. The main concern is the fate of the small proportion of solvents included in the POL waste. Some of these solvents may have percolated into the ground. These solvents may have included (unconfirmed) methyl ethyl ketone, trichloroethane, TCE, toluene, cresylic acid, o-dichlorobenzene, phenolic paint strippers, acetone, and paint residues and thinners. This site is designated as a site where known moderate quantities of hazardous wastes have been disposed of in the past; therefore, this site was rated using the Air Force site rating methodology.

- Site No. 5, referred to as the POL Waste Disposal Trench Site, was used from approximately 1970 until 1972. POL waste from the base was transported to this site in a 5,000-gallon tanker truck and disposed of in shallow trenches, approximately 1-1/2 feet deep. The waste was allowed to weather for 4 to 6 weeks and then covered with soil. Numerous shallow trenches were excavated in this area for POL waste disposal, as well as a shallow lagoon located at the northeast corner of the site. This area is now used to store asphalt rubble from the demolition of an aircraft taxiway in 1979. One of the interviewees reported that POL waste volume, mostly JP-4, in excess of 100,000 gallons per year was disposed of at this site. As with Site No. 4, the main concern at this site is the fate of the solvents included in the POL waste which may have percolated into the ground. The shallow trench disposal and weathering procedures and the high evaporation rate would have resulted in the majority of the waste being evaporated into the atmosphere. This site is designated as a site where suspected large quantities of hazardous wastes have been disposed of in the past; therefore, this site was rated using the Air Force site rating methodology.

The locations of two former fire department training areas were determined from the records search. As discussed previously, the total volume of POL waste generated during the early history of the base, i.e., 1941 to 1946, was small and was disposed of in fire department training exercises. Standard procedure was to transport the POL waste in 55-gallon drums to the fire department training site. The POL waste was poured onto an old aircraft or simulated aircraft in a cleared, bermed circular area approximately 100 feet in diameter and then set on fire. Most of the POL waste was consumed in the fire; however, some minor percolation into the ground may have taken place. After 1954, the volume of POL waste increased, due mainly to contaminated JP-4 from assigned jet aircraft. Some POL waste was used in fire department training exercises; however, the majority of the POL waste was disposed of on the perimeter road (Site No. 4) and in the disposal trenches (Site No. 5).

- Site No. 6, referred to as the South Fire Department Training Area, was the original fire department training area and was located in the southern portion of the base, east of the Facility 1009 power check pad. This site was used from 1941 until deactivation of the base in 1946, and again from the time of base reactivation in 1951 until approximately 1963.

- Site No. 7, referred to as the North Fire Department Training Area, was located in the northern portion of the base, west of the current Facility 1356 fire department training area. This site was used from approximately 1963 until 1973.

One of the interviewees estimated that fire department training exercises were conducted about once per month until 1973, and about once per quarter thereafter. Current fire department training exercises are conducted at Facility 1356 (constructed in 1973) on a concrete pad using JP-4.

Both of the above sites are designated as sites where known small quantities of hazardous wastes have been disposed of in the past; therefore these sites were rated using the Air Force site rating methodology.

- Site No. 8, referred to as the F-15 Burial Site, is the site where an F-15 aircraft was buried in 1978 after it was destroyed in a fire. Some structural components of the aircraft contained boron fibers. The aircraft was reportedly shrouded in plastic prior to disposal at the site. No known or suspected hazardous wastes were disposed of at this site; therefore, it was not rated.

- Site No. 9, referred to as the Canberra Burial Site, is the site where a Canberra reciprocating engine aircraft was buried in the early 1950's. The site is located in the runway clear zone where the aircraft reportedly crashed. No known or suspected hazardous wastes were disposed of at this site; therefore, it was not rated.

- Site No. 10, referred to as the Concrete Rubble Burial Site, is located in the northwest corner of the base. Concrete and asphalt rubble from runway repair and extension operations was stored above ground and accumulated in this area since 1951. All of the accumulated rubble was then disposed of in a burial pit in 1974. No known or suspected hazardous wastes were disposed of at this site; therefore, it was not rated.

- Site No. 11, referred to as the Former Outside Transformer Storage Area, was used by base exterior electric shop personnel prior to June 1981 for temporary storage of out-of-service transformers. This site is included because the out-of-service transformers, some of which contained PCBs, were stored on the ground. However, no indication was found from the interviews or from the records of any PCB spills or leaks from transformers stored in this area; therefore, this site was not rated. Since June 1981, all out-of-service transformers have been stored in a designated, fenced area on an asphalt surface. Recent testing of these transformers indicated that the majority do not contain regulated concentrations of PCBs.

- Site No. 12, referred to as the Old EOD Burial Pit, was located between the outboard runway and the perimeter road, northeast of Site No. 8. The exact dates of operation of the pit could not be determined; however, it is known that the pit was in existence in the early 1970s. The site is located near the EOD Demolition and Burn Facility 1047, which was constructed in 1963 and was probably used to dispose of the residue from the incineration or detonation of unused or outdated ordnance. All hazardous constituents would have been destroyed in the incineration/detonation operations and there is no reason to believe that hazardous materials were disposed of at this site; therefore, it was not rated. Currently, all unexploded ordnance is taken to the Luke Air Force Range at Gila Bend for demolition and disposal.

- Site No. 13, referred to as the Old Drainage Ditch Disposal Area, was the location of a drainage ditch along the northwest perimeter of the base that was reportedly used for the disposal of some general refuse during the 1940s. Waste materials reportedly disposed of at this location included concrete rubble, wire, fencing, and waste lumber. No known or suspected industrial type wastes or hazardous wastes were disposed of at this location; therefore, this site was not rated. The ditch was filled in and covered when the base was deactivated in 1946.

- Site No. 14, referred to as the Old Salvage Yard Burial Site, is located in the northeast corner of the base in the former salvage yard area. This site was reportedly used for disposal of surplus materials such as tools, aircraft parts, and equipment following temporary base closure in 1946. No known or suspected hazardous wastes were disposed of at this site; therefore, it was not rated.

Some of the interviewees indicated that numerous burial sites, similar to Site No. 14, are located in the northern portion of the base. These sites were also reportedly used for disposal of surplus materials during deactivation of the base in 1946. The exact locations or numbers of these sites could not be confirmed. No indication was determined from the interviews of known or suspected hazardous wastes being disposed of at these sites.

Other sites of interest include two reported fuel spill sites, which are described below:

- Site No. 15, referred to as the Facility 328 Spill Site, is the site of a minor fuel spill, estimated to be less than 1,000 gallons, which occurred during replacement of an old underground fuel line with a new above-ground fuel line in 1964. The low permeability of the soil and high evaporation rate would have resulted in the majority of the spilled fuel being evaporated into the atmosphere. Some percolation into the soil may have taken place, but the quantity involved is judged to be insignificant; therefore, this site was not rated.

- Site No. 16 is the location of the Facility 321 underground fuel storage tanks. Infrequent spills reportedly have taken place in this area as a result of overtopping of the fuel storage tanks. The spills involved are believed to be insignificant, and the majority of the spilled fuel would have evaporated into the atmosphere since the aboveground area surrounding the tanks is paved; therefore, this site was not rated.

a. Other Considerations--Drainage Ditches

As discussed previously in Section III.C, "Hydrology", large-scale agricultural ground-water withdrawals have caused a water table depression around the Luke AFB area. Furthermore, the receding water table causes a condition of land subsidence in the Luke AFB area. Geologic conditions associated with the Luke Salt Body are such that land subsidence causes fissures or cracks to occur in the land surface. Unpublished geologic data indicate that the fissures may be quite deep, possibly extending vertically to the water table. Surface drainage in this area could enter a fissure and therefore the ground-water aquifer quite rapidly. Of particular concern are the drainage ditches which collect runoff from the base and flow through the subsidence fissure-prone area surrounding the base.

These drainage ditches are dry most of the time because of the low rainfall in the area; however, there is a concern regarding the times when rainfall occurs and the ditches are flowing. Water quality monitoring of the drainage ditches is currently not routinely performed by the base.

The drainage ditches and the potential for contamination are described below:

- The drainage ditch near Facility 912 receives runoff from the main industrial areas of the base and has the highest potential for contamination. This drainage ditch also flows through an area off-base where subsidence fissures are known to exist.

- Two drainage ditches west of the above ditch receive runoff primarily from runway areas. Although the potential for contamination is relatively low, these ditches also flow through an area off-base where subsidence fissures are known to exist.

- The remaining three drainage ditches receive runoff primarily from non-industrial areas of the base. One of the drainage ditches receives runoff from the 26th Air Division complex and cooling tower discharge (approximately 20 gpm) from the 26th Air Division's power plant. Although no known subsidence fissures exist in the offbase areas where these drainage ditches flow, the potential exists for subsidence fissures to develop at any time in the future.

The above drainage ditches have not been included in the disposal site evaluations. However, monitoring of these ditches is included in Section VI "Recommendations", to be performed by the base environmental staff.

2. Disposal Site Evaluation

A preliminary screening was performed on all 16 identified past disposal sites based on the information obtained from the interviews and the base records. The major characteristics of each disposal site are summarized in Table 4. Eleven of the identified sites were eliminated from further consideration because the Records Search did not indicate that hazardous wastes were disposed of at these sites. The remaining sites (2, 4, 5, 6, and 7) were identified as sites where known or suspected hazardous wastes were disposed of in the past. These five sites were rated using a system for rating the hazard potential of waste disposal facilities that was developed by CH2M HILL and Engineering-Science for specific application to the Air Force Installation Restoration Program. This system was modified from the rating system developed by JRB Associates, Inc., of McLean, Virginia, for the United States Environmental Protection Agency.

The Air Force site evaluation system consists of 26 rating factors that are divided into four categories, i.e., receptors, pathways, waste characteristics, and waste

Table 4
SUMMARY OF DISPOSAL SITE CHARACTERISTICS

Site No.	Site Description	Distance to Nearest Water Well (ft)	Distance to Nearest Water Body (miles)	Depth to Groundwater (ft)	Critical Environments	Evidence/Quantity of Hazardous Wastes	Waste/ Hazardous Waste Type
1	Incinerator	1,200	2.7	320	None	None	Municipal Waste
2	Waste Treatment Annex	120	<500 feet	310	None	Known/Small	POL Waste
3	Outboard Runway Landfill	2,400	4.0	350	None	None	General Refuse
4	Perimeter Road POL Waste Application	2,000	4.7	370	None	Known/Moderate	POL Waste
5	POL Waste Disposal Trenches	200	4.1	370	None	Suspected/Large	POL Waste
6	South Fire Department Training Area	1,600	3.7	340	None	Known/Small	POL Waste
7	North Fire Department Training Area	1,200	3.7	360	None	Known/Small	POL Waste
8	F-15 Burial Site	3,000	4.1	350	None	None	Aircraft

Table 4--Continued

Site No.	Site Description	Distance to Nearest Water Well (ft)	Distance to Nearest Water Body (miles)	Depth to Groundwater (ft)	Critical Environments	Evidence/Quantity of Hazardous Wastes	Waste/ Hazardous Waste Type
9	Canberra Burial Site	4,400	4.7	370	None	None	Aircraft
10	Concrete Rubble Burial Site	400	4.0	380	None	None	Concrete Rubble
11	Former Outside Transformer Storage Area	2,200	2.7	340	None	None	None
12	Old EOD Burial Pit	3,000	4.1	350	None	None	Expended Ordnance
13	Old Drainage Ditch Disposal Area	100	4.0	380	None	None	General Refuse
14	Old Salvage Yard Burial Site	3,200	2.7	340	None	None	Equipment Burial
15	Facility 328 Spill Site	1,600	2.7	340	None	Known/Small	Fuel Spill
16	Facility 321 Fuel Storage Tanks	1,600	2.7	340	None	Known/Small	Infrequent Over-topping Spills

Note: The nearest surface water body in all cases is the Aqua Fria River which is classified by the State of Arizona as Aquatic Life/Wildlife/Agriculture usage.

management practices, which are used to evaluate the principal targets of contamination, the mechanisms for migration, the hazards posed by the contaminants, and the facility's design and operation, respectively. Relative scores from each category are combined to give an overall score using appropriate weighting factors. A more detailed description of this hazard evaluation methodology is included in Appendix L.

The following is a brief discussion of the results of the site assessments and a description of general site characteristics in each of the four rating categories.

a. Receptors. This category assesses the human population and critical environments which may potentially be affected by hazardous materials released from a waste disposal site.

All of the five sites rated are remote from populated areas but close to the reservation boundary. The land surrounding the reservation boundary is agricultural land where cotton is raised as the main crop. No critical environments were identified in the area on or surrounding the base. All of the sites are within 3,000 feet of Luke AFB drinking water supply wells. In particular, Sites No. 2 and 5 are within 200 feet of Luke AFB drinking water supply wells. In summary, the close proximity of the sites to the reservation boundary and drinking water supply wells are the main rating factors contributing to the overall medium range subscores (48-52) for the receptors category.

b. Pathways. This category assesses the potential routes and mechanisms by which hazardous materials can escape from a waste disposal site.

All of the five sites received very low pathways category subscores for the following reasons:

i. Potable water wells on-base are deep, with the depth to ground water ranging from 380 to 390 feet below land surface. The unsaturated zone above the water table also contains several clay and hardpan layers which would tend to impede vertical contaminant migration in the unsaturated zone above the water table.

ii. A ground-water depression occurs below the Luke AFB area as a result of heavy pumping by numerous off-base agricultural water supply wells. As a result, any contaminant migration from disposal activities at Luke AFB would tend not to migrate beyond the base boundaries, but would be retained in the water table depressed area below the base. The only exception would be Site No. 2, which is located 2 miles east of the base. However, any subsurface contaminants from disposal activities at this site would migrate westerly toward the water table depression beneath the Luke AFB area. It should be noted that during the onsite base visit, the City of Phoenix reported that TCE contamination was found in three City water supply wells located in the Phoenix-Scottsdale area. The distance to these wells (greater than 20 miles) and the known direction of ground-water movement eliminate, from a pathways standpoint, Luke AFB as a suspect source of this contamination. From a waste characteristics standpoint, no indication was found from the records search that any significant quantities of TCE were disposed of at the identified sites at Luke AFB.

iii. Recent well water analyses at all active Luke AFB drinking water supply wells do not indicate the presence of hazardous contaminants. These wells are periodically sampled and analyzed for heavy metals, pesticides, gross alpha radioactivity, and TCE (indicator of volatile organic compound contamination). Since the ground-water movement in the area is toward Luke AFB, the absence of hazardous contaminants in the drinking water supply wells is an indication that (1) no significant amounts of hazardous materials are present in the disposal sites, or (2) if hazardous materials are present, the potential for vertical migration to the water table is low.

It should be emphasized, however, that even though the pathways category subscores are low, it is highly probable that any contaminant migration from the sites would still be contained in the unsaturated zone above the water table. At an estimated 10 to 20 feet per year vertical migration rate for irrigated water, the travel time of contaminants from the surface to the water table would be at least 20 to 40 years. Although Luke AFB drinking water supply wells are not contaminated today, there is no guarantee that they could not become contaminated in the future if hazardous contaminants are present in the unsaturated zone above the water table.

Subsidence fissures in the area surrounding Luke AFB provide a possible direct pathway from the surface to the water table. However, the subsidence fissures are remote from the identified past disposal sites and, therefore, do not contribute to the potential for migration of contaminants from these sites. The major concerns related to subsidence fissure pathways are the base drainage ditches that flow through this area. These concerns have been discussed in the previous Section III.B.1 "Disposal Site Identification."

c. Waste Characteristics. This category assesses the potential hazards posed by the waste materials present in a disposal site. The waste characteristics that are evaluated include the probable type and relative quantities of waste materials present as well as the degree of certainty as to their existence, whether known, suspected, or unknown. The potential for contaminant migration is low if no known quantities or only small quantities of hazardous materials are present, even if the site has receptors and pathways favorable to migration.

Three of the sites evaluated (2, 6, and 7) have known small quantities of hazardous wastes. Site No. 2, the Waste Treatment Annex Site, has a small quantity of POL wastes buried at the site. Sites No. 6 and 7 are former fire department training areas where some waste solvents used in the fire department training exercises may have percolated into the ground. Sites No. 4 and 5 were major land disposal areas for POL waste, consisting mainly of contaminated fuels and engine oils, but also including waste solvents from the industrial areas of the base. These sites have been assigned a higher waste characteristics category subscore.

d. Waste Management Practices. This category assesses the design characteristics and management practices at a disposal site as they relate to the site's environmental impact. It also examines the measures that have been taken to minimize exposures to hazardous wastes.

None of the sites were a designated hazardous waste landfill or disposal site. The sites do not have liners, leachate, or gas collection systems, or accurate records. None of the sites have impervious covers, although about half of the surface area of Site No. 2 is occupied by the DPDO asphalt storage yard.

The impact of these management practices is minimized, however, by the relatively small quantities of hazardous wastes and total wastes disposed of at these sites.

Copies of the rating forms completed for each site are included in Appendix M. A summary of the results of the site assessments, using the Air Force rating system, is given in Table 5.

Table 5
SUMMARY OF RESULTS OF SITE ASSESSMENTS

Site No.	Site Description (Weighting Factor):	Subscores (% of Maximum Possible Score in Each Category) Receptors 0.22	Pathways 0.30	Waste Characteristics 0.24	Waste Management Practice 0.24	Overall Score (Weighted Average)	Page Reference of Site Rating Form
2	Waste Treatment Annex	52	16	60	44	41	M-1
4	Perimeter Road POL Waste Application	52	10	80	59	48	M-3
5	POL Waste Disposal Trenches	52	12	90	59	51	M-5
6	South Fire Department Training Area	52	10	60	44	39	M-7
7	North Fire Department Training Area	48	10	60	44	39	M-9

V. CONCLUSIONS

V. CONCLUSIONS

A. Information obtained through interviews with past and present base personnel, base records, including shop folders, well logs, soil borings and water quality analyses, and field observations indicates that potentially hazardous wastes have been disposed of on Luke AFB property in the past. No direct evidence indicates migration of hazardous contaminants.

B. Industrial activity at Luke AFB consisted primarily of routine aircraft and vehicle maintenance. Quantities of hazardous wastes generated have been small, in comparison to bases having significant aircraft overhaul and maintenance missions; therefore, associated disposal problems are considered to be relatively small.

C. The potential for migration of hazardous contaminants is low because of (1) low ground-water table, (2) extremely low precipitation, (3) extremely high evapotranspiration rate, and (4) presence of a ground-water table depression below the base. Although low, the potential for migration exists because of (1) moderate permeability of the soil and (2) the absence of continuous impermeable confining strata in the unsaturated zone above the water table.

D. As a result of large-scale off-base agricultural withdrawals, a large cone of depression has formed around the Luke AFB area. Consequently, ground water flows toward Luke AFB from all directions.

E. Subsidence fissures in the area surrounding Luke AFB provide a possible direct pathway from the surface to the water table. These subsidence fissures are remote from past disposal sites and do not provide a pathway for contaminant migration from these sites. However, several base drainage ditches flow through this area, and the potential exists for migration of any hazardous contaminants in the drainage ditch effluents, if present, to the water table by subsidence fissure pathways. This potential is reduced by the fact that the drainage ditches are dry most of the time because of the low rainfall in the area.

F. Table 6 presents a priority listing of the rated sites and their overall scores. Although no high priority sites were identified, the following sites were designated as areas showing the most significant potential (relative to other Luke AFB sites) for environmental impact.

Table 6
PRIORITY LISTING OF DISPOSAL SITES

Medium Priority Site No.	Site Description	Overall Score
5	POL Waste Disposal Trenches	51
Low Priority Site No.		
4	Perimeter Road POL Waste Application	48
2	Waste Treatment Annex	41
6	South Fire Department Training Area	39
7	North Fire Department Training Area	39

NOTE: No high priority sites were identified.

1. <u>Site No. 4 (Perimeter Road POL Waste Application Site and Site No. 5 (POL Waste Disposal Trench Site)</u>

These sites were used for disposal of the majority of the base POL wastes, including waste solvents and leaded tank sludge from fuel storage tank cleaning operations, from 1951 until 1972. It is believed that most of the POL waste evaporated into the atmosphere because of (1) the low precipitation and high evapotranspiration rate in the area, and (2) the method of disposal, i.e., surface application to a dirt perimeter road at Site No. 4 and disposal to shallow trenches at Site No. 5. However, some of the POL waste may have percolated into the soil and may be migrating through the unsaturated zone above the water table. Soil attenuation would be expected to further retard the vertical migration of contaminants in the unsaturated zone. Of particular concern are the waste solvents, especially chlorinated solvents, which would tend to persist and not be assimilated or degraded by soil bacteria.

Site No. 5 has a higher potential for contaminant migration than Site No. 4 since the POL waste at Site No. 5 was concentrated in a small area (trenches) relative to Site No. 4 (Perimeter Road). Site No. 5 also contained a shallow lagoon for POL waste disposal which was located very close (less than 200 feet) to Luke AFB drinking water supply Well No. 11. Although water quality in Well No. 11 is good, waste solvents from Site No. 5 may possibly be migrating through the unsaturated zone and may not yet have reached the water table.

G. The remaining sites are not considered to pose a hazard for migration of contaminants. Therefore, these sites do not warrant additional study.

H. Areas of concern, other than disposal sites, include the discharges from the base drainage ditches and the discharge from the sewage treatment plant.

1. The base drainage ditches flow through an area of known or potential subsidence fissures which may provide a direct pathway from the surface to the water table. Routine monitoring of water quality in the drainage ditches is currently not done by the base.

2. The base sewage treatment plant discharges directly to the Agua Fria River. Any hazardous contaminants in the treated effluent, if present, would then migrate off the base by this surface-water pathway.

The treated effluent is currently monitored for conventional water quality parameters as required by the EPA. The effluent, however, has never been monitored for hazardous contaminants.

Based on a review of industrial operations at the base, we believe that the potential for hazardous contaminants being present in the drainage ditch effluents or the treated effluent from the sewage treatment plant is low. However, this needs to be verified.

VI. RECOMMENDATIONS

VI. RECOMMENDATIONS

A. Phase II Program

To verify that hazardous contaminant migration is not a problem at Site No. 5, a limited Phase II program is advisable. The recommended program includes the following.

1. Soil sampling is recommended at Site No. 5, the POL Waste Disposal Trench Site, to determine if contaminant migration is occurring in the unsaturated zone below this site. The recommended program is as follows:

   a. Three soil borings should be taken at the northeast corner of the site in the vicinity of the former POL waste disposal lagoon.

   b. The soil borings should extend to a depth of 200 feet, and soil samples should be collected at 10-foot intervals and saved.

   c. The soil samples from depths of 10, 50, 100, 150, and 200 feet should be analyzed.

   d. If contaminants are found in any of the above samples, then additional analyses of collected samples should be performed to determine the vertical extent of contaminant migration.

   e. After completion, the borings should be properly filled to prevent potential migration pathways.

   The 200-ft soil boring depth was selected based on the maximum vertical migration rate of 20 feet/year and the time that this site was first placed in operation (10 years ago).

2. The above soil samples should be analyzed for the following:

Parameter	Reason
COD, TOC, Oil and Grease	Indicators of non-specific gross contamination from POL wastes.
Volatile organic compounds (including trichloroethylene o-dichlorobenzene, toluene, 1,1,1-trichloroethane, and carbon tetrachloride) and phenols	Indicators of specific hazardous waste solvents generated at Luke AFB.
Lead	Possible contaminant from tank sludge.

3. Details of parts 1 and 2 outlined above, including the exact location of soil sampling points, should be finalized as part of the Phase II program.

4. In the event that contaminants are detected in the soil samples, a more extensive field survey program should be implemented to determine the extent of contaminant migration. The Phase II Contractor should be responsible for evaluating the results of the program outlined above and for recommending additional monitoring, as appropriate.

B. In-House Environmental Monitoring Program

To verify that hazardous contaminant migration is not a problem with the base drainage ditches or the base sewage treatment plant effluent, the following routine monitoring should be conducted by the base.

1. The drainage ditch effluents leaving the base should be monitored to establish a baseline for heavy metals, volatile organic compounds, phenols, oil and grease, COD, and TOC. This monitoring is recommended to ensure that the drainage ditch effluents do not contain hazardous contaminants which could possibly migrate to the water table through subsidence fissures. Monitoring should be continued periodically after rainfall events.

2. The base should continue its program of comprehensive sampling and analysis of active base drinking water wells. It is recommended that a volatile organic compound analysis be included in addition to the analyses currently performed. This monitoring is recommended as a precautionary measure to determine if a long-term contaminant migration potential exists.

3. The treated effluent from the base sewage treatment plant should be sampled and analyzed to establish a baseline for heavy metals, phenols, and volatile organic compounds. This monitoring is recommended as a precautionary measure to ensure that the treated effluent discharge to the Agua Fria River does not contain hazardous contaminants. Monitoring should be continued periodically.

4. A waste sludge sample from the sewage treatment plant should be collected and analyzed for hazardous contaminants.

5. In the event that hazardous contaminants are detected in the routine monitoring conducted by the base, a risk assessment should be made to determine follow-on action.

C. Since no imminent hazard has been determined, there is no immediate urgency to conduct the above program, which can be implemented as financial resources become available.

VII. GILA BEND AIR FORCE AUXILIARY FIELD AND LUKE AIR FORCE RANGE

VII. GILA BEND AIR FORCE AUXILIARY FIELD AND LUKE AIR FORCE RANGE

A. INTRODUCTION

A cursory review of the activities at Gila Bend Air Force Auxiliary Field (AFAF) and Luke Air Force Range (AFR) was included in the Luke Air Force Base records search. Information on the above off-site facilities was obtained from interviews with personnel familiar with past and present operations, installation records, ground tours, and a helicopter overflight of the auxiliary air field and portions of the range.

B. DESCRIPTION

1. Gila Bend Air Force Auxiliary Field

Gila Bend AFAF is a Luke AFB satellite installation located 71 miles southwest of Phoenix on 1,885 acres of land. The installation is operated by the 58th Combat Support Group and is responsible for the management, maintenance, and operation of the manned and unmanned ranges encompassing the Gila Bend Segment of Luke AFR.

Facilities at Gila Bend AFAF include an 8,500-foot runway for the emergency recovery of aircraft unable to proceed back to their home base, vehicle maintenance shops, housing, and other associated facilities necessary to provide living accommodations for the 300 personnel stationed there. Aircraft maintenance activities are performed infrequently and only on an emergency basis. No aircraft are permanently assigned to the auxiliary air field. The primary activities are concerned with support of the range and include construction, operation, and maintenance of on-range roads, targets, and burial sites.

2. Luke Air Force Range

The Luke Air Force Range consists of a wedge-shaped land area of 2,669,225 acres (4,170 square miles) which lies within southern Yuma County and extends eastward into Maricopa and Pima Counties in southwestern Arizona.

The 2,669,225-acre range is divided into two parts; the eastern section is designated the Gila Bend Segment and the western section is designated the Yuma Segment. The Gila Bend Segment consists of a 1,651,235-acre parcel with some 280 miles of exterior perimeter, while the Yuma Segment consists of 1,017,990 acres with some 186 miles of exterior perimeter.

Under a joint use agreement between the U.S. Air Force and the U.S. Navy dated 1958 and amended in 1965, the airspace over the Yuma Segment belongs to and is controlled by the U.S. Navy, while the Gila Bend Segment airspace belongs to and is controlled by the U.S. Air Force. Ground access to these segments is also controlled by the agency controlling the overlying airspace. Control by the U.S. Navy is through the U.S. Marine Corps Air Station, Yuma, Arizona. USAF control is through Luke Air Force Base. The construction of ground installations, including roads, buildings, targets, wells, towers, and burial pits, at any location on Luke AFR requires the approval of Luke Air Force Base.

U.S. Air Force, U.S. Marine Corps, and U.S. Navy units utilize Luke AFR for aerial combat proficiency training. A list of the units which utilize the range is given in Appendix I. A typical mission lasts 1 to 2 hours, with 30 to 45 minutes of that time spent in weapons delivery training.

Luke AFR is divided into 13 separate aerial weapons ranges or target complexes plus a drone maneuvering area. Four of the ranges are located in the Yuma Segment and are under the operational control of the Yuma Marine Corps Air Station, Yuma, Arizona. The four ranges include Rakish Litter and Panel Stager manned ranges, an air-to-air gunnery range, and an air combat maneuvering range (ACMR).

The remaining nine ranges and target complexes plus the drone maneuvering area are within the Gila Bend Segment and are under the operational control of Luke Air Force Base. The nine include manned ranges 1 through 4, unmanned target 5, three tactical ranges, and an air-to-air gunnery range.

A description of the ranges is given in Appendix J.

C. GEOLOGY

Luke Air Force Range and Gila Bend Auxiliary Field are located within the Sonoran Desert section of the Basin and Range physiographic province. This physiographic section consists of 76.4 million acres, including the 2.6-million-acre range. The Sonoran Desert extends across all of southwestern Arizona and includes parts of southern California, northwestern Mexico, and Baja, California. The area is characterized by north to northwest trending, basins, and isolated mountain ranges separated by desert plains. The plains are wide, nearly level alluvial valleys separated by mountain ranges. The land surface within the basins is relatively flat, with elevations ranging from greater than 1,200 feet to approximately 200 feet above msl. The basins slope gently downward to the north and west toward the Gila and Colorado Rivers. The mountains separating the basins are barren, with peak elevations ranging from 3,000 to greater than 4,000 feet above msl. The highest peak within the range is Maricopa Peak on Javelina Mountain in the Sand Tank Mountains on the eastern boundary of Luke AFR.

Rivers occurring near Luke AFR include the Gila and the Colorado Rivers. The Gila River lies roughly along the northern boundary of Luke AFR and flows westward, discharging to the Colorado River. The Colorado River occurs west of the Luke AFR boundary on the west side of Yuma, Arizona. The Colorado flows south, discharging to the Gulf of California. The Gila River is dry most of the time. The flow of the Colorado River has been markedly reduced by upstream water withdrawal.

Two types of soils generally occur at Luke AFR, coarse-grained and fine-grained soils. Coarse-grained soils occur on 98 percent of the range. This soil type is typically associated with the basin-fill areas. The soil consists of gravel, cobbles, boulders, and sand (primarily) with some silt and little clay. The soil was derived from upland areas and is similar in composition to the source rock, i.e., granite, granite-gneiss, andesite, basalt, schist, and limestone. Locally, some calcium-carbonate cemented layers occur below the surface.

The fine-grained soil deposits occur on only 2 percent of the range. These soils consist of clay (primarily) with some silt.

Most desert soils are well aerated and high in salt content. Permeability of the coarse-grained soils is relatively high (>0.01 cm/sec or 0.02 ft/min), whereas permeability of the fine grained soil is very low (<0.00001 cm/sec or 0.00002 ft/min).

Rock types occurring within Luke AFR include crystalline igneous and metamorphic basement rock, volcanic and sedimentary bedrock, and volcanic flow rock. Bedrock occurs at various depths throughout the range. In some parts of the range, basement rock occurs at ground surface or extends above surrounding ground level. The mountain ranges are outcrops of basement rock. Within the basins, basement rock may be as deep as 10,000 feet below land surface.

The range is technically stable; however, faults, which offset basin-fill deposits by as much as 60 feet are known to occur within the eastern part of the range. These faults are capable of generating earthquakes due to movement along the fault plane.

Subsidence problems such as those reported at Luke AFB, have not occurred at Luke AFR. However, since geologic conditions at Luke AFR are similar to those at Luke AFB, it can be assumed that, if large ground-water withdrawals occur in the future, subsidence would soon follow.

D. HYDROLOGY

The range receives little rainfall during normal years (<7 inches/year). Coupled with a high evapotranspiration rate (80 inches/year), this results in the absence of surface-water bodies. Surface drainage during storm events generally flows north toward the Gila River, which discharges to the Colorado River. Some surface drainage on the south edge of the range flows south into Mexico. However, runoff from the range is minimal. The occurrence of large areas of coarse-grained soils further reduces the possibility of runoff leaving the range. During and after a storm event, surface runoff occurs initially as overland sheet flooding. However, most runoff is consumed rapidly by evaporation and infiltration into the coarse-grained soils in the basins.

In those areas where the fine-grained soils occur, primarily playas, water from rainfall and snowmelt accumulate and are eventually depleted by evaporation and slow seepage through fractures. Most of the recharge to the underlying ground-water system occurs through river/stream or wash bottoms. The flowing waters of the rivers remove and transport fine-grained materials, leaving behind coarse-grain permeable sediments in the stream course.

Surface-water recharge and its associated quality is reflected by ground-water quality. Flow within the Gila River currently occurs only during rainstorms, since the river is dammed at Painted Rock. Water quality in the past within the Gila River has been poor, although it is flow-dependent, i.e., at high flow rates, water quality is improved.

Ground water occurs within the unconsolidated sediments in the alluvium filled basins. Two major ground-water basins occur within Luke AFR: the Lower Colorado Basin and the Gila Basin. The Colorado Basin occurs in the western portion of the range in the vicinity of Yuma. Flow is westward toward the Colorado River. The remainder of Luke AFR is within the Gila Basin, and flow is northward toward the Gila River. The depth to ground water is extremely variable and ranges from less than four feet in the west end of the range near rivers and canals, to a few hundred feet in the western basins. Ground water occurs primarily under unconfined conditions, although perched aquifers and local confining beds are common.

Ground-water discharge occurs by pumping, evapotranspiration, and underflow parallel to the Gila and Colorado Rivers. Depth to water level in the Gila Bend area ranges from 24 feet to over 250 feet below land surface. At Gila Bend AFAF, the static water level is approximately 250 feet below land surface. Generally, the depth to water level increases with distance from the Gila River to a maximum of approximately 400 feet below land surface.

Permeability of the unsaturated upper sediments is variable. However, in general, the permeability ranges from 1×10^{-3} to 3×10^{-3} cm/sec, similar to Luke AFB.

Figure 17 illustrates a geologic log for one of the water supply wells at Gila Bend AFAF. Table 7 lists water chemical characteristics from this well. The analysis of this well is typical of water quality in the Gila Bend area. Water quality, in general, is poor; the water is naturally high in chlorides (500 mg/l), fluorides (4.0 mg/l), boron (0.02 mg/l), arsenic (0.02 mg/l), and total dissolved solids (1,034 mg/l). This water is not suitable as a potable supply without treatment. Gila Bend Auxiliary Field is supplied by three wells, and potable supplies are treated by reverse osmosis.

Vertical travel time at Luke AFR within the unsaturated sediments above the water table would be approximately 10 to 20 feet/year. Once reaching the water table, a contaminant would migrate northward to the Gila River and then move west parallel to the river toward a pumping well.

E. ENVIRONMENTAL SETTING

1. Biotic Communities

The Sonoran Desert is a very diverse ecosystem comprised of 76.4 million acres. This desert encircles the Gulf of California like a giant horseshoe, and covers portions of southeastern California; southern Arizona; and most of the Mexican States of Sonora, Baja California, and Baja California Sur. Luke AFR includes only a small portion of the vast Sonoran Desert, but within its boundaries much of the desert's diverse ecosystem is represented. Three of the seven vegetal subdivisions of the Sonoran Desert are found on Luke AFR: the Arizona Upland, the Lower Colorado Valley, and the Desert Grassland.

The representative vegetation of the Lower Colorado Valley subdivision is of the creosotebush-bursage community. This vegetation is generally found on lower bajadas, hills, and intermountain alluvial plains. Partly because this vegetal zone receives relatively little precipitation (5 to 10 inches of rainfall annually) the vegetation consists predominantly of low, open stands, either mixed or pure, of creosotebush and bursage.

The mixed paloverde-cacti community is characteristic of the Arizona Uplands subdivision. The Arizona Upland association is found on the upper bajadas and lower flanks of Luke AFR mountains and is a Sonoran Desert vegetation subdivision that contains a wider diversity of species than the Lower Colorado Valley type. Creosotebush predominates, but with a greater number of associated species. The foothill

Table 7
WATER QUALITY CHARACTERISTICS FROM SELECTED WELLS AT GILA BEND AFAF[a]

Parameter[b]	Well No. 9[c]	Well No. 4[c]
Total Depth (ft)	--	460
Perforated Interval (ft)	--	--
Arsenic	0.026	0.02
Barium	<1	<1
Cadmium	<0.01	<0.01
Chromium	<0.05	<0.05
Lead	<0.02	<0.02
Mercury	0.002	<0.002
Selenium	<0.01	<0.01
Silver	<0.01	<0.01
Copper	0.24	0.38
Iron	0.15	0.31
Manganese	<0.05	<0.05
Zinc	<0.05	<0.05
Calcium as Ca	44	39
Magnesium as Mg	3.2	2.7
Potassium	5.9	5.1
Sodium	349	309
Alkalinity, total as $CaCO_3$	52	48
Chloride	500	500
Hardness as $CaCO_3$	122	108
Residue, Filtrable (TDS)	1,135	1,034
Residue, Non-Filtrable (SS)	1	<1
Specific Conductance (μmhos/cm)	1,800	1,700
Sulfate as SO_4	200	150
Nitrate as N	4.2	2.8
Fluoride	4.1	4.0
Turbidity (JTU)	<1	<1
TCE Solvent	ND[d] <0.0005	ND[d] <0.0005

Source: USAF OEHL, Brooks AFB, Texas.

[a]Raw water quality prior to reverse osmosis treatment.

[b]Parameters are in mg/l unless otherwise noted.

[c]Sampled March - April, 1981.

[d]ND = None detected.

paloverde, iron-wood, mesquite, and whip-like octillo, as well as small shrubs and grasses, provide locally abundant plant cover.

Both the Arizona Upland and Lower Colorado Valley subdivisions are characterized by low, open stands of creosote-bush in the Sonoran Desert plains. A distinguishing characteristic of the Sonoran Plain, which is best developed in the Arizona Upland subdivision, is the presence of small drought-adapted trees and arborescent cacti. These species exhibit a great diversity of size and distribution.

Desert grasslands are of the highly diverse Galleta-Grass Scrub community, where the grasses are comingled with various woody shrubs including a number of uniquely desert grassland dry-tropic species such as palmilla, sotol, bear-grass, mesquite, crucillo, and grassland species of cholla and other cacti. It is a peculiarly southwestern grassland community centered for the most part near the international boundary.

Life-zones are bands or groups of vegetation, including the animals inhabiting them, that vary with latitude and/or altitude. Luke AFR is generally characteristic of the Lower-Sonoran Life-Zone as indicated by the presence of the round-tailed ground squirrel, the cactus mouse, and the desert pocket mouse. Desert bighorn sheep and the desert chuckwalla are found in the mountain ranges. The desert kangaroo rat, desert pocket mouse, and numerous species of lizards and snakes, including the sidewinder rattlesnake, occupy the open desert valleys.

The Cabeza Prieta National Wildlife Refuge lies within Luke AFR and is located on the border of Arizona and Mexico in Yuma and Pima Counties. The Range was established in 1939 to protect the desert bighorn sheep, but also provides habitat for the Sonoran pronghorn, the javelina or collared peccary, Gambel's quail, and white-winged dove. The Yuma mountain lion can be found in all parts of Luke AFR, with concentration of the species being approximately one per 100 square miles. Using this estimate, 40 mountain lions would be found on the range.

The varied habitats within Luke AFR and surrounding area support one of the most diversified desert faunal groupings in the world. The Organ Pipe Cactus National Monument checklist contains 43 species of mammals, 225 species of birds (of which 39 are considered permanent residents), 3 species of turtles, 15 species of lizards, 27 species of snakes, and 5 species of amphibian. Luke AFR lies in the path of many migrating birds. From mid-February to early June, and again in the fall, these migrants are common visitors to Luke AFR. During the summer, gatherings of white-winged doves at waterholes provide one of the desert's ornithological spectacles. There are no water bodies within Luke AFR which contain water throughout the year; hence fish life is non-existent on Luke AFR.

2. Threatened and Endangered Species

Luke AFR provides a habitat for several species listed as threatened or endangered by the Federal and State governments. Table 8 provides a summary of these species.

Three species on the range are on the Federal Endangered Species List: the peregrine falcon, the Sonoran pronghorn antelope, and the southern bald eagle. The habitat of the American peregrine falcon is open country, and it has been reported to occasionally winter in the lower Colorado River Valley. Along the southen edge of Luke AFR, between the Cabez Prieta Mountains and the Organ Pipe Cactus National Monument is a herd of about 60 pronghorn antelope that are the last remnant of the pale-haired race Sonoriensis found in the United States. Also endangered and found on the periphery of the range is the southern bald eagle.

Listed as "threatened" by the Arizona Game and Fish Department are the desert bighorn sheep, the zone-tailed hawk, the black hawk, the osprey, the desert tortoise, and the gila monster. The habitat of the bighorn sheep is restricted to the mountains.

3. Environmental Stress

No evidence of biological stress related to hazardous materials was noted during the site visit to Luke AFR. The continued use of Luke AFR distributes small amounts of hazardous substances (i.e., explosive components of undetonated or incompletely detonated ordnance) throughout the range, but this is not thought to result in significant adverse impacts to biota.

F. FINDINGS

1. Gila Bend Air Force Auxiliary Field

a. The water supply at Gila Bend AFAF is obtained from three onsite wells. A small reverse osmosis plant treats some of the water for potable use in base facilities. The untreated water is used for irrigation, cleaning, toilet flushing, and other non-potable purposes.

b. Sanitary sewage is treated on-base in two lagoons, including an aerated lagoon and a stabilization pond. There is no discharge from the lagoons, and all treated effluent evaporates or percolates into the ground.

Table 8
THREATENED AND ENDANGERED SPECIES OCCURRING ON LUKE AIR FORCE RANGE

Common Name	Scientific Name	Federal Status	State Status	Known Occurrence on LAFR	Source	Accidental or Suspected Occurrence on LAFR
Sonoran pronghorn antelope	Antilocapra americana sonoriensis	E	E	*	Phelps (1981)	-
Desert bighorn sheep	Ovis canadensis mexicana	-	T	*	USAF (1978)	-
Peregrine falcon	Falco peregrinus	E	E	*	Phelps (1981)	-
Southern bald eagle	Haliaeetus l. leucocephalus	E	E	-	USAF (1978)	*
Gray hawk	Buteo nitidis	-	E	*	Fisher (1981)	-
Zone-tailed hawk	Buteo albonotatus	-	T	*	Fisher (1981)	-
Black hawk	Buteogallus a. anthracinus	-	T	-	Fisher (1981)	*
Osprey	Pandion haliaetus	-	T	-	Fisher (1981)	*
Desert tortoise	Gopherus agassizi	-	T	*	Koch (1981)	-
Gila monster	Heloderma suspectum	-	T	*	USAF (1978)	-

Since there is no discharge to surface waters, analysis of the treated effluent is not required by the State.

c. All refuse from the base was disposed of in two onsite landfills from 1941 until deactivation of the base in 1946; and from 1951 when the base was reactivated until approximately 1972. Since 1972, the majority of base refuse has been disposed of in the Maricopa County landfill in Gila Bend.

d. Interviews with base employees resulted in the identification of three disposal sites at Gila Bend AFAF. The approximate locations of these sites are shown on Figure 18. The following is a brief description of each site:

- o Site GB-1 is located northeast of the radio tower and was used for disposal of mess hall wastes and household garbage from 1941 until 1946; and again from 1951 until 1972. The waste was placed in 10- to 12-foot-deep trenches and burned and covered on a daily basis. No known or suspected hazardous wastes were disposed of at this site; therefore, it was not rated.

- o Site GB-2 is located southwest of the radio tower along the south perimeter fenceline. This site was used for disposal of scrap metal, waste lumber, construction rubble, and old tires. Some contaminated diesel fuel, waste oil, and possibly some small quantities of waste solvents were also disposed of at this site. This waste was poured into the trench, burned, and then covered. Although some of the waste could be hazardous, the majority of the waste would have been consumed in the burning operation. The potential for contamination from this site is considered insignificant; therefore, this site was not rated.

- o Site GB-3 is located northwest of the radio tower. Two trenches were excavated at this site in 1976 for disposal of construction rubble and yard trash. The site was in operation for 8 months, after which it was closed by Luke AFB environmental personnel because of the lack of a security fence around the site. No known or suspected hazardous wastes were disposed of at this site; therefore, it was not rated.

2. Luke Air Force Range

a. A ground tour of portions of the East Tactical Range and Range No. 3 was taken to observe several active expended ordnance disposal sites. A typical disposal site consisted of an excavated trench approximately 40 feet wide, 100 feet long, and 10 feet deep. Ordnance collected on the range is inspected by EOD personnel to determine if any unexploded ordnance or suspected unexploded ordnance is present. Any live ordnance is taken to a designated ordnance demolition site for destruction by detonation or burning. Expended ordnance with no metal salvage value is placed in a disposal trench and burned to destroy any unexploded ordnance which may have been missed during the initial inspection. When a trench is full it is covered with soil and a new trench is excavated. All of the disposal sites visited were marked with appropriate warning signs.

b. There are approximately 20 known past and present expended ordnance sites on the Gila Bend Segment and 4 known past and present expended ordnance burial sites on the Yuma Segement of Luke AFR (see Figure 19). A list of the types of ordnance which can be expected to be found on Luke AFR is given in Appendix K. Past practices may have introduced live munitions and ordnance into some of the burial sites. Although this practice has been discouraged, it cannot positively be stated that any of the burial sites are free of explosive items. There are also two active areas for detonation or destruction of live ordnance; one in the Gila Bend Segment and one in the Yuma Segment. Although the burial sites may contain hazardous unexploded ordnance, no potential for contaminant migration exists; therefore, these sites were not rated.

c. A massive clean-up of the East Tactical Range (Gila Bend Segment) was conducted in 1975. Range debris included junked vehicles and aircraft used as targets, cables, aluminum dart fragments, cardboard, numerous empty drums used to construct targets, and numerous old tires. Salvagable metal items were sold to area contractors. Unsalvagable items, including old tires and empty drums, were placed in two trenches and covered with soil. One of the interviewees also indicated that some debris from the 1975 clean-up of Gila Bend AFAF may also have been disposed of at this site. No known or suspected hazardous wastes were disposed of at this site; therefore, it was not rated.

d. Luke AFR has also been used for testing of proposed MX missile basing modes. The project sites, known as the Have Host Test Site and the Buried Trench Construction and Test Site (Figure 19), were used to validate cost, production projections, rapid construction technology, and survivability for the alternate basing modes. After completion of the project, inert debris and rubble from the sites were disposed of in the excavations, which were then buried. No known or suspected hazardous wastes were disposed of at these sites; therefore, they were not rated.

e. An enormous variety and quantity of ordnance has been delivered to a host of targets on and in the air space over Luke AFR during the past 40 years. Since decontamination efforts are restricted to the ground surface only, there is a high probability of finding either buried or self-buried live ordnance under the surface of those areas of Luke AFR which are covered with soil. Depth of cover could conceivably vary from inches to 20 feet. Although this material is hazardous, there is no potential for contaminant migration off the range boundaries.

f. Discussions with personnel from the Yuma Marine Corps Air Station confirmed the locations of expended ordnance and range residue burial sites on the Yuma Segment of Luke AFR. There was no knowledge of other types of waste materials disposed of in the Yuma Segment.

G. CONCLUSIONS

1. Gila Bend Air Force Auxiliary Field

a. The Records Search did not indicate any significant potential for migration of hazardous contaminants from any of the identified disposal sites.

b. Some of the treated sewage in the onsite treatment lagoons may potentially migrate to the water table by percolation. Based on a review of industrial operations, the potential for hazardous contaminants being present in the treated effuent appears to be low. However, this needs to be verified.

2. Luke Air Force Range

The potential for hazardous contaminant migration from the identified disposal sites at Luke AFR is extremely low because of a number of factors, as follows: (1) the characteristics of the wastes disposed of do not facilitate transport, (2) remoteness of the area, (3) low precipitation, (4) high evapotranspiration, and (5) low ground-water level and movement rate.

H. RECOMMENDATIONS

1. Gila Bend Air Force Auxiliary Field

Additional hazardous waste monitoring (Phase II work) is not considered necessary for any of the identified disposal sites at Gila Bend AFAF. However, the following in-house environmental monitoring program is recommended.

a. It is recommended that the effluent in the two treatment lagoons be sampled and analyzed to establish a baseline for heavy metals, phenols, and volatile organic compounds. This monitoring should be done periodically as a precautionary measure to ensure that the treated effluent which may be percolating to the water table does not contain hazardous contaminants.

b. Gila Bend AFAF should continue its program of environmental sampling and analysis of active onsite water supply wells. It is recommended that a volatile organic compound analysis be included in addition to the analyses currently performed. This monitoring is recommended as a precautionary measure to determine if a long-term contaminant migration potential exists.

2. Luke Air Force Range

Additional hazardous waste monitoring is not considered necessary for any of the identified disposal sites at Luke AFR.

VIII. OTHER OFF-BASE INSTALLATIONS

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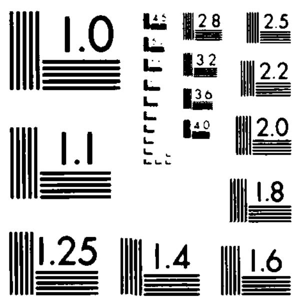

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

VIII. OTHER OFF-BASE INSTALLATIONS

A. DESCRIPTION

A cursory review of five other off-base facilities owned or leased by Luke AFB was also included in the records search. This review was based on interviews with individuals familiar with the activities of each facility. These properties include Fort Tuthill Recreation Annex, Auxiliary Field No. 1, the Sanitary Landfill Annex, Holbrook Radar Bomb Scoring Range, and Humbolt Mountain Radar Site. The locations of these facilities are shown on Figure 1.

1. Fort Tuthill Recreation Annex is located 156 miles from Luke AFB in the Coconino National Forest and includes approximately 14 acres of land leased from the State. Facilities include 16 guest trailers, 9 small cabins, and 23 private trailer spaces. The records search did not reveal evidence of the use or disposal of any hazardous materials at this site.

2. Auxiliary Field No. 1, located 13 miles northwest of Luke AFB, consists of 400 acres of land owned by the U.S. Air Force and 750 acres of land leased from the State. The four runways at the auxiliary field are primarily used for Instrument Landing System (ILS) practice approaches. The Ground Control Approach (GCA) unit is located at the field. Surveillance and precision radar equipment, stored at the field by the AN/MPN-13 Radar Unit, provides a Radar Air Traffic Control environment to train advanced student pilots from Luke AFB, Davis-Monthan AFB, Williams AFB, Phoenix-Litchfield Airport, and ANG-Sky Harbor Airport. The records search did not reveal evidence of the use or disposal of any hazardous materials at this site.

3. The Sanitary Landfill Annex is leased from the State of Arizona and is located 8 miles west of Luke AFB near the White Tank Mountains. This area consists of 33 acres and was intended for use as a sanitary landfill; however no sanitary landfill operations have been conducted at the site. The records search did not reveal evidence of the use or disposal of any hazardous materials on this site.

4. Holbrook Radar Bomb Scoring Range is located in Navaho County 5 miles northeast of Holbrook, Arizona on U.S. Highway 66. The site comprises 8 acres which are leased by Luke AFB. The Strategic Air Command (SAC) owns and operates the facilities on the property. The records search did not reveal evidence of the use or disposal of any hazardous materials on this site.

5. Humbolt Mountain Radar Site is located on 1 acre of land in the Tonto National Forest northeast of Phoenix, Arizona. The site is used as a joint surveillance system by

Luke AFB and the Phoenix Regional Office of the Federal Aviation Administration (FAA). All of the equipment on the site is owned and operated by the Phoenix FAA except the radar tower, which is the property of Luke AFB. The records search did not reveal evidence of the use or disposal of any hazardous materials on this site.

B. CONCLUSIONS

Hazardous wastes were not associated with any of the other off-base sites in quantities sufficient to cause an environmental problem.

C. RECOMMENDATIONS

Additional hazardous waste monitoring is not considered necessary at any of the other off-base facilities.

FIGURES

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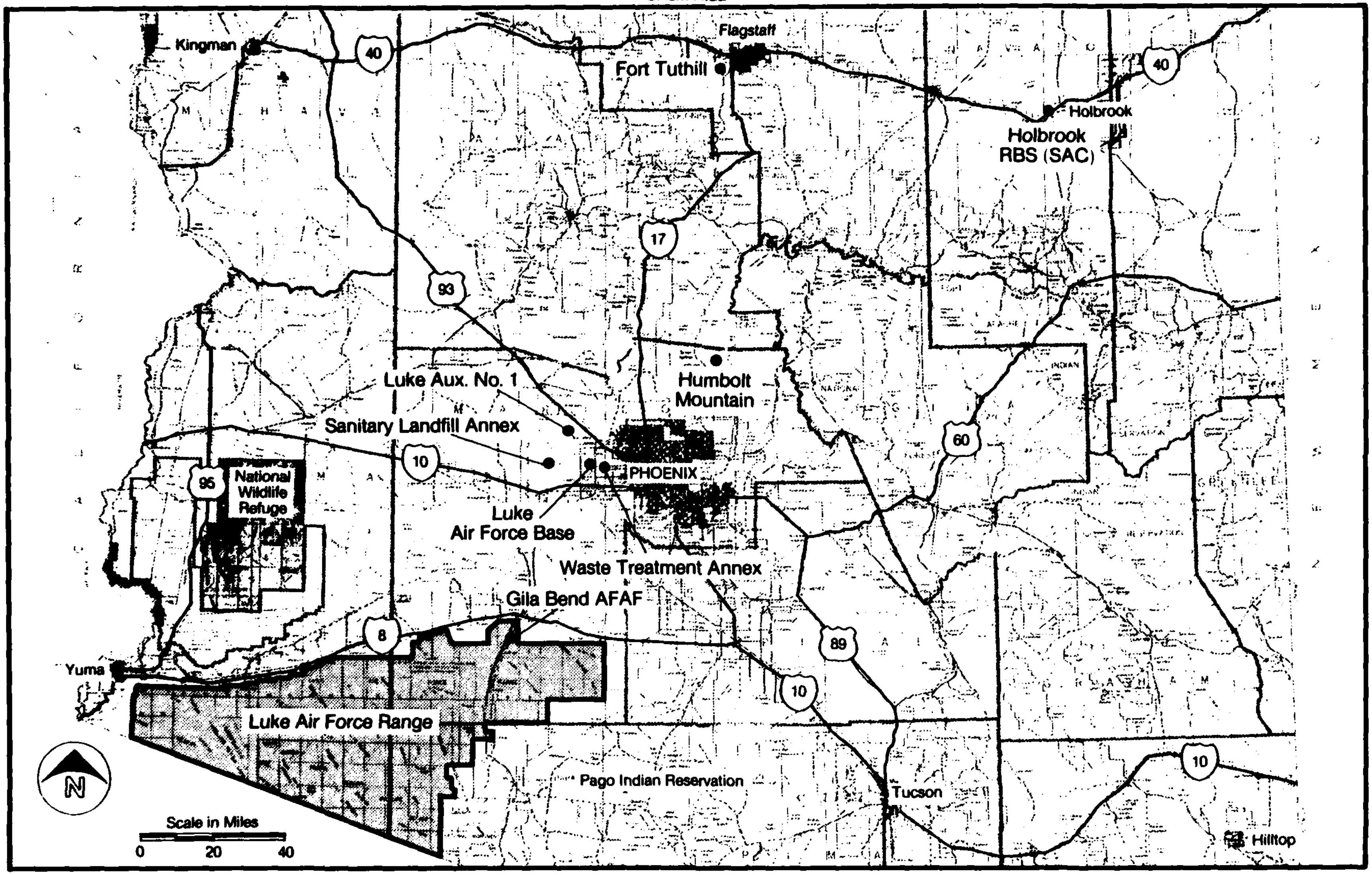

FIGURE 1. Location map of Luke AFB properties.

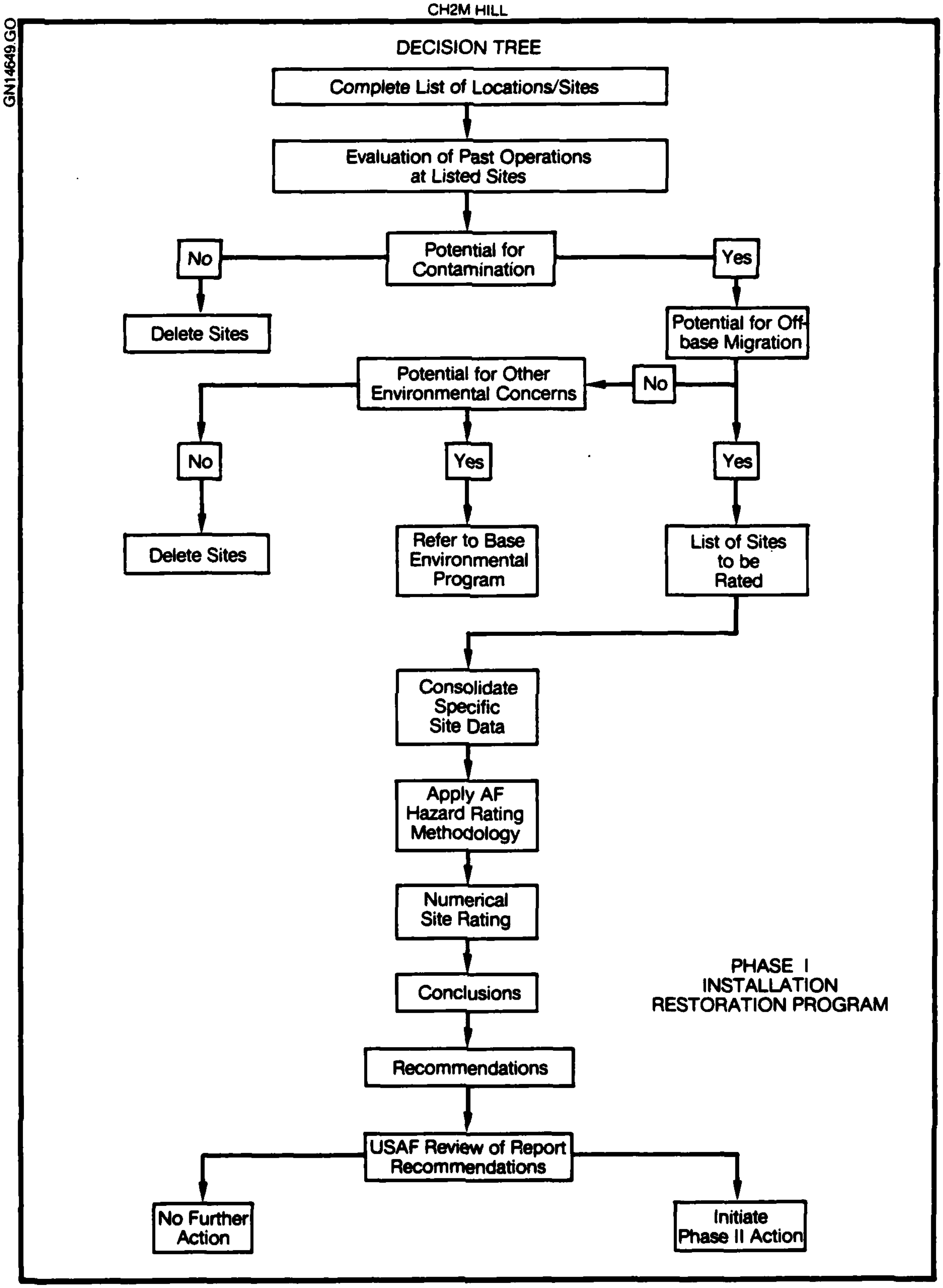

FIGURE 2. Records Search Methodology.

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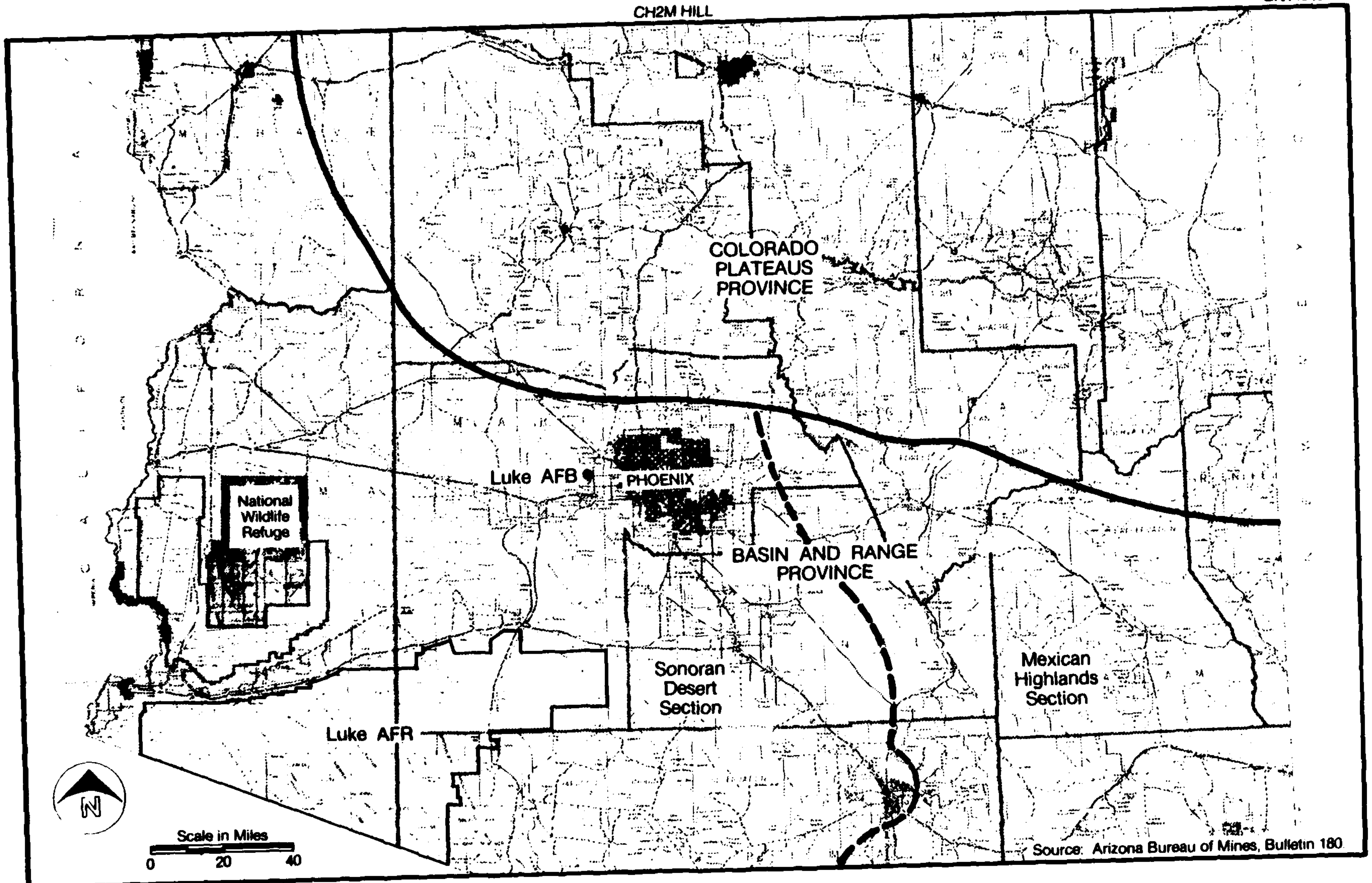

FIGURE 3. Physiographic map of Luke AFB area.

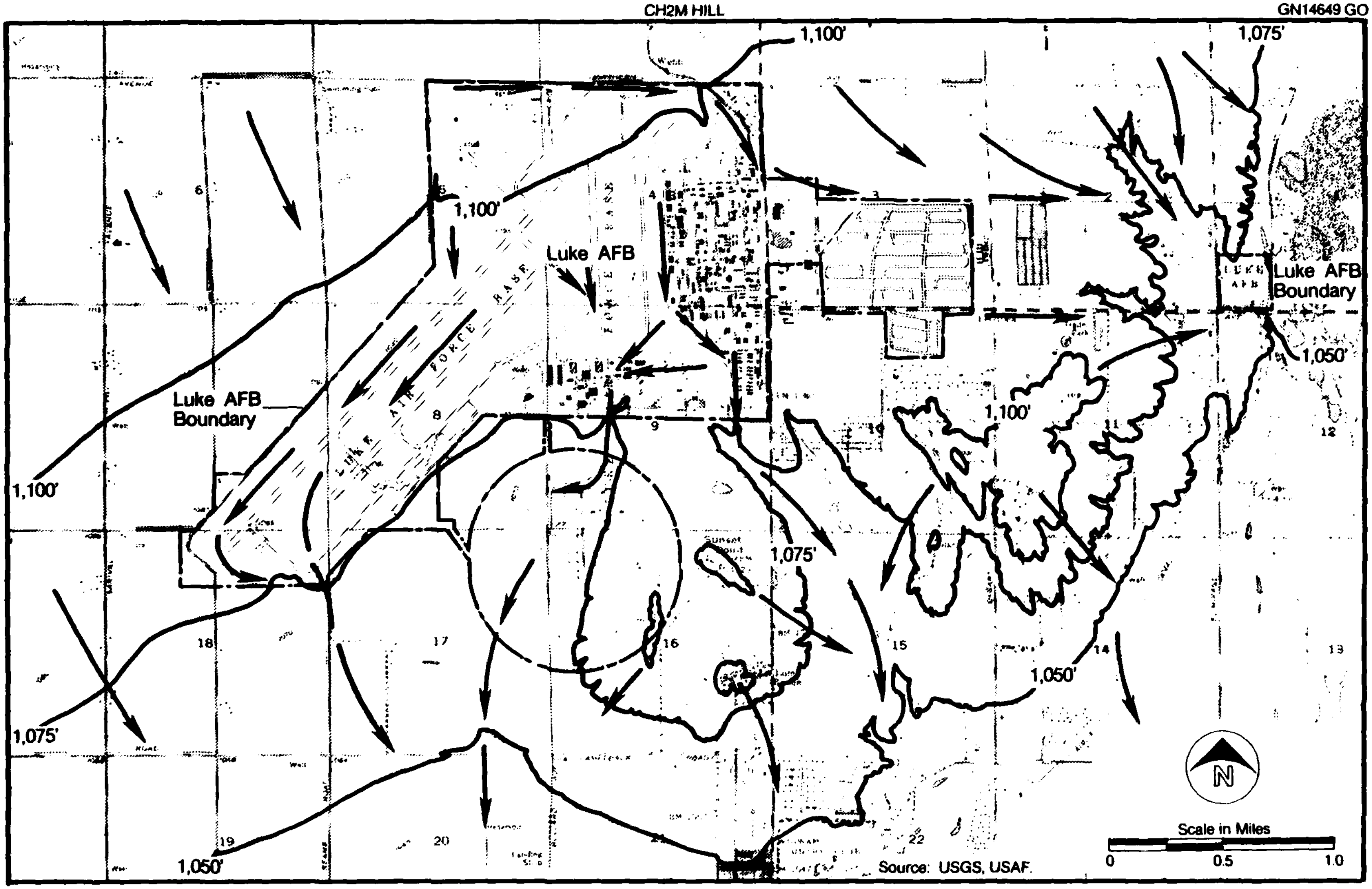

FIGURE 4. Topography and drainage map of Luke AFB.

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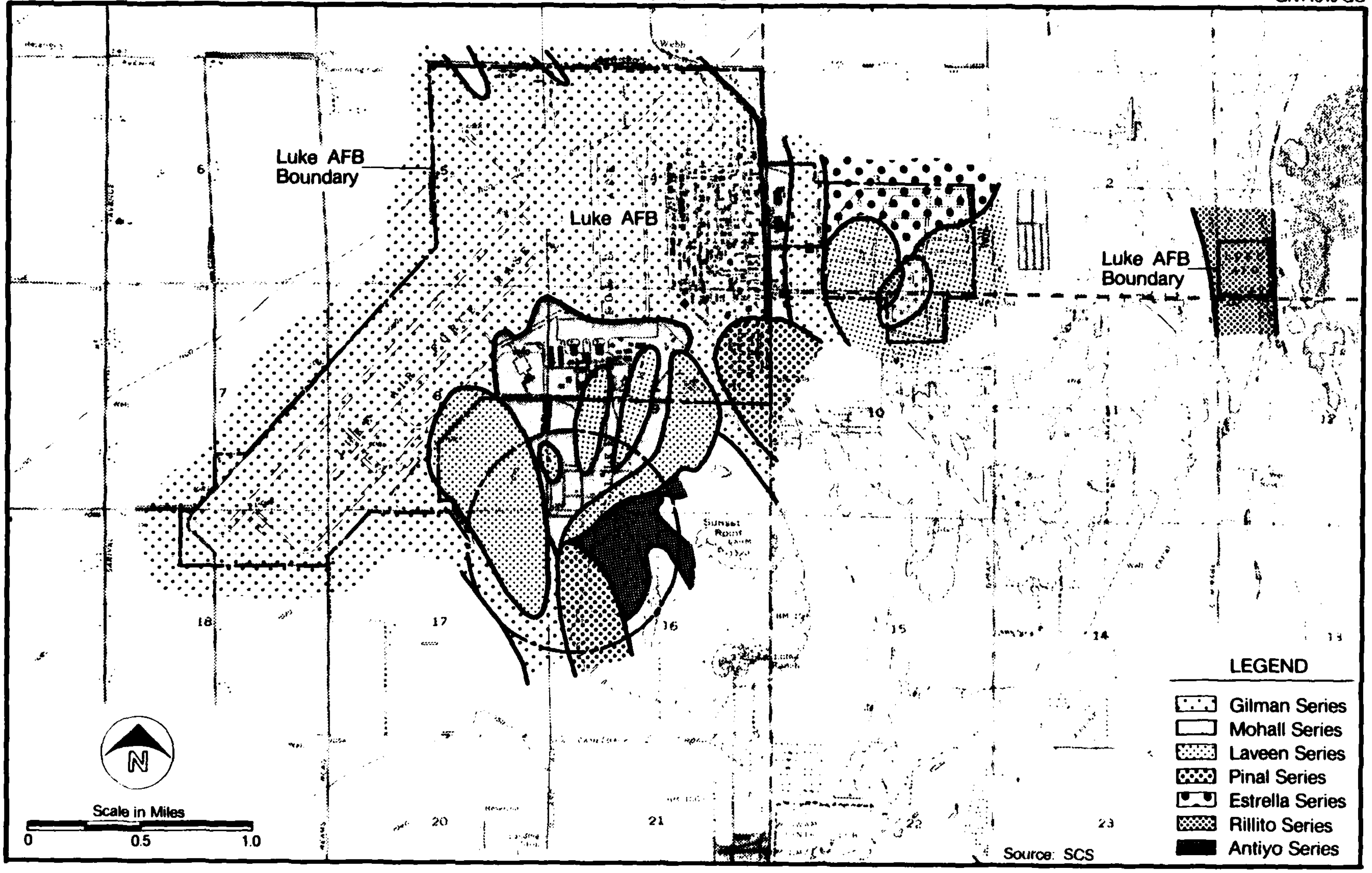

FIGURE 5. Soils map of Luke AFB.

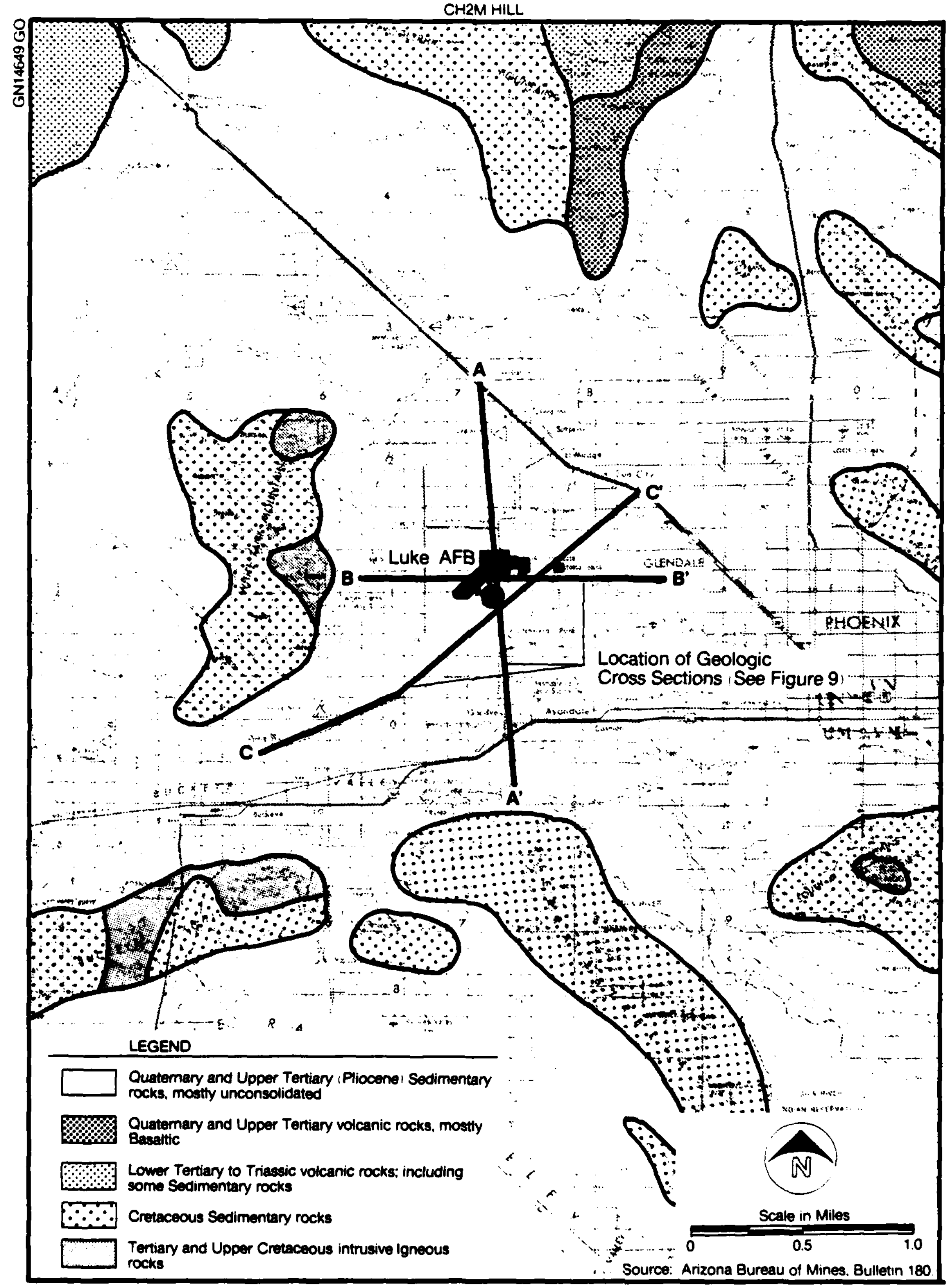

FIGURE 6. Geologic map of Luke AFB.

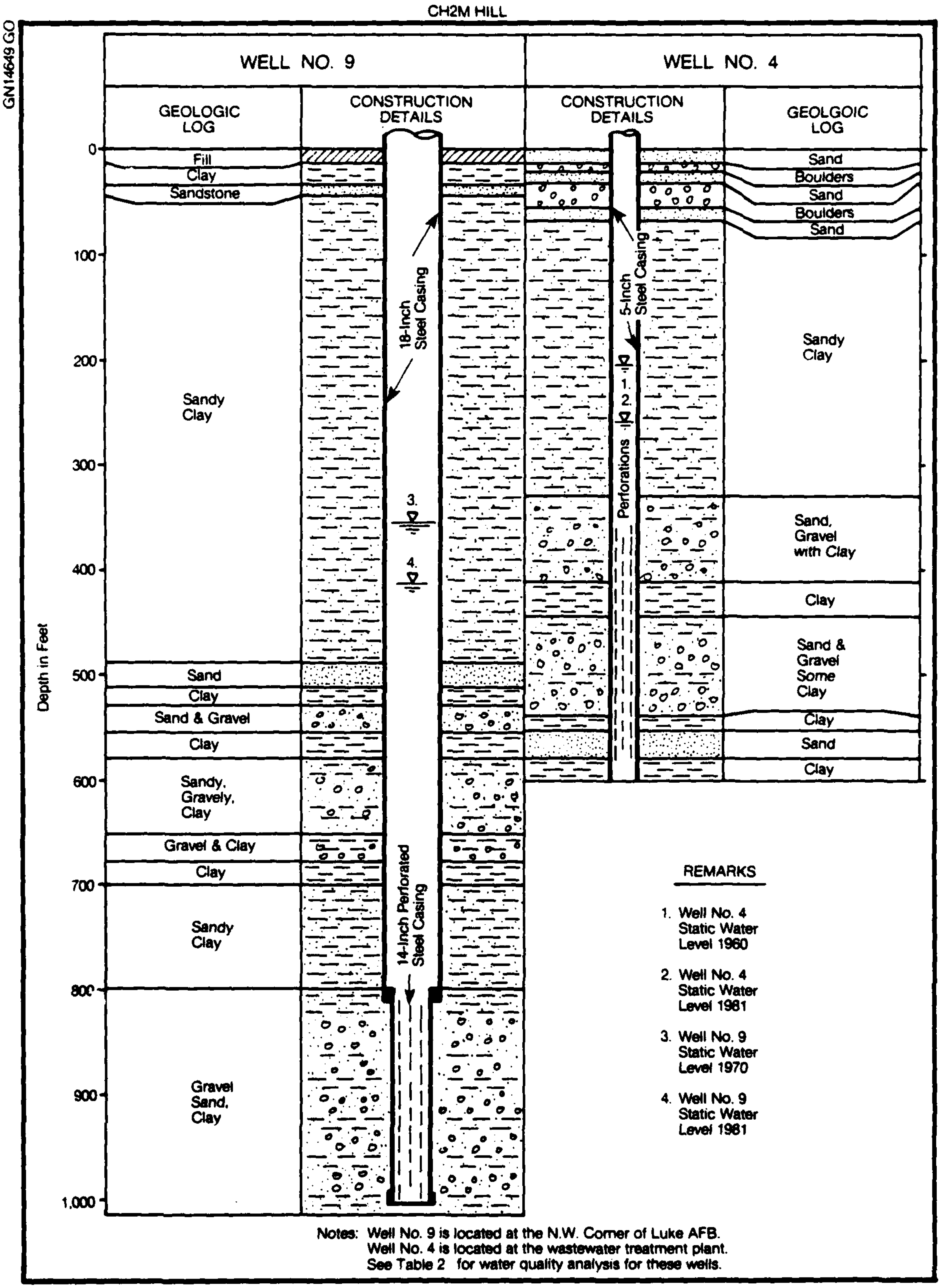

FIGURE 7. Geologic log and well construction detail of typical water well at Luke AFB.

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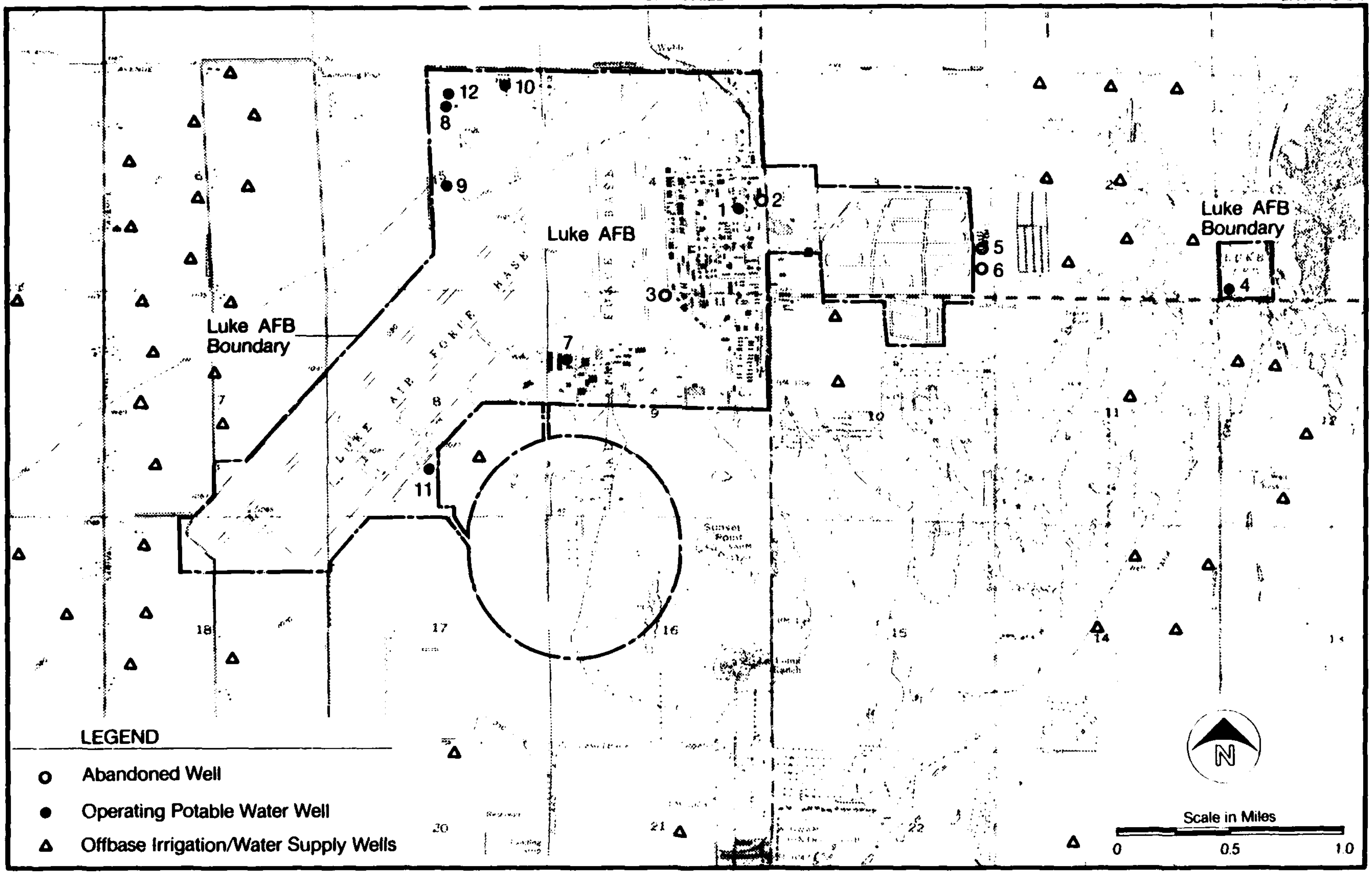

FIGURE 8. Location of water wells at Luke AFB and vicinity.

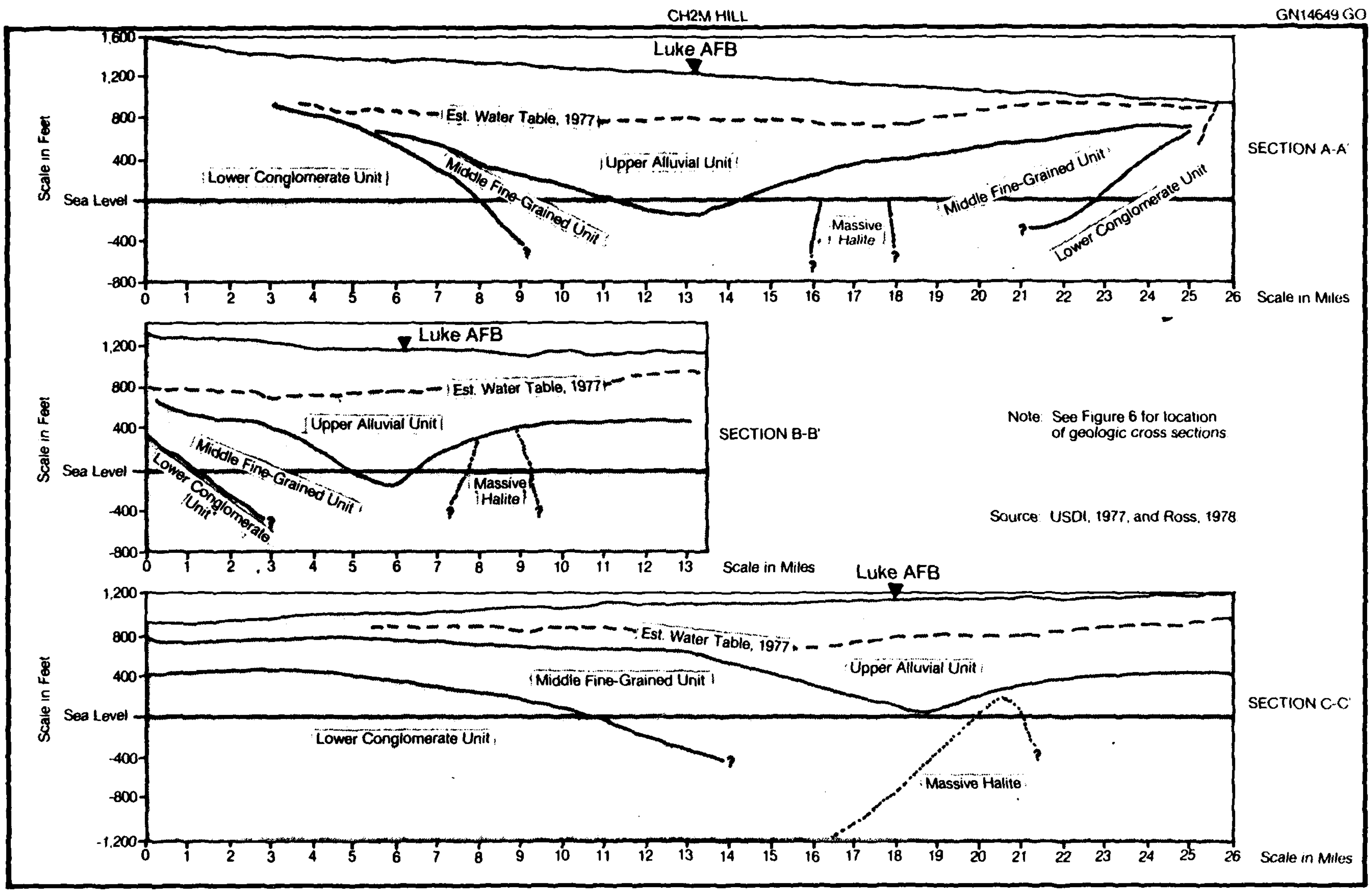

FIGURE 9. Geologic cross section of Luke AFB and vicinity.

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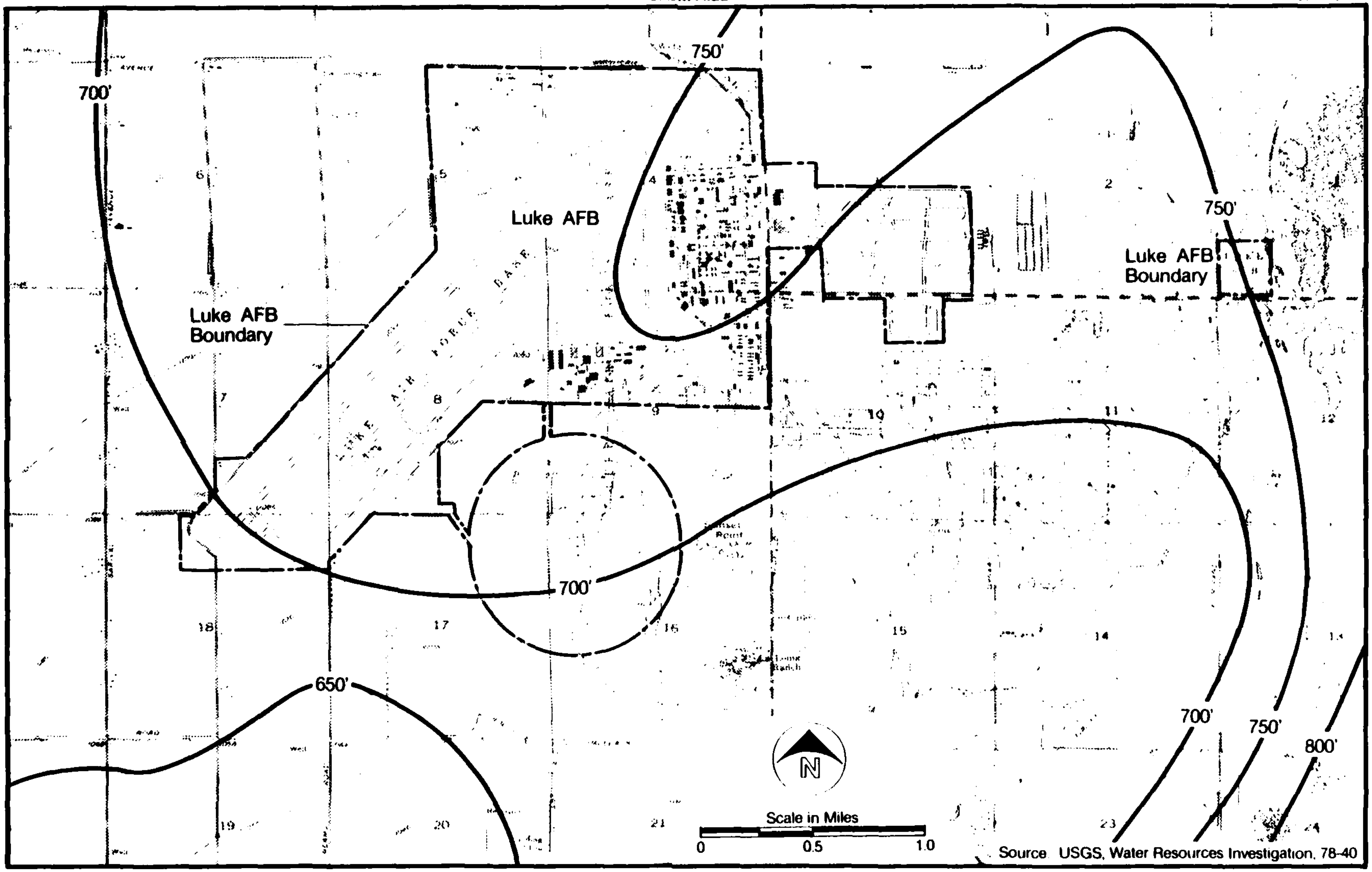

FIGURE 10. Elevation of ground water (in feet above mean sea level) in 1977 at Luke AFB.

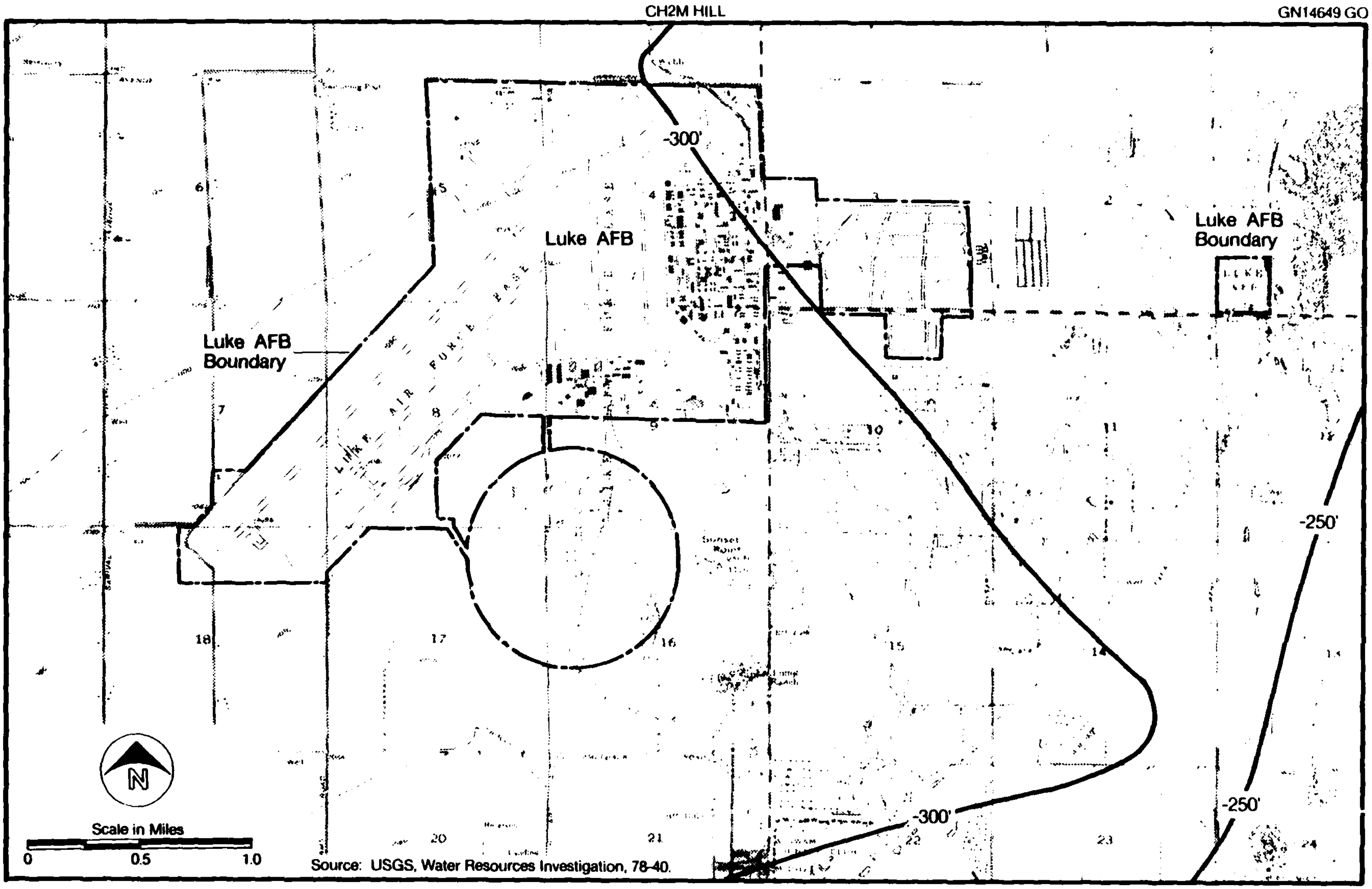

FIGURE 11. Change in ground water (in feet) from 1923 to 1977 at Luke AFB.

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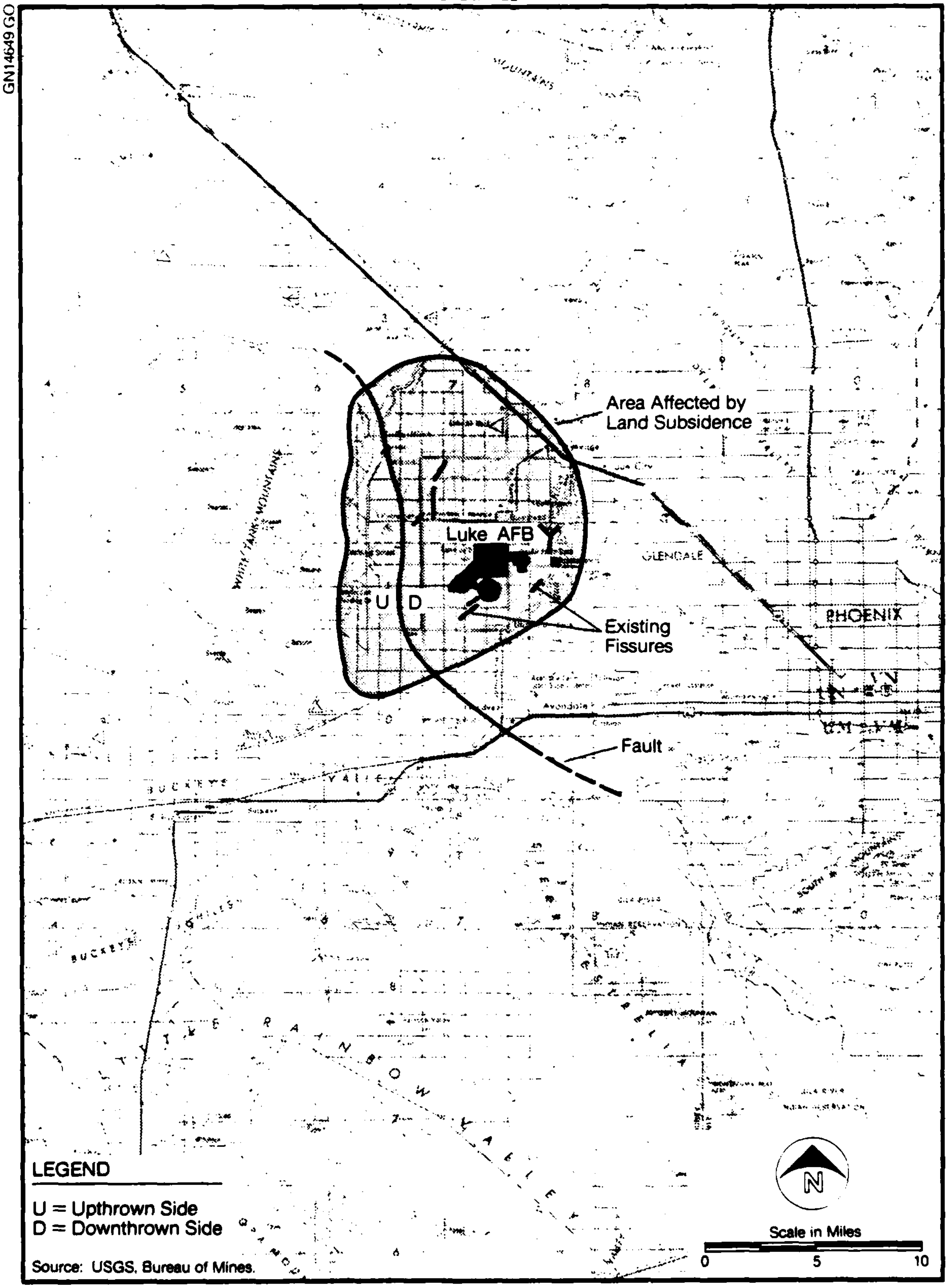

FIGURE 12. Land subsidence, earth fissures, and fault map of Luke AFB and vicinity.

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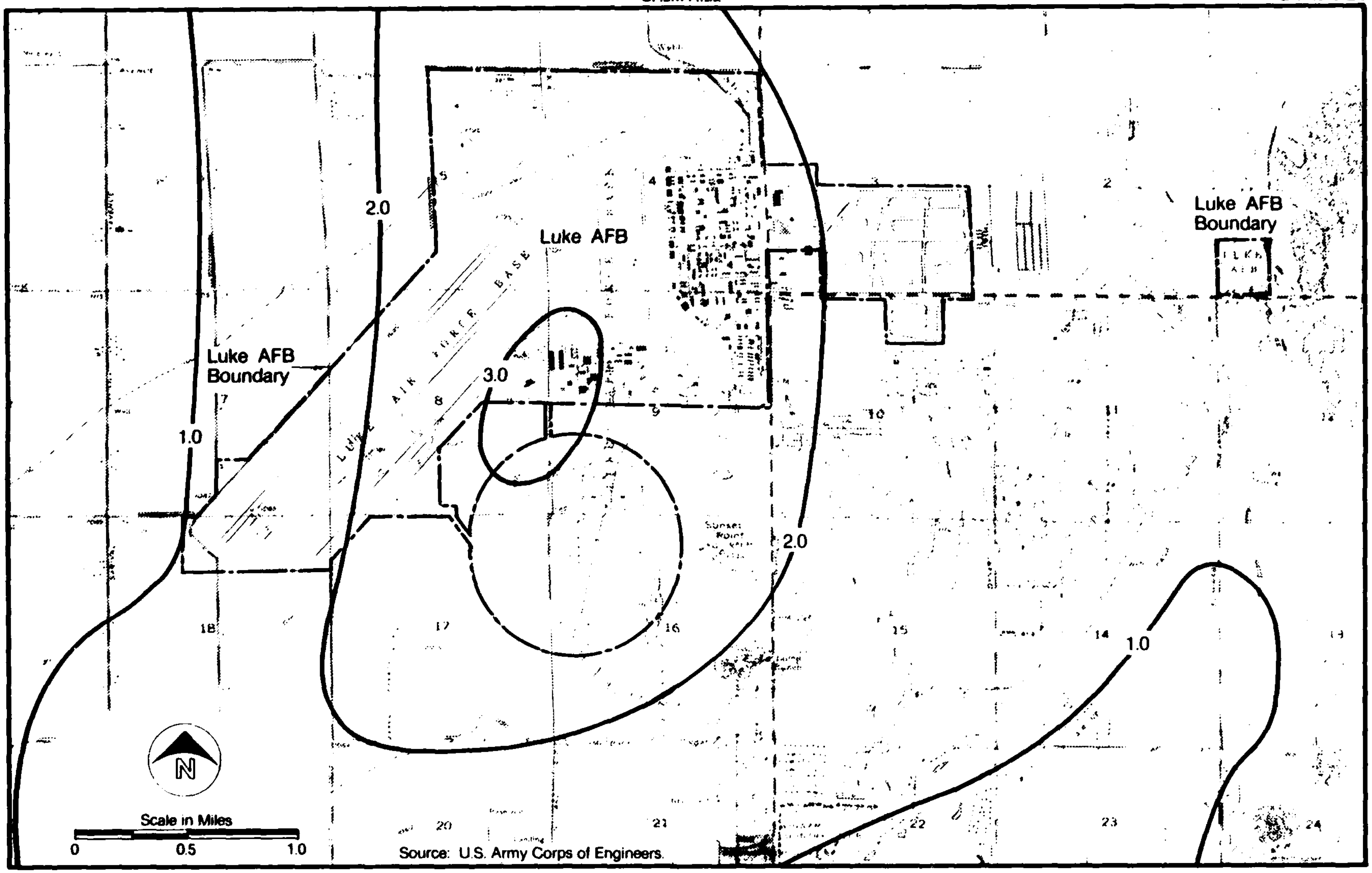

FIGURE 13. Fluoride content (in mg/l) from large capacity wells in the area of Luke AFB.

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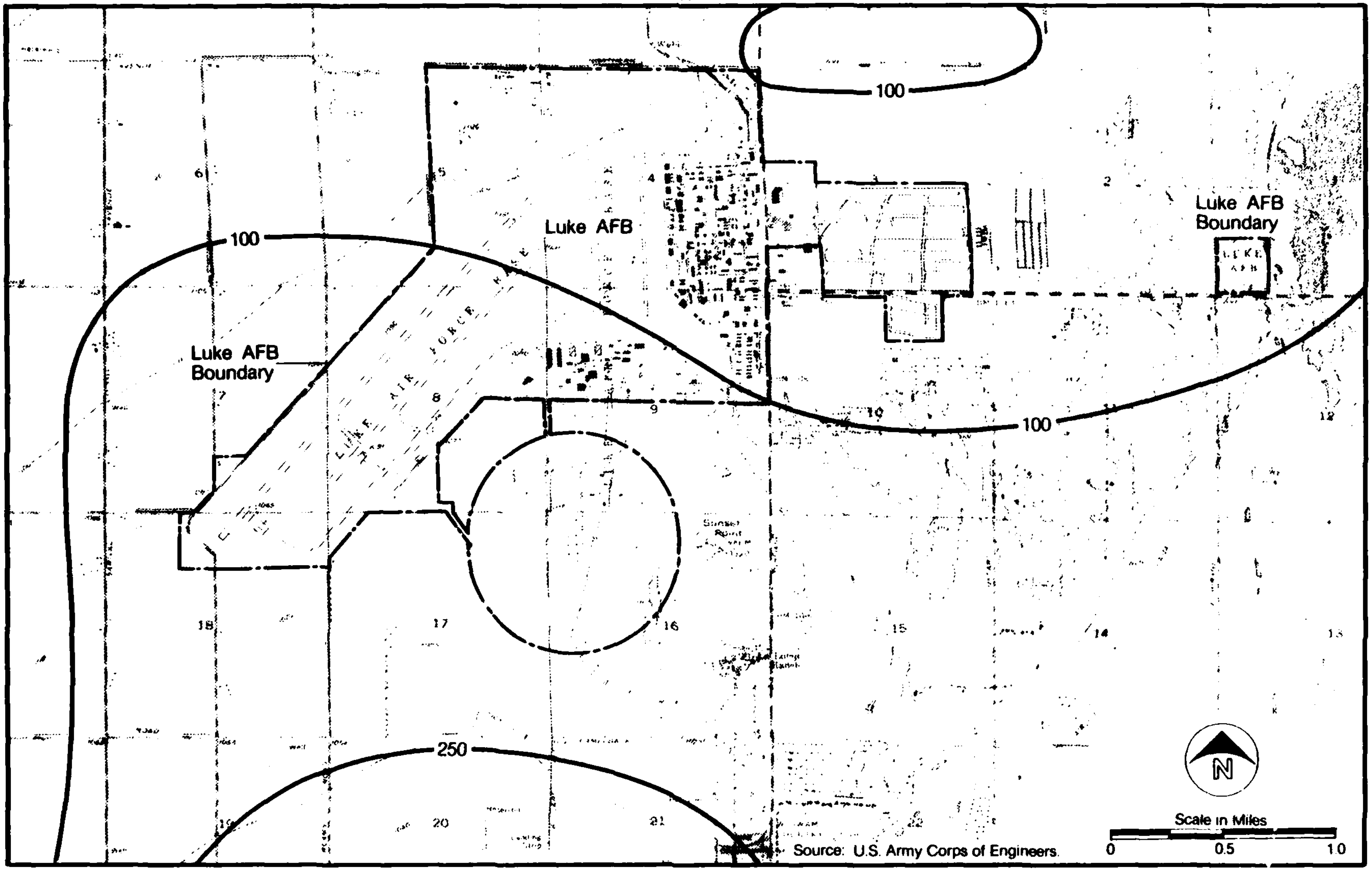
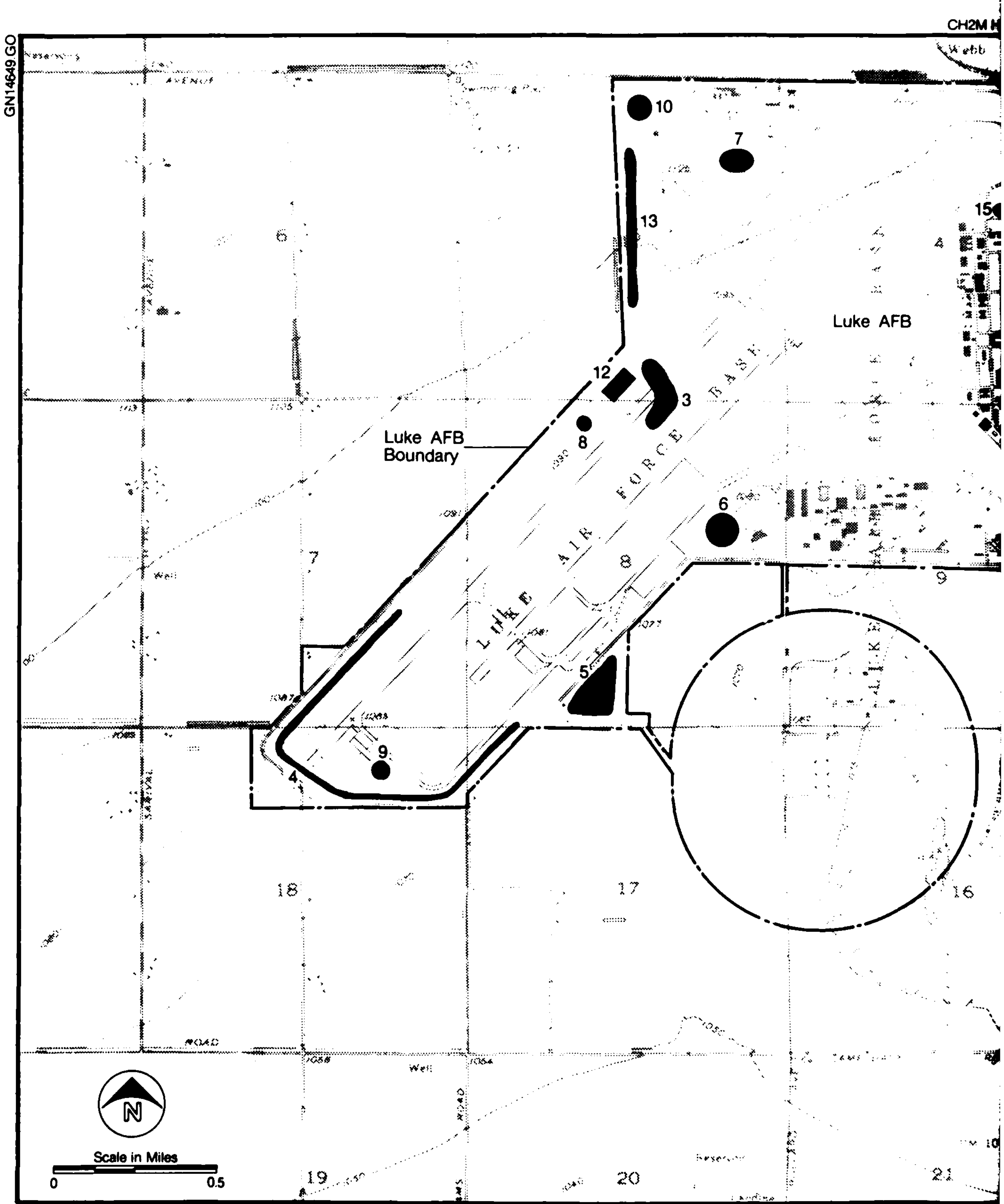


FIGURE 14. Chloride content (in mg/l) from large capacity wells in the area of Luke AFB.



Location map of identified

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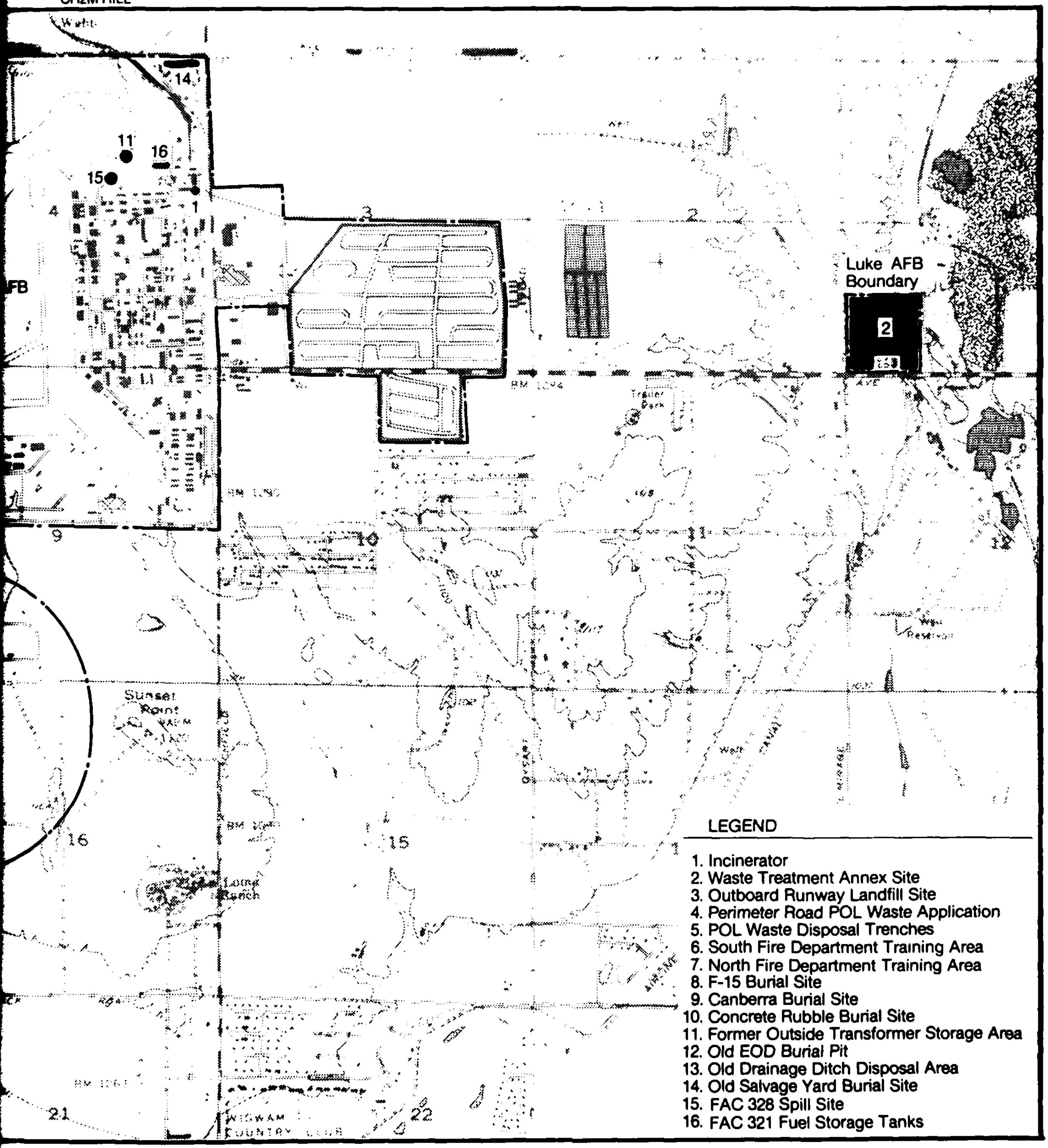

p of identified disposal sites at Luke AFB.

FIGURE 15.

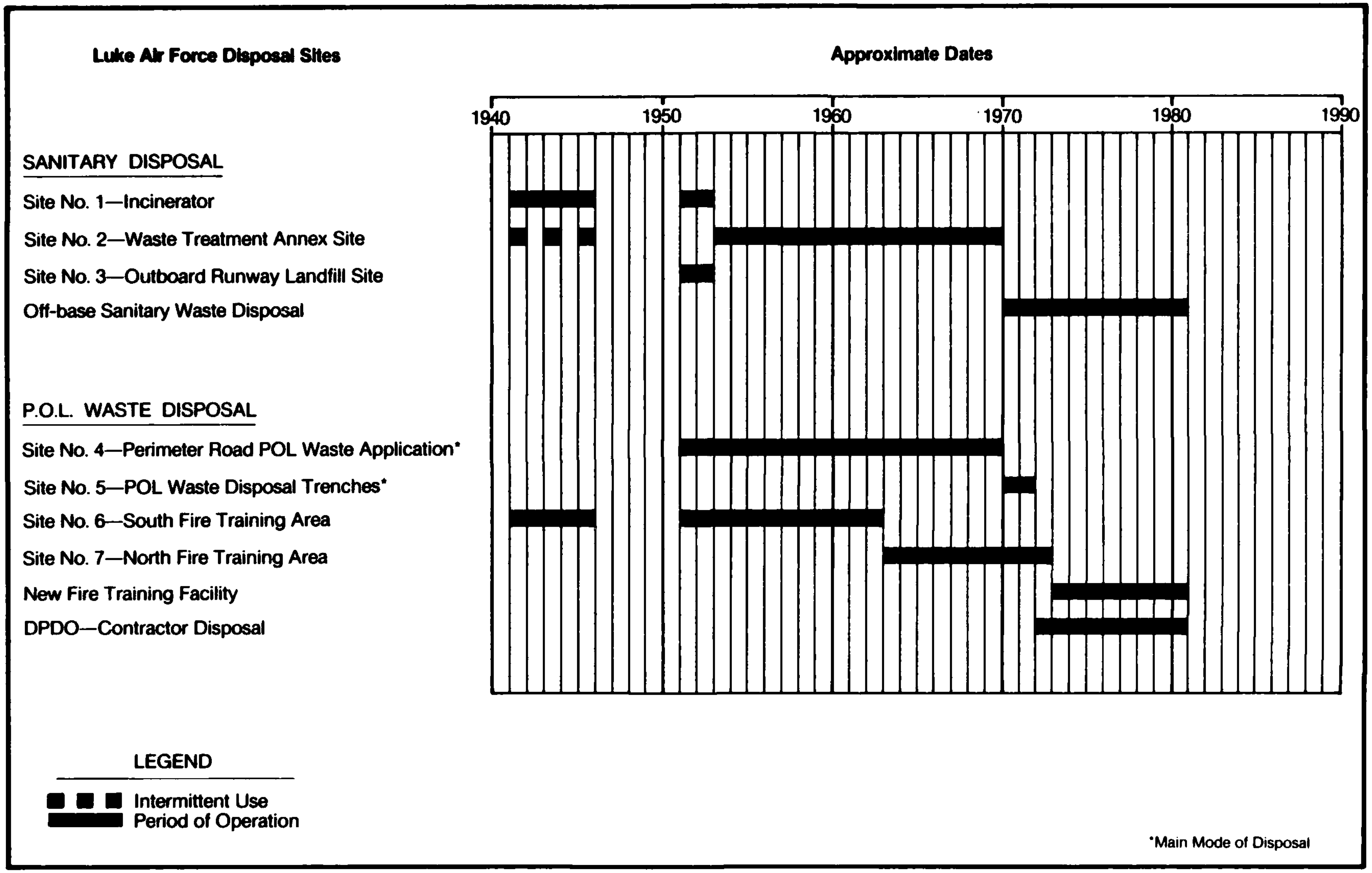

FIGURE 16. Historical summary of disposal activities at Luke AFB.

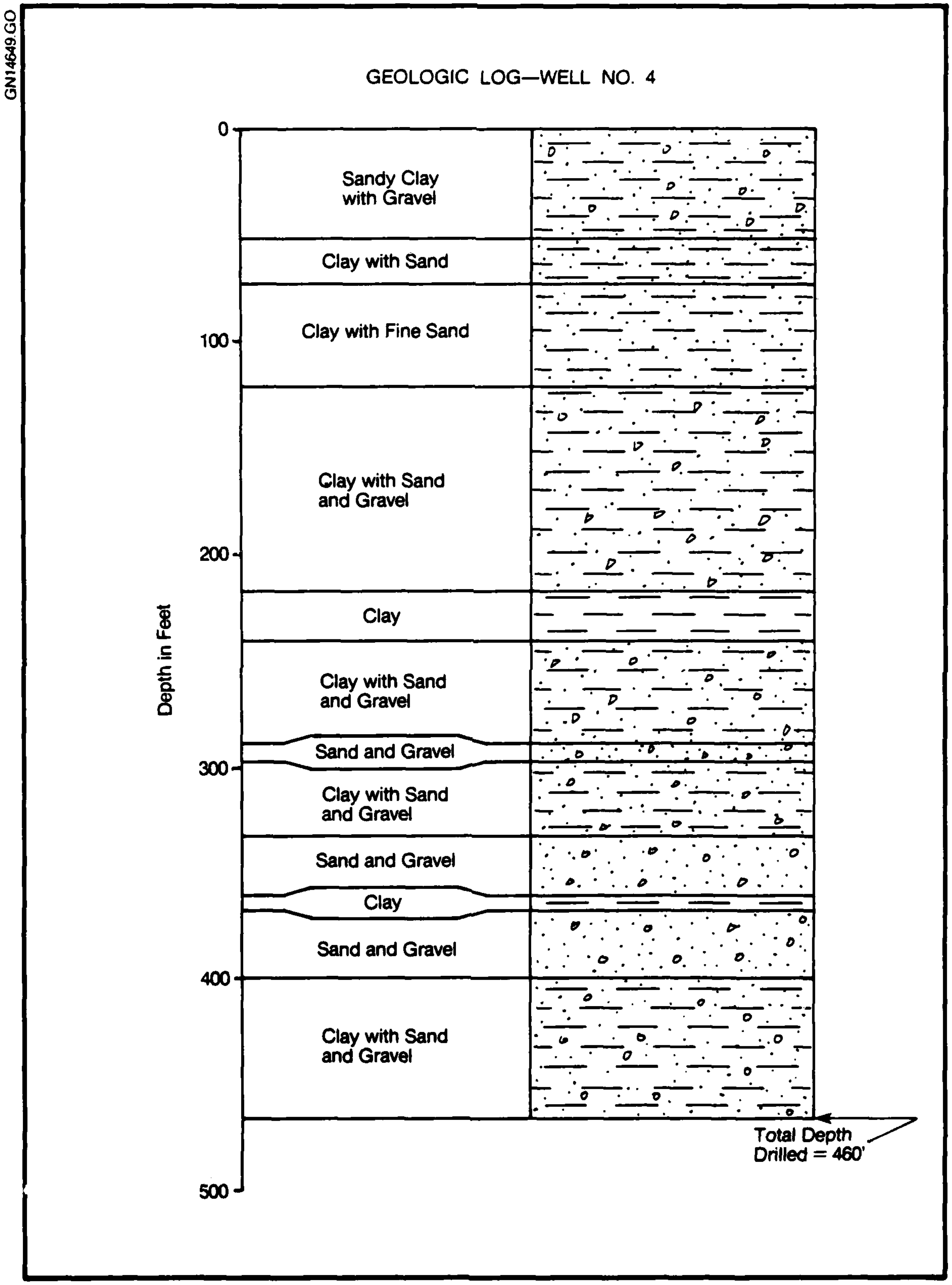

FIGURE 17. Geologic log of a water supply well at Gila Bend AFAF.

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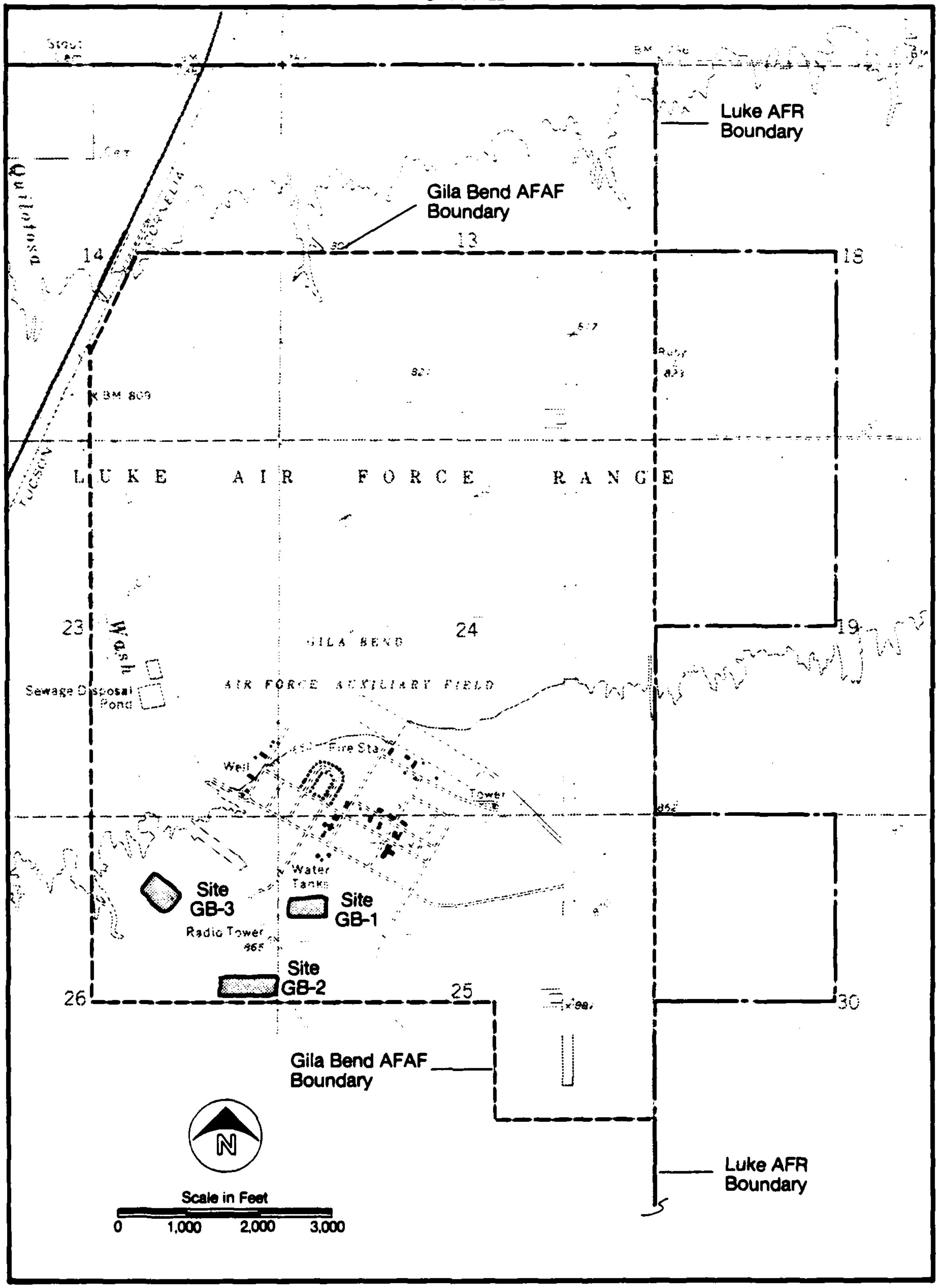
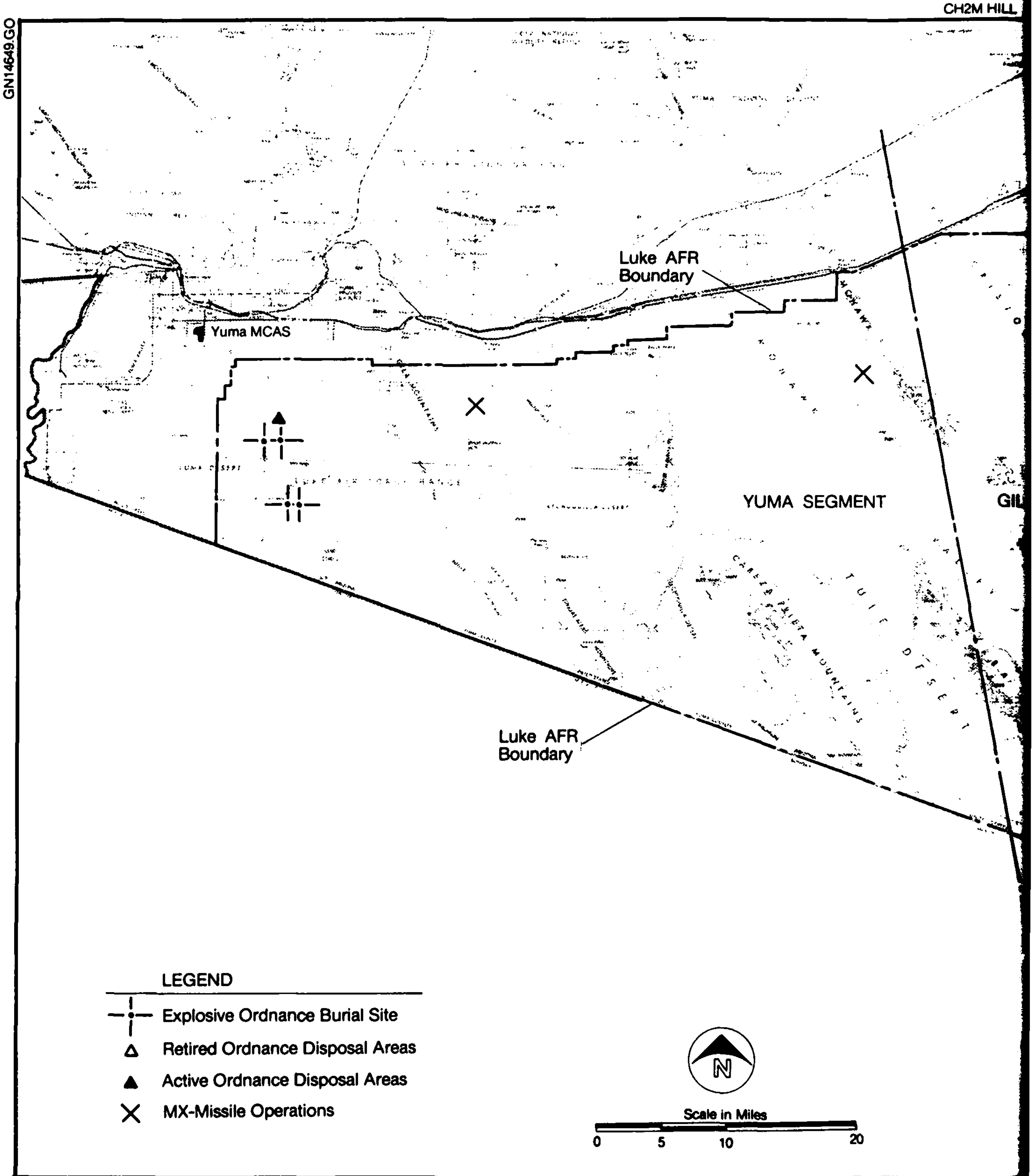


FIGURE 18. Location map of identified disposal sites at Gila Bend AFAF.



Explosive ordnance burial pits, MX-missile test sites, and a

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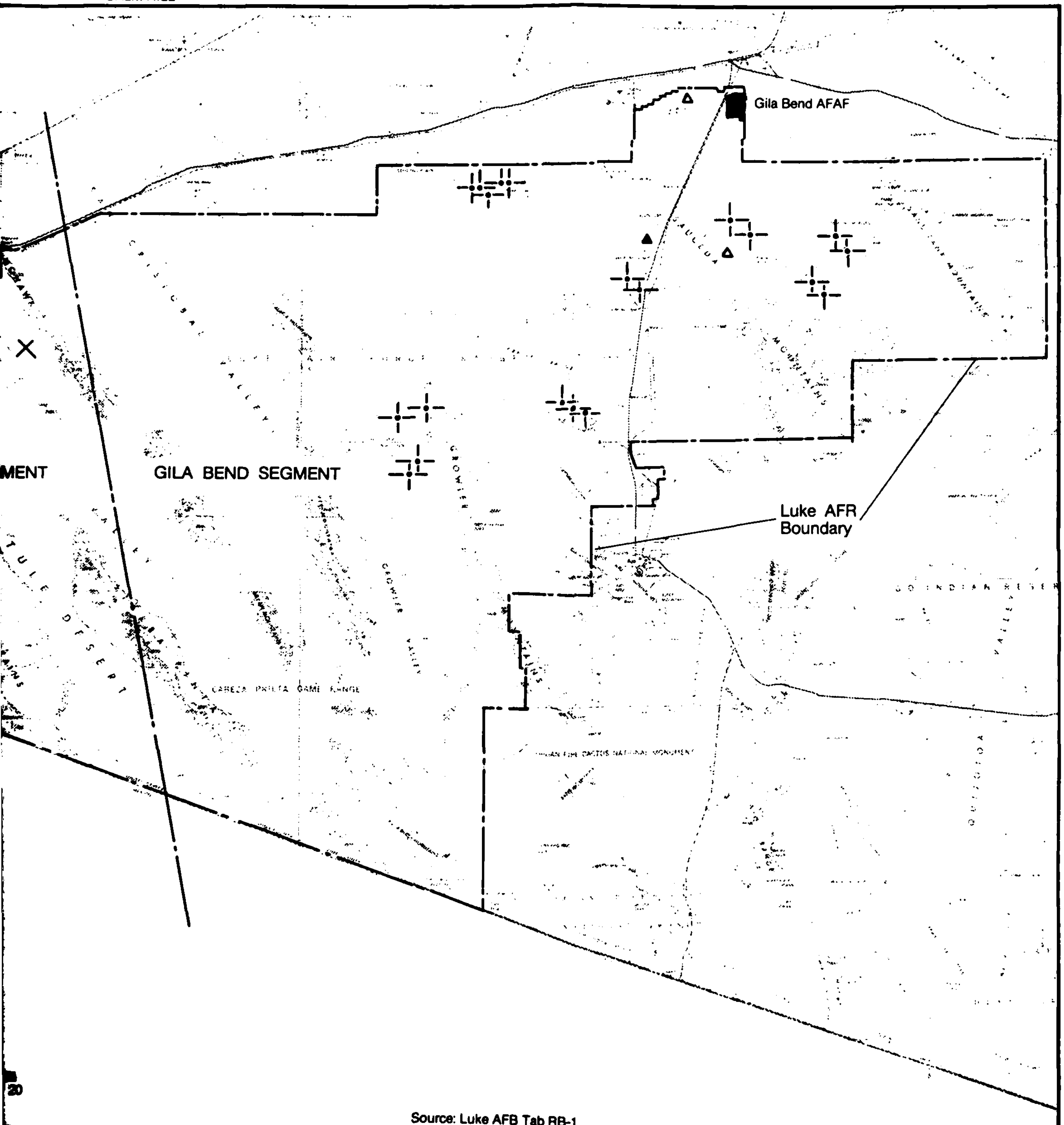

Source: Luke AFB Tab RB-1.

...ssile test sites, and active/inactive ordnance disposal sites on Luke AFR.

FIGURE 19.

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REFERENCES

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Appendix A
RESUMES OF TEAM MEMBERS

NORMAN N. HATCH, JR.

Industrial Wastewater and Hazardous Waste Projects Manager

Education

M.S., Environmental Engineering, University of Florida, 1973
M.S., Analytical Chemistry, University of Florida, 1972
B.S., Chemistry, University of New Hampshire, 1969

Experience

Mr. Hatch joined CH2M HILL in 1973 and is currently the Manager of the Industrial Wastewater Reclamation Department. His range of engineering experience includes hazardous waste projects, laboratory and pilot treatability studies, process design of industrial wastewater treatment facilities, and process design of municipal water and wastewater treatment facilities. Examples of his work include:

- Overall responsibility for hazardous materials disposal site records searches for 12 U.S. Air Force installations throughout the United States. The purpose of the records searches is to assess the potential for hazardous contaminant migration from past disposal practices and to recommend follow-up actions.

- Assistance in a comprehensive RCRA compliance program for Gulf Oil Company's Port Arthur Refinery.

- Project manager of a feasibility study for treatment of high nitrogen industrial wastewater from the Air Products and Chemicals, Inc., manufacturing facility in Pensacola, Florida. Treatment technologies investigated included aerated lagoons, oxidation ponds, anaerobic treatment ponds, spray irrigation, activated carbon, and air stripping.

- Project manager of a comprehensive treatability and process selection study for the American Cyanamid Fibers Division plant in Milton, Florida. Investigations included spray irrigation, deep well injection, activated sludge, rotating biological contactors, anerobic contact treatment, activated carbon, ion exhange, and chemical coagulation.

- Project manager for several other treatability and process selection studies for industrial clients including Arizona Chemical Company, Kaiser Agricultural Chemicals, Engelhard Industries, and Production Plating Company.

- Assistance in the negotiation of NPDES permits for Air Products and Chemicals, Inc., American Cyanamid, and Kaiser Agricultural Chemicals.

GN282

- Lead engineer on an ozone disinfection feasibility study for the City of Philadelphia's Queen Lane Water Treatment Plant. Also served as chief process engineer for the subsequent design of chemical feed systems at the Queen Lane Plant.

- Process design and design of chemical feed and sludge handling facilities for the Alexander City, Alabama, Water Treatment Plant.

- Process design and design of chemical feed system modifications for the St. Augustine, Florida, Water Treatment Plant.

- Project manager for the design of water treatment facilities, including lime softening, zeolite softening, and granular activated carbon adsorption for a sugar mill in south Florida.

- Project manager for development of a comprehensive water system master plan, including raw water supply, treatment, and distribution systems for the Fort Pierce Utilities Authority, Fort Pierce, Florida.

- Project manager for a feasibility study of direct wastewater reuse for potable water for the City of St. Petersburg, Florida.

- Project manager for the planning, supervision, and performance of pilot plant investigations for the removal of hydrogen sulfide from potable water for the Orlando Utilities Commission, Orlando, Florida.

- Cost-effective analysis and process selection for treatment of combined domestic and paper mill wastewater for the City of Harriman, Tennessee.

- Preparation of various segments of 201 facilities plans for Monroe County (Florida Keys); Lake City, Florida; Alachua County, Florida; Puerto Rico; and Live Oak, Florida.

Before joining CH2M HILL, Mr. Hatch was employed with the E.I. du Pont de Nemours Photo Products Plant in Parlin, New Jersey.

Membership in Organizations

Phi Beta Kappa
Phi Kappa Phi
Society of the Sigma Xi
Water Pollution Control Federation

Professional Engineer Registration

Florida
Georgia

J. KENDALL CABLE
Environmental Engineer

Education

M.E., Civil Engineering, University of Tennessee, 1980
B.S., Civil Engineering, University of Tennessee, 1979

Experience

Mr. Cable's responsibilities at CH2M HILL involve projects dealing with hazardous and solid waste management and industrial waste treatment processes.

While employed with the Western Electric Company, he was a member of an organization responsible for planning and designing a state-of-the-art integrated circuits manufacturing plant. Mr. Cable's primary responsibilities included:

- Planning and conceptual design of the ultrapure water treatment plant, the industrial waste treatment plant, and the air pollution control facilities.
- Development of specifications for computer controlled environment in the cleanroom manufacturing area.

While in graduate school working part-time for a small consulting firm, Mr. Cable's activities included the following:

- Managed a planning study involving the utilization and disposal of wood ash from a 15-MW wood burning power plant in Burlington, Vermont.
- Participated in a project involved in fixating a chrome plating sludge using fly ash from a limestone kiln.
- Conducted a treatability study on a wastestream containing pentachlorophenol from a wood preservation process. Options studied included polymer flocculation, ultraviolet/ozonation, and complete recycle of the waste stream.
- Participated in a treatability study using activated sludge to break down an oily waste from an aluminum recycling process.

While working as a civil engineer for the National Parks Service in Yellowstone National Park, Mr. Cable surveyed the preliminary layout and inspected construction of a water and distribution system.

Professional Registration

E.I.T., Tennessee

J. KENDALL CABLE

Membership in Organizations

American Society of Civil Engineers
Water Pollution Control Federation
Chi Epsilon

Publications

"An Evaluation of the Adsorption and Flotation of Nonpolar Organic Compounds in Clay Colloid Suspensions." M. S. Thesis, University of Tennessee, 1980.

GARY E. EICHLER
Hydrogeologist

Education

M.S., Engineering Geology, University of Florida, 1974
B.S., Construction and Geology, Utica College of Syracuse University, 1972

Experience

Mr. Eichler has been responsible for ground-water projects for both water supply and effluent disposal. Studies have included site selection, well design, construction services, monitoring and testing programs, determination of aquifer characteristics, and well field design. Examples of projects on which Mr. Eichler has worked include:

- Palm Coast, Florida. Conducted a test well program to determine available ground-water resources of a 250,000-person coastal development.

- Live Oak, Florida. Determination of geologic conditions at a pond failure site; identification of failure causes and recommendation for redesign of the facility compatible with site geology.

- Quaker Oats Company, Belle Glade, Florida. Test pumping and water quality sampling for an injection well facility; provided operational design criteria for the disposal system and determined aquifer characteristics.

- St. Augustine, Florida. Prepared a program of exploration and testing to locate a future supply of water; determined hydrogeologic conditions, located potential well sites, and initiated a test program.

Prior to joining CH2M HILL in 1976, Mr. Eichler was an engineering geologist with Environmental Science and Engineering, Inc., of Gainesville, Florida. Responsibilities there included project management, soils investigations, siting studies, ground-water and surface-water reports, and federal and state environmental impact studies. He has professional capabilities in the following areas.

- Hydrogeology. Water supply well location, aquifer testing, well field layout, injection well testing and monitoring program design, and well construction inspection.

- Water resources inventory. Potentiometric mapping, water yield, and availability determinations.

GARY E. EICHLER

- Site investigations. Determination of subsurface conditions, primarily in soil media. Determination of stratigraphic correlation and associated physical properties for engineering design.

- Environmental permitting. Federal, state, regional, and local permit studies associated with industrial and mining projects.

- Clay mineralogy. Clay mineral reactions primarily associated with lime stabilization for highways and other engineering projects. Participated in a Brazilian highway project and developed laboratory analysis for lime-soil reactions.

- Engineering geology. Geologic exploration, soil property determinations for engineering design, and water and earth materials interactions associated with construction.

- Geophysics. Well logging and interpretation.

Mr. Eichler directed the laboratory analysis of tropical soils to determine engineering properties and reaction potential with lime additives for a Brazilian highway project. He also assisted in the preparation and presentation of a seminar on lime stabilization sponsored by the National Lime Association.

Membership in Organizations

American Water Resources Association
Association of Engineering Geologists
Geological Society of America
Southeastern Geological Society

Publications

Engineering Properties and Lime Stabilization of Tropically Weathered Soils. M.S. thesis, Department of Geology, University of Florida. August 1974.

BRIAN H. WINCHESTER
Ecologist

Education

B.S., Wildlife Ecology, University of Florida, 1973

Experience

Mr. Winchester's responsibilities at CH2M-HILL include project management, design and implementation of field sampling programs, data analysis and interpretation, impact assessment and prediction, environmental planning for impact mitigation, report preparation and review, and technical consulting at client-agency hearings. He has applied his expertise to numerous Environmental Impact Statements (EIS's), Developments of Regional Impact (DRI), and industry, power plant, and 208 studies.

- Trident Submarine Base EIS—Managed terrestrial and wetland biology subproject. Designed and directed quarterly field sampling and analyses for coastal sites in Rhode Island, Virginia, South Carolina, Georgia, and Florida. Prepared terrestrial and wetland portions of draft and final EIS.

- Gulf Intracoastal Waterway EIS—Conducted flora/fauna assessment of biota along the 300-mile Intracoastal Waterway in coastal Louisiana. Assessed impacts of maintenance dredging.

- California Lake Watershed EIS—Inventoried and mapped biotic communities for a 9-square-mile watershed in Dixie County, Florida. Assessed impacts of flood control channelization of major watercourses.

- Phosphate Industry DRI's—Managed or assisted in preparing five phosphate mine DRI's in central Florida. Helped develop mining and reclamation plans and provided technical input at client/agency hearings. Also provided biological baseline and impact assessment data for beneficiation plant sitings.

- Residential Development DRI's—Conducted biotic community inventories delineated wetlands, and prepared DRI's for three proposed residential developments in central and southern Florida.

- Wetlands Studies—Developed cost-effective, time-effective methodology for estimating the ecological value of freshwater wetlands and applied the technique to over 800 wetlands in central peninsular Florida. Assessed potential dredge and fill impacts on numerous wetlands.

- Transportation/Corridor Studies—Evaluated biological impacts associated with alternative routings of major new highways in Pinellas and Duval Counties, Florida. Assessed environmental impacts of upgrading a telephone communications corridor extending from Windermere to Tampa. Described biota and prepared a negative declaration for a proposed interstate highway interchange in Flagler County.

- Power Plant Studies—Conducted study of aquatic biota entrained at a Miami generating station. Assessed impacts of blowdown on plant communities surrounding two Florida generating stations. Assisted in delineation of biotic communities for a generating station expansion in Crystal River, Florida. Prepared environmental assessments for siting power plants in western and northeastern Washington.

- Industry Studies—Managed a 2-year biological monitoring program to assess potential impacts of industrial effluents in upper Escambia Bay. Conducted baseline terrestrial and aquatic quarterly sampling for a clean fuels facility to be located adjacent to an estuarine area in Jacksonville, Florida. Predicted SO_2 and NO_x air emission impacts on vegetation for a proposed caprolactam facility in southern Alabama. Contributed to preliminary biological inventories of limestone quarry and processing plantsites in central and coastal Alabama.

- 208 Studies—Mapped and assigned value classifications for all nonmarine wetlands in Pasco, Pinellas, Hillsborough, and Manatee Counties, Florida, for Tampa area 208.

- Rare and Endangered Biota Research—Managed and designed a research project on the ecology and management of a recently rediscovered endangered mammal. Conducted numerous endangered biota inventories.

Membership in Organizations

Ecological Society of America

Publications

"An Approach to Valuation of Florida Freshwater Wetlands." *Proceedings of the Sixth Annual Conference on the Restoration and Creation of Wetlands*, 1979 (with L. D. Harris).

The Current Status of the Colonial Pocket Gopher. *Oriole* 43:33-35. 1978 (with R. S. DeLotelle).

Ecology and Management of the Colonial Pocket Gopher: A Progress Report. *Proceedings of the Rare and Endangered Wildlife Symposium*, Athens, Georgia, 1978 (with R. S. DeLotelle, J. R. Newman, and J. T. McClave).

The Ecological Effects of Arsenic Emitted from Nonferrous Smelters. Final Report for U.S. EPA, Washington, D.C. (with Francis E. Benenati and Timothy P. King) February 1976.

Appendix B
OUTSIDE AGENCY CONTACT LIST

Appendix B
OUTSIDE AGENCY CONTACT LIST

1. Arizona Department of Water Resources--Basic Data Unit
   2810 South 24th Street, Phoenix, Arizona
   Mr. Bill Remick, 602/255-1543

2. Arizona Health Services--Hazardous Waste Section
   1740 West Adams Street, Phoenix, Arizona
   Mr. Bill Williams, 602/255-1160

3. Arizona Department of Water Resources--Hydrology
   99 East Virginia Avenue, Suite 245, Phoenix, Arizona
   Mr. Ed Nemeck, 602/255-1586

4. U.S. Department of Agriculture--Water Conservation Lab
   4331 East Broadway, Phoenix, Arizona
   Ms. Freda Bell, 602/261-4356

5. U.S. Department of Agriculture--Soil Conservation Service
   230 North 1st Avenue, Phoenix, Arizona
   Mr. David Richmond and Mr. Richard Swenson, 602/261-3058

6. U.S. Geological Survey
   201 North Central Avenue, Phoenix, Arizona
   Mr. Ed Dennis, 602/261-3188

7. Arizona State University--Geology Department
   Tempe, Arizona
   602/965-5081

8. Maricopa County Department of Planning and Development
   111 South 3rd Avenue, Phoenix, Arizona
   Dean Swaboda, 602/262-3403

9. Maricopa Assoc. of Government
   1820 West Washington St., Phoenix, Arizona
   Ms. Cindy Cook, 602/254-6308

10. Arizona Department of Health Services, Bureau of Waste Control, Hazardous Waste Division, Phoenix, Arizona
    Mr. Bill Williams, 602/225-1160

11. Arizona Department of Health Services, Water Quality Division, Phoenix, Arizona
    Mr. Lindon Hammond, 602/255-1254

12. Environmental Protection Agency, Region IX, Hazardous Materials Branch, San Francisco, California
    Mr. Fred Hoffman, 415/556-9881

13. Maricopa County Health Department, Phoenix, Arizona
    Mr. Larry Chrisofoli, 602/258-6381

14. Arizona Game and Fish Department, Phoenix, Arizona
Mr. John Phelps, 602/942-3000

15. U.S. Fish and Wildlife Service, Phoenix, Arizona
Mr. John Kurtz, 602/241-2487

16. Bureau of Land Management, Phoenix District Office, Phoenix, Arizona
Ms. Mary Butterwick, 602/241-2950

17. Arizona State University--Gout Documents/Hayden Library, Phoenix, Arizona

18. Arizona Commission of Agriculture and Horticulture
Phoenix, Arizona
602-255-4373

Appendix C
LUKE AFB RECORDS SEARCH INTERVIEW LIST

Appendix C
LUKE AFB RECORDS SEARCH INTERVIEW LIST

Interviewee	Area of Knowledge	Years at Installation
1	Bioenvironmental Engineering	3
2	Welding; Shops	11
3	Bioenvironmental Engineering; Controller	1
4	Secretary: Safety; Maintenance; Civil Engineering	25
5	Safety	1
6	Civil Engineering	28
7	Civil Engineering	23
8	Civil Engineering; Planning	8
9	Entomology; Refuse Collection and Disposal	25
10	Fire Department; Electrical Shop	18
11	EOD	4
12	Water and Wastewater Treatment	15
13	Corrosion Control Division	1
14	Fuels Maintenance	27
15	Fuels Maintenance	25
16	Maintenance	9
17	Sheet Metal	25
18	Electric Shop	28
19	Parachute Shop	24
20	CE; AGE; Fuels Maintenance	21
21	Electrical Department; PME Lab	33
22	Electric Shop	28
23	SAGE	22
24	Exterior Electric	10
25	Exterior Electric	2
26	DPDO	7
27	Lockheed	16
28	Environmental Coordinator	1
29	Bioenvironmental Engineering	1
30	Luke Air Force Range Maintenance	10
31	Civil Engineering Operations and Maintenance	23
32	Civil Engineering Operations and Maintenance	8
33	Yuma MCAS - Mechanical/Environmental Engineer	8
34	Yuma MCAS - Environmental Coordinator	14
35	MX Missile Project - Luke AFR	3

Appendix D
INSTALLATION HISTORY

Appendix D
INSTALLATION HISTORY

The mission at Luke Air Force Base historically has always been to provide advanced training to fighter pilots. Initially in 1941 the airplane used was the AT-6. Today the F-4, F-5, F-15, and F-104 provide training to both allied and American pilots.

The site for Luke Field was purchased in 1940 by the City of Phoenix for $40,000 and offered to the War Department as a location for an air base. In February, 1941, the site was surveyed and reported to be acceptable by Lt. Col. Ennis C. Whitehead, the first commander of Luke Air Force Base. Ground breaking began on March 29, 1941, and on June 6, 1941 the facility was ready to be occupied. Also on this date, the base officially became Luke Field, named in honor of Frank Luke, Jr., a native of Phoenix who gained fame as an ace in World War I. Killed in action on September 29, 1917, Lt. Luke was the first aviator to be awarded the Medal of Honor.

Luke Air Force Base was deactivated on November 30, 1946. During its 5-year existence more than 17,000 pilots were trained; most received training in the AT-6, and the remainder of the pilots were trained in the P-40, the P-38, and the P-51. Gila Bend Gunnery Range, a major part of the Luke AFB training operation, remained open after 1946 but under the control of Williams Field.

The federalized 127th Fighter Wing, a Michigan Air National Guard Unit, reactivated the base on February 1, 1951, and became a Pilot Training Wing at Luke. Pilots were trained in the F-84 Thunderjet and in the P-51 Mustang. The P-51 Mustangs belonged to an Arizona Air National Guard (ANG) Squadron which had also been federalized and assigned to the wing. In November 1951, the ANG units were released from active duty, and the 3600th Combat Crew Training Wing assumed operation of the base and the aircraft and equipment of the deactivated ANG units. On July 1, 1958, the base was transferred from Air Training Command to Tactical Air Command, and the 4510th Combat Crew Training Wing assumed control. Luke AFB was then beginning Supersonic training operations in the F-100 Super Sabre. During the early and mid-50's the primary training aircraft were the F-84 Thunderjet, the Sweptwing F84-F, the Thunderstreak, the F-80 Shooting Star, and the P-51 piston engine Mustang.

Older model aircraft had a history of flying well past their expected service life at Luke. The French Air Force continued to train in the P-51 until 1953. The Swept Wing F-84-F Thunderstreak was in use until 1964; and the F-100 remained until 1971, when it was replaced by the F4C Phantom II. The F-5 Freedom Fighter and the F104G Starfighter first came to Luke AFB in 1964 and remain today. The F-5 Freedom Fighter is used to train allied pilots from numerous smaller nations, while the F-104G Starfighter was specifically dedicated for training German Air Force and Navy pilots. The latest fighter to join the Luke fleet is the F-15 Eagle, which arrived in November, 1974. The Honorable Gerald R. Ford, former President of the United States, was present at its arrival.

The 4510th remained as the host of Luke AFB until the 58th Tactical Fighter Training Wing (TFTW) was activated on October 15, 1969. The 58th TFTW was in charge until Tactical Training Luke was created on April 1, 1977. The 58th TFTW remained at Luke AFB until August 29, 1979, when the 405th Tactical Training Wing was activated and replaced the 58th TFTW's F-5 and F-15 aircraft operations. On December 1, 1980, the 832nd Air Division replaced Tactical Training Luke as the intermediate headquarters unit at Luke AFB. Today the Air Division provides command supervision to the F-4 and F-104 training programs of the 58th Tactical Training Wing and also to the F-5 and F-15 training programs of the 405th Tactical Training Wing. The F-5 training program belongs to Luke AFB but operates out of Williams AFB because of maintenance similarities between the F-5 and the T-38 aircraft. The F-104 program is distinctive in that it consists of aircraft owned by a foreign air force, is maintained by a civilian contractor, and is under the operational control of the USAF. The uniqueness of the Luke AFB fighter training mission has been matched by the excellence of its performance. Repeatedly Luke AFB has received Air Force Outstanding Unit Awards, the most recent being received for the period between January 1, 1978 and December 31, 1979.

PRIMARY MISSION

The mission of Tactical Training Luke, the host unit at Luke AFB, is to provide combat crew training for aircrew personnel of the U.S. military forces and selected allied military services as determined by Headquarters, USAF, and directed by Headquarters, Tactical Air Command.

This aircrew training is conducted in the F-4C, F/TF-15A, F-5B/E, and F/TF-104G aircraft. In the F-4C, training consists of an operational training course for undergraduate pilot training graduates, a special course for experienced fighter pilots transitioning into the F-4, and the Central Instructor School, which trains F-4 instructor pilots from all Tactical Air Command units equipped with the F-4 aircraft. The F-5B/E training consists of training allied military services pilots in an advanced fighter course, and a variety of category checkouts and conversions involving F-5 pilots. A new Air Weapons Instructor Course in the F-5E will be offered in the future. The F/TF-15A training consists of a conversion course and an instructor course for F-15 pilots. The F/TF-104G training is conducted for the German Air Force, and occasionally, F-104 pilots from other North Atlantic Treaty Organization countries. A basic operational training course, Air Warfare Instructor Course, and an instructor pilot upgrading course are offered in the F-104 aircraft.

The Deputy Commander for Maintenance, 58th Tactical Training Wing, provides aircraft maintenance support through his staff and four squadrons, the 58th and 59th Aircraft Generation, 58th Equipment Maintenance, and 58th Component Repair. The Wing's maintenance concept is governed by AFM 66-1. The Deputy Commander for Resources provides supply, comptroller, logistics plans, transportation, and F-104 contract management support to the flying mission. The Deputy Commander for Operations conducts the flying operations of the Wing through his staff and eight flying squadrons. F-4C training and operations are conducted in the 310th, 311th, and 426th Tactical Fighter Training Squadrons. F-5B/E training and operations are conducted by the 425th Tactical Fighter Training Squadron. F/TF-15A training and operations are conducted by the 461st, 550th, and 555th Tactical Fighter Training Squadrons. F/TF-104G training and operations are conducted by the 69th Tactical Fighter Training Squadron. Administrative, legal, personnel, special services, services, security police, civil engineering, and chaplain support are provided by the 58th Combat Support Group Commander.

TENANT MISSION

Luke's largest tenant is the 26th NORAD Region/Air Division, which is the central command and control center for the air defense of more than one million square miles of the southwestern United States. Its primary mission is to maintain surveillance over sovereign airspace of the southwestern United States, and to defend that airspace during periods of national emergency. The unit has dual assignment to the North American Air Defense Command (NORAD) and the USAF's Tactical Air Command.

The 2037th Communications Squadron is responsible for the programming, operation, and maintenance of all communications systems used at Luke and is a member of the Air Force Communications Service. The Air Training Command's 527th Field Training Detachment administers advanced aircraft maintenance training for personnel of the Wing's four maintenance squadrons. Detachment 9 of the 4400th Management Engineering Squadron (TAC) develops and implements manpower standards for the 58th TFTW, and assists commanders and staff agencies in effectively managing manpower resources. Detachment 1705, Air Force Office of Special Investigations, provides specialized professional criminal and counterintelligence investigative services to commanders of all Air Force units at Luke and in western Arizona.

Detachment 15, 25th Weather Squadron (MAC) provides current weather data to all units at Luke AFB, the 161st Air Refueling Group (Arizona Air National Guard), and Libby Army Air Field at Ft. Huachuca, Arizona. Detachment 11, 12th Weather Squadron (MAC) is located in the 26th NORAD Region/ Air Division and provides 24-hour weather support to the air defense command and control system and ADC and ANG interceptors and radar sites. The 302nd Special Operations Squadron is an active Air Force Reserve (AFRES) helicopter unit. Its primary mission is to conduct day and night infiltration, reinforcement, and resupply into hostile or enemy territory, psychological air operations, aid in escape and evasion, and recovery of personnel in combat search and rescue operations. The 41st Medical Squadron Reserve Unit is also an AFRES unit, which conducts its monthly and two-week drills at Luke AFB. If activated the unit would be divided, with half its personnel augmenting Air Force hospital staffs and the remainder going to MAC Aeromedical Evacuation Staging Groups. The Resident Auditor, Air Force Audit Agency, assists Air Force managers at Luke to accomplish their missions in the most economical and effective manner possible by providing auditing services.

The 607th Tactical Control Squadron is a deployable unit which supports Composite Air Strike Force operations with radar control and navigational assistance to aircraft. OL 23AK, USAF Postal and Courier Service, operates the military postal function at Luke. OL AA, 4510th Support Squadron (TAC), ensures timely resolution of F-15 logistical engineering problems. OLAC, Air Force Test and Evaluation Center (AFTEC), is a test team for follow-on test and evaluation of the F-15. OL AH, USAF Tactical Air Warfare Center (TAC), provides single operational manager capability for the Simulator Air-to-Air Combat and F-4E Weapon System Training Set Number 18. The Lockheed Aircraft Services Company is a civilian firm that provides F-104 maintenance for the German Air Force. The Defense Property Disposal Office furnishes disposal support for excess/surplus property generated by Luke AFB and other DOD activities in the adjacent area.

Appendix E
MASTER LIST OF INDUSTRIAL SHOPS AND LABORATORIES

Appendix E

MASTER LIST OF INDUSTRIAL SHOPS AND LABORATORIES

Name	Present Location and Dates (Building Number)		Past Location and Dates (Building Number)		Handles Hazardous Materials	Handles Hazardous Waste	Treatment/Storage/Disposal
58 AGS							
310 AMU	913	1954 to Present			x	x	DPDO
311 AMU	914	1954 to Present			x	x	DPDO
58 CRS							
Weapons Control	917	1970 to Present			x	x	All consumed except radioactive tubes
Photo/Camera	917	1970 to Present					
Comm/Nav	917	1970 to Present					
Elec Warfare Sys	917	1970 to Present					
Internal Nav. Sys	717	1970 to Present					
Inst/Auto Pilot	917	1970 to Present					
Avionics Age	917	1970 to Present			x		Consumed
Calibration Dock	985	1963 to Present					
Metals Process	915	1962 to Present	409	Prior to 1962	x		Consumed
Machine Shop	915	1962 to Present	409	Prior to 1962			
Structural Repair	915	1962 to Present	408	Prior to 1964	x	x	DPDO
Pneudraulics	931	1969 to Present	483	1964 to 1969	x	x	DPDO
			407	Prior to 1964			
Envir Sys Control	931	1969 to Present					
Elec. Shop	913	1954 to Present	409	Prior to 1954			
Simulators (F-4)	616	1960 to Present			x	x	DPDO
SAAC	617	1975 to Present					
Jet Engines	931	1969 to Present	483	1964 to 1969	x	x	DPDO and oil/water separator
			408	Prior to 1964			
Test Cell	NE of 937	1959 to Present			x	x	DPDO and oil/water separator
Non-Power AGE	943A	1960 to Present	480	1943 to 1960			

Appendix E--Continued

Name	Present Location and Dates (Building Number)		Past Location and Dates (Building Number)		Hazardous Materials	Hazardous Waste	Treatment/Storage/Disposal
58 EMS							
AGE Insp. and Repair	480	1943 to Present			x	x	DPDO
Non-Powered AGE	480	1943 to Present			x	x	DPDO or Consumed
AGE Ser P/U & Del	900	1980 to Present					
Egress	920	1958 to Present					
Aero Repair	913	1954 to Present	408	Prior to 1954			
Phase Docks	913	1954 to Present					
Corr. Control/Paint	922	1962 to Present	408 & 303	Prior to 1962	x	x	DPDO, Washrack Drain to Sanitary Sewer, Consumed
Fuel Sys Repair	983	1963 to Present			x	x	Small Quantities, DPDO or Consumed
Missile Shop	1236	1975 to Present					
Munitions Insp.	1221	1960 to Present					
EOD	986	1978 to Present					
Gun & Armament Sys.	926	1975 to Present					
Munitions Storage	1221	1960 to Present					
Munit Trailor Maint	1233	1971 to Present					
405 AGS							
461 AMU	483	1943 to Present					
550 AMU	455	1943 to Present					
426 AMU	921	1958 to Present					
405 CRS							
Auto Test Sta	417	1955 to Present					
Manual Test Sta	417	1955 to Present			x	x	DPDO
ESS	417	1955 to Present			x	x	DPDO
PMEL	417	1955 to Present			x	x	DPDO
Metals Process	915	1962 to Present	409	Prior to 1962	x		Consumed
Machine Shop	915	1962 to Present	409	Prior to 1962	x	x	DPDO
Struct Repair	915	1962 to Present	409	Prior to 1962	x	x	DPDO
Fiberglass	915	1962 to Present					
Pneudraulics	931	1969 to Present	407	Prior to 1969	x	x	DPDO

Appendix E--Continued

Name	Present Location and Dates (Building Number)		Past Location and Dates (Building Number)		Hazardous Materials	Hazardous Waste	Treatment/Storage/Disposal
405 CRS--Continued							
Environmental Control Sys	931	1969 to Present			x	x	DPDO
NDI	931	1969 to Present			x	x	DPDO and Sanitary Sewer
SOAP	931	1969 to Present					
Electric Shop	962	1962 to Present	409	Prior to 1962	x	x	DPDO
Non-Powered AGE	944	1969 to Present					DPDO
Jet Engine Inter. Maintenance	930	1969 to Present	480 & 483	Prior to 1959	x	x	DPDO
Small Gas Turbine/Modular Repair	932	1975 to Present			x	x	DPDO
F-15 Trim Pad	1010	1975 to Present			x	x	DPDO and Oil/Water Separator
Test Cell	929	1974 to Present			x	x	DPDO and Oil/Water Separator
Simulators (F-15)	617	1975 to Present			x	x	DPDO
NiCad Batteries	913	1954 to Present	409	Prior to 1954	x	x	Neutralized to Sanitary Sewer
Lead Acid Batteries	913	1954 to Present	409	Prior to 1954	x	x	Neutralized to Sanitary Sewer
405 EMS							
AGE Insp. & Repair	480	1943 to Present			x	x	DPDO
Non-Powered AGE	480	1943 to Present			x	x	DPDO or Consumed
AGE SER P/U & Del.	900	1980 to Present					
Egress	964	1964 to Present					
Aero Repair	914	1955 to Present	409	Prior to 1955			
Phase Docks	914	1955 to Present					
Corrosion Cont/Paint	922	1962 to Present	408	Prior to 1962	x	x	DPDO, Washrack Drain to Sanitary Sewer, or Consumed
Fuel Sys Repair	984	1977 to Present			x	x	DPDO or Consumed
Tire/Dart	985	1963 to Present	409	Prior to 1963	x	x	DPDO
Aircraft Washrack	935	1958 to Present	456	1953 to 1958	x	x	Sanitary Sewer
			481	Prior to 1953			
Base Flight/Trans	455	1943 to Present					
Armament Systems	927	1968 to Present					

Appendix E--Continued

Name	Present Location and Dates (Building Number)		Past Location and Dates (Building Number)	Hazardous Materials	Hazardous Waste	Treatment/Storage/Disposal
832 CES						
Paint Shop	339	1972 to Present	Civil Engineering shops used to be located in several temporary structures in the same general location as the existing structures.	x	x	DPDO
Plumbing Shop	339	1972 to Present				
Pwr PRO/Barr Maint	360	1978 to Present				
Water Plant	284	1941 to Present				
Grounds	338	1972 to Present				
Fire Dept	457	1941 to Present				
Pavements	338	1972 to Present				
Carpentry	339	1972 to Present				
Refrigeration	339	1972 to Present				
Heating	339	1972 to Present				
Interior Elect.	339	1972 to Present				
Exterior Elect.	339	1972 to Present				
Smart Shop	460	1980 to Present				
Liquid Fuels Maint	353	1953 to Present				
Heavy Equip Ops	338	1972 to Present				
Hospital Maint.	1130	1974 to Present				
Housing Maint.	1113	1980 to Present				
Entomology	354	1965 to Present		x	x	Landfill after Triple Rinsing
Metals Process	339	1972 to Present				
832 MWR						
Bowling Center	1525	1974 to Present				
Cermaics Hobby Shop	247	1981 to Present				
Auto Hobby Shop	248	1955 to Present		x	x	DPDO
Photo Hobby Shop	242	1942 to Present		x	x	Silver Recovery Effluent to Sanitary Sewer
832 Supply						
Fuels Lab & QC	328	1969 to Present		x	x	DPDO, Consumed, Washrack Drain to Sanitary Sewer
Fuels Distribution	331	1958 to Present		x	x	DPDO, Consumed, Washrack Drain to Sanitary Sewer
Fuels Storage/Base Gas Station	299	1972 to Present				
Liquid Oxygen	992	1966 to Present		x		Consumed

Appendix E--Continued

Name	Present Location and Dates (Building Number)		Past Location and Dates (Building Number)	Hazardous Materials	Hazardous Waste	Treatment/Storage/Disposal
832 TRANSPORTATION						
Tanker Repair	353	1953 to Present		x	x	DPDO
Fire Truck Maint	444	1952 to Present		x	x	DPDO
Minor Repair	335	1943 to Present		x	x	DPDO
Heavy Equip Repair	346	1966 to Present		x	x	DPDO
Tire/Battery Shop	297	1942 to Present		x	x	Sanitary Sewer
Packing & Crating	948	1971 to Present				
Paint Shop	333	1942 to Present				
Allied Trades	336	1942 to Present				
Vehicle Maintenance	336	1942 to Present		x	x	DPDO, Sanitary Landfill, Drain to Sanitary Sewer
Air Freight Term.	448	1943 to Present				
USAF HOSPITAL LUKE						
Laboratory	1130	1974 to Present	Prior to 1974, the hospital facilities were located in several temporary structures, T-800	x	x	Sanitary Sewer
Surgical	1130	1974 to Present				
Dental Lab	1130	1974 to Present				
Histopathology	1130	1974 to Present		x	x	Sewer in Small Amounts
Medical X-Ray	1130	1974 to Present		x	x	Silver Recovery Effluent to Sanitary Sewer
Dental X-Ray	1130	1974 to Present		x	x	Silver Recovery Effluent to Sanitary Sewer
Medical Equip Maint.	1130	1974 to Present				
Central Supply	1130	1974 to Present				
Dental Operatories	1130	1974 to Present				
2037 COMMON SQ.						
Radio Maint.	1040	1970 to Present				
Teletype Maint.	176	1964 to Present				
Radio Shop (G.B.)	319	1942 to Present				
Closed Circuit T.V.	27	1965 to Present				
NAV Aids	1040	1970 to Present				
Radar Maint.	979	1973 to Present				

Appendix E--Continued

Name	Present Location and Dates (Building Number)		Past Location and Dates (Building Number)	Hazardous Materials	Hazardous Waste	Treatment/Storage/Disposal
85 TAC CON FLT						
Vehic.e Maint.	1365	1978 to Present				
AGE	1365	1978 to Present				
Radar Maint.	1365	1978 to Present				
Radio Maint.	1365	1978 to Present				
607 TAC CON SQ						
Radio Maint	1382	1977 to Present				
Comp Rep & Maint	1383	1978 to Present				
Radar Maint.	1382	1977 to Present				
AGE	1377	1970 to Present				
832 COMBAT SUPPORT GROUP						
Reproduction Shop	583	1969 to Present				
Photo Shop	583	1969 to Present	Used to be located at corner of "D" Street and 7th Street--structure no longer exists.	x		
Graphics Division	583	1969 to Present		x	x	To Sanitary Sewer
Small Arms Training Unit	909	1973 to Present				
832 AIR DIVISION						
Data Automation	121	1945 to Present				
405 COMBAT SUPPORT GROUP						
Continuous Processing	583	1969 to Present	Used to be located at corner of "D" Street and 7th Street--structure no longer exists.			

Appendix E--Continued

Name	Present Location and Dates (Building Number)		Past Location and Dates (Building Number)	Hazardous Materials	Hazardous Waste	Treatment/Storage/Disposal
58 TTW						
302 SPECIAL OPS SQ						
Avionics	999	1970 to Present				
Life Support	999	1970 to Present				
Engine Shop	999	1970 to Present				DPDO
Pneudraulics	999	1970 to Present				DPDO
Aerospace Groups Equip	999	1970 to Present				
Phase Dock/Flight Line	999	1970 to Present				
Fabrications/Fuel Sys Repair	999	1970 to Present		x	x	DPDO
Weapons Shop	999	1970 to Present				
26 AIR DEFENSE SQ						
Power Prod/Refrig.	1158A	1960 to Present		x	x	DPDO
OTHER TENANT UNITS						
4444 Ops Sq Trng Aids	656	1943 to Present		x	x	Consumed
527 FTD	500 or 610	1975 to Present		x		Not in Use Currently
DPDO	Waste Treatment Annex	June 1981 to Present	Used to be located in north-west corner of the base: Buildings 370 and 373			
DET 15 25 Weather Sq	439	1942 to Present				
LOCKHEED AIRCRAFT SERVICE COMPANY						
AGE	400	1964 to Present		x	x	DPDO
Washrack, AGE	403	1964 to Present		x	x	DPDO
NDI	407	1964 to Present				Consumed

Appendix E--Continued

Name	Present Location and Dates (Building Number)		Past Location and Dates (Building Number)	Hazardous Materials	Hazardous Waste	Treatment/Storage/Disposal
LOCKHEED AIRCRAFT SERVICE COMPANY (Continued)						
Field Maint Shops	408	1964 to Present				
Weapons Maint	409	1964 to Present				
Weld Shop	409	1964 to Present				
Paint Dope	413	1964 to Present		x	x	DPDO--Outside Contractor
Electronic Shops	415	1964 to Present		x		Consumed
Weld Shop	930A	1964 to Present				
Engine Test Cell	968/988	1964 to Present				DPDO
Fuel Cell Repair	1024	1964 to Present				DPDO
832 COMBAT SUPPORT SQUADRON GILA BEND						
Building Maint.	1009	1973 to Present				
Welding Sheet Metal	1014	Not Known				
Mechanical Section	1009	1973 to Present				
Sanitation	45	1964 to Present				
Electrical	1009	1973 to Present				
Power Prod.	2079	1977 to Present		x	x	Neutralized to Ground
Pavement & Grounds	1009	1973 to Present				
A,C, & W Radar Maint.	2008	1977 to Present				
Autotrak Radar Maint.	2008	1977 to Present				
Radio Shop	2009	Not Known				
TOSS	2008	1977 to Present				
Vehicle Maint.	3110	1976 to Present		x	x	To Drain, DPDO
Battery Shop	3111	1976 to Present		x	x	Neutralized to Sanitary Sewer
Allied Trades	19	1967 to Present				
Tire Shop	19	1967 to Present				
Heavy Equip. Maint.	16	1956 to Present				
Fire Truck Maint.	314	1972 to Present				
Range Ops.	324	1977 to Present				
Auto Hobby Shop	39	1963 to Present				DPDO

Appendix F
INVENTORY OF EXISTING FUEL STORAGE TANKS

Appendix F
EXISTING FUEL TANK LOCATION SUMMARY

Facility No.	Type POL	Capacity[a] of Each Tank (gal)	Above/ Below Ground	Diked
11	Diesel	280	Below	--
176	Diesel	550	Below	--
177	MOGAS	10,000	Below	--
	MOGAS	10,000	Below	--
	MOGAS	10,000	Below	--
	MOGAS	6,000	Below	--
	MOGAS	6,000	Below	--
284	Diesel	500	Above	No
299	MOGAS	10,000	Below	--
	MOGAS	10,000	Below	--
305 Area	JP-4	(28) 5,000	Above	No
	MOGAS	1,200	Above	No
	Diesel	1,200	Above	No
321	115/145	50,000	Below	--
	MOGAS	50,000	Below	--
	MOGAS	50,000	Below	--
	Diesel	50,000	Below	--
	Diesel	50,000	Below	--
	JP-4	50,000	Below	--
321 RS	MOGAS	1,000	Below	--
	MOGAS	1,000	Below	--
351	JP-4	420,000	Above	Yes
356	JP-4	1,680,000	Above	Yes
370	MOGAS	200	Above	No
403	Kerosene	300	Above	No
405	JP-4	5,000	Below	--
	MOGAS	5,000	Below	--
		(5) 5,000	Above	No
	PD-680	300	Above	No
902	MOGAS	5,000	Below	--
	JP-4	5,000	Below	--
927	PD-680	110	Above	No
	PD-680	150	Above	No
928	JP-4	5,000	Above	Yes
	JP-4	5,000	Above	Yes
935	PD-680	8,000	Above	No
	PD-680	1,000	Above	No
952	Diesel	1,000	Below	--
955	Diesel	1,000	Below	--

[a] A number in parentheses ( ) beside the tank capacity indicates the number of tanks.

Appendix F--Continued

Facility No.	Type POL	Capacity[a] of Each Tank (gal)	Above/ Below Ground	Diked
968	JP-4	2,000	Above	Yes
979	Diesel	1,300	Below	--
991	AFFF	1,200	Above	No
993	JP-4	10,000	Below	--
	JP-4	10,000	Below	--
	JP-4/Oil Mix	5,000	Below	--
999	MOGAS	550	Above	No
	PD-680	550	Above	No
1001	Diesel	280	Below	--
1002	Diesel	275	Below	--
1012	Diesel	350	Above	No
1040	Diesel	1,000	Below	--
1041	Diesel	400	Below	--
1079	Diesel	300	Below	--
1115	MOGAS	10,000	Below	--
	MOGAS	10,000	Below	--
	MOGAS	10,000	Below	--
1132	Diesel	20,000	Below	--
1151	Diesel	30,000	Below	--
	Diesel	30,000	Below	--
	Diesel	30,000	Below	--
	Lube Oil	2,000	Below	--
1221	Diesel	525	Below	--
1233	MOGAS	550	Above	No
1236	JP-4	350	Above	No
1239	JP-4	5,000	Above	Yes
	AFFF	1,200	Above	No
1365	JP-4	600	Above	Yes
1375	JP-4	5,000	Above	Yes
	JP-4	5,000	Above	Yes
	JP-4	5,000	Above	Yes
	JP-4	1,000	Above	Yes
	PD-680	500	Above	Yes
1379	Diesel	600	Below	--
1380	Diesel	300	Below	--
4022	Diesel	350	Above	No

[a] A number in parentheses ( ) beside the tank capacity indicates the number of tanks.

Appendix G
ABANDONED FUEL TANK LOCATION SUMMARY

Appendix G
ABANDONED FUEL TANK LOCATION SUMMARY

Facility No.	Type Fuel	Capacity/Gal	Type Tank
151[a]	Unknown	1,000	Underground
337[b]	Used Oil	10,000	Underground
434[a]	Diesel	1,000	Underground
East of 979[c]	Diesel	1,000	Underground

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[a] Tank is paved over.
[b] Located beneath building 337.
[c] Tank is probably paved over, but the exact tank location cannot be determined.

Appendix H
REPORTED CURRENT PESTICIDE
USAGE AT LUKE AFB

Appendix H

REPORTED CURRENT PESTICIDE USAGE ON LUKE AFB

Trade Name	Target Pest(s)	Site Identification	Area Covered Per Application	Number of Applications Per Year	Time of Year
INSECTICIDES					
Dursban	Ants	Residential/Industrial	25,000 sf	As required	All months
	Cockroaches	Residential/Industrial	560,000 sf	As required	All months
	Crickets	Residential/Industrial	840,000 sf	As required	April-October
	Earwigs	Residential/Industrial	840,000 sf	As required	All months
	Firebrats	Residential/Industrial	1,680,000 sf	As required	All months
	Silverfish	Residential/Industrial	1,680,000 sf	As required	All months
Diazinon	Ants	Residential/Industrial	25,000 sf	As required	All months
	Crickets	Residential/Industrial	840,000 sf	As required	April-October
	Earwigs	Residential/Industrial	840,000 sf	As required	All months
	Fleas	Residential/Industrial	25 acres	As required	April-October
	Scorpions	Residential/Industrial	840,000 sf	As required	All months
	Ticks	Residential/Industrial	840,000 sf	As required	All months
Ficam W	Ground Beetles	Residential/Industrial	50,000 sf	As required	April-June
	German Cockroaches	Food Facilities	40,000 sf	Monthly	All months
	Fleas	Residential/Industrial	1,680,000 sf	As required	April-October
	Scorpions	Residential/Industrial	840,000 sf	As required	All months
	Spiders	Residential/Industrial	1,680,000 sf	As required	All months
	Ticks	Residential/Industrial	840,000 sf	As required	All months
	Wasps and Bees	Residential/Industrial	100 sf	One	April-October
Malathion	Aphids	Residential/Industrial	100 trees	Three	April-October
	Flies	120 Dumpster, Platforms	10,000 sf	Weekly	All months
	Spider Mites	Industrial/Residential	100 shrubs	Three	April-October
PT 550	German Cockroaches	Food Facilities	40,000 sf	Monthly	All months
	Cockroaches	Residential/Industrial	560,000 sf	As required	All months
Dibrom 14	Mosquitoes	Residential/Industrial	300 acres	Triweekly	April to September
Diazinon Dust	Cockroaches	Residential/Industrial	560,000 sf	As required	All months

Appendix H--Continued

Trade Name	Target Pest(s)	Site Identification	Area Covered Per Application	Number of Applications Per Year	Time of Year
Dursban 10 CR	Mosquitoes	Low Areas	6 acres	One	April-June
Chlordane	Subterranean Termites	Residential/Industrial	20,000 sf	State treatment performed only when termite activity identified	All months
RODENTICIDES					
Rat Pucks	Rats and Mice	Industrial	250 Bait Stations	Six	October-April
Dival	Rats and Mice	Industrial	250 Bait Stations	Six	October-April
HERBICIDES					
Spike	Vegetation	Areas Around Runway	45 acres	One	February-March
Promital 25E	Vegetation	Areas Around Runway	50 acres	One	February-March
Dowpon	Undesirable Grasses	Streets/Parking Lots	5 acres	One	March, April
Round Up	Undesirable Weeds and Grasses	Streets/Parking Lots Ornamental Areas	5 acres 5 acres	One One	March, April April, May
Weed Boomer	Undesirable Weeds and Grasses	Streets/Parking Lots Ornamental Areas	5 acres	One	April, May

Appendix I
USERS OF LUKE AIR FORCE RANGE

Appendix I
USERS OF LUKE AIR FORCE RANGE

A. U.S. Air Force Units

- o 302nd Special Operations Squadron; Luke AFB, Arizona
- o 58th Tactical Training Wing; Luke AFB, Arizona
- o 355th Tactical Fighter Wing; Davis-Monthan AFB, Arizona
- o 432nd Tactical Drone Group; Davis-Monthan AFB, Arizona
- o 474th Tactical Fighter Wing; Nellis AFB, Nevada
- o 57th Fighter Weapons Wing; Nellis AFB, Nevada
- o 27th Tactical Fighter Wing; Cannon AFB, New Mexico
- o 49th Tactical Fighter Wing; Holloman AFB, New Mexico
- o 162nd Tactical Fighter Training Group (Air National Guard); Tucson International Airport, Tucson, Arizona
- o 35th Tactical Fighter Wing; George AFB, California
- o 425th Tactical Fighter Training Squadron; Williams AFB, Arizona

B. U.S. Marine Corps and U.S. Navy Units

USMC/USN Units include those based at Miramar Naval Air Station and North Island Naval Air Station, San Diego, California; El Toro USMC Air Station, Santa Ana, California; Camp Pendleton, California; Yuma USMC Air Station, Yuma, Arizona; as well as units from throughout the continental United States, Hawaii, and the Atlantic and Pacific Fleets.

Appendix J
DESCRIPTION OF RANGE TARGETS
AT LUKE AIR FORCE RANGE

Appendix J
DESCRIPTION OF RANGE TARGETS AT LUKE AIR FORCE RANGE

I. Air Force Range Targets

A. A typical Air Force Range contains the following common features:

1. Range Layout: The "baseball diamond" type layout consisting of two towers and two bomb/rocket circles.

2. Strafe Target: There are four scored strafe targets, two on each side of the range. The aiming reference is an F-4 drag chute with electronic scoring being accomplished by Accoustiscore. This system counts the number of supersonic projectiles passing within a designated area, and the numerical count is automatically displayed for the range officer located in the main observation tower. There are no provisions for manual scoring except in limited cases involving test and evaluation projects.

3. Low Angle/Low Level Targets: There are two scored targets, one on each side of the range. An outlined area is situated directly in front of a truck aligned with the published attack heading. Scoring is accomplished visually by the range officer on the basis of a "hit" or "miss."

4. Bomb/Rocket Circle: There are two bomb/rocket circles, one on each side of the range. High angle strafing is also accomplished on these targets. Each target consists of a vertical pylon, a 75-foot-radius circle, and a 150-foot-radius circle. Scoring is accomplished by visual triangulation from the main and satellite spotting towers.

5. Applied Tactics Target: An applied tactics target consisting of one to four aircraft or vehicles is located 3,500 feet downrange of the foul line. The target may be used for strafing, low angle/low level bombing, high angle bombing, and rockets.

6. Nuclear Weapons Delivery (NWD) Target: The simulated nuclear weapons delivery target consists of a vertical pylon painted white with concentric circles at various radii. Radar reflectors are elevated above-ground level to accommodate aircraft radar runs on the published attack course. In addition to NWD events, non-nuclear level radar events are conducted on the NWD target. Scoring is accomplished by visual triangulation with calibrated optics from the main and satellite observation towers.

B. MANNED AIR FORCE RANGES

The four manned ranges in the eastern or Gila Bend Segment of the Luke Air Force Range (LAFR) are: Range 1, Range 2, Range 3, and Range 4.

1. Range 1

A composite simulated nuclear weapons delivery and non-nuclear weapons delivery range used during daylight hours only. This range is used primarily by the 355th Tactical Fighter Wing, Davis-Monthan AFB, Arizona. It is located beneath the eastern edge of R-2301 East (restricted airspace) approximately 24 nautical miles (NM) south southwest of Gila Bend Air Force Auxiliary Field.

2. Range 2

A composite simulated nuclear weapons delivery and non-nuclear weapons delivery range used during daylight hours only. It is located beneath the eastern edge of R-2301 approximately 16 NM south-southwest of Gila Bend AFAF.

3. Range 3

A composite simulated nuclear weapons delivery and non-nuclear weapons delivery range used day and night (24-hour capability). Only non-nuclear events are permitted at night. This range is located approximately 7.5 NM south of Gila Bend AFAF.

4. Range 4

A non-nuclear weapons delivery range used day and night (24 hour capability). This range is located beneath the northern edge of R-2301 approximately 20 NM west-southwest of Gila Bend AFAF.

C. UNMANNED AIR FORCE RANGES

1. Target 5

Located beneath R-2301 East approximately 31 NM west-southwest of Gila Bend AFAF and formerly classified as a complete weapons range similar to the manned ranges listed above, although it is now considered as a target only. It is used primarily as a target for simulated nuclear weapons delivery at the termination of a visual or radar navigation training route.

2. North/South Tactical (TAC) Range

The North/South Tactical Range complex includes a number of targets of varying types designed to simulate situations likely to be encountered in combat. The North Tactical Range (NTACRg) is located approximately 26 NM southwest of Gila Bend AFAF. The South Tactical Range (STACRg) is located approximately 35 NM southwest of Gila Bend AFAF. Both the NTACRg and STACRg are within Restricted Area R-2301. Live ordnance can be delivered on Target 16 in the NTACRg and on Target 21 in the STACRg.

3. East Tactical (TAC) Range

The East Tactical Range (ETACRg) is located approximately 12 NM south-southeast of Gila Bend AFAF. The ETACRg is located mainly within Restricted Area R-2304 (restricted airspace) and partially within R-2305 (restricted airspace). It provides for the same type of training as the N/STACRg listed in the preceding paragraph. Manned Range 3 and the ETACRg cannot be used simultaneously due to the close proximity of the two ranges and the probability of conflicting flight traffic patterns. Live ordnance can be delivered on ETACRg Target 311.

Commercial fireworks have been used on a limited basis on the ETACRg to simulate enemy antiaircraft fire, thus providing a more realistic training environment. The operation consists of placing up to 120 paper or metal launch tubes on the range and connecting these to a remote location by field wire so that they can be fired from a point well off the target. The pyrotechnics are commercial fireworks and are fired to an altitude of 300 to 400 feet above ground level (AGL). Little or no debris is generated, and the launch tubes can be removed. Expansion of this project is being studied.

4. Electronic Warfare Range

The Electronic Warfare (EW) Range overlies the East Tactical Range and is used in conjunction with scheduled Ground Attack Tactical (GAT) training missions. The EW Range provides simulated enemy air defenses for tactical units conducting strike and strike-related operations. A variety of AAA, SAM, and Jamming systems are deployed in the vicinity of the East Tac Range for units to employ Electronic Counter Measures (ECM), Chaff and Radar Warning Receiver (RWR) equipment tactics and techniques. The radar threat environment is generated from Gila Bend AFAF, and from field sites located within the area.

5. Air-to-Air Range

The unmanned Air-to-Air Range is used for various types of Air-to-Air Gunnery and Missile Training, principally Air-to-Air Dart Firing. AIM-7 (Sparrow missile) firings require both the eastern and western portions of Restricted Area R-2301. The northernmost portion of the area is designated a rendezvous area for flights, for holding, and for dart target launching. The actual firing operation is conducted south of the rendezvous area. A major portion of the Cabeza Prieta National Wildlife Refuge underlies the Air-to-Air Range and flight/firing operations are permitted over this area by a 24 March 1975 Memorandum of Understanding between the Departments of the Air Force, the U.S. Navy, and the Department of the Interior. Firing operations are permitted as low as 5,000 feet AGL and overflight is permitted down to 1,500 feet AGL.

6. Drone Maneuvering Area

The Drone Maneuvering Area is not considered a range for purposes of weapons delivery. The primary user of this area for drone flight operations is the 432nd Tactical Drone Group, Davis-Monthan AFB, Arizona. The area encompasses all of the Air-to-Air Range, N/S Tactical Ranges, Range 4, and Target 5.

7. Air Combat Maneuvering (ACM) High Area

This area is basically the same as the Drone Maneuvering Area. It is used for Air Combat Maneuvering when other airspace which is normally used is not available. Ordnance is not expended during these missions.

II. NAVY/MARINE CORPS RANGE TARGETS

A. RAKISH LITTER TARGET COMPLEX

This complex is located in the western portion of R-2301 West consisting of three air-to-ground rocket, bombing, and strafing targets. The north target is primarily used for conventional rocket and bomb deliveries and consists of a 20-foot-diameter bullseye. The south target is of the same design and is used in the same manner as the north target. The east target is used primarily for non-instrumented loft (or toss) bombing, laydown bombing, and practice napalm deliveries. The east target consists of a 20-foot-diameter bullseye. Four 12-x-8-foot strafing targets are located on this range, and only inert ordnance up to and including 5-inch rockets and 1,000-pound bombs may be delivered on this complex. Also included within this target complex is a tow banner pattern for dropping the banner on the western side along with a hung tow cable cutter located 1,500 feet south of the southern spotting tower.

A live ordnance jettison area located just outside the Rakish Litter Targets, is used for dropping unexpended live ordnance from aircraft experiencing a malfunction wherein emergency procedures are observed. On an average, approximately 10,000 pounds of ordnance is jettisoned annually.

An Explosive Ordnance Disposal (EOD) decontamination site has also been in operation in this area for the past 30 years. Extensive weapons delivery training has been conducted throughout the 30-year period and considerable quantities and types of ordnance remain in the range complex. EOD work is carried out on a regular and frequent basis.

B. PANEL STAGER TARGET COMPLEX

This target area is located in the western portion of R-2301 and includes a loft target plus a conventional target. A fully instrumental special weapons and conventional air-to-ground rocket and bombing range, it consists of a 50-foot-diameter bullseye for special weapons delivery and a 20-foot-diameter bullseye for conventional ordnance delivery. Both targets are capable of providing complete profile data including surface winds and temperatures, altitude, and airspeed. Radar profiles are provided for all accepted delivery tactics when the tracker has been informed of the type maneuver to be performed. Two strafing panels are also available.

C. AIR-TO-AIR GUNNERY RANGE

This range is located in the central portion of R-2301 West. Air-to-Air gunnery and rocket firing is conducted above FL 180 (approximately 18,000 feet above mean sea level). Missile firing is conducted along a 085-degree magnetic track from over the Panel Stager ground range between 15 nautical miles and 42 nautical miles from Panel Stager.

D. LIGHT ANTIAIRCRAFT MISSILE BATTALION (LAAMBn) DEPLOYMENT SITE

The 2nd Light Antiaircraft Missile Battalion conducts a maximum of 3 live fire exercises a year, each of which are scheduled for a 10-day duration. Due to the exceptional range of the missile, the entire R-2301 area of the Luke Air Force Range must be used during the live fire operations. From four to nine improved Hawk surface-to-air missiles are fired at target drones. In the event of a miss or in-flight malfunction, the missiles are destroyed while airborne. Missile fragmentation does reach the ground, and could fall out almost anywhere within the R-2301 range area. Flight patterns are programmed so as not to overfly the Cabeza Prieta National Wildlife Refuge to preclude debris from falling into this area. In conjunction with the live missile firing exercise, a helicopter-borne operation is conducted which provides needed training in the movement of men and materials associated with a special operation of this type. The helelift expedition is normally culminates with a live fire machine gun exercise employing organic 50 and 30 caliber guns against simulated enemy ground positions. Approximately 30,000 rounds of ammunition is expended during each of these exercises. The 2nd LAAMBn is only one of two active anti-air units in the Marine Corps.

E. WEST COAST AIR COMBAT MANEUVERING RANGE (WCACMR)

A $20 million WCACMR is located east of Yuma in the Yuma Segment of LAFR. The approximate area of the ACMR is that portion of R-2301W bounded by the Gila Mountains on the west, the Mohawk Mountains on the east, Interstate 8 on the north, and the Mexican border on the south. Aircraft utilizing the ACMR must be equipped with specially instrumented pods to be tracked by the ACMR system. Flight and weapons information are transmitted from the pods back to ground facilities where they are processed for real-time display and are recorded. Up to four high activity and twelve escort aircraft can be tracked on the ACMR. The tracking and display capabilities enable the Range Training Officer (RTO) supporting the exercise to follow the aircraft maneuvers in real time on a graphics display, and to monitor significant parameters and mission data on two other displays. UHF communications capabilities built into the system permit the RTO to transmit essential flight information, mission results, and advisory data to the Flight Leader and aircrews. Depending on the training mode, audio tones can be broadcast selectively to indicate whether a particular aircraft is within the designated weapons envelope boundaries, or has scored a kill in a simulated missile firing.

ACM missions normally do not involve actual ordnance expenditure, although a considerable amount of supersonic flight takes place.

Appendix K
EXPLOSIVE ORDNANCE FOUND ON
LUKE AIR FORCE RANGE

Appendix K
EXPLOSIVE ORDNANCE FOUND ON LUKE AIR FORCE RANGE

The following explosive ordnance can be expected to be found within the Luke Air Force Range. It is estimated that approximately 3.5 million pounds of ordnance/ammunition is expended annually within this complex.

a. BDU-33 practice bombs (contains a Mark 4 signal charge, i.e., 4 ounces of red phosphorus spotting charge).

b. MK-76 practice bombs (contains a Mark 4 signal charge, i.e., 4 ounces of red phosphorus spotting charge).

c. MK-106 practice bombs (contains a Mark 4 signal charge, i.e., 4 ounces of red phosphorus spotting charge).

d. M38A2 100 pound practice bombs (contains a 10-pound black powder spotting charge).

e. 20mm ball ammunition (inert projectiles).

f. Inert rockets (propellant only, no explosive charge).

g. Inert general purpose bombs (concrete filled--no spotting charge or high explosive).

h. General purpose practice bombs (contains spotting charge of either black powder or composition C-4).

i. Inert fire bombs (water filled).

j. BDU-8/12 SHAPES (no high explosive or spotting charge, but has 8 ounces of drogue parachute propellant--Class B).

k. 30mm inert ammunition (A-10 aircraft) (inert projectiles).

l. 30mm high explosive ammunition (A-10 aircraft).

m. Live general purpose bombs (not used on a regular basis) (500-pound up to 2,000-pound bombs). Forty to fifty percent of the gross weight of each bomb is high explosive filler.

n. MK-24/LUU-2B parachute flares (contains Class B incendiary mixture--thermite and magnesium).

o. Live fire bombs (not used on a regular basis) (100 gallons of incendigel per bomb with two each 8-ounce white phosphorus ignitors).

p. 250 pound semi-armor piercing bombs.

q. AIM-9, AIM-7, and AGM-12 missiles.

Appendix L
SITE HAZARD EVALUATION METHODOLOGY

HQ AIR FORCE ENGINEERING AND SERVICES CENTER
AND
USAF OCCUPATIONAL AND ENVIRONMENTAL HEALTH LABORATORY

SITE RATING METHODOLOGY

FOR

PHASE I
INSTALLATION RESTORATION PROGRAM

July 1981

SITE RATING METHODOLOGY
FOR
PHASE I INSTALLATION RESTORATION PROGRAM

1. This site rating methodology for Phase I of the Installation Restoration Program (IRP) has been jointly developed by CH2M HILL and Engineering-Science based on experience in performing record searches at several Air Force installations. This standard site rating system should be used for all Air Force IRP Records Search efforts to assist in Air Force prioritization and commitment of resources for Phase II survey actions.

2. The basis for the rating system is the document developed by JRB Associates, Inc., for the EPA Hazardous Waste Enforcement office. The JRB system was modified to accurately address specific Air Force installation conditions and to provide meaningful comparison of landfills and contaminated areas other than landfills.

3. Questions pertaining to use of the Air Force Site Rating Methodology should be addressed to either Mr. Lindenberg, AFESC/DEVP, AUTOVON 970-6189 (Commercial 904/283-6189) or Major Fishburn, USAF OEHL/EC, AUTOVON 240-3305 (Commercial 512/536-3305).

Note: Both CH2M HILL and Engineering-Science are Engineering Support contractors for the US Air Force.

WASTE DISPOSAL SITE AND SPILL AREA ASSESSMENT AND RATING FORM

Name of Site ____________________

Location ____________________

Owner/Operator ____________________

Comments ____________________

RATING FACTOR	FACTOR RATING (0-3)	MULTIPLIER	FACTOR SCORE	MAXIMUM POSSIBLE SCORE
RECEPTORS				
Population Within 1,000 Feet		4		
Distance to Nearest Drinking Water Well		15		
Distance to Reservation Boundary		6		
Land Use/Zoning		3		
Critical Environments		12		
Water Quality of Nearby Surface Water Body		6		

Number of Assumed Values = _____ Out of 6

Percentage of Assumed Values = _____%

Number of Missing Values = ____ Out of 6

Percentage of Missing Values = ____%

SUBTOTALS ______ ______

SUBSCORE ______

(Factor Score Divided by Maximum Score and Multiplied by 100)

RATING FACTOR	FACTOR RATING (0-3)	MULTIPLIER	FACTOR SCORE	MAXIMUM POSSIBLE SCORE
PATHWAYS				
Evidence of Water Contamination		10		
Level of Water Contamination		15		
Type of Contamination, Soil/Biota		5		
Distance to Nearest Surface Water		4		
Depth to Groundwater		7		
Net Precipitation		6		
Soil Permeability		6		
Bedrock Permeability		4		
Depth to Bedrock		4		
Surface Erosion		4		

Number of Assumed Values = ____ Out of 10

Percentage of Assumed Values = ____%

Number of Missing Values = ____ Out of 10

Percentage of Missing Values = ____%

SUBTOTALS ______ ______

SUBSCORE ______

(Factor Score Divided by Maximum Score and Multiplied by 100)

WASTE CHARACTERISTICS

Hazardous Rating: Judgemental rating from 30 to 100 points based on the following guidelines:

Points	
30	Closed domestic-type landfill, old site, no known hazardous wastes
40	Closed domestic-type landfill, recent site, no known hazardous wastes
50	Suspected small quantities of hazardous wastes
60	Known small quantities of hazardous wastes
70	Suspected moderate quantities of hazardous wastes
80	Known moderate quantites of hazardous wastes
90	Suspected large quantities of hazardous wastes
100	Known large quantities of hazardous wastes

SUBSCORE ______

Reason for Assigned Hazardous Rating:

______

______

______

WASTE MANAGEMENT PRACTICES

RATING FACTOR	FACTOR RATING (0-3)	MULTIPLIER	FACTOR SCORE	MAXIMUM POSSIBLE SCORE
Record Accuracy and Ease of Access to Site		7		
Hazardous Waste Quantity		7		
Total Waste Quantity		4		
Waste Incompatibility		3		
Absence of Liners or Confining Beds		6		
Use of Leachate Collection System		6		
Use of Gas Collection Systems		2		
Site Closure		8		
Subsurface Flows		7		

Number of Assumed Values = ____ Out of 9

Percentage of Assumed Values = ____%

Number of Missing and Non-Applicable Values = ____ Out of 9

Percentage of Missing and Non-Applicalbe Values = ____%

SUBTOTALS ______ ______

SUBSCORE ______

(Factor Score Divided by Maximum Score and Multiplied by 100)

Overall Number of Assumed Values = ____ Out of 25

Overall Percentage of Assumed Values = ____%

OVERALL SCORE ______

(Receptors Subscore X 0.22 plus
Pathways Subscore X 0.30 plus
Waste Characteristics Subscore X 0.24 plus
Waste Management Subscore X 0.24)

RATING FACTOR SYSTEM GUIDELINES				
RECEPTORS				
	Rating Scale Levels			
Rating Factors	0	1	2	3
Population within 1,000 Feet	0	1 to 25	26 to 100	Greater than 100
Distance to Nearest Drinking Water Well	Greater than 3 miles	1 to 3 miles	3,001 feet to 1 mile	0 to 3,000 feet
Distance to Reservation Boundary	Greater than 2 miles	1 to 2 miles	1,001 feet to 1 mile	0 to 1,000 feet
Land Use/Zoning	Completely remote (zoning not applicable)	Agricultural	Commercial or industrial	Residential
Critical Environments	Not a critical environment	Pristine natural areas	Wetlands; flood plains, and preserved areas; presence of economically important natural resources	Major habitat of an endangered or threatened species; presence of recharge area
Water Quality Designation of Nearest Surface-Water Body	Agricultural or industrial use	Recreation, propagation and management of fish and wildlife	Shellfish propagation and harvesting	Potable water supplies
	PATHWAYS			
Evidence of Water Contamination	No contamination	Indirect evidence	Positive proof from direct observation	Positive proof from laboratory analyses
Level of Water Contamination	No contamination	Low levels, trace levels, or levels less than maximum contaminant level (MCL) or EPA drinking water standards	Moderate levels or levels near MCL or EPA drinking water standards	High levels greater than MCL or EPA drinking water standards
Type of Contamination Soil/Biota	No contamination	Suspected contamination	Moderate contamination	Severe contamination
Distance to Nearest Surface Water	Greater than 1 mile	2,001 feet to 1 mile	501 feet to 2,000 feet	0 to 500 feet
Depth to Ground Water	Greater than 500 feet	51 to 500 feet	11 to 50 feet	0 to 10 feet
Net Precipitation	Less than −10 inches	−10 to +5 inches	+5 to +20 inches	Greater than +20 inches
Soil Permeability	Greater than 50% clay ($<10^{-6}$ cm/s)	30% to 50% clay (10^{-4} to 10^{-6} cm/s)	15% to 30% clay (10^{-2} to 10^{-4} cm/s)	0% to 15% clay ($>10^{-2}$ cm/s)
Bedrock Permeability	Impermeable ($<10^{-6}$ cm/s)	Relatively impermeable (10^{-4} to 10^{-6} cm/s)	Relatively impermeable (10^{-2} to 10^{-4} cm/s)	Very permeable ($>10^{-2}$ cm/s)
Depth to Bedrock	Greater than 60 feet	31 to 60 feet	11 to 30 feet	0 to 10 feet
Surface Erosion	None	Slight	Moderate	Severe

WASTE CHARACTERISTICS

Judgemental hazardous rating from 30 to 100 points based on the following guidelines:

Points	Condition
30	Closed domestic-type landfill, old site, no known hazardous wastes
40	Closed domestic-type landfill, recent site, no known hazardous wastes
50	Suspected small quantities of hazardous wastes
60	Known small quantities of hazardous wastes
70	Suspected moderate quantities of hazardous wastes
80	Known moderate quantities of hazardous wastes
90	Suspected large quantities of hazardous wastes
100	Known large quantities of hazardous wastes

WASTE MANAGEMENT PRACTICES

	Rating Scale Levels			
Rating Factors	0	1	2	3
Record Accuracy and Ease of Access to Site	Accurate records, no unauthorized dumping	Accurate records, no barriers	Incomplete records, no barriers	No records, no barriers
Hazardous Waste Quantity	<1 ton	1 to 5 tons	5 to 20 tons	>20 tons
Total Waste Quantity	0 to 10 acre feet	11 to 100 acre feet	101 to 250 acre feet	Greater than 250 acre feet
Waste Incompatibility	No incompatible wastes are present	Present, but does not pose a hazard	Present and may pose a future hazard	Present and posing an immediate hazard
Absence of Liners or Confining Strata	Liner and confining strata	Liner or confining strata	Low quality liner or low permeability strata	No liner, no confining strata
Use of Leachate Collection Systems	Adequate collection and treatment	Inadequate collection or treatment	Inadequate collection and treatment	No collection or treatment
Use of Gas Collection Systems	Adequate collection and treatment	Collection and controlled flaring	Venting or inadequate treatment	No collection or treatment
Site Closure	Impermeable cover	Low permeability cover	Permeable cover	Abandoned site, no cover
Subsurface Flows	Bottom of landfill greater than 5 feet above high ground-water level	Bottom of landfill occasionally submerged	Bottom of fill frequently submerged	Bottom of fill located below mean ground-water level

JRB RATING SYSTEM
INTRODUCTION AND METHODOLOGY

Source: "Methodology for Rating the Hazard Potential of Waste Disposal Sites" JRB Associates, Inc., December 15, 1980

Note: The following material includes Chapters 1 and 2 of the JRB Report. The reader is referred to the above source for the complete report.

CHAPTER 1.0 INTRODUCTION

As part of EPA's nationwide waste management program, land disposal facilities containing hazardous wastes will be investigated and evaluated. Remedial action plans will be formulated for those sites presenting a significant hazard. Because resources for this task are limited, the initial focus of the work must be on the most hazardous sites. Under the auspices of EPA's Office of Enforcement, JRB Associates has devised a methodology for selecting sites for investigation based on their high potential for environmental impact.

This methodology has several advantages over other rating systems:

- It is easy to use
- It does not require users to have an extensive technical background
- It uses readily available information
- It does not require complex chemical or hydrological analyses
- It does not require users to visit the facilities in question
- It allows sites to be rated even if some data needs cannot be met.

The system consists of 31 rating factors that are divided into 4 categories: receptors; pathways; waste characteristics; and waste management practices. Factors in the receptors category determine the prime targets of environmental contamination. Factors in the pathways category assess mecha nisms for contaminant migration. Factors in the waste characteristics category examine the types of hazards posed by contaminants in the site. Factors in the waste management practices category evaluate the quality of the facility's design and operation. Each rating factor has an associated four-level scale. Because all of these factors are not of equal importance, each also has been assigned a weighing factor, called a multiplier. Raters must simply decide which level of the rating factor's scale is most appropriate for a given site and multiply the numeric value of that level by the corresponding multiplier. The sum of the products for the 31 factors divided by the maximum possible score and multiplied by 100 is the site's rating. The ratings are on a scale of 0 to 100 and can be interpreted in relative or absolute terms.

Users can assign additional points when the rating factors do not adequately address all of the problems of a site. However, only a limited number of additional points can be assigned. This arrangement helps to ensure that a site's rating is both complete and objective.

The methodology has been designed primarily for landfills, surface impoundments, and other types of land-based storage and disposal facilities. Incinerators and waste treatment facilities, however, are beyond scope with the exception of the solid wastes produced by them.

Site ratings should be performed as part of an overall investigation procedure. Prior to a site visit, ratings can be based on published materials, public and private records, and contacts with knowledgable parties. The results of this type of rating can be used to determine which sites present the greatest potential hazard and should be visited first. A final rating can be obtained with information obtained from a visit to a site. This rating can be used as a tool to help determine how limited resources should be spent for additional sampling, which may be required to fill data gaps, and for preparing remedial action plans and/or enforcement cases for sites that represent particularly severe hazards.

The methodology's validity has been tested at sites across the country. This testing includes comparing ratings completed for the same facilities both by different raters, and before and after site visits. Officials of New Jersey's Department of Environmental Protection agreed that the ratings on 30 sites in their state were good reflections of the true hazard potential of those sites. These results show that the methodology is an exceptionally useful and efficient tool for classifying and ranking the hazard potential of land disposal facilities.

The methodology is discussed in more detail in the following four chapters. Chapter 2 describes the six basic components of the methodology. Chapter 3 identifies sources of information for the system and describes how to resolve data gaps. Chapter 4 presents the step-by-step procedure for rating sites, and Chapter 5 discusses how site ratings can be used. The three appendices provide guidance for rating sites. Finally, the glossary located at the end of this document defines all terms related to the methodology.

CHAPTER 2.0 DESCRIPTION OF THE METHODOLOGY

The site rating methodology has been developed in terms of six elements. These are:

- Factor categories
- Rating factors
- Rating scales
- Multipliers
- Additional points
- Hazard potential scores.

These elements are described below.

2.1 FACTOR CATEGORIES

In assessing the environmental impacts of any hazardous waste disposal site, four considerations must be addressed. These are:

- Receptors
- Pathways
- Waste characteristics
- Waste management practices.

Receptors refer to the biota (human and non-human) which are potentially affected by the materials released from a waste disposal site. Within this category, special attention is given to human populations and critical environments. Pathways refer to aspects of the routes by which hazardous materials can escape from a given site. The focus of this cateory is on the ease of migration of water soluble pollutants and on contamination due to the site. Waste characteristics refer to the types of hazards posed by materials in the facility in terms of both their health-related effects and their environmental mobility. Waste management practices refer to the design characteristics and management practices of a given disposal site as they relate to the site's environmental impact. In particular, this category examines measures that are being taken to minimize exposure to hazardous wastes.

The prime importance of the factor categories is in partitioning the rating factors into manageable groups so that site ratings can be more easily and completely interpreted. This topic is discussed in greater detail in Chapter 5.

2.2 RATING FACTORS

The initial rating of a waste disposal facility is based on a set of 31 rating factors. Each of these has been assigned to one of the four factor categories. The receptors catgegory has five rating factors:

- "Residential population within 1,000 feet" and "Distance to the nearest off-site building" measure the potential for human exposure to the site
- "Distance to the nearest drinking-water well" measures the potential for human ingestion of contaminants should underlying aquifers be polluted
- "Land use/zoning" evaluates the current and anticipated uses of the surrounding area
- "Critical environments" assesses the potential for adversely affecting important biological resources and fragile natural settings.

The pathways category contains nine rating factors concerned with the potential migration and attenuation of contaminants. The primary focus is on waterborne pollutants, since they can affect the greatest number of people.

- "Distance to the nearest surface water" and "Depth to groundwater" measure the availability of pollutant migration routes
- "Soil permeability," "bedrock permeability," and "depth to bedrock" measure the potential for contaminant attenuation and ease of migration

- "Net precipitation" uses annual precipitation and evapotranspiration to estimate the amount of leachate a site produces

- "Evidence of contamination," "type of contamination," and "level of contamination" evaluate pollution currently apparent at the site.

The waste characteristics category contains rating factors which examine the waste's environmental mobility and the adverse effects it can cause.

- "Solubility," "volatility," and "physical state" measure the extent to which mobile wastes can leave the site

- "Toxicity," "radioactivity," and "persistence" assess the site's potential to cause health-related injuries

- "Ignitability," "reactivity," and "corrosiveness" evaluate the possibility of fire, explosion, or similar emergencies.

The waste management practices factor category evaluates site design and operation. This category includes eight rating factors:

- "Use of leachate collection systems," "use of gas collection systems," and "use of liners" examine features of site design for containing contamination

- "Site security" assesses the measures taken to limit site access

- "Total waste quantity" and "hazardous waste quantity" measure the quantity of waste in the site, and thus, the potential magnitude of resulting contamination

- "Waste incompatibility" evaluates the potential for incompatible wastes to combine and pose a hazard

- "Use of containers" assesses the adequacy of using containers to isolate wastes.

These factors have been selected because they are relevant to an evaluation of any land-based disposal facility. The definition and purpose of each rating factor appear in Appendix A.

2.3 RATING SCALES

For each of the factors, a four-level rating scale has been developed which provides factor-specific levels ranging from "0" (indicating no potential hazard) to "3" (indicating a high potential hazard). The rating factors and their corresponding rating scales for each of the factor categories are listed in Table 1. These scales have been defined so that the rating factors typically can be evaluated on the basis of readily available information from published materials, public and private records, contacts with knowledgeable parties, or site visits. Raters compare the information collected for a site with the limits set in the scales, and see which level of each scale most closely fits the information. The numeric value of that level is the factor rating for that factor. This process is described in more detail in Chapter 4. Additional guidance for assessing the rating scales appears in Appendix A.

2.4 MULTIPLIERS

The rating factors do not all assess the same magnitude of potential environmental impact. Consequently, a numerical value called a multiplier has been assigned to each factor in accordance with the relative magnitude of impact that it does assess. These values are multiplied, hence the term multiplier, by the appropriate factor ratings (see Section 2.3) to result in factor scores for each of the rating factors. The 31 multipliers appear as the third column from the right on the methodology's two-page Rating Form (see Figure 3).

2.5 ADDITIONAL POINTS

Special features of a facility's location, design, or operation are frequently encountered that cannot be handled satisfactorily by rating factors alone. These features might present hazards that are unusually serious, unique to the site, or not assessable by rating scales. For example, an extremely high population density near a site should be considered even more hazardous than the rating factor for "population within 1,000 feet" indicates.

Power lines running through sites containing explosive or flammable wastes, though not generally typical of waste disposal sites, should be considered a potential hazard. Finally, the function of the nearest off-site building might indicate a serious threat of human exposure exists, even though types of functions cannot be quantitatively evaluated by rating scales the way distance can be. In such cases, raters should assign a greater hazard potential score to a site than it might otherwise receive by using the additional points system. To guide raters as to the types of situations that might warrant additional points, several examples have been identified for each of the factor categories. These are:

RECEPTORS

- Use of site by local residents
- Neighboring land use
- Neighboring transportation routes, drinking water supplies, and important natural resources.

PATHWAYS

- Extreme runoff and erosion problems
- Slope instability
- Flooding
- Seismic activity.

WASTE CHARACTERISTICS

- Carcinogenicity, mutagenicity, and teratogenicity
- Infectiousness
- Low biodegradability
- High-level radioactivity.

WASTE MANAGEMENT PRACTICES

- Excessively large waste quantities
- Open burning of wastes
- Site abandonment
- Unsafe disposal practices
- Inadequate cover
- Inadequate safety precautions
- Inadequate recordkeeping.

Table 1. Rating Factors and Scales for Each of the Four Factor Categories (Continued)

RATING FACTORS	RATING SCALE LEVELS 0	1	2	3
RECEPTORS				
POPULATION WITHIN 1,000 FEET	0	1 TO 25	26 TO 100	GREATER THAN 100
DISTANCE TO NEAREST DRINKING-WATER WELL	GREATER THAN 3 MILES	1 TO 3 MILES	3,001 FEET TO 1 MILE	0 TO 3,000 FEET
DISTANCE TO NEAREST OFF-SITE BUILDING	GREATER THAN 2 MILES	1 TO 2 MILES	1,001 FEET TO 1 MILE	0 TO 1,000 FEET
LAND USE/ZONING	COMPLETELY REMOTE (ZONING NOT APPLICABLE)	AGRICULTURAL	COMMERCIAL OR INDUSTRIAL	RESIDENTIAL
CRITICAL ENVIRONMENTS	NOT A CRITICAL ENVIRONMENT	PRISTINE NATURAL AREAS	WETLANDS, FLOODPLAINS, AND PRESERVED AREAS	MAJOR HABITAT OF AN ENDANGERED OR THREATENED SPECIES
PATHWAYS				
EVIDENCE OF CONTAMINATION	NO CONTAMINATION	INDIRECT EVIDENCE	POSITIVE PROOF FROM DIRECT OBSERVATION	POSITIVE PROOF FROM LABORATORY ANALYSES
LEVEL OF CONTAMINATION	NO CONTAMINATION	LOW LEVELS, TRACE LEVELS, OR UNKNOWN LEVELS	MODERATE LEVELS OR LEVELS THAT CANNOT BE SENSED DURING A SITE VISIT BUT WHICH CAN BE CONFIRMED BY A LABORATORY ANALYSIS	HIGH LEVELS OR LEVELS THAT CAN BE SENSED EASILY BY INVESTIGATORS DURING A SITE VISIT
TYPE OF CONTAMINATION	NO CONTAMINATION	SOIL CONTAMINATION ONLY	BIOTA CONTAMINATION	AIR, WATER, OR FOODSTUFF CONTAMINATION
DISTANCE TO NEAREST SURFACE WATER	GREATER THAN 5 MILES	1 TO 5 MILES	1,001 FEET TO 1 MILE	0 TO 1,000 FEET
DEPTH TO GROUNDWATER	GREATER THAN 100 FEET	51 TO 100 FEET	21 TO 50 FEET	0 TO 20 FEET
NET PRECIPITATION	LESS THAN -10 INCHES	-10 TO +5 INCHES	+5 TO +20 INCHES	GREATER THAN +20 INCHES
SOIL PERMEABILITY	GREATER THAN 50% CLAY	30% TO 50% CLAY	15% TO 30% CLAY	0 TO 15% CLAY
BEDROCK PERMEABILITY	IMPERMEABLE	RELATIVELY IMPERMEABLE	RELATIVELY PERMEABLE	VERY PERMEABLE
DEPTH TO BEDROCK	GREATER THAN 60 FEET	31 TO 60 FEET	11 TO 30 FEET	0 TO 10 FEET

Table 1

RATING FACTORS AND SCALES FOR EACH OF THE FOUR FACTOR CATEGORIES

RATING FACTORS	RATING SCALE LEVELS 0	1	2	3
WASTE CHARACTERISTICS				
TOXICITY	SAX'S LEVEL 0 OR NFPA'S LEVEL 0	SAX'S LEVEL 1 OR NFPA'S LEVEL 1	SAX'S LEVEL 2 OR NFPA'S LEVEL 2	SAX'S LEVEL 3 OR NFPA'S LEVELS 3 OR 4
RADIOACTIVITY	AT OR BELOW BACKGROUND LEVELS	1 TO 3 TIMES BACKGROUND LEVELS	3 TO 5 TIMES BACKGROUND LEVELS	OVER 5 TIMES BACKGROUND LEVELS
PERSISTENCE	EASILY BIODEGRADABLE COMPOUNDS	STRAIGHT CHAIN HYDROCARBONS	SUBSTITUTED AND OTHER RING COMPOUNDS	METALS, POLYCYCLIC COMPOUNDS, AND HALOGENATED HYDROCARBONS
IGNITABILITY	FLASH POINT GREATER THAN 200° OR NFPA'S LEVEL 0	FLASH POINT OF 140°F, to 200°F, OR NFPA'S LEVEL 1	FLASH POINT OF 80°F, TO 140°F, OR NFPA'S LEVEL 2	FLASH POINT LESS THAN 80°F, OR NFPA'S LEVELS 3 OR 4
REACTIVITY	NFPA'S LEVEL 0	NFPA'S LEVEL 1	NFPA'S LEVEL 2	NFPA'S LEVELS 3 OR 4
CORROSIVENESS	pH OF 6 TO 9	pH OF 5 TO 6 OR 9 TO 10	pH OF 3 TO 5 OR 10 TO 12	pH OF 1 TO 3 OR 12 TO 14
SOLUBILITY	INSOLUBLE	SLIGHTLY SOLUBLE	SOLUBLE	VERY SOLUBLE
VOLATILITY	VAPOR PRESSURE LESS THAN 0.1 mm Hg	VAPOR PRESSURE OF 0.1 TO 25 mm Hg	VAPOR PRESSURE OF 78 TO 25 mm Hg	VAPOR PRESSURE GREATER THAN 78 mm Hg
PHYSICAL STATE	SOLID	SLUDGE	LIQUID	GAS
WASTE MANAGEMENT PRACTICES				
SITE SECURITY	SECURE FENCE WITH LOCK	SECURITY GUARD BUT NO FENCE	REMOTE LOCATION OR BREACHABLE FENCE	NO BARRIERS
HAZARDOUS WASTE QUANTITY	0 TO 250 TONS	251 TO 1,000 TONS	1,001 TO 2000 TONS	GREATER THAN 2,000 TONS
TOTAL WASTE QUANTITY	0 TO 10 ACRE FEET	11 TO 100 ACRE FEET	101 TO 250 ACRE FEET	GREATER THAN 250 ACRE FEET
WASTE INCOMPATIBILITY	NO INCOMPATIBLE WASTES ARE PRESENT	PRESENT, BUT DOES NOT POSE A HAZARD	PRESENT AND MAY POSE A FUTURE HAZARD	PRESENT AND POSING AN IMMEDIATE HAZARD
USE OF LINERS	CLAY OR OTHER LINER RESISTENT TO ORGANIC COMPOUNDS	SYNTHETIC OR CONCRETE LINER	ASPHALT BASE LINER	NO LINER USED
USE OF LEACHATE COLLECTION SYSTEMS	ADEQUATE COLLECTION AND TREATMENT	INADEQUATE COLLECTION OR TREATMENT	INADEQUATE COLLECTION AND TREATMENT	NO COLLECTION OR TREATMENT
USE OF GAS COLLECTION SYSTEMS	ADEQUATE COLLECTION AND TREATMENT	COLLECTION AND CONTROLLED FLARING	VENTING OR INADEQUATE TREATMENT	NO COLLECTION OR TREATMENT
USE AND CONDITION OF CONTAINERS	CONTAINERS ARE USED AND APPEAR TO BE IN GOOD CONDITION	CONTAINERS ARE USED BUT A FEW ARE LEAKING	CONTAINERS ARE USED BUT MANY ARE LEAKING	NO CONTAINERS ARE USED

While this list is by no means exhaustive, and other examples may be encountered by raters using the methodology, it does include the more commonly occurring situations. Appendix B provides guidance on the number of additional points that should be assigned for these situations.

In order to maintain the objectivity of the rating methodology while allowing the assignment of additional points, the following limits are placed on the number of additional points that may be assigned in each factor category:

- Receptors 50 points
- Pathways 25 points
- Waste characteristics 20 points
- Waste management practices 30 points.

The number of additional points allowed in each factor category is a function of the total available rating factor points and the relative importance of the category.

The actual procedure for assigning additional points is outlined in Chapter 4.

2.6 HAZARD POTENTIAL SCORES

The result of a site rating is a set of five hazard potential scores. These scores are:

- Overall score
- Receptors subscore
- Pathways subscore
- Waste characteristics subscore
- Waste management practices subscore.

The overall score is based on all the rating factors and additional points that are used to rate a site. Each subscore is based on those rating factors and additional points in that factor category which are used to rate a site. All of these scores are normalized so that they are on a scale of 0 to 100. The normalization procedure is described in Chapter 4. Associated with every hazard potential score is a percentage of missing and assumed data. These percentages flag scores that are based on large amounts of missing data and, generally, measure the reliability of the scores. Chapter 5 describes how to interpret these scores.

AD-A120 953 INSTALLATION RESTORATION PROGRAM RECORDS SEARCH FOR LUKE AIR FORCE BASE ARIZONA(U) CH2M HILL GAINESVILLE FL JUN 82 F08637-80-G-0010

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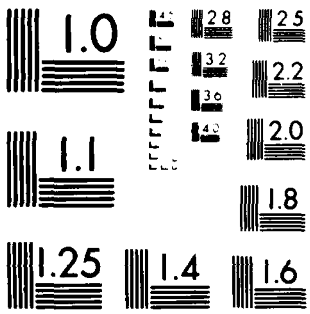
1.0
2.8
2.5
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1.1
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1.4
1.6

Appendix M
SITE RATING FORMS

WASTE DISPOSAL SITE AND SPILL AREA ASSESSMENT AND RATING FORM

Name of Site ② WASTE TREATMENT ANNEX
Location LUKE AIR FORCE BASE
Owner/Operator LUKE AIR FORCE BASE
Comments Used intermittently from 1941 to 1946. Principle base landfill from 1953 to 1970

RATING FACTOR	FACTOR RATING (0-3)	MULTIPLIER	FACTOR SCORE	MAXIMUM POSSIBLE SCORE
RECEPTORS				
Population Within 1,000 Feet	0	4	0	12
Distance to Nearest Drinking Water Well	3	15	45	45
Distance to Reservation Boundary	3	6	18	18
Land Use/Zoning	1	3	3	9
Critical Environments	0	12	0	36
Water Quality of Nearby Surface Water Body	1	6	6	18
		SUBTOTALS	72	138
		SUBSCORE		52

Number of Assumed Values = ____ Out of 6
Percentage of Assumed Values = ____ %
Number of Missing Values = ____ Out of 6
Percentage of Missing Values = ____ %

(Factor Score Divided by Maximum Score and Multiplied by 100)

RATING FACTOR	FACTOR RATING (0-3)	MULTIPLIER	FACTOR SCORE	MAXIMUM POSSIBLE SCORE
PATHWAYS				
Evidence of Water Contamination	0	10	0	30
Level of Water Contamination	0	15	0	45
Type of Contamination, Soil/Biota	0	5	0	15
Distance to Nearest Surface Water	3	4	12	12
Depth to Groundwater	1	7	7	21
Net Precipitation	0	6	0	18
Soil Permeability	2	6	12	18
Bedrock Permeability	0	4	0	12
Depth to Bedrock	0	4	0	12
Surface Erosion	0	4	0	12
		SUBTOTALS	31	195
		SUBSCORE		16

Number of Assumed Values = ____ Out of 10
Percentage of Assumed Values = ____ %
Number of Missing Values = ____ Out of 10
Percentage of Missing Values = ____ %

(Factor Score Divided by Maximum Score and Multiplied by 100)

WASTE CHARACTERISTICS

Hazardous Rating: Judgemental rating from 30 to 100 points based on the following guidelines:

Points	
30	Closed domestic-type landfill, old site, no known hazardous wastes
40	Closed domestic-type landfill, recent site, no known hazardous wastes
50	Suspected small quantities of hazrrdous wastes
60	Known small quantities of hazardous wastes
70	Suspected moderate quantities of hazardous wastes
80	Known moderate quantites of hazardous wastes
90	Suspected large quantities of hazardous wastes
100	Known large quantities of hazardous wastes

• SUBSCORE 60

Reason for Assigned Hazardous Rating:

Known disposal of low-level radioactive electron tubes and POL waste in small quantities.

WASTE MANAGEMENT PRACTICES

RATING FACTOR	FACTOR RATING (0-3)	MULTIPLIER	FACTOR SCORE	MAXIMUM POSSIBLE SCORE
Record Accuracy and Ease of Access to Site	2	7	14	21
Hazardous Waste Quantity	0	7	0	21
Total Waste Quantity	2	4	8	12
Waste Incompatibility	0	3	0	9
Absence of Liners or Confining Beds	2	6	12	18
Use of Leachate Collection System	3	6	18	18
Use of Gas Collection Systems	3	2	6	6
Site Closure	1	8	8	24
Subsurface Flows	0	7	0	21
		SUBTOTALS	66	150
		SUBSCORE		44

(Factor Score Divided by Maximum Score and Multiplied by 100)

Number of Assumed Values = ____ Out of 9

Percentage of Assumed Values = ____ %

Number of Missing and Non-Applicable Values = ____ Out of 9

Percentage of Missing and Non-Applicalbe Values = ____ %

Overall Number of Assumed Values = ____ Out of 25

Overall Percentage of Assumed Values = ____ %

OVERALL SCORE 41

(Receptors Subscore X 0.22 plus
Pathways Subscore X 0.30 plus
Waste Characteristics Subscore X 0.24 plus
Waste Management Subscore X 0.24)

WASTE DISPOSAL SITE AND SPILL AREA ASSESSMENT AND RATING FORM

Name of Site ② PERIMETER ROAD POL. WASTE APPLICATION

Location LUKE AIR FORCE BASE

Owner/Operator LUKE AIR FORCE BASE

Comments Operated from 1951 to 1970

RATING FACTOR	FACTOR RATING (0-3)	MULTIPLIER	FACTOR SCORE	MAXIMUM POSSIBLE SCORE
RECEPTORS				
Population Within 1,000 Feet	0	4	0	12
Distance to Nearest Drinking Water Well	3	15	45	45
Distance to Reservation Boundary	3	6	18	18
Land Use/Zoning	1	3	3	9
Critical Environments	0	12	0	36
Water Quality of Nearby Surface Water Body	1	6	6	18

Number of Assumed Values = ____ Out of 6

Percentage of Assumed Values = ____%

Number of Missing Values = ____ Out of 6

Percentage of Missing Values = ____%

SUBTOTALS 72 138

SUBSCORE 52

(Factor Score Divided by Maximum Score and Multiplied by 100)

PATHWAYS				
Evidence of Water Contamination	0	10	0	30
Level of Water Contamination	0	15	0	45
Type of Contamination, Soil/Biota	0	5	0	15
Distance to Nearest Surface Water	0	4	0	12
Depth to Groundwater	1	7	7	21
Net Precipitation	0	6	0	18
Soil Permeability	2	6	12	18
Bedrock Permeability	0	4	0	12
Depth to Bedrock	0	4	0	12
Surface Erosion	0	4	0	12

Number of Assumed Values = ____ Out of 10

Percentage of Assumed Values = ____%

Number of Missing Values = ____ Out of 10

Percentage of Missing Values = ____%

SUBTOTALS 19 195

SUBSCORE 10

(Factor Score Divided by Maximum Score and Multiplied by 100)

WASTE CHARACTERISTICS

Hazardous Rating: Judgemental rating from 30 to 100 points based on the following guidelines:

Points	
30	Closed domestic-type landfill, old site, no known hazardous wastes
40	Closed domestic-type landfill, recent site, no known hazardous wastes
50	Suspected small quantities of hazardous wastes
60	Known small quantities of hazardous wastes
70	Suspected moderate quantities of hazardous wastes
80	Known moderate quantites of hazardous wastes
90	Suspected large quantities of hazardous wastes
100	Known large quantities of hazardous wastes

• SUBSCORE 80

Reason for Assigned Hazardous Rating:
Known disposal of waste POL products, mostly JP4. Road oiling

WASTE MANAGEMENT PRACTICES

RATING FACTOR	FACTOR RATING (0-3)	MULTIPLIER	FACTOR SCORE	MAXIMUM POSSIBLE SCORE
Record Accuracy and Ease of Access to Site	3	7	21	21
Hazardous Waste Quantity	3	7	21	21
Total Waste Quantity	1	4	4	12
Waste Incompatibility	0	3	0	9
Absence of Liners or Confining Beds	2	6	12	18
Use of Leachate Collection System NOT APPLICABLE	—	6	—	—
Use of Gas Collection Systems NOT APPLICABLE	—	2	—	—
Site Closure	2	8	16	24
Subsurface Flows	0	7	0	21

Number of Assumed Values = ____ Out of 9

Percentage of Assumed Values = ____%

Number of Missing and Non-Applicable Values = ____ Out of 9

Percentage of Missing and Non-Applicalbe Values = ____%

SUBTOTALS 74 126

SUBSCORE 59

(Factor Score Divided by Maximum Score and Multiplied by 100)

Overall Number of Assumed Values = ____ Out of 25

Overall Percentage of Assumed Values = ____%

OVERALL SCORE 48

(Receptors Subscore X 0.22 plus
Pathways Subscore X 0.30 plus
Waste Characteristics Subscore X 0.24 plus
Waste Management Subscore X 0.24)

WASTE DISPOSAL SITE AND SPILL AREA ASSESSMENT AND RATING FORM

Name of Site [illegible] P.O.L. WASTE DISPOSAL TRENCHES

Location LUKE AIR FORCE BASE

Owner/Operator LUKE AIR FORCE BASE

Comments Operated from 1970 to 1972

RATING FACTOR	FACTOR RATING (0-3)	MULTIPLIER	FACTOR SCORE	MAXIMUM POSSIBLE SCORE
RECEPTORS				
Population Within 1,000 Feet	0	4	0	12
Distance to Nearest Drinking Water Well	3	15	45	45
Distance to Reservation Boundary	3	6	18	18
Land Use/Zoning	1	3	3	9
Critical Environments	0	12	0	36
Water Quality of Nearby Surface Water Body	1	6	6	18
		SUBTOTALS	72	138
		SUBSCORE		52

Number of Assumed Values = ____ Out of 6

Percentage of Assumed Values = ____%

Number of Missing Values = ____ Out of 6

Percentage of Missing Values = ____%

(Factor Score Divided by Maximum Score and Multiplied by 100)

RATING FACTOR	FACTOR RATING (0-3)	MULTIPLIER	FACTOR SCORE	MAXIMUM POSSIBLE SCORE
PATHWAYS				
Evidence of Water Contamination	0	10	0	30
Level of Water Contamination	0	15	0	45
Type of Contamination, Soil/Biota	1	5	5	15
Distance to Nearest Surface Water	0	4	0	12
Depth to Groundwater	1	7	7	21
Net Precipitation	0	6	0	18
Soil Permeability	2	6	12	18
Bedrock Permeability	0	4	0	12
Depth to Bedrock	0	4	0	12
Surface Erosion	0	4	0	12
		SUBTOTALS	2[illegible]	195
		SUBSCORE		[illegible]

Number of Assumed Values = ____ Out of 10

Percentage of Assumed Values = ____%

Number of Missing Values = ____ Out of 10

Percentage of Missing Values = ____%

(Factor Score Divided by Maximum Score and Multiplied by 100)

WASTE CHARACTERISTICS

Hazardous Rating: Judgemental rating from 30 to 100 points based on the following guidelines:

Points	
30	Closed domestic-type landfill, old site, no known hazardous wastes
40	Closed domestic-type landfill, recent site, no known hazardous wastes
50	Suspected small quantities of hazardous wastes
60	Known small quantities of hazardous wastes
70	Suspected moderate quantities of hazardous wastes
80	Known moderate quantites of hazardous wastes
90	Suspected large quantities of hazardous wastes
100	Known large quantities of hazardous wastes

SUBSCORE 90

Reason for Assigned Hazardous Rating:
Known disposal of waste POL products, mostly JP4. Shallow trenches (≥ 1.5 ft).

WASTE MANAGEMENT PRACTICES

RATING FACTOR	FACTOR RATING (0-3)	MULTIPLIER	FACTOR SCORE	MAXIMUM POSSIBLE SCORE
Record Accuracy and Ease of Access to Site	3	7	21	21
Hazardous Waste Quantity	3	7	21	21
Total Waste Quantity	1	4	4	12
Waste Incompatibility	0	3	0	9
Absence of Liners or Confining Beds	2	6	12	18
Use of Leachate Collection System	-	6	-	-
Use of Gas Collection Systems	-	2	-	-
Site Closure	2	8	16	24
Subsurface Flows	0	7	0	21

Number of Assumed Values = ____ Out of 9

Percentage of Assumed Values = ____%

Number of Missing and Non-Applicable Values = ____ Out of 9

Percentage of Missing and Non-Applicalbe Values = ____%

SUBTOTALS 74 126

SUBSCORE 59

(Factor Score Divided by Maximum Score and Multiplied by 100)

Overall Number of Assumed Values = ____ Out of 25

Overall Percentage of Assumed Values = ____%

OVERALL SCORE 51

(Receptors Subscore x 0.22 plus
Pathways Subscore x 0.30 plus
Waste Characteristics Subscore x 0.24 plus
Waste Management Subscore x 0.24)

WASTE DISPOSAL SITE AND SPILL AREA ASSESSMENT AND RATING FORM

Name of Site (5) SOUTH FIRE TRAINING AREA

Location LUKE AIR FORCE BASE

Owner/Operator LUKE AIR FORCE BASE

Comments operated from 1941 to 1946 and 1951 to 1963. Quantities of fuel were ignited and fire control was practiced by the Fire Department.

RATING FACTOR	FACTOR RATING (0-3)	MULTIPLIER	FACTOR SCORE	MAXIMUM POSSIBLE SCORE
RECEPTORS				
Population Within 1,000 Feet	0	4	0	12
Distance to Nearest Drinking Water Well	3	15	45	45
Distance to Reservation Boundary	3	6	18	18
Land Use/Zoning	1	3	3	9
Critical Environments	0	12	0	36
Water Quality of Nearby Surface Water Body	1	6	6	18

Number of Assumed Values = ____ Out of 6

Percentage of Assumed Values = ____%

Number of Missing Values = ____ Out of 6

Percentage of Missing Values = ____%

SUBTOTALS 72 138

SUBSCORE 52

(Factor Score Divided by Maximum Score and Multiplied by 100)

RATING FACTOR	FACTOR RATING (0-3)	MULTIPLIER	FACTOR SCORE	MAXIMUM POSSIBLE SCORE
PATHWAYS				
Evidence of Water Contamination	0	10	0	30
Level of Water Contamination	0	15	0	45
Type of Contamination, Soil/Biota	0	5	0	15
Distance to Nearest Surface Water	0	4	0	12
Depth to Groundwater	1	7	7	21
Net Precipitation	0	6	0	18
Soil Permeability	2	6	12	18
Bedrock Permeability	0	4	0	12
Depth to Bedrock	0	4	0	12
Surface Erosion	0	4	0	12

Number of Assumed Values = ____ Out of 10

Percentage of Assumed Values = ____%

Number of Missing Values = ____ Out of 10

Percentage of Missing Values = ____%

SUBTOTALS 19 195

SUBSCORE 10

(Factor Score Divided by Maximum Score and Multiplied by 100)

WASTE CHARACTERISTICS

Hazardous Rating: Judgemental rating from 30 to 100 points based on the following guidelines:

Points	
30	Closed domestic-type landfill, old site, no known hazardous wastes
40	Closed domestic-type landfill, recent site, no known hazardous wastes
50	Suspected small quantities of hazardous wastes
60	Known small quantities of hazardous wastes
70	Suspected moderate quantities of hazardous wastes
80	Known moderate quantites of hazardous wastes
90	Suspected large quantities of hazardous wastes
100	Known large quantities of hazardous wastes

• SUBSCORE 60

Reason for Assigned Hazardous Rating:
Known to be a former fire training area with POL wastes burned on site.

WASTE MANAGEMENT PRACTICES

RATING FACTOR	FACTOR RATING (0-3)	MULTIPLIER	FACTOR SCORE	MAXIMUM POSSIBLE SCORE
Record Accuracy and Ease of Access to Site	3	7	21	21
Hazardous Waste Quantity	1	7	7	21
Total Waste Quantity	0	4	0	12
Waste Incompatibility	0	3	0	9
Absence of Liners or Confining Beds	2	6	12	18
Use of Leachate Collection System	-	6	-	-
Use of Gas Collection Systems	-	2	-	-
Site Closure	2	8	16	24
Subsurface Flows	0	7	0	21

Number of Assumed Values = ___ Out of 9

Percentage of Assumed Values = ___%

Number of Missing and Non-Applicable Values = ___ Out of 9

Percentage of Missing and Non-Applicalbe Values = ___%

SUBTOTALS 56 126

SUBSCORE 44

(Factor Score Divided by Maximum Score and Multiplied by 100)

Overall Number of Assumed Values = ___ Out of 25

Overall Percentage of Assimed Values = ___%

OVERALL SCORE 39

(Receptors Subscore X 0.22 plus
Pathways Subscore X 0.30 plus
Waste Characteristics Subscore X 0.24 plus
Waste Management Subscore X 0.24)

WASTE DISPOSAL SITE AND SPILL AREA ASSESSMENT AND RATING FORM

Name of Site (7) NORTH FIRE TRAINING AREA

Location LUKE AIR FORCE BASE

Owner/Operator LUKE AIR FORCE BASE

Comments Operated from 1963 to present. Quantities from 300 to 1000 gallons were ignited and fire control was practiced.

RATING FACTOR	FACTOR RATING (0-3)	MULTIPLIER	FACTOR SCORE	MAXIMUM POSSIBLE SCORE
RECEPTORS				
Population Within 1,000 Feet	0	4	0	12
Distance to Nearest Drinking Water Well	3	15	45	45
Distance to Reservation Boundary	2	6	12	18
Land Use/Zoning	1	3	3	9
Critical Environments	0	12	0	36
Water Quality of Nearby Surface Water Body	1	6	6	18

Number of Assumed Values = ____ Out of 6

Percentage of Assumed Values = ____%

Number of Missing Values = ____ Out of 6

Percentage of Missing Values = ____%

SUBTOTALS 66 138

SUBSCORE 48

(Factor Score Divided by Maximum Score and Multiplied by 100)

RATING FACTOR	FACTOR RATING (0-3)	MULTIPLIER	FACTOR SCORE	MAXIMUM POSSIBLE SCORE
PATHWAYS				
Evidence of Water Contamination	0	10	0	30
Level of Water Contamination	0	15	0	45
Type of Contamination, Soil/Biota	0	5	0	15
Distance to Nearest Surface Water	0	4	0	12
Depth to Groundwater	1	7	7	21
Net Precipitation	0	6	0	18
Soil Permeability	2	6	12	18
Bedrock Permeability	0	4	0	12
Depth to Bedrock	0	4	0	12
Surface Erosion	0	4	0	12

Number of Assumed Values = ____ Out of 10

Percentage of Assumed Values = ____%

Number of Missing Values = ____ Out of 10

Percentage of Missing Values = ____%

SUBTOTALS 19 195

SUBSCORE 10

(Factor Score Divided by Maximum Score and Multiplied by 100)

WASTE CHARACTERISTICS

Hazardous Rating: Judgemental rating from 30 to 100 points based on the following guidelines:

Points	
30	Closed domestic-type landfill, old site, no known hazardous wastes
40	Closed domestic-type landfill, recent site, no known hazardous wastes
50	Suspected small quantities of hazardous wastes
60	Known small quantities of hazardous wastes
70	Suspected moderate quantities of hazardous wastes
80	Known moderate quantites of hazardous wastes
90	Suspected large quantities of hazardous wastes
100	Known large quantities of hazardous wastes

• SUBSCORE 60

Reason for Assigned Hazardous Rating:

Fire training Area - POL waste burned on site

WASTE MANAGEMENT PRACTICES

RATING FACTOR	FACTOR RATING (0-3)	MULTIPLIER	FACTOR SCORE	MAXIMUM POSSIBLE SCORE
Record Accuracy and Ease of Access to Site	3	7	21	21
Hazardous Waste Quantity	1	7	7	21
Total Waste Quantity	0	4	0	12
Waste Incompatibility	0	3	0	9
Absence of Liners or Confining Beds	2	6	12	18
Use of Leachate Collection System	-	6	-	-
Use of Gas Collection Systems	-	2	-	-
Site Closure	2	8	16	24
Subsurface Flows	0	7	0	21

Number of Assumed Values = ___ Out of 9

Percentage of Assumed Values = ___%

Number of Missing and Non-Applicable Values = ___ Out of 9

Percentage of Missing and Non-Applicaibe Values = ___%

SUBTOTALS 56 126

SUBSCORE 44

(Factor Score Divided by Maximum Score and Multiplied by 100)

Overall Number of Assumed Values = ___ Out of 25

Overall Percentage of Assumed Values = ___%

OVERALL SCORE 39

(Receptors Subscore X 0.22 plus
Pathways Subscore X 0.30 plus
Waste Characteristics Subscore X 0.24 plus
Waste Management Subscore X 0.24)

Appendix N
NEW HAZARDOUS ASSESSMENT RATING METHODOLOGY

USAF INSTALLATION RESTORATION PROGRAM

HAZARD ASSESSMENT RATING METHODOLOGY

BACKGROUND

The Department of Defense (DOD) has established a comprehensive program to identify, evaluate, and control problems associated with past disposal practices at DOD facilities. One of the actions required under this program is to:

> "develop and maintain a priority listing of contaminated installations and facilities for remedial action based on potential hazard to public health, welfare, and environmental impacts." (Reference: DEQPPM 81-5, 11 December 1981).

Accordingly, the United States Air Force (USAF) has sought to establish a system to set priorities for taking further actions at sites based upon information gathered during the Records Search phase of its Installation Restoration Program (IRP).

The first site rating model was developed in June 1981 at a meeting with representatives from USAF Occupational Environmental Health Laboratory (OEHL), Air Force Engineering Services Center (AFESC), Engineering-Science (ES) and CH_2M Hill. The basis for this model was a system developed for EPA by JRB Associates of McLean, Virginia. The JRB model was modified to meet Air Force needs.

After using this model for 6 months at over 20 Air Force installations, certain inadequacies became apparent. Therefore, on January 26 and 27, 1982, representatives of USAF OEHL, AFESC, various major commands, Engineering Science, and CH_2M Hill met to address the inadequacies. The result of the meeting was a new site rating model designed to present a better picture of the hazards posed by sites at Air Force installations. The new rating model described in this presentation is referred to as the Hazard Assessment Rating Methodology.

PURPOSE

The purpose of the site rating model is to provide a relative ranking of sites of suspected contamination from hazardous substances. This model will assist the Air Force in setting priorities for follow-on site investigations and confirmation work under Phase II of IRP.

This rating system is used only after it has been determined that (1) potential for contamination exists (hazardous wastes present in sufficient quantity), and (2) potential for migration exists. A site can be deleted from consideration for rating on either basis.

DESCRIPTION OF MODEL

Like the other hazardous waste site ranking models, the U.S. Air Force's site rating model uses a scoring system to rank sites for priority attention. However, in developing this model, the designers incorporated some special features to meet specific DOD program needs.

The model uses data readily obtained during the Record Search portion (Phase I) of the IRP. Scoring judgments and computations are easily made. In assessing the hazards at a given site, the model develops a score based on the most likely routes of contamination and the worst hazards at the site. Sites are given low scores only if there are clearly no hazards at the site. This approach meshes well with the policy for evaluating and setting restrictions on excess DOD properties.

Site scores are developed using the appropriate ranking factors according to the method presented in the flow chart (Figure 1). The site rating form is provided in Figure 2 and the rating factor guidelines are provided in Table 1.

As with the previous model, this model considers four aspects of the hazard posed by a specific site: the possible receptors of the contamination the waste and its characteristics, potential pathways for waste contaminant migration, and any efforts to contain the contaminants. Each of these categories contains a number of rating factors that are used in the overall hazard rating.

The receptors category rating is calculated by scoring each factor, multiplying by a factor weighting constant and adding the weighted scores to obtain a total category score.

The pathways category rating is based on evidence of contaminant migration or an evaluation of the highest potential (worst case) for contaminant migration along one of three pathways. If evidence of contaminant migration exists, the category is given a subscore of 80 to 100 points. For indirect evidence, 80 points are assigned and for direct evidence 100 points are assigned. If no evidence is found, the highest score among three possible routes is used. These routes are surface water migration, flooding, and ground-water migration. Evaluation of each route involves factors associated with the particular migration route. The three pathways are evaluated and the highest score among all four of the potential scores is used.

The waste characteristics category is scored in three steps. First, a point rating is assigned based on an assessment of the waste quantity and the hazard (worst case) associated with the site. The level of confidence in the information is also factored into the assessment. Next, the score is multiplied by a waste persistence factor, which acts to reduce the score if the waste is not very persistent. Finally, the score is further modified by the physical state of the waste. Liquid wastes receive the maximum score, while scores for sludges and solids are reduced.

The scores for each of the three categories are then added together and normalized to a maximum possible score of 100. Then the waste management practice category is scored. Sites at which there is no containment are not reduced in score. Scores for sites with limited containment can be reduced by 5 percent. If a site is contained and well managed, its score can be reduced by 90 percent. The final site score is calculated by applying the waste managment practices category factor to the sum of the scores for the other three categories.

FIGURE 1

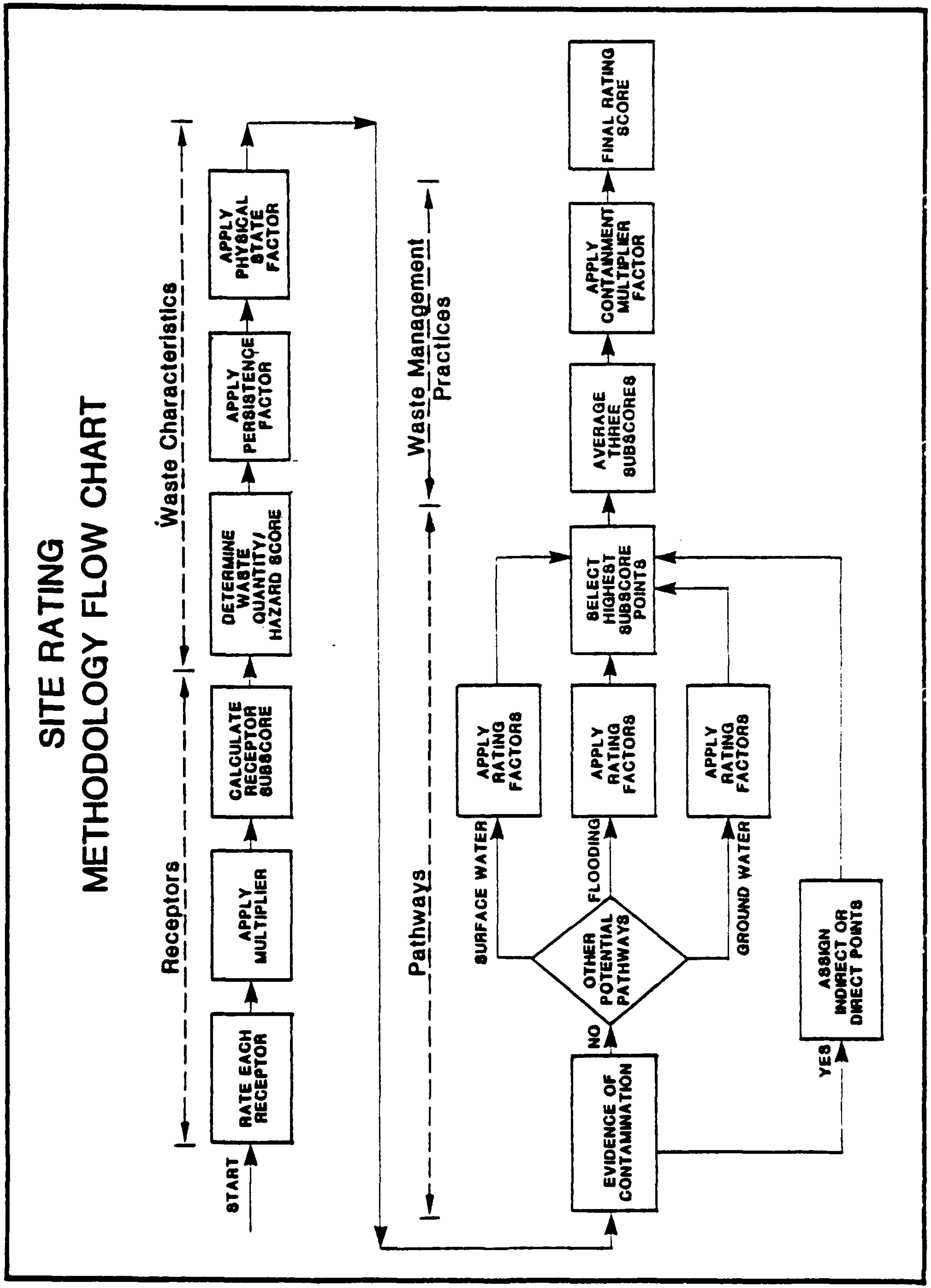
SITE RATING
METHODOLOGY FLOW CHART
Receptors
Waste Characteristics
START
RATE EACH RECEPTOR
APPLY MULTIPLIER
CALCULATE RECEPTOR SUBSCORE
DETERMINE WASTE QUANTITY/ HAZARD SCORE
APPLY PERSISTENCE FACTOR
APPLY PHYSICAL STATE FACTOR
Pathways
Waste Management Practices
EVIDENCE OF CONTAMINATION
NO
YES
OTHER POTENTIAL PATHWAYS
SURFACE WATER
FLOODING
GROUND WATER
APPLY RATING FACTORS
APPLY RATING FACTORS
APPLY RATING FACTORS
ASSIGN INDIRECT OR DIRECT POINTS
SELECT HIGHEST SUBSCORE POINTS
AVERAGE THREE SUBSCORES
APPLY CONTAINMENT MULTIPLIER FACTOR
FINAL RATING SCORE

FIGURE 2

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE ______________________________

LOCATION ______________________________

DATE OF OPERATION OR OCCURRENCE ______________________________

OWNER/OPERATOR ______________________________

COMMENTS/DESCRIPTION ______________________________

SITE RATED BY ______________________________

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site		4		
B. Distance to nearest well		10		
C. Land use/zoning within 1 mile radius		3		
D. Distance to reservation boundary		6		
E. Critical environments within 1 mile radius of site		10		
F. Water quality of nearest surface water body		6		
G. Ground water use of uppermost aquifer		9		
H. Population served by surface water supply within 3 miles downstream of site		6		
I. Population served by ground-water supply within 3 miles of site		6		
		Subtotals	______	______

Receptors subscore (100 X factor score subtotal/maximum score subtotal) ______

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) ______
2. Confidence level (C = confirmed, S = suspected) ______
3. Hazard rating (H = high, M = medium, L = low) ______

Factor Subscore A (from 20 to 100 based on factor score matrix) ______

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

______ X ______ = ______

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

______ X ______ = ______

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore ______

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water		8		
Net precipitation		6		
Surface erosion		8		
Surface permeability		6		
Rainfall intensity		8		
Subtotals			______	______

Subscore (100 X factor score subtotal/maximum score subtotal) ______

2. Flooding

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Flooding		1		

Subscore (100 x factor score/3) ______

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water		8		
Net precipitation		6		
Soil permeability		8		
Subsurface flows		8		
Direct access to ground water		8		
Subtotals			______	______

Subscore (100 x factor score subtotal/maximum score subtotal) ______

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore ______

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors ______
Waste Characteristics ______
Pathways ______

Total ______ divided by 3 = ______
Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

______ X ______ = ☐

TABLE 1

HAZARDOUS ASSESSMENT RATING METHODOLOGY GUIDELINES

I. RECEPTORS CATEGORY

Rating Factors	Rating Scale Levels: 0	1	2	3	Multiplier
A. Population within 1,000 feet (includes on-base facilities)	0	1 - 25	26 - 100	Greater than 100	4
B. Distance to nearest water well	Greater than 3 miles	1 to 3 miles	3,001 feet to 1 mile	0 to 3,000 feet	10
C. Distance to installation boundary	Greater than 2 miles	1 to 2 miles	1,001 feet to 1 mile	0 to 1,000 feet	3
D. Land Use/Zoning (within 1 mile radius)	Completely remote (zoning not applicable)	Agricultural	Commercial or industrial	Residential	6
E. Critical environments (within 1 mile radius)	Not a critical environment	Natural areas	Pristine natural areas; minor wetlands; preserved areas; presence of economically important natural resources susceptible to contamination.	Major habitat of an endangered or threatened species; presence of recharge area; major wetlands.	10
F. Water quality/use designation of nearest surface water body	Agricultural or industrial use.	Recreation, propagation and management of fish and wildlife.	Shellfish propagation and harvesting.	Potable water supplies	6
G. Ground-Water use of uppermost aquifer	Not used, other sources readily available.	Commercial, industrial, or irrigation, very limited other water sources.	Drinking water, municipal water available.	Drinking water, no municipal water available; commercial, industrial, or irrigation, no other water source available.	9
H. Population served by surface water supplies within 3 miles downstream of site	0	1 - 50	51 - 1,000	Greater than 1,000	6
I. Population served by aquifer supplies within 3 miles of site	0	1 - 50	51 - 1,000	Greater than 1, 000	6

TABLE 1 (Continued)

HAZARDOUS ASSESSMENT RATING METHODOLOGY GUIDELINES (Cont'd)

II. WASTE CHARACTERISTICS

A-1 Hazardous Waste Quantity

S = Small quantity (5 tons or 20 drums of liquid)
M = Moderate quantity (5 to 20 tons or 21 to 85 drums of liquid)
L = Large quantity (20 tons or 85 drums of liquid)

A-2 Confidence Level of Information

C = Confirmed confidence level (minimum criteria below)

- o Verbal reports from interviewer (at least 2) or written information from the records.
- o Knowledge of types and quantities of wastes generated by shops and other areas on base.
- o Based on the above, a determination of the types and quantities of waste *disposed of at the site*.

S = Suspected confidence level

- o No verbal reports or conflicting verbal reports and no written information from the records.
- o Logic based on a knowledge of the types and quantities of hazardous wastes generated at the base, and a history of past waste disposal practices indicate that these wastes were *disposed of at a site*.

A-3 Hazard Rating

Hazard Category	Rating Scale Levels: 0	1	2	3
Toxicity	Sax's Level 0	Sax's Level 1	Sax's Level 2	Sax's Level 3
Ignitability	Flash point greater than 200°F	Flash point at 140°F to 200°F	Flash point at 80°F to 140°F	Flash point less than 80°F
Radioactivity	At or below background levels	1 to 3 times background levels	3 to 5 times background levels	Over 5 times background levels

Use the highest individual rating based on toxicity, ignitability and radioactivity and determine the hazard rating.

Hazard Rating	Points
High (H)	3
Medium (M)	2
Low (L)	1

TABLE 1 (Continued)

HAZARDOUS ASSESSMENT RATING METHODOLOGY GUIDELINES (Cont'd)

II. WASTE CHARACTERISTICS (Continued)

Waste Characteristics Matrix

Point Rating	Hazardous Waste Quantity	Confidence Level of Information	Hazard Rating
100	L	C	H
80	L	C	M
	M	C	H
70	L	S	H
60	S	C	H
	M	C	M
50	L	S	M
	L	C	L
	M	S	H
	S	C	M
40	S	S	H
	M	S	M
	M	C	L
	L	S	L
30	S	C	L
	M	S	L
	S	S	M
20	S	S	L

Notes:
For a site with more than one hazardous waste, the waste quantities may be added using the following rules:
Confidence Level
o Confirmed confidence levels (C) can be added
o Suspected confidence levels (S) can be added
o Confirmed confidence levels cannot be added with suspected confidence levels
Waste Hazard Rating
o Wastes with the same hazard rating can be added
o Wastes with different hazard ratings can only be added in a downgrade mode, e.g., MCM + SCH = LCM if the total quantity is greater than 20 tons.
Example: Several wastes may be present at a site, each having an MCM designation (60 points). By adding the quantities of each waste, the designation may change to LCM (80 points). In this case, the correct point rating for the waste is 80.

B. Persistence Multiplier for Point Rating

Persistence Criteria	Multiply Point Rating From Part A by the Following
Metals, polycyclic compounds, and halogenated hydrocarbons	1.0
Substituted and other ring compounds	0.9
Straight chain hydrocarbons	0.8
Easily biodegradable compounds	0.4

C. Physical State Multiplier

Physical State	Multiply Point Total From Parts A and B by the Following
Liquid	1.0
Sludge	0.75
Solid	0.50

TABLE 1 (Continued)

HAZARDOUS ASSESSMENT RATING METHODOLOGY GUIDELINES (Cont'd)

III. PATHWAYS CATEGORY

A. Evidence of Contamination

Direct evidence is obtained from laboratory analyses of hazardous contaminants present above natural background levels in surface water, ground water, or air. Evidence should confirm that the source of contamination is the site being evaluated.

Indirect evidence might be from visual observation (i.e., leachate), vegetation stress, sludge deposits, presence of taste and odors in drinking water, or reported discharges that cannot be directly confirmed as resulting from the site, but the site is greatly suspected of being a source of contamination.

Rating Factor	Rating Scale Levels: 0	1	2	3	Multiplier
B-1 POTENTIAL FOR SURFACE WATER CONTAMINATION					
Distance to nearest surface water (includes drainage ditches and storm sewers)	Greater than 1 mile	2,001 feet to 1 mile	501 feet to 2,000 feet	0 to 500 feet	8
Net precipitation	Less than -10 in.	-10 to + 5 in.	+5 to +20 in.	Greater than +20 in.	6
Surface erosion	None	Slight	Moderate	Severe	8
Surface permeability	0% to 15% clay ($>10^{-2}$ cm/sec)	15% to 30% clay (10^{-2} to 10^{-4} cm/sec)	30% to 50% clay (10^{-4} to 10^{-6} cm/sec)	Greater than 50% clay ($<10^{-6}$ cm/sec)	6
Rainfall intensity based on 1 year 24-hr rainfall	<1.0 inch	1.0-2.0 inches	2.1-3.0 inches	>3.0 inches	8
B-2 POTENTIAL FOR FLOODING					
Floodplain	Beyond 100-year floodplain	In 25-year floodplain	In 10-year floodplain	Floods annually	1
B-3 POTENTIAL FOR GROUND-WATER CONTAMINATION					
Depth to ground water	Greater than 500 ft	50 to 500 feet	11 to 50 feet	0 to 10 feet	8
Net precipitation	Less than -10 in.	-10 to +5 in.	+5 to +20 in.	Greater than +20 in.	6
Soil permeability	Greater than 50% clay ($>10^{-6}$ cm/sec)	30% to 50% clay (10^{-4} to 10^{-6} cm/sec)	15% to 30% clay (10^{-2} to 10^{-4} cm/sec)	0% to 15% clay ($<10^{-2}$ cm/sec)	8
Subsurface flows	Bottom of site greater than 5 feet above high ground-water level	Bottom of site occasionally submerged	Bottom of site frequently submerged	Bottom of site located below mean ground-water level	8
Direct access to ground water (through faults, fractures, faulty well casings, subsidence fissures,	No evidence of risk	Low risk	Moderate risk	High risk	8

TABLE 1 (Continued)

HAZARDOUS ASSESSMENT RATING METHODOLOGY GUIDELINES (Cont'd)

IV. WASTE MANAGEMENT PRACTICES CATEGORY

A. This category adjusts the total risk as determined from the receptors, pathways, and waste characteristics categories for waste management practices and *engineering* controls designed to reduce this risk. The total risk is determined by first averaging the receptors, pathways, and waste characteristics subscores.

B. WASTE MANAGEMENT PRACTICES FACTOR

The following multipliers are then applied to the total risk points *(from A)*:

Waste Management Practice	Multiplier
No containment	1.0
Limited containment	0.95
Fully contained and in full compliance	0.10

Guidelines for fully contained:

Landfills:

- Clay cap or other impermeable cover
- Leachate collection system
- Liners in good condition
- Adequate monitoring wells

Surface Impoundments:

- Liners in good condition
- Sound dikes and adequate freeboard
- Adequate monitoring wells

Spills:

- Quick spill cleanup action taken
- Contaminated soil removed
- Soil and/or water samples confirm total cleanup of the spill

Fire Proection Training Areas:

- Concrete surface and berms
- Oil/water separator for pretreatment of runoff
- Effluent from oil/water separator to treatment plant

General Note: If data are not available or known to be complete the factor ratings under items I-A through I, III-B-1 or III-B-3, then leave blank for calculation of factor score and maximum possible score.

Appendix O
NEW SITE RATING FORMS

Table 1

SUMMARY OF RESULTS OF SITE ASSESSMENTS

Site No.	Site Description	Subscores (% of Maximum Possible Score in Each Category)			Overall Score (Sum of Subscores/3)
		Receptors	Pathways	Waste Characteristics	
2	Waste Treatment Annex	61	42	56	50
4	Perimeter Road POL Waste Application Site	51	42	100	64
5	POL Waste Disposal Trench	62	42	100	68
6	South Fire Department Training Area	64	42	100	69
7	North Fire Department Training Area	65	42	80	62

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE: No. 2, Waste Treatment Annex

LOCATION: Luke AFB

DATE OF OPERATION OR OCCURRENCE: Intermittent from 1941 to 1946, 1953 to 1970

OWNER/OPERATOR: Luke AFB

COMMENTS/DESCRIPTION: Primary base landfill for disposal of general refuse

SITE RATED BY: G. McIntyre

I. RECEPTORS

	Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A.	Population within 1,000 feet of site	1	4	4	12
B.	Distance to nearest well	3	10	30	30
C.	Land use/zoning within 1 mile radius	2	3	6	9
D.	Distance to reservation boundary	3	6	18	18
E.	Critical environments within 1 mile radius of site	0	10	0	30
F.	Water quality of nearest surface-water body	1	6	6	18
G.	Ground-water use of uppermost aquifer	3	9	27	27
H.	Population served by surface-water supply within 3 miles downstream of site	0	6	0	18
I.	Population served by ground-water supply within 3 miles of site	3	6	18	18
			Subtotals	109	180

Receptors subscore (100 x factor score subtotal/maximum subtotal) 61

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) L

2. Confidence level (C = confirmed, S = suspected) S

3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 70

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

70 x 0.8 = 56

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

56 x 1.0 = 56

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.				
			Subscore	--
B. Rate the migration potential for three potential pathways: surface-water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.				
1. *Surface-water migration*				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
		Subtotals	38	108
Subscore (100 x factor score subtotal/maximum score subtotal)				35
2. Flooding	30	1	30	100
	Subscore (100 x factor score/3)			30
3. Ground-water migration				
Depth to ground water	1	8	8	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	3	8	24	24
		Subtotals	48	114
Subscore (100 x factor score subtotal/maximum score subtotal)				42

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3 above.

Pathways Subscore **42**

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	61
Waste Characteristics	56
Pathways	42
Total 159 divided by 3 =	53
	Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score x Waste Management Practices Factor = Final Score

53 x 0.95 = **50**

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE: No. 4, Perimeter Road POL Waste Application Site

LOCATION: Luke AFB

DATE OF OPERATION OR OCCURRENCE: 1951 to 1970

OWNER/OPERATOR: Luke AFB

COMMENTS/DESCRIPTION: Disposal of waste fuels and oils by road oiling

SITE RATED BY: G. McIntyre

I. RECEPTORS

	Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A.	Population within 1,000 feet of site	1	4	4	12
B.	Distance to nearest well	1	10	10	30
C.	Land use/zoning within 1 mile radius	3	3	9	9
D.	Distance to reservation boundary	3	6	18	18
E.	Critical environments within 1 mile radius of site	0	10	0	30
F.	Water quality of nearest surface-water body	1	6	6	18
G.	Ground-water use of uppermost aquifer	3	9	27	27
H.	Population served by surface-water supply within 3 miles downstream of site	0	6	0	18
I.	Population served by ground-water supply within 3 miles of site	3	6	18	18
			Subtotals	92	180

Receptors subscore (100 x factor score subtotal/maximum subtotal) 51

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) L

2. Confidence level (C = confirmed, S = suspected) C

3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 100

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

100 x 1.0 = 100

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

100 x 1.0 = 100

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.				
			Subscore	--
B. Rate the migration potential for three potential pathways: surface-water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.				
1. Surface-water migration				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
		Subtotals	38	108
Subscore (100 x factor score subtotal/maximum score subtotal)				35
2. Flooding	0	1	0	100
	Subscore (100 x factor score/3)			0
3. Ground-water migration				
Depth to ground water	1	8	8	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	3	8	24	24
		Subtotals	48	114
Subscore (100 x factor score subtotal/maximum score subtotal)				42

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3 above.

Pathways Subscore 42

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	51
Waste Characteristics	100
Pathways	42
Total 193 divided by 3 =	64 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score x Waste Management Practices Factor = Final Score

64 x 1.0 = 64

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE: No. 5, POL Waste Disposal Trench Site

LOCATION: Luke AFB

DATE OF OPERATION OR OCCURRENCE: 1970 to 1972

OWNER/OPERATOR: Luke AFB

COMMENTS/DESCRIPTION: POL waste disposed of in shallow trenches

SITE RATED BY: G. McIntyre

I. RECEPTORS

	Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A.	Population within 1,000 feet of site	1	4	4	12
B.	Distance to nearest well	3	10	30	30
C.	Land use/zoning within 1 mile radius	3	3	9	9
D.	Distance to reservation boundary	3	6	18	18
E.	Critical environments within 1 mile radius of site	0	10	0	30
F.	Water quality of nearest surface-water body	1	6	6	18
G.	Ground-water use of uppermost aquifer	3	9	27	27
H.	Population served by surface-water supply within 3 miles downstream of site	0	6	0	18
I.	Population served by ground-water supply within 3 miles of site	3	6	18	18
			Subtotals	112	180

Receptors subscore (100 x factor score subtotal/maximum subtotal) 62

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) L
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 100

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

100 x 1.0 = 100

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

100 x 1.0 = 100

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.				
			Subscore	--
B. Rate the migration potential for three potential pathways: surface-water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.				
1. Surface-water migration				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
		Subtotals	38	108
Subscore (100 x factor score subtotal/maximum score subtotal)				35
2. Flooding	0	1	0	100
	Subscore (100 x factor score/3)			0
3. Ground-water migration				
Depth to ground water	1	8	8	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	3	8	24	24
		Subtotals	48	114
Subscore (100 x factor score subtotal/maximum score subtotal)				42

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3 above.

Pathways Subscore **42**

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	62
Waste Characteristics	100
Pathways	42
Total 204 divided by 3 =	68
	Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score x Waste Management Practices Factor = Final Score

68 x 1.0 = **68**

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE: No. 6, South Fire Department Training Area

LOCATION: Luke AFB

DATE OF OPERATION OR OCCURRENCE: 1941 to 1946, 1951 to 1963

OWNER/OPERATOR: Luke AFB

COMMENTS/DESCRIPTION: Site used for fire department training exercises

SITE RATED BY: G. McIntyre

I. RECEPTORS

	Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A.	Population within 1,000 feet of site	2	4	8	12
B.	Distance to nearest well	3	10	30	30
C.	Land use/zoning within 1 mile radius	3	3	9	9
D.	Distance to reservation boundary	3	6	18	18
E.	Critical environments within 1 mile radius of site	0	10	0	30
F.	Water quality of nearest surface-water body	1	6	6	18
G.	Ground-water use of uppermost aquifer	3	9	27	27
H.	Population served by surface-water supply within 3 miles downstream of site	0	6	0	18
I.	Population served by ground-water supply within 3 miles of site	3	6	18	18
			Subtotals	116	180

Receptors subscore (100 x factor score subtotal/maximum subtotal) 64

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) L

2. Confidence level (C = confirmed, S = suspected) C

3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 100

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

100 x 1.0 = 100

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

100 x 1.0 = 100

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore --

B. Rate the migration potential for three potential pathways: surface-water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
1. Surface-water migration				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
		Subtotals	38	108
Subscore (100 x factor score subtotal/maximum score subtotal)				35
2. Flooding	0	1	0	100
	Subscore (100 x factor score/3)			0
3. Ground-water migration				
Depth to ground water	1	8	8	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	3	8	24	24
		Subtotals	48	114
Subscore (100 x factor score subtotal/maximum score subtotal)				42

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3 above.

Pathways Subscore 42

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	64
Waste Characteristics	100
Pathways	42
Total 206 divided by 3 =	69
	Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score x Waste Management Practices Factor = Final Score

69 x 1.0 = 69

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE: No. 7, North Fire Department Training Area

LOCATION: Luke AFB

DATE OF OPERATION OR OCCURRENCE: 1963 to 1973

OWNER/OPERATOR: Luke AFB

COMMENTS/DESCRIPTION: Site used for fire department training exercises

SITE RATED BY: G. McIntyre

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	3	4	12	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface-water body	1	6	6	18
G. Ground-water use of uppermost aquifer	3	9	27	27
H. Population served by surface-water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
		Subtotals	117	180

Receptors subscore (100 x factor score subtotal/maximum subtotal) 65

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) M

2. Confidence level (C = confirmed, S = suspected) C

3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 80

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

80 x 1.0 = 80

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

80 x 1.0 = 80

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore --

B. Rate the migration potential for three potential pathways: surface-water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
1. Surface-water migration				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
		Subtotals	38	108
Subscore (100 x factor score subtotal/maximum score subtotal)				35
2. Flooding	0	1	0	100
	Subscore (100 x factor score/3)			0
3. Ground-water migration				
Depth to ground water	1	8	8	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	3	8	24	24
		Subtotals	48	114
Subscore (100 x factor score subtotal/maximum score subtotal)				42

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3 above.

Pathways Subscore 42

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	65
Waste Characteristics	80
Pathways	42
Total 187 divided by 3 =	62
	Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score x Waste Management Practices Factor = Final Score

62 x 1.0 = 62