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AD-A227 086

INSTALLATION RESTORATION PROGRAM

PHASE I - RECORDS SEARCH

ALTUS AFB, OKLAHOMA

PREPARED FOR

UNITED STATES AIR FORCE
AFESC/DEV
Tyndall AFB, Florida
and
HQ MAC/DEEV
Scott AFB, Illinois

MARCH 1985

ES ENGINEERING-SCIENCE

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This report has been prepared for the United States Air Force by Engineering-Science for the purpose of aiding in 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, nor the Department of Defense.

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INSTALLATION RESTORATION PROGRAM
PHASE I: RECORDS SEARCH
ALTUS AFB
OKLAHOMA

Prepared For

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HQ MAC/DEEV
Scott AFB, Illinois

March 1985

Prepared By

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EXECUTIVE SUMMARY

The Department of Defense (DOD) has developed a program to identify and evaluate past hazardous material disposal sites on DOD property, to control the migration of hazardous contaminants, and to control hazards to health or welfare that may result from these past disposal operations. This program is called the Installation Restoration Program (IRP). The IRP has four phases consisting of Phase I, Installation Assessment/Records Search; Phase II, Confirmation/Quantification; Phase III, Technology Base Development; and Phase IV, Operations/Remedial Actions. Engineering-Science (ES) was retained by the United States Air Force to conduct the Phase I, Initial Assessment/Records Search for Altus Air Force Base (AFB) under Contract No. F5ESCO 4074 0001 through 0014.

INSTALLATION DESCRIPTION

Altus AFB is located in the City of Altus, Oklahoma (Jackson County), approximately 125 miles southwest of Oklahoma City. The base has an area of 2515 acres.

Altus AFB was established in 1942 and operated until the end of World War II as a flight training facility. After the war the installation was turned over to the City of Altus for a municipal airport. In 1953 the base was reactivated. Since that time its mission has been training aircraft crews, first under the Tactical Air Command (TAC), second under the Strategic Air Command (SAC) and later under the Military Airlift Command (MAC). Numerous large multi-engined aircraft have operated from the base in support of the TAC, SAC and MAC missions.

ENVIRONMENTAL SETTING

The environmental setting data reviewed for this investigation identified the following points relevant to Altus AFB:

- The calculated net precipitation value for Altus AFB is minus 42 inches annually. The one-year, 24-hour precipitation figure is given as 2.6 inches. These low values suggest a low potential for the generation or migration of contamination from a disposal site and the development of erosion.
- Surface soils mapped on the extreme north end of the base are sandy and permeable terrace materials. Their permeability may be assumed to be moderate. Soils mapped over most of the installation's land area are described as clayey residual deposits with low permeabilities and infiltration rates which promote to development of runoff to local surface waters.
- No major or regionally significant aquifers exist in the study area. The terrace deposits, in concert with alluvium form a major aquifer more than 15 miles north of the base. The postulated flow direction of ground water in this unit is south, in the vicinity of the base. Therefore, if contaminants did enter this unit at the installation, they would likely be discharged near the base into local surface waters and not be transmitted to the zone from which large populations derive potable water supplies.
- Low permeability residual soils underlie most of the installation. Ground water was encountered by several test borings in this unit at shallow depths, usually perched just above bedrock. The lateral limits, persistence, etc., of this water-bearing zone are not known. It is assumed that this unit either recharges the underlying bedrock or discharges to local surface waters, although this is unconfirmed.
- The bedrock is known to be a local aquifer. Small to moderate quantities of highly variable quality water may be obtained from discontinuous sandstone lenses in the predominantly shale bedrock. Two individual consumers are reported to use this unit as a source of water within a mile of the base.

- The City of Altus serves Altus AFB from its municipal water distribution system. The city supply is derived from surface sources and from wells into the Red River alluvium. The Jackson County Water Company provides water to most other consumers in the vicinity of the base using ground and surface supplies. These city and county ground water supplies are located several miles from the base.
- Base surface water quality monitoring data indicates that local surface waters are generally of acceptable quality with a few exceptions due primarily to natural conditions. One surface water quality excursion was noted during the July 1984 sampling period.

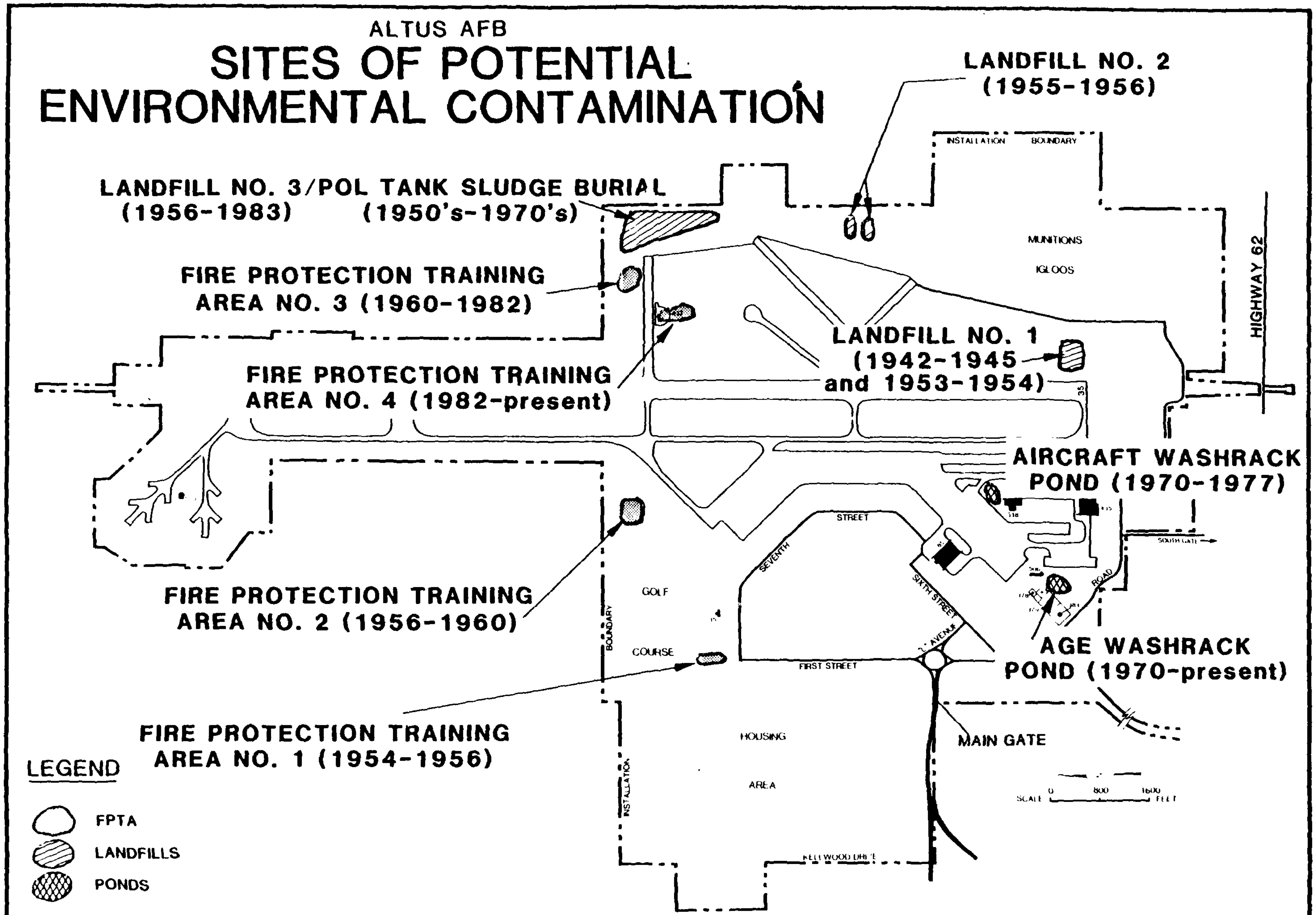
METHODOLOGY

During the course of this project, interviews were conducted with installation personnel (past and present) familiar with past waste disposal practices; file searches were performed for past hazardous waste activities; interviews were held with local, state and federal agencies; and field surveys were conducted at suspected past hazardous waste activity sites. Nine sites (Figure 1) were initially identified as potentially containing hazardous contaminants and having the potential for contaminant migration resulting from past activities. These sites have been assessed using a Hazard Assessment Rating Methodology (HARM) which takes into account factors such as site characteristics, waste characteristics, potential for contaminant migration and waste management practices. The details of the rating procedure are presented in Appendix G and the results of the assessment are given in Table 1. The rating system is designed to indicate the relative need for follow-up investigation.

FINDINGS AND CONCLUSIONS

The following conclusions have been developed based on the results of the project team field inspection, reviews of base records and files, interviews with base personnel, and evaluations using the HARM system.

FIGURE 1



SOURCE: INSTALLATION DOCUMENTS

TABLE 1
SITES EVALUATED USING THE
HAZARD ASSESSMENT RATING METHODOLOGY
ALTUS AFB

Rank	Site	Operation Period	HARM Score(1)
1	Aircraft Washrack Pond	1970-1977	69
2	AGE Washrack Pond	1970-present	64
3	FPTA No. 3	1960-1982	64
4	Landfill No. 3/ POL Tank Sludge Burial	1956-1983	53
5	FPTA No. 2	1956-1960	51
6	FPTA No. 1	1954-1956	50
7	FPTA No. 4	1982-present	47
8	Landfill No. 1	1942-1945; 1953-1954	44
9	Landfill No. 2	1955-1956	40

(1) This ranking was performed according to the Hazard Assessment Rating Methodology (HARM) described in Appendix G. Individual rating forms are in Appendix H.

The areas found to have sufficient potential to create environmental contamination are as follows:

- o Aircraft Washrack Pond
- o AGE Washrack Pond
- o Fire Protection Training Area (FPTA) No. 3

The areas judged to have minimal potential to create environmental contamination are as follows:

- o Landfill No. 3/POL Tank Sludge Burial
- o FPTA No. 2
- o FPTA No. 1
- o FPTA No. 4
- o Landfill No. 1
- o Landfill No. 2

RECOMMENDATIONS

Recommended guidelines for future land use restrictions at the disposal sites are presented in Section 6. A program for proceeding with Phase II and other IRP activities at Altus AFB is also presented in Section 6. The recommended actions include a soil boring, sampling and analysis program to determine if contamination exists. This program may be expanded to define the extent and type of contamination if the initial step reveals contamination. The Phase II recommendations are summarized in Table 2.

TABLE 2
RECOMMENDED MONITORING PROGRAM FOR PHASE II IRP
AT ALTUS AFB

Site (Rating Score)	Recommended Monitoring Program
Aircraft Washrack Pond (69)	Conduct a magnetometer survey at close grid spacing (10 to 20 ft) across the site to define the former pond location. Obtain four soil borings within the pond area and one outside the area for control purposes. Collect soil samples every foot in the first 10 ft and then sample every 5 ft to bedrock. Visually classify each soil sample. Based upon the observations of the soils obtained in the first 10 ft, select 4 samples for chemical analyses. Analyze the soil samples for the parameters in Table 6.2. If groundwater is encountered in the borings install a screen and develop a well for sampling in lieu of soil analyses.
AGE Washrack Pond (64)	Obtain six soil borings around the pond site and one at a more remote location for control purposes. Collect soil samples every 5 ft to bedrock. Visually classify each soil sample. Based upon the observations of the soils obtained in the first 10 ft, select 4 samples for chemical analyses. Analyze the soil samples for the parameters in Table 6.2. If groundwater is encountered in the borings install a screen and develop a well for sampling in lieu of soil analyses.

TABLE 2
(Continued)
RECOMMENDED MONITORING PROGRAM FOR PHASE II IRP
AT ALTUS AFB

Site (Rating Score)	Recommended Monitoring Program
FPTA No. 3 (64)	Obtain seven soil borings within the burning and runoff pond area and one control boring outside the area for control. Collect soil samples every 5 ft to bedrock. Visually classify each soil sample. Based upon the observations of the soils obtained in the first 10 ft, select 4 samples for chemical analyses. Analyze the soil samples for the parameters in Table 6.2. If groundwater is encountered in the borings install a screen and develop a well for sampling in lieu of soil analyses.

Source: Engineering-Science

SECTION 1

INTRODUCTION

BACKGROUND AND AUTHORITY

The United States Air Force, due to its primary mission of defense of the United States, has long been engaged in a wide variety of operations dealing with toxic and hazardous materials. Federal, state, and local governments have developed strict regulations to require that disposers identify the locations and contents of past disposal sites and take action to eliminate hazards in an environmentally responsible manner. The primary Federal legislation governing disposal of hazardous waste is the Resource Conservation and Recovery Act (RCRA) of 1976, as amended. Under Section 6003 of the Act, Federal agencies are directed to assist the Environmental Protection Agency (EPA) and under Section 3012, state agencies are required to inventory past disposal sites, and Federal agencies are required to make the information available to the requesting agencies. To assure compliance with these hazardous waste regulations, the Department of Defense (DOD) developed the Installation Restoration Program (IRP). The current DOD IRP policy is contained in Defense Environmental Quality Program Policy Memorandum (DEQPPM) 81-5, dated 11 December 1981 and 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. DOD policy is to identify and fully evaluate suspected problems associated with past hazardous contamination, and to control hazards to health and welfare that resulted from these past operations. The IRP is the basis for response actions on Air Force installations under the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, clarified by Executive Order 12316. CERCLA is the primary legislation governing remedial action at past hazardous waste disposal sites.

PURPOSE AND SCOPE

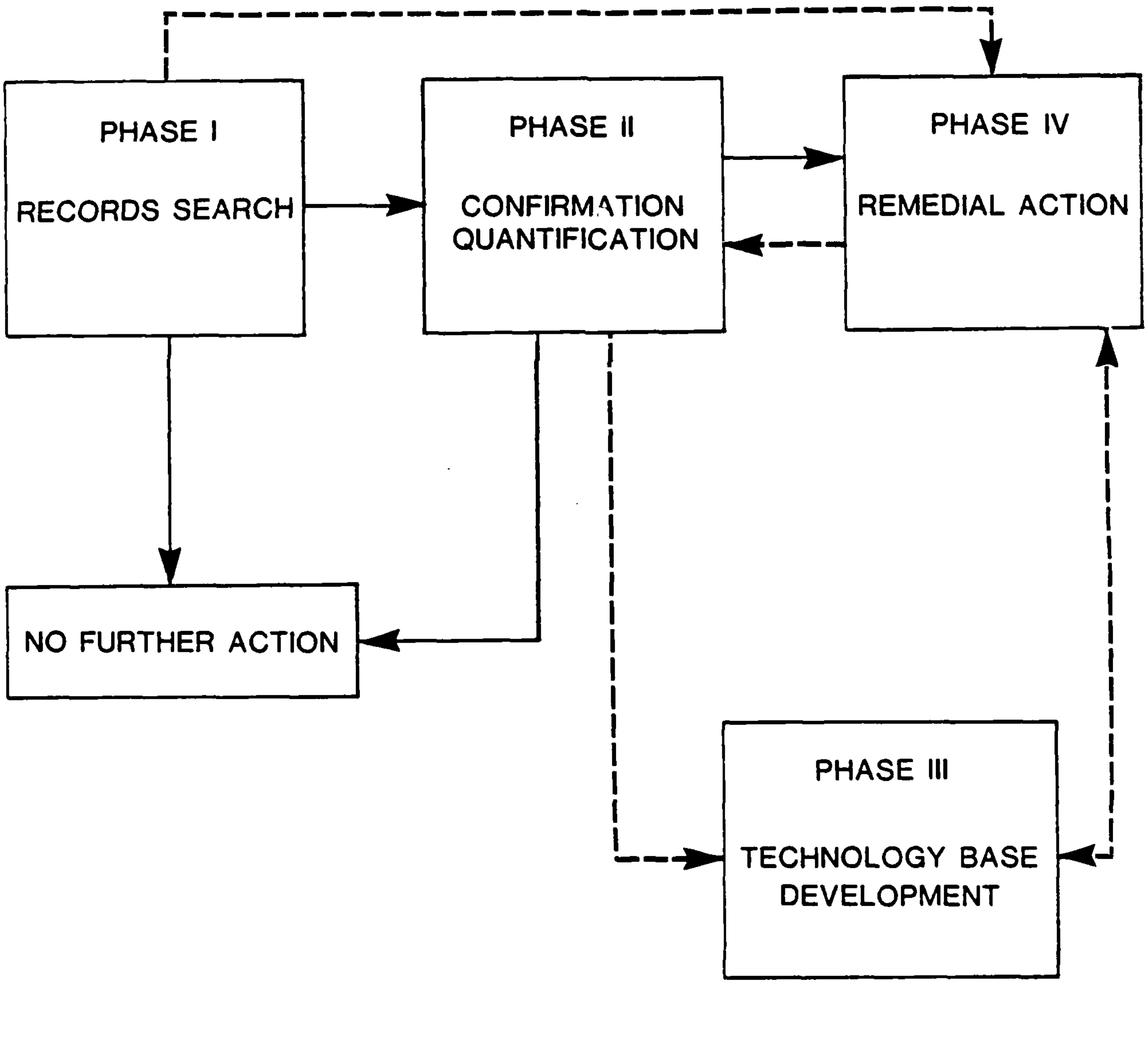
The Installation Restoration Program is a four-phased program (Figure 1.1) designed to assure that identification, confirmation/ quantification, and remedial actions are performed in a timely and cost-effective manner. Each phase is briefly described below:

- Phase I - Installation Assessment/Records Search - Phase I is to identify and prioritize those past disposal sites that may pose a hazard to public health or the environment as a result of contaminant migration to surface or ground waters, or have an adverse effect by its persistence in the environment. In this phase, it is determined whether a site requires further action to confirm an environmental hazard or whether it may be considered to present no hazard at this time. If a site requires immediate remedial action, such as removal of abandoned drums, the action can proceed directly to Phase IV. Phase I is a basic background document for the Phase II study.
- Phase II - Confirmation/Quantification - Phase II is to define and quantify, by preliminary and comprehensive environmental and/or ecological survey, the presence or absence of contamination, the extent of contamination, waste characterization (when required by the regulatory agency), and to identify sites or locations where remedial action is required in Phase IV. Research requirements identified during this phase will be included in the Phase III effort of the program.
- Phase III - Technology Base Development - Phase III is to develop a sound data base upon which to prepare a comprehensive remedial action plan. This phase includes implementation of research requirements and technology for objective assessment of adverse effects. A Phase III requirement can be identified at any time during the program.
- Phase IV - Operations/Remedial Actions - Phase IV includes the preparation and implementation of the remedial action plan.

Engineering-Science (ES) was retained by the United States Air Force to conduct the Phase I Records Search at Altus AFB under Contract

FIGURE 1.1

U.S. AIR FORCE INSTALLATION RESTORATION PROGRAM



SOURCE: AFESC

No. F08637 84 C0070. This report contains a summary and an evaluation of the information collected during Phase I of the IRP and recommended follow-on actions. The land area included as part of the Altus AFB study is the 2515 acres of the main base site. The activities performed as a part of the Phase I study scope included the following:

- Review of site records
- Interviews with personnel familiar with past generation and disposal activities
- Survey of types and quantities of wastes generated
- Determination of current and past hazardous waste treatment, storage, and disposal activities
- Description of the environmental setting at the base
- Review of past disposal practices and methods
- Reconnaissance of field conditions
- Collection of pertinent information from federal, state and local agencies
- Assessment of the potential for contaminant migration
- Development of recommendations for follow-on actions

ES performed the on-site portion of the records search during December 1984. The following team of professionals were involved:

- R. L. Thoem, Environmental Engineer and Project Manager, MS Sanitary Engineering, 21 years of professional experience in environmental engineering
- J. R. Absalon, Hydrogeologist, BS Geology, 10 years of professional experience in geology
- B. D. Moreth, Environmental Scientist, BS Forest Science, BS Zoology, 15 years of professional experience in environmental sciences

More detailed information on these three individuals is presented in Appendix A.

METHODOLOGY

The methodology utilized in the Altus AFB Records Search began with a review of past and present industrial operations conducted at the base. Information was obtained from available records such as shop files and real property files, as well as interviews with 91 past and present base employees from various operating areas. Those interviewed included current and past personnel associated with civil engineering, fuels management, roads and grounds maintenance, fire protection, real property, history, field maintenance, organizational maintenance, safety, entomology and supply. A listing of interviewee positions with approximate years of service is presented in Appendix B.

Concurrent with the employee interviews, the applicable federal, state and local agencies were contacted for pertinent study area related environmental data. The agencies contacted are listed below and in Appendix B.

- U.S. Environmental Protection Agency, Region VI (Dallas, TX)
- U.S. Geological Survey, Water Resources Division (Oklahoma City, OK)
- Oklahoma Department of Health, Industrial and Solid Waste Service (Oklahoma City, OK)
- Oklahoma Water Resources Board (Oklahoma City, OK)
- Jackson County Health Department (Altus, OK)
- Altus Water Department (Altus, OK)
- Washington National Record Center (Suitland, MD)
- National Archives (Washington, DC and Alexandria, VA)
- Office of Air Force History (Washington, DC)

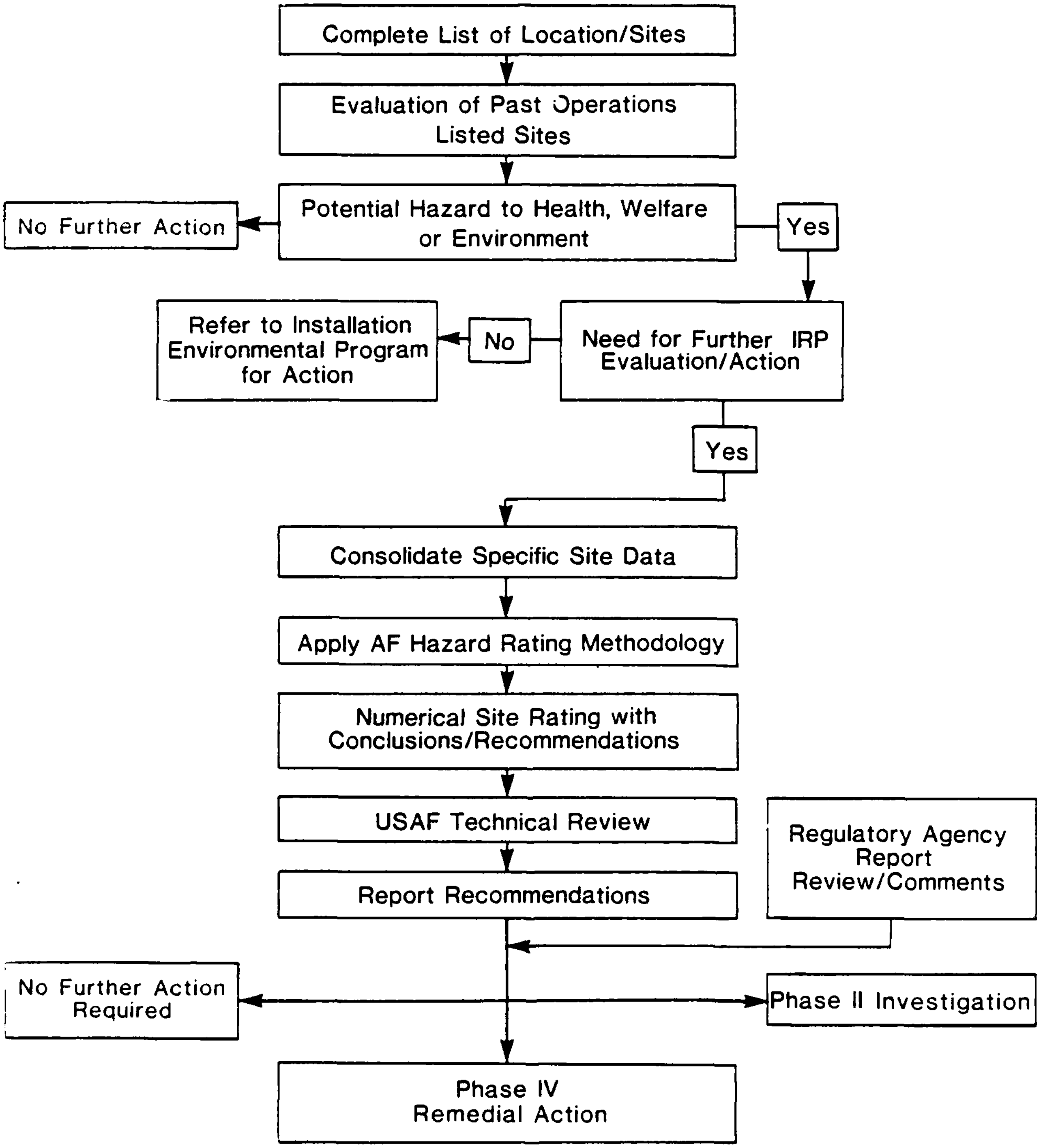
The next step in the activity review was to identify all sources of hazardous waste generation and to determine the past management practices regarding the use, storage, treatment, and disposal of hazardous materials from the various sources on the base. Included in this part of the activities review was the identification of all known past disposal sites and other possible sources of contamination such as spill areas. Appendix F includes photographs of some sites.

A general ground tour and an overflight of the identified sites were made by the ES Project Team to gather site-specific information including: (1) general observations of existing site conditions; (2) visual evidence of environmental stress; (3) presence of nearby drainage ditches or surface waters; and (4) visual inspection of these water bodies for any obvious signs of contamination or leachate migration.

A decision was then made, based on all of the above information, whether a potential hazard to health, welfare or the environment exists at any of the identified sites using the Flow Chart shown in Figure 1.2. If no potential existed, the site was deleted from further consideration. For those sites where a potential hazard was identified, a determination of the need for IRP evaluation/action was made by considering site-specific conditions. If no further IRP evaluation was determined necessary, then the site was referred to the installation environmental program for appropriate action. If a site warranted further investigation, it was evaluated and rated using the Hazard Assessment Rating Methodology (HARM). The HARM score is a resource management tool which indicates the relative potential for adverse effects on health or the environment at each site evaluated.

PHASE I INSTALLATION RESTORATION PROGRAM

RECORDS SEARCH FLOW CHART



Source: AFESC

SECTION 2

INSTALLATION DESCRIPTION

LOCATION, SIZE AND BOUNDARIES

Altus AFB is located in the City of Altus and Jackson County, Oklahoma. As shown in Figure 2.1, the base is approximately 125 miles southwest of Oklahoma City. Within the City of Altus, the installation is accessed from either U.S. Highway 283 or 62 (Figure 2.2).

The base comprises 2515 acres of Air Force owned land. The west-southwest part of the base is adjoined with land that is beginning to develop for residential-commercial uses. All other areas of the installation are bordered by agricultural land. An irrigation channel crosses the runway in an easterly direction and then flows south just inside the eastern boundary of the base. A drainage channel enters and exits the base after passing through the housing area. Figure 2.3 presents a site plan of the installation.

HISTORY

Altus AFB was established in 1942 and served as a flight training school during World War II. Pilots were trained on multi-engined aircraft. At the end of the war, the base was closed and the airfield was turned over to the City of Altus for use as a municipal airport. For a while the airfield was used as a storage area for a large number of World War II aircraft prior to selling to civilian firms.

As the Korean conflict emerged Altus was evaluated for reactivation and in January 1953 the base reopened under the Tactical Air Command (TAC). Later in 1953 the TAC unit was reassigned and the base came under control of the Strategic Air Command (SAC). In the period 1953-1955 considerable runway and building construction/reconstruction took place at the installation. During the period 1961-1965 several remote missile silos were under control by the base.

FIGURE 2.1

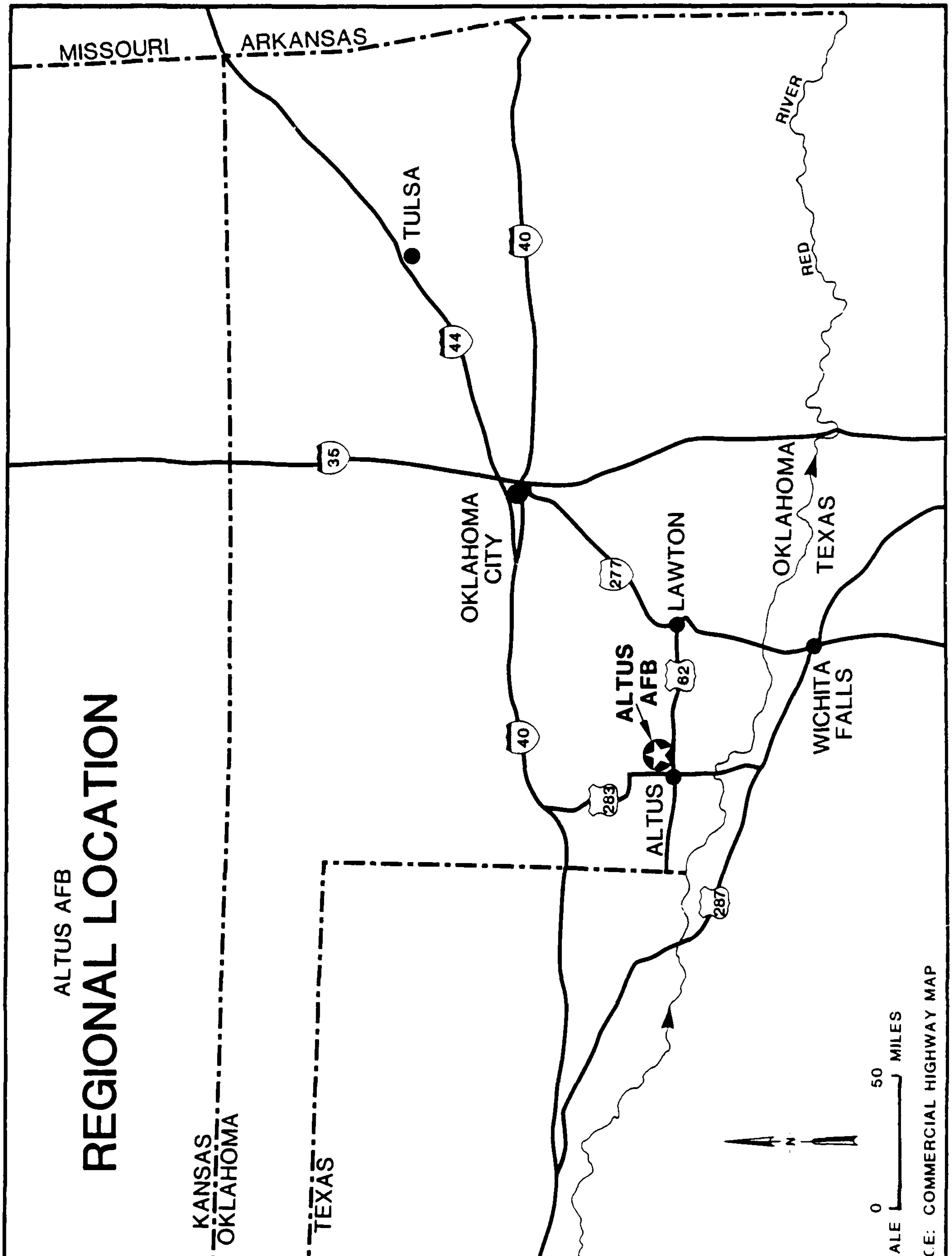

ALTUS AFB
REGIONAL LOCATION
MISSOURI
ARKANSAS
KANSAS
OKLAHOMA
TEXAS
TULSA
OKLAHOMA CITY
LAWTON
ALTUS AFB
ALTUS
WICHITA FALLS
OKLAHOMA
TEXAS
RED
RIVER
44
40
35
277
82
283
287
N
SCALE
0
50
MILES
SOURCE: COMMERCIAL HIGHWAY MAP

FIGURE 2.2

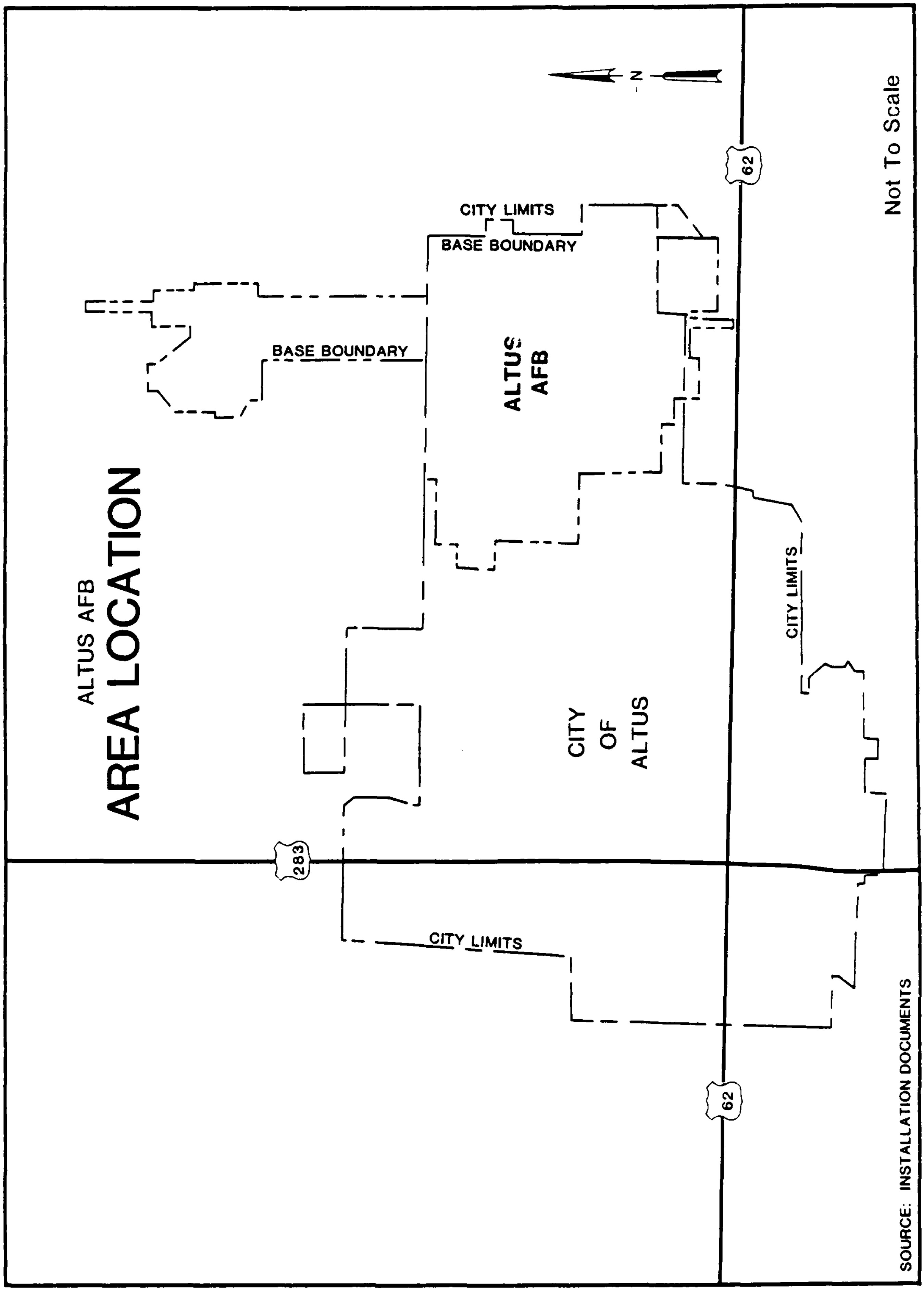
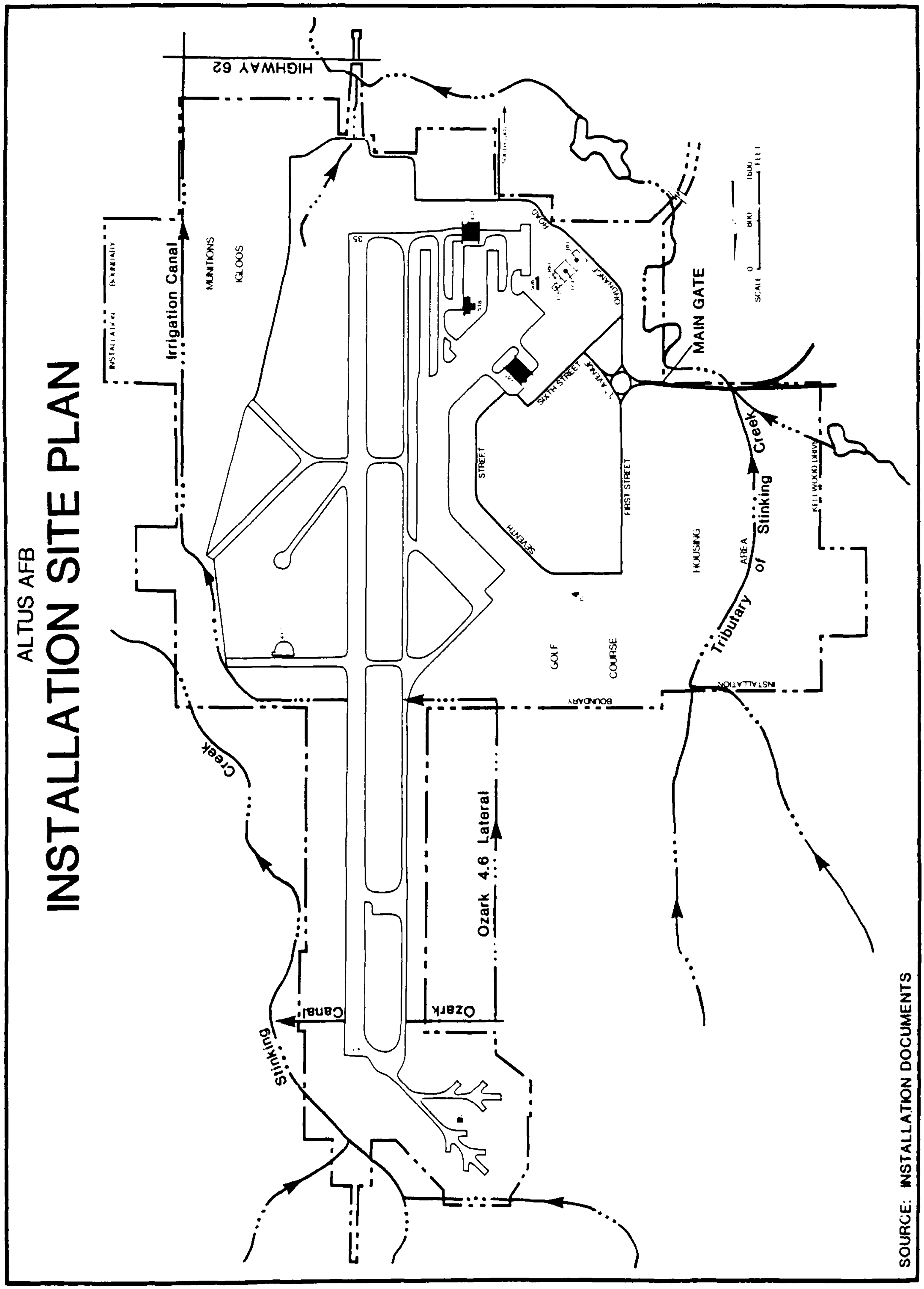

ALTUS AFB
AREA LOCATION
Not To Scale
N
CITY LIMITS
BASE BOUNDARY
BASE BOUNDARY
ALTUS AFB
CITY OF ALTUS
CITY LIMITS
CITY LIMITS
62
283
62
SOURCE: INSTALLATION DOCUMENTS

FIGURE 2.3



SOURCE: INSTALLATION DOCUMENTS

In 1968 the Military Airlift Command (MAC) received operational control of Altus AFB. MAC has continued as the host unit since 1968.

Training aircraft crews has been the primary mission of both the SAC and MAC operations since 1953. Numerous large multi-engined aircraft have been stationed at the base. The aircraft currently assigned at the installation include C-5 and C-141 troop/cargo carriers, KC-135 tankers, and T-37 trainers.

ORGANIZATION AND MISSION

The 443rd Military Airlift Wing (MAW) is the MAC host unit at the Altus AFB. Major units within the wing include Operations, Resource Management, Maintenance, 443rd Air Base Group, and USAF Hospital.

The primary mission of the 443rd MAW is to conduct transition and upgrade training for MAC aircrews in the C-5 and C-141. Operations directs the personnel training activities and Maintenance manages the aircraft maintenance resources. Resource Management provides supply, transportation and other logistical support. The 443rd Air Base Group manages and maintains all base facilities and service functions. Medical services are provided by the USAF Hospital.

The largest tenant at Altus is the SAC 340th Air Refueling Wing (AREFW). Major units within the Group are Operations and Maintenance. The mission of the 340th AREFW is to be in a state of readiness to support SAC during war or other contingency operations, to provide refueling for other air operations such as TAC and MAC, and to train refueling aircrews.

Other tenant organizations are listed below and the missions for several are enumerated in Appendix C.

Detachment 4, 17th Weather Squadron

2002nd Information Systems Squadron

403rd Field Training Detachment (3785th Field Air Training Wing, ATC)

Detachment 4, 136th Audiovisual Squadron

Detachment 3, 1600th Management Engineering Squadron

Detachment 1101 Air Force Office of Special Investigations

Area Defense Counsel

Detachment, Accelerated Co-pilot Enrichment (47th Flying Training Wing, ATC)

American Red Cross

U.S. Army Corps of Engineers

Red River Credit Union

Air Force Commissary Service

SECTION 3

ENVIRONMENTAL SETTING

The environmental setting of Altus AFB is described in this section with the primary emphasis directed toward the identification of features or conditions that may facilitate the movement of hazardous waste contaminants off base. A summary of relevant environmental conditions is presented at the end of the section.

METEOROLOGY

The study area is situated in the southwestern quadrant of Oklahoma. This area has a typically continental climate, with hot summers and cold winters. Altus AFB experiences an average annual precipitation of 23.3 inches (1953-1977). A review of National Oceanographic and Atmospheric Administration rainfall distribution maps (NOAA, 1983) indicates that most precipitation occurs during the spring and summer months. Average temperature in the study area may vary from 40 to 85°F. Temperatures tend to be lowest during December to February and highest during July and August.

The net annual precipitation (i.e., precipitation minus evaporation) calculated for Altus AFB is minus 42 inches, based on NOAA data (NOAA 1983). This low negative value suggests that there is a very low potential for the generation and subsequent migration of hazardous waste contaminants from past disposal facilities. The calculation of this figure does not consider evapotranspiration, which may vary greatly with changing seasons. The one year, 24-hour precipitation value is reported to be 2.6 inches (NOAA, 1977). This figure suggests a generally low to moderate potential for the development of surface erosion. Table 3.1 summarizes significant climatic data for Altus AFB.

TABLE 3.1
CLIMATOLOGICAL DATA

Month	Monthly Mean				
	Precipitation (inches)(1)	Temperature (°F)(1)	Snowfall (inches)	No. of Days With Rain/Snow(2)	Low Temperature Days Below 32°F
January	0.8	40	2	4/1	22
February	0.9	45	2	4/1	15
March	1.3	50	1	5/1	9
April	1.4	60	T	6/T	1
May	4.8	70	0	9/0	0
June	2.6	80	0	6/0	0
July	2.2	85	0	5/0	0
August	2.2	85	0	6/0	0
September	2.7	75	0	6/0	0
October	2.6	65	T	6/0	0
November	0.9	50	1	4/T	7
December	0.9	42	1	5/T	16
Annual Total	23.3	--	7	66/3	70

(1) Average normal precipitation and temperature data.
(2) Average normal number of days rainfall, 0.01 inch or more. Average normal number of days snow and/or ice pellets, 1.0 inch or more.
T = Trace.
Years of Record: 1953 - 1977.
Source: Altus AFB documents and NOAA, 1983.

GEOGRAPHY

The Altus area is located within the Central Redbed Plains subdivision of the Central Lowland Physiographic Province (Curtis and Ham, 1972). The bedrock-controlled land surface appears nearly level to gently sloping, with broad plains, low rolling hills and well-entrenched main streams. Distinct features are generally lacking and the visual perspective offers little spatial variation. The valleys of secondary streams may exhibit a sag and swale appearance when viewed in cross section, indicative of the erosion of somewhat cohesive residual soils.

Topography

The topography of the Altus AFB study area varies from generally level to gently rolling in appearance. Local relief is primarily the result of dissection by erosional activity or stream channel development. At Altus AFB, surface elevations range from 1330 feet, National Geodetic Vertical Datum of 1929 (NGVD) in the drainage alignment south of the main instrument runway to 1390 feet NGVD, just north of Taxiway No. 6. Maximum local relief is on the order of 10 feet, where the Ozark Canal crosses the installation.

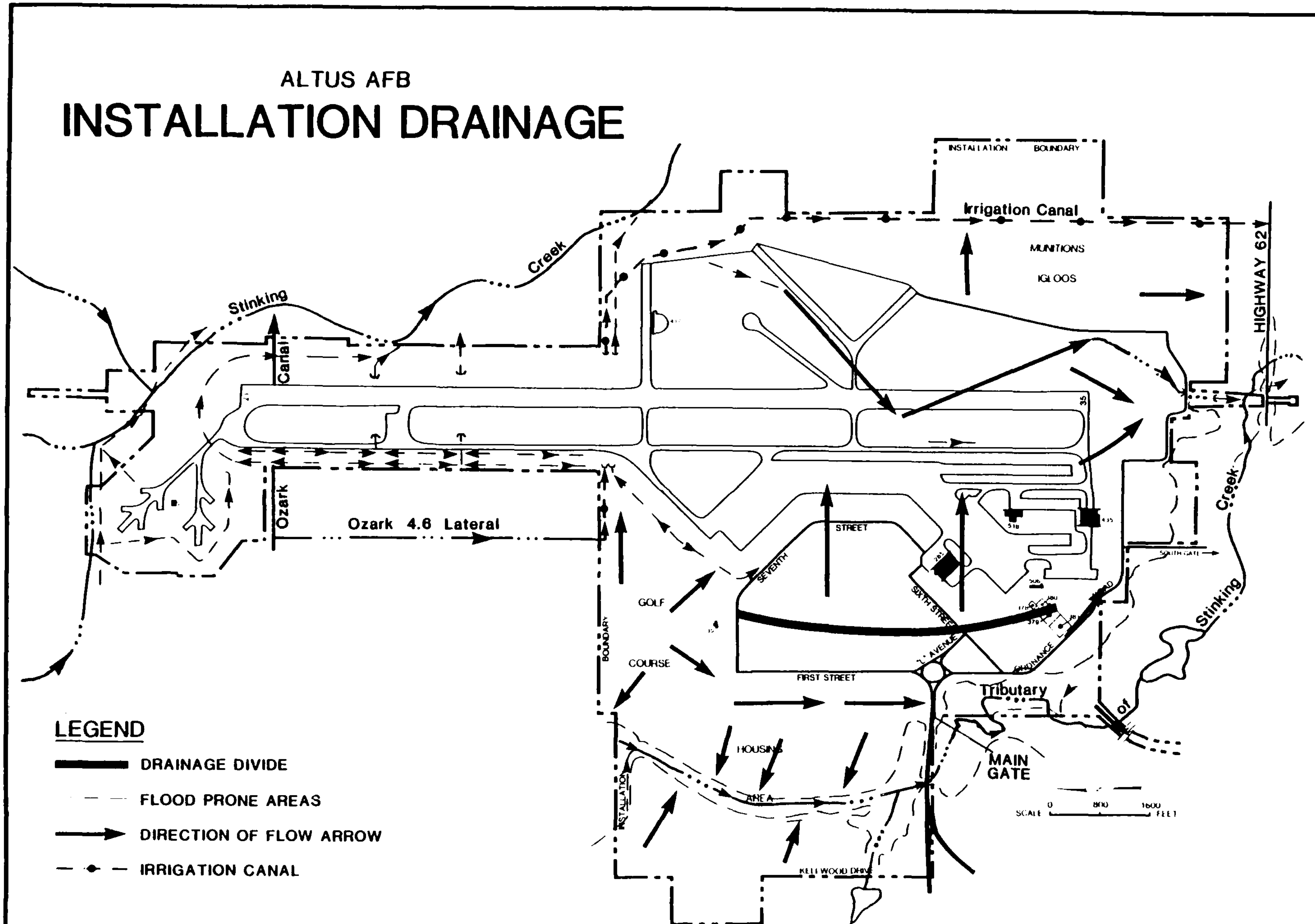
Drainage

The drainage of Altus AFB land areas is accomplished by overland flow to diversion structures and finally to local surface streams. Most north and east installation drainage is directed to Stinking Creek. Drainage originating from the western part of the base (housing and flightline shop areas) and the southern extremity of Altus AFB is directed to an unnamed tributary of Stinking Creek. Figure 3.1 depicts installation surface drainage features.

Surface Soils

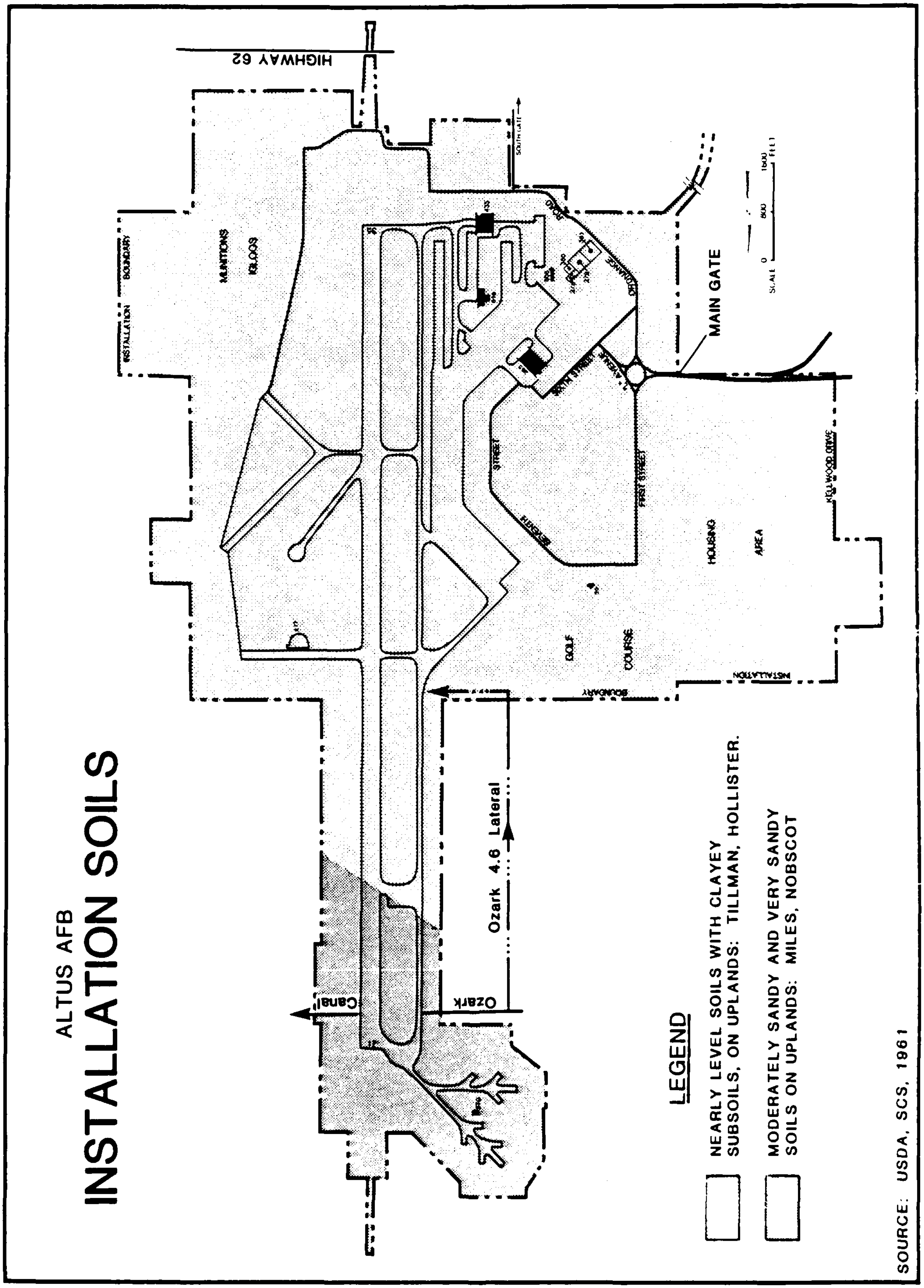
The surface soils of the Altus AFB study area have been mapped by the U.S. Department of Agriculture, Soil Conservation Service (1961). Two major soil associations have been mapped within installation boundaries and are depicted on Figure 3.2. The soil association occurring on the south part of the base has been identified as the Tillman-Hollister Association. These soils are typically clay loams and clayey subsoils that have formed in soft clayey sandstone (bedrock). A typical soil profile is some 60 inches thick. The percolation and permeability rates

FIGURE 3.1



SOURCE: INSTALLATION DOCUMENTS

FIGURE 3.2



ALTUS AFB
INSTALLATION SOILS
HIGHWAY 62
SOUTH GATE
MAIN GATE
INSTALLATION BOUNDARY
MUNITIONS IGLOOS
MAIN STREET
FIRST STREET
KELLWOOD DRIVE
HOUSING AREA
GOLF COURSE
Ozark 4.6 Lateral
Ozark Canal
LEGEND
NEARLY LEVEL SOILS WITH CLAYEY SUBSOILS, ON UPLANDS: TILLMAN, HOLLISTER.
MODERATELY SANDY AND VERY SANDY SOILS ON UPLANDS: MILES, NOBSCOT
SOURCE: USDA, SCS, 1961

of these soils may be described as slow. This association may be subject to both wind and water erosion if left unprotected for long periods.

The Miles-Nobscot Association occurs on the north part of the base. This association consists of moderately sandy to very sandy loam and loamy fine sand, with a sandy clay loam subsoil. A typical profile may be on the order of 84 inches thick. Percolation rates are described as high and permeability is rapid (probably 5.0 inches per hour or greater). This unit is particularly susceptible to wind erosion.

GEOLOGY

Study area geology has been reported by Miser, et al. (1954), Havens (1977) and Johnson, et al. (1980). Additional information has been obtained from installation construction test boring records. A brief review of this data has been summarized in support of this investigation.

Two principal geologic units have been mapped in the Altus AFB area. The southern portion of the installation is underlain by the Lower Permian age Hennessey Group. The Hennessey consists of a 130 to 200 foot-thick sequence of gray-brown to gray shale with tan sandstone and sandy or limy shale locally. The unit is assumed to be relatively flat-lying and unfaulted in the vicinity of the base. It is mantled by a thin (less than 30-foot thick) accumulation of clayey, silty and occasionally sandy residual soil, which has formed as a result of bedrock weathering. Installation test borings indicate the soil overburden to average 10 feet in thickness in the industrial areas of the base. The typical soil description is that of a stiff, low to high plasticity silty clay.

The major geologic unit underlying the installation north of the Ozark Canal has been identified as Quaternary Terrace Deposits. The unit is reported to consist of stratified sand, gravel and clay, ranging in thickness from 5 to 50 feet. Installation test borings taken in the northern aircraft alert area of Altus AFB indicate that the unit occurs on base as sand, sandy clay and clay, with a unit thickness on the order of 10 feet. The individual materials appear to be segregated according to grain size; discrete sand or sandy clay strata do not appear to correlate over distances of more than a few hundred feet.

The distribution of the two major geologic units present on base are shown in Figure 3.3. A geologic cross-section, based on two installation test borings at Building 215 is presented as Figure 3.4. The cross section shows the relatively flat-lying nature of local geologic units and the apparent shallow depth to bedrock.

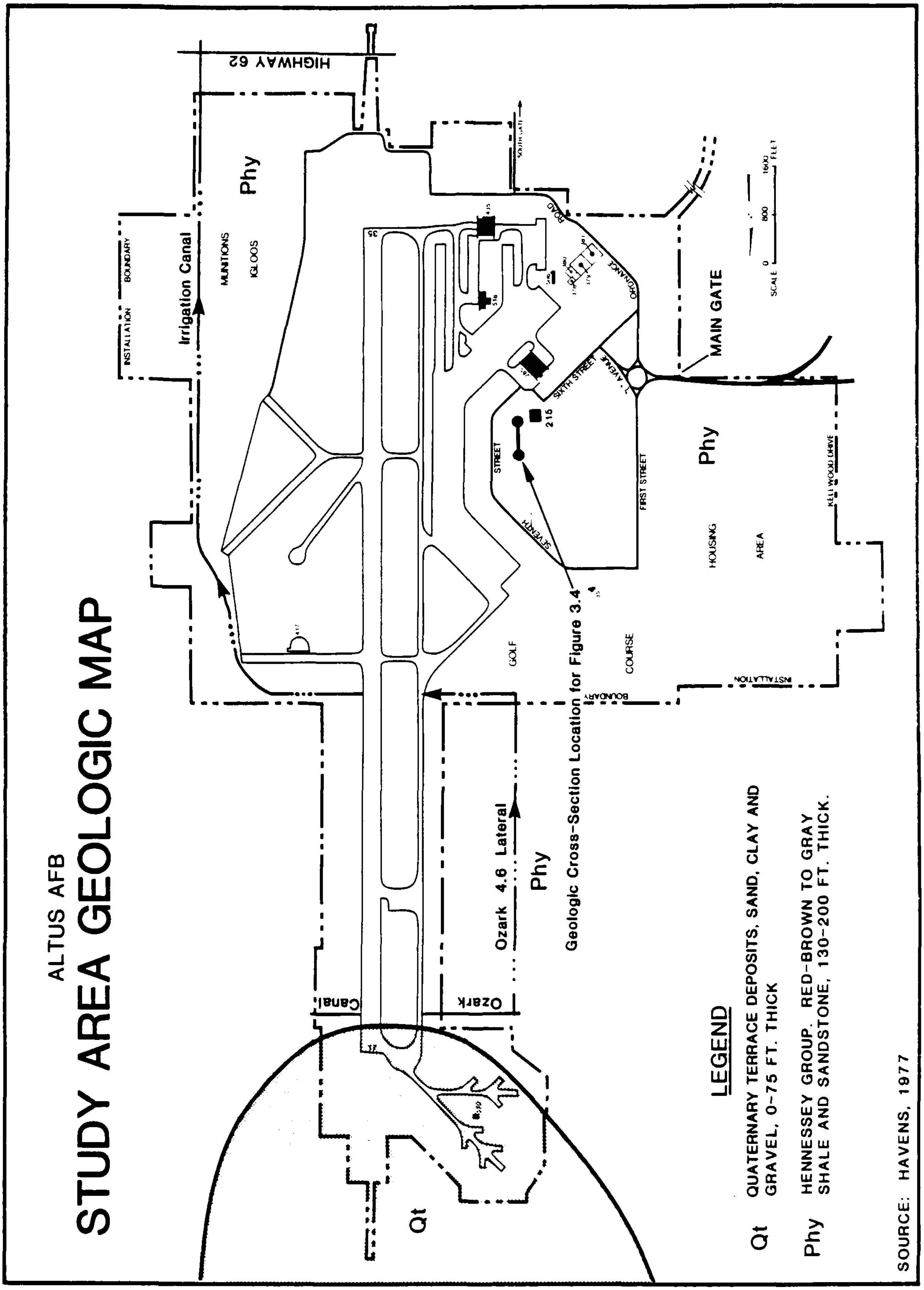
GROUND-WATER RESOURCES

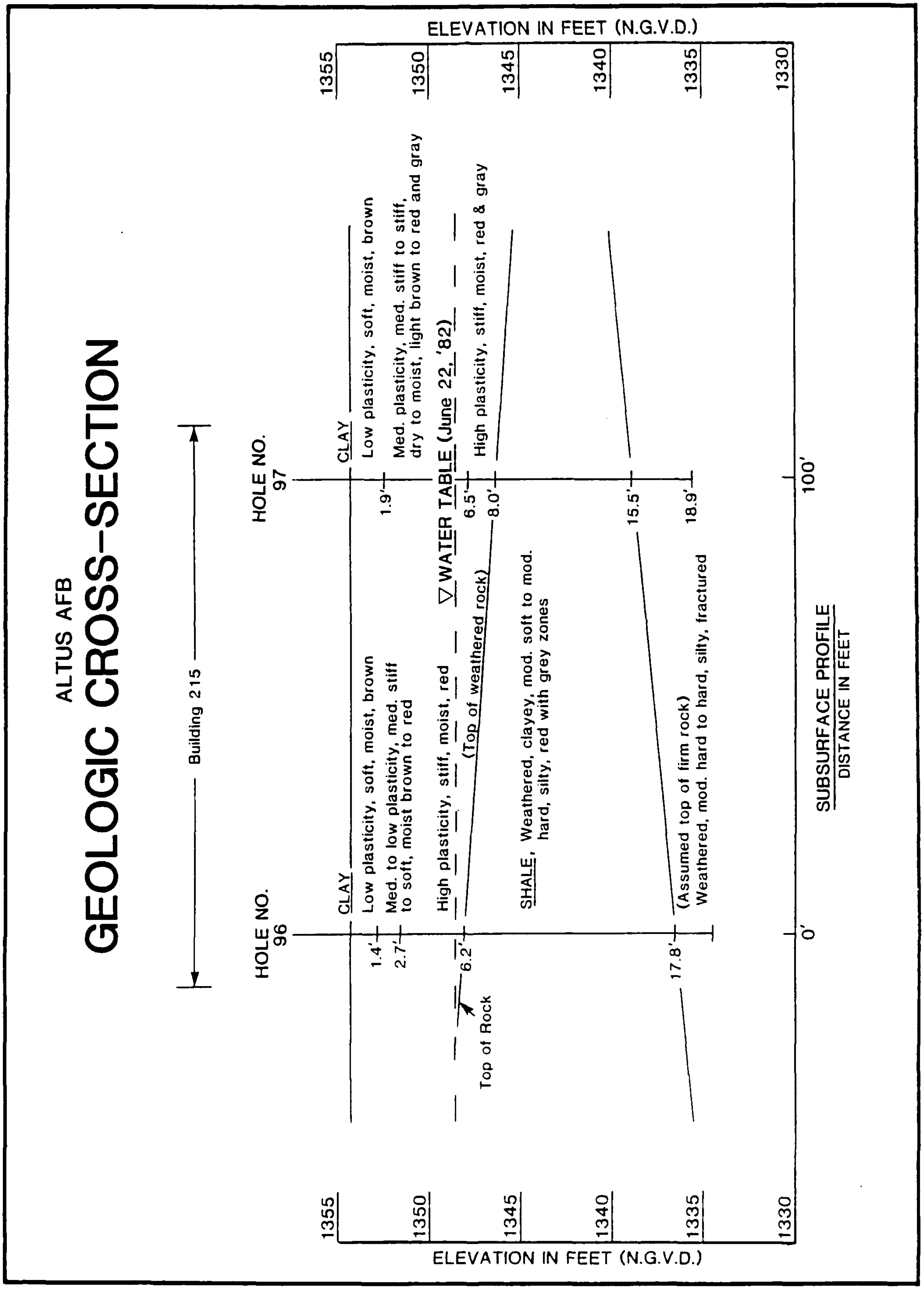
Information describing study area ground-water hydrology has been obtained from Bedinger and Sniegocki (1976); Havens (1977) and Kent (1980). Additional information has been obtained from an interview with a U.S. Geological Survey Water Resources Division hydrologist.

Altus AFB is located in an area of southwestern Oklahoma that does not possess any major aquifers. Large-scale consumers including municipalities and industries rely upon surface water sources as a primary water supply. The City of Altus uses surface and ground-water sources conjunctively to provide adequate water supplies of reasonable quality. The wells used by the City of Altus are constructed into Red River alluvium, some 16 miles south of the city. The Jackson County Water Company, which serves many rural consumers, primarily utilizes water from wells located greater than five miles northeast of Altus AFB near Warren, Oklahoma and from wells across the North Fork of the Red River in Kiowa County. Surface water also supplements the county supply.

At the installation, the principal water-bearing units likely correspond to the geologic units previously described (see Figure 3.3). These water-bearing units include the Quaternary Terrace Deposits (Qt), the Hennessey Group rocks (Phy) and the residual soil mantle overlying the Hennessey.

Most of the installation is underlain by the Hennessey Group and its residual soil cover. The residual soil is, presumably, the shallow aquifer of the study area. Several installation test borings performed at the base encountered ground water at shallow depths in the residual soil. This is probably indicative of the fact that water is essentially perched on the bedrock surface and is contained in loose or more porous zones within the soil. Water may be contained in the soil only on a


ALTUS AFB
STUDY AREA GEOLOGIC MAP
HIGHWAY 62
INSTALLATION BOUNDARY
Irrigation Canal
MUNITIONS IGLOOS
Phy
SOUTH GATE
ROAD
ORDNANCE
MAIN GATE
SCALE 0 800 1600 FEET
SIXTH STREET
215
STREET
FIRST STREET
SEVENTH
KELLWOOD DRIVE
HOUSING AREA
GOLF COURSE
Geologic Cross-Section Location for Figure 3.4
BOUNDARY
INSTALLATION
Ozark 4.6 Lateral
Ozark
Canal
Qt
LEGEND
Qt QUATERNARY TERRACE DEPOSITS, SAND, CLAY AND GRAVEL, 0-75 FT. THICK
Phy HENNESSEY GROUP. RED-BROWN TO GRAY SHALE AND SANDSTONE, 130-200 FT. THICK.
SOURCE: HAVENS, 1977


ALTUS AFB
GEOLOGIC CROSS-SECTION
Building 215
HOLE NO. 96
HOLE NO. 97
CLAY
Low plasticity, soft, moist, brown
Med. to low plasticity, med. stiff to soft, moist brown to red
High plasticity, stiff, moist, red
(Top of weathered rock)
Top of Rock
SHALE, Weathered, clayey, mod. soft to mod. hard, silty, red with grey zones
(Assumed top of firm rock)
Weathered, mod. hard to hard, silty, fractured
CLAY
Low plasticity, soft, moist, brown
Med. plasticity, med. stiff to stiff, dry to moist, light brown to red and gray
WATER TABLE (June 22, '82)
High plasticity, stiff, moist, red & gray
1.4'
2.7'
6.2'
17.8'
1.9'
6.5'
8.0'
15.5'
18.9'
ELEVATION IN FEET (N.G.V.D.)
1355
1350
1345
1340
1335
1330
0'
100'
SUBSURFACE PROFILE
DISTANCE IN FEET

seasonal basis when precipitation and subsequent percolation are greatest or may be limited to soil zones near local surface waters, including irrigation canals and ditches. The direction of ground-water flow, recharge characteristics and discharge are not certain. It is assumed that ground water contained in the soil eventually discharges to either local surface waters or to underlying geologic units, or both.

The Hennessey Group underlies the residual soils. As noted in the subsection describing geology, the unit consists of shale with sandstone and sandy or limy shale locally. The Hennessey is not considered to be a primary aquifer, although limited water resources may be obtained by constructing wells into the discontinuous sandstone lenses within it. The Hennessey is also reported to produce water having excessive hardness, sulfates, chlorides and iron locally, although just a short distance from a poor water source, quality may improve substantially. Little has been reported regarding the Hennessey's ground-water resources or its characteristics as an aquifer. According to Havens (1977), two wells have been constructed into the Hennessey near Altus AFB. One well, located some 4,000 feet west of the main gate is reported to be 60 feet deep; the depth to ground water is 19 feet and the well yield is 150 gallons per minute. The second well is located at a private dwelling approximately 4,200 feet north of Building 415 along an adjacent county road. This well is reported to be 122 feet deep. The depth to water is reported to be 60 feet and the well yield is 100 gallons per minute. It is assumed that these wells are still active and that the water resources they produce are utilized for human consumption, stock watering, crop irrigation, etc. Presumably, the Hennessey is recharged directly by precipitation falling on exposed portions of the unit, by discharge from overlying units, such as the residual soil, or by streamflow loss, where local streams traverse exposed sections. Where or how the Hennessey discharges in the study area is uncertain. The direction of flow in this unit is also unknown.

The Quaternary Terrace Deposits exist generally north of the Ozark Canal at Altus AFB. These materials consist of generally discontinuous layers of sand, silt, clay and gravel. Local stratification is apparent. The unit may be at least 10 feet thick at the base. The Terrace Deposits are the most permeable unit existing on base. They are present at or very near ground surface. It is not known if this unit contains ground water at Altus AFB, however, Kent (1980) reported that ground-water elevations in the vicinity of the base near the canal were on the order of 1,360 feet, NGVD, or about 20 feet below land surface, using 1979 data. The ground-water flow direction was reported to be generally south. Discharge to the canal is suspected. The Terrace Deposits are most likely recharged by precipitation falling directly on exposed portions of the unit. Its hydraulic communication with other waterbearing strata is uncertain. There are no known wells installed into this unit within the study area. Several miles north of the installation, the Terrace Deposits combined with Red River North Fork alluvium form an important regional aquifer. Because ground-water flow in this unit is generally south to the canal at the base, potential contaminants reaching the aquifer would not flow to the area where the unit is utilized as a source of water supplies. Rather, the contaminant flow would be south, likely discharging into the canal, at the base.

BASE WATER SUPPLIES

Altus AFB obtains its water supplies from the City of Altus. The city originally utilized the municipal reservoir located within its political jurisdiction. Water obtained from the local reservoir was determined to be of generally poor quality due to high values of naturally-occurring constituents, including calcium, sodium, chloride, sulfate and total dissolved solids (U.S. Geological Survey - Water Resources Division data, dated 25 May 1966). The City of Altus now obtains water supplies of good quality by conjunctive use of ground and surface water sources. The ground-water supplies are obtained from a municipal system based on 17 wells constructed into the Red River alluvium, some 16 miles south of the city. The surface water portion of the required water supplies are obtained from Lake Altus, approximately 15 miles north of the base, and Tom Steed Reservoir, approximately 20 miles northeast of the base. A review of current Altus AFB drinking water quality data indicates that present supplies are acceptable.

SURFACE WATER RESOURCES

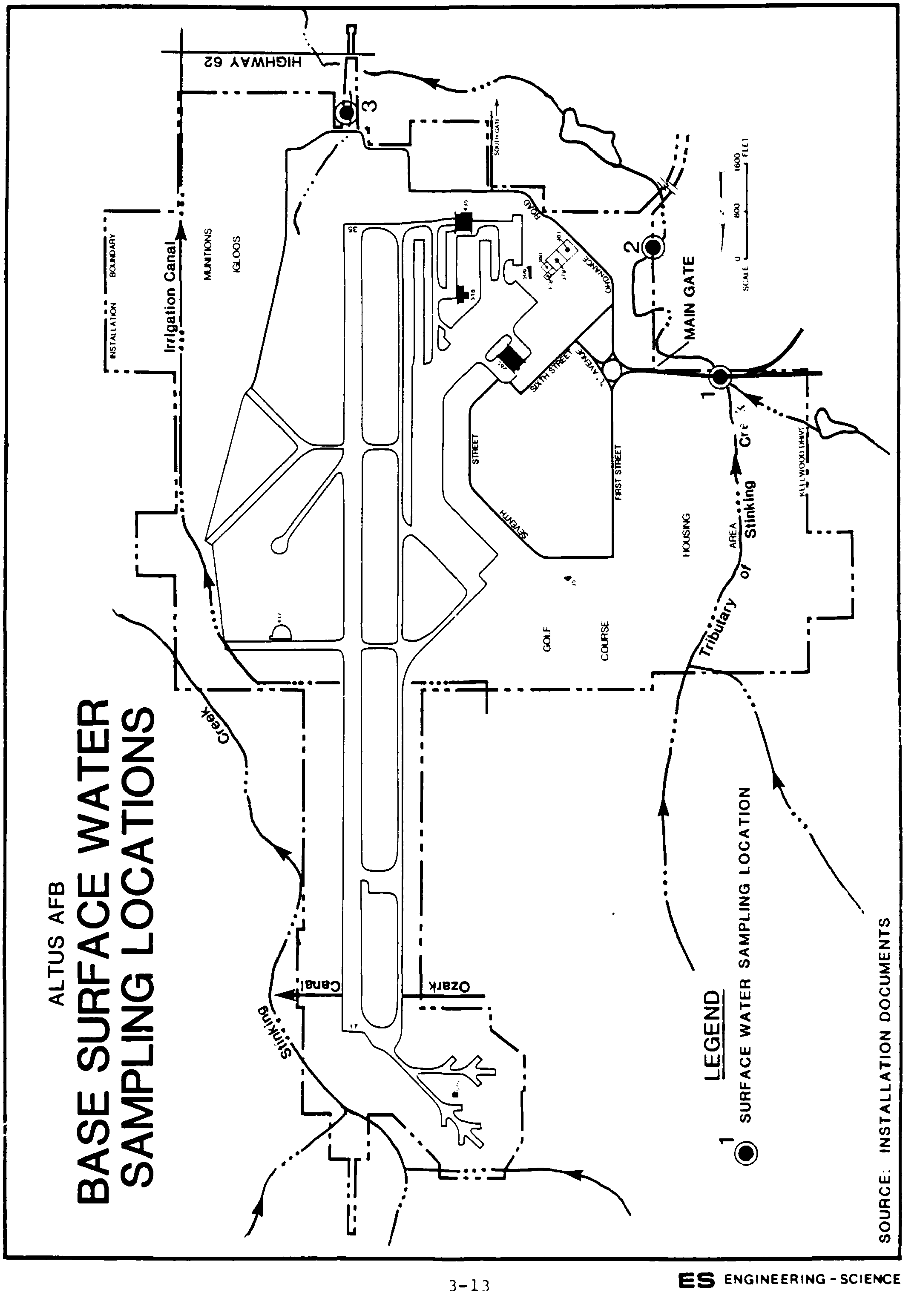
Two surface waters traverse Altus AFB. Stinking Creek, a tributary of the North Fork of the Red River, drains much of the land installation's north and east land areas. An unnamed tributary of Stinking Creek drains the west (housing) area of the base, the flightline shop area and the south part of the airfield. The Ozark Canal, which is piped beneath the extreme north end of the main runway, does not receive installation drainage. Similarly, the unnamed irrigation channel which passes under the runway and then flows south does not receive base runoff.

Stinking Creek (Stream Segment 310830) has been assigned the following "Beneficial Uses" by the Oklahoma Water Resources Board (1982):

- Public and private water supply
- Primary warm water fishery
- Agriculture
- Municipal and industrial cooling water
- Primary and secondary recreation
- Aesthetics

The unnamed tributaries to Stinking Creek have not been identified in the document Oklahoma's Water Quality Standards (Oklahoma Water Resources Board, 1982). Presumably, discharges to the tributary must not ultimately cause water quality degradation in the receiving stream.

Altus AFB routinely performs surface water quality monitoring on a quarterly basis in accordance with Air Force Regulation 19-7 at the locations shown in Figure 3.5. A review of historical surface water quality monitoring data (1980 to date - see Appendix D) indicates that base surface water quality is generally good. The only exceptions to this are noticeably elevated levels of chloride, sulfate and total dissolved solids at all three monitoring points for the entire period that data has been recorded. In addition, elevated chemical oxygen demand and total organic carbon levels were detected at monitoring points 1 and 2 during July 1984. High oil and grease levels were detected during the same time period at point 2.


ALTUS AFB
BASE SURFACE WATER
SAMPLING LOCATIONS
HIGHWAY 62
INSTALLATION BOUNDARY
Irrigation Canal
MUNITIONS IGLOOS
SOUTH GATE
ROAD
ORDNANCE
SIXTH STREET
AVENUE
STREET
SEVENTH
FIRST STREET
MAIN GATE
HOUSING AREA
GOLF COURSE
Tributary of Stinking Creek
KILLWOOD DRIVE
Stinking
Creek
Ozark
Canal
35
17
1
2
3
SCALE 0 800 1600 FEET
LEGEND
SURFACE WATER SAMPLING LOCATION
SOURCE: INSTALLATION DOCUMENTS

A Water Pollution Emissions Inventory was performed by the base BEE (Hodgson, 1984) and a copy is included in Appendix D. This study reviewed and summarized pertinent water quality data during the period 1 January, 1983 to 31 December, 1983. It concluded that high concentrations of sulfate, chloride and dissolved solids were due to natural conditions, as high levels of these constituents were detected in roughly equal concentrations at points where local surface waters both entered and exited the installation. Pesticides were also assessed. These organic parameters were detected at very low levels, usually just above the minimum laboratory detection limits (0.02 ug/l).

It has been concluded that after study of the historical base water quality data and that reported by Hodgson (1984), that the poor water quality excursion recorded in the July 1984 sampling information represents an isolated event.

THREATENED AND ENDANGERED SPECIES

There are no known species of threatened or endangered plants and animals in residence at Altus AFB. This may be due to the fact that the installation's land area has been disturbed by developmental activities over the years as the base's mission was changed or expanded. Such site use modifications may have inadvertently disrupted habitats that could have been utilized by resident or transient species. Much of the land area surrounding the base has similarly been altered by intensive agricultural activities that have occurred in the region during most of this century.

SUMMARY OF ENVIRONMENTAL SETTING

The environmental setting data reviewed for this study indicate the following key items to be significant when evaluating the potential for the migration of hazardous waste-related constituents from past waste disposal facilities:

- The calculated net precipitation value for Altus AFB is minus 42 inches annually. The one-year, 24-hour precipitation figure is given as 2.6 inches. These low values suggest a low potential for the generation or migration of contamination from a disposal site and the development of erosion.

- Surface soils mapped on the extreme north end of the base are sandy and permeable terrace materials. Their permeability may be assumed to be moderate. Soils mapped over most of the installation's land area are described as clayey residual deposits with low permeabilities and infiltration rates which promote to development of runoff to local surface waters.
- No major or regionally significant aquifers exist in the study area. The terrace deposits, in concert with alluvium form a major aquifer more than 15 miles north of the base. The postulated flow direction of ground water in this unit is south, in the vicinity of the base. Therefore, if contaminants did enter this unit at the installation, they would likely be discharged near the base into local surface waters and not be transmitted to the zone from which large populations derive potable water supplies.
- Low permeability residual soils underlie most of the installation. Ground water was encountered by several test borings in this unit at shallow depths, usually perched just above bedrock. The lateral limits, persistence, etc., of this water-bearing zone are not known. It is assumed that this unit either recharges the underlying bedrock or discharges to local surface waters, although this is unconfirmed.
- The bedrock is known to be a local aquifer. Small to moderate quantities of highly variable quality water may be obtained from discontinuous sandstone lenses in the predominantly shale bedrock. Two individual consumers are reported to use this unit as a source of water within a mile of the base.
- The City of Altus serves Altus AFB from its municipal water distribution system. The city supply is derived from surface sources and from wells into the Red River alluvium. The Jackson County Water Company provides water to most other consumers in the vicinity of the base using ground and surface supplies. These city and county ground water supplies are located several miles from the base.

- Base surface water quality monitoring data indicates that local surface waters are generally of acceptable quality with a few exceptions due primarily to natural conditions. One surface water quality excursion was noted during the July 1984 sampling period.

From these major points it may be concluded that the potential for ground-water contamination at Altus AFB is minimal. It is more probable that if contaminants are mobilized, local surface waters would become the receptor rather than ground water.

SECTION 4

FINDINGS

This section summarizes the hazardous wastes generated by installation activities, identifies hazardous waste accumulation and disposal sites located on the installation, and evaluates the potential environmental contamination from hazardous waste sites. Past waste generation and disposal methods were reviewed to assess hazardous waste management practices at Altus AFB.

INSTALLATION HAZARDOUS WASTE ACTIVITY REVIEW

A review was made of past and present installation activities that resulted in generation, accumulation and disposal of hazardous wastes. Information was obtained from files and records, interviews with past and present installation employees and site inspections.

The sources of hazardous waste at Altus AFB are grouped into the following categories:

- o Industrial Operations (Shops)
- o Waste Accumulation Areas
- o Fuels Management
- o Spills and Leaks
- o Pesticide Utilization
- o Fire Protection Training

The subsequent discussion addresses only those wastes generated at Altus AFB which are either hazardous or potentially hazardous. Potentially hazardous wastes are grouped with and referenced as "hazardous wastes" throughout this report. A hazardous waste, for this report, is defined by, but not limited to, the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA). For study purposes, waste petroleum products such as contaminated fuels, waste oils and waste solvents are also included in the "hazardous waste" category.

No distinction is made in this report between "hazardous substances/materials" and "hazardous wastes". A potentially hazardous waste is one which is suspected of being hazardous although insufficient data are available to fully characterize the material.

Industrial Operations (Shops)

Industrial operations at Altus AFB consist primarily of aircraft and vehicle maintenance, and repair activities. These and other mission support operations generate potentially hazardous materials at a number of industrial shops. The Bioenvironmental Engineering (BEE) Office provided a listing of industrial shops which was used as a basis for evaluating past waste generation and hazardous material disposal practices. The BEE individual shop files were also examined for information on hazardous material usage, and hazardous waste generation and disposal practices. From this information, a master list of industrial shops (Appendix E) was prepared showing building locations, hazardous materials handlers, hazardous waste generators, and typical treatment and disposal methods. Additionally, documents prepared by the base Civil Engineering Squadron were reviewed to develop further information on the shops located at Altus AFB.

Shops which were determined to be generators of hazardous wastes, which could pose a potential for ground-water or surface water contamination, were selected for further evaluation. During the site visit, interviews were conducted with personnel from the industrial shops, particularly the shops that generate the largest amounts of hazardous wastes. Shops generating lesser amounts of hazardous wastes were contacted by telephone. Shop interviews focused on hazardous waste materials, waste quantities, and disposal methods. Disposal timelines were prepared for each major hazardous waste from information provided by shop records, shop personnel and others familiar with the shop's operations and activities.

Table 4.1 summarizes the information obtained from the detailed shop review. The table includes a listing of the types of hazardous wastes generated at the various shops, waste quantities and disposal

TABLE 4.1

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	CURRENT WASTE QUANTITY GENERATED	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1950 – 1960 – 1970 – 1980)
USAF HOSPITAL ALTUS				
DENTAL LAB AND X RAY	47	SPENT FIXER	120 GALS./YR.	1953 SILVER RECOVERY/SANITARY SEWER
MEDICAL X RAY	46	SPENT FIXER	400 GALS./YR.	SILVER RECOVERY/SANITARY SEWER
443 AIRBASE GROUP (ABG)				
AUTO HOBBY	343	WASTE OIL	3,900 GALS./YR.	1959 DPDO
		ANTI FREEZE	3,600 GALS./YR.	OIL WATER SEPARATOR SANITARY SEWER
PHOTO LAB	136	SPENT FIXER	500 GALS./YR.	SILVER RECOVERY/SANITARY SEWER
		WET CHEMISTRY	1,000 GALS./YR.	DILUTE TO SANITARY SEWER
BASE SERVICE STATION	303	WASTE OIL	1,000 GALS./YR.	OFF BASE CONTRACT DISPOSAL
		ANTIFREEZE	250 GALS./YR.	SANITARY SEWER
		BATTERIES AND ACID	120 UNITS/YR.	OFF BASE CONTRACT DISPOSAL
443 AVIONICS MAINTENANCE SQUADRON (AMS)				
BATTERY ELECTRIC	330	LEAD BATTERY ACID	150 GALS./YR.	NEUTRALIZED TO SANITARY SEWER
		LEAD BATTERY CASES	150 CASINGS/YR.	DPDO
		NiCad BATTERY ACID	60 GALS./YR.	1968 NEUTRALIZED TO SANITARY SEWER

KEY

——— CONFIRMED TIME FRAME DATA BY SHOP PERSONNEL

- - - - - - ESTIMATED TIME FRAME DATA BY SHOP PERSONNEL

DPDO DEFENSE PROPERTY DISPOSAL OFFICE

FPTA FIRE PROTECTION TRAINING AREA

TABLE 4.1 (CONT'D)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	CURRENT WASTE QUANTITY GENERATED	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1950–1980)
BATTERY ELECTRIC (CONT'D)	330	NiCad BATTERY CASES	450 CASINGS/YR.	1968 DPDO
		CONTAMINATED SODA WATER	40 GALS./YR.	1953 DILUTED TO SANITARY SEWER
PMEL TMDE	323	MERCURY	15 LBS./YR.	DPDO
SIMULATOR	444	HYDRAULIC FLUID	36 GALS./YR.	1961 DPDO
443 FIELD MAINTENANCE SQUADRON (FMS)				
PROPULSION	296	PD 680	120 GALS./YR.	1953 DPDO
		CARBON REMOVER	25 GALS./YR.	DPDO
		FINGERPRINT REMOVER	25 GALS./YR.	DPDO
AGE	506	ENGINE OIL	660 GALS./YR.	1960 FPTA; 1983 DPDO
		PD 680	240 GALS./YR.	1953 STORM SEWER; 1970 OIL WATER SEPARATOR LAGOON SANITARY SEWER
		SYNTHETIC OIL	120 GALS./YR.	DPDO
		WASTE FUEL	7,200 GALS./YR.	RECYCLE
		WASTE FUEL	120 GALS./YR.	FPTA
GTU APU	296	ENGINE OIL	60 GALS./YR.	1960 FPTA; 1983 DPDO
		HYDRAULIC FLUID	10 GALS./YR.	FPTA; DPDO

KEY

——— CONFIRMED TIME FRAME DATA BY SHOP PERSONNEL

- - - - ESTIMATED TIME FRAME DATA BY SHOP PERSONNEL

DPDO DEFENSE PROPERTY DISPOSAL OFFICE

FPTA FIRE PROTECTION TRAINING AREA

TABLE 4.1 (CONT'D)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	CURRENT WASTE QUANTITY GENERATED	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1950 1960 1970 1980)
NDI	450	FLUORESCENT PENETRANT	40 GALS./YR.	1961 SANITARY SEWER 1975 DPDO
		EMULSIFIER	110 GALS./YR.	SANITARY SEWER DPDO
		SPENT FIXER	12 GALS./YR.	SANITARY SEWER SILVER RECOVERY
		DEODORIZED KEROSENE	55 GALS./YR.	WEED CONTROL DPDO
PNEUDRAULICS	285	PD-680	800 GALS./YR.	DPDO
		CARBON REMOVER (TRICLOBENZENE)	60 GALS./YR.	DPDO
		HYDRAULIC FLUID	1,320 GALS./YR.	DPDO
REFURBISHING	291	WASTE PAINT AND THINNERS (MEK, TOLUENE & OTHERS)	55 GALS./YR.	1970 DPDO
WHEEL AND TIRE	424	PD 680 AND SLUDGE	1,000 GALS./YR.	1953 DPDO
		STRIPPER (ELDORADO) AND SLUDGE	1,000 GALS./YR.	DPDO
TEST CELL	298	JP 4 FUEL	1,000 GALS./YR.	OIL WATER SEPARATOR SANITARY SEWER
		ENGINE OIL	300 GALS./YR.	DPDO
		HYDRAULIC FLUID	100 GALS./YR.	OIL WATER SEPARATOR SANITARY SEWER
		PD 680	150 GALS./YR.	OIL WATER SEPARATOR SANITARY SEWER
		CARBON REMOVER	10 GALS./YR.	OIL WATER SEPARATOR SANITARY SEWER

KEY

——— CONFIRMED TIME FRAME DATA BY SHOP PERSONNEL

- - - - - - ESTIMATED TIME FRAME DATA BY SHOP PERSONNEL

DPDO DEFENSE PROPERTY DISPOSAL OFFICE

FPTA FIRE PROTECTION TRAINING AREA

TABLE 4.1 (CONT'D)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	CURRENT WASTE QUANTITY GENERATED	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1950 1960 1970 1980)
WASHRACK	402	PD 680	3,600 GALS./YR.	1953 STORM SEWER – 1970 LAGOON – 1976 OIL/WATER SEPARATOR/SANITARY SEWER
		SOLVENTS AND STRIPPERS	NONE	STORM SEWER – 1969
CORROSION CONTROL	291	PAINT AND THINNERS	660 GALS./YR.	FPTA – 1974 DPDO
		ETCHING ACIDS	110 GALS./YR.	DPDO
340 CAMS		THE 340 CAMS SHOP WASTES ARE DISPOSED OF THROUGH THE 443 FMS SHOPS WITH WHICH THEY SHARE FACILITIES		
443 ORGANIZATIONAL MAINTENANCE SQUADRON (OMS)				
NON POWERED AGE	506	HYDRAULIC FLUID	40 GALS./YR.	1953 DPDO
443 TRANSPORTATION SQUADRON (TRANS)				
VEHICLE AND REFUELING TRUCK MAINTENANCE AND PAINTING	392, 351	PAINT AND THINNERS	55 GALS./YR.	DPDO
		WASTE OIL	2,860 GALS./YR.	DPDO
		WASTE OIL, THINNERS AND SOLVENTS	330 GALS./YR.	FPTA – 1974 DPDO
		BATTERY ACID	360 GALS./YR.	DPDO – 1982 NEUTRALIZED TO SANITARY SEWER
		BATTERY CASES	240 CASES/YR.	DPDO
		JP 4	2,600 GALS./YR.	OIL/WATER SEPARATOR/SANITARY SEWER

KEY

———— CONFIRMED TIME FRAME DATA BY SHOP PERSONNEL

- - - - - - ESTIMATED TIME FRAME DATA BY SHOP PERSONNEL

DPDO DEFENSE PROPERTY DISPOSAL OFFICE

FPTA FIRE PROTECTION TRAINING AREA

TABLE 4.1 (CONT'D)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	CURRENT WASTE QUANTITY GENERATED	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1950–1980)
443 SUPPLY SQUADRON (SUPS)				
FUELS MANAGEMENT AND FUELS LAB	374, 376, 445	FUELS	48,000 GALS./YR.	1953 RECYCLED
		CONTAMINATED FUEL	12,000 GALS./YR.	FPTA
443 CIVIL ENGINEERING SQUADRON (CES)				
EXTERIOR ELECTRIC	357	PCB CONTAMINATED TRANSFORMERS	6 UNITS/YR.	DPDO
ENTOMOLOGY	347	EMPTY CONTAINERS	300 CONTAINERS/YR.	LANDFILL
LIQUID FUELS MAINTENANCE	347	WASTE FUELS	100 GALS./YR.	FPTA
		TANK SLUDGE	5 GALS./YR.	LANDFILL BURIAL; WEATHERED AT SEWAGE TREATMENT PLANT
PAINT	356	PAINT AND THINNERS	330 GALS./YR.	DPDO
		EMPTY ENAMEL CANS	240 CANS/YR.	LANDFILL
POWER PRODUCTION	347	BATTERY CASES	30 UNITS/YR.	DPDO
		BATTERY ACID	200 GALS./YR.	NEUTRALIZED TO SANITARY SEWER
		WASTE OIL	440 GALS./YR.	DPDO
REFRIGERATION	356	COMPRESSOR OIL	55 GALS./YR.	DPDO

KEY

——— CONFIRMED TIME FRAME DATA BY SHOP PERSONNEL

- - - - - - ESTIMATED TIME FRAME DATA BY SHOP PERSONNEL

DPDO DEFENSE PROPERTY DISPOSAL OFFICE

FPTA FIRE PROTECTION TRAINING AREA

methods. Table 4.1 does not include the shops which generate minor quantities of hazardous waste.

Since 1953 the base shops have accomplished modifications, repairs and minor maintenance at base level in a variety of aircraft. These shops have for the most part remained in their present location for a number of years. The wastes generated in the shops at Altus AFB consist mainly of contaminated jet fuel (JP-4), waste oils and lubricants, acid and alkaline cleaning solutions, solvents and paint.

Until the mid-1970's, much of the waste fuels, oils, and solvents from the shops was taken to the fire protection training area for use in training exercises. Since the mid-1970's, the shops have disposed of the waste oils and solvents through the Defense Property Disposal Office (DPDO). Most non-flammables and synthetic oils have always been disposed of through DPDO and its predecessor agencies.

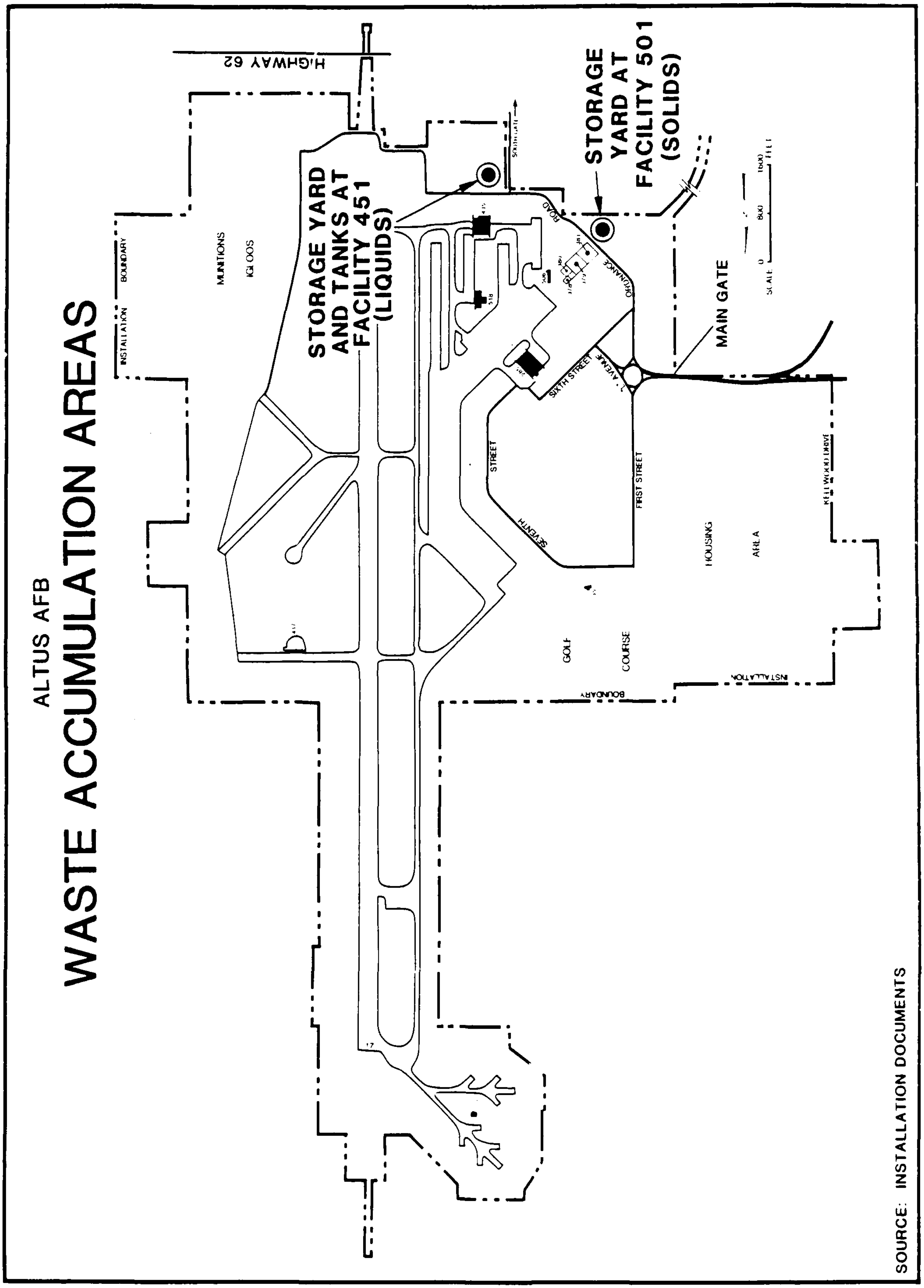
Waste Accumulation Areas

Currently shop waste materials are drummed and placed in the storage yard at Facility 451 (Figure 4.1) or placed in one of the three underground tanks (designated for waste fuel, waste oil, and waste synthetic fluids) at Facility 451. Oils from the oil-water separators are also taken to Facility 451. Some spillage is indicated on the ground at the 451 area, but evidence of major spills was not present. The underground tanks have not been cleaned or tested for leaks; however, there has been no reason to suspect tank leakage based upon present operations.

Battery cases and materials of a solid nature are placed in a holding area at Facility 501. These waste materials are contract disposed or recycled through DPDO.

Fuels Management

The Altus AFB petroleum handling system includes substantial volumes of JP-4 jet fuel, diesel fuel, motor vehicle gasoline (Mogas), unleaded gasoline, #2 fuel oil, aircraft de-icing fluid and PD-680 solvent. The capacity of the storage tanks is provided in Appendix D. The JP-4 is delivered by rail and truck the remaining products are delivered solely by truck.



SOURCE: INSTALLATION DOCUMENTS

The larger tanks, over 25,000 gallons, are cleaned every 3 years. Waste fuel from the cleaning is recycled if possible. If the contaminated fuel is not suitable for recycling it is used for fire protection training. Sludges and tank bottoms have been disposed of on the sludge drying beds at the old sewage treatment plant since 1977. Before 1977 the sludge was weathered and/or buried in diked areas and other areas on base, as discussed later in this section.

Spills and Leaks

Numerous small spills of fuels and oils were confirmed by base records and interviews with base personnel. These spills occurred on paved areas, in shop areas or along the flightline; they were contained with absorbent materials or washed into the drainage system, generally to an oil/water separator. The oil/water separators are identified in Appendix D. They discharge to the sanitary sewer system and as a result, no potential for environmental contamination is associated with these small spills.

In the late 1960's or early 1970's a fuel loss occurred in the diked bulk tank area. An estimated 2,000 to 3,000 gallons of fuel reportedly passed through an opened valve in the diked area and entered the adjoining storm drainage ditch. The drainage system was dammed and all fuel was retained on base. A large percentage of the fuel was recovered from the ditches during the cleanup operation.

A gasoline tank at the base exchange service station Facility 303 was found in 1982 to have some water leaking into the tank. A repair order was completed and it is estimated that only a minor amount of fuel was lost. The service station site and the bulk tank area drainage system are judged not to present a potential for contaminant migration.

A few small spills involving PCB oils have occurred in the past several years. The soils at these sites were removed and analyzed and those which were less than 0.5 ppm were disposed on the base.

Pesticide Utilization

Numerous types of pesticides have been used at Altus AFB. A list of the pesticides currently applied is in Appendix D. Application of pesticides has been done by entomology, pavement and grounds and golf course maintenance personnel.

Pesticides applied at the golf course are mixed at Building 32 on the golf course. Pesticide containers are rinsed and the rinsewater is used for dilution water in the sprayers. Sprayers are rinsed and runout at random locations on the golf course.

Pesticides used by entomology have been routinely mixed at Building 347. The pesticide containers are rinsed and the rinsewater is sent to the sanitary sewer. Sprayers are rinsed outside Building 347 or at the CE washrack with drainage to the sanitary sewer system.

The pesticides used by pavement and grounds have been handled as described for entomology but some container and sprayer rinsing has taken place at the AGE washrack at Building 506. The rinsewater at this location gets pumped to a nearby pond prior to entering the sanitary sewer system. A truck fillstand located near Facility 558 has at times been used to obtain dilution water for mixing pesticides but no container or sprayer rinsing took place at this location.

Empty pesticide containers and bags were disposed of at the base landfill until the solid waste was contracted for off base disposal.

Fire Protection Training

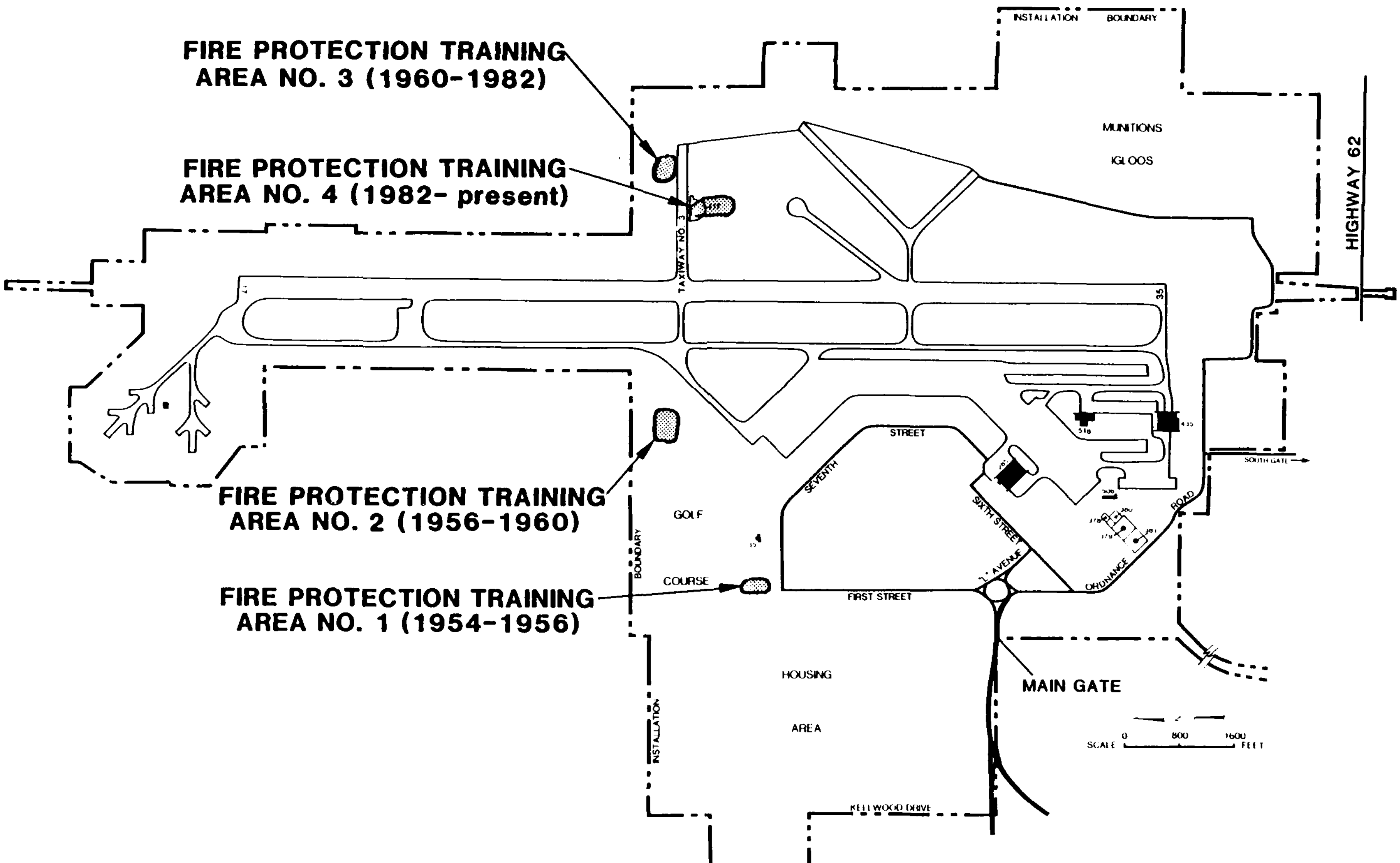
Fire protection training activities have been conducted at four known locations at Altus AFB (Figure 4.2). Appendix F presents photographs of some of the sites. The initial fire protection training area (FPTA) was reportedly located at the north end of First Street just into where the golf course is currently situated (about midway along the fairway to Hole No. 1). This site was apparently used for only a few years, approximately 1954 to 1956. It may have been used during World War II but this cannot be confirmed.

Fire Protection Training Area No. 2 was located in the eastern portion of the current golf course area, generally around the green for Hole No. 5. This site operated from 1956 to 1960 when the golf course was constructed.

The next area used for training purposes was FPTA No. 3, located near the northeastern corner of the base at the northern edge of Taxiway No. 3. This site operated from 1960 until 1982 when FPTA No. 4 was constructed. FPTA No. 4 is currently operational on the southern edge of Taxiway No. 3 near the old FPTA No. 3.

FIGURE 4.2

ALTUS AFB
FIRE PROTECTION TRAINING AREAS



SOURCE: INSTALLATION DOCUMENTS

From about 1976 until the present, the typical frequency for conducting training fires has been eight fires per quarter. Prior to 1976 the frequency was much greater. Typically in the earlier years, one training session was conducted each week. Each training session included anywhere from two to five fires.

Materials burned at the fire protection training areas from the 1950's until the mid-1970's consisted of contaminated fuels waste oils, solvents and other combustibles from shops. Since the mid-1970's cleaner fuels have been used, primarily clean and contaminated JP-4. Waste oils, solvents and thinners have not been burned as extensively as in the early years. Since 1976 the quantity of fuel used per fire has been about 300 gallons, but in the previous years 500 to 1,000 gallons was typical.

The areas used for combustion at FPTA Nos. 1,2 and 3 were shallow ground pits where the waste materials were poured prior to ignition. Water was applied to the ground before putting the fuel down only if the soil was extremely dry. Runoff from FPTA No. 3 was directed to two small ponds in series.

FPTA No. 4 is a recently constructed circular shaped facility with concrete side walls and 16 inches of aggregate placed on soil. Underdrains in the aggregate connect to an oil-water separator followed by an unlined, no-outlet evaporation pond. Water has been applied to the burning area before combustion at FPTA No. 4 since it started in 1982.

Extinguishing agents used at the fire protection training areas primarily included protein foam until the early 1970's and then aqueous film forming foam (AFFF). Chlorobromomethane was also used until about 1975. In the earlier years a water fog and carbon tetrachloride were sometimes used.

INSTALLATION WASTE DISPOSAL METHODS

The facilities at Altus AFB which have been used for management and disposal of waste are as follows:

- Landfills
- Hardfills
- Burial Areas

- Wastewater System
- Surface Drainage System

Landfills

Solid waste was being placed in landfills on Altus AFB until about the mid-1960's when disposal by contract at off base sites began. Three areas have been utilized for landfills (Figure 4.3). Table 4.2 summarizes the operations and Appendix F presents photographs of some of the sites.

The earliest landfill operation at the base was near the south end of the runway. The location of this initial operation has been somewhat indeterminate but the site shown in Figure 4.3 appears most probable. Landfill No. 1 operated during World War II and for the first few years when the base was reactivated in the 1950's. Material disposed included garbage, paper, metal, wood and occasionally some shop wastes. The area is approximately three acres. Waste was reportedly buried 5 to 6 feet deep in either an area or trench fill method and burning of the waste was a regular practice.

Landfill No. 2 operated for about a year (1955-1956) at a location near the eastern perimeter road. This site is approximately located in Figure 4.3. About four or five trenches eight feet deep were utilized for disposal of garbage, paper, wood, metal and minor amounts of shop wastes. Burning at the site occurred regularly. The site area is estimated at 0.8 acres.

Landfill No. 3 operated at the base was located in the northeast corner at the eastern end of Taxiway No. 3 (Figure 4.3). Landfill No. 3 (approximately 15 acres) was used to dispose of base solid wastes from about 1956 to the mid-1960's when contract services began taking waste off base. From the mid-1960's until 1983 the Landfill No. 3 site continued to be used for nonputrescible waste disposal. The waste disposed at the site from 1956 to the mid-1960's consisted of garbage, paper, metal, wood, sewage sludge, and some shop wastes. Disposal in these initial years was in trenches about six to eight feet deep running in an east-west direction off the end of Taxiway No. 3. Burning in the trenches occurred up through the early 1960's. In later years construction and demolition wastes, brush, concrete and a couple partially filled

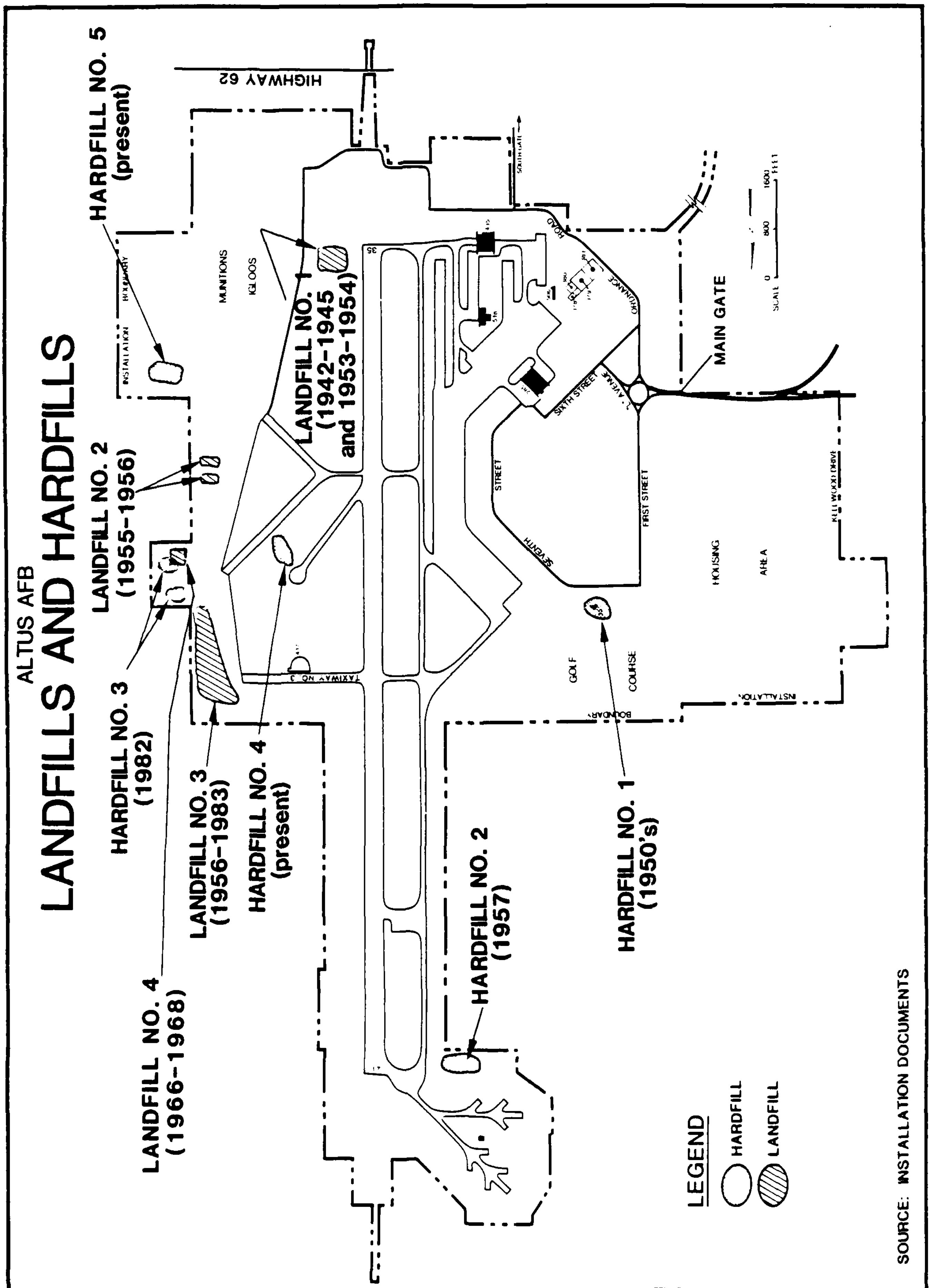

ALTUS AFB
LANDFILLS AND HARDFILLS
HARDFILL NO. 5 (present)
HIGHWAY 62
LANDFILL NO. 2 (1955-1956)
LANDFILL NO. 1 (1942-1945 and 1953-1954)
MUNITIONS IGLOOS
INSTALLATION BOUNDARY
HARDFILL NO. 3 (1982)
LANDFILL NO. 3 (1956-1983)
HARDFILL NO. 4 (present)
LANDFILL NO. 4 (1966-1968)
HARDFILL NO. 2 (1957)
HARDFILL NO. 1 (1950's)
TAXIWAY NO. 3
SOUTH GATE
ORDNANCE ROAD
SIXTH STREET
SEVENTH STREET
FIRST STREET
GOLF COURSE
HOUSING AREA
KELLWOOD DRIVE
MAIN GATE
SCALE 0 800 1600 FEET
LEGEND
HARDFILL
LANDFILL
SOURCE: INSTALLATION DOCUMENTS

TABLE 4.2
LANDFILL SITES

Site	Period of Operation	Approximate Area (acres)	Type of Wastes	Method of Operation
1	1942-1945 1953-1954	3	Garbage, paper, metal, wood and some shop wastes	Trench or area fill; 5-6 feet deep; burning
2	1955-1956	0.8	Garbage, paper, metal, wood and some shop wastes	Trench fill; four or five trenches 8 feet deep; burning
3	1956-1983	15	Garbage, paper, metal, wood, some shop wastes, construction and demolition debris, brush, concrete	Trench fill; 6-8 feet deep; burning to early 1960's; disposed of primarily hardfill materials after the mid-1960's
4	1966-1968 (approximate)	1.0	Possibly only hardfill materials	Probably trench fill

Source: Interviews and installation documents.

drums of waste paint were buried in the southern and eastern portions of the site. This material was placed in about six feet deep trenches which ran in a north-south direction. As discussed later, the northern portion of Landfill No. 3 also received periodic disposal of POL tank cleaning sludges.

Landfill No. 4, shown in Figure 4.3, is an area designated as "sanitary fill" on some early base drawings. Aerial photographs from the late 1960's indicate some filling in this area. In the mid-1960's most of the base refuse was reportedly hauled to off-base sites by contract so the wastes disposed at this location may only have been hardfill materials. Personnel familiar with the filling operations at this site were not located.

The vegetation on Landfill No. 1 and 2 sites is well established and there is no readily apparent stress. Landfill No. 3 and No. 4, however, have a few areas where the vegetation is not well developed. Landfill No. 3 has some surface indications that materials are buried at the site but surface remnants were not readily apparent at the other sites.

Hardfills

Five areas on the base have been used exclusively as hardfills. Figure 4.3 shows the location of these areas.

Hardfill No. 1, in the golf course, was used in the early 1950's during the construction activities that took place when the base was reactivated. The material buried includes concrete, asphalt, and other demolition wastes. The site is mounded above the surrounding terrain about five feet.

Hardfill No. 2, in the aircraft alert area, is a shallow (2-3 feet) burial site used for disposing of asphalt in 1957.

Hardfill No. 3 consists of two trenches excavated in 1982 to bury debris created from a tornado which passed through portions of the base.

Hardfill Nos. 4 and 5 are currently operated in the eastern section of the base. Material is currently being placed at grade without cover. Pavement, soil, wood and other such debris are disposed at these sites.

Burial Areas

In addition to the materials placed in landfills and hardfills, as previously discussed, several burial sites have been used for special wastes generated at Altus AFB (Figure 4.4). These wastes have included radioactive materials, red fuming nitric acid and sludges from cleaning of various POL tanks. Each of these has typically been buried at infrequent intervals.

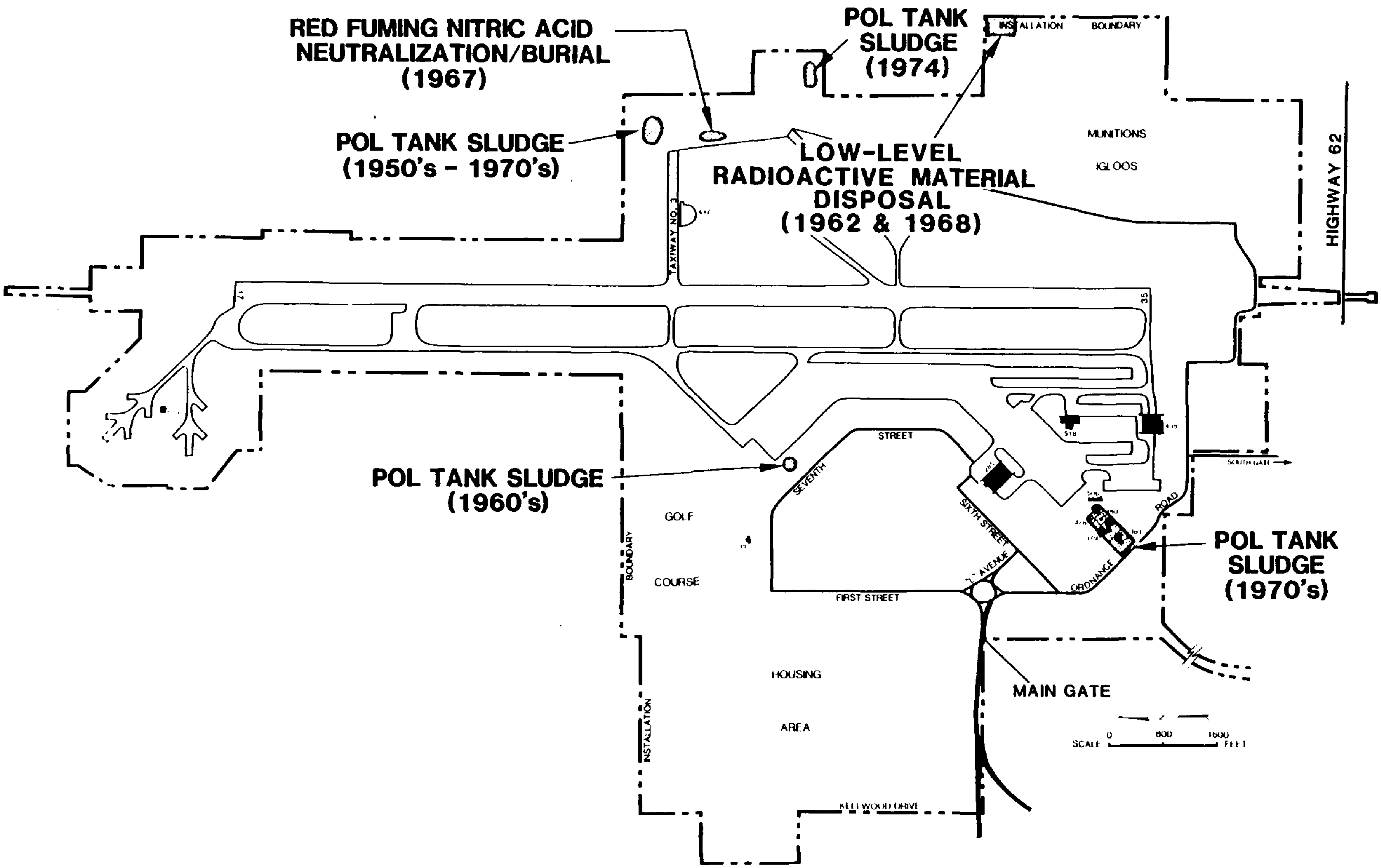
Low-level radioactive materials were disposed on two separate occasions at a site adjacent to the eastern installation boundary, as shown in Figure 4.4. The material disposed is believed to be electron tubes. In about 1962 approximately six five-gallon containers were encased in a one-foot layer of concrete and buried ten feet below grade. In 1968 approximately nine to twelve five-gallon containers were encased with concrete in 30-inch diameter concrete pipe and buried with about eleven feet of cover. The disposal site is a fenced area of approximately one-quarter acre. Ground-level readings in 1970 indicated radiation levels at and below normal background.

It has been reported that in 1967 a one-time-only disposal of 12 to 15 drums of red fuming nitric acid (RFNA) occurred east of the taxiway which borders the eastern side of Building 415 (near Landfill No. 3). A pit about 4 feet deep, 10 feet wide and 15 feet long was excavated and soaked with water. The RFNA was then dumped into the pit followed by about 10 to 15 drums of caustic solution to provide some neutralizaton of the acid. There is no evidence of vegetation stress in the vicinity of the indicated burial site.

The sludges obtained from cleaning the major POL tanks on the base have been buried at several locations as shown in Figure 4.4. The primary burial site has been at the north and northwest edge of Landfill No. 3 near the eastern end of Taxiway No. 3. This area has provided for POL sludge disposal from the 1950's through the 1970's. The sludge was usually buried three feet deep. Several other sites on the base have served as one-time-only POL disposal areas. In the early 1960's about two to three drums of sludge from the Facility 182 fuel tanks were buried in the northwest corner of the fenced Facility 182 area. In the 1970's approximately two to three drums of sludge from tank cleaning was buried at each of four different locations within the fenced bulk tank area: one in the southeast corner near Facility 397; one in the southeast corner and another in the northwest corner of bermed Facility 379;

FIGURE 4.4

ALTUS AFB WASTE DISPOSAL AREAS



SOURCE: INSTALLATION DOCUMENTS

and one in the center of the northeastern edge of the bermed Facility 381. In 1974, sludges from cleaning all tanks in the bulk tank area (Facilities 378, 379, 380 and 381) were taken to a disposal site near the eastern installation boundary (See Figure 4.4). An estimated eight to twelve drums of sludge were buried at this location. This site is adjacent to or on top of Landfill No. 4.

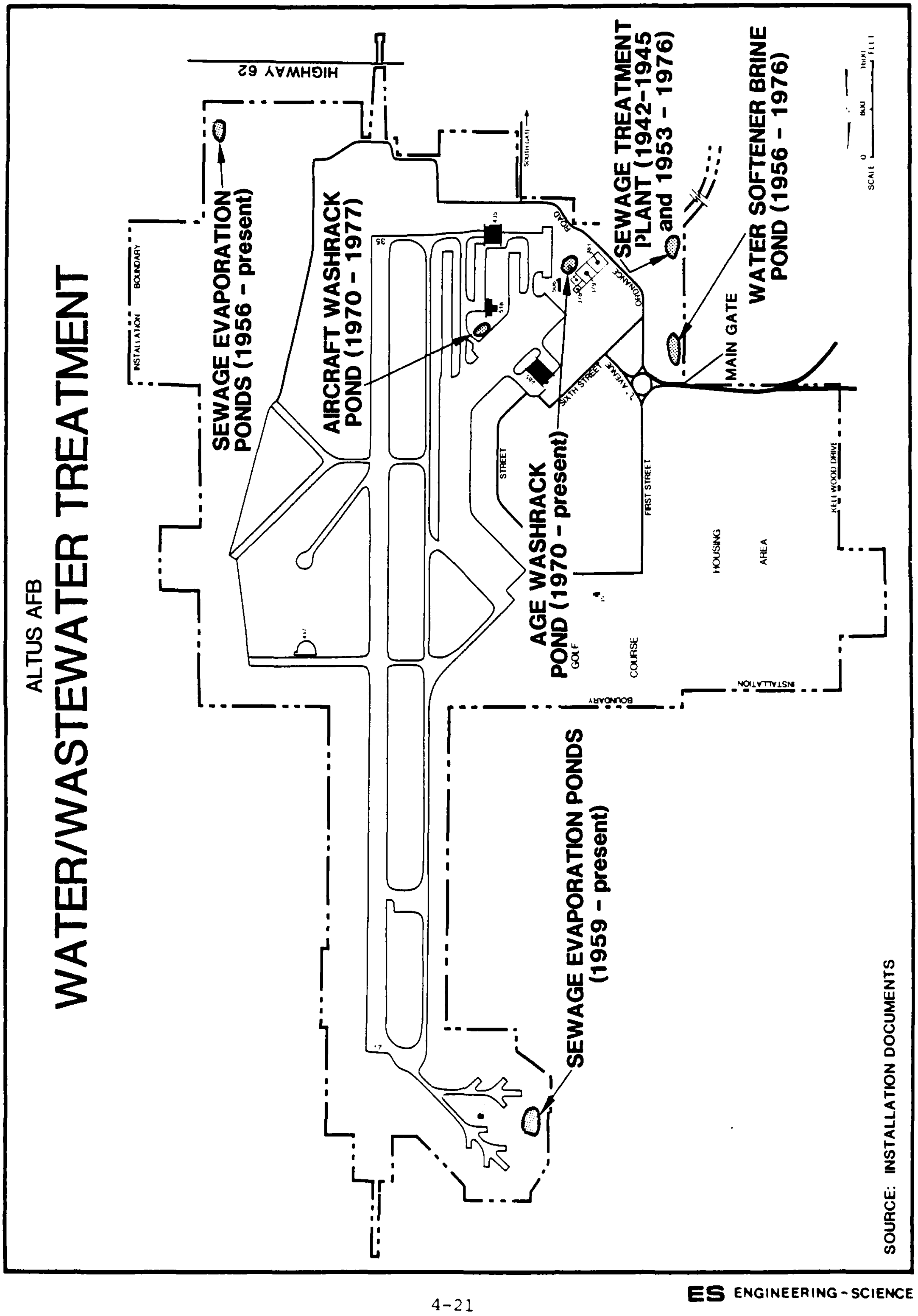
Wastewater System

Wastewater from various sources on the base has been handled by several different systems. Figure 4.5 shows the facilities which have been utilized.

The main sanitary sewerage system served most of the base during the war years and again from 1953 until 1976. The sewage treatment plant was located at the southwestern corner of the base and the effluent was discharged to an unnamed tributary of Stinking Creek. In 1976 the treatment plant was abandoned and wastewater began to be treated by the City of Altus at an off-base location. Dried sludge from the treatment plant was disposed in the base landfills. Since the base plant closed, the drying beds have received some POL tank cleaning sludge which has not yet been removed for disposal.

Two sets of evaporation ponds provide sanitary sewerage service at isolated sections of the base (Figure 4.5). One facility serves the 472-476 area and the other serves the 570 aircraft alert area. These ponds have no outlet and receive only sanitary sewage. A few of the buildings east of the runway are served by septic tank systems; these all receive only sanitary wastes.

Two unlined wastewater pretreatment ponds have been utilized at the base (Figure 4.5). One pond received wastewater from an aircraft washrack (Facility 402 near Building 518) from 1970 to 1977. Effluent from this pond discharged to the storm drainage system. In 1976-1977 this pond was abandoned and filled in with soil. It was replaced with an oil-water separator which was then connected to the sanitary sewer. Another pretreatment wastewater pond has served the AGE washrack area (Building 506) since 1970. A sand and grease trap precede the pond and the pond effluent discharges through a grease trap to the sanitary sewer system.



SOURCE: INSTALLATION DOCUMENTS

A holding-evaporation pond operated near the main gate of the base from 1956 to 1976. This lagoon received brine wastes from the base water softening plant. The need for the brine pond was eliminated when the quality of the city water supply changed.

Surface Drainage System

As discussed previously, the surface drainage system at Altus AFB consists of storm sewers and open ditches/channels. The drainage system has received accidental fuel spills and prior to 1970 discharges from washracks. Surface water quality does not indicate any contamination from the discharges which have reached the drainage system.

Incinerators

Incinerators are located at Facilities 46 and 72 at Altus AFB. Facility 46 is the base hospital which uses the incinerator to dispose of pathological materials. The SAC incinerator located at Facility 72 is used to incinerate classified information and overseas refuse which is considered hazardous by the U.S. Department of Agriculture (USDA). No Environmental Protection Agency (EPA) classified hazardous wastes are treated at either incinerator.

Explosive Ordnance Disposal

The area east of the perimeter road and the munitions igloos was designated an area for explosive ordnance disposal during the period when SAC was host at Altus (1953-1968). It is uncertain whether any specific pits were used for burning. The frequency of burning waste explosives at the site was reported to have been very infrequent. Surface evidence of extensive burning does not exist.

EVALUATION OF PAST DISPOSAL ACTIVITIES AND FACILITIES

Review of past waste generation and management practices at Altus AFB has resulted in identification of 30 sites and/or activities which were considered as areas of concern for potential contamination and migration of contaminants.

Sites Eliminated from Further Evaluation

The sites of initial concern were evaluated using the Flow Chart presented in Figure 1.2. Sites not considered to have a potential for contamination were deleted from further evaluation. The sites which have potential for contamination and migration of contaminants were evaluated using the Hazard Assessment Rating Methodology (HARM). Table 4.3 summarizes the results of the flow chart logic for each of the areas of initial concern.

Twenty of the 30 sites/activities assessed did not warrant further evaluation. The rationale for omitting these from HARM evaluation is discussed below.

Landfill No. 4 operated for only a couple years and since most wastes were being hauled off base at the time it is believed this facility received primarily hardfill materials. There is no reason to suspect potential contamination from this site based upon discussions with interviewees.

The various hardfill sites at the base have received construction and demolition debris, brush and other bulky materials. There is no evidence of hazardous waste disposal at these sites. Therefore these were not evaluated further.

The one-time burial of red fuming nitric acid (RFNA) was accompanied by steps to neutralize the material during the disposal operations. No surface evidence of contamination exists. Based upon the volume and the procedures utilized, this site was eliminated from further evaluation.

Low-level radioactive waste material at the base was encapsulated in concrete and buried with substantial soil cover. The radioactive material disposed was solid and not liquid. Ground level readings have not indicated any evidence of radioactivity above normal background levels. Based upon these data there is no reason to suspect contamination from this burial site.

Three areas on base (east boundary, bulk tanks and Facility 182) have received one-time-only burial of sludge resulting from cleaning various POL storage tanks. The volume of material buried on each occasion was small and the sites are judged not to be a potential for environmental contamination.

The wastewater treatment system has received periodic discharges of shop wastes. No major upsets were reported from the industrial-type wastes. Dried sludge from the treatment plant was placed in the base landfills. The sewage evaporation ponds and septic tank systems serving

TABLE 4.3
SUMMARY OF FLOW CHART LOGIC FOR AREAS OF
INITIAL HEALTH, WELFARE AND ENVIRONMENTAL CONCERN
AT ALTUS AFB

Site	Potential Hazard to Health, Welfare or Environment	Need for Further IRP Evaluation/ Action	HARM Rating
Landfill No. 1	Ye,	Yes	Yes
Landfill No. 2	Yes	Yes	Yes
Landfill No. 3	Yes	Yes	Yes
FPTA No. 1	Yes	Yes	Yes
FPTA No. 2	Yes	Yes	Yes
FPTA No. 3	Yes	Yes	Yes
FPTA No. 4	Yes	Yes	Yes
POL Tank Sludge Burial (At Landfill No. 3)	Yes	Yes	Yes
Aircraft Washrack Pond	Yes	Yes	Yes
AGE Washrack Pond	Yes	Yes	Yes
Landfill No. 4	No	No	No
Hardfill No. 1	No	No	No
Hardfill No. 2	No	No	No
Hardfill No. 3	No	No	No
Hardfill No. 4	No	No	No
Hardfill No. 5	No	No	No
RFNA Neutralization/Burial	No	No	No
Low-Level Radioactive Material Disposal	No	No	No
POL Tank Sludge Burial			
(East Boundary - 1974)	No	No	No
(Bulk Tank Area - 1970's)	No	No	No
(Facility 182 - 1960's)	No	No	No
Wastewater System	No	No	No
Sewage Evaporation Ponds	No	No	No
Water Softener Brine Pond	No	No	No
Surface Drainage System	No	No	No
Spill and Leak Areas	No	No	No
Waste Accumulation Areas	No	No	No
Pesticide Handling	No	No	No
Incinerators	No	No	No
Explosive Ordnance Disposal	No	No	No

Source: Engineering-Science

other portions of the base have no history of receiving hazardous materials. The brine evaporation pond previously used in the water treatment operations did not receive hazardous wastes. Based upon these water and wastewater system activities no further evaluation is warranted.

The surface drainage system has through the years of base activity received periodic spills (primarily fuels) and some routine pretreated discharges from the aircraft washrack pond. Water quality data does not suggest any contamination from these activities, therefore further assessment of the surface drainage system has been eliminated.

Several spills and leaks have been reported to have occurred at the base. Most of the flightline spills have been small and generally evaporate on the pavement. The larger flightline spills have been absorbed or diluted and washed to the storm drainage system by fire protection personnel. Other POL leaks on base have generally been controlled and contained on base with recovery of most fuels. The historical information concerning spills and leaks does not suggest potential for environmental contamination.

There are no records of major spills or leaks at waste accumulation areas on base. The 451 waste storage area has no history of tank leakage; evidence of routine spills exist at the site but significant losses have not been reported. Therefore, waste accumulation sites have been eliminated from further assessment.

The methods used for handling pesticides on the base do not suggest potential contamination. Containers have been routinely rinsed and properly disposed.

The incinerators on base have no indication of operations which cause hazardous disposal of wastes. Similarly, the explosive ordnance disposal area was reportedly used infrequently and has no evidence of potential contamination.

Sites Evaluated Using HARM

The remaining ten sites identified in Table 4.3 were evaluated using the Hazard Assessment Rating Methodology. The HARM process takes into account characteristics of potential receptors, waste characteristics, pathways for migration, and specific characteristics of the site related to waste management practices. Results of the HARM analysis for the sites are summarized in Table 4.4. The POL tank cleaning sludge disposal activity which has taken place as a part of Landfill No. 3 has been rated with the landfill. Thus, only nine harm ratings appear in Table 4.4.

The procedures used in the HARM system are outlined in Appendix G and the specific rating forms for the ten sites at Altus AFB are presented in Appendix H. The HARM system is designed to indicate the relative need for follow-on action.

TABLE 4.4
SUMMARY OF HARM SCORES FOR
POTENTIAL CONTAMINATION SITES
AT ALTUS AFB

Rank	Site	Receptor Subscore	Waste Charac-teristics Subscore	Pathways Subscore	Waste Management Factor	HARM Score
1	Aircraft Washrack Pond	51	100	56	1.0	69
2	AGE Washrack Pond	56	80	56	1.0	64
3	FPTA No. 3	56	80	56	1.0	64
4	Landfill No. 3/ POL Tank Sludge Burial	56	48	56	1.0	53
5	FPTA No. 2	49	64	41	1.0	51
6	FPTA No. 1	53	48	48	1.0	50
7	FPTA No. 4	52	48	48	0.95	47
8	Landfill No. 1	44	32	56	1.0	44
9	Landfill No. 2	48	32	41	1.0	40

Source: Engineering-Science

SECTION 5

CONCLUSIONS

The goal of the IRP Phase I study is to identify sites where there is potential for environmental contamination resulting from past waste disposal practices and to assess the probability of contamination migration from these sites. The conclusions given below are based on field inspections; review of records and files; review of the environmental setting; interviews with base personnel, past employees and local, state and federal government employees; and assessments using the HARM system. Table 5.1 contains a list of the potential contamination sources identified at Altus AFB and a summary of the HARM scores for those sites.

AIRCRAFT WASHRACK POND

The abandoned aircraft washrack pond site has sufficient potential to create environmental contamination to justify follow-on investigations. The unlined pond received cleaning solvents (PD-680) and associated oils and grease for several years in the early 1970's prior to discharging to the surface drainage system. The pond was filled in and abandoned when an oil-water separator was constructed in 1976-1977. The waste characteristics predominately influence the total HARM score of 69.

AGE WASHRACK POND

The AGE washrack pond has sufficient potential to create environmental contamination to justify follow-on investigations. This unlined pond has been receiving cleaning solutions (PD-680), oils and grease, and other wastes since about 1970. Effluent from the pond discharges to a sanitary sewer. The waste characteristics subscore contributes to a total HARM score of 64.

TABLE 5.1
SITES EVALUATED USING THE
HAZARD ASSESSMENT RATING METHODOLOGY
ALTUS AFB

Rank	Site	Operation Period	HARM Score (1)
1	Aircraft Washrack Pond	1970-1977	69
2	AGE Washrack Pond	1970-present	64
3	FPTA No. 3	1960-1982	64
4	Landfill No. 3/ POL Tank Sludge Burial	1956-1983	53
5	FPTA No. 2	1956-1960	51
6	FPTA No. 1	1954-1956	50
7	FPTA No. 4	1982-present	47
8	Landfill No. 1	1942-1945; 1953-1954	44
9	Landfill No. 2	1955-1956	40

(1) This ranking was performed according to the Hazard Assessment Rating Methodology (HARM) described in Appendix G. Individual rating forms are in Appendix H.

FIRE PROTECTION TRAINING AREA NO.3

FPTA No. 3 has sufficient potential to create environmental contamination to justify follow-on investigations. This FPTA served the base for nearly 22 years. Contaminated fuels, waste oils, and other combustible shop wastes such as solvents and thinners have been burned at this site. Until 1976, weekly training sessions consisting of from two to five fires were typical without pre-application of water on the site. The waste characteristics subscore results in a total HARM score of 64.

LANDFILL NO. 3/POL TANK SLUDGE BURIAL

The site of Landfill No. 3 and long-term POL tank sludge burial is judged to have minimal potential for environmental contamination. The quantity of shop wastes disposed of in the landfill were reported low; most wastes went to the fire protection training area or off base. The waste characteristics subscore is mainly due to the POL tank cleaning sludge. The sludge weathering and/or infrequent burial will minimize potential contamination from the site. The overall HARM score for the site is 53.

FIRE PROTECTION TRAINING AREA NO. 2

FPTA No. 2 is judged to have minimal potential for environmental contamination. Weekly fire training sessions occurred in the five years that this site operated; however the location of the facility results in relatively low receptor and pathways subscores. The routine burning over only a few years should result in a small quantity of residual materials. In addition, construction of the golf course disturbed much of the old site. The total HARM score for the site is 51.

FIRE PROTECTION TRAINING AREA NO. 1

This fire protection training site is considered to have minimal potential for environmental contamination. The short period of operation (three years) and regular combustion results in a small quantity of potential residuals at the site. Construction of the golf course will have disturbed much of this old site. The pathways subscore contributes to the total HARM score of 50.

FIRE PROTECTION TRAINING AREA NO. 4

FPTA No. 4 is judged to have minimal potential for environmental contamination. The few years of operation and reduced frequency of fires in recent years results in a small quantity of wastes. The underdrain system for the burning area and the oil-water separator and evaporation pond for underflow will assist in recovering most of the combustion products. The HARM score for this site was 47.

LANDFILL NO.1

The Landfill No. 1 site is considered to have minimal potential for environmental contamination. Only small quantities of shop wastes are suspected to have been disposed at the site. This landfill operated for only a few years and routine burning will have minimized many residual materials. The waste characteristics subscore influences the total HARM score of 44.

LANDFILL NO.2

The Landfill No. 2 site is considered to have minimal potential for environmental contamination. Small quantities of shop wastes are suspected to have been disposed at the site during its short period of operation. Burning of wastes at the site will have minimized residual materials. The waste characteristics subscore influences the total HARM score of 40.

SECTION 6

RECOMMENDATIONS

Nine sites were identified at Altus AFB as having the potential for environmental contamination. These sites have been evaluated and rated using the HARM system which assesses their relative potential for contamination and provides the basis for determining the need for additional Phase II IRP investigations. Three of the nine sites have sufficient potential to create environmental contamination and warrant Phase II investigations. The sites evaluated have been reviewed concerning land use restrictions which may be applicable.

RECOMMENDED PHASE II MONITORING

The subsequent recommendations are made to further assess the potential for environmental contamination from waste disposal areas at Altus AFB. The recommended actions are sampling and monitoring programs to determine if contamination does exist at the site. If contamination is identified in this first-step investigation, the Phase II sampling program should be expanded to define the extent and type of contamination. The recommended monitoring program is summarized in Table 6.1 and discussed below for each site. It is noted that soil borings and soil samples are recommended at the three sites in lieu of monitoring wells. This is due to the potential low probability of developing wells within the perched water table. If water is encountered, however, wells should be installed and ground water samples taken for analysis rather than conducting soil analyses.

Aircraft Washrack Pond

It is recommended that a magnetometer survey be initially conducted at the abandoned aircraft washrack pond site. Performing a survey using a close grid (10 to 20 feet) should enable developing an outline of the physical limits of the old pond facility. After the pond area is defined, it is recommended that four borings be obtained through the old

TABLE 6.1
RECOMMENDED MONITORING PROGRAM FOR PHASE II IRP
AT ALTUS AFB

Site (Rating Score)	Recommended Monitoring Program
Aircraft Washrack Pond (69)	Conduct a magnetometer survey at close grid spacing (10 to 20 ft) across the site to define the former pond location. Obtain four soil borings within the pond area and one outside the area for control purposes. Collect soil samples every foot in the first 10 ft and then sample every 5 ft to bedrock. Visually classify each soil sample. Based upon the observations of the soils obtained in the first 10 ft, select 4 samples for chemical analyses. Analyze the soil samples for the parameters in Table 6.2. If groundwater is encountered in the borings install a screen and develop a well for sampling in lieu of soil analyses.
AGE Washrack Pond (64)	Obtain six soil borings around the pond site and one at a more remote location for control purposes. Collect soil samples every foot in the first 10 ft and then sample every 5 ft to bedrock. Visually classify each soil sample. Based upon the observations of the soils obtained in the first 10 ft, select 4 samples for chemical analyses. Analyze the soil samples for the parameters in Table 6.2. If groundwater is encountered in the borings install a screen and develop a well for sampling in lieu of soil analyses.

TABLE 6.1
(Continued)
RECOMMENDED MONITORING PROGRAM FOR PHASE II IRP
AT ALTUS AFB

Site (Rating Score)	Recommended Monitoring Program
FPTA No. 3 (64)	Obtain seven soil borings within the burning and runoff pond area and one control boring outside the area for control. Collect soil samples every foot in the first 10 ft and then sample every 5 ft to bedrock. Visually classify each soil sample. Based upon the observations of the soils obtained in the first 10 ft, select 4 samples for chemical analyses. Analyze the soil samples for the parameters in Table 6.2. If groundwater is encountered in the borings install a screen and develop a well for sampling in lieu of soil analyses.

Source: Engineering-Science

TABLE 6.2
RECOMMENDED LIST OF ANALYTICAL PARAMETERS FOR PHASE II IRP
AT ALTUS AFB

Aircraft Washrack Pond and AGE Washrack Pond

Oil and Grease
Volatile Hydrocarbons

Fire Protection Training Area No. 3

Oil and Grease
Volatile Hydrocarbons
Lead

Source: Engineering-Science

facility. One boring located away from the site would be used for control. Soil samples taken in the upper ten feet would be used to characterize the various layers where pollutants may have traveled. Visual observations and classification of the soils will enable selectively choosing four samples for chemical analysis (Table 6.2). Deeper soil samples are also recommended to characterize the soil layer above the bedrock.

AGE Washrack Pond

To assess the potential contamination from the AGE pond, it is recommended that six soil borings be obtained around the pond and one at another location for control. The borings would obtain several samples in the upper ten feet (the same as for the aircraft washrack pond) to characterize the potential pollutant pathways. Four samples would be selected from the upper ten feet for chemical analyses (Table 6.2) based upon visual observations and classification of the soils. Deeper samples are also recommended as noted in Table 6.1.

Fire Protection Training Area No. 3

At the recently abandoned (1982) FPTA No. 3 it is recommended that seven borings be obtained within the old burning and runoff pond area. One boring at another location will serve for control purposes. As with the two ponds described above, samples are recommended frequently in the upper ten feet and then at a greater interval to bedrock. Four samples from the upper ten feet in each boring are recommended for the analyses noted in Table 6.2. Deeper samples would receive the same analyses.

OTHER SITES

The remaining six sites out of the nine evaluated have minimal potential to create environmental contamination. Based upon the data accumulated in this investigation, residual materials at these sites are judged to be small due to the short period of operation, extensive combustion, and/or small quantities disposed. No further action is considered necessary for these six sites.

RECOMMENDED GUIDELINES FOR LAND USE RESTRICTIONS

It is desirable to have land use restrictions for the identified sites to (1) provide continued protection of human health, welfare, and environment, (2) insure that migration of potential contaminants is not promoted through improper land uses, (3) facilitate compatible development of future USAF facilities and (4) allow identification of property which may be proposed for excess or outlease.

A description of the land use restriction guidelines is included in Table 6.3. The recommended guidelines for land use restrictions at each identified disposal site at Altus AFB are presented in Table 6.4. Land use restrictions at sites recommended for on-site monitoring should be re-evaluated upon completion of the Phase II program and appropriate changes made.

TABLE 6.3
DESCRIPTION OF GUIDELINES FOR LAND USE RESTRICTIONS

Guideline	Description
Construction on the site	Restrict the construction of structures which make permanent (or semi-permanent) and exclusive use of a portion of the site's surface.
Excavation	Restrict the disturbance of the cover or subsurface materials.
Well construction on or near the site	Restrict the placement of any wells (except for monitoring purposes) on or within a reasonably safe distance of the site. This distance will vary from site to site, based on prevailing soil conditions and ground-water flow.
Agricultural use	Restrict the use of the site for agricultural purposes to prevent food chain contamination.
Silvicultural use	Restrict the use of the site for silvicultural uses (root structures could disturb cover or subsurface materials).
Water infiltration	Restrict water run-on, ponding and/or irrigation of the site. Water infiltration could produce contaminated leachate.
Recreational use	Restrict the use of the site for recreational purposes.
Burning or ignition sources	Restrict any and all unnecessary sources of ignition, due to the possible presence of flammable compounds.
Disposal operations	Restrict the use of the site for waste disposal operations, whether above or below ground.
Vehicular traffic	Restrict the passage of unnecessary vehicular traffic on the site due to the presence of explosive material(s) and/or of an unstable surface.
Material storage	Restrict the storage of any and all liquid or solid materials on the site.
Housing on or near the site	Restrict the use of housing structures on or within a reasonably safe distance of the site.

TABLE 6.4
RECOMMENDED GUIDELINES AT POTENTIAL CONTAMINATION SITES FOR LAND USE RESTRICTIONS
ALTUS AFB

Site Name	Construction	Excavation	Wells	Agriculture	Silviculture	Water Infiltration	Recreation	Burning	Disposal Operations	Vehicular Traffic	Material Storage	Housing
Aircraft Washrack Pond	NR	NR	R	NR	R	R	NR	NR	R	NR	NR	R
AGE Washrack Pond	NR	NR	R	NA	NA	NA	R	R	NA	NA	NA	R
FPTA No. 3	NR	NR	R	NR	R	R	NR	NR	R	NR	NR	R
Landfill No. 3/POL Tank Sludge Burial	R	R	R	NR	R	R	NR	NR	R	NR	NR	R
FPTA No. 2	NR	NR	R	NR	R	R	NR	NR	R	NR	NR	R
FPTA No. 1	NR	NR	R	NR	R	R	NR	NR	R	NR	NR	R
FPTA No. 4	NR	NR	R	NR	R	R	NR	NR	R	NR	NR	R
Landfill No. 1	R	R	R	NR	R	R	NR	NR	R	NR	NR	R
Landfill No. 2	R	R	R	NR	R	R	NR	NR	R	NR	NR	R

Notes: R = Restrict the use of the site for this purpose.
NR = No restriction of the site for this purpose.
NA = Not applicable.

Source: Engineering-Science

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APPENDICES

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APPENDIX A

BIOGRAPHICAL DATA

Biographical Data

ROBERT L. THOEM
Civil/Environmental Engineer

Personal Information

Date of Birth: August 26, 1940

Education

B.S. Civil Engineering, 1962, Iowa State University, Ames, IA
M.S. Sanitary Engineering, 1967, Rutgers University, New Brunswick, NJ

Professional Affiliations

Registered Professional Engineer in six states
American Academy of Environmental Engineering (Diplomate)
American Society of Civil Engineers (Fellow)
National Society of Professional Engineers (Member)
Water Pollution Control Federation (Member)

Honorary Affiliations

Who's Who in Engineering
Who's Who in the Midwest
USPHS Traineeship

Experience Record

1962-1965 U.S. Public Health Service, New York, NY. Staff Engineer, Construction Grants Section (1962-1964). Technical and administrative management of grants for municipal wastewater facilities.

Water Resources Section Chief (1964-1965). Supervised preparation of regional water supply and pollution control reports.

1966-1983 Stanley Consultants, Muscatine, IA and Atlanta, GA. Project Manager and Project Engineer (1966-1973). Responsible for managing studies and preparing reports for a variety of industrial and governmental environmental projects.

Environmental Engineering Department Head (1973-1976). Supervised staff involved in auditing environmental practices, conducting studies and preparing reports concerning water and wastewater systems, solid waste and resource recovery and water resources projects (industrial and governmental).

Resource Management Department Head (1976-1982). Responsible for multidiscipline staff engaged in planning and design of water and wastewater systems, solid waste and resource recovery, water resources, bridge, site development and recreational projects (industrial, domestic and foreign governments).

Associate Chief Environmental Engineer (1980-1983). Corporate-wide quality assurance responsibilities on environmental engineering planning projects.

Operations Group Head and Branch Office Manager (1982-1983). Directed multidiscipline staff responsible for planning and design of steam generation, utilities, bridge, water and wastewater systems, solid waste and resource recovery, water resources, site development and recreational projects (industrial, domestic and foreign governments). Administered branch office support activities.

Project Manager/Engineer for over 25 industrial projects, 25 city and county projects ranging in present study area population from 1,400 to 1,700,000, 10 regional (multi-county) planning or operating agency projects, five state agency projects, 10 projects for federal agencies, and several projects for Middle East governments.

1983-Date Engineering-Science. Senior Project Manager. Responsible for managing a variety of environmental projects. Conducted hazardous waste investigations at seven U.S. Air Force installations to identify the potential migration of contaminants resulting from past disposal practices under the Phase I Installation Restoration Program. Evaluated solid waste collection, disposal and potential for resource recovery at a U. S. Army post.

Publications and Presentations

Thirteen presentations and/or papers in technical publications dealing with solid waste, sludge, water, wastewater and project cost evaluations.

Biographical Data

JOHN R. ABSALON
Hydrogeologist

Personal Information

Date of Birth: 12 May 1946

Education

B.S. in Geology, 1973, Upsala College, East Orange, New Jersey

Professional Affiliations

Certified Professional Geologist (Indiana No. 46) (Virginia No. 241)
Association of Engineering Geologists
Geological Society of America
National Water Well Association

Experience Record

1973-1974 Soil Testing Incorporated-Drilling Contractors, Seymour, Connecticut. Geologist. Responsible for the planning and supervision of subsurface investigations supporting geotechnical, ground-water contamination, and mineral exploitation studies in the New England area. Also managed the office staff, drillers, and the maintenance shop.

1974-1975 William F. Loftus and Associates, Englewood Cliffs, New Jersey. Engineering Geologist. Responsible for planning and management of geotechnical investigations in the northeastern U.S. and Illinois. Other duties included formal report preparation.

1975-1978 U.S. Army Environmental Hygiene Agency, Fort McPherson, Georgia. Geologist. Responsible for performance of solid waste disposal facility siting studies, non-complying waste disposal site assessments, and ground-water monitoring programs at military installations in the southeastern U.S., Texas, and Oklahoma. Also responsible for operation and management of the soil mechanics laboratory.

1978-1980 Law Engineering Testing Company, Atlanta, Georgia. Engineering Geologist/Hydrogeologist. Responsible for the project supervision of waste management, water quality assessment, geotechnical, and hydrogeologic studies at commercial, industrial, and government

John R. Absalon (Continued)

facilities. General experience included planning and management of several ground-water monitoring programs, development of remedial action programs, and formulation of waste disposal facility liner system design recommendations. Performed detailed ground-water quality investigations at an Air Force installation in Georgia, a paper mill in southwestern Georgia, and industrial facilities in Tennessee.

1980-Date Engineering-Science. Hydrogeologist. Responsible for supervising efforts in waste management, solid waste disposal, ground-water contamination assessment, leachate generation, and geotechnical and hydrogeologic investigations for clients in the industrial and governmental sectors. Performed geologic investigations at twelve Air Force bases and otherindustrial sites to evaluate the potential for migration of hazardous materials from past waste disposal practices. Conducted RCRA ground-water monitoring studies for industrial clients and evaluated remedial action alternatives for a county landfill in Florida. Conducted quality management, hydrogeologic and ground-water quality programs for the pulp and paper industry at several mills located in the Southeast United States.

Publications and Presentations

Eleven presentations and/or papers in technical publications or conferences dealing with geology, ground water, and waste disposal/ ground water interaction.

Biographical Data

BRIAN D. MORETH
Environmental Engineer

Personal Information

Date of Birth: 27 September 1949

Education

B.S. in Forest Science and Zoology, 1971, Pennsylvania State University, University Park

Wildlife Management, Pennsylvania State University, University Park

Professional Affiliations

American Fisheries Society
Society of American Foresters
Wildlife Society

Honory Affiliations

Phi Epsilon Phi
Phi Sigma
Xi Sigma Phi

Experience Record

1971-1973 Pennsylvania Cooperative Wildlife Unit. Research Assistant. Participated in wildlife research studies and design and implementation of public land use surveys. Cover mapped a parcel of state game lands by means of aerial photography and prepared suggestions for land management. Conducted research on the vegetative preferences of the ruffed grouse. Delivered public lectures to organized groups and schools.

1973-1980 Buchart-Horn, Inc., Environmental Division, York, Pennsylvania. Project Scientist. Researched, prepared, and supervised aspects of environmental studies dealing with wildlife, fishery, forestry, and land use. Coordinated preparation of various environmental impact statements. Prepared natural resource inventories for proposed sewer and highway construction areas and assessed possible impacts. Participated in evaluation of alternative sewage disposal systems. Coauthored a trout hatchery feasibility study of present facilities for the State of New Jersey, and prepared revegetation plans for reservoir and strip mined lands.

Brian D. Moreth (Continued)

Task Force Leader. Prepared an inventory of all natural resources and environmentally sensitive and degraded areas for the environmental quality segment of the Comprehensive Water Quality Management Plan for a seven-county area in northeast Pennsylvania.

1974-1980 — Pennsylvania Game Commission, York County, Pennsylvania (concurrent position). Deputy Game Protector. Responsible for enforcement of game, fish, forestry, and park laws of the Commonwealth of Pennsylvania. Assisted in public presentations including instruction of hunter safety courses.

1980-Date — Engineering-Science. Scientist. Involved in the development of environmental studies, inventories, and evaluations for municipal, industrial, and federal government projects. Served as deputy project manager for preparation of a third-party EIS addressing multiple impacts from construction and operation of a phosphate mine in Florida.

Mr. Moreth has been involved in environmental audits of past waste disposal practices including the disposal of hazardous wastes. These evaluations were conducted at seven Air Force Bases and three industrial facilities. He was involved in records search, data evaluation, shop inspections, disposal site investigations and ecological analyses for these installations. He was a key member in the preparation of Part Bs for a plastics manufacturing facility and an adhesives manufacturing facility. He prepared the hazardous waste portions of environmental audit manuals for a major pharmaceutical firm located in five states. He assisted in the preparation of an environmental audit for an electrical component manufacturer in New York. He is serving as project manager for providing hazardous waste permitting assistance to the IBM Field Engineering Education Center in Atlanta. He has also prepared spill prevention and response plans for industrial and governmental facilities.

APPENDIX B

LIST OF INTERVIEWEES AND OUTSIDE AGENCY CONTACTS

TABLE B.1
LIST OF INTERVIEWEES

Most Recent Position	Years of Service at Altus
1. CE Operations (Retired)	25
2. Deputy Base Civil Engineer	21
3. Superintendent, Pavement and Grounds	19
4. NCOIC, Entomology	3
5. Chief, Fire Protection	15
6. Crew Chief, Fire Protection	22
7. Gardner Foreman, Golf Course	5
8. Grounds Foreman, CE	16
9. Garden Equipment Repair, CE	18
10. Engineering Technician/Planner, CE	29
11. Foreman, Water and Wastewater	14
12. Assistant NCOIC, Entomology	10
13. Construction Inspector	31
14. Chief, Fire Protection (Retired)	19
15. Assistant Chief, Fire Protection (Retired)	15
16. Assistant Chief, Fire Protection (Retired)	20
17. Engineering Technician, CE	24
18. Crane Operator, Pavement and Grounds (Retired)	23
19. Contract Programmer (Retired)	27
20. Pavement and Grounds (Retired)	15
21. Tank Cleaning/Safety, Liquid Fuels Maintenance	25
22. Safety Technician	2
23. Pavement/Pollution Control Engineer, CE (Retired)	22
24. NCOIC Receiving, Material Storage and Distribution	3
25. Branch Chief, Material Storage and Distribution	9
26. Assistant Chief, DPDO (Fort Sill)	6
27. Realty Officer, Real Property	10
28. Environmental Coordinator, CE	25
29. Contracting Services	23
30. Bioenvironmental Engineer	1
31. NCOIC Bioenvironmental Engineer	1
32. NCOIC Radiology	1
33. NCOIC Dental Service	2
34. Foreman Fabrication, 443 TTS	16
35. NCOIC Weather Maintenance	6
36. Auto Mechanic, Auto Hobby	2
37. NCOIC Graphics	1
38. NCOIC Reduction	1
39. Clerk Arts & Crafts	2
40. Production Chief, Photo Lab	2
41. NCOIC Welding Shop	1

TABLE B.1
LIST OF INTERVIEWEES
(Continued)

Most Recent Position	Years of Service at Altus
42. NCOIC, Plumbing Shop	1
43. Foreman, Plumbing Shop	18
44. Asst. NCOIC, Machine Shop	4
45. NCOIC, Auto Pilot Shop	7
46. AFCI Section Chief	1
47. Asst. NCOIC Navigation	1
48. Chief Superintendent C-5 Maintenance	3
49. C-5 Flightline OIC	4
50. NCOIC Inspection Branch	4
51. Maintenance Superintendent	1
52. Supervisor, 780 AME	3
53. Asst. NCOIC, Electric	3
54. Asst. NCOIC, FMB	2
55. Pneudraulics Technician	8
56. Corrosion Control Technician	16
57. Foreman, Packing and Crating	19
58. Fabrication Branch Superintendent	5
59. Supervisor NDI	15
60. Engine Mechanic GTU	3
61. Test Cell Supervisor	16
62. Corroson Control Technician	15
63. Engine Mechanic	13
64. NCOIC Simulator	3
65. NCOIC Inertial Navigation	1
66. TMDE Branch Chief	1
67. Asst. NCOIC Battery Shop	4
68. NCOIC Wheel and Tire	4
69. NCOIC Environmental Systems	5
70. Aerospace Branch Superintendent	15
71. NCOIC Repair & Reclamation	10
72. NCOIC Non-Powered AGE	2
73. AGE Branch Chief	2
74. AGE Production Control	10
75. Washrack Manager	1
76. Paint Shop Foreman	18
77. Refrigeration Foreman	15
78. Sheet Metal Foreman	18
79. Power Production Foreman	21
80. Interior Electric Foreman	2
81. Heat Shop Foreman	26
82. Liquid Fuels Maintenance Technician	6
83. Radio Repairman	34
84. Carpenter Shop Foreman	18
85. NCOIC Exterior Electric	1

TABLE B.1
LIST OF INTERVIEWEES
(Continued)

Most Recent Position	Years of Service at Altus
86. Housing Maintenance Foreman	16
87. Contracts Management	8
88. Vehicle Maintenance Supervisor	15
89. Refueling Maintenance Foreman	30
90. Chief, Fuels Management	1
91. Base Service Station Manager	12

TABLE B.2
OUTSIDE AGENCY CONTACTS

Alice R. Barr, Hydrogeologist
U.S. Environmental Protection Agency
Region VI (6AW-HE)
1201 Elm Street
Interfirst Two Building
Dallas, TX 75270
214/767-2949

Thomas H. Maiello, Pollution Specialist
Oklahoma Water Resources Board
Northeast 10th and Stonewall
Oklahoma City, OK 73105
405/271-2549

John S. Havens, Hydrologist
U.S. Geological Survey
Water Resources Division
621 Old Post Office Building
201 NW 3rd Street
Oklahoma City, OK 73102
405/231-4256

Kent Stafford, Environmental Specialist
Jackson County Health Department
Altus, OK 73522
405/482-7308

R. Fenton Rood, Director
Solid Waste Division
Oklahoma State Department of Health
Industrial and Solid Waste Service
Industrial Waste Division
1000 Northeast 10th Street
Oklahoma City, OK 73152
405/271-5338

Fred Curtis, Plant Supervisor
Altus Water Department
Altus, OK 73522
405/477-1950

Kenneth C. Burns
Senior Environmental Specialist
Superfund Group
Oklahoma State Department of Health
Industrial and Solid Waste Service
Industrial Waste Division
1000 Northeast 10th Street
Oklahoma City, OK 73152
405/271-5338

Mr. William Lewis
Modern Military Field Branch
Washington National Record Center
4025 Suitland Road
Suitland, MD
301/763-1710

TABLE B.2 (Continued)
OUTSIDE AGENCY CONTACTS

Mr. J. Dwyer Cartographic and Architectural Branch National Archives 841 S. Pickett Street Alexandria, VA 22304 703/756-6700	Mr. E. Reese Modern Military Branch National Archives 8th and Pennsylvania Avenue Washington, DC 202/523-3340
Sgt. Jernigan Office of Air Force History Bolling AFB Washington, DC 202/767-5090	

APPENDIX C

TENANT ORGANIZATIONS AND MISSIONS

APPENDIX C

TENANT ORGANIZATIONS AND MISSIONS

Following is a listing of tenant organization at Altus AFB and a description of the mission for several of the units:

340th AIR REFUELING WING

The mission of the 340th AREFW is to be in a state of readiness to support SAC during war or other contingency operations, to provide refueling for other air operations such as TAC and MAC, and to train refueling crews.

DETACHMENT 4, 17TH WEATHER SQUADRON

Detachment 4 gives weather briefings to all Altus flying units as well as transient aircraft.

2002ND INFORMATION SYSTEMS SQUADRON

The 2002nd Information Systems Squadron provides base communications, air traffic control services, nagivational aids and ground communications in support of the 443rd MAW and 340th AREFW.

403RD FIELD TRAINING DETACHMENT, 3785TH FIELD AIR TRAINING WING (ATC)

This ATC detachment provides training support services to both the 443rd MAW and 340th AREFW.

DETACHMENT 4, 1365TH AUDIOVISUAL SQUADRON

This detachment provides photographic and audiovisual support to all units of Altus AFB.

DETACHMENT 3, 1600TH MANAGEMENT ENGINEERING SQUADRON

Detachment 3 provides manpower, organization and management engineering support to all MAC units on the installation.

DETACHMENT 1101 AIR FORCE OFFICE OF SPECIAL INVESTIGATIONS

This detachment provides special investigative services for dealing with crimes concerning all Altus military and civilian personnel.

AREA DEFENSE COUNSEL

The Area Defense Counsel provides defense counsel to military persons when disciplinary actions are brought against them.

OTHER ALTUS TENANT ORGANIZATIONS

Detachment, ACE (47th Flying Training Wing, ATC)

American Red Cross

U.S. Army Corps of Engineers

Red River Credit Union

Air Force Commissary Service

APPENDIX D

SUPPLEMENTAL BASE FINDINGS INFORMATION

TABLE D.1
PESTICIDES CURRENTLY USED AT ALTUS AFB

Insecticides	Rodenticide	Herbicides	Avicide	Fungicide
Oorgphosp	Anticoagu	Ouncmherb	All repell	Kromad
Alphos	Calcyanoe	2,4-D; 2,4,5-T		Dymac
Malathon		Prametol		Formac
Diazinon		Dalapon		
Sevin		Roundup		
Chlordane		Pre-San		
Pyrethrum		Tupper-San		
Ochemcomp		Balan		
Dursban				

TABLE D.2
OIL/WATER SEPARATORS
ALTUS AFB

Facility	Type	Quantity	Capacity (gallons)	Normal Removal Frequency*
188	Oil Separator	1	1,000	Monthly
284	Oil Separator	1	800	Monthly
291	Oil Separator	1	800	Monthly
296	Oil Separator	1	700	Monthly
298	Fuel Separator	1	700	Monthly
343	Oil Separator	3	1,500	Monthly
347	Oil Separator	1	1,400	Monthly
351	Oil Separator	1	2,400	Monthly
351	Hydraulic Lifts (Oil)	2	200	Quarterly
392	Fuel Separator	1	3,000	Monthly
402	Solvent (Skimmer Collector)	1	6,500	Monthly
402	Transfer Well (Solvent)	1	2,100	Quarterly
402	Sediment Basin (Solvent)	1	3,000	Semi-Annually
417	Fuel Separator	1	4,500	Monthly
424	Oil Separator	1	700	Monthly
435	Fuel Separator	2	3,600	Monthly
506	Oil Separator	2	1,500	Monthly
506	Lagoon (Skimmer Oil)	1	NA	Quarterly
515	Fuel Separator	1	4,800	Monthly
518	Fuel Separator	1	2,300	Monthly
523	Fuel Separator	1	800	Monthly
553	Fuel Separator	1	800	Monthly

Note: All Oil/Water Separators except Facility 417 (FPTA No. 4) discharge to the sanitary sewer system. Facility 417 discharges to an evaporation pond.

* Or as required.

Source: Installation documents.

TABLE D.3
LISTING OF LIQUID FUEL AND WASTE FLUID TANKS
ALTUS AFB

Facility	Material and Tank Type*	Estimated Quantity Stored (gallons)
32	Gasoline, Aboveground Tank	250
45	Diesel, Underground Tank	2,000
	Diesel, Underground Tank (Abandoned - Filled With Water)	250
46	Diesel, Underground Tank	5,000
	Diesel, Underground Tanks (2 Ea. x 20,000)	40,000
130	MOGAS, Aboveground Tank	250
180	Gasoline, Underground Tank	250
182	JP-4, Underground Tanks (5 Ea. x 50,000 1 Ea. x 25,000)	275,000
185	Diesel, Underground Tank	5,000
	Diesel, Aboveground Tank	250
191	Diesel, Aboveground Tank	250
198	Diesel, Underground Tank	250
214	Diesel, Underground Tank	250
267	Diesel, Underground Tank	500
273	JP-4, Underground Tanks (5 Ea. x 50,000 1 Ea. x 25,000)	275,000
298	JP-4 (2 Ea. Underground Tanks)	20,000
303	Gasoline (3 Ea. Underground Tanks)	30,000
	Waste Oil, Underground Tank	
323	Diesel, Aboveground Tank	250
343	Used Oil, Underground Tank	500

TABLE D.3
LISTING OF LIQUID FUEL AND WASTE FLUID TANKS
ALTUS AFB
(Continued)

Facility	Material and Tank Type*	Estimated Quantity Stored (gallons)
354	Diesel, Underground Tank	500
	MOGAS, Underground Tank	15,000
	No Lead Gas, Underground Tank	15,000
362	Diesel, Aboveground Tank	250
377	Diesel Fuel, Aboveground Tank	6,500
	De-Icing Fluid, Aboveground Tank	6,000
378	Diesel, Aboveground Tank	220,000
379	JP-4, Aboveground Tank	1,650,000
380	JP-4, Aboveground Tank	440,000
381	JP-4, Aboveground Tank	1,650,000
394	Diesel, Aboveground Tank	250
397	Gasoline, Underground Tank	25,000
402	PD-680-Type II Solvent, Aboveground Tank	1,100
	A/C Surface Cleaning Compound Underground Tank (Abandoned - Half Full)	2,500
405	Diesel, Aboveground Tank	250
407	Diesel, Aboveground Tank	250
408	Diesel, Aboveground Tank	1,000
409	JP-4, Aboveground Tank	2,500
413	Diesel, Aboveground Tank	275
415	Diesel, Underground Tank	1,000
	Aboveground Tank	500
417	Used Fuel, Aboveground Tank	5,000
418	Diesel, Aboveground Tank	300

TABLE D.3
LISTING OF LIQUID FUEL AND WASTE FLUID TANKS
ALTUS AFB
(Continued)

Facility	Material and Tank Type*	Estimated Quantity Stored (gallons)
420	Diesel, Underground Tank	1,000
430	JP-4, Underground Tanks (6 Ea. x 50,000)	300,000
434	JP-4, Underground Tanks (6 Ea. x 50,000)	300,000
443	JP-4, Underground Tanks (6 Ea. x 50,000)	300,000
451	Contaminated JP-4, Underground Tank	12,000
	Unreclaimable Solvents, Underground Tank	5,000
	Used Oils, Underground Tank	8,000
453	Diesel, Aboveground Tank	250
454	Diesel, Aboveground Tank	250
471	Diesel, Underground Tank	5,000
472	Diesel, Abovegrond Tank	250
506	Gasoline, Underground Tank	2,000
	JP-4, Underground Tank	4,000
570	Diesel, Aboveground Tank	250
581	MOGAS, Underground Tank	150
600	Diesel, Aboveground Tank	300
620	Diesel, Underground Tank	275
934	Diesel, Underground Tank	250

*All tanks are active unless otherwise noted.

Source: Installation documents.

WATER POLLUTION EMISSIONS INVENTORY

February 1984

USAF Hospital Altus
Altus AFB, OK

Prepared By:

JOHN G. HODGSON, Capt, USAF, BSC
Base Bioenvironmental Engineer

Approved By:

PETER F. HOFFMAN, Lt. Col, USAF, MC, SFS
Director of Base Medical Services

1. INTRODUCTION: This Water Pollution Emissions Inventory is a compilation of waterborne discharges arising from basewide operations. AFR 19-7, Section 7g, requires the DBMS to conduct and maintain an installation emissions inventory for all environmental pollutants.

2. LIMITATIONS:

a. This inventory is based upon sampling data gathered by Bioenvironmental Engineering from 1 Jan 1983 to 31 Dec 1983.

b. The data has been averaged from twelve monthly composite samples. This information is shown on Atch 1.

(1). Site 1 is located west of the main gate, just before Stinking Creek enters the base industrial area.

(2). Site 2 is between Bldgs. 392 and 394, downstream from Site 1, just before Stinking Creek leaves the base.

(3). Site 3 is located at the south end of the runway. It receives drainage from the north and west ends of the base. It is dry during the summer.

3. FINDINGS:

a. The high concentrations of sulfates, chlorides and residues are directly attributed to the local terrain--flat land with much erosion.

b. Pesticides were seldom detected. When they were detected, they were just above the minimum detectable concentrations (i.e., 0.02ug/1).

4. CONCLUSION: No further water pollution controls are necessary.

WATER SAMPLING DATA

Parameter	Oklahoma Standard	Site 1	Site 2	Site 3	Net Pollutants Site 2 Tons	Pollutants Site 3 Tons
Flow rate, cfm	-	600.	1000.	200.	-	-
Temperature, degrees-C	34.4	15.	14.	16.	-	-
pH	6.8-8.5	7.8	7.8	7.8	-	-
Dissolved Oxygen,mg/l	above 5.0	9.0	8.0	8.0	-	-
Color, units	75.	63.	48.	31	-	-
Turbidity, JTU	50.	21.	18.	13.	-	-
Detergents, mg/l	0.2	0.0	0.0	0.0	0	0
Phosphates, mg/l	1.0	0.40	0.4	0.30	3	0
Nitrates, mg/l	10.	1.4	1.4	1.9	9	5
Sulfates, mg/l	250.	200.	95.	350.	225	20
Fluorides, mg/l	1.40	0.6	0.6	0.6	4	2
Chlorides, mg/l	250.	540.	600	500.	400	16
Oils & Greases, mg/l	15.	0.0	0.0	0.0	0	0
Residual Suspended Solids	45.	1.	8.	19.	1	6
Residual Total Dissolved	500.	2680.	2640.	6930.	1650	121

SITE #1 - STREAM OUTSIDE MAIN GATE

All results are in mg/l EXCEPT Color & Turbidity which is in units

ANALYSIS PERFORMED	DEC 80	MAR 81	JUN 81	AUG 81	DEC 81	JUL 82	OCT 82	JAN 83	APR 83	JUL 83	OCT 83	MAY 84
COD	25	10	20	--	12	17	17	21	66	45	20	125
Tot Organic Carbon as C	4	2	4	10.9	3	5	5	2	--	11	--	7
Oil & Grease	< 0.3	< 0.3	0.6	< 0.3	0.4	7.7	< 0.3	< 0.3	< 0.3	0.5	< 0.3	0.5
Nitrate	0.8	1.2	1.3	0.774	1.0	0.2	0.4	0.7	1.0	0.79	0.42	0.1
Nitrite	--	--	--	--	--	--	--	--	< 0.02	--	--	--
Phosphorus as Ortho PO4 as P	< 0.1	< 0.2	0.1	--	--	--	--	--	< 0.1	--	0.10	--
Phosphorus as P	--	--	--	0.027	< 0.1	0.22	< 0.1	< 0.1	--	0.11	0.10	< 0.1
Chloride	500	600	700	489	400	264	400	700	800	500	240	720
Color	5	10	25	5	25	20*	15	15	30	20	30	25*
Fluoride	0.6	0.7	0.6	0.85	0.6	0.4	0.7	--	< 0.1	0.5	0.5	0.6
TDS	2192	2896	2913	2950	2181	1273	--	2287	2812	2491	1780	3272
SS	53	19	52	13.5	21	355	--	1	1	11	1	35
Sulfate	850	1250	1000	1100	900	90	880	58	58	950	95	740
Surfactants	0.2	0.2	0.1	< 0.1	< 0.1	< 0.1	0.1	< 0.1	0.1	0.2	< 0.1	0.1
Turbidity	3	5	26	2.1	14	234	15	6	5	3	62	26

	JUL 84	OCT 84
COD	2100	137
Tot Organic Carbon as C	1680	--
Oil & Grease	< 0.3	2.4
Nitrate	< 0.1	< 0.1
Nitrite	--	--
Phosphorus as Ortho PO4 as P	--	--
Phosphorus as P	< 0.1	1.2
Chloride	480	460
Color	20	20
Fluoride	1.0	1.1
TDS	4371	3776
SS	13	16
Sulfate	2175	2000
Surfactants	0.2	1.6
Turbidity	2.0	8.6

* = Filtered for color

-- = Analysis not done

MAC FORM OCT 47 36g

GENERAL PURPOSE WORK SHEET

SITE #1 - STREAM OUTSIDE MAIN GATE, PESTICIDES

All results are in ug/l

Pesticide	JUL 81	OCT 81	JUL 82	JAN 33	APR 83	JUL 83
Aldrin	ND	--	--	--	--	--
DDD	ND	<0.02	--	<0.02	<0.05	<5.0
DDE	ND	<0.02	--	<0.02	0.18	<5.0
Dieldrin	ND	<0.02	<0.02	<0.02	<0.05	<0.1
Endrin	ND	<0.02	0.038	<0.02	<0.05	<0.02
Heptachlor	ND	<0.02	<0.02	<0.02	<0.05	<0.02
Heptachlorepoxide	ND	<0.02	<0.02	<0.02	<0.05	<0.02
Lindane	ND	<0.01	<0.01	<0.01	0.13	<0.4
p,pl-JDT	ND	<0.02	0.24	--	0.58	<5.0
Methoxychlor	ND	<0.20	--	<0.20	<0.25	<10.0
o,p-DDT	ND	<0.02	--	0.11	<0.1	<5.0
Chlordane	ND	<0.20	<0.20	<0.20	<0.5	<0.3
Toxaphene	ND	<1.0	<1.0	<1.0	<3.0	<1.0
s,4-D	ND	0.076	0.25	0.15	<0.06	<10.0
Silvex	ND	<0.06	<0.06	--	<0.06	<3.0

ND = None Detected

-- = Analysis not done

MAC FORM OCT 67 36g

GENERAL PURPOSE WORK SHEET

SITE #2 - STREAM NEAR OLD SEWAGE PLANT

All results are in mg/l EXCEPT Color & Turbidity which is in units

ANALYSIS PERFORMED	JAN 81	MAR 81	JUL 81	OCT 81	JAN 82	APR 82	JUL 82	OCT 82	JAN 83	APR 83	OCT 83	MAY 84
COD	15	12	--	--	12	24	18	18	23	120	14	82
Tot Organic Carbon as C	5	2	7	14	3	4	5	4	2	--	7	5
Oil & Grease	0.6	<0.3	1.2	<0.3	0.4	0.5	3.7	<0.3	<0.3	0.5	<0.3	0.5
Nitrate	10.5	0.8	0.8	0.016	0.9	0.5	0.2	0.4	1.0	0.5	0.39	1.26
Nitrite	--	--	--	--	--	--	--	--	--	<.02	--	--
Phosphorus as Ortho PO4 as P	5.4	<0.2	--	--	--	--	--	--	--	<0.1	--	--
Phosphorus as P	--	--	0.17	0.074	0.49	0.11	0.16	0.12	0.11	--	0.12	3.5
Chloride	400	600	1200	289	BIT	560	268	300	800	800	240	680
Color	20	10	10	30	BIT	15	25	15	15	25	25	25*
Fluoride	0.4	0.5	1.3	0.62	BIT	0.5	0.4	0.7	--	<0.1	0.8	0.7
TDS	1281	2287	5328	1835	BIT	2200	1336	2183	2400	2876	2404	3201
SS	32	12	10	4.3	BIT	40	170	19	8	1	12	24
Sulfate	500	850	2700	800	BIT	825	90	880	58	--	87	1000
Surfactants	0.2	0.2	0.2	0.19	BIT	<0.1	<0.1	<0.1	<0.1	--	0.1	<0.1
Turbidity	2	3	<1	19	BIT	34	116	13	7	--	26	58

ANALYSIS PERFORMED	JUL 84	OCT 84
COD	2800	110
Tot Organic Carbon as C	1620	--
Oil & Grease	732	<0.3
Nitrate	0.17	0.7
Nitrite	--	--
Phosphorus as Ortho PO4 as P	--	--
Phosphorus as P	<0.1	0.3
Chloride	600	440
Color	30	25
Fluoride	0.7	0.8
TDS	2475	2909
SS	126	20
Sulfate	1000	1150
Surfactants	<0.1	<0.1
Turbidity	40	17

* = Filtered for color

-- = Analysis not done

BIT = Broken in transit

MAC FORM 36g — GENERAL PURPOSE WORK SHEET

SITE #2 - STREAM NEAR OLD SEWAGE PLANT, PESTICIDES

All results are in ug/l

PESTICIDE	JUL 81	OCT 81	OCT 82
Aldrin	ND	--	--
DDD	ND	< 0.02	--
DDE	ND	< 0.02	--
Dieldrin	ND	< 0.02	<0.02
Endrin	ND	<0.02	0.040
Heptachlor	ND	<0.02	<0.02
Heptachlorepoxide	ND	<0.02	<0.02
Lindane	ND	<0.01	<0.01
p.pl-DDT	ND	<0.02	0.043
Methoxychlor	ND	<0.20	<0.20
o,p-DDT	ND	<0.02	--
Chlordane	ND	<0.20	<0.20
Toxaphene	ND	<1.0	<1.0
2,4-D	ND	<0.06	0.31
Silvex	0.12	0.30	<0.06

ND = None detected
-- = Analysis not done

MAC FORM 36g GENERAL PURPOSE WORK SHEET

SITE #3 - STINKING CREEK

All results are in mg/l EXCEPT Color & Turbidity which is in units

ANALYSIS PERFORMED	DEC 80	JAN 81	MAR 81	JUL 81	OCT 81	JAN 82	APR 82	JUL 82	OCT 82	JAN 83	APR 83	JUL 83
COD	12	12	18	--	1950	28	34	33	36	65	150	35
Tot Organic Carbon as C	2	2	5	5	672	5	4	6	5	8	--	9
Oil & Grease	<0.3	<0.3	1.1	1.2	<0.3	0.4	0.5	<0.3	0.5	0.6	0.5	0.8
Nitrate	0.4	0.4	0.6	1.4	0.11	1.1	0.4	1.1	<0.1	0.1	0.6	0.38
Nitrite	--	--	--	--	--	--	--	--	--	--	<0.2	--
Phosphorus as Ortho PO4 as P	<0.1	<0.1	<0.2	--	--	--	--	<0.10	--	--	<0.10	--
Phosphorus as P	--	--	--	0.16	0.043	<0.10	<0.10	0.13	0.10	0.1	--	<0.1
Chloride	600	600	800	1000	606	500	500	564	500	700	800	600
Color	5	5	10	25	25	5	10	20	15	15	20	15
Fluoride	0.8	0.8	1.1	0.6	1.2	1.1	0.9	1.0	1.1	--	0.12	1.0
TDS	4080	4080	4853	2629	5420	4043	4242	4326	--	4577	5039	4274
SS	9	9	8	25	60.4	11	13	8	--	13	13	25
Sulfate	2000	2000	2500	775	3700	2150	2450	77	1375	58	--	2400
Surfactants	0.2	0.2	0.2	0.1	0.19	0.2	0.2	0.3	0.2	0.3	--	0.2
Turbidity	3	3	2	20	8.9	3	5	<1	<1	7	--	7

ANALYSIS PERFORMED	OCT 83	JAN 84	MAY 84	JUL 84	OCT 84
COD	15	240	82	3400	150
Tot Organic Carbon as C	8	50	2	1420	--
Oil & Grease	<0.3	0.5	0.5	0.4	3.1
Nitrate	0.34	1.54	1.08	0.36	<0.1
Nitrite	--	--	--	--	--
Phosphorus as Ortho PO4 as P	--	--	--	--	--
Phosphorus as P	0.13	0.19	<0.1	<0.1	1.1
Chloride	400	460	600	800	456
Color	25	15*	15*	35	35
Fluoride	0.5	1.8	1.1	0.7	1.1
TDS	2172	3062	4703	2395	3845
SS	2	19	22	69	19
Sulfate	94	100	1825	770	2100
Surfactants	<0.1	0.1	0.2	<0.1	2.0
Turbidity	64	7	39	30	9.7

* = Filtered for color
-- = Analysis not done

MAC FORM OCT 67 36g GENERAL PURPOSE WORK SHEET

SITE #3 - STINKING CREEK, PESTICIDES

All results are in ug/l

PESTICIDE	JUL 81	OCT 81	JUL 82	OCT 82
Aldrin	ND	--	--	--
DDD	ND	--	<0.02	<0.02
DDE	ND	--	<0.02	0.04
Dieldrin	ND	<0.02	<0.02	<0.02
Endrin	ND	<0.02	<0.02	<0.02
Heptachlor	ND	<0.02	<0.02	0.12
Heptachlorepoxide	ND	0.085	<0.02	<0.02
Lindane	ND	0.029	<0.01	0.02
p,pl-DDT	ND	--	<0.02	0.06
Methoxychlor	ND	<0.20	<0.20	<0.20
o,p-DDT	ND	--	<0.02	1.1
Chlordane	ND	<0.20	<0.20	<0.20
Toxaphene	ND	<1.0	<1.0	<1.0
2,4-D	ND	0.57	0.26	0.06
Silvex	ND	0.16	<0.06	0.34
DDT Isomers	--	0.11	--	--

ND = None detected

-- = Analysis not done

APPENDIX E

MASTER LIST OF SHOPS

APPENDIX E
MASTER LIST OF SHOPS

Name	Present Location	Handles Hazardous Materials	Generates Hazardous Wastes	Typical TSD Methods
USAF Hospital Altus				
Dental Lab & X-Ray	47	Yes	Yes	Silver Recovery
Medical X-Ray	46	Yes	Yes	Silver Recovery
443 Air Base Group (ABG)				
Auto Hobby	343	Yes	Yes	Contractor Disposal
Arts & Crafts	343	Yes	No	--
Reproduction	114	Yes	No	--
Firing Range	398	Yes	No	--
Graphics	168	No	No	--
Photo Lab	136	Yes	Yes	Silver Recovery
443 Avionics Maintenance Squadron (AMS)				
Auto Pilot	323	Yes	No	--
Battery/Electric	330	Yes	Yes	Neutralized to Sanitary Sewer
Communication	323	Yes	No	--
Inertial Navigation	323	No	No	--

APPENDIX E
MASTER LIST OF SHOPS

Name	Present Location	Handles Hazardous Materials	Generates Hazardous Wastes	Typical TSD Methods
443 Avionics Maintenance Squadron (AMS) (Continued)				
Instruments	323	Yes	No	--
Navigation	323	No	No	--
PMEL/TMDE	323	Yes	Yes	DPDO
Simulator	444	Yes	Yes	DPDO
443 Field Maintenance Squadron (FMS)				
AGE	506	Yes	Yes	DPDO & FPTA
Aircraft Repair & Reclamation	435	Yes	No	--
Corrosion Control	291	Yes	No	--
Environmental Systems	424	Yes	No	--
Fuel Systems	518	Yes	No	--
GTU	291	Yes	Yes	DPDO
Machine	291	Yes	No	--
NDI	450	Yes	Yes	DPDO & Silver Recovery
Pneudraulics	285	Yes	Yes	DPDO
Propulsion	296	Yes	Yes	DPDO
Refurbishing	511	Yes	Yes	DPDO
Structural Repair	291	Yes	No	--
Survival Equipment	275	Yes	No	--

APPENDIX E
MASTER LIST OF SHOPS

Name	Present Location	Handles Hazardous Materials	Generates Hazardous Wastes	Typical TSD Methods
443 Field Maintenance Squadron (FMS) (Continued)				
Test Cell	298	Yes	Yes	Contractor Disposal
Wash Rack	402	Yes	Yes	O/W Separator
Welding Shop	291	Yes	No	--
Wheel & Tire	424	Yes	Yes	DPDO
340 Consol'dated Aircraft Maintenance Squadron (CAMS)				
Aero Repair	285	Yes	No	--
Auto Pilot	323	Yes	No	--
Communication	323	Yes	No	--
Corrosion Control	523	Yes	Yes	DPDO
Doppler	325	No	No	--
Electric	285	Yes	Yes	DPDO
Environmental Systems	285	Yes	No	--
Fuel Systems	515/516	Yes	No	--
Instruments	323	No	No	--
Machine	291	Yes	No	--
Navigation	323	Yes	No	--
Pneudraulics	285	Yes	Yes	DPDO
Propulsion	296	Yes	Yes	DPDO

APPENDIX E
MASTER LIST OF SHOPS

Name	Present Location	Handles Hazardous Materials	Generates Hazardous Wastes	Typical TSD Methods
340 Consolidated Aircraft Maintenance Squadron (CAMS) (Continued)				
Structural Repair	275	Yes	Yes	DPDO
Survival Equipment	279	Yes	No	--
Test Cell	298	Yes	Yes	Contractor
Welding Shop	291	Yes	No	--
443 Organizational Maintenance Squadron (OMS)				
ISO Dock	285	Yes	No	--
Non-Powered AGE	506	Yes	Yes	DPDO
780 AME	285	Yes	No	--
443 Transportation Squadron (TRANS)				
Packing & Crating	394	Yes	No	--
Refueling Truck Maint.	392	Yes	Yes	O/W Separator
Vehicle Maintenance/Paint	351	Yes	Yes	DPDO
Welding	351	Yes	No	--
443 Supply Squadron (SUPS)				
Fuels Distribution	374/376	Yes	Yes	Recycle/FPTA

APPENDIX E
MASTER LIST OF SHOPS
(Continued)

Name	Present Location	Handles Hazardous Materials	Generates Hazardous Wastes	Typical TSD Methods
443 Supply Squadron (SUPS) (Continued)				
Fuels Lab	445	Yes	Yes	Recycle
443 Civil Engineering Squadron (CES)				
Carpenter	356	Yes	No	--
Electrical, Interior	347	Yes	No	--
Electrical, Exterior	347	Yes	Yes	DPDO
Entomology	347	Yes	Yes	Contractor Disposal
Fire Department	267	Yes	No	--
Golf Course Maintenance	30/32	Yes	No	--
Housing Maintenance	347	Yes	No	--
Liquid Fuels Maintenance	347	Yes	Yes	FPTA
Paint	356	Yes	Yes	Contractor Disposal
Pavements & Grounds	345	Yes	No	--
Plumbing	347	Yes	No	--
Power Production	347	Yes	Yes	DPDO
Refrigeration & Heating	356	Yes	No	--
Sheet Metal/Welding	356	Yes	No	--

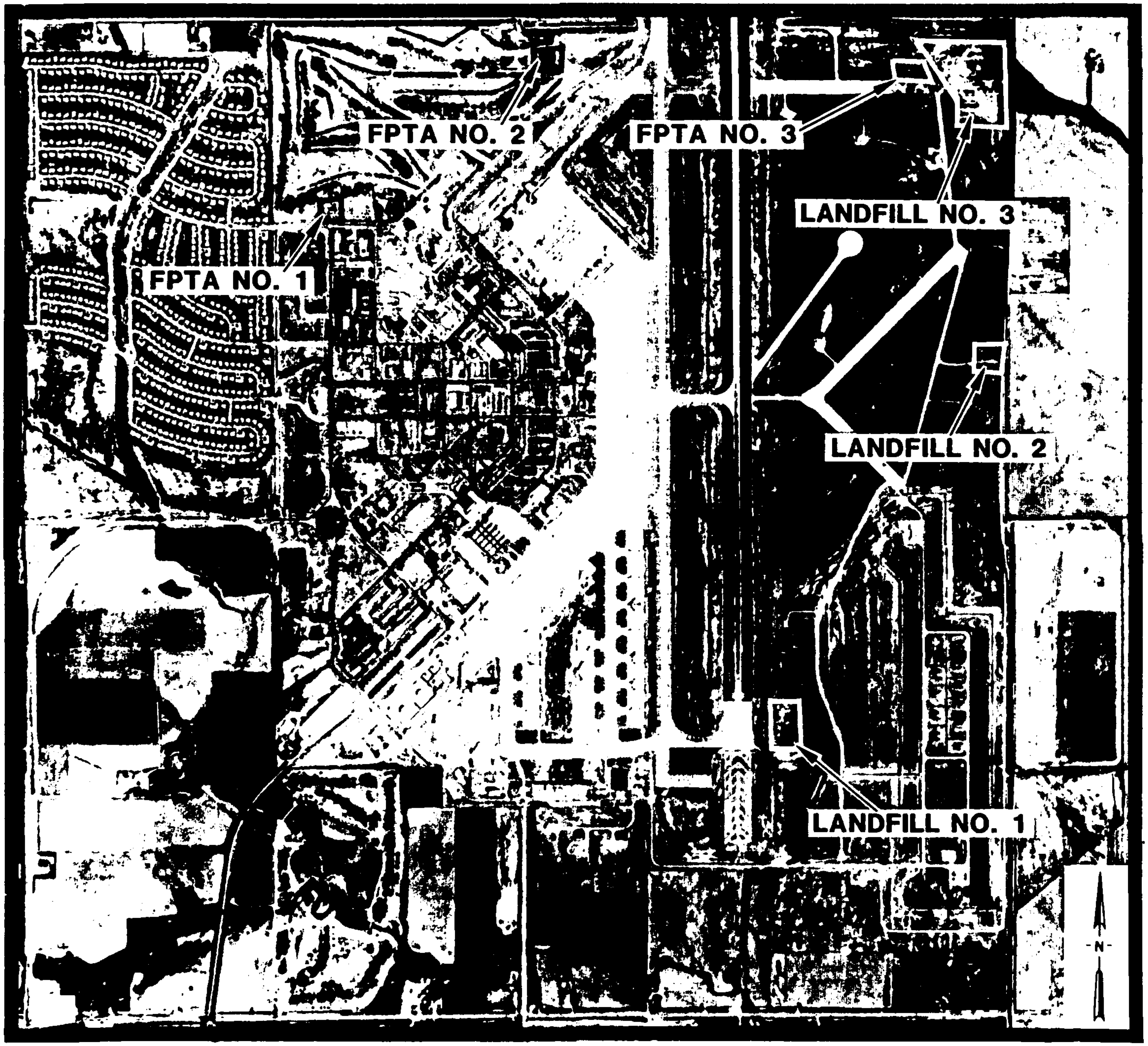
APPENDIX E
MASTER LIST OF SHOPS
(Continued)

Name	Present Location	Handles Hazardous Materials	Generates Hazardous Wastes	Typical TSD Methods
443 Civil Engineering Squadron (CES) (Continued)				
SMART Team	41	Yes	No	--
2002 Information Systems Squadron (ISS)				
Weather Maintenance	185	Yes	No	--
443 Technical Training Squardon (TTS)				
Fabrication	168	Yes	No	--

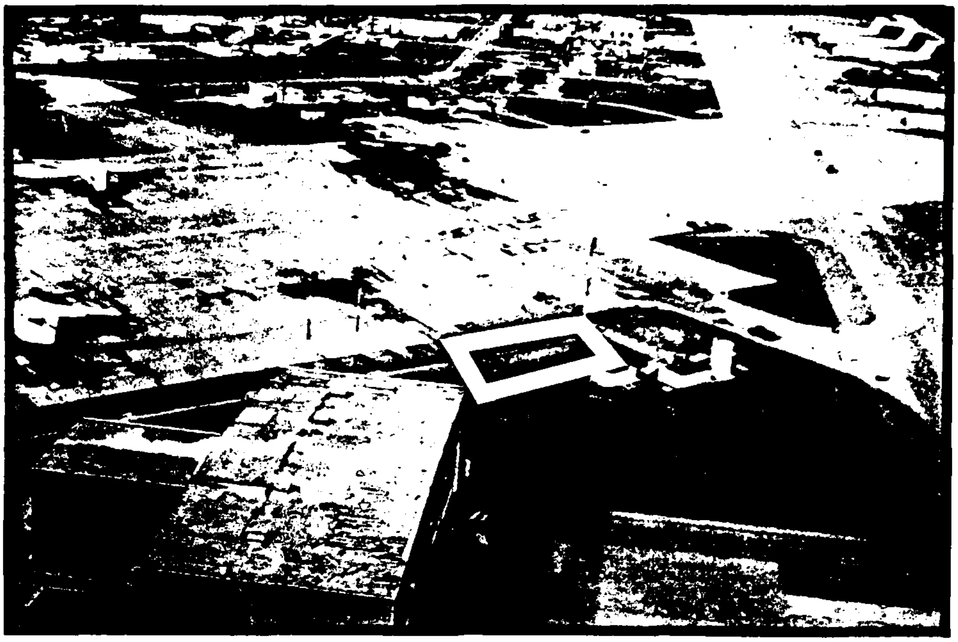
Note: DPDO - Defense Property Disposal Office through Ft. Sill
FPTA - Fire Protection Training Area
Oil/Water Separator-Connected to Sanitary Sewer

APPENDIX F

PHOTOGRAPHS

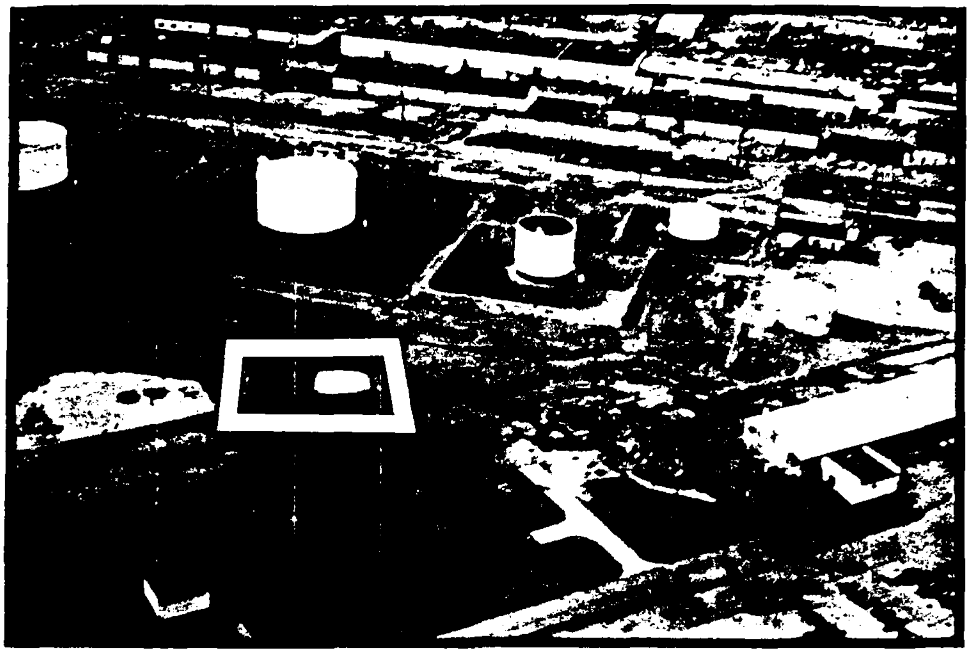


ALTUS AFB, OKLAHOMA 1968

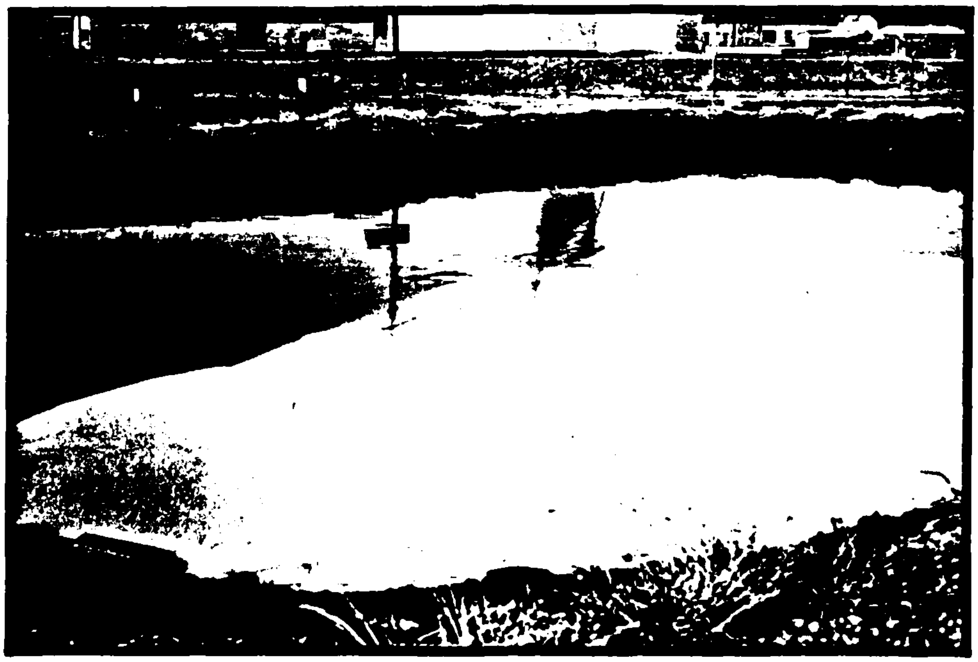


Aircraft Washrack Pond Site

Aircraft Washrack Pond Site
(FACING SOUTHWEST)

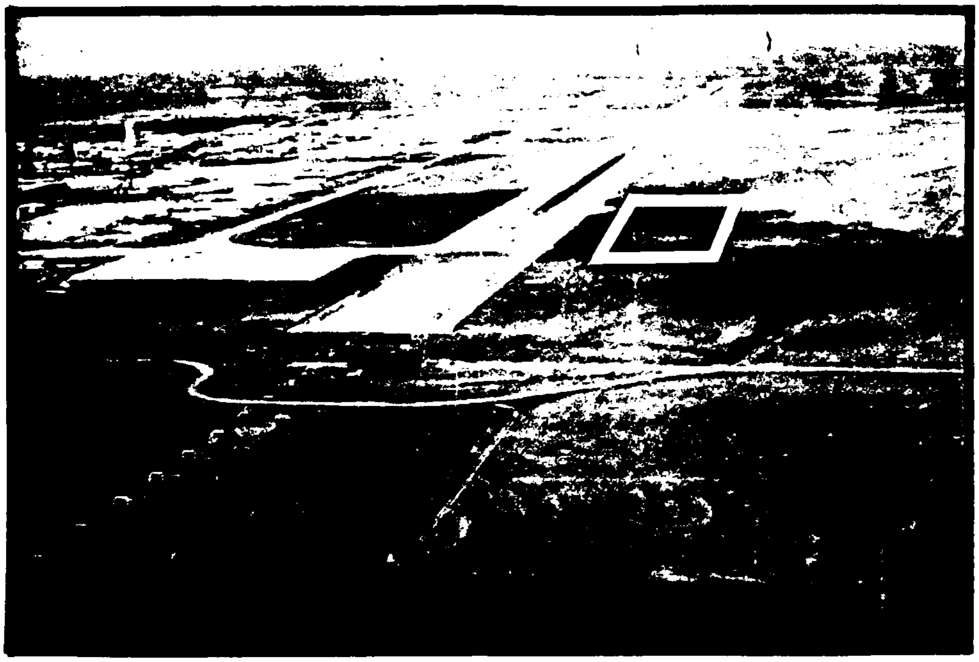


AGE Washrack Pond



AGE Washrack Pond
(FACING NORTHWEST)

ALTUS AFB



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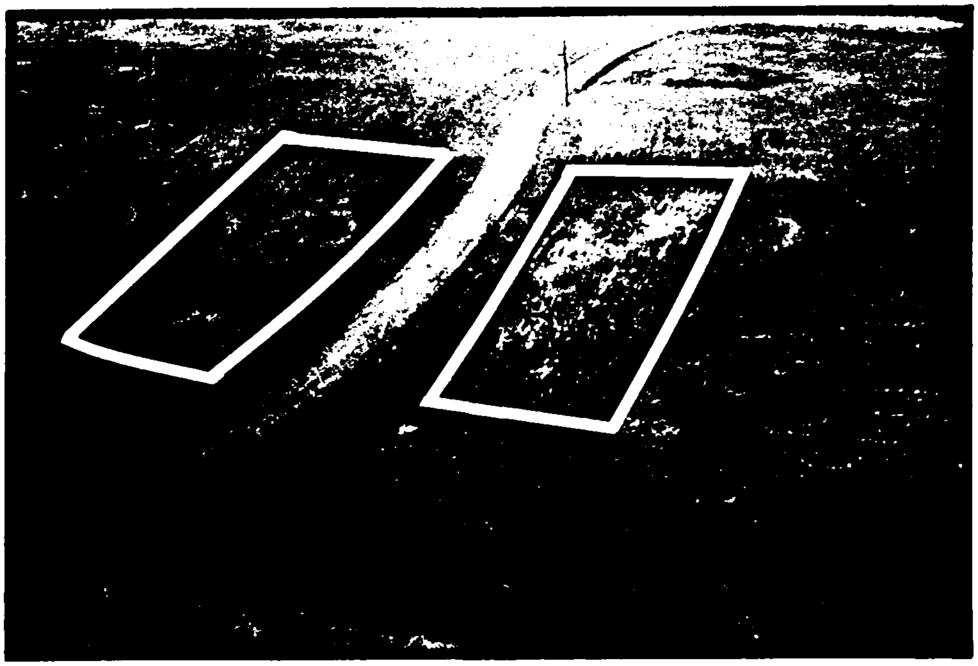


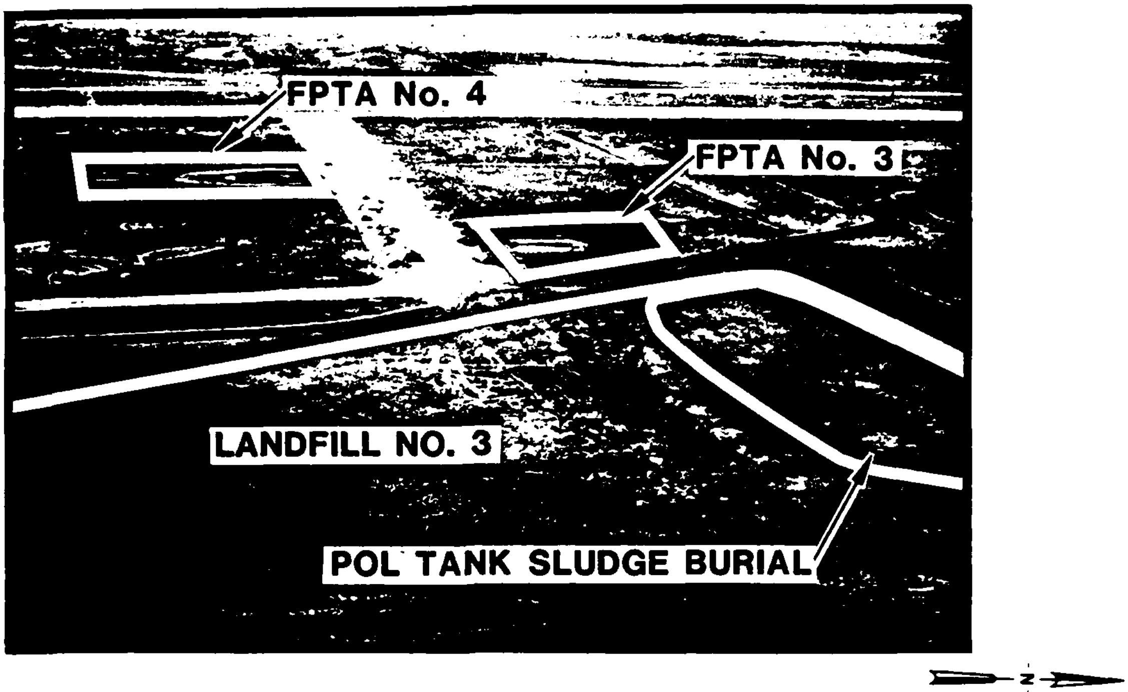
Landfill No. 2

ALTUS AFB

FPTA No. 1

FPTA No. 2

ALTUS AFB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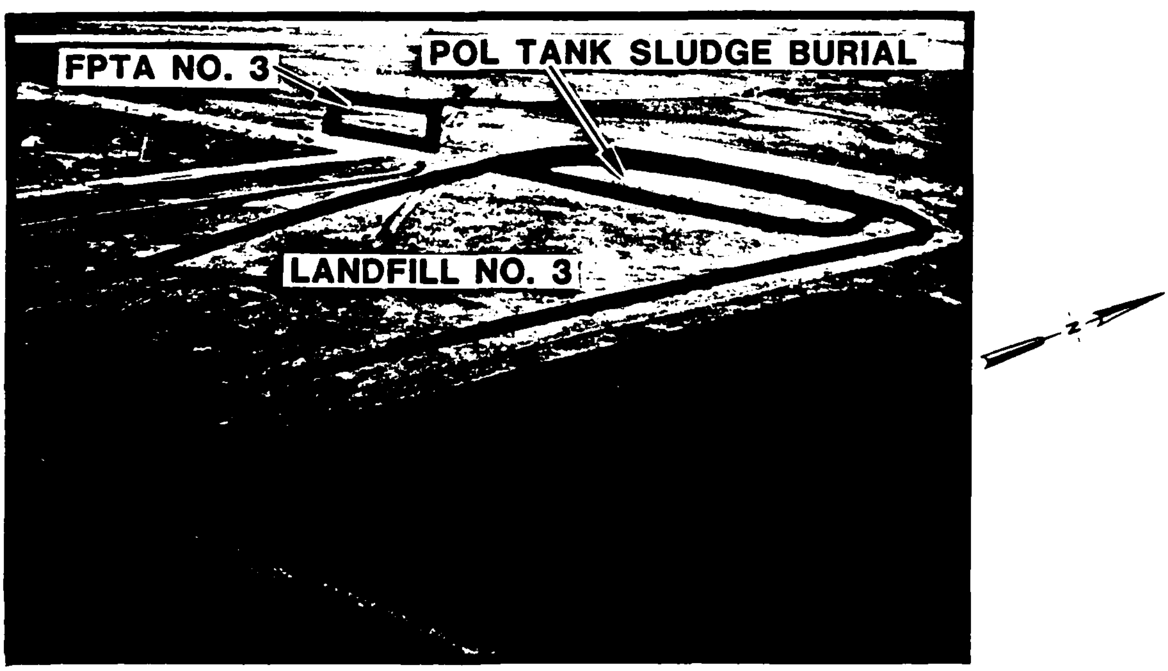
FPTA No. 3
LANDFILL NO. 3
POL TANK SLUDGE BURIAL
N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POL TANK SLUDGE BURIAL
LANDFILL NO. 3
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APPENDIX G

USAF INSTALLATION RESTORATION PROGRAM

HAZARD ASSESSMENT RATING METHODOLOGY

APPENDIX G

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 represenatives from USAF Occupational and Environmental Health Laboratory (OEHL), Air Force Engineering and Services Center (AFESC), Engineering-Science (ES) and CH2M 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 CH2M 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 the 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 Records 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.

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 management practices category factor to the sum of the scores for the other three categories.

FIGURE 1

HAZARD ASSESSMENT RATING METHODOLOGY FLOW CHART

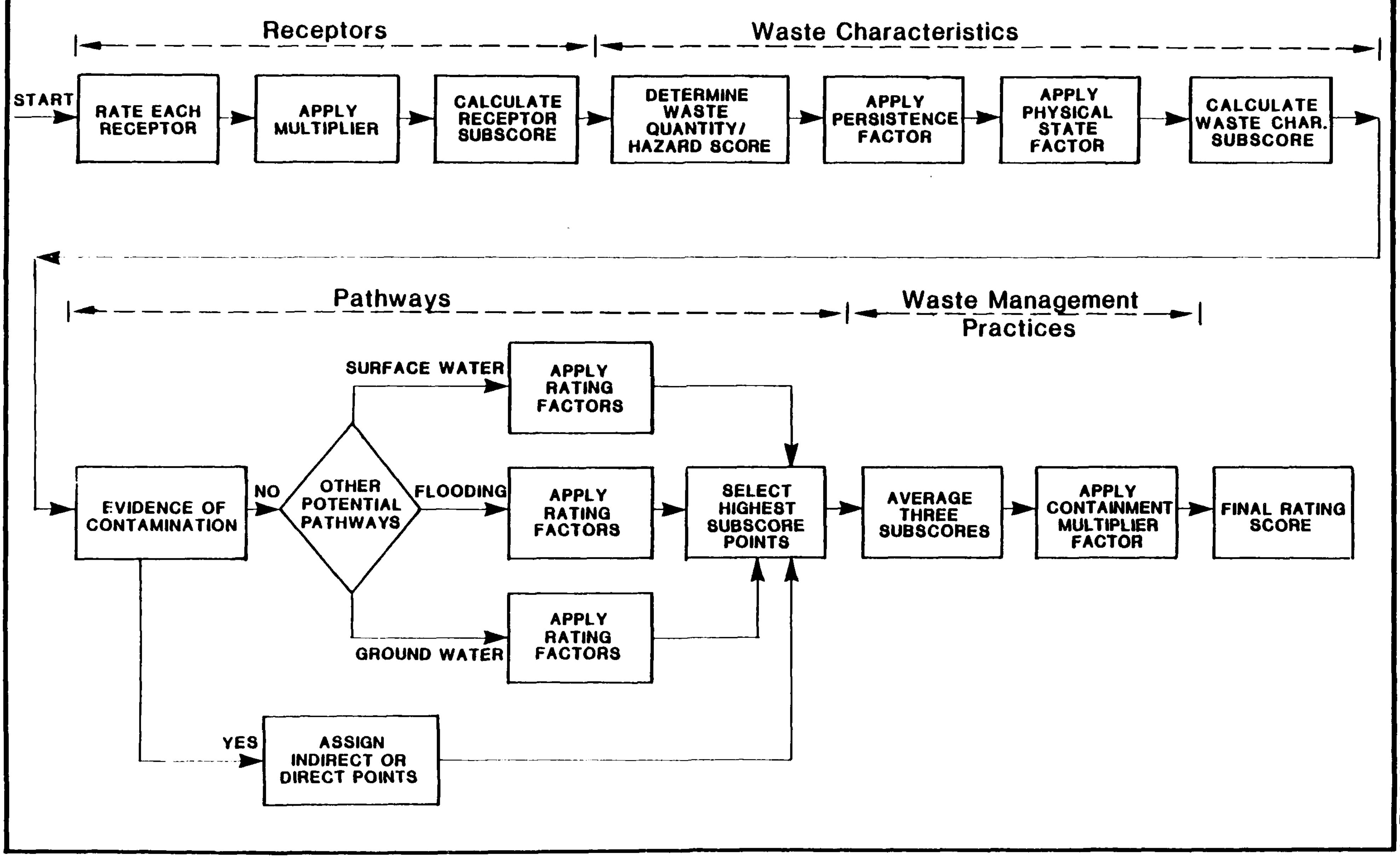

FIGURE 2

HAZARD ASSESSMENT RATING METHODOLOGY 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 ______ = ______

FIGURE 2 (Continued)

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) ______

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
2. 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

HAZARD 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. Land Use/Zoning (within 1 mile radius)	Completely remote (zoning not applicable)	Agricultural	Commercial or industrial	Residential	3
D. Distance to installation boundary	Greater than 2 miles	1 to 2 miles	1,001 feet to 1 mile	0 to 1,000 feet	6
E. Critical environments (within 1 mile radius)	Not a critical environment	Natural areas	Pristine natural areas; minor wet-lands; preserved areas; presence of economically impor-tant natural re-sources susceptible to contamination.	Major habitat of an en-dangered 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, propa-gation and manage-ment of fish and wildlife.	Shellfish propaga-tion and harvesting.	Potable water supplies	6
G. Ground-Water use of uppermost aquifer	Not used, other sources readily available.	Commercial, in-dustrial, or irrigation, very limited other water sources.	Drinking water, municipal water available.	Drinking water, no muni-cipal water available; commercial, industrial, or irrigation, no other water source available.	9
H. Population served by surface water supplies within 3 miles down-stream 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)

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

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

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)

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

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.

B-1 POTENTIAL FOR SURFACE WATER CONTAMINATION

Rating Factor	Rating Scale Levels 0	1	2	3	Multiplier
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

Rating Factor	0	1	2	3	Multiplier
Floodplain	Beyond 100-year floodplain	In 25-year flood-plain	In 10-year flood-plain	Floods annually	1

B-3 POTENTIAL FOR GROUND-WATER CONTAMINATION

Rating Factor	0	1	2	3	Multiplier
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 [illegible]gs, [illegible]iden[illegible] [illegible] [illegible])	No evidence of risk	Low risk	Moderate risk	High risk	8

TABLE 1 (Continued)

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

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:

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

Surface Impoundments:

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

Spills:

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

Fire Proection Training Areas:

- o Concrete surface and berms
- o Oil/water separator for pretreatment of runoff
- o 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 H

SITE HAZARD ASSESSMENT RATING FORMS

APPENDIX H

INDEX FOR HAZARD ASSESSMENT RATING FORMS

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of site: Aircraft Washrack Pond
Location: North of Building 518
Date of Operation: 1970 to 1977
Owner/Operator: Altus AFB
Comments/Description: Unlined pond received PD-680 cleaning solutions; effluent discharge to storm sewer
Site Rated by: R.L.Thoem and J.R.Absalon

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	2	4	8	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 installation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	3	6	18	18
G. Ground water use of uppermost aquifer	2	9	18	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	1	6	6	18
Subtotals			91	180

Receptors subscore (100 x factor score subtotal/maximum score 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 (small, medium, or large) L = large
2. Confidence level (confirmed or suspected) C = confirmed
3. Hazard rating (low, medium, or high) H = high

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 1.00 = 100

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

100 x 1.00 = 100

III. PATHWAYS

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 0

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.

Rating Factor	Factor Rating (0-3)	Multi-plier	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	1	8	8	24
Surface permeability	2	6	12	18
Rainfall intensity	2	8	16	24
Subtotals			60	108
Subscore (100 x factor score subtotal/maximum score subtotal)				56
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	2	8	16	24
Net precipitation	0	6	0	18
Soil permeability	1	8	8	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			24	114
Subscore (100 x factor score subtotal/maximum score subtotal)				21

C. Highest pathway subscore.

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

Pathways Subscore 56

IV. WASTE MANAGEMENT PRACTICES

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

Receptors		51	
Waste Characteristics		100	
Pathways		56	
Total	207	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 1.00 = 69

FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of site: AGE Washrack Pond
Location: SW of Building 506
Date of Operation: 1970 to present
Owner/Operator: Altus AFB
Comments/Description: Unlined pond received PD-680 cleaning solutions; effluent discharge to sanitary sewer
Site Rated by: R.L.Thoem and J.R.Absalon

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	3	4	12	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 installation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	3	6	18	18
G. Ground water use of uppermost aquifer	2	9	18	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	1	6	6	18
Subtotals			101	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 56

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 (small, medium, or large) M = medium
2. Confidence level (confirmed or suspected) C = confirmed
3. Hazard rating (low, medium, or high) H = high

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 1.00 = 80

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

80 x 1.00 = 80

III. PATHWAYS

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 0

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.

Rating Factor	Factor Rating (0-3)	Multi-plier	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	1	8	8	24
Surface permeability	2	6	12	18
Rainfall intensity	2	8	16	24
Subtotals			60	108
Subscore (100 x factor score subtotal/maximum score subtotal)				56
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	2	8	16	24
Net precipitation	0	6	0	18
Soil permeability	1	8	8	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			24	114
Subscore (100 x factor score subtotal/maximum score subtotal)				21

C. Highest pathway subscore.

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

Pathways Subscore 56

IV. WASTE MANAGEMENT PRACTICES

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

Receptors		56	
Waste Characteristics		80	
Pathways		56	
Total	192	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 1.00 = 64

FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of site: FPTA No. 3
Location: NE corner of base, adjacent to Taxiway No.3 and Landfill No.3
Date of Operation: 1960 to 1982
Owner/Operator: Altus AFB
Comments/Description: Burned contaminated fuels, waste oils, and other combustible shop wastes
Site Rated by: R.L.Thoem and J.R.Absalon

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	2	10	20	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to installation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	3	6	18	18
G. Ground water use of uppermost aquifer	2	9	18	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	1	6	6	18
Subtotals			100	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 56

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 (small, medium, or large) L = large
2. Confidence level (confirmed or suspected) C = confirmed
3. Hazard rating (low, medium, or high) H = high

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 0.80 = 80

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

80 x 1.00 = 80

III. PATHWAYS

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 0

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.

Rating Factor	Factor Rating (0-3)	Multi-plier	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	1	8	8	24
Surface permeability	2	6	12	18
Rainfall intensity	2	8	16	24
Subtotals			60	108
Subscore (100 x factor score subtotal/maximum score subtotal)				56
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	2	8	16	24
Net precipitation	0	6	0	18
Soil permeability	1	8	8	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			24	114
Subscore (100 x factor score subtotal/maximum score subtotal)				21

C. Highest pathway subscore.

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

Pathways Subscore 56

IV. WASTE MANAGEMENT PRACTICES

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

Receptors		56	
Waste Characteristics		80	
Pathways		56	
Total	192	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 1.00 = \ 64 \

FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of site: Landfill No. 3/ POL Sludge Burial
Location: NE corner of base near Taxiway No. 3
Date of Operation: 1956 to 1983
Owner/Operator: Altus AFB
Comments/Description: Putrescible wastes disposed until mid 1960's and then hardfill materials;some shop wastes disposed. POL tank cleaning sludge buried in northern part of the site from 1950's to 1970's.Routine burning at site.
Site Rated by: R.L.Thoem and J.R.Absalon

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	2	10	20	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to installation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	3	6	18	18
G. Ground water use of uppermost aquifer	2	9	18	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	1	6	6	18
Subtotals			100	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 56

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 (small, medium, or large) M = medium
2. Confidence level (confirmed or suspected) C = confirmed
3. Hazard rating (low, medium, or high) H = high

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 0.80 = 64

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

64 x 0.75 = 48

III. PATHWAYS

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 0

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.

Rating Factor	Factor Rating (0-3)	Multi-plier	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	1	8	8	24
Surface permeability	2	6	12	18
Rainfall intensity	2	8	16	24
Subtotals			60	108
Subscore (100 x factor score subtotal/maximum score subtotal)				56
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	2	8	16	24
Net precipitation	0	6	0	18
Soil permeability	1	8	8	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			24	114
Subscore (100 x factor score subtotal/maximum score subtotal)				21

C. Highest pathway subscore.

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

Pathways Subscore 56

IV. WASTE MANAGEMENT PRACTICES

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

Receptors		56	
Waste Characteristics		48	
Pathways		56	
Total	160	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 1.00 = \ 53 \

FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of site: FPTA No. 2
Location: NE part of Golf course near Perimeter Road
Date of Operation: 1956 to 1960
Owner/Operator: Altus AFB
Comments/Description: Burned contaminated fuels, waste oils and other combustible shop wastes
Site Rated by: R.L.Thoem and J.R.Absalon

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	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 installation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	3	6	18	18
G. Ground water use of uppermost aquifer	2	9	18	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	1	6	6	18
Subtotals			89	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 49

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 (small, medium, or large) M = medium
2. Confidence level (confirmed or suspected) C = confirmed
3. Hazard rating (low, medium, or high) H = high

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 0.80 = 64

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

64 x 1.00 = 64

III. PATHWAYS

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 0

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.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	1	8	8	24
Net precipitation	0	6	0	18
Surface erosion	1	8	8	24
Surface permeability	2	6	12	18
Rainfall intensity	2	8	16	24
Subtotals			44	108
Subscore (100 x factor score subtotal/maximum score subtotal)				41
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	2	8	16	24
Net precipitation	0	6	0	18
Soil permeability	1	8	8	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			24	114
Subscore (100 x factor score subtotal/maximum score subtotal)				21

C. Highest pathway subscore.

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

Pathways Subscore 41

IV. WASTE MANAGEMENT PRACTICES

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

Receptors		49
Waste Characteristics		64
Pathways		41
Total	154	divided by 3 = 51 Gross total score

B. Apply factor for waste containment from waste management practices.

Gross total score x waste management practices factor = final score

51 x 1.00 = \ 51 \

FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of site: FPTA No. 1
Location: SW part of Golf course near First St.
Date of Operation: 1954 to 1956
Owner/Operator: Altus AFB
Comments/Description: Burned contaminated fuels, waste oils, and other combustible shop wastes
Site Rated by: R.L.Thoem and J.R.Absalon

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	3	4	12	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 installation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	3	6	18	18
G. Ground water use of uppermost aquifer	2	9	18	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	1	6	6	18
Subtotals			95	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 53

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 (small, medium, or large) S = small
2. Confidence level (confirmed or suspected) C = confirmed
3. Hazard rating (low, medium, or high) H = high

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

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

60 x 0.80 = 48

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

48 x 1.00 = 48

III. PATHWAYS

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 0

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.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	2	8	16	24
Net precipitation	0	6	0	18
Surface erosion	1	8	8	24
Surface permeability	2	6	12	18
Rainfall intensity	2	8	16	24
Subtotals			52	108
Subscore (100 x factor score subtotal/maximum score subtotal)				48
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	2	8	16	24
Net precipitation	0	6	0	18
Soil permeability	1	8	8	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			24	114
Subscore (100 x factor score subtotal/maximum score subtotal)				21

C. Highest pathway subscore.

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

Pathways Subscore 48

IV. WASTE MANAGEMENT PRACTICES

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

Receptors		53	
Waste Characteristics		48	
Pathways		48	
Total	149	divided by 3 =	50 Gross total score

B. Apply factor for waste containment from waste management practices.

Gross total score x waste management practices factor = final score

50 x 1.00 = 50 FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of site: FPTA No. 4
Location: Adjacent to Taxiway No. 3 and near FPTA No. 3
Date of Operation: 1982 to present
Owner/Operator: Altus AFB
Comments/Description: Burned contaminated fuels, waste oils, and other combustible shop wastes
Site Rated by: R.L. Thoem and J.R. Absalon

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	2	10	20	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to installation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	3	6	18	18
G. Ground water use of uppermost aquifer	2	9	18	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	1	6	6	18
Subtotals			94	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 52

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 (small, medium, or large) S = small
2. Confidence level (confirmed or suspected) C = confirmed
3. Hazard rating (low, medium, or high) H = high

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

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

60 x 0.80 = 48

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

48 x 1.00 = 48

III. PATHWAYS

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 0

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.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	2	8	16	24
Net precipitation	0	6	0	18
Surface erosion	1	8	8	24
Surface permeability	2	6	12	18
Rainfall intensity	2	8	16	24
Subtotals			52	108
Subscore (100 x factor score subtotal/maximum score subtotal)				48
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	2	8	16	24
Net precipitation	0	6	0	18
Soil permeability	1	8	8	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			24	114
Subscore (100 x factor score subtotal/maximum score subtotal)				21

C. Highest pathway subscore.

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

Pathways Subscore 48

IV. WASTE MANAGEMENT PRACTICES

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

Receptors	52
Waste Characteristics	48
Pathways	48
Total 148 divided by 3 =	49 Gross total score

B. Apply factor for waste containment from waste management practices.

Gross total score x waste management practices factor = final score

49 x 0.95 = 47

FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of site: Landfill No. 1
Location: Near SE corner of runway
Date of Operation: 1942 to 1945; 1953 to 1954
Owner/Operator: Altus AFB
Comments/Description: Some occasional shop wastes;routine burning at site

Site Rated by: R.L.Thoem and J.R.Absalon

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi- plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest well	1	10	10	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to installation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	3	6	18	18
G. Ground water use of uppermost aquifer	2	9	18	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	1	6	6	18
Subtotals			80	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 44

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 (small, medium, or large) S = small
2. Confidence level (confirmed or suspected) S = suspected
3. Hazard rating (low, medium, or high) H = high

Factor Subscore A (from 20 to 100 based on factor score matrix) 40

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

40 x 0.80 = 32

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

32 x 1.00 = 32

III. PATHWAYS

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 0

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.

Rating Factor	Factor Rating (0-3)	Multi-plier	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	1	8	8	24
Surface permeability	2	6	12	18
Rainfall intensity	2	8	16	24
Subtotals			60	108
Subscore (100 x factor score subtotal/maximum score subtotal)				56
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	2	8	16	24
Net precipitation	0	6	0	18
Soil permeability	1	8	8	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			24	114
Subscore (100 x factor score subtotal/maximum score subtotal)				21

C. Highest pathway subscore.

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

Pathways Subscore 56

IV. WASTE MANAGEMENT PRACTICES

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

Receptors		44	
Waste Characteristics		32	
Pathways		56	
Total	132	divided by 3 =	44 Gross total score

B. Apply factor for waste containment from waste management practices.

Gross total score x waste management practices factor = final score

44 x 1.00 = 44

FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of site: Landfill No. 2
Location: Near Eastern Perimeter Road
Date of Operation: 1955 to 1956
Owner/Operator: Altus AFB
Comments/Description: Minor amounts of shop wastes; routine burning at site

Site Rated by: R.L.Thoem and J.R.Absalon

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest well	1	10	10	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to installation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	3	6	18	18
G. Ground water use of uppermost aquifer	2	9	18	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	1	6	6	18
Subtotals			86	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 48

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 (small, medium, or large) S = small
2. Confidence level (confirmed or suspected) S = suspected
3. Hazard rating (low, medium, or high) H = high

Factor Subscore A (from 20 to 100 based on factor score matrix) 40

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

40 x 0.80 = 32

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

32 x 1.00 = 32

III. PATHWAYS

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 0

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.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	1	8	8	24
Net precipitation	0	6	0	18
Surface erosion	1	8	8	24
Surface permeability	2	6	12	18
Rainfall intensity	2	8	16	24
Subtotals			44	108
Subscore (100 x factor score subtotal/maximum score subtotal)				41
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	2	8	16	24
Net precipitation	0	6	0	18
Soil permeability	1	8	8	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			24	114
Subscore (100 x factor score subtotal/maximum score subtotal)				21

C. Highest pathway subscore.

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

Pathways Subscore 41

IV. WASTE MANAGEMENT PRACTICES

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

Receptors		48	
Waste Characteristics		32	
Pathways		41	
Total	121	divided by 3 =	40 Gross total score

B. Apply factor for waste containment from waste management practices.

Gross total score x waste management practices factor = final score

40 x 1.00 = 40

FINAL SCORE

APPENDIX I

GLOSSARY OF TERMINOLOGY AND ABBREVIATIONS

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GLOSSARY OF TERMINOLOGY AND ABBREVIATIONS

ABG: Air Base Group.

ACE: Accelerated Co-pilot Enrichment.

ACFT MAINT: Aircraft Maintenance.

AF: Air Force.

AFB: Air Force Base.

AFCI: Automatic Flight Control/Instruments.

AFESC: Air Force Engineering and Services Center.

AFFF: Aqueous Film Forming Foam, a fire extinquishing agent. AFFF concentrates include fluorinated surfactants plus foam stabilizers diluted with water to a 3 to 6 percent solution.

AFR: Air Force Regulation.

AFRCE: Air Force Regional Civil Engineer.

Ag: Chemical symbol for silver.

AGE: Aerospace Ground Equipment.

Al: Chemical symbol for aluminum.

ALERT AREA: An area near the end of the runway where aircraft are parked and ready for immediate takeoff.

ALLUVIUM: Materials eroded, transported and deposited by streams.

ALLUVIAL FAN: A fan-shaped deposit formed by a stream either where it issues from a narrow mountain valley into a plain or broad valley, or where a tributary stream joins a main stream.

AME: Alternate Mission Equipment.

AMS: Avionics Maintenance Squadron.

APU: Auxiliary Power Unit.

AQUIFER: A geologic formation, group of formations, or part of a formation that is capable of yielding water to a well or spring.

AREFW: Air Refueling Wing.

AROMATIC: Description of organic chemical compounds in which the carbon atoms are arranged into a ring with special electron stability associated. Aromatic compounds are often more reactive than non-aromatics.

ARTESIAN: Ground water contained under hydrostatic pressure.

ATC: Air Training Command.

AVGAS: Aviation Gasoline.

Ba: Chemical symbol for barium.

BEDROCK: Any solid rock exposed at the surface of the earth or overlain by unconsolidated material.

BEE: Bioenvironmental Engineer.

BES: Bioenvironmental Engineering Services.

BIOACCUMULATE: Tendency of elements or compounds to accumulate or build up in the tissues of living organisms when they are exposed to these elements in their environments, e.g., heavy metals.

BIODEGRADABLE: The characteristic of a substance to be broken down from complex to simple compounds by microorganisms.

BOWSER: A portable tank, usually under 200 gallons in capacity.

BX: Base Exchange.

$CaCO_3$: Chemical symbol for calcium carbonate.

CAMS: Consolidated Aircraft Maintenance Squadron.

Cd: Chemical symbol for cadmium.

CE: Civil Engineering.

CERCLA: Comprehensive Environmental Response, Compensation and Liability Act.

CES: Civil Engineering Squadron.

CIRCA: About; used to indicate an approximate date.

CLOSURE: The completion of a set of rigidly defined functions for a hazardous waste facility no longer in operation.

CMS: Component Maintenance Squadron.

CN: Chemical symbol for cyanide.

COD: Chemical Oxygen Demand, a measure of the amount of oxygen required to oxidize organic and oxidizable inorganic compounds in water.

COE: Corps of Engineers.

COMD: Command.

CONFINED AQUIFER: An aquifer bounded above and below by impermeable strata or by geologic units of distinctly lower permeability than that of the aquifer itself.

CONTAMINATION: The degradation of natural water quality to the extent that its usefulness is impaired; there is no implication of any specific limits since the degree of permissible contamination depends upon the intended end use or uses of the water.

Cr: Chemical symbol for chromium.

Cu: Chemical symbol for copper.

CURIE: Unit for measuring radioactivity. One curie is the quantity of any radioactive isotope undergoing 3.7×10^{10} disintegrations per second.

D: Disposal site/method.

DEQPPM: Defense Environmental Quality Program Policy Memorandum

DET: Detachment.

DIP: The angle at which a stratum is inclined from the horizontal.

DISPOSAL FACILITY: A facility or part of a facility at which hazardous waste is intentionally placed into or on land or water, and at which waste will remain after closure.

DISPOSAL OF HAZARDOUS WASTE: The discharge, deposit, injection, dumping, spilling, or placing of any hazardous waste into or on land or water so that such waste or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including ground water.

DOD: Department of Defense.

DOWNGRADIENT: In the direction of decreasing hydraulic static head; the direction in which ground water flows.

DPDO: Defense Property Disposal Office, previously included Redistribution and Marketing (R&M) and Salvage.

DUMP: An uncovered land disposal site where solid and/or liquid wastes are deposited with little or no regard for pollution control or aesthetics; dumps are susceptible to open burning and are exposed to the elements, disease vectors and scavengers.

EFFLUENT: A liquid waste discharge from a manufacturing or treatment process, in its natural state, or partially or completely treated, that discharges into the environment.

ELECTRICAL RESISTIVITY (ER): Specialized equipment designed to produce an electrical current through subsurface geologic strata. The instrument and the technique permit the operator to examine conditions at specific depths below land surface. Subsurface contrasts indicative of specific geologic or hydrologic conditions may be obtained through correlation of the ER data with known site information such as that provided by test borings or well construction logs.

EOD: Explosive Ordnance Disposal.

EP: Extraction Procedure, the EPA's standard laboratory procedure for leachate generation.

EPA: U.S. Environmental Protection Agency.

EPHEMERAL: Short-lived or temporary.

EPHEMERAL AQUIFER: A water-bearing zone typically located near the surface which normally contains water seasonally.

EROSION: The wearing away of land surface by wind, water, or chemical processes.

ES: Engineering-Science, Inc.

FAA: Federal Aviation Administration.

FACILITY (As Applied to Hazardous Wastes): Any land and appurtenances thereon and thereto used for the treatment, storage and/or disposal of hazardous wastes.

FAULT: A fracture in rock along which the adjacent rock surfaces are differentially displaced.

Fe: Chemical symbol for iron.

FLOOD PLAIN: The lowland and relatively flat areas adjoining inland and coastal areas of the mainland and off-shore islands, including, at a minimum, areas subject to a one percent or greater chance of flooding in any given year.

FLOW PATH: The direction or movement of ground water as governed principally by the hydraulic gradient.

FMB: Field Maintenance Branch.

FMS: Field Maintenance Squadron.

FPTA: Fire Protection Training Area.

FTD: Field Training Detachment.

GC/MS: Gas chromatograph/mass spectrophotometer, a laboratory procedure for identifying unknown compounds.

GEOPHYSICS: (Geophysical survey) the use of one or more geophysical instruments or methods to measure specific properties of the earth's subsurface through indirect means. Geophysical equipment may include electrical resistivity, geiger counter, magnetometer, metal detector, electromagnetic conductivity, magnetic susceptibility, etc. Geophysics seeks to provide specific measurements of the earth's magnetic field, the electrical properties of specific geologic strata, radioactivity, etc.

GLACIAL TILL: Unsorted and unstratified drift consisting of clay, sand, gravel and boulders which is deposited by or underneath a glacier.

GROUND WATER: Water beneath the land surface in the saturated zone that is under atmospheric or artesian pressure.

GROUND WATER RESERVOIR: The earth materials and the intervening open spaces that contain ground water.

GTU: Gas Turbine Unit.

HALF-LIFE: The time required for half the atoms present in radioactive substance to disintegrate.

HALOGEN: The class of chemical elements including fluorine, chlorine, bromine, and iodine.

HARDFILL: Disposal sites receiving construction debris, wood, miscellaneous spoil material.

HARM: Hazard Assessment Rating Methodology.

HAZARDOUS SUBSTANCE: Under CERCLA, the definition of hazardous substance includes:

1. All substances regulated under Paragraphs 311 and 307 of the Clean Water Act (except oil);

2. All substances regulated under Paragraph 3001 of the Solid Waste Disposal Act;

3. All substances regulated under Paragraph 112 of the Clean Air Act;

4. All substances which the Administrator of EPA has acted against under Paragraph 7 of the Toxic Substance Control Act;

5. Additional substances designated under Paragraph 102 of CERCLA.

HAZARDOUS WASTE: As defined in RCRA, a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical or infectious characteristics may cause or significantly contribute to an increase in mortality or an increase in serious, irreversible, or incapacitating reversible illness; or pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed.

HAZARDOUS WASTE GENERATION: The act or process of producing a hazardous waste.

HEAVY METALS: Metallic elements, including the transition series, which include many elements required for plant and animal nutrition in trace concentrations but which become toxic at higher concentrations.

Hg: Chemical symbol for mercury.

HQ: Headquarters.

HWMF: Hazardous Waste Management Facility.

HYDROCARBONS: Organic chemical compounds composed of hydrogen and carbon atoms chemically bonded. Hydrocarbons may be straight chain, cyclic, branched chain, aromatic, or polycyclic, depending upon arrangement of carbon atoms. Halogenated hydrocarbons are hydrocarbons in which one or more hydrogen atoms has been replaced by a halogen atom.

INCOMPATIBLE WASTE: A waste unsuitable for commingling with another waste or material because the commingling might result in generation of extreme heat or pressure, explosion or violent reaction, fire, formation of substances which are shock sensitive, friction sensitive, or otherwise have the potential for reacting violently, formation of toxic dusts, mists, fumes, and gases, volatilization of ignitable or toxic chemicals due to heat generation in such a manner that the likelihood of contamination of ground water or escape of the substance into the environment is increased, any other reaction which might result in not meeting the air, human health, and environmental standards.

INFILTRATION: The movement of water through the soil surface into the ground.

IRP: Installation Restoration Program.

JP-4: Jet Propulsion Fuel Number Four; contains both kerosene and gasoline fractions.

LANDFILL: A land disposal site used for disposing solid and semi-solid materials. May refer either to a sanitary landfill or dump.

LEACHATE: A solution resulting from the separation or dissolving of soluble or particulate constituents from solid waste or other man-placed medium by percolation of water.

LEACHING: The process by which soluble materials in the soil, such as nutrients, pesticide chemicals or contaminants, are washed into a lower layer of soil or are dissolved and carried away by water.

LENTICULAR: A bed or rock stratum or body that is lens-shaped.

LINER: A continous layer of natural or man-made materials beneath or on the sides of a surface impoundment, landfill, or landfill cell which restricts the downward or lateral escape of hazardous waste, hazardous waste constituents or leachate.

LITHOLOGY: The description of the physical character of a rock.

LOESS: An essentially unconsolidated unstratified calcareous silt; commonly homogeneous, permeable and buff to gray in color.

m: Milli (10^{-3}).

MAC: Military Airlift Command.

MAGNETOMFTER (MG): A device capable of measuring localized variations in the earth's magnetic field that may be due to disturbed areas such as backfilled trenches, buried objects, etc. Measurements may be obtained at points located on a grid pattern so that the data can be contoured, revealing the location, size and intensity of the suspected anomaly.

MAW: Military Airlift Wing.

MEK: M.thyl Ethyl Ketone.

METALS: See "Heavy Metals."

MICRO: [illegible] (10^{-6}).

ug/1: Micrograms per liter.

mg/l: Milligrams per liter.

MGD: Million Gallons per Day.

MOGAS: Motor gasoline.

Mn: Chemical symbol for manganese.

MONITORING WELL: A well used to measure ground-water levels and to obtain ground-water samples for water quality analyses. As distinguished from observation wells, monitoring wells are often designed for longer term operations. They are constructed of materials for the site-specific climatic, hydrogeologic and contaminant conditions.

MSL: Mean Sea Level.

MUNITION ITEMS: Munitions or portions of munitions having an explosive potential.

MUNITIONS RESIDUE: Non-explosive segments of waste munitions (i.e., bomb casings).

MWR: Morale Welfare and Recreation.

NCO: Non-commissioned Officer.

NCOIC: Non-commissioned Officer In-Charge.

NDI: Non-destructive Inspection.

NET PRECIPITATION: The amount of annual precipitation minus annual evaporation.

NGVD: National Geodetic Vertical Datum of 1929. A national datum system, tied to Mean Sea Level, but referenced primarily to land-based benchmarks.

Ni: Chemical symbol for nickel.

NOAA: National Oceanic and Atmospheric Administration.

NON-CALCAREOUS: Not bearing calcium carbonate ($CaCO_3$) a characteristic mineral of marine paleoenvironment.

NPDES: National Pollutant Discharge Elimination System.

OBSERVATION WELL: An informally designed cased well, open to a specific geologic unit or formation, designed to allow the measurement of physical ground-water properties within the zone or unit of interest. Observation wells are designed to permit the measurement of water levels and in-situ parameters such as ground-water (flow velocity and flow direction. Not to be confused with a monitoring well, a well designed to permit accurate ground-water quality monitoring. Monitoring wells are constructed of materials compatible with site-specific climatic, hydrogeologic and contaminant conditions. monitoring well installation and construction is planned to have minimal impacts on apparent ground-water quality and will often be for longer term operation compared with observation wells.

OEHL: USAF Occupational and Environmental Health Laboratory.

OIC: Officer-In-Charge.

OMS: Organizational Maintenance Squadron.

ORGANIC: Being, containing or relating to carbon compounds, especially in which hydrogen is attached to carbon.

OSI: Office of Special Investigations.

O&G: Symbols for oil and grease.

Pb: Chemical symbol for lead.

PCB: Polychlorinated Biphenyl; liquids used as a dielectrics in electrical equipment.

PD-680: Cleaning solvent; petroleum distillate, Stoddard solvent.

PERCHED WATER TABLE: A water table above a relatively impermeable zone underlain by unsaturated rocks of sufficient permeability to allow ground-water movement.

PERCOLATION: Movement of moisture by gravity or hydrostatic pressure through interstices of unsaturated rock or soil.

PERMEABILITY: The relative rate of water flow through a porous medium. The USDA, Soil Conservation Service describes permeability qualitatively as follows:

very slow	<0.06	inches/hour
slow	0.06 to 0.2	inches/hour
moderately slow	0.2 to 0.6	inches/hour
moderate	0.6 to 2.0	inches/hour
moderately rapid	2.0 to 6.0	inches/hour
rapid	6.0 to 20	inches/hour
very rapid	>20	inches/hour

PERSISTENCE: As applied to chemicals, those which are very stable and remain in the environment in their original form for an extended period of time.

PESTICIDE: An agent used to destroy pests. Pesticides include such specialty groups as herbicides, fungicides, insecticides, etc.

pH: Negative logarithm of hydrogen ion concentration; measurement of acids and bases.

pico: 10^{-12}

PL: Public Law.

PMEL: Precision Measurement Equipment Laboratory.

POL: Petroleum, Oils and Lubricants.

POLLUTANT: Any introduced gas, liquid or solid that makes a resource unfit for a specific purpose.

POLYCYCLIC COMPOUND: All compounds in which carbon atoms are arranged into two or more rings, usually aromatic in nature.

POTENTIOMETRIC SURFACE: The imaginery surface to which water in an artesian aquifer would rise in tightly screened wells penetrating it.

ppb: Parts per billion by weight.

ppm: Parts per million by weight.

PRECIPITATION: Rainfall.

RCRA: Resource Conservation and Recovery Act.

RECEPTORS: The potential impact group or resource for a waste contamination source.

RECHARGE AREA: A surface area in which surface water or precipitation percolates through the unsaturated zone and eventually reaches the zone of saturation. Recharge areas may be natural or manmade.

RECHARGE: The addition of water to the ground-water system by natural or artificial processes.

RECON: Reconnaissance.

RESISTIVITY: See "Electrical Resistivity."

RFNA: Red fuming nitric acid.

RM: Resource Management.

S: Storage site/method.

SAC: Strategic Air Command.

SANITARY LANDFILL: A land disposal site using an engineered method of disposing solid wastes on land in a way that minimizes environmental hazards.

SATURATED ZONE: That part of the earth's crust in which all voids are filled with water.

SAX'S TOXICITY: A rating method for evaluating the toxicity of chemical materials.

SCS: U.S. Department of Agriculture Soil Conservation Service.

SEISMICITY: Pertaining to earthquakes or earth vibrations.

SLUDGE: The solid residue resulting from a manufacturing or wastewater treatment process which also produces a liquid stream. The residue which accumulates in liquid fuel storage tanks.

SMART: Structural maintenance and repair team.

SOLID WASTE: Any garbage, refuse, or sludge from a waste treatment plant, water supply treatment, or air pollution control facility and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, commercial, mining, or agricultural operations and from community activities, but does not include solid or dissolved materials in domestic sewage; solid or dissolved materials in irrigation return flows; industrial discharges which are point source subject to permits under Section 402 of the Federal

Water Pollution Control Act, as amended (86 USC 880); or source, special nuclear, or by-product material as defined by the Atomic Energy Act of 1954 (68 USC 923).

SPILL: Any unplanned release or discharge of a hazardous waste onto or into the air, land, or water.

STORAGE OF HAZARDOUS WASTE: Containment, either on a temporary basis or for a longer period, in such a manner as not to constitute disposal of such hazardous waste.

STP: Sewage Treatment Plant.

SUPS: Supply Squadron.

T: Treatment site/method.

TAC: Tactical Air Command.

TCE: Trichloroethylene, a solvent and suspected carcinogen.

TDS: Total Dissolved Solids.

TMDE: Test Measurement and Diagnostic Equipment.

TOC: Total Organic Carbon.

TOXICITY: The ability of a material to produce injury or disease upon exposure, ingestion, inhalation, or assimilation by a living organism.

TRANS: Transportation Squadron.

TRANSMISSIVITY: The rate at which water is transmitted through a unit width of aquifer under a unit hydraulic gradient.

TREATMENT OF HAZARDOUS WASTE: Any method, technique, or process including neutralization designed to change the physical, chemical, or biological character or composition of any hazardous waste so as to neutralize the waste or so as to render the waste nonhazardous.

TSD: Treatment, storage and disposal.

TTS: Technical Training Squadron.

UPGRADIENT: In the direction of increasing hydraulic static head; the direction opposite to the prevailing flow of ground-water.

US: United States.

USAF: United States Air Force.

USDA: United States Department of Agriculture.

USFWS: United States Fish and Wildlife Service.

USGS: United States Geological Survey.

WATER TABLE: Surface of a body of unconfined ground water at which the pressure is equal to that of the atmosphere.

WWTP: Wastewater Treatment Plant.

Zn: Chemical symbol for zinc.

APPENDIX J

REFERENCES

APPENDIX J

REFERENCES

1. Bedinger, M.S. and Sniegocki, R.T., 1976. Summary Appraisals of the Nation's Ground-Water Resources - Arkansas-Red-White Region, U.S. Geological Survey Professional Paper 813-H.
2. Curtis, N.M. and Ham, W.E., 1972 (rev. 1979). Geomorphic Provinces of Oklahoma, in Geology and Earth Resources of Oklahoma, Oklahoma Geological Survey Publication No. 1.
3. Havens, John S., 1977. Reconnaissance of the Water Resources of the Lawton Quadrangle Southwestern Oklahoma. Oklahoma Geological Survey Hydrologic Atlas 6.
4. Hayes, Curtis J., 1971. Landslides and Related Phenomena Pertaining to Highway Construction in Oklahoma, in Environmental Aspects of Geology and Engineering in Oklahoma. Annals of the Oklahoma Academy of Science Publication No. 2. Norman, OK.
5. Hodgson, John G., 1984. Water Pollution Emissions Inventory. U.S. Air Force Hospital Altus, Altus AFB, OK.
6. Johnson, K.S. and Luza, K.V., 1980. Surface Disposal of Industrial Wastes in Oklahoma, in Disposal of Industrial Wastes in Oklahoma, Oklahoma Geological Survey Circular 80.
7. Kent, Douglas C., 1980. Evaluation of Aquifer Performance and Water Supply Capabilities of Alluvial and Terrace Deposits of the North Fork of the Red River in Beckham, Greer, Kiowa and Jackson Counties, Oklahoma. Final Report to Oklahoma Water Resources Board, Oklahoma City, OK.
8. Miser, Hugh D., 1954. Geologic Map of the State of Oklahoma. Oklahoma Geological Survey.
9. NOAA, 1983. National Oceanographic and Atmospheric Administration Climatic Atlas of the United States.

10. Oklahoma Water Resources Board, 1982. (With Addenda for 1983 and 1984). Oklahoma Water Quality Standards with Rules, Regulations and Modes of Procedure. Oklahoma City, OK.

11. U.S. Department of Agriculture, Soil Conservation Service, 1961. Soil Survey of Jackson County, Oklahoma.

APPENDIX K

INDEX OF REFERENCES TO POTENTIAL CONTAMINATION

SITES AT ALTUS AFB

APPENDIX K

INDEX OF REFERENCES TO POTENTIAL CONTAMINATION SITES AT ALTUS AFB