AD-A158 056

INSTALLATION RESTORATION PROGRAM
PHASE I: RECORDS SEARCH
BROOKS AFB
TEXAS

Prepared For

United States Air Force
AFESC/DEV
Tyndall AFB, Florida
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March 1985

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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 Brooks Air Force Base (AFB) under Contract No. F08637 84 C0070.

INSTALLATION DESCRIPTION

Brooks AFB is located within the San Antonio, Texas metropolitan area in Bexar County. The main base has a land area of 1,310 acres that is owned by the Air Force. One remote annex, "El Rancho Cima", is leased from the Boy Scouts of America. The 200 acre leased parcel is used by Brooks AFB for survival training.

Brooks AFB was established in 1917 and served as a training center for flight instructors, pilots and aerial observation during different periods until 1960 when all flying activities were discontinued. The Aerospace Medical Division, formerly designated the Air Force Medical Center, has been the host organization at Brooks since 1959. The mission of Brooks AFB is one of research, development and acquisition; education and training; clinical practice; and consultation in aerospace medicine.

ENVIRONMENTAL SETTING

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

- The primary regional aquifer, the Edwards, underlies Brooks AFB at great depth (1600 feet or deeper).
- Brooks AFB lies south of the reservoir zone of the Edwards Aquifer. The base is over the so-called "bad water" area. Drinking water supplies are provided to the base from the City of San Antonio municipal distribution system which obtains water from the Edwards Aquifer Reservoir Zone located several miles north of Brooks AFB.
- The Edwards Aquifer is under artesian conditions at Brooks AFB and is sealed from ground surface by substantial sequences of clay, marl, and sandstone.
- A shallow water table (unconfined) aquifer probably exists on base and is likely in communication with adjacent surface waters (Salado Creek) periodically or perenially. The full extent of this aquifer is unknown. This aquifer supplies some domestic and irrigation uses in the study area.
- Base surficial soils are predominantly silts or clays that exhibit characteristically low permeabilities. More permeable, coarser-grained soils are present at shallow depth below ground surface as in zones proximate to local surface waters.
- Historical water quality and sampling and analytical data suggested that some surface water quality permit conditions have been exceeded at Brooks AFB during heavy rainfall events. However, the quality of water entering the base exceeds permit levels during these events.
- Annual net precipitation for the area is minus 30 inches. This condition reduces the potential for leachate generation from landfills or other spill/disposal areas located on Brooks AFB. However, routine irrigation at several areas on base offsets this condition.
- No wetlands exist within the installation boundary.

- o Natural populations of either threatened or endangered plants or animals do not exist on the base. However, several protected animals are known or believed to exist in the San Antonio area.

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 a resource management tool and is designed to indicate the relative need for follow-on 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.

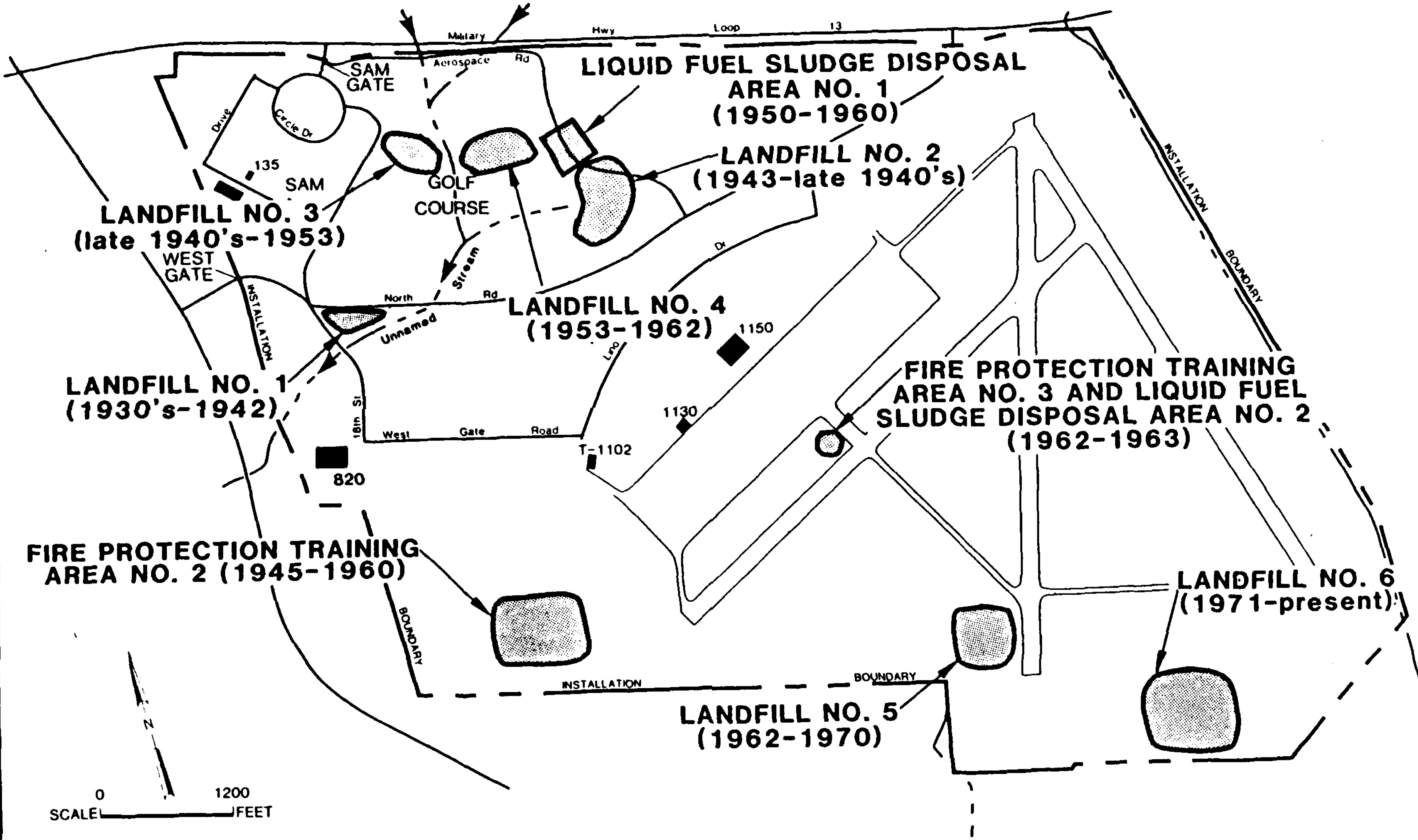
The areas found to have sufficient potential to create environmental contamination are as follows:

- o Liquid Fuel Sludge Disposal Area No. 1
- o Landfill No. 5
- o Landfill No. 6
- o Fire Protection Training Area (FPTA) No. 2
- o Landfill No. 3
- o Landfill No. 4

FIGURE 1

BROOKS AFB

SITES OF POTENTIAL CONTAMINATION



SOURCE: INSTALLATION DOCUMENTS

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

Rank	Site	Operation Period	HARM Score(1)
1	Liquid Fuel Sludge Disposal Area No. 1	1950 - 1960	65
2	Landfill No. 5	1962 - 1970	59
3	Landfill No. 6	1971 - Present	57
4	FPTA No. 2	1945 - 1960	54
5	Landfill No. 3	Late 1940's-1953	53
6	Landfill No. 4	1953 - 1962	53
7	Landfill No. 1	1930's - 1942	51
8	Landfill No. 2	1943-late 1940's	49
9	FPTA No. 3 & Liquid Fuel Sludge Disposal Area No. 2	1962 - 1963	47

(1) This ranking was performed according to the Hazard Assessment Rating Methodology (HARM) described in Appendix G. Individual rating forms are in Appendix H. Table 4.4 shows the HARM scores.

- o Landfill No. 1
- o Landfill No. 2

The area judged to have minimal potential to create environmental contamination is as follows:

- o Fire Protection Training Area (FPTA) No. 3 & Liquid Fuel Sludge Disposal Area No. 2

RECOMMENDATIONS

A program for proceeding with Phase II and other IRP activities at Brooks AFB is presented in Section 6. The recommended actions include a soil boring, monitoring well, sampling and analysis program to determine if contamination exists. This program will need to 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. Recommended guidelines for future land use restrictions at the disposal sites are also presented in Section 6. These restrictions will possibly need to be revised after more data is developed in the Phase II investigation.

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

Site (Rating Score)	Recommended Monitoring Program
Liquid Fuel Sludge Disposal Area No. 1 (65)	Conduct magnetometer and electrical resistivity studies to identify boundaries of the site and potential contaminant pathways. Collect soil samples at depths of 5, 10 and 15-feet from a control boring and from a minimum of 5 soil borings in the area identified using geophysical testing methods. The samples should be analyzed for the parameters listed in Table 6.2. If contamination is found, the sampling program may need to be expanded to identify the extent of contamination.
Landfill No. 5 (59)	Conduct magnetometer and electrical resistivity surveys to define landfill limits and to locate possible contaminant pathways. Conduct a site hydrogeological study and then locate and install one upgradient and a minimum of two downgradient monitoring wells. Collect ground-water samples from the wells and analyze for the parameters listed in Table 6.2. If contamination is indicated in these samples, the sampling program may need to be expanded to identify the extent and type of contamination.

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

Site (Rating Score)	Recommended Monitoring Program
Landfill No. 6 (57)	Conduct magnetometer and electrical resistivity surveys to assist in locating monitoring wells and to evaluate potential contaminants in the perched seasonal aquifer. Conduct a hydrogeological survey at the site to locate and install one upgradient and a minimum of three downgradient wells. Analyze ground-water samples from these wells for the parameters listed in Table 6.2. The sampling program may need to be expanded to identify the extent and type of contamination if positive results are obtained in the initial sampling.
FPTA No. 2 (54)	Conduct an electrical resistivity survey to define the site limits and any potentially contaminated subsurface zones. Perform infiltration tests to assess the impact of garden watering at the site. Advance at least five borings within the facility limits and one control boring outside the site boundaries. Collect soil samples at the surface and at depths of 5, 10 and 15 feet below grade. Analyze the soil samples for the parameters listed in Table 6.2. Expand the sampling program as required if contamination is confirmed. If contamination is detected below 5 feet, install a site specific ground-water quality monitoring system, obtain water samples and analyze in accordance with the expanded analyses program.

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

Site (Rating Score)	Recommended Monitoring Program
Landfills 1,2,3 and 4 (51,49,53,53)	Conduct a geophysical survey utilizing both magnetometer and electrical resistivity equipment to define the landfill limits and to locate possible contaminant pathways (granular strata, perched water table, etc.). Conduct a hydrogeological study for each site to assist in locating monitoring wells. Perform infiltration tests to assess the impact of irrigation on these sites. Install a ground-water quality monitoring system at each site consisting of a maximum of one well located hydraulically upgradient of the landfill and two wells installed hydraulically downgradient. Wells should be constructed to take maximum advantage of site-specific hydrogeologic conditions. Collect ground-water samples from the wells and analyze for the parameters listed in Table 6.2. The sampling program may need to be expanded to identify the extent and type of contamination if contaminants are detected.

Source: Engineering-Science

SECTION 1

INTRODUCTION

BACKGROUND AND AUTHORITY

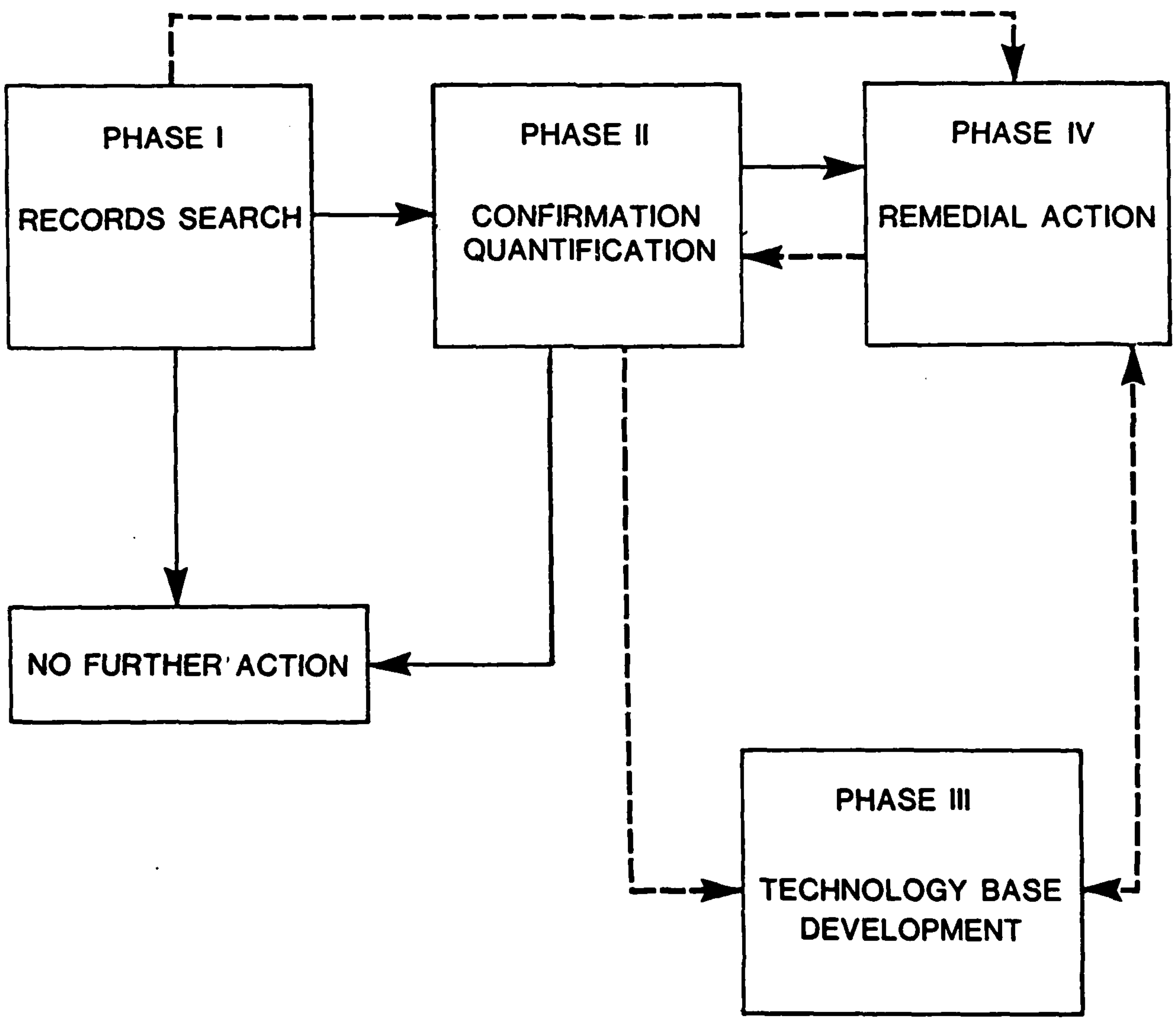
The United States Air Force, due to its primary mission of defense of the United States, has long been engaged in a wide variety of operations dealing with toxic and hazardous materials. Federal, state, and local governments have developed strict regulations to require that disposers identify the locations 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.

U.S. AIR FORCE INSTALLATION RESTORATION PROGRAM



SOURCE: AFESC

Engineering-Science (ES) was retained by the United States Air Force to conduct the Phase I Records Search at Brooks AFB under Contract 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 approximate land area included as part of the Brooks AFB study is as follows:

- Main Base Site	1310 acres (owned)
- El Rancho Cima Boy Scout Camp (Survival Training Annex)	200 acres (leased)

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 November, 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 and ecology.

- R.M. Palazzolo, Environmental Engineer, MS Environmental Engineering, 3 years of professional experience in environmental engineering.

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

METHODOLOGY

The methodology utilized in the Brooks 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 66 past and present base employees from various operating areas. Those interviewed included current and past personnel associated with civil engineering, pavements and grounds maintenance, fire protection, real property, base supply, San Antonio Real Property Maintenance Agency (SARPMA) and the Aerospace Medical Division (AMD). 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. Geological Survey - Water Resources Division (San Antonio, TX)
- Edwards Underground Water District (San Antonio, TX)
- Texas Department of Health - Solid Waste Management Program (San Antonio, TX)
- Texas Department of Water Resources - Water Quality Division (San Antonio, TX)
- Office of Air Force History (Washington, DC)
- Washington National Record Center (Suitland, MD)
- National Archives (Washington, DC and Alexandria, VA)

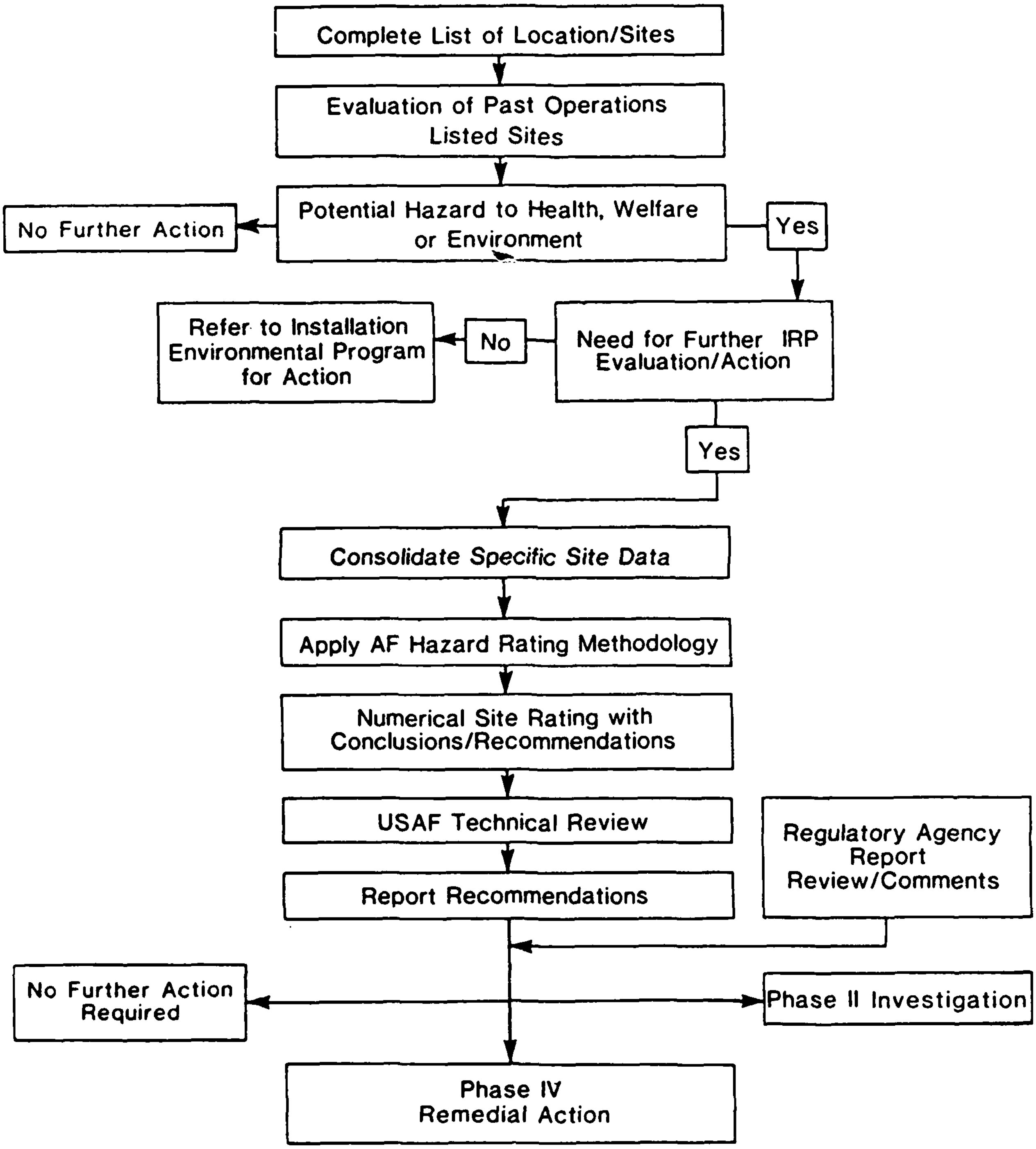
The next step in the activity review was to identify all sources of hazardous waste generation and to determine the past management practices regarding the use, storage, treatment, and disposal of hazardous materials from the various sources on the base. Included in this part of the activities review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

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

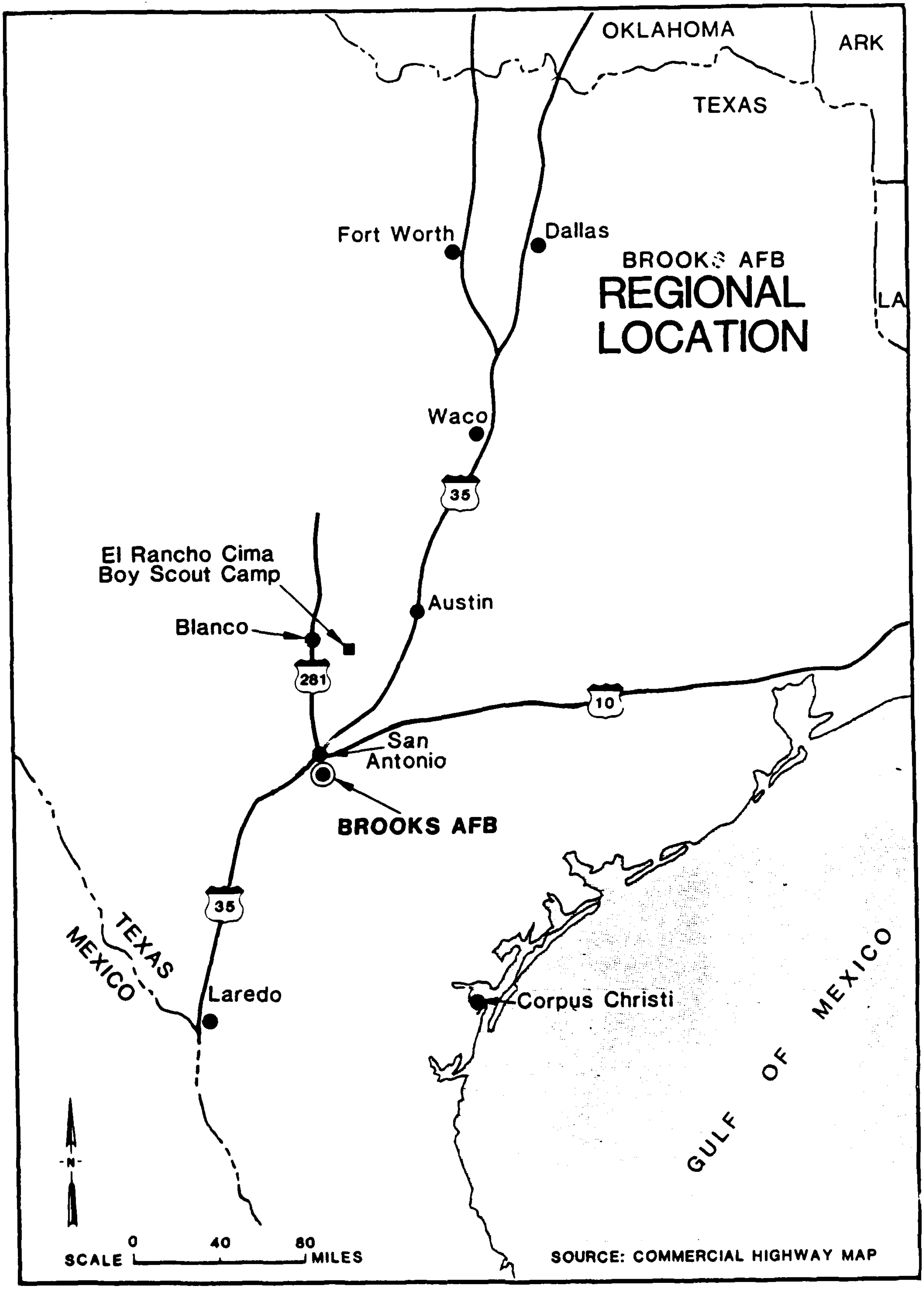
LOCATION, SIZE AND BOUNDARIES

Brooks AFB is located in Bexar County approximately 6 miles southeast of downtown San Antonio, Texas (Figures 2.1 and 2.2). The base consists of 1,310 acres of Air Force owned land which is shown in Figure 2.3. The base is bounded on the north by Loop 13, the Military Highway. The base is located approximately 800 feet east of the San Antonio River. Residential and commercial and/or light industrial areas are located in the vicinity of the base. The areas north and west of the base are more developed than the areas to the south and east.

One remote annex, "El Rancho Cima", is leased from the Boy Scouts of America. The 200 acre leased parcel is used by Brooks AFB as a Survival Training Site. The annex is located on the Blanco River approximately 50 miles northeast of San Antonio and approximately 35 miles southwest of Austin.

BASE HISTORY

Brooks Field was established in 1917 as a flight instructor training facility for the Air Service of the U.S. Army's Signal Corps. In 1919, the pilot instructor school was replaced with a Balloon and Airship School for pilots and ground crew members. The program was discontinued in 1922 and was replaced by a primary flight school for aircraft pilots. In 1926, the Army moved the School of Aviation Medicine to Brooks. The School of Aviation Medicine and the flight training school were transferred to Randolph Field in 1931. From 1931 to 1943, Brooks Field became a center of activity in aerial observation. In 1941, the U.S. Army Advanced Flying School was established at Brooks. The Twelfth Air Force assumed command from the Tenth Air Force and the base was redesignated Brooks AFB. The Fourteenth Air Force took over command in 1952



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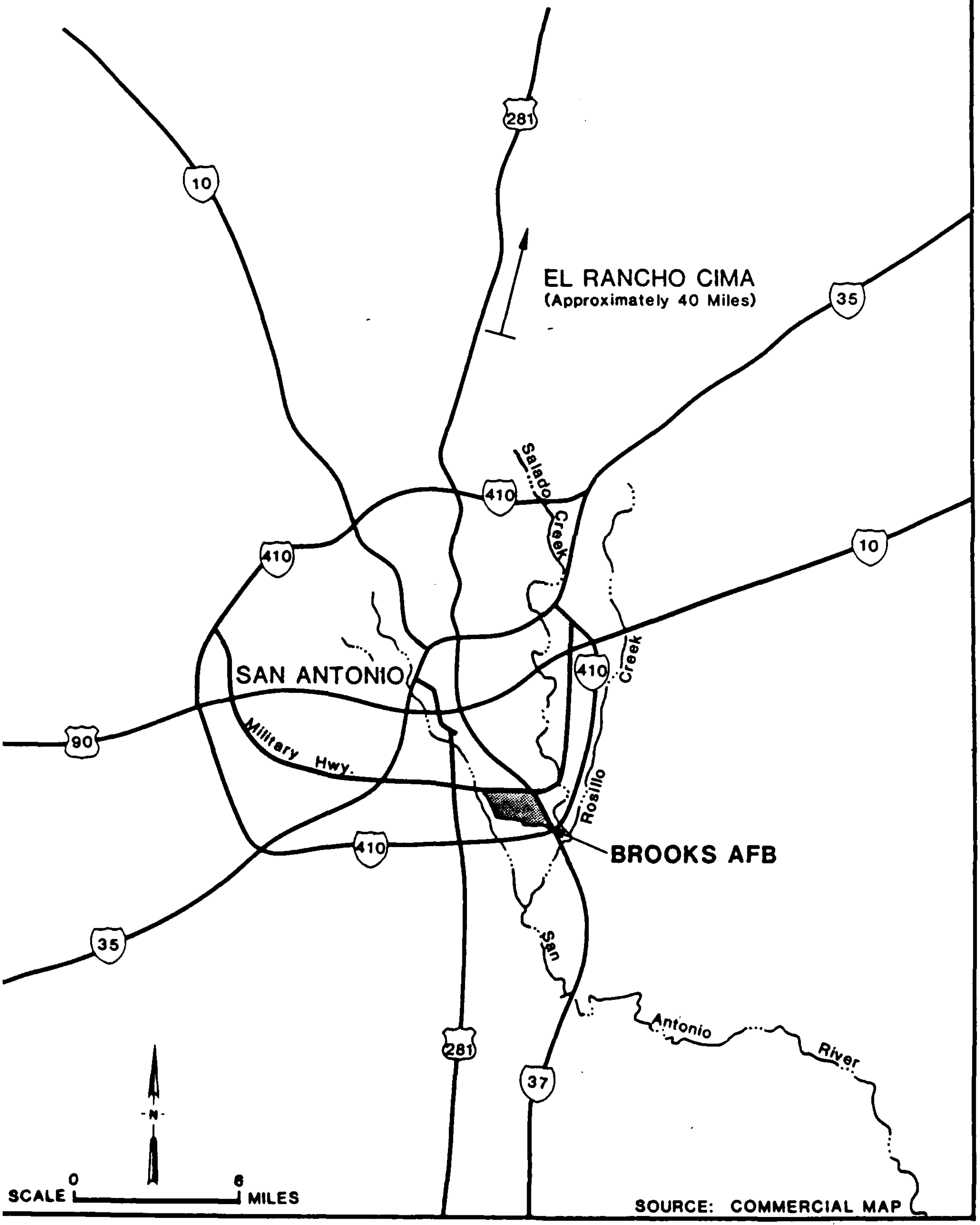
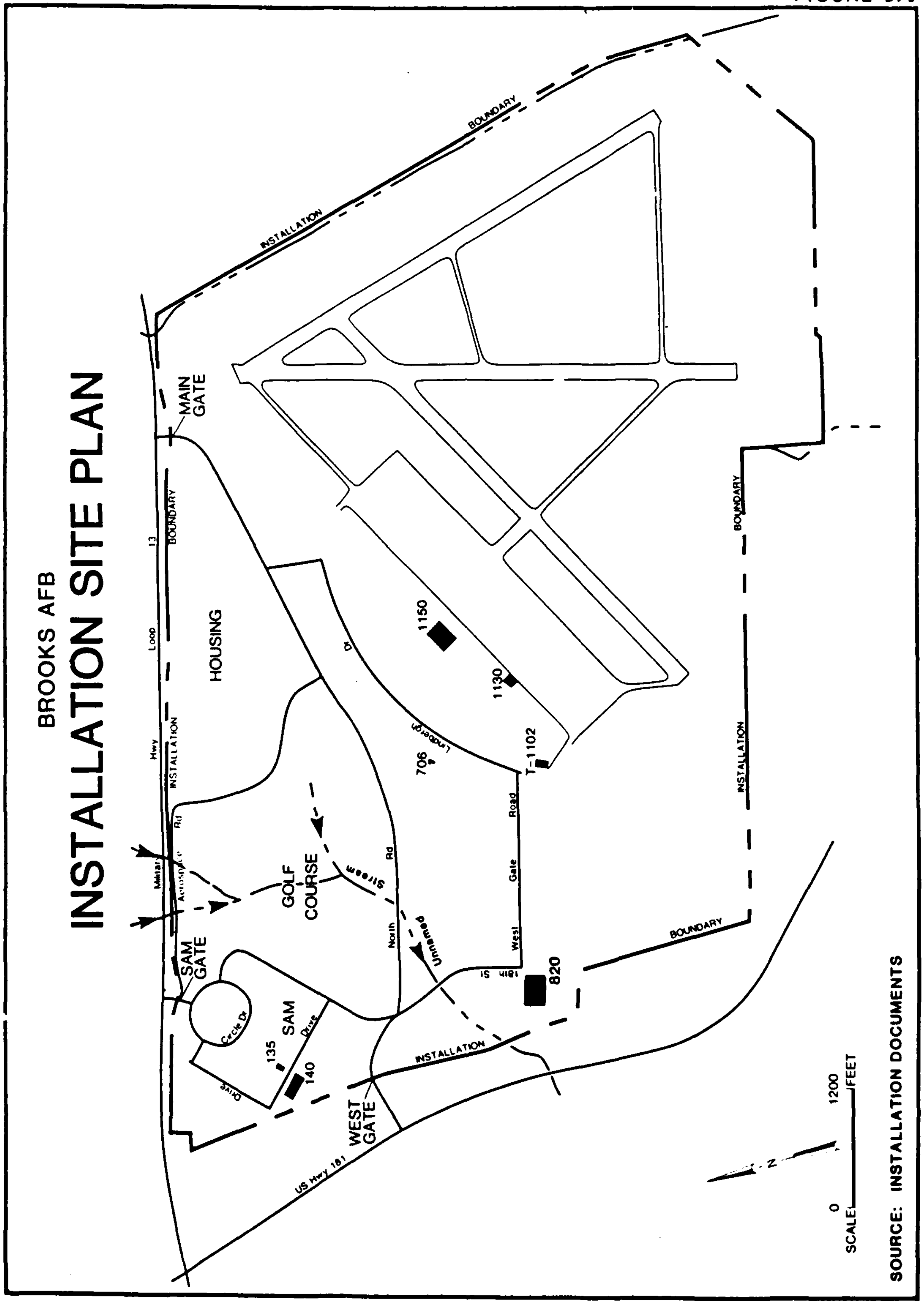
BROOKS AFB
AREA LOCATION



SOURCE: COMMERCIAL MAP

FIGURE 2.3



SOURCE: INSTALLATION DOCUMENTS

and remained in command until 1958. The Tenth Air Force took command again in 1958 until 1959 when the Air Training Command (ATC) assumed command and the School of Aviation Medicine returned to Brooks. In 1960, all flying activities were discontinued and transferred over to Kelly AFB and Randolph AFB. The Air Force Space Medical Center was redesignated as the Aerospace Medical Division (AMD) under Air Force Systems Command in 1961.

ORGANIZATION AND MISSION

The Aerospace Medical Division (AMD) at Brooks AFB includes the headquarters, the USAF School of Aerospace Medicine (SAM), the USAF Occupational and Environmental Health Laboratory (OEHL), the Air Force Human Resources Laboratory, the USAF Clinic Brooks and the 6570 Air Base Group (ABG). The mission of the Aerospace Medical Division is to manage bioastronautic research and development programs in support of Air Force systems development, and to manage assigned programs in support of the Air Force personnel system, clinical and aerospace medicine requirements, and as directed specialized educational programs in aerospace medicine.

The USAF School of Aerospace Medicine is involved in three major activities: aeromedical evalution and consultation, biotechnology research and development, and aeromedical education. The USAF Occupational and Environmental Health Laboratory provides specialized laboratory services and operational field support for Air Force programs in the field of occupational, radiological and environmental health. It also supports the Air Force's environmental quality effort. The Air Force Human Resources Laboratory is the principal Air Force Systems Command organization charged with planning and executing exploratory and advanced development programs related to personnel management, weapon system logistics, flight simulation, instructional technology, and flying and technical training. The Air Force Medical Service Center assists the Air Force Surgeon General in developing programs, policies and practices relating to Air Force health care. Medical and dental care is provided by the USAF Clinic Brooks. The 6570th Air Base Group (ABG) operates Brooks AFB. It provides support to all organizations on the base.

The major tenant organizations at Brooks AFB are listed below. Descriptions of the major tenants and their missions are presented in Appendix C.

- Detachment 1018, Air Force Office of Special Investigation
- Detachment 3, 1923 Communications Group
- Detachment 26, 6592 Management Engineering Team
- San Antonio Real Property Maintenance Agency (SARPMA)
- 6906th Electronic Security Squadron
- U.S. Coast Guard Reserve Unit
- 8075th Electronic Security Squadron (USAF Reserve)

SECTION 3
ENVIRONMENTAL SETTING

The environmental setting of Brooks Air Force Base is described in this section with the primary emphasis directed toward identifying features that may affect the movement of hazardous waste contaminants off base. A summary of the environmental conditions pertinent to this study is presented at the end of the section.

METEOROLOGY

Temperature, precipitation and other relevant climatic data furnished by Detachment 7, 15th Weather Squadron, Kelly AFB are presented in Table 3.1 and are considered to be representative of most of the study area. The indicated period of record is 43 years. The summarized data indicate that net annual precipitation (precipitation minus evaporation) is minus 30 inches for non-irrigated areas. This condition reduces the amount of leachate generation from waste management facilities that may be located on Brooks AFB resulting from precipitation. However, this beneficial condition is offset by routine irrigation which occurs at several locations on the base.

GEOGRAPHY AND TOPOGRAPHY

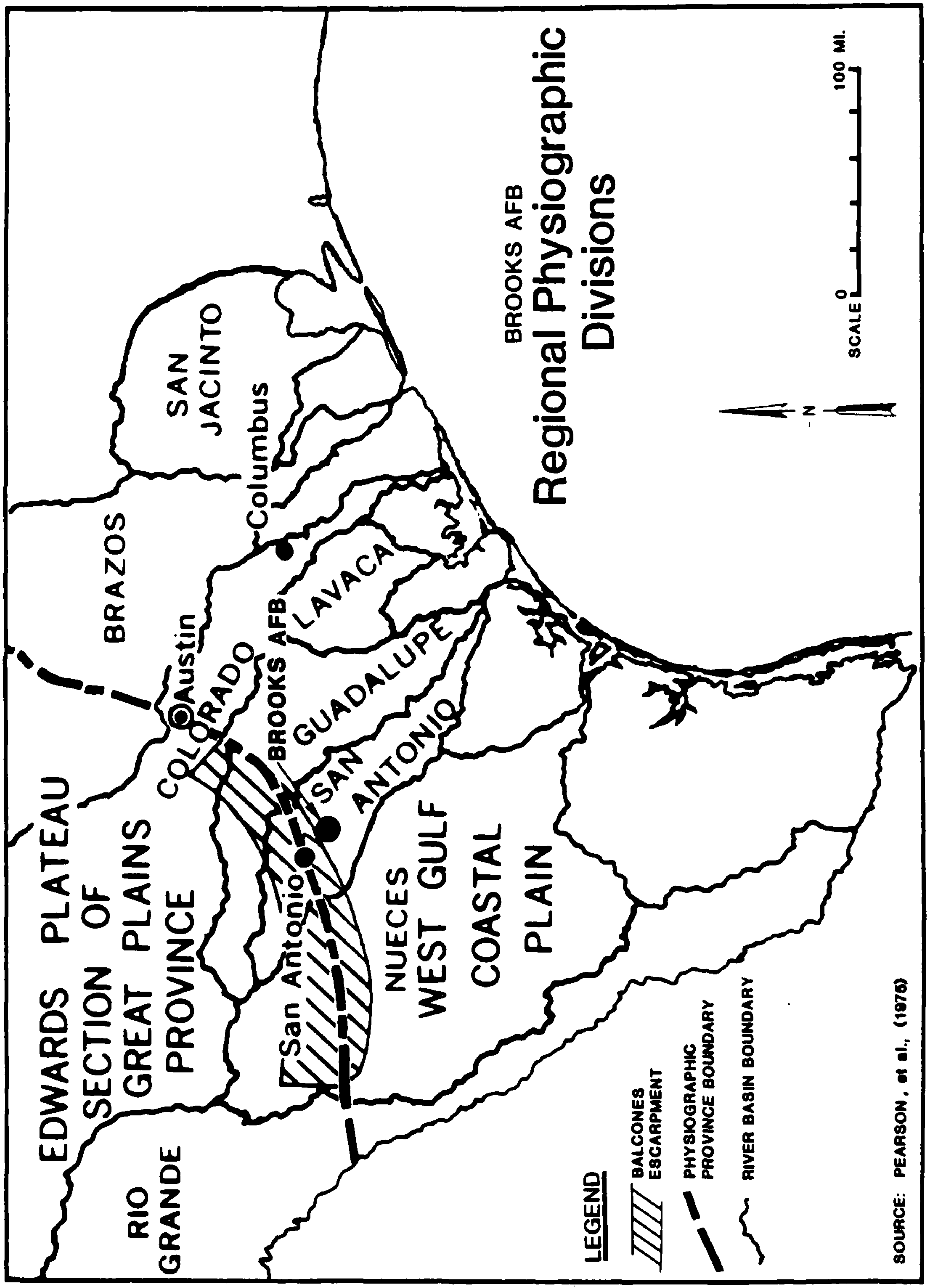
The San Antonio area lies across two distinct physiographic regions, the Edwards Plateau Section of the Great Plains Province and the West Gulf Coastal Plain, as depicted on Figure 3.1. The two regions are separated by the east-west trending Balcones Escarpment. Erosion by stream activity has created distinct relief on the Edwards Plateau; typically, elevations range from 1100 to 1900 feet MSL. The plateau is significant to this project as it serves as the precipitation catchment for surface waters flowing to aquifer recharge zones and streams extending through the study area.

TABLE 3.1
SAN ANTONIO CLIMATIC CONDITIONS

Month	Temperature Mean Max(°F)	Temperature Mean Min(°F)	Rainfall Precipitation Mean (in)	Rainfall Precipitation Max (in)	Snowfall Precipitation Mean (in)	Snowfall Precipitation Max (in)	Wind Mean Speed (kts)	Wind Prevailing Direction
Jan.	62	41	1.5	9.5	0	17*	6	N
Feb.	66	44	1.8	5.9	0	4	6	N
Mar.	74	61	1.3	3.7	0	4	7	SSE
Apr.	80	60	2.6	10.2	0	0	7	SE
May	86	67	3.6	9.3	0	0	6	SSE
June	92	73	2.5	9.2	0	0	6	SSE
July	95	74	1.7	6.1	0	0	6	SSE
August	95	74	2.8	15.1	0	0	5	SSE
Sept.	90	64	3.9	13.5	0	0	5	S
Oct.	82	60	3.0	9.0	0	0	5	S
Nov.	71	49	1.8	5.1	0	0	6	N
Dec.	65	43	1.3	4.0	0	0	5	N
Annual	-	-	27.8	-	-	-	-	-

Elevation: 690 feet
Period of Record: September 1937-August 1980
* Record snowfall in 1985.

Source: Detachment 7, 15th Weather Squadron, Kelly AFB, TX



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The Balcones Escarpment, located north of the base, was created by the faulting of underlying geologic units and is significant since this area corresponds to the recharge zone of the major regional aquifer. Relief changes abruptly across the escarpment, with elevations ranging from approximately 1100 feet to 700 feet MSL. Brooks AFB is located on the West Gulf Coastal Plain, some 15 miles south of the escarpment. The Coastal Plain consists of a gently undulating prairie, where elevations typically range from 450 feet to approximately 700 feet, MSL. The plain slopes to the southeast gradually toward the Gulf of Mexico. Brooks AFB elevations vary from 671 feet MSL near Building 486 to approximately 545 feet MSL along segments of the cut incised by the unnamed stream at a point some 500 feet northwest of Building 820.

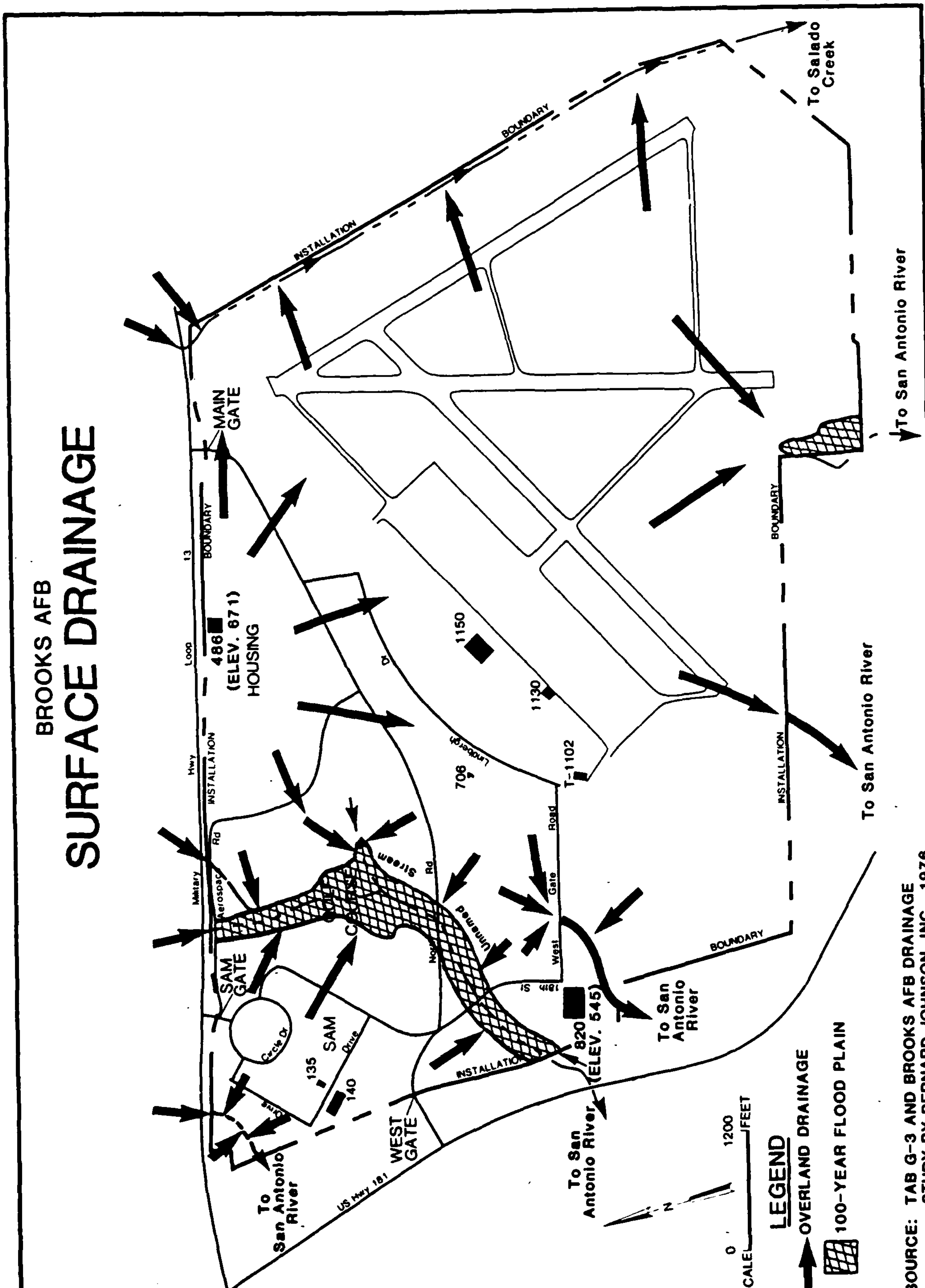
Drainage

Drainage of base land areas is accomplished by overland flow to ditches and swales which direct flow to local streams, all of which are tributaries of the San Antonio River, the main stream of consequence in the study area. Drainage originating on the eastern part of the base flows to an intermittent stream which drains to Salado Creek. Drainage originating from the west and southern sections of the installation flow to unnamed San Antonio River tributaries. Runoff from off-base land enters the base from the north and flows through the installation to either Salado Creek or the San Antonio River. Installation drainage is depicted in Figure 3.2. No wetlands have been identified at the base.

Surface Soils

Surface soils of the installation area have been studied by the USDA, Soil Conservation Service (1966). Twelve soil types have been mapped within installation boundaries and are depicted in Figure 3.3. The individual soil types are described in Table 3.2. Base surface soils are typically alluvial, predominantly poorly drained, fine-grained soils possessing generally low permeabilities. Permeability tests conducted on soil samples obtained from the active landfill trench bottom resulted in very low permeabilities on the order of 1.4×10^{-5} inches per hour (Raba-Kistner, Consult., Inc., 1982). Installation test borings indicate that gravelly clays underlie surficial soils at shallow depths. The thickness of the gravelly layer is reported to range from

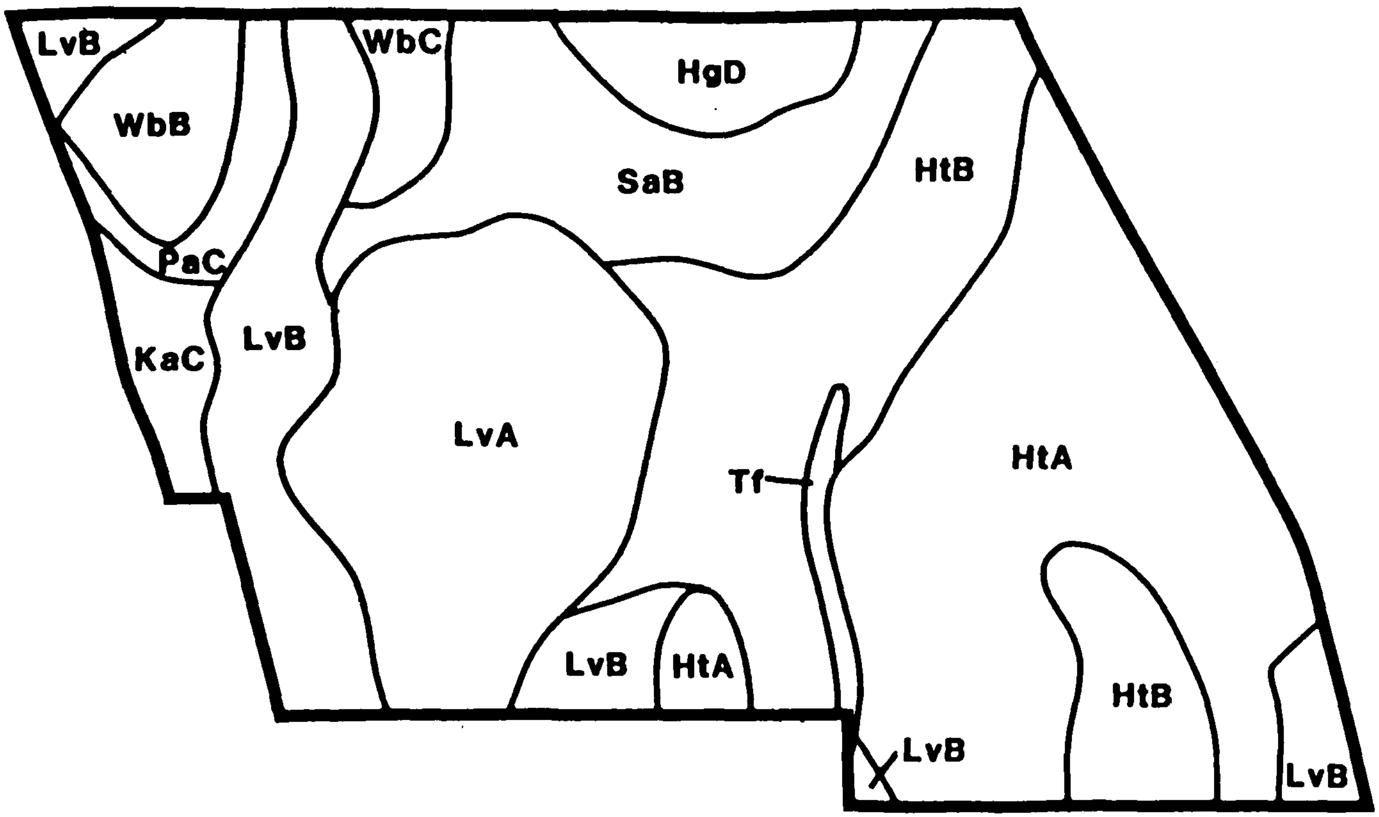
FIGURE 3.2



BROOKS AFB
SURFACE DRAINAGE
INSTALLATION BOUNDARY
To Salado Creek
To San Antonio River
MAIN GATE
Loop 13
Military Hwy
486 (ELEV. 671) HOUSING
1150
1130
T-1102
706
Lindbergh Dr
Aerospace Rd
Golf Course
Unnamed Stream
Nopal Rd
West Gate Road
18th St
820 (ELEV. 545)
SAM GATE
Circle Dr
SAM Drive
135
140
WEST GATE
US Hwy 181
To San Antonio River
LEGEND
OVERLAND DRAINAGE
100-YEAR FLOOD PLAIN
SCALE 0 1200 FEET
N
SOURCE: TAB G-3 AND BROOKS AFB DRAINAGE STUDY BY BERNARD JOHNSON, INC., 1976.

BROOKS AFB

SURFACE SOILS MAP



NOTE: SOIL INFORMATION IS SUMMARIZED ON TABLE 3.2

SOURCE: USDA, SCS, 1966

TABLE 3.2
BROOKS AFB SOILS

Symbol	Description (Major Fraction)	Thickness (inches)	Unified Classification (Major Fraction)	Permeability (inches/hour)	Disposal Site Use Constraints
HgD	Hilly gravelly land. Gravel pits and caliche outcrops.	unknown	varies	Probably higher than 5.0*	Severe. Gravel may connect to local surface water.
HtA	Houston black clay. Clay, gravelly clay, loam over gravelly alluvium. 0-1 per cent slopes.	42-120	CH, CL or GC	0.3-1.5+	Severe. Underlain by gravel.
HtB	Houston black clay. Clay, gravelly clay, loam over gravelly alluvium.	42-120	CH, CL or GC	0.3-1.5+	Severe. Underlain by gravel.
KaC	Karnes loam. Loam, clay loam, sandy loam and gravelly loam over stratified gravelly alluvium. 3-5 per cent slopes.	0-60	CL, ML-CL, SM or GM	2.5+	Severe. Underlain by gravel.
LvA	Lewisville silty clay. Silty clay, silty clay loam and gravel. 0-1 per cent slopes.	0-62	CL	1.0-1.2	Moderate due to permeability.
LvB	Lewisville silty clay. Silty clay, silty clay loam and gravel. 1-3 per cent slopes.	0-62	CL	1.0-2.0	Moderate due to permeability.
PaC	Patrick soils. Loam, clay loam, silty clay loam over gravel. 3-5 per cent slopes.	0-60+	CL, CH, ML-CL over GM or GC	2.0-5.0+	Severe. Permeability and gravel substrate.
SaB	San Antonio clay loam. Clay loam, clay, sandy clay loam with occasional interbedded sandstone. 1-3 per cent slopes.	6-120	CL or CH	0.6-1.0	Slight.
Tf	Trinity and Frio soils. Clay and sandy clay loam over gravel locally (stream channel alluvium).	0-84+	CL, CH over GM, SM or CL	1.0-2.5	Severe. Subject to flooding; Underlain by gravel connecting to local surface water.
WbB	Webb fine sandy loam. Fine sandy loam, clay loam, sandy clay, interbedded with sandstone. 1-3 per cent slopes.	5-48	SM, SC, CL, CH or SM-SC	0.6-1.5	Slight.
WbC	Webb fine sandy loam. Fine sandy loam, clay loam, sandy clay, interbedded with sandstone. 3-5 per cent slopes.	5-48	SM, SC, CL, CH or SM-SC	0.6-1.5	Slight.

Source: USDA, Soil Conservation Service, 1966.

*Estimated by Engineering Science.

one to five feet, with local variations. The permeability value reported by Raba-Kistner, Consult., Inc. (1982) was very low reflecting the laboratory test procedure performed and the types of soil materials present at the landfill trench bottom. In addition, the test performed is a vertical permeability, that is, a measurement of flow rate in one direction. In contrast, the USDA, SCS (1966) reported permeabilities for various surface soils occurring in the study area (Table 3.2) are most likely percolation values, indicative of seepage in both the horizontal and vertical directions.

GEOLOGY

The geology of the San Antonio area has been reported by Sellards, et al. (1932, reprinted 1981), Arnow (1959 and 1963), McIntosh and Behm (1967) and the Texas Bureau of Economic Geology (1974, revised 1983), among others. A brief review of the published information has been summarized in support of this investigation.

Stratigraphy

Geologic units ranging in age from Cretaceous to Quaternary have been described in the San Antonio area and are presented as Table 3.3. The lithologies of these units include unconsolidated materials and sedimentary rocks.

The Leona Formation consists of silt over gravel, 0-30 feet thick. The Uvalde Gravel includes silty, sandy gravel with caliche, reaching a maximum thickness of twenty feet. Faulting has exposed the Wilcox Group locally, which consists of 440-1200 feet thick sequences of mud stone and sandstone. The Midway Group's sand and clay ranges in thickness from 100-400 feet.

Bedrock is known to be shallow at Brooks AFB, based on installation test borings. Bedrock may be present at depths as shallow as 2.5 feet below surface in the north central part of the installation and eighty feet deep in the northwest corner of the base.

Distribution

The area of significant geologic units relevant to this study are mapped as Figure 3.4, which has been modified from TBEG Creologic Atlas of Texas, San Antonio Sheet (1974, revised 1983). Generally, the upper geology of Brooks AFB is dominated by thick sections of clays of the

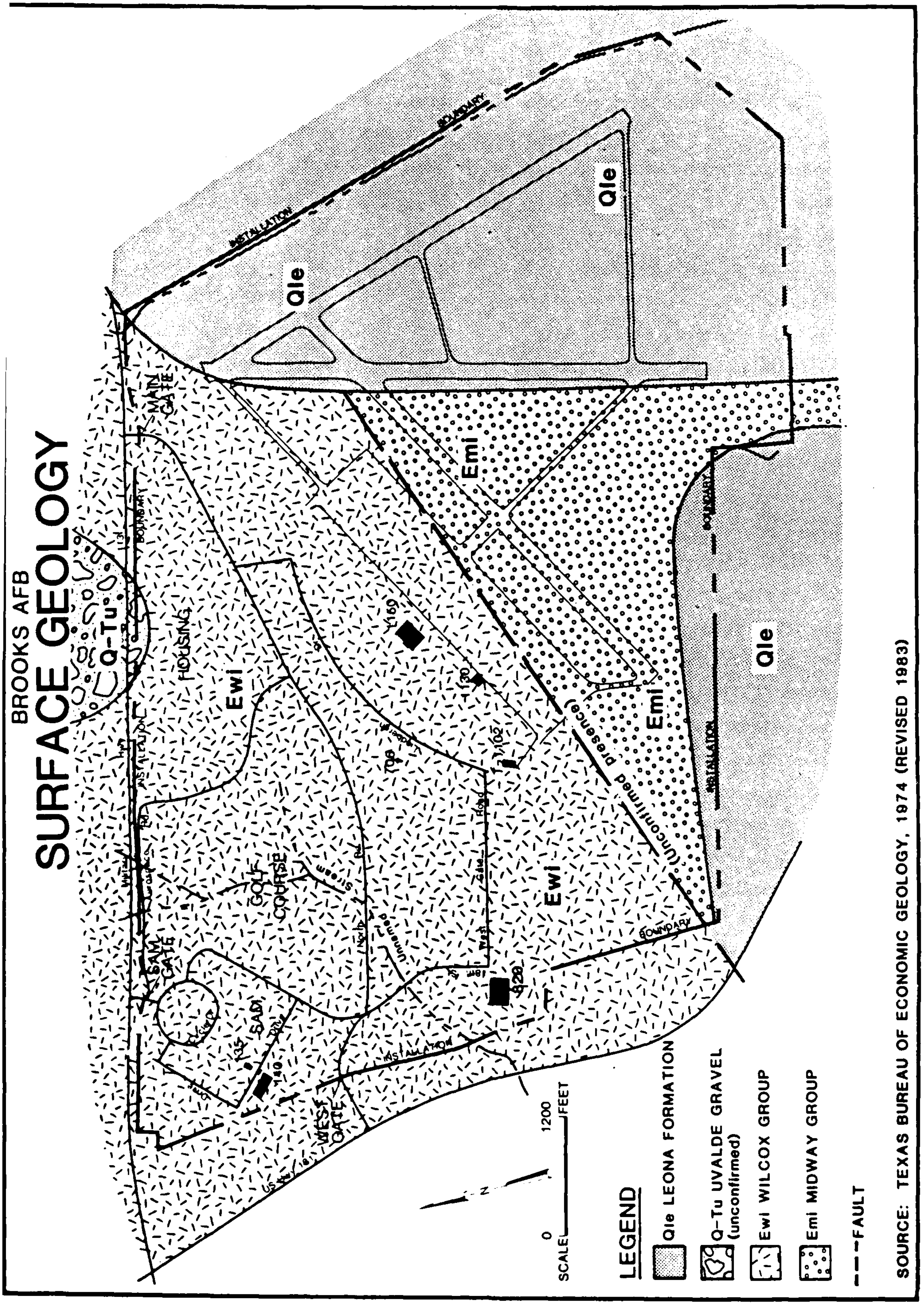
TABLE 3.3
SAN ANTONIO AREA GEOLOGIC UNITS
BROOKS AFB

System	Series	Group	Stratigraphic unit	Approximate Maximum Thickness (feet)	Character of Material	Water-supply properties
Quaternary	Recent and Pleistocene	--	Leona formation	30	Silt, sand, and gravel.	In places yields water for stock and domestic wells.
Tertiary	Pliocene	--	Uvalde gravel	30	Coarse flinty gravel in matrix of clay or silt.	Not known to yield water to wells in Bexar County.
Tertiary	Eocene	Claiborne	Mount Selman formation	200	Sand and clay with iron concretions.	Not know to yield water to wells in Bexar County.
			Carrizo sand	800	Coarse to medium-grained sand and sandstone; some clay.	Yields moderate supplies of potable water.
		Wilcox	undifferentiated deposits	1,070	Thin-bedded sand and sandstone and some clay, lignite and calcareous concretions.	Yields moderate supplies of water of good to poor quality.
	Paleocene	Midway	Wills Point formation	490	Arenaceous clay containing numerous arenaceous and calcareous concretions.	Not known to yield water to wells in Bexar County.
Cretaceous	Gulf	Navarro	Kemp clay, Escondido formation, and Corsicana marl	535	Clay and marl.	Not know to yield water to wells in Bexar County.
			Taylor marl	540	Marl and calcareous clay.	Not known to yield water to wells in Bexar County.
			Anacacho limestone	355	Marly chalk.	Not known to yield water to wells in Bexar County.
			Austin chalk	210	Limestone and argillaceous chalky limestone.	Yields small to large supplies of water of good to poor quality.
			Eagle Ford shale	40	Calcareous and sandy shale and some argillaceous limestone.	Not known to yield water to wells in Bexar County.

TABLE 3.3
SAN ANTONIO AREA GEOLOGIC UNITS
BROOKS AFB
(Continued)

System	Series	Group	Stratigraphic unit	Approximate Maximum Thickness (feet)	Character of Material	Water-supply properties
Cretaceous (Continued)	Comanche	Washita	Buda limestone	80	Dense, hard limestone.	Yields sufficient water near the outcrop for stock and domestic use.
			Grayson shale (Del Rio clay)	60	Blue clay, weathering greenish and yellowish brown.	Does not yield water to wells in Bexar County.
			Georgetown limestone	65	Hard massive limestone and argillaceous limestone.	Yields large supplies of water for municipal, industrial, and irrigation supplies. Forms the principal aquifer in the county (Edwards Aquifer). Water is highly mineralized downdip in the southern part of the county.
		Fredericksburg	Edwards limestone	600+	Hard semicrystalline massive limestone and dolomite and some thin-bedded limestone and marly limestone.	
			Comanche Peak limestone	40	Light-gray massive limestone and marl.	
			Walnut clay	20	Sandy clay or marl.	Not known to yield water to wells in Bexar County.
		Trinity	Glen Rose limestone	1,200	Massive chalky limestone alternating with beds of less resistant marly limestone.	Generally yields sufficient water in the outcrop for stock and domestic use. Water from deeper wells generally is more highly mineralized than is water from shallow wells.
			Pearsall formation	190	Shale and limestone.	Not known to yield water to wells in Bexar County.
	Pre-Comanche (Coahuila of of Mexico)	(Nuevo Leon of Mexico)	Sligo formation	1,100	Limestone, dolomite, and shale.	Not known to yield water to wells in Bexar County.
		(Nuevo Leon and Durango of Mexico)	Hosston formation		Limestone, shale, and sandstone.	Yields small to moderate supplies of water which becomes more highly mineralized downdip toward the southern part of the county.
Pre-Cretaceous	--	--	Sedimentary and metamorphic		Slate, black limestone, and schist.	Not known to yield water to wells in Bexar County.

Source: Modified from Arnow, 1959.


BROOKS AFB
SURFACE GEOLOGY
Q-Tu
Qle
Qle
Qle
Ewi
Ewi
Emi
Emi
HOUSING
GOLF COURSE
MAIN GATE
SAM GATE
WEST GATE
SAM
INSTALLATION
BOUNDARY
(unconfirmed presence)
Stream
Unnamed
US Hwy 181
SCALE
0
1200
FEET
N
LEGEND
Qle LEONA FORMATION
Q-Tu UVALDE GRAVEL (unconfirmed)
Ewi WILCOX GROUP
Emi MIDWAY GROUP
FAULT
SOURCE: TEXAS BUREAU OF ECONOMIC GEOLOGY, 1974 (REVISED 1983)

Wilcox and Midway Groups. The Leona formation occupies the east portion of the base. A geologic cross section is presented as Figure 3.5. This section illustrates the area's major geologic units with respect to the base.

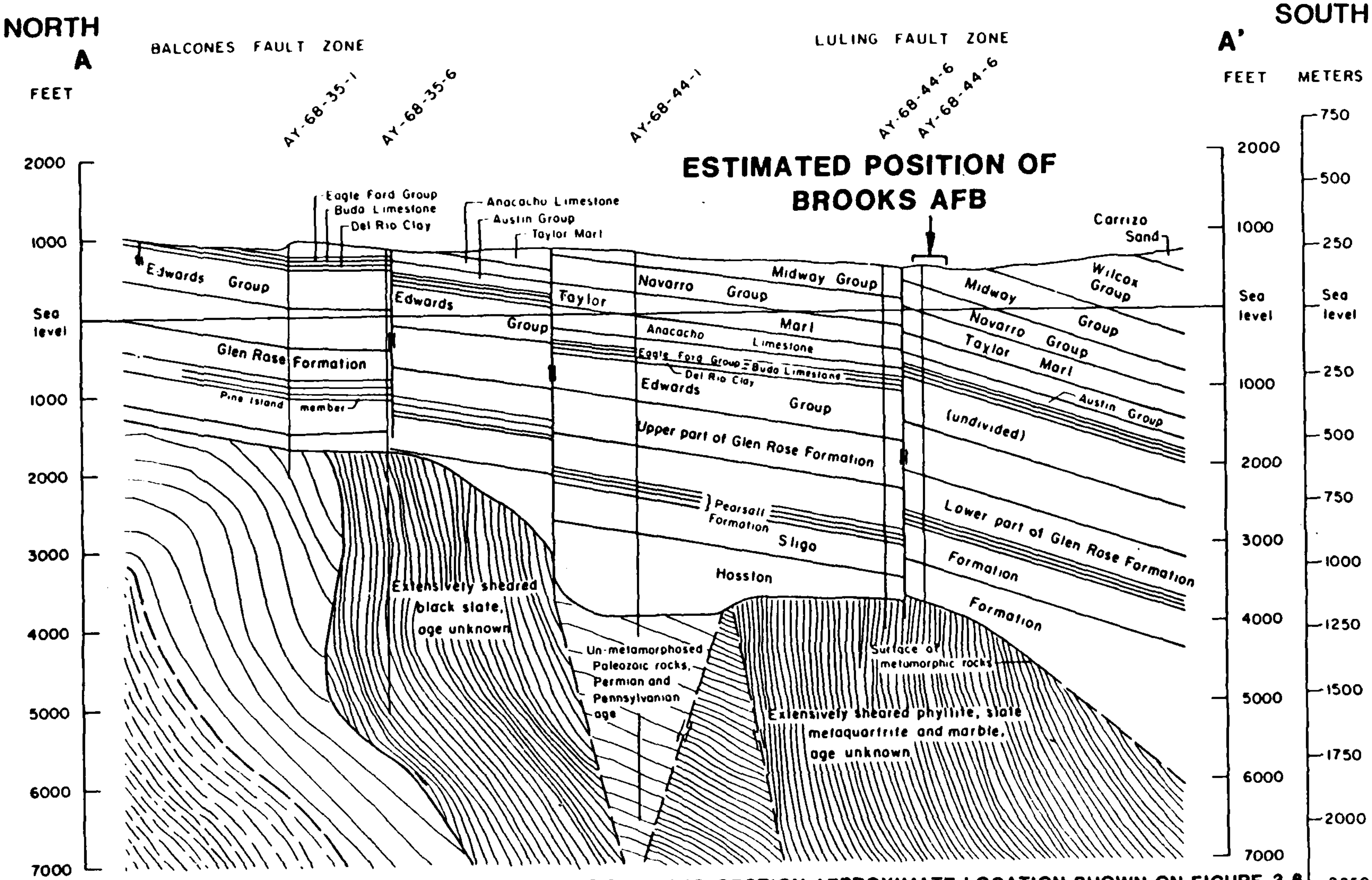
Structure

Brooks AFB occupies a position within the tectonically significant Balcones Fault Zone. Normal faulting in this area has been attributed to the settlement of the Gulf of Mexico geosyncline, which is presently receiving large quantities of terrestrial sediments. Faulting has occurred along parallel lines trending roughly from southwest to northeast across the study area. The faulting is significant because it has modified the gross structure of area geologic units and has permitted the development of secondary porosity in some units. According to Arnow (1959) many of the faults are not traces of discrete separation but are actually shatter zones which have created a series of smaller step faults along parallel lines. Displacement along individual fault lines may vary from a few tens of feet to several hundred feet, with the greatest amount of movement occurring near the fracture center. Total vertical displacement observed in strata extending between the Edwards Plateau and the Coastal Plain is on the order of 3,000 feet. Movement along similar lines of displacement may be the cause of foundation breakage at Brooks AFB Buildings 615 and 617.

The sedimentary rocks of Bexar County tend to strike east-northeast and dip south-southeast toward the Gulf of Mexico. In the northern part of the county, the dip averages ten to fifteen feet per mile (relatively flat). In the southern part of the county the dip increases to 150 feet per mile, which may be due in part to the previously discussed faulting. According to the work of McIntosh and Behm (1967), compartmentalized faulting may have altered local strike and dip relationships from the reported regional trends. This may be seen in the Geologic Cross-Section, Figure 3.5, where displacement along major fault lines has modified regional conditions within relatively confined zones beneath Brooks AFB.

FIGURE 3.5

SAN ANTONIO AREA GENERALIZED GEOLOGIC CROSS-SECTION OF THE STUDY AREA SHOWING BROOKS AFB LOCATION RELATIVE TO MAJOR LOCAL GEOLOGIC FEATURES



NOTE: FAULT SHOWN IN FIGURE 3.4 IS NOT SHOWN IN THIS FIGURE. CROSS-SECTION APPROXIMATE LOCATION SHOWN ON FIGURE 3.6

SOURCE: MACLAY et al., 1984

APPROXIMATE HORIZONTAL SCALE 0 4 MILES

HYDROLOGY

Ground-water hydrology of the Brooks AFB-San Antonio area has been reported by Arnow (1959, 1963), Garza (1962), Pearson et al. (1975), Baker and Wall (1976), Maclay and Small (1976), Muller and Price (1979), Marquardt and Elder (1979), Maclay, et al. (1980), and Maclay, et al. (1981 and 1984). Additional information has been obtained from interviews with officials of the U.S. Geological Survey Water Resources Division and the Edwards Underground Water District.

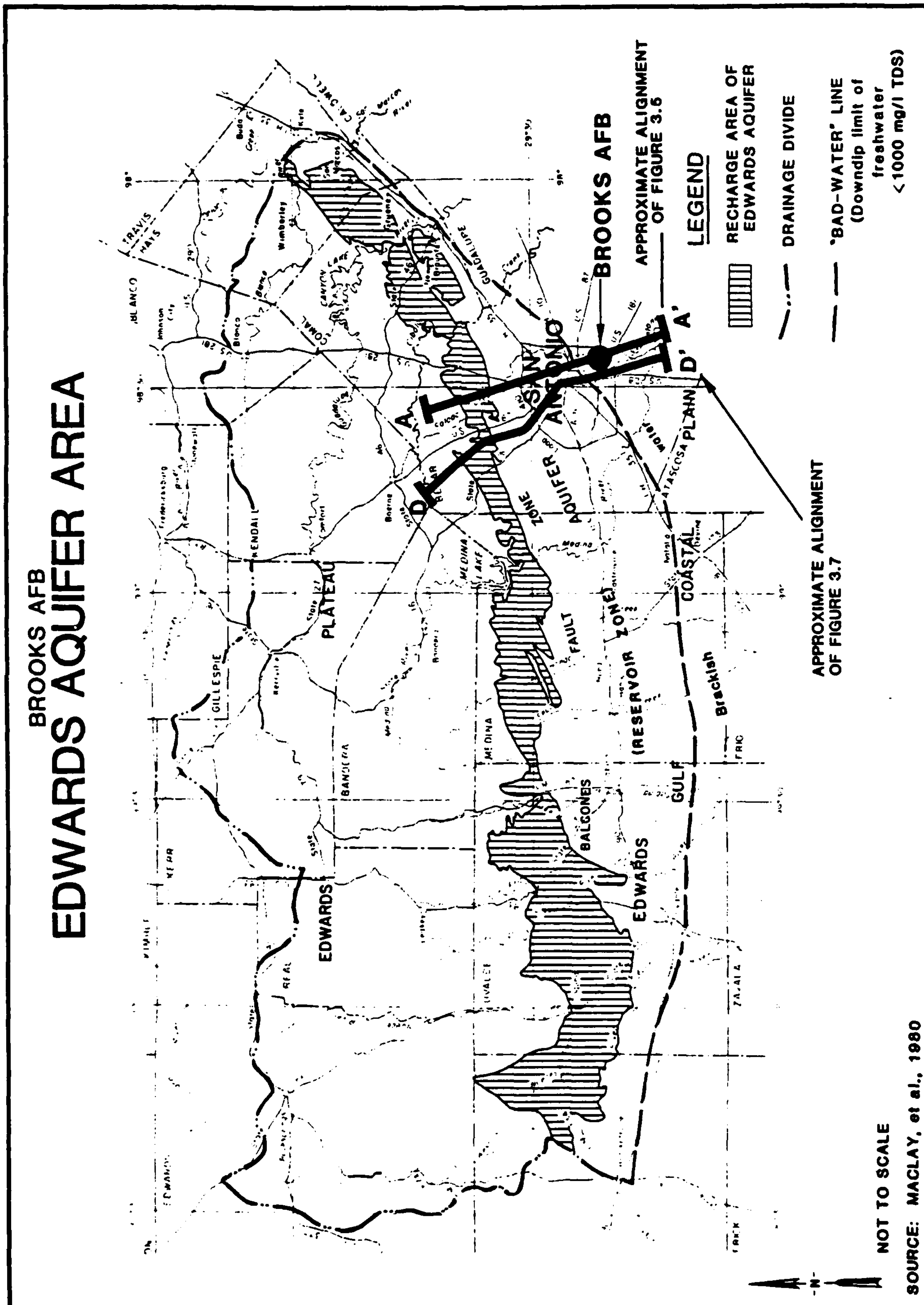
Edwards (Balcones Fault Zone) Aquifer

Brooks AFB lies just outside the limits of the Edwards (Balcones Fault Zone) Aquifer reservoir zone. The Edwards Aquifer is defined as a "sole source" aquifer by the USEPA. In 1959, the Texas Legislature created the Edwards Underground Water District to provide for the systematic planning and protection of subsurface water resources derived from the Edwards Aquifer. Regulatory authority is governed by the Texas Water Code Section II, Chapters 156.20.01.001-.019 and extends into the recharge zone (outcrop area) located north of the reservoir zone.

The area underlain by the Edwards Aquifer sweeps an arc extending from Kinney County to the west, to Hays County on the east aquifer boundary. This area is approximately 175 miles long and varies in width from 5 to 30 miles. The west, north and east aquifer boundaries are defined geologically where hydrogeologic units crop out forming the generally acknowledged recharge zone or where ground-water divides exist. The south aquifer boundary is arbitrarily defined by the State of Texas as the "bad water line" where total dissolved solids concentrations exceed 1,000 milligrams per liter. The aquifer (reservoir) area and its associated recharge zone are presented in Figure 3.6. Brooks AFB is located southeast (beyond) of the "bad water line".

The Edwards Aquifer consists of three hydrogeologic units which are know to be hydraulically continuous: the Georgetown Limestone, the Edwards Limestone and the Comanche Peak Limestone. The limestone units are described as being thin to massive-bedded, nodules, cherty, gypseous, argillaceous white to gray limestone and dolomite. The rock is characterized by an extensively honeycombed, cavernous structure created by solution channeling over wide areas.

FIGURE 3.6


BROOKS AFB
EDWARDS AQUIFER AREA
LEGEND
RECHARGE AREA OF EDWARDS AQUIFER
DRAINAGE DIVIDE
"BAD-WATER" LINE (Downdip limit of freshwater <1000 mg/l TDS)
APPROXIMATE ALIGNMENT OF FIGURE 3.5
APPROXIMATE ALIGNMENT OF FIGURE 3.7
BROOKS AFB
A
A'
D
D'
EDWARDS PLATEAU
BALCONES FAULT ZONE
EDWARDS (RESERVOIR ZONE)
SAN ANTONIO
AQUIFER
GULF COASTAL PLAIN
Brackish
KERR
GILLESPIE
KENDALL
BANDERA
MEDINA
UVALDE
REAL
BLANCO
COMAL
HAYS
TRAVIS
GUADALUPE
CALDWELL
ATASCOSA
FRIO
ZAVALA
EDWARDS
MEDINA LAKE
NOT TO SCALE
SOURCE: MACLAY, et al., 1980
N

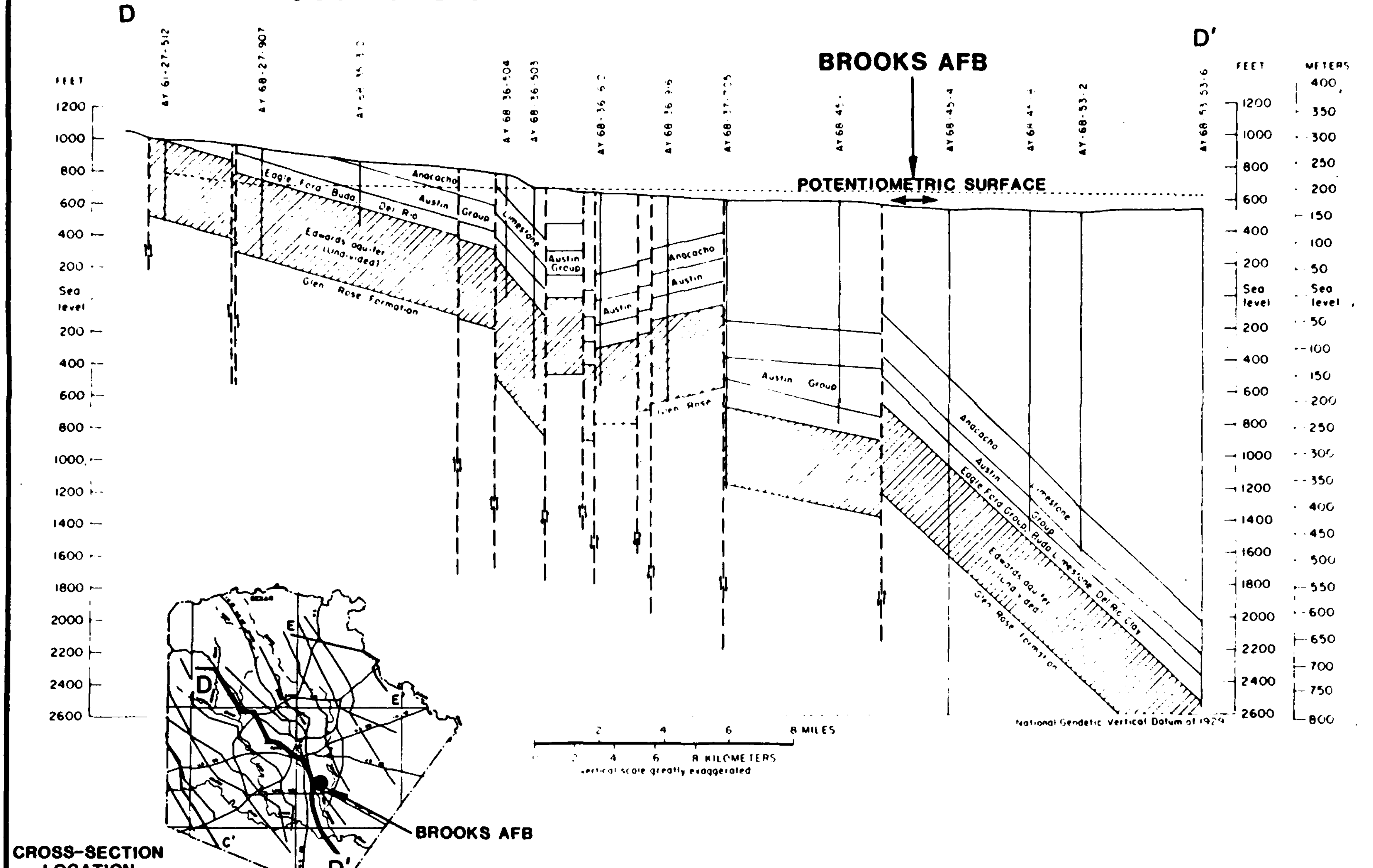
The Edwards Aquifer is confined at its base by the Glen Rose Formation and at its upper surface by the Del Rio Clay or correlative units. Figure 3.7 illustrates a typical hydrogeologic cross-section of the study area. Water is contained in the Edwards Aquifer under confined (artesian) conditions.

The Edwards Aquifer is recharged principally by the downward percolation of surface waters from streams traversing the area of outcrop and by precipitation infiltration in this same zone. Figure 3.8 depicts the recharge area in a generalized cross-section. In areas where streams cross the aquifer area of outcrop, numerous large solution channels have been noted on driller's well logs in the reservoir zone several miles to the south. Runoff enters the Edwards Aquifer via surface openings, cavities and sinkholes in the intake area shown in Figure 3.9. Water then moves downdip (Maclay, 1981) in channels toward the large solution openings and toward zones of decreasing head. Groundwater flow directions are both to the south (downdip along formation gradients) and to the east - northeast paralleling the fault system and according to prevailing hydraulic gradients (Pearson, et al, 1975). Figure 3.10 depicts water levels within the Edwards Aquifer as of July, 1974 with approximate ground-water flow directions. It should be noted here that local variations in flow directions may occur.

The quality of ground water derived from the Edwards Aquifer has been studied by Reeves (1976), Maclay, et al. (1980) and Reeves, et al. (1980 and 1984), among others. Water quality is generally considered to be acceptable in wells sampled north of the "bad water line" shown on Figure 3.6. Because of its high yield potential (i.e., highly porous materials), the Edwards Aquifer is easily susceptible to contamination in the recharge (outcrop) zone, but not in the reservoir zone or in the "bad water" area where Brooks AFB is located. In the reservoir zone the Edwards Aquifer is tightly confined and under strong artesian pressure.

At present, Brooks AFB draws water supplies from the San Antonio Municipal water system which has wells throughout the area. Two interconnections with the city distribution system are provided at the base. Records indicate no wells have ever existed on base.

BROOKS AFB
HYDROGEOLOGIC CROSS-SECTION

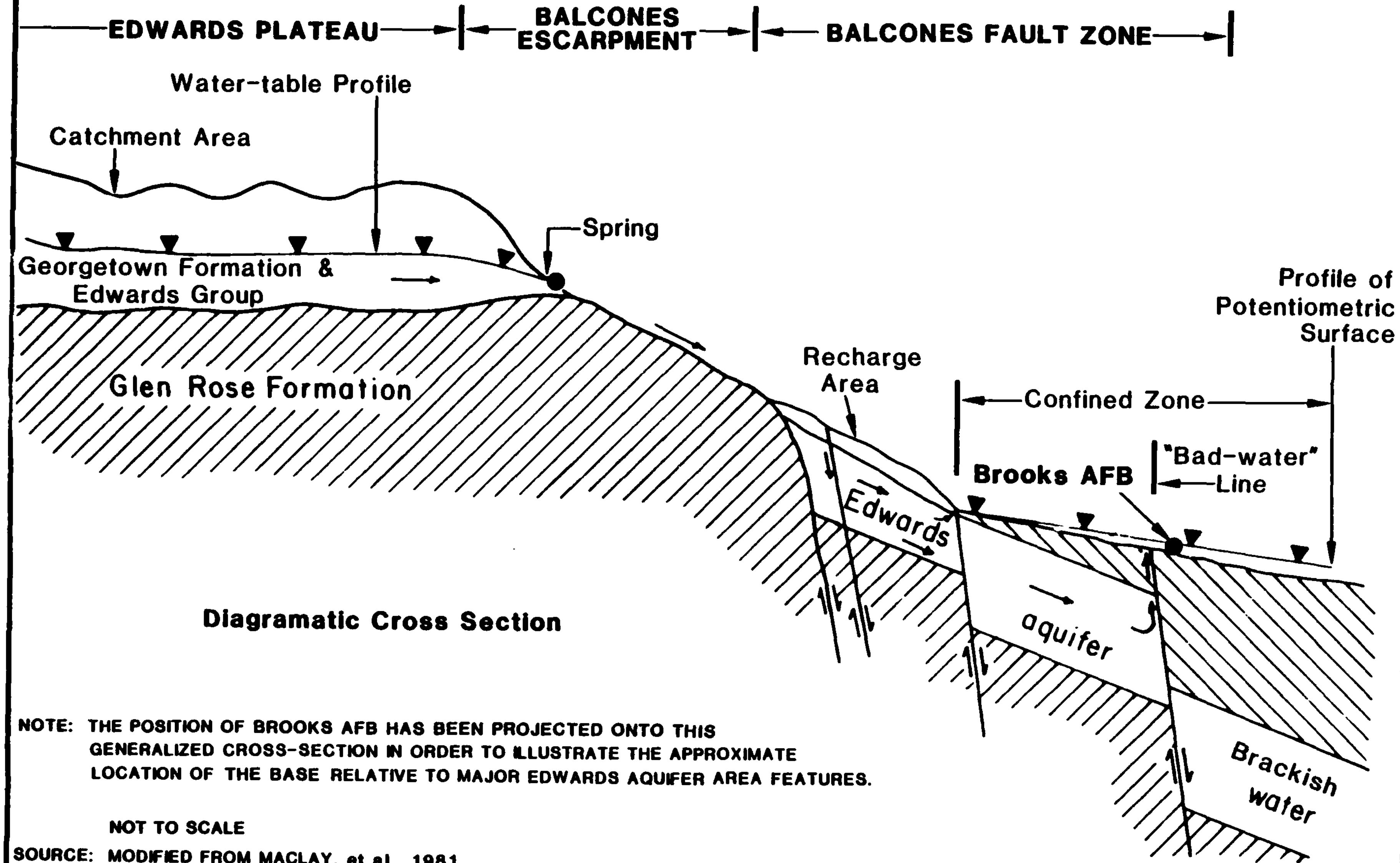


SOURCE: MACLAY, et al., 1984

FIGURE 3.8

BROOKS AFB

GENERALIZED EDWARDS AREA CROSS-SECTION



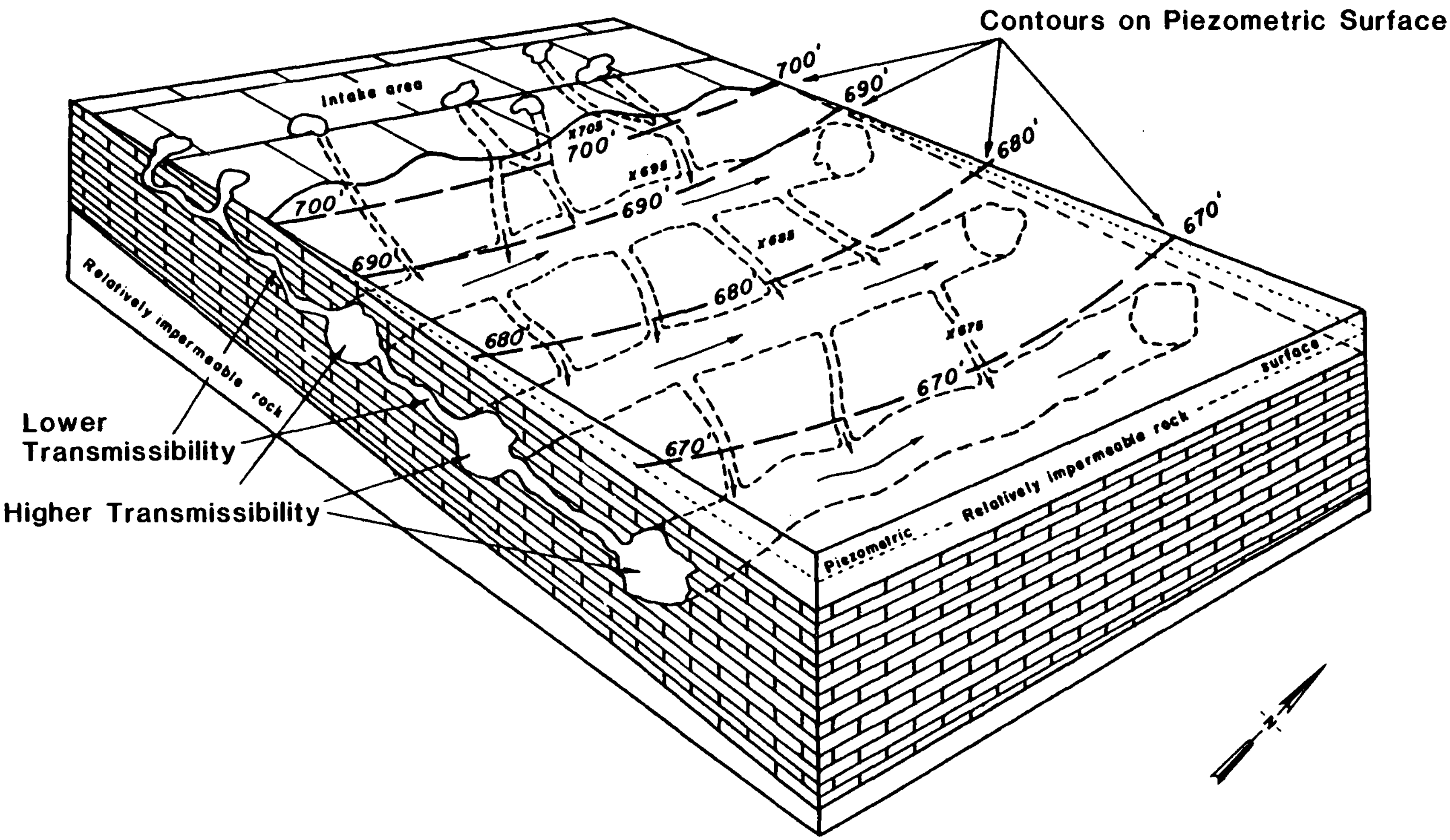
NOTE: THE POSITION OF BROOKS AFB HAS BEEN PROJECTED ONTO THIS GENERALIZED CROSS-SECTION IN ORDER TO ILLUSTRATE THE APPROXIMATE LOCATION OF THE BASE RELATIVE TO MAJOR EDWARDS AQUIFER AREA FEATURES.

NOT TO SCALE

SOURCE: MODIFIED FROM MACLAY, et al., 1981

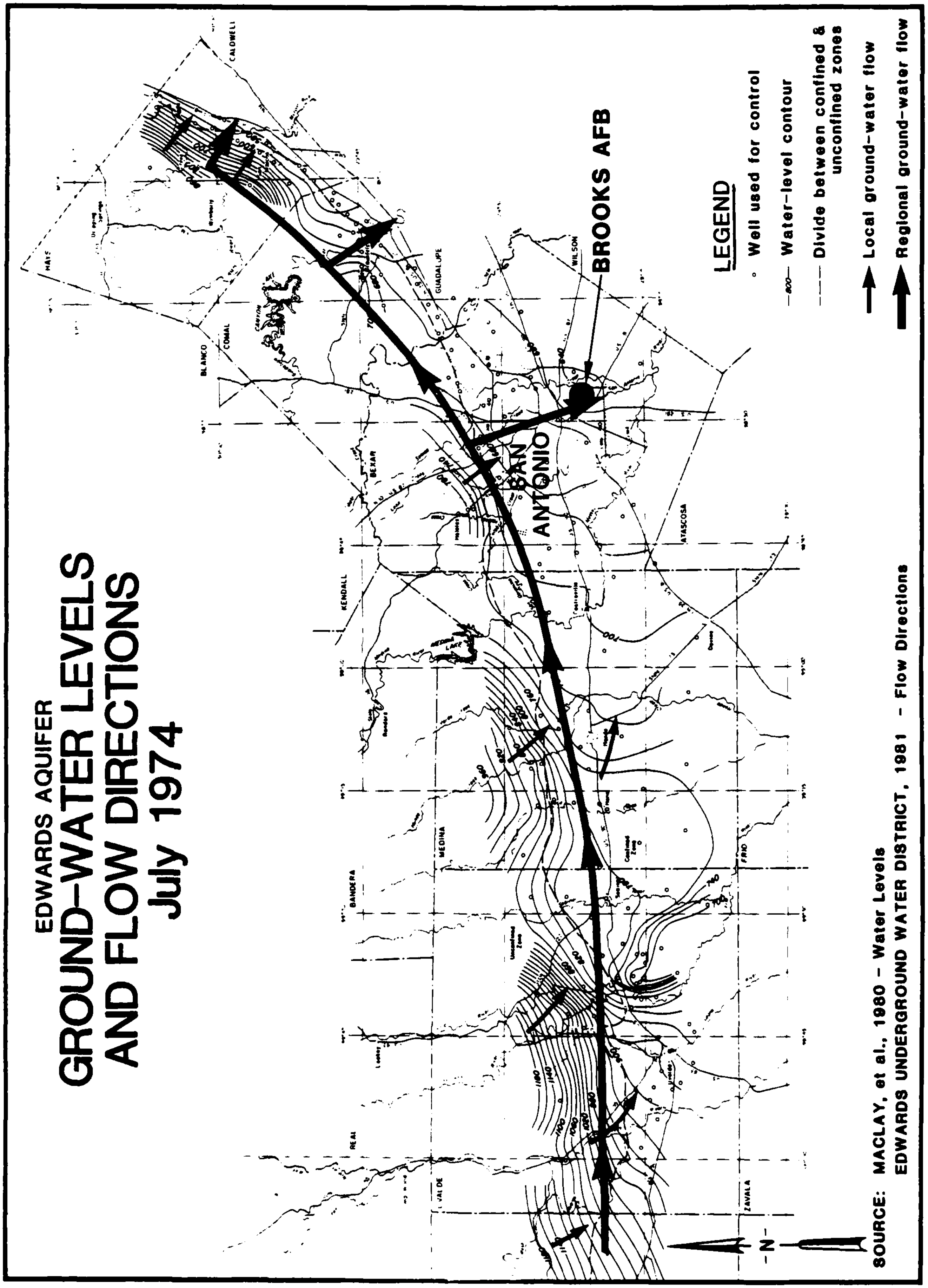
FIGURE 3.9

EDWARDS AQUIFER
HYPOTHETICAL FLOW DIAGRAM



SOURCE: ARNOW, 1959

FIGURE 3.10


EDWARDS AQUIFER
GROUND-WATER LEVELS
AND FLOW DIRECTIONS
July 1974
BROOKS AFB
SAN
ANTONIO
LEGEND
Well used for control
Water-level contour
Divide between confined & unconfined zones
Local ground-water flow
Regional ground-water flow
-N-
HAYS
CALDWELL
BLANCO
COMAL
GUADALUPE
WILSON
KENDALL
BEXAR
ATASCOSA
BANDERA
MEDINA
FRIO
REAL
UVALDE
ZAVALA
SOURCE: MACLAY, et al., 1980 - Water Levels
EDWARDS UNDERGROUND WATER DISTRICT, 1981 - Flow Directions

Shallow Aquifer Zones

Coarse-grained alluvium deposited by existing or now abandoned stream channels exist at shallow depths throughout much of the study area. The granular alluvium typically is present at or near land surface and varies in thickness, ranging from two to thirty feet. Ground water contained in the alluvium may be present at depths below ground surface in the range of ten to twenty feet or may be absent below twenty-five feet (from installation test boring data). This condition has been interpreted by McIntosh and Behm (1967) to indicate that a perched water table exists in the general study area. The perched water table system is probably recharged directly by precipitation and/or where the granular materials are intersected by local surface waters. Flow directions, persistence and lateral limits of this perched system are uncertain. The shallow aquifer is used for some domestic and irrigation purposes in the study area.

The Texas Department of Water Resources has regulatory responsibility for the maintenance of surface water quality in the Brooks AFB area. The ephemeral streams crossing the base are not classified, however, their respective receiving waters are subject to regulation. A discharge into an unclassified stream that could potentially cause violation of the receiving stream's standards is not permitted. Both the San Antonio River and Salado Creek are classified as suitable for non-contact recreation, propagation of fish and wildlife and for domestic raw water supplies. The applicable water quality standards are summarized on Table 3.4.

Surface Water Quality

Brooks AFB has a National Pollutant Discharge Elimination System (NPDES) permit for the discharge of storm water to unnamed tributaries of the San Antonio River. Surface water quality of the tributaries is monitored routinely by the Base Bioenvironmental Engineer for permit compliance and analyses are performed for the following parameters; total suspended solids, oil and grease and flow. The surface water sampling points are depicted on Figure 3.11. A review of historical data indicates that flow entering the installation has occasionally contained elevated total suspended solids and oil and grease levels.

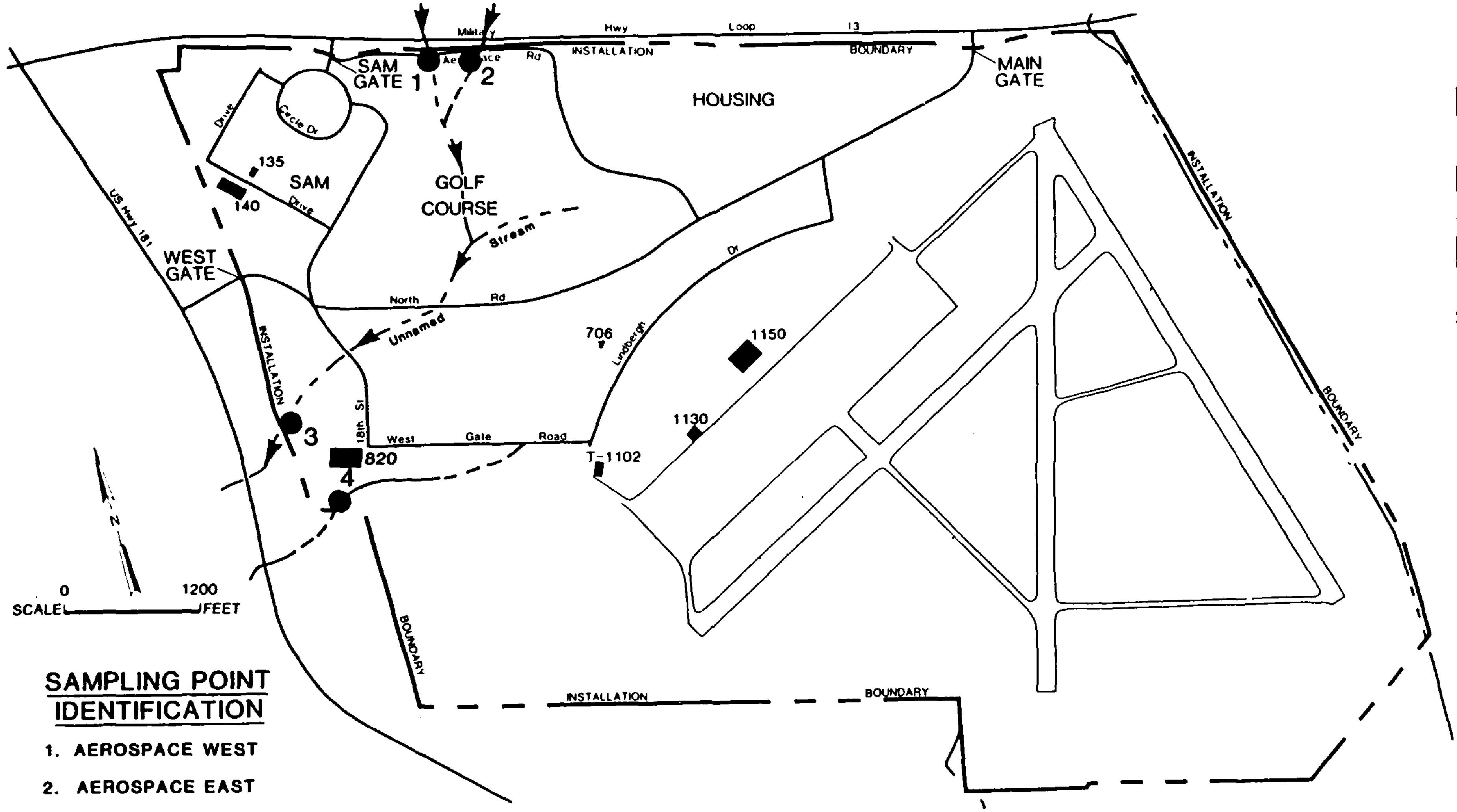
TABLE 3.4
STUDY AREA SURFACE WATER QUALITY STANDARDS
BROOKS AFB

Stream	Cl (mg/l)	SO_4 (mg/l)	TDS (mg/l)	DO (mg/l)	pH (Standard Units)	Fecal Coliform (Count)	Temp. (°F)
San Antonio River (Segment 1901)	200	150	700	5.0	6.5-9.0	2000	90
Salado Creek (Segment 1910)	50	200	550	5.0	6.5-9.0	2000	90

Source: Texas Department of Water Resources Surface Water Quality Standards, March, 1984.

FIGURE 3.11

BROOKS AFB
SURFACE WATER SAMPLING LOCATIONS



SAMPLING POINT IDENTIFICATION

1. AEROSPACE WEST
2. AEROSPACE EAST
3. 820 NORTH (NO. 001)
4. 820 SOUTH (NO. 002)

SOURCE: INSTALLATION DOCUMENTS

A portion of the runoff entering the base originates from a vehicular maintenance facility located north of Brooks AFB on the Military Highway (Loop 13). A few departures from permitted discharge limits have occurred in the past following heavy rainfall, possibly due to the quality of flow entering the base. Generally, the quality of water discharged to local streams has been good.

THREATENED OR ENDANGERED SPECIES

There are no known threatened or endangered species of plant or wildlife in residence at Brooks AFB (Clegern, 1978). However, some 27 varieties of birds, reptiles, amphibians, fish and mammals on the Federal and State Endangered and Protected Lists are known or believed to exist within 50 to 100 miles of the San Antonia area (Howard, et al., 1984).

ENVIRONMENTAL SUMMARY

Geographic, geologic and hydrologic data evaluated for this study indicate the following:

- The primary regional aquifer, the Edwards, underlies Brooks AFB at great depth (1600 feet or deeper).
- Brooks AFB lies south of the reservoir zone of the Edwards Aquifer. The base is over the so-called "bad water" area. Drinking water supplies are provided to the base from the City of San Antonio municipal distribution system which obtains water from the Edwards Aquifer Reservoir Zone located several miles north of Brooks AFB.
- The Edwards Aquifer is under artesian conditions at Brooks AFB and is sealed from ground surface by substantial sequences of clay, marl, and sandstone.
- A shallow water table (unconfined) aquifer probably exists on base and is likely in communication with adjacent surface waters (Salado Creek) periodically or perenially. The full extent of this aquifer is unknown. This aquifer supplies some domestic and irrigation uses in the study area.

- Base surficial soils are predominantly silts or clays that exhibit characteristically low permeabilities. More permeable, coarser-grained soils are present at shallow depth below ground surface as in zones proximate to local surface waters.
- Historical water quality and sampling and analytical data suggested that some surface water quality permit conditions have been exceeded at Brooks AFB during heavy rainfall events. However, the quality of water entering the base also exceeds permit levels during these events.
- Annual net precipitation for the area is minus 30 inches. This condition reduces the amount of leachate generation from landfills or other spill/disposal areas located on Brooks AFB. However, routine irrigation at several areas on base offsets this condition.
- No wetlands exist within the installation boundary.
- Natural populations of either threatened or endangered plants or animals do not exist on the base. However, several protected animals are known or believed to exist in the San Antonio area.

From these major points it may be concluded that the potential for the generation and subsequent migration of contaminants originating from past waste disposal sites to the deep (Edwards) aquifer is not likely. Water contained in the Edwards Aquifer beneath Brooks AFB is not potable and in the improbable event that it were contaminated, would pose no threat to human health.

A potential does exist for the migration of waste contaminants into and through the shallow aquifer zone. Wastes landfilled in areas adjacent to streams have been placed in the unsaturated portion of this aquifer. The aquifer, which is used for some domestic and irrigation purposes in the area, may be present at shallow depths and is probably recharged by precipitation and/or by communicaton with local surface waters. Migrating wastes would reasonably be expected to move through the shallow aquifer and enter streams as part of the base flow during dry periods. Local irrigation at Brooks AFB aggravates the contaminant migration potential.

SECTION 4

FINDINGS

This section summarizes the hazardous wastes generated by installation activities, identifies hazardous waste storage 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 Brooks AFB.

SATELLITE FACILITIES REVIEW

A review file data and interviews with base personnel were conducted to identify past and present activities at the Brooks AFB Annex, El Rancho Cima Boy Scout Camp, that could have resulted in generation or disposal of hazardous waste. The site has been leased from the Sam Houston Area Council of the Boy Scouts of America for use for survival training since 1974. There are no activities at the annex that result in the generation or disposal of hazardous waste. The Air Force does not have fuel tanks or other facilities where spills could have occurred or maintenance is required.

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 Brooks AFB are grouped into the following categories:

- Industrial Operations (Shops)
- Hazardous Waste Storage Areas
- Fuels Management

- o Spills and Leaks
- o Pesticide Utilization
- o Fire Protection Training

It is noted that file data and interviews did not enable determination of waste handling activities prior to the late 1940's. From the historical descriptions of the activities at the base, it is believed that the generation of hazardous materials was small. In addition, many of the currently known hazardous chemicals were developed during and after World War II.

The subsequent discussion addresses only those wastes generated at Brooks 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 Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA). Compounds such as polychlorinated biphenyls (PCB's) which are listed in the Toxic Substances Control Act (TSCA) are also considered hazardous. For study purposes, waste petroleum products such as contaminated fuels, waste oils, waste non-chlorinated solvents are also included in the "hazardous waste" category. It is noted, however, that waste oil is not designated a hazardous waste under Texas or USEPA regulations.

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)

Summaries of industrial operations at Brooks AFB were developed from installation files and interviews. Information obtained was used to determine which shops handle hazardous materials and which ones generate hazardous wastes. Summary information on all installation shops is provided as Appendix E, Master List of Shops.

For the shops identified as generating hazardous wastes, file data were reviewed and personnel were interviewed to determine the types and quantities of materials and present and past disposal methods. Information developed from base files and interviews with installation employees is summarized in Table 4.1. This table presents shop location, waste material, current waste quantity and disposal method timelines. As indicated previously, specific information concerning shops that used to function on the flightline was minimal. Painting, stripping and minor maintenance activities are known to have existed on the Brooks AFB flightline. Major aircraft maintenance reportedly was done at nearby Kelly AFB so waste generation at Brooks may not have been extensive. It appears from interviews that much of the combustible flightline wastes were taken to the fire protection training areas. Noncombustible wastes from the flightline may have found their way to base landfills which operated at the time.

The characteristics of the wastes generated and disposed at Brooks AFB have ranged from petroleum-based products associated with the aircraft and flightline activities to the chemical/biological/radiological products resulting from the current research and development activities. The wastes from the present base activities consist primarily of a wide variety of chemicals which are typically small in volume. As shown in Table 4.1 most all wastes from current shops have either been disposed to the sanitary sewer or taken off base through contract or DPDO arrangements. Brooks AFB personnel conduct university-type radiation-related research, nuclear medicine radioisotope studies, and environmental/occupational/radiological health testing. Research isotopes, such as Calcium 45, are used to tag chemicals in biological processes for study. Radioisotope wastes are stored to allow for radioactive decay until they reach safe/background levels. Hospital nuclear medicine radioisotopes, such as Technicium 99, are used in heart catherterization studies. These used radioisotopes are also stored for a period and then disposed of as a special waste. Iodine 125 is used at the Drug Testing Laboratory; disposal of this radioisotope requires a longer storage period to reach background levels, usually over 14 months.

Samples tested by the USAF OEHL sometimes have long decay times. These radioisotopes of longer half lives are transported to approved off-base burial sites using accepted shipping and packing containers.

TABLE 4.1

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	CURRENT WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1950 – 1960 – 1970 – 1980)
SCHOOL OF AEROSPACE MEDICINE				
RADIATION BIOLOGY	175E	LAB CHEMICALS/SOLUTIONS(1)	3 GALS./YR.	1959 SANITARY SEWER →
		AUTOCLAVED BIOLOGICAL MATERIALS, VIALS, ETC.	14 CU. FT./YR.	LANDFILL → 1983 OBCR →
VULNERABILITY ASSESSMENT	186	ACID/BASE CLEANING SOLUTIONS (CAGE CLEANING PRODUCTS)	180 GALS./YR.	SANITARY SEWER →
RADIATION PHYSICS	175E	ANIMAL CARCASSES WITH IODINE 125 (HALF-LIFE=60 DAYS)	51 CU. FT. (ONE TIME ONLY)	RADIOLOGICAL BURIAL AREA 1974
SEVERAL SAM/AMD RADIOLOGICAL LABS	140, 125, 110, 186, 930, 170, 175E, 160, 100	SOLID RADIOLOGICAL WASTES (CARCASSES, RAGS, ETC.)	690 CU. FT./YR.	1959 OBCR →
		LIQUID SCINTILLATION VIALS FROM RADIOLOGICAL ACTIVITIES	135 CU. FT./YR.	OBCR →
		LOW-LEVEL LIQUID RADIOLOGICAL WASTES	50 GALS./YR.(2)	SANITARY SEWER →
ANIMAL RESOURCES	185 1001-1019	RESEARCH ANIMAL TISSUE	9,000 LBS./YR.	INCINERATOR →
		INCINERATOR ASH	900 LBS./YR.	LANDFILL → 1983 OBCR →
		DETERGENTS AND DISINFECTANTS	2,200 GALS./YR.	SANITARY SEWER →
		SURGICAL DRAPES AND DRESSINGS	8,200 LBS./YR.	INCINERATOR →

KEY

——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

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

OBCR - OFF-BASE CONTRACT REMOVAL

DPDO - DEFENSE PROPERTY DISPOSAL OFFICE

FPTA - FIRE PROTECTION TRAINING AREA

(1) MAINLY BENZOIC, HYDROCHLORIC AND ACETIC ACIDS AND METHANOL

(2) LESS THAN 10% MAXIMUM PERMISSIBLE CONCENTRATION (10CFR20)

TABLE 4.1 (CONT'D)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	CURRENT WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1950 – 1960 – 1970 – 1980)
	125	FIXER	60 GALS./YR.	SILVER RECOVERY (1959 →)
		DEVELOPER	60 GALS./YR.	SANITARY SEWER
		ACID/BASE CLEANING SOLUTIONS (CAGE CLEANING PRODUCTS)	200 GALS./YR.	SANITARY SEWER
PATHOLOGY	125	MISCELLANEOUS LAB CHEMICALS (3)	420 GALS./YR.	SANITARY SEWER
		AUTOCLAVED BIOLOGICAL MATERIALS, VIALS, ETC.	80 LBS./YR.	INCINERATOR
CREW SYSTEMS	170	MISCELLANEOUS LAB CHEMICALS (4)	10 GALS./YR.	SANITARY SEWER
AEROMEDICAL SYSTEMS	170	FULLERS EARTH	2,400 LBS./YR.	LANDFILL (1979); OBCR
		LUBRICATING OIL	5 GALS./YR.	SANITARY SEWER/LANDFILL; SANITARY SEWER/OBCR (1983)
		METHANOL, ACETONE AND BUTANOL	530 GALS./YR.	SANITARY SEWER
SYSTEMS ENGINEERING	160/170	LUBRICATING OILS	380 GALS./YR.	DPDO
INTERNAL MEDICINE	110	BARIUM HYDROXIDE	50 LBS./YR.	LANDFILL; OBCR (1983)
		MISCELLANEOUS CHEMICALS (MAINLY BUFFERS)	4 GALS./YR.	SANITARY SEWER

KEY

——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

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

OBCR – OFF-BASE CONTRACT REMOVAL

DPDO – DEFENSE PROPERTY DISPOSAL OFFICE

FPTA – FIRE PROTECTION TRAINING AREA

(3) MAINLY ALCOHOLS, XYLENE, FORMALDEHYDE AND ACETONE

(4) MAINLY ISOPROPYL ALCOHOL

TABLE 4.1 (CONT'D)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	CURRENT WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1950–1980)
DENTAL INVESTIGATION	125	DEVELOPER	18 GALS./YR.	1959 → SANITARY SEWER
		FIXER	18 GALS./YR.	SILVER RECOVERY
OPTHAMOLOGY	110/130	TIN OXIDE, SERIUM OXIDE AND EMERY	30 LBS./YR.	SANITARY SEWER/ GROUND(BASEMENT BLDG. 130)
		COOLANT AND ANTIFREEZE	16 GALS./YR.	SANITARY SEWER
FLIGHT MEDICINE	100	DEVELOPER	180 GALS./YR.	SANITARY SEWER
		FIXER	240 GALS./YR.	SILVER RECOVERY
EPIDEMIOLOGY	930	MISCELLANEOUS LAB CHEMICALS (5)	600 GALS./YR.	SANITARY SEWER
		BIOLOGICAL MATERIALS	3,000 LBS./YR.	INCINERATION (ASH TO LANDFILL)
		AUTOCLAVED BIOLOGICAL MATERIALS, VIALS, ETC.	10,000 CU. FT./YR.	LANDFILL → 1983 OBCR
HYPERBARIC MEDICINE	160	LUBRICATING OILS	3 GALS./YR.	DPDO
EDUCATION	160	LUBRICATING OILS	30 GALS./YR.	DPDO
PHOTOGRAPHY	130	FIXER	290 GALS./YR.	SILVER RECOVERY
		DEVELOPER AND OTHER SOLUTIONS (BLEACHES, STABILIZERS, CONDITIONERS)	480 GALS./YR.	SANITARY SEWER

KEY

——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

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

OBCR - OFF-BASE CONTRACT REMOVAL

DPDO - DEFENSE PROPERTY DISPOSAL OFFICE

FPTA - FIRE PROTECTION TRAINING AREA

(5) MAINLY CHLOROFORM, SODIUM HYDROXIDE, ETHYL ACETATE, METHANOL, ACETONE AND HYDROCHLORIC ACID

TABLE 4.1 (CONT'D)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	CURRENT WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1950 / 1960 / 1970 / 1980)
FABRICATIONS	130	PD-680	10 GALS./YR.	1959 DPDO
		PLATING RINSEWATER	100 GALS./YR.	SANITARY SEWER
		ANODIZING RINSEWATER	2,400 GALS./YR.	SANITARY SEWER
		CADMIUM PLATING BATH	5 GALS. (ONE TIME)	SANITARY SEWER
		NICKEL PLATING BATH	5 GALS. (ONE TIME)	DPDO
		ALUMINUM ANODIZING SOLUTION (H_2SO_4)	150 GALS. (ONE TIME)	SANITARY SEWER
		ALUMINUM ANODIZING ETCHING SOLUTION (NaOH)	75 LBS./YR.	SANITARY SEWER
OCCUPATIONAL AND ENVIRONMENTAL HEALTH LABORATORY				
RADIATION SERVICES	140	MISCELLANEOUS NONRADIOLOGICAL LAB CHEMICALS(6)	200 GALS./YR.	SANITARY SEWER 1978
ANALYTICAL SERVICES		MISCELLANEOUS LAB CHEMICALS AND AQUEOUS SAMPLES(7)	360 GALS./YR.	SANITARY SEWER
		PCB OILS AND SOLVENTS	30 GALS./YR.	DPDO
		SOILS AND OTHER WASTE SAMPLES	50 LBS./YR.	DPDO

KEY

——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

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

OBCR - OFF-BASE CONTRACT REMOVAL

DPDO - DEFENSE PROPERTY DISPOSAL OFFICE

FPTA - FIRE PROTECTION TRAINING AREA

(6) MAINLY NITRIC AND HYDROCHLORIC ACIDS AND AMMONIUM HYDROXIDE

(7) CHEMICALS ARE MAINLY ANALYTICAL REAGENTS

TABLE 4.1 (CONT'D)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	CURRENT WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1950–1980)
CONSULTANT SERVICES	175W/796	BIOASSAY SOILS	12 CU. FT./YR.	LANDFILL, OBCR (1983)
CLINIC BROOKS				
DENTAL LAB	615	MISCELLANEOUS LAB CHEMICALS (8)	12 GALS./YR.	SANITARY SEWER
		DEVELOPER	24 GALS./YR.	SANITARY SEWER
		FIXER	24 GALS./YR.	SILVER RECOVERY
RADIOLOGY	615	FIXER	170 GALS./YR.	SILVER RECOVERY
		DEVELOPER	130 GALS./YR.	SANITARY SEWER
CLINICAL LAB	615	MISCELLANEOUS LAB CHEMICALS (9)	15 GALS./YR.	SANITARY SEWER
		AUTOCLAVED BIOLOGICAL MATERIALS	2,600 LBS./YR.	LANDFILL, OBCR (1983)
6570TH AIR BASE GROUP				
VEHICLE MAINTENANCE	1102	PD 680	300 GALS./YR.	FPTA, DPDO
		PAINT THINNER	25 50 GALS./YR.	FPTA, DPDO
		ENGINE OIL	300 GALS./YR.	FPTA, DPDO

KEY

——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

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

OBCR - OFF-BASE CONTRACT REMOVAL

DPDO DEFENSE PROPERTY DISPOSAL OFFICE

FPTA FIRE PROTECTION TRAINING AREA

(8) MAINLY PICKLING SOLUTIONS AND ALCOHOLS

(9) MAINLY ACIDIC ANALYTICAL REAGENTS

TABLE 4.1 (CONT'D)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1950 – 1960 – 1970 – 1980)
VEHICLE MAINTENANCE (CONT'D)	1102	PAINT	10 GALS./YR.	FPTA - - - 1959 — DPDO
		BATTERY ACID	55 GALS./YR.	- - - NEUTRALIZED/SANITARY SEWER - - -
		BATTERY CASES	60 CASES/YR.	- - - DPDO - - -
AUTO HOBBY SHOP	698	ENGINE AND LUBRICATING OILS	2,000 GALS./YR.	- - - FPTA - - - 1959 - - - OBCR - - -
TENANT ORGANIZATIONS				
SAN ANTONIO REAL PROPERTY MANAGEMENT AGENCY (SARPMA)				
CLIMATIC CONTROL	633	DESCALING SOLUTION (DILUTE HYDROCHLORIC ACID)	4,400 GALS./YR.	- - - SANITARY SEWER —
		RUST INHIBITOR SOLUTION	55 GALS./YR.	- - - SANITARY SEWER —
		LUBRICATING OILS	5 GALS./YR.	- - - FPTA - - - 1959 — DPDO
POWER PRODUCTION	629	BATTERY ACID	30 GALS./YR.	- - - NEUTRALIZED/SANITARY SEWER - - -
		BATTERY CASES	11 CASES/YR.	- - - DPDO - - -
		ENGINE OIL	200 GALS./YR.	- - - FPTA - - - 1959 — DPDO
		DIESEL FUEL	500 GALS./YR.	- - - HEATING & COOLING PLANT COMBUSTION —
HEATING AND COOLING PLANT	165	LUBRICATING OILS	65 GALS./YR.	- - - FPTA - - - 1959 — DPDO — HEATING & COOLING PLANT COMBUSTION
		FUEL STORAGE TANK OILS/ SLUDGE	440 GALS./EVERY 5 YRS.	- - - PERIMETER ROADS —

KEY

——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

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

OBCR - OFF-BASE CONTRACT REMOVAL

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	WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1950 – 1960 – 1970 – 1980)
PAVEMENT AND GROUNDS	609	MOTOR OIL	110 GALS./YR.	FPTA; DPDO
		EMPTY PESTICIDE CANS	24 CANS/YR.	LANDFILL
		EMPTY PESTICIDE BAGS	25 BAGS/YR.	LANDFILL; 1970 OBCR
LAWNMOWER REPAIR		BATTERY ACID	10 GALS./YR.	NEUTRALIZED/SANITARY SEWER
		BATTERY CASES	18 CASES/YR.	DPDO
SANITATION/PEST CONTROL	629	EMPTY PESTICIDE CANS AND BAGS	70 /YR.	LANDFILL; 1970 OBCR
BASE EXCHANGE				
BX SERVICE STATION	706	ANTIFREEZE SOLUTIONS	300 GALS./YR.	SANITARY SEWER
		ENGINE AND LUBRICATING OILS	1,500 GALS./YR.	OBCR
		WATER/FUEL MIXTURE	1,080 GALS./YR.	LANDFILL; STORAGE FOR BRUSH FIRE

KEY

——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

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

OBCR - OFF-BASE CONTRACT REMOVAL

DPDO - DEFENSE PROPERTY DISPOSAL OFFICE

FPTA - FIRE PROTECTION TRAINING AREA

All radiological wastes have been taken off base for disposal except for a one-time only burial of animal carcasses in 1974 (discussed later).

All items containing potential biological contaminants have either been incinerated or autoclaved and landfilled (on or off base). Petroleum products from base support activities were predominantly burned at fire protection training areas until the close of the flightline when they were taken off base through the DPDO.

Hazardous Waste Storage Areas

Hazardous wastes are stored at five major locations on base: Facility 1020/1030, Facility 1130, adjacent to Facility 1014, in Building 135, and adjacent to Building 186. Wastes generated in various shops are temporarily accumulated in each shop and then transported to one of the five locations for subsequent disposition. Figure 4.1 shows the location of these storage areas.

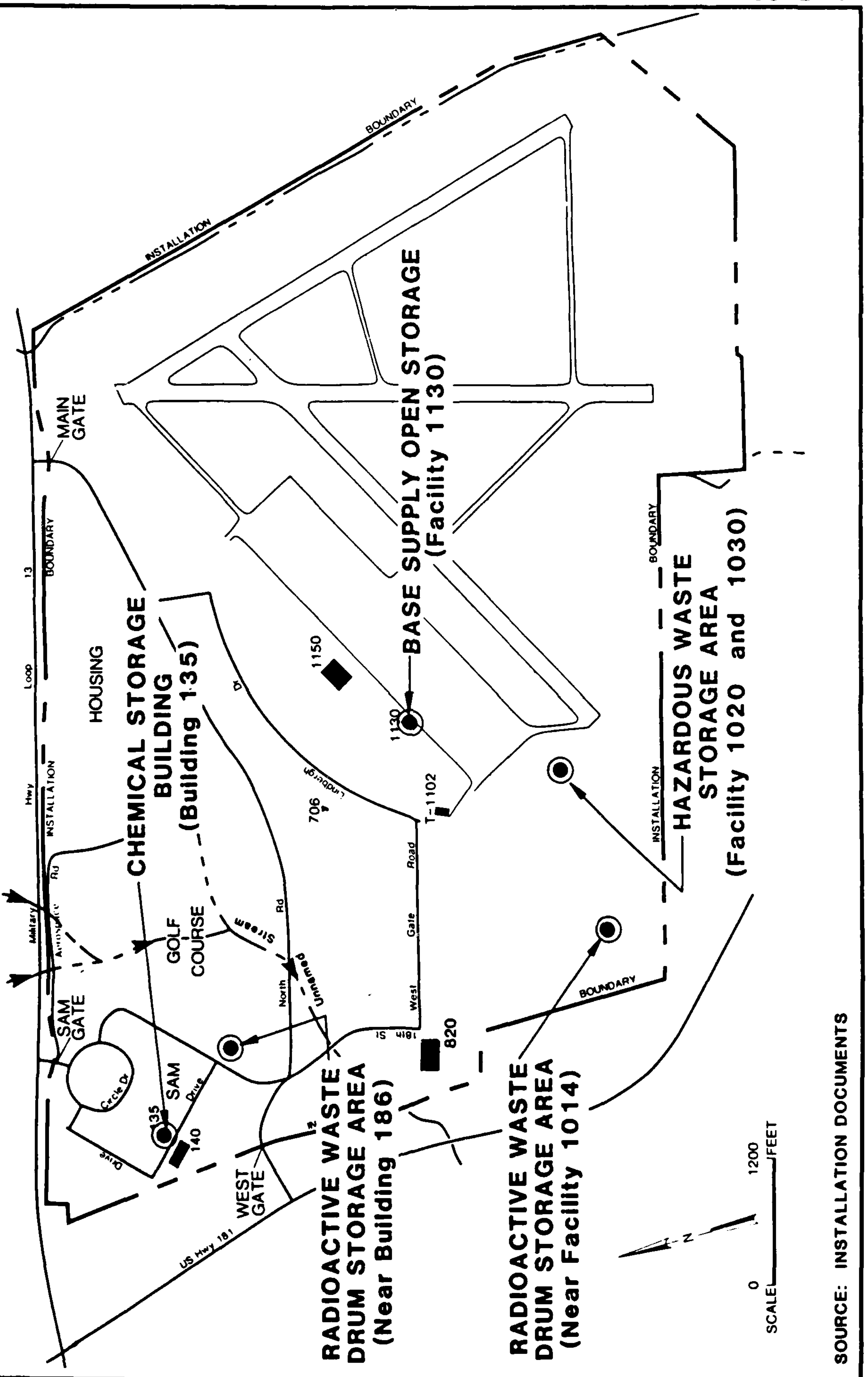
Facility 1020/1030 is the storage point for drummed hazardous, non-radioactive wastes prior to transport off base through DPDO. The facilities are slightly above ground and any leakage from materials stored drain into one of two tanks located at 1020 and 1030. The two tanks at Facility 1020 and 1030 were designed to store liquid radiological waste prior to hauling to off base disposal sites, but they were never used for this purpose. Facility 1130 is an open, fenced area which is currently utilized for storing waste petroleum products prior to removal for petroleum recycling off base. Low-level radiological wastes (Iodine 125 and Cobalt 57) are drummed and stored for varying decay times at an outside location adjacent to Building 186 prior to removal for disposal off base by contract. Radiological wastes are also stored near Facility 1014 and are then moved to the area near Building 186 when they are to be hauled off base.

Building 135 is a facility designed to store laboratory chemicals to prevent storage difficulties inside high-value research and development laboratories. Each major laboratory within SAM has an assigned area for storage. The facility functions as a "clearing house" type operation where chemicals from one research laboratory may be obtained and used by another. Chemicals which eventually are to be disposed of from Building 135 are drummed for transport off base. For leak and

FIGURE 4.1

BROOKS AFB

HAZARDOUS WASTE STORAGE AREAS



SOURCE: INSTALLATION DOCUMENTS

spill control, acids room, bases room and toxics-flammables rooms of the building have floor drains connected to three separate underground tanks. These tanks are empty.

With the exception of a motor oil spill of less than 20 gallons at Facility 1130, there have been no reports of spills and leaks at the five hazardous waste storage areas discussed previously. No information is available concerning waste storage areas which may have existed during the earlier years on the base when the flightline was active. It appears probable that none existed since shop wastes would likely have been transported directly to the disposal point without intermediate storage.

Fuels Management

The present liquid fuels storage system consists of several underground and above ground storage tanks. A summary of the major fuel, oil, waste oil and chemical storage facilities is presented in Appendix D. Most of the tanks are still in service but a few have been abandoned in place. Several large above ground fuel tanks were dismantled when flight operations at the base ceased. Inventory controls have been used to determine whether potential leaks exist. Tank leaks are discussed in the following subsection.

Large tanks have been periodically cleaned. At the Heating and Cooling Plant the fuel oil tanks have normally been cleaned out about every five years and the residual oil and sludge placed randomly on some of the base perimeter roads. The aircraft fuel tanks (now dismantled) used for the flight operations were cleaned every three years. The sludge was disposed of in shallow pits until 1960. When aircraft operations were discontinued the tanks were cleaned and removed from the base. The sludges from the tanks were spread on the ground in an area along the aircraft parking area. These areas are discussed further in a subsequent section. Fuel tanks are currently cleaned when required by personnel from Kelly AFB. The residues removed from the tanks are taken off base. In addition to tank cleaning, fuel operations have also resulted in generation of waste materials. At the BX Service Station a mixture of fuel and water is periodically withdrawn from the gasoline tanks for disposal. Until 1983 this fuel-water mixture was disposed at the base landfills.

Spills and Leaks

A few spills and leaks have been identified at Brooks AFB (Figure 4.2). In the early 1970's a 1200 gallon acid tank located between the cooling towers at the heating and cooling plant (Building 165) leaked its contents to the ground. Basic chemicals were placed on the soil to neutralize the effect of the acid at the site. The storage tank has since been removed from the site. The new sulfuric acid tank used at the plant has been diked.

In about 1980 a fuel line feeding the standby generators at Building 930 leaked approximately 100-200 gallons of diesel fuel to the ground. No special cleanup efforts were undertaken, but no contamination is presently noted at the site.

A loss of an estimated 150 gallons of gasoline occurred at the BX gas station (Building 706) in 1984. The leak was attributed to a flexible fuel line between the storage tanks and the pump island. A fuel and water mixture was pumped from the ground near the leak and placed in drums. Sand which was contaminated with fuel was also removed from the site. The fuel-water mixture and sand were disposed off base by a contractor.

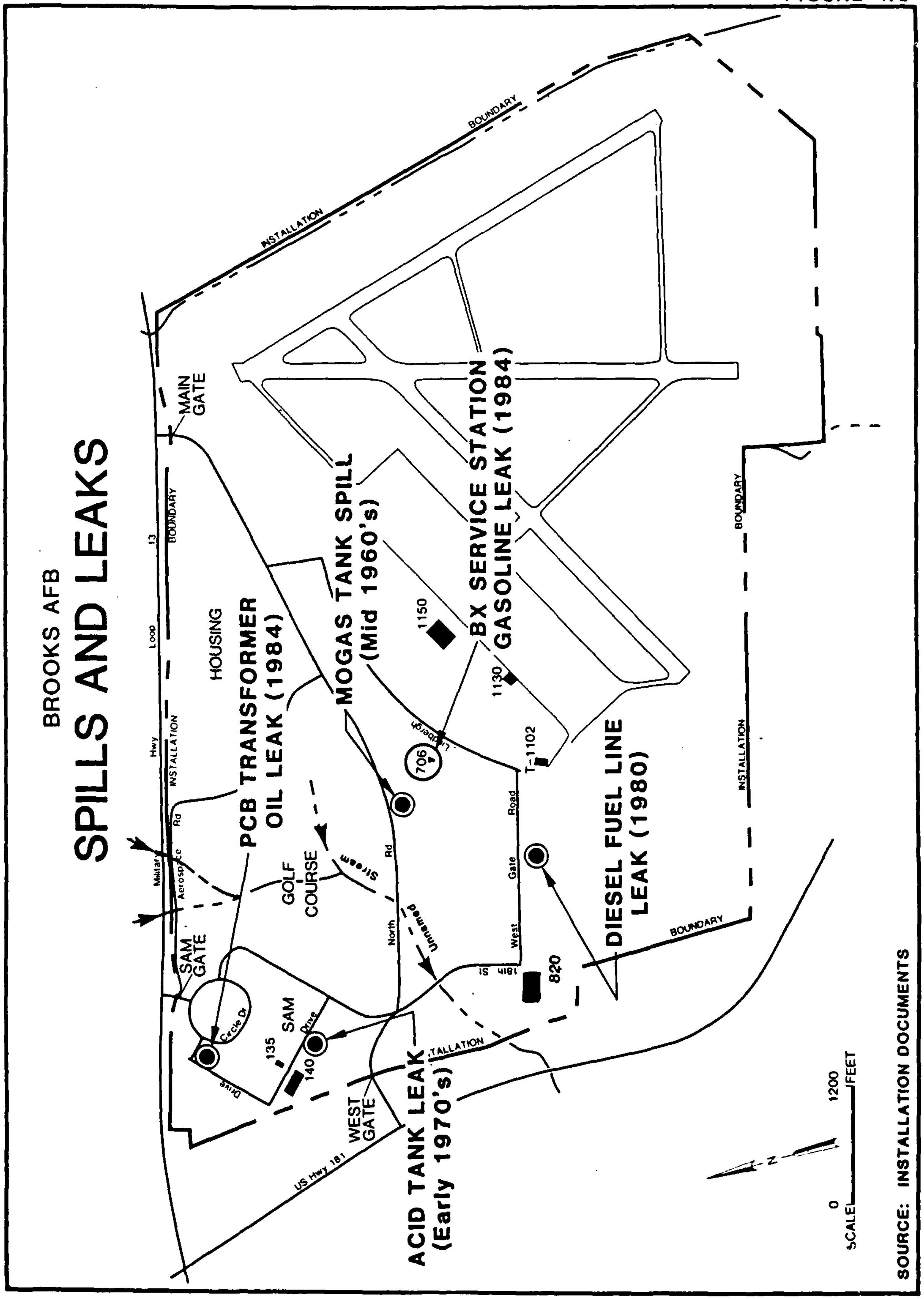
In 1984 approximately 100 gallons of oil containing PCB leaked from a transformer in Building 100 to the ground beneath the building. Soil tests conducted indicate an area of approximately 100 square feet with elevated levels of PCB. At the time of the site visit for this study the base was in the process of establishing the extent of contamination and procedures to be used for cleaning up the site.

Information concerning spills and leaks during the flightline operations are lacking. It is presumed that numerous small fuel leaks occurred from the aircraft operations. One larger spill of 500-1000 gallons was reported to have occurred in the mid 1960's at a site in the present golf course adjacent to North Road. A tank drain value was not closed resulting in the leakage to a nearby drainage ditch. The fire protection personnel hosed the area with water.

Pesticide Utilization

A variety of pesticides have been utilized at Brooks AFB for control of insects, weeds and rodents. Herbicides have been used by pavements and grounds personnel primarily on the golf course and along fence

FIGURE 4.2


BROOKS AFB
SPILLS AND LEAKS
PCB TRANSFORMER OIL LEAK (1984)
MOGAS TANK SPILL (Mid 1960's)
BX SERVICE STATION GASOLINE LEAK (1984)
DIESEL FUEL LINE LEAK (1980)
ACID TANK LEAK (Early 1970's)
MAIN GATE
SAM GATE
WEST GATE
HOUSING
GOLF COURSE
SAM
INSTALLATION BOUNDARY
Loop 13
Military Hwy
Aerospace Rd
North Rd
West Gate Road
18th St
Lindbergh
Unnamed Stream
Circle Dr
SAM Drive
US Hwy 181
1150
1130
T-1102
706
820
135
140
SCALE 0 1200 FEET
N
SOURCE: INSTALLATION DOCUMENTS

lines. Fungicides are used by pavements and grounds personnel on the golf course greens. The herbicides and fungicides are stored in Building 607. Smaller quantities of pesticides for use in three-gallon sprayers are mixed in a curbed area adjacent to Building 607. Larger quantities are mixed in the area where they are to be applied. Water from rinsing sprayers and triple rinsing of empty pesticide containers is applied in the location where the pesticides were sprayed. The containers are punctured and crushed prior to disposal in the on-base landfill.

Insecticides are used by the Sanitation Shop (Water, Wastewater & Pest Control) primarily in the housing area. The insecticides are stored and mixed inside Building 629. Empty pesticide containers are triple rinsed, punctured and placed in a dumpster for disposal. Rinsewaters are collected and used for make-up water for compatible pesticides.

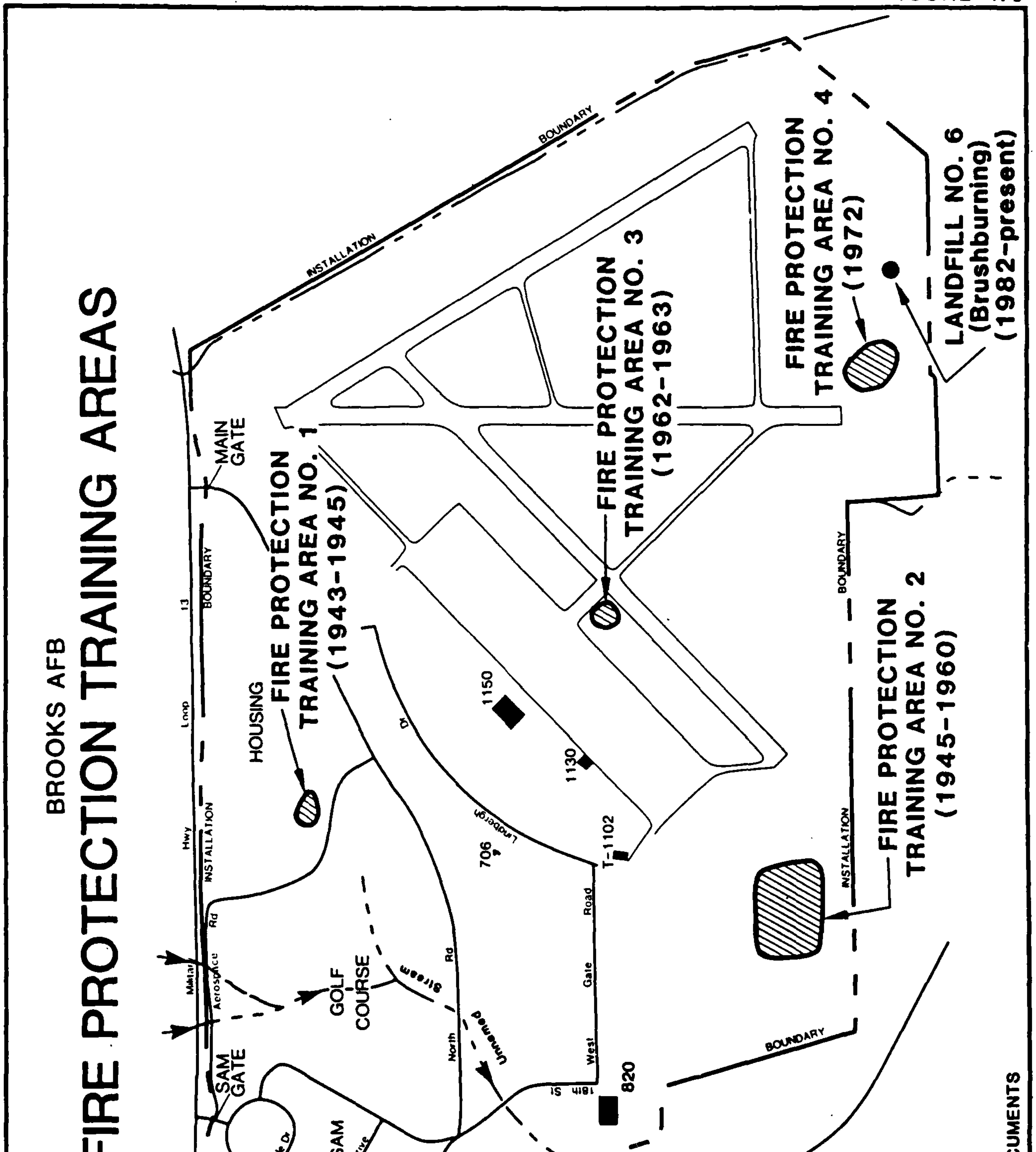
The practices discussed above have been used for at least the past ten years. The pesticides were formerly stored in Building 696. This building was located east of the Auto Hobby Shop (Building 697). Rinse water from sprayers was dumped on the ground on the west side of Building 696. According to base personnel pesticides were used in relative-small quantities and no major spills of pesticides occurred in this area.

Fire Protection Training

There are four areas that have been used for fire protection training at Brooks AFB. The locations of these areas and appoximate dates of operation were determined from a review of aerial photographs and interviews with current and former base personnel (see Figure 4.3). Fire Protection Training Area Nos. 1 and 2 were used for airplane crash training. There have been two fire protection training areas since the end of flying missions at Brooks. Fire Protection Training Area No. 3 was used for training in fighting grass fires. Fire Protection Training Area No. 4 was used in conjunction with training of medical personnel in evacuation of airplane crash victims.

One training exercise per week was conducted at Fire Protection Training Area No. 1 (1943-1945). Approximately 50 to 100 gallons of contaminated fuel, waste oil, spent solvents and/or gunk were spread on

FIGURE 4.3



BROOKS AFB
FIRE PROTECTION TRAINING AREAS
HOUSING
FIRE PROTECTION TRAINING AREA NO. 1 (1943-1945)
FIRE PROTECTION TRAINING AREA NO. 3 (1962-1963)
FIRE PROTECTION TRAINING AREA NO. 4 (1972)
LANDFILL NO. 6 (Brushburning) (1982-present)
FIRE PROTECTION TRAINING AREA NO. 2 (1945-1960)
MAIN GATE
SAM GATE
WEST GATE
GOLF COURSE
SAM
Circle Dr
SAM Drive
Drive
Military Hwy
Loop 13
INSTALLATION BOUNDARY
Aerospace Rd
Lindbergh Dr
North Rd
Unnamed Stream
West Gate Road
18th St
US Hwy 181
1150
1130
T-1102
706
820
135
140
N
SCALE 0 1200 FEET
SOURCE: INSTALLATION DOCUMENTS

the ground in shallow pits approximately 1-foot deep and 30-feet in diameter. Fires were extinguished with water.

Fire Protection Training Area No. 2 was used between approximately 1945 and 1960. One large circular fire pit surrounded by four or five smaller circular pits are indicated in aerial photographs. A mixed product consisting of 50 to 100 gallons of waste oil, spent solvents and/or contaminated fuel was burned in weekly exercises. The wastes burned in the training exercises were stored near the fire pits. The maximum accumulation of wastes in this area was less than ten 55-gallon drums.

Fire Protection Training Area No. 3 was used for approximately one year (1962-1963) for training in fighting grass fires. Exercises were conducted once per month in a circular area approximately 25-feet in diameter. The area was surrounded by empty 55-gallon drums that had been cut in half. The material that was burned included diesel fuel, MOGAS and possibly small quantities of waste oil and spent solvents; however, during the period of use of this area oils and solvents were taken to base supply for removal by DPDO.

Fire Protection Training Area No. 4 is an area that was used to train medical personnel in crash rescue in 1972. Fires were ignited in 55-gallon drums to generate smoke for training purposes. On two occasions in 1972 fuel was placed in a shallow (18-in deep x 24-in wide) trench around the airplane. A fire was ignited in the trench. After rescue training had been completed, the fire department would extinguish the fire. The trench was excavated the day before the exercise and was filled in the day following the exercise.

The only area where fires are currently started at Brooks AFB is at Landfill No. 6. With permission from the San Antonio Metropolitan Health District, brush and tree limbs collected on the base are burned once per year. A small amount of gasoline is used to start the fires. After the brush has burned the fire department extinguishes the fire with water. Air Force military personnel currently train in fighting aircraft fires quarterly at Kelly AFB or Randolph AFB.

BASE WASTE TREATMENT AND DISPOSAL METHODS

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

- o Landfills
- o Low-Level Radioactive Waste Disposal Site
- o Sanitary Sewerage System
- o Fuel Sludge Disposal Areas
- o Incinerators
- o Surface Drainage System

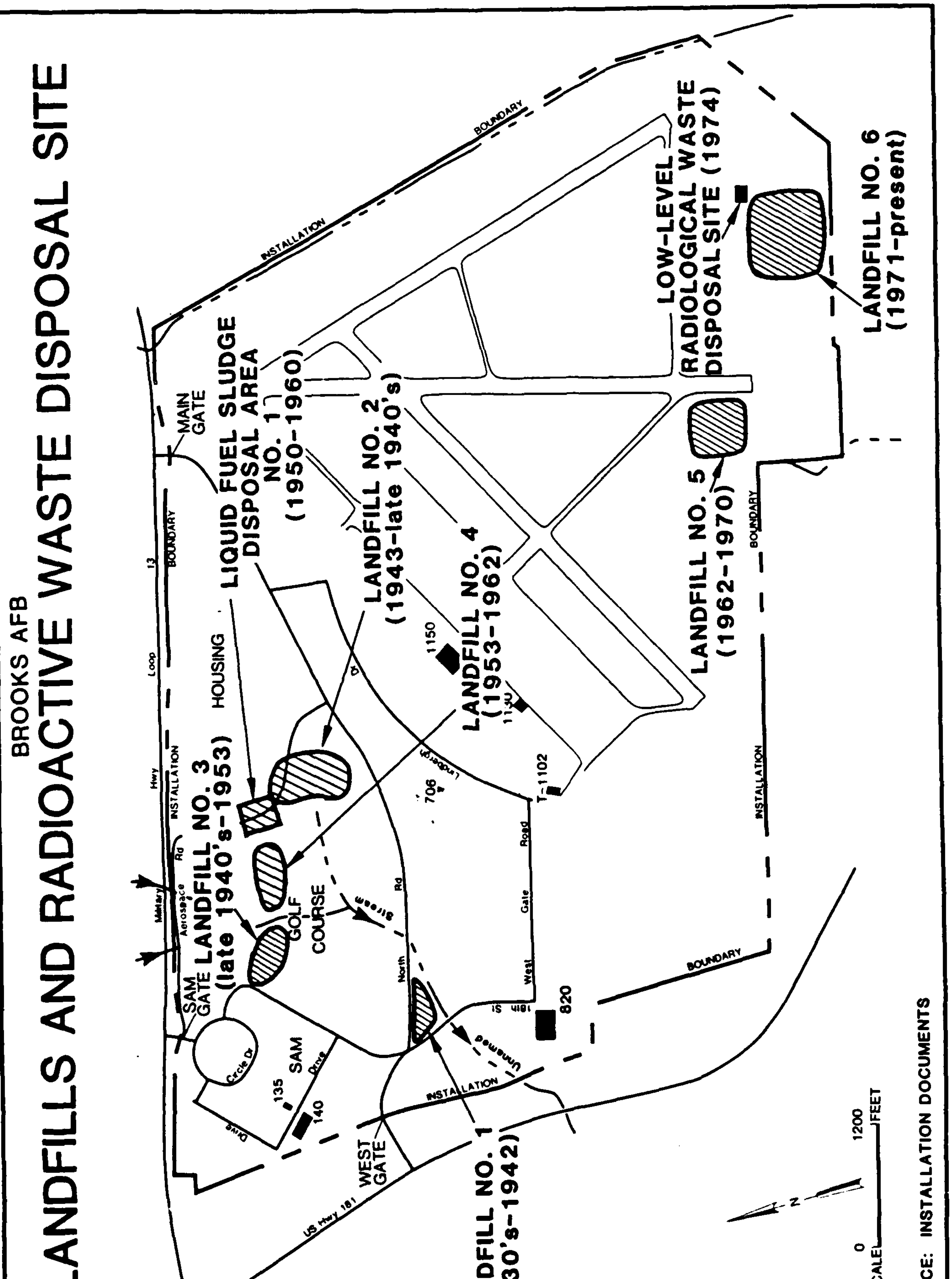
The waste management facilities are discussed individually in the following sub-sections.

Landfills

Six areas have been used for landfilling of wastes at Brooks AFB. The locations of these landfills and approximate periods of operation are shown in Figure 4.4. The locations of Landfill 1, 2, 3, and 4 are also shown in Figure 4.5. Summary information on the landfills from interviews and file data is provided on Table 4.2.

Landfill No. 1 was operated during the late 1930's and early 1940's. Little information is available concerning the quantities and types of wastes that were disposed of in this landfill; however records indicate that garbage was collected and sold off-base and that trash was burned at the landfill. The area of the landfill is estimated to be 1.3 acres and is currently part of the base golf course.

Landfill No. 2 was operated between 1943 and the late 1940's. The area of the landfill is estimated to be 3.9 acres. Wastes were disposed of in trenches having a northeast to southwest orientation. As with Landfill No. 1 little information concerning waste disposal is available. Waste materials including: packing materials, paper, scrap lumber, garbage, etc. were placed in trenches, burned and compacted by bulldozing. Significant quantities of waste oil, spent solvents and contaminated fuel were probably not disposed of in this landfill, since combustible wastes were used in fire protection training exercises during its years of operation. The landfill is in an area that is currently part of the base golf course.


BROOKS AFB
LANDFILLS AND RADIOACTIVE WASTE DISPOSAL SITE
LANDFILL NO. 1 (1930's-1942)
LANDFILL NO. 2 (1943-late 1940's)
LANDFILL NO. 3 (late 1940's-1953)
LANDFILL NO. 4 (1953-1962)
LANDFILL NO. 5 (1962-1970)
LANDFILL NO. 6 (1971-present)
LIQUID FUEL SLUDGE DISPOSAL AREA NO. 1 (1950-1960)
LOW-LEVEL RADIOLOGICAL WASTE DISPOSAL SITE (1974)
MAIN GATE
SAM GATE
WEST GATE
HOUSING
GOLF COURSE
INSTALLATION BOUNDARY
Loop 13
Military Rd
Aerospace Rd
North Rd
West Gate Road
Lindbergh Dr
Circle Dr
SAM Drive
Stream
Unnamed
US Hwy 181
18th St
1150
1130
1102
T-1102
706
820
135
140
N
SCALE 0 1200 FEET
SOURCE: INSTALLATION DOCUMENTS

BROOKS AFB

LANDFILLS LOCATED ON THE BASE GOLF COURSE

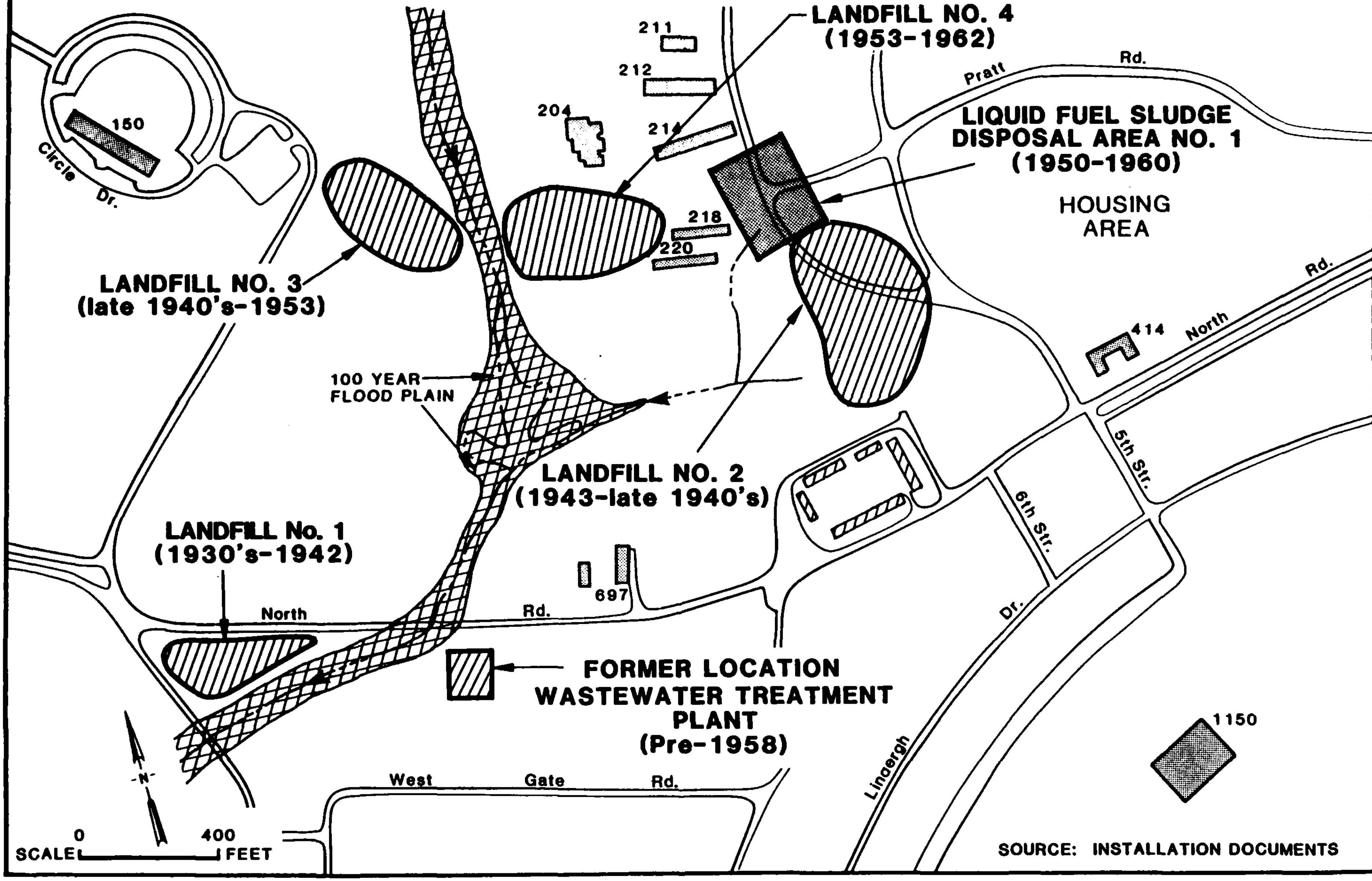


TABLE 4.2
SUMMARY OF LANDFILLS
BROOKS AFB

Site	Period of Operation	Approximate Area	Method of Operation	Types of Wastes	Current Land Use
Landfill No. 1	1930's to 1942	1.3	Area fill; depth unknown; burning of wastes.	Rubbish, suspected small quantities of shop wastes.	Base Golf Course
Landfill No. 2	1943 to late 1940's	3.9	Trench fill; depth unknown; burning of wastes.	Primarily rubbish and garbage, suspected small quantities of shop wates.	Base Golf Course adjacent to Capehart Housing Area.
Landfill No. 3	Late 1940's to 1953	1.9	Trench fill, about 12-ft. deep; burning of wastes.	Primarily rubbish and garbage, scrap construction materials, suspected small quantities of waste oils, spent solvents, paints, and paint thinner.	Base Golf Course
Landfill No. 4	Late 1953 to 1962	2.6	Trench fill, about 12-ft. deep; burning of wastes.	Primarily rubbish and garbage, scrap construction materials, suspected small quantities of waste oils, spent solvents, paints, and paint thinner.	Base Golf Course
Landfill No. 5	1962 to 1970	7	Trench fill, about 20-ft. deep; burning of wastes.	Rubbish and garbage, paints, thinners, unrinsed pesticide containers, and contaminated fuel.	Recreation
Landfill No. 6	1971 to Present	13	Trench fill, about 20-ft. deep; burning of wastes until late 1960's; burning of brush at present.	Rubbish and garbage, paints, thinners, unrinsed pesticide containers, contaminated fuel, construction and demolition debris, and brush.	Landfill

Source: Interviews and File Data.

Landfills 3 and 4 were operated between the early 1950's and 1962. The area of these landfills is estimated to be 1.9 and 2.6 acres, respectively. Wastes were placed in trenches about 12-ft deep x 50-ft wide x 400-ft long, burned and compacted using a bulldozer. The wastes disposed of in these trenches consisted mainly of rubbish, i.e., paper, packing materials and scrap lumber from the industrial shops and garbage from food service areas. It is noted that the majority of facilities in the SAM area were constructed after 1959 and that the Capehart housing area was not constructed until the early 1960's, therefore wastes from these areas, with the exception of scrap construction materials, were not disposed of in these landfills. Base personnel do not recall the disposal of significant quantities of chemical wastes; however, small quantities of waste oils, spent solvents, paint, thinner, etc. may have been disposed of in these landfills. These landfills are located in an area that is currently part of the base golf course.

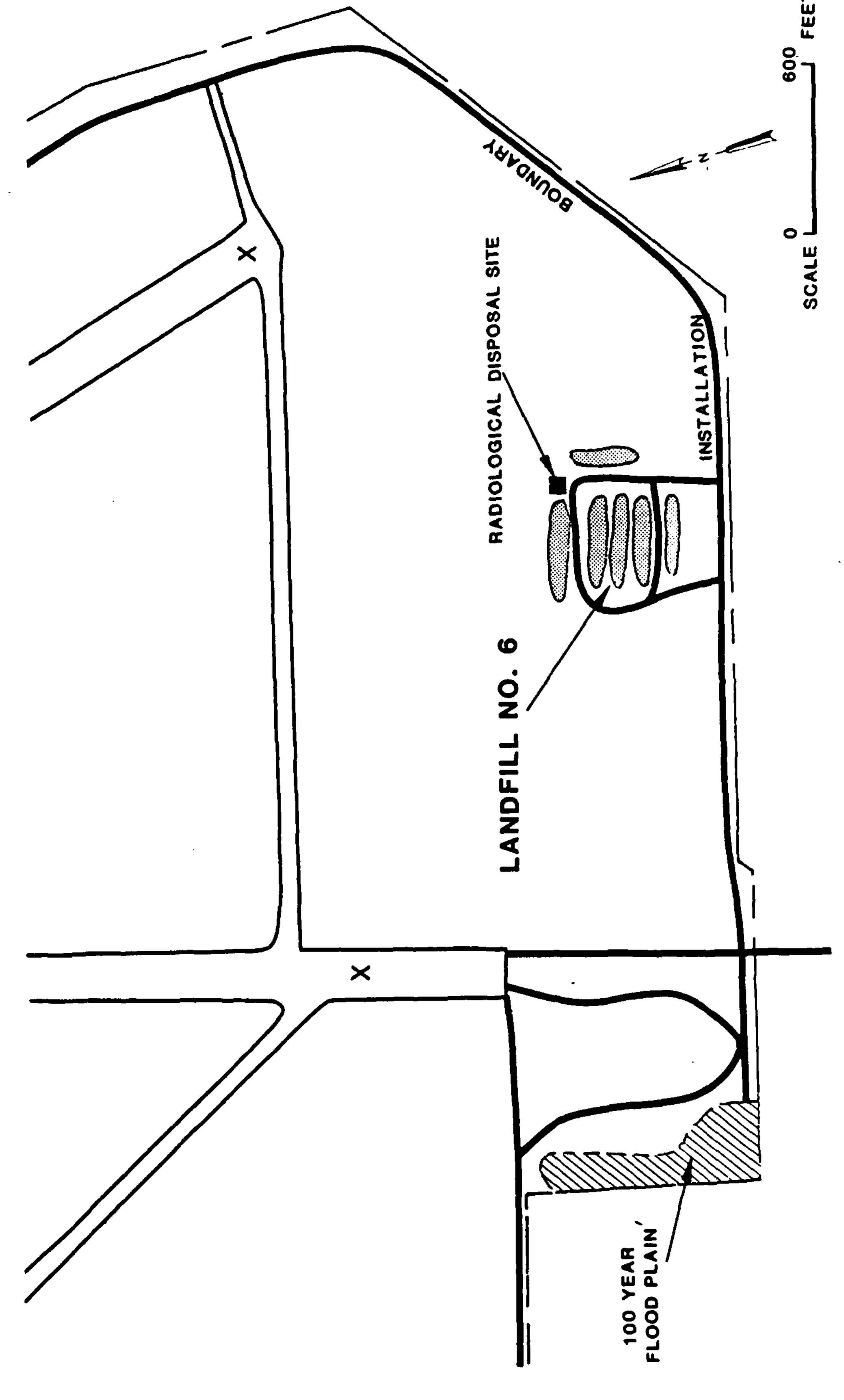
Landfill No. 5 was operated between approximately 1962 and 1970. The overall area of the site is estimated to be 7 acres. Wastes were disposed of in trenches approximately 20-ft deep, 75-ft wide and 350-ft long. One disposal trench adjacent to the edge of the pavement of the runway had a north-south orientation. This trench was used for disposal of broken concrete. The other trenches had an east-west orientation and were used for disposal of garbage and rubbish from the housing area, and wastes from the SAM area and from shops. During the period of operation of the landfill most of the chemical wastes from the SAM area were discharged to the sanitary sewer system. Wastes that were taken to the landfill from the SAM area included broken glassware, used medical supplies, etc. The wastes from the shop area consisted mainly of packing material, garbage, paper, etc. Hazardous wastes from the shop area may have included small quantities of excess paints, thinners and unrinsed pesticide containers as well as small quantities of oils, solvents and contaminated fuels. It is noted that the quantities of oils and contaminated fuels generated during the period of operation of this landfill were significantly less than during previous years of aircraft operations at the base and that the practice of drumming oil for off-base disposal was started in approximately 1960. Approximately two feet of cover material was placed over the trenches when the landfill was closed. The terrain is relatively flat in the area of the landfill with the ground sloping downward at the western end of the trenches. No areas of vegetative stress were observed during the site visit for this study. The area is currently used for recreational purposes including horseback riding, running and skeet shooting.

When Landfill No. 5 was closed in 1970 refuse began being hauled off-base by contract. Landfill No. 6 was operated as a landfill from the early 1970's until 1983. During this period most base and family housing solid waste was hauled off-base by a contractor. However, construction and demolition debris, periodic office housecleaning wastes, bulky items from base housing, and shop/laboratory wastes were disposed at Landfill No. 6. The area in which wastes have been landfilled is estimated to be approximately 13 acres. Until the late 1960's daily burning of wastes in trenches was practiced. During the period between 1976 and 1983 the wastes were covered with soil and compacted weekly. The trenches that have been filled with wastes are approximately 20-ft deep, 50-ft wide and 400-ft long (Figure 4.6). Five of six trenches in this area have an east-west orientation. Three of these trenches are located inside an area that is enclosed by a dirt road. Two of the trenches are located north and south of the area enclosed by the road. A sixth trench, having a north-south orientation, is located east of the other five trenches. This trench was used for disposal of hardfill. The other five trenches received solid wastes and shop and laboratory wastes, including small quantities of hazardous wastes.

Until October, 1983 when access to the landfill was restricted, contaminated fuel including leaded gasoline from the BX Station had been disposed of in this landfill. The fuel water mixture was poured into the trenches from 55-gallon drums. In 1983, 30 to 50 55-gallon drums of waste oil were removed from the area of the landfill. The drums were in storage in this area. Some of the drums did not have covers for the small pour opening and/or were leaking. Before the drums were removed from the area, oil samples were collected from each drum and analyzed for PCB's. The results were negative and the oil-contamined soils were spread out in the landfill area. The waste oil was taken to a fenced area of a runway (Pavements and Grounds storage area) where it is being

BROOKS AFB

LANDFILL NO. 6 DISPOSAL TRENCHES



SOURCE: INSTALLATION DOCUMENTS

stored until it can be moved to the Base Supply Open Storage area for disposal through DPDO. One disposal trench was open at the time of the site visit for this study. This trench will be used for disposal of hardfill. Brush and tree limbs that are collected on base are taken to the landfill. The brush is burned once per year.

Low-Level Radioactive Waste Disposal Site

One disposal of radioactive waste was made on Brooks AFB in 1974. The waste consisted of less than 70 micro-curies of I-125 contained in animal cadavers that had been stored in a freezer. Due to a freezer compressor malfunction, biological decay of the cadavers occurred. The waste was packaged in plastic bags, placed in seven 55-gallon drums and buried in a hole 7 to 8 feet deep. The drums were covered with approximately 4 feet of soil. The site was marked and fenced until 1978 when the site was decommissioned with the permission of the USAF Radioisotope Committee. The total activity at the time of decommissioning was determined to be less than 1 picocurie (less than one millionth the quantity requiring licensing) which indicates no potential hazard to health, welfare or the environment. The location of the burial site is shown in Figures 4.4 and 4.6.

Sanitary Sewer System

The base has separate sanitary and storm sewer systems. A base wastewater treatment plant existed until approximately 1960 (Figure 4.5). The plant was scrapped and removed from the base, due to the large increase in wastewater flow from the facilities for the School of Aerospace Medicine and the Capehart Housing Area in the late 1950's and early 1960's. Since the closing of the base wastewater treatment plant, sanitary wastewater has been pumped off base to a San Antonio treatment plant.

The original on-base treatment plant consisted of an Imhoff Tank, sand filters and sludge drying beds. The plant was upgraded in the early 1950's to contact stabilization activated sludge process. After treatment the wastewater was discharged to the San Antonio River. The wastewater sludge was digested anaerobically, dewatered in drying beds and used as fertilizer in flower beds.

The wastewater treatment plant probably received only sanitary wastewater from industrial shops with the exception of an aircraft wash rack. Facility 1130 (currently Base Open Storage Area) was a washrack which discharged water along the flightline to the storm sewer system which drained off base. "Gunk", a degreasing and decarbonizing agent, was used for cleaning airplanes at the washrack. An above ground oil/water separator was installed at the 1130 washrack in the mid 1950's because of complaints from local residents, south of the base. After oil/water separation the water from this washrack flowed to the sanitary sewer system.

As noted previously, the wastewater now flows to a City treatment plant. From May 14-17, 1984 Bioenvironmental Engineering Services conducted composite sampling of the total sanitary sewage exiting the base. The sample analyses all met criteria established in the City industrial waste ordinance and Federal pretreatment guidelines. This included parameters such as cyanide, arsenic, phenols, heavy metals, oil and grease, etc. Thus, the sampling program confirms that the wide variety of chemicals from the base shops and laboratories does not adversely impact the sewerage system.

Fuel Sludge Disposal Areas

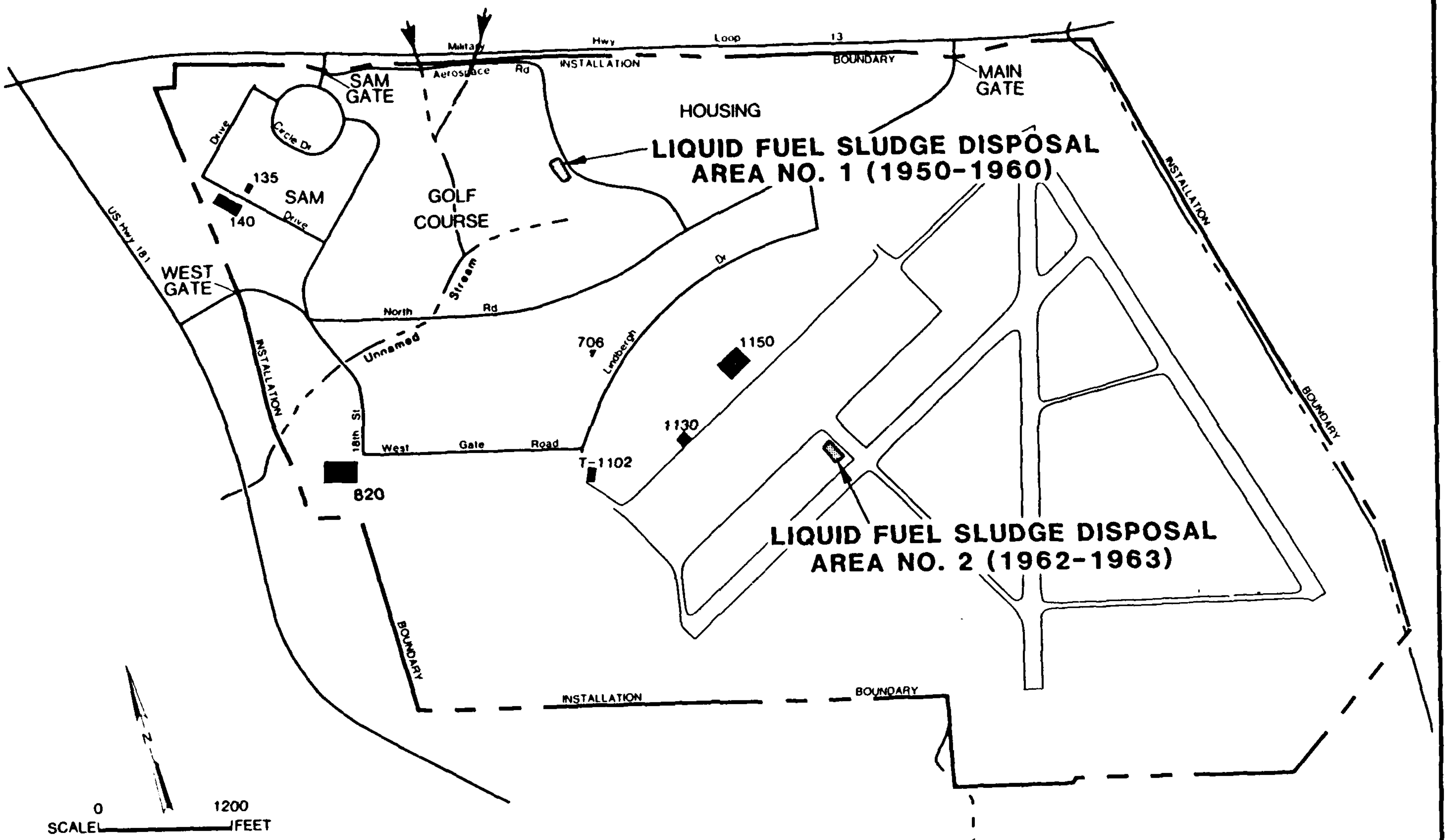
There are two areas at Brooks AFB that have been used for disposal of fuel sludges (Figure 4.6). From 1950 to 1960, four 25,000-gallon underground and four 50,000-gallon AVGAS storage tanks were cleaned every three years. The sludges that were removed from the tanks were disposed of at Liquid Fuel Sludge Disposal Area No. 1 in sludge pits east of the current location of Buildings 218 and 220. The sludge pits were approximately 5 feet deep, 8 foot wide and 20 to 30 feet long. Each of the three pits was used for disposal of approximately 2,000 gallons of sludge. The location was marked with a sign, however the sign was removed several years ago. The exact location of the sludge pits is uncertain due to differences in the information provided by interviewees. The approximate location of the pits is shown in Figures 4.5 and 4.7.

When the aircraft fuel tanks were removed from the base in the early 1960's tank residues were disposed of at Liquid Fuel Sludge Disposal Area No. 2. The sludges were spread on the ground at the location of Fire Protection Training Area No. 3.

FIGURE 4.7

BROOKS AFB

LIQUID FUEL SLUDGE DISPOSAL AREAS



SOURCE: INSTALLATION DOCUMENTS

Incinerators

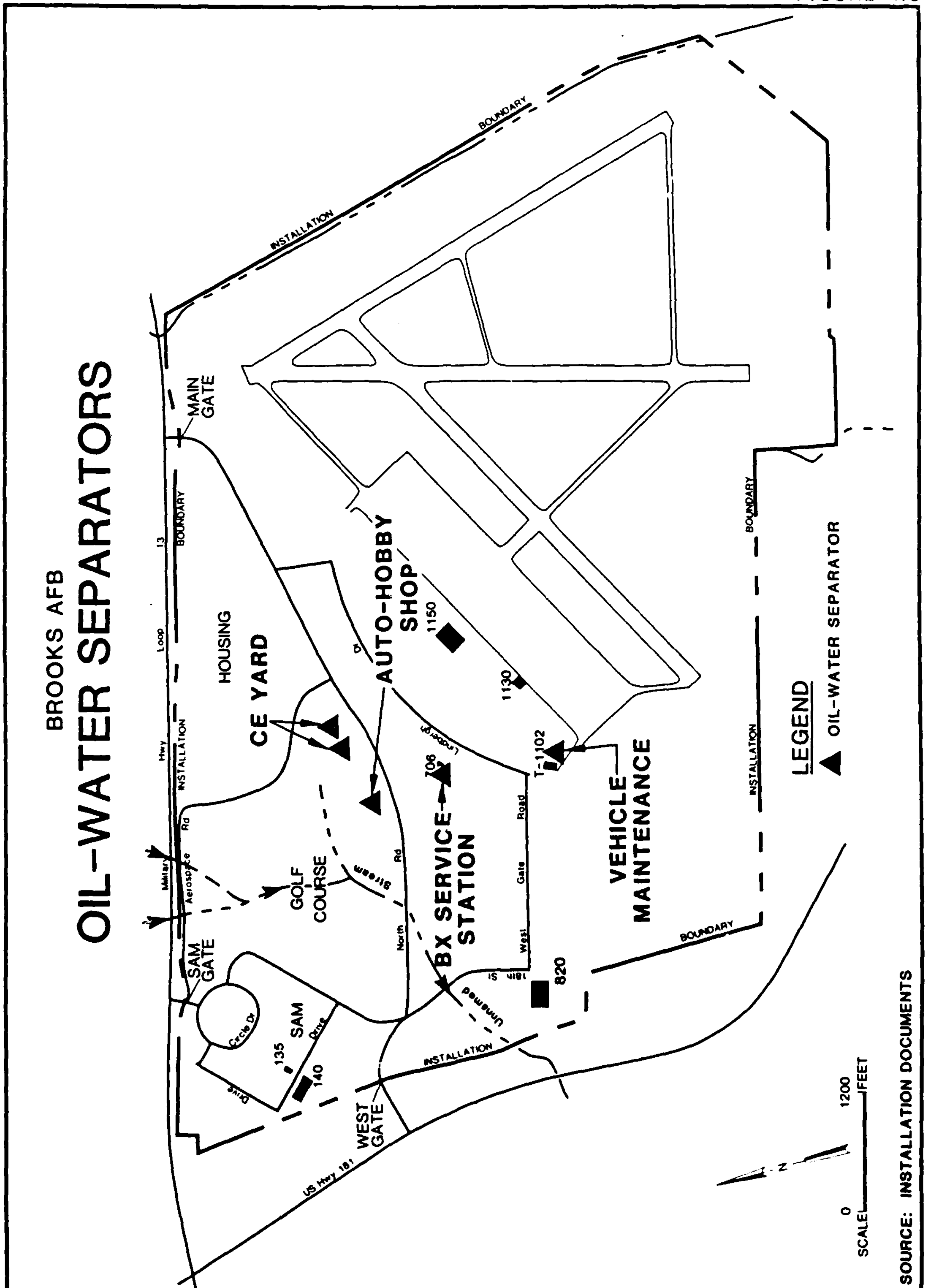
There are four incinerators at Brooks AFB. The incinerator that serves the Epidemiology Department (Building 930) is used for disposal of biological samples. The incinerator is 4 ft long x 4 ft wide x 6 ft high. It is equipped with a wet scrubber for air pollution control. The incinerator in the 1000 Area is used for disposal of animal carasses. The incinerator is a dual chamber auxilliary gas unit 5 ft long x 5 ft wide x 6 ft high. The incinerator between Buildings 617 and 618 is used by the Communications Group to destroy classified documents (paper only). The incinerator is currently used as a back-up to a paper shredder. The fourth incinerator is at Building 613. This incinerator is used by the Electronic Security Squadron for disposal of classified film and papers. The incinerator was not in service at the time of the site visit for the IRP. The classified material will be taken to Kelly AFB for disposal until replacement parts are available. The incinerators are checked for visual opacity by the San Antonio Metropolitan Health District. All four incinerators meet state standards, however, the Health Department has requested that the unit between Buildings 617 and 618 not be used.

Surface Drainage System

As discussed previously in Section 3, the surface drainage system at Brooks AFB consists of storm sewers and open ditches/channels. The surface drainage system has been used to dispose of wastes from several operations. Oil-water separators were installed in approximately 1976 at the following locations (Figure 4.8) to minimize the discharge of petroleum products: Auto-hobby shop (Building 698), BX service station (Building 706), CE yards (Facility 611 and 632), and vehicle maintenance (Building 1100). Fuel and/or oil separated in these units is pumped by an off base contractor. During this timeframe, the heating and cooling plant was repiped to discharge boiler blowdown to the sanitary sewer and cooling water continued to the "Duck Pond".

Aerial photos show the surface drainage systems in and around the flightline received periodic oil discharges from aircraft operations in the 1940-1960 period. There is no evidence of present contamination in the ditches.

FIGURE 4.8


BROOKS AFB
OIL-WATER SEPARATORS
MAIN GATE
SAM GATE
WEST GATE
INSTALLATION BOUNDARY
Loop 13
Hwy
Military
Aerospace Rd
HOUSING
CE YARD
AUTO-HOBBY SHOP
1150
1130
T-1102
706
820
135
140
GOLF COURSE
Stream
North Rd
BX SERVICE STATION
VEHICLE MAINTENANCE
West Gate Road
18th St
Unnamed
Lindbergh Dr
SAM
Circle Dr
Drive
US Hwy 181
N
LEGEND
OIL-WATER SEPARATOR
SCALE 0 1200 FEET
SOURCE: INSTALLATION DOCUMENTS

EVALUATION OF PAST DISPOSAL ACTIVITIES AND FACILITIES

Review of past generation and management practices at Brooks AFB has resulted in identification of 17 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.

Eight of the 17 sites assessed did not warrant further evaluation. The rationale for omitting these sites from HARM evaluation is discussed below.

Fire Protection Training Area No. 1 was used for only a relatively short time period from 1943 to 1945. The quantity of residual hazardous materials at the site at the time when use was discontinued was small. Between the period from 1945 to the present, land use in the area has changed significantly. The area is currently used for base housing. During the construction of the housing the area was excavated and filled with soil, therefore the potential for hazards resulting from contamination is small.

Fire Protection Training Area No. 4 was used for only two fires on the ground (1972). These fires were ignited in a shallow trench. The fires were allowed to burn until medical evacuation exercises were completed. The quantity of residual materials in the soil resulting from these two fires is extremely small, therefore the site is judged to have a minimal potential for hazards resulting from contamination.

The radiological burial site adjacent to Landfill No. 6 was used for a one time burial of low level radioactive wastes (1974). The radioactive material has decayed to levels less than one picocurie, therefore there is not a potential hazard to health, welfare or the environment.

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

Site	Potential Hazard to Health, Welfare or Environment	Need for Further IRP Evaluation/ Action	HARM Rating
Landfill No. 1	Yes	Yes	Yes
Landfill No. 2	Yes	Yes	Yes
Landfill No. 3	Yes	Yes	Yes
Landfill No. 4	Yes	Yes	Yes
Landfill No. 5	Yes	Yes	Yes
Landfill No. 6	Yes	Yes	Yes
Liquid Fuel Sludge Disposal Area No. 1	Yes	Yes	Yes
Fire Protection Training Area No. 2	Yes	Yes	Yes
Fire Protection Training Area No. 3/Liquid Fuel Sludge Disposal Area No. 2	Yes	Yes	Yes
PCB Transformer Oil Spill	Yes	No	No
Fire Protection Training Area No. 1	No	No	No
Fire Protection Training Area No. 4	No	No	No
Low-Level Radiological Disposal Site	No	No	No
Pesticide Handling	No	No	No
Acid Tank Leak	No	No	No
MOGAS Tank Spill	No	No	No
BX Service Station Gasoline Leak	No	No	No

Source: Engineering-Science

Pesticides have been used at Brooks AFB for several years; however, the quantities that have been used are relatively small, no major spills have been reported and present operations do not indicate potential hazards due to contamination.

The acid tank leak (early 1970's) resulted in a discharge of acid to the environment. At the time of the leak the acid was diluted and neutralized with caustic materials, thereby eliminating potential hazards to health, welfare or the environment.

The PCB transformer dielectric oil spill (1984) resulted in contamination of the soil beneath Building No. 100. At the time of the site visit the base was in the process of establishing the extent of the contamination and procedures to be used for cleaning up the site. Since the base is currently in the process of preparing to remove contaminated soils, this site was eliminated from further consideration.

The spill of 500 to 1,000 gallons of MOGAS from the storage tank in the 1960's is not considered to have a potential for hazard resulting from contamination. The fuel leaked to a drainage ditch and was hosed by the base fire department. Sampling of the drainage ditch for compliance monitoring indicates that there is no continued contamination of the surface water or migration of contaminants off-base as a result of this fuel spill.

The BX Service Station fuel leak (1984) is not considered to have a potential for hazard resulting from contamination; since the quantity of fuel that was released was relatively small, a portion of the fuel was recovered by pumping, and contaminated soils were drummed and removed from the base.

Sites Evaluated Using HARM

The remaining nine 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 procedures used in the HARM system are outlined in Appendix G and the specific rating forms for the nine sites at Brooks 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 BROOKS AFB

Rank	Site	Receptor Subscore	Waste Charac-teristics Subscore	Pathways Subscore	Waste Management Factor	HARM Score
1	Liquid Fuel Sludge Disposal Area No. 1	51	75	70	1.0	65
2	Landfill No. 5	44	64	70	1.0	59
3	Landfill No. 6	44	64	63	1.0	57
4	FPTA No. 2	44	48	69	1.0	54
5	Landfill No. 3	51	32	76	1.0	53
6	Landfill No. 4	51	32	76	1.0	53
7	Landfill No. 1	44	32	76	1.0	51
8	Landfill No. 2	47	32	69	1.0	49
9	FPTA No. 3 & Liquid Fuel Sludge Disposal Area No. 2	41	45	56	1.0	47

NOTE:

$$\text{HARM Score} = [(\text{Receptor} + \text{Waste Characteristics} + \text{Pathways}) \times \frac{1}{3}] \times \text{Waste Management Factor}$$

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 Brooks AFB and a summary of the HARM scores for those sites. Eight of the nine sites discussed below are concluded to have potential for environmental contamination, primarily due to possible contaminant migration to surface waters and/or the shallow ground water aquifer.

LIQUID FUEL SLUDGE DISPOSAL AREA NO. 1

Liquid Fuel Sludge Disposal Area No. 1 has sufficient potential to create environmental contamination and follow-on investigation is warranted. Over a 10-year period, sludges from cleaning AVGAS tanks were buried in shallow pits. The area in which the sludges were disposed is adjacent to the base housing area. The waste characteristics and pathways subscores primarily contributed to the HARM score of 65.

LANDFILL NO.5

Landfill No. 5 has sufficient potential to create environmental contamination and follow-on investigation is warranted. This landfill received hardfill, garbage and rubbish, paints, thinners, unrinsed pesticide containers, and contaminated fuels. The quantity of hazardous

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

Rank	Site	Operation Period	HARM Score(1)
1	Liquid Fuel Sludge Disposal Area No. 1	1950 - 1960	65
2	Landfill No. 5	1962 - 1970	59
3	Landfill No. 6	1971 - Present	57
4	FPTA No. 2	1945 - 1960	54
5	Landfill No. 3	Late 1940's-1953	53
6	Landfill No. 4	1953 - 1962	53
7	Landfill No. 1	1930's - 1942	51
8	Landfill No. 2	1943-late 1940's	49
9	FPTA No. 3 & Liquid Fuel Sludge Disposal Area No. 2	1962 - 1963	47

(1) This ranking was performed according to the Hazard Assessment Rating Methodology (HARM) described in Appendix G. Individual rating forms are in Appendix H. Table 4.4 shows the HARM scores.

wastes disposed at the site is judged to be moderate. The relatively high pathways score is primarily responsible for the overall HARM score of 59.

LANDFILL NO. 6

Landfill No. 6 has sufficient potential to create environmental contamination and follow-on investigation is warranted. This landfill has received primarily sanitary wastes, hardfill and some hazardous wastes, including contaminated fuel from the BX service station and oil that leaked from drums that were stored in the area. The quantity of hazardous wastes disposed at the landfill is considered to be moderate. The overall HARM score for the site is 57 due primarily to the waste characteristics and pathways subscores.

FIRE PROTECTION TRAINING AREA NO. 2

FPTA No. 2 has sufficient potential for environmental contamination and follow-on investigation is warranted. This fire protection training area was used for a relatively long period for weekly training exercises. Exercises were conducted over a relatively large area. The quantity of combustibles used per fire was relatively small and the remaining residual waste materials is considered to be small. However, the site has been used for garden plots and irrigation has taken place. The irrigation may have promoted migration of any remaining residual materials to the shallow ground water aquifer. The overall HARM score for this site is 54.

LANDFILL NOS. 1, 2, 3 AND 4

Landfills Nos. 1 through 4 have sufficient potential for environmental contamination and follow-on investigation is warranted. The landfills are located in an area that is currently used as the base golf course. These landfills served the installation during the period from the 1930's until the early 1960's. The wastes received were primarily rubbish and garbage from the shop areas. Most of the combustible wastes from the shop area and flightline were used in fire protection training exercises or were discharged to the storm sewer system; however, some shop wastes (oils, solvents, thinners, etc.) are suspected to have been disposed at these landfill sites. The golf course, which is situated over these landfills, has been irrigated for a number of years after the landfills were closed. Irrigation can enhance potential migration of contaminants from the landfills to the shallow aquifer. The overall HARM scores for these landfills range from 49 to 53.

FIRE PROTECTION TRAINING AREA NO. 3 & LIQUID FUEL SLUDGE DISPOSAL AREA NO. 2

This area which was used for fire protection training (No. 3) and disposal of liquid fuel sludges (No. 2) is judged to have minimal potential for environmental contamination. The area was used for monthly fires for approximately one year only (1962-1963). Cleaner fuels such as MOGAS and diesel were primarily burned. Due to the low frequency of fires and short period of operation, the residuals remaining after burning at the site will be very small. Disposal of a small quantity of fuel sludge occurred in this area on one occasion (early 1960's) when sludge from the AVGAS storage tanks was spread on the ground. The remaining residual material from this one-time-only weathering of fuel sludge is minimal. The overall HARM score for this site is 47.

SECTION 6

RECOMMENDATIONS

Nine sites were identified at Brooks 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 and/or extent of additional Phase II IRP investigations. Eight of the nine sites have sufficient potential to create environmental contamination and warrant Phase II investigations. The remaining site has minimal potential to create environmental contamination. 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 the eight waste disposal areas of concern at Brooks 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 may need to 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.

Liquid Fuel Sludge Disposal Area No. 1

It is recommended that geophysical studies (magnetometer and electrical resistivity) be conducted to establish more precisely the location of the liquid fuel sludge pits. A magnetometer survey should be conducted to locate the disposal pits. This should be followed by electrical resistivity studies of areas identified using magnetometry to determine the potential extent of contaminant migration, if any. After the location of the pits are identified it is recommended that a minimum of 6 soil borings (including one control) with three soil samples per

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

Site (Rating Score)	Recommended Monitoring Program
Liquid Fuel Sludge Disposal Area No. 1 (65)	Conduct magnetometer and electrical resistivity studies to identify boundaries of the site and potential contaminant pathways. Collect soil samples at depths of 5, 10 and 15-feet from a control boring and from a minimum of 5 soil borings in the area identified using geophysical testing methods. The samples should be analyzed for the parameters listed in Table 6.2. If contamination is found, the sampling program may need to be expanded to identify the extent of contamination.
Landfill No. 5 (59)	Conduct magnetometer and electrical resistivity surveys to define landfill limits and to locate possible contaminant pathways. Conduct a site hydrogeological study and then locate and install one upgradient and a minimum of two downgradient monitoring wells. Collect ground-water samples from the wells and analyze for the parameters listed in Table 6.2. If contamination is indicated in these samples, the sampling program may need to be expanded to identify the extent and type of contamination.

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

Site (Rating Score)	Recommended Monitoring Program
Landfill No. 6 (57)	Conduct magnetometer and electrical resistivity surveys to assist in locating monitoring wells and to evaluate potential contaminants in the perched seasonal aquifer. Conduct a hydrogeological survey at the site to locate and install one upgradient and a minimum of three downgradient wells. Analyze ground-water samples from these wells for the parameters listed in Table 6.2. The sampling program may need to be expanded to identify the extent and type of contamination if positive results are obtained in the initial sampling.
FPTA No. 2 (54)	Conduct an electrical resistivity survey to define the site limits and any potentially contaminated subsurface zones. Perform infiltration tests to assess the impact of garden watering at the site. Advance at least five borings within the facility limits and one control boring outside the site boundaries. Collect soil samples at the surface and at depths of 5, 10 and 15 feet below grade. Analyze the soil samples for the parameters listed in Table 6.2. Expand the sampling program as required if contamination is confirmed. If contamination is detected below 5 feet, install a site specific ground-water quality monitoring system, obtain water samples and analyze in accordance with the expanded analyses program.

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

Site (Rating Score)	Recommended Monitoring Program
Landfills 1,2,3 and 4 (51,49,53,53)	Conduct a geophysical survey utilizing both magnetometer and electrical resistivity equipment to define the landfill limits and to locate possible contaminant pathways (granular strata, perched water table, etc.). Conduct a hydrogeological study for each site to assist in locating monitoring wells. Perform infiltration tests to assess the impact of irrigation on these sites. Install a ground-water quality monitoring system at each site consisting of a maximum of one well located hydraulically upgradient of the landfill and two wells installed hydraulically downgradient. Wells should be constructed to take maximum advantage of site-specific hydrogeologic conditions. Collect groundwater samples from the wells and analyze for the parameters listed in Table 6.2. The sampling program may need to be expanded to identify the extent and type of contamination if contaminants are detected.

Source: Engineering-Science

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

Liquid Fuel Disposal Area No. 1 and FPTA No. 2

Oil and Grease
Lead
Volatile Hydrocarbons

Landfill Nos. 1,2,3,4,5 and 6

Oil and Grease
Phenols
Lead
Total Organic Carbon
Total Organic Halogens

---

* Note: If contamination is indicated in the first part of Phase II using these parameters at a specific site, sampling and analyses will need to be expanded to fully characterize the specific constituents.

Source: Engineering-Science

boring be taken at depths of 5, 10 and 15 feet. These samples should be analyzed for the parameters listed in Table 6.2. If contamination is found additional soil borings may be required to determine the extent of the contamination.

Landfill No. 5

A ground-water monitoring program should be established at Landfill No. 5 to identify the potential existence of contamination and to evaluate the migration of any contaminants in the shallow seasonal aquifer. Geophysical studies are first recommended to determine the site limits and potential ground-water characteristics (contamination, flow, etc.). This would be followed by a site hydrogeological study to locate a minimum of one upgradient and not less than two downgradient monitoring wells at the site. USEPA (1980) recommends a minimum of one downgradient monitoring well per 250 feet of landfill frontage. The site hydrogeologic study may indicate a need for observation wells prior to monitoring wells to establish ground water flow direction. After monitoring well installation, ground-water samples would be collected and analyzed for the parameters listed in Table 6.2. These parameters are intended as a screening approach to determine whether or not contamination exists at the site and whether migration of contaminants is occurring. More extensive analyses may be required if positive results are obtained in the initial sampling.

Landfill No. 6

A ground-water monitoring program for Landfill No. 6 is recommended to evaluate the seasonal shallow aquifer for the potential presence and migration of contaminants. A minimum of one upgradient and three downgradient wells are recommended. An additional downgradient well, compared with Landfill No. 5, is recommended due to the size of the site and the landfill frontage (as discussed above). Geophysical surveys followed by a site-specific hydrogeological study should be utilized to aid in locating the monitoring wells. Groundwater samples should be analyzed for the parameters listed in Table 6.2. If positive results are obtained in the first set of samples, additional sampling and analysis may be required to more fully characterize the nature of the contamination at the site.

Fire Protection Training Area No. 2

The initial Phase II step recommended at FPTA No. 2 is to conduct an electrical resistivity survey of the area to determine where burning took place in previous years and to identify the extent of any contamination. This area has been used for gardening by base personnel and irrigation has been regularly practiced. After the FPTA has been defined, it is recommended that at least two infiltration tests be conducted to assess the impact of garden watering. Excessive watering may cause migration of contaminants. The infiltration tests should be performed using a double-ring infiltrometer in conformance with ASTM D-3385: "Standard test method for infiltration rate of soils in the field using double ring infiltrometers" (1982 Annual Book of ASTM Standards, Part 19).

Following infiltration tests, it is recommended six borings be obtained, five in the site and one outside the area for control purposes. Soil samples should be collected at the surface and at depths of 5, 10 and 15 feet and analyzed for the parameters in Table 6.2. If these samples show contamination, additional analyses will probably be required. Also, if contamination deeper than five feet below the ground surface is indicated, it is recommended that ground water monitoring wells be installed and water samples collected and analyzed more extensively.

Landfill Nos. 1,2,3 and 4

The base golf course is located over Landfills Nos. 1,2,3 and 4. Irrigation of the course has been practiced on a regular basis for a number of years. Excessive irrigation may cause migration of waste-related constituents. At least two infiltration tests should be performed at each landfill site to quantitatively assess the impact of irrigation. The infiltration tests should be conducted as previously described for FPTA No. 2.

The infiltration tests recommended above would be conducted after the sites limits are defined. Geophysical surveys (magnetometer and electrical resisitivity) are recommended to delineate the extent of filling for these four sites. The geophysical data will also assist in determining the potential extent of contaminant migration, if any.

A site-specific hydogeological study is recommended for Landfill Nos. 1,2,3 and 4 to enable location of monitoring wells. Since these sites are clustered together it may be possible to use only two or three wells (instead of four) to establish upgradient conditions for the four landfills. Similarly, data from the geophysical/hydrogeological studies may enable locating downgradient wells so that less than two per site are required. Ground water from the monitoring wells would be sampled and analyzed for the parameters in Table 6.2. If contamination is found, the Phase II program may need to be expanded to determine the extent and type of contamination from each site.

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.

The recommended guidelines for land use restrictions at each identified disposal site at Brooks AFB are presented in Table 6.3. A description of the land use restriction guidelines is included 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. Results of the Phase II investigation will provide more information to determine the need and/or desirability for restricting activities such as irrigation and construction on the sites.

TABLE 6.3
RECOMMENDED GUIDELINES FOR FUTURE LAND USE RESTRICTIONS[1]
BROOKS AFB

Site Name	Construction	Excavation	Wells	Agriculture	Silviculture	Water Infiltration	Recreation	Burning	Disposal Operations	Vehicular Traffic	Material Storage	Housing
Liquid Fuel Sludge Disposal Area No. 1	R[6]	R	R	NR	R	R	NR	NR	R[2]	NR	NR[3]	NR
Landfill No. 5	R[6]	R	R	NR	R	R	NR	NR	R[2]	NR	NR[3]	R
Landfill No. 6	R[6]	R	R	NR	R	R	NR	NR	R[2]	NR	NR[3]	R
FPTA No. 2	NR	NR	R	NR	NR	(4)	NR	NR	R[2]	NR	NR[3]	NR
Landfill Nos. 1, 2, 3, & 4	R[6]	R	R	NR	R	(4)	NR	NR	R[2]	NR	NR[3]	(5)
FPTA No. 3 & Liquid Fuel Sludge Disposal Area No. 2	NR	NR	R	NR	NR	R	NR	NR	R[2]	NR	NR[3]	NR
FPTA Nos. 1 & 4	NR	NR	R	NR	NR	R	NR	NR	R[2]	NR	NR[3]	NR
Low-Level Radiological Disposal Site	NR	R	R	NR	R	R	NR	NR	R[2]	NR	NR[3]	NR

(1) See Table 6.4 for description of guidelines.

Note the following symbols in this table:

R = Restrict the use of the site for this purpose.

NR = No restriction of the site for this purpose.

NA = Not applicable.

(2) Restrict for all wastes except for construction/demolition debris.

(3) No restriction on solid materials but liquids undesirable.

(4) Irrigation will likely need to be restricted, particularly if the Phase II studies reveal contaminant migration from the sites.

(5) Housing on the sites is not desirable but near the areas is acceptable; adjust this pending Phase II study results.

(6) Generally, construction on these sites should be restricted; soil borings and the proposed Phase II studies will provide more data to establish the need for restriction.

TABLE 6.4
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 (forestry) use	Restrict the use of the site for silvicultural (forestry) 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.

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APPENDIX A

BIOGRAPHICAL DATA

Biographical Data

ROBERT L. THOEM
Civil/Environmental Engineer

PII Redacted [redacted]

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).

Robert L. Thoem (Continued)

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

Over 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

PII Redacted

[redacted]

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 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

John R. Absalon (Continued)

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 other industrial 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

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

BIOGRAPHICAL DATA

Rocco M. Palazzolo
Environmental Engineer

PII Redacted

[redacted]

Education

B.S. in Civil Engineering, Wayne State University, 1981
M.S. in Environmental Engineering, Georgia Institute of Technology, 1983.

Professional Affiliations

Water Pollution Control Federation

Honorary Affiliation

Tau Beta Pi

Experience Record

1974-1976 R. D. Palazzolo Associates, Consulting Engineers, P.C., Detroit, Michigan. Engineering Assistant responsible for vendor follow-up during expansion of an transmission manufacturing plant. Acted as liaison between automobile manufacturer and vendors of machine tools, fixtures, gages, etc. Duties included preparation of weekly progress reports, maintenance of records, informing vendors of design changes, etc.

1978-1981 R. D. Palazzolo Associates, Consulting Engineers, P.C., Detroit, Michigan. Checked designs of machine tools, fixtures, gages, and materials handling equipment. Also served as Manufacturers' Representative for tool and die shops.

1981-1983 Georgia Institute of Technology, Atlanta, GA. Graduate Research Assistant in projects including development of a means to improve hydraulic behavior of fluidized bed reactors, review and experimental testing of hydraulic models of fluidization and sedimentation, and a study of absorption enhanced anaerobic treatment of coal gassification wastewater. Responsible for design and construction of experimental apparatus, system operation and maintenance, experimental measurements and analyses, review of

Rocco M. Palazzolo

data and preparation of reports. Also taught undergraduate classes in water distribution and sewer system collection design.

1983-Date Engineering-Science, Inc., Atlanta, GA. Project Engineer responsible for preparation of a RCRA Part B Permit Application. Work included review of hazardous waste management practices and facilities at the plant for compliance with federal and state regulations. Hazardous waste management processes included container and tank storage, disposal in an on-site secure landfill, and treatment by incineration.

Project Engineer responsible for investigation of environmental impact of a closed garbage and rubbish landfill on a proposed apartment development, including investigation of pollution of ground water and surface water in a nearby stream. Work included development of the history of the landfill, field sampling and measurements, review of data, and presentation of recommendations.

Publications

Khudenko, B.M. and Palazzolo, R.M. "Hydrodynamics of Fluidized Bed Reactors for Wastewater Treatment". Proceedings: First International Conference on Fixed Film Biological Processes, April 20-23, 1982, Kings Island, Ohio, Vol. 3, pp. 1288-1334.

Palazzolo, R.M. and Khudenko, B.M. "Development of A New Type of Fluidized Bed Reactor". International Conference on Scale-up of Water and Wastewater Treatment Processes, March 17 and 18, 1983, Edmonton, Alberta, Canada.

APPENDIX B

LIST OF INTERVIEWEES AND

OUTSIDE AGENCY CONTRACTS

TABLE B.1

LIST OF INTERVIEWEES

	Most Recent Position	Years of Service at Brooks AFB
1.	Chief, Water Analysis Section, OEHL	7
2.	NCOIC, Dental Lab, Clinic Brooks	6
3.	NCOIC, Radiology, Clinic Brooks	1
4.	Painter, SARPMA	6
5.	Foreman, Climatic Control, SARPMA	30
6.	Asst. NCOIC, Clinical Lab, Clinic Brooks	2
7.	Manager BX Service Station	3
8.	Chief, Research Respiratory Physiology, SAM	22
9.	Chief, Fabrication Branch, SAM	27
10.	Chief, Ecology Function, OEHL	6
11.	Chief, Bioeffects Function, SAM	13
12.	Mechanic, Power Support Systems, SARPMA	6
13.	High Voltage Electrician, External Electric, SARPMA	2
14.	Automotive Employee, Auto-Hobby Shop, 6570 ABG	2
15.	Chemist, Radiological Services Branch, OEHL	7
16.	Chief, Trace Organics Section, OEHL	7
17.	Chief, Occupational Chemistry, OEHL	7
18.	Asst. NCOIC, Aerospace Physiology Maintenance, SAM	3
19.	NCOIC, Chamber Operations, SAM	4
20.	NCOIC, Hyperbaric Medicine Operations, SAM	1
21.	Foreman, Heating and Cooling Plant, 6570 ABG	23
22.	Utility System Repair-Operator, Heating and Cooling Plant, 6570 ABG	10
23.	Chief, Radioassay, Epidemiology, SAM	2
24.	Energy Conservation Engineer, 6570 ABG	18
25.	Radiation Protection Officer, SAM	25
26.	Task Manager for Chemical Defense, SAM	4
27.	Facility Manager, SAM	23
28.	Chief, Facility Management Function, SAM	9
29.	NCOIC, Animal Resources Branch, SAM	6
30.	Chief, Facilities Engineering Office, SAM	23
31.	Research Chemist, Crew Technology, SAM	25
32.	Supervising Research Chemist, Clinical Pathology, SAM	26

TABLE B.1
LIST OF INTERVIEWEES
(Continued)

	Most Recent Position	Years of Service at Brooks AFB
33.	Asst. NCOIC, Internal Medicine Branch, SAM	2
34.	NCOIC, Research, Clinical Pathology, SAM	3
35.	Safety Administrator, SAM	26
36.	Chief, Audio Visual Services Branch	13
37.	Chief, Optical Research Lab, SAM	26
38.	Chief, Aerospace Vision Lab, SAM	16
39.	NCOIC, Opthalmology Branch, SAM	2
40.	NCOIC, Comparative Pathology, SAM	6
41.	Bioenvironmental Engineer, Clinic Brooks	2
42.	Electron Microscopist, SAM	26
43.	Chief, Research Support Section, SAM	3
44.	Environmental Planner, 6570 ABG	3
45.	Chief of Supply, 6570 ABG	12
46.	Supply Warehouse Foreman, 6570 ABG	26
47.	Supply Warehouse Checker, 6570 ABG	20
48.	Material Processor, 6570, ABG	28
49.	Base Service Station Operator, 6570 ABG	11
50.	Deputy Civil Engineer (Retired)	31
51.	Sanitation Superintendent (Retired)	31
52.	NCOIC Vehicle Maintenance, 6570 ABG	3
53.	Water, Waste & Pest Control Foreman, SARPMA	10
54.	Construction Inspector (Retired)	25
55.	Water, Waste & Pest Control Worker, SARPMA	28
56.	Grounds Foreman, SARPMA	5
57.	Pavements & Equipment Foreman, SARPMA	14
58.	Assistant Fire Chief, 6570 ABG	13
59.	Pavements & Grounds Superintendent, SARPMA	2
60.	Plumber, SARPMA	14
61.	Equipment Operator, SARPMA	26
62.	Real Property Officer, 6570 ABG	26
63.	Boiler Plant Foreman (Retired)	36
64.	Radiology Officer, Dental Investigations, SAM	1
65.	NCOIC Radiology Function, Flight Medicine, SAM	8
66.	Fire Chief, 6570 ABG	21

TABLE B.2
OUTSIDE AGENCY CONTACTS

Richard D. Reeves, Hydrologist
Robert W. Maclay, Hydrologist
Paul M. Buszka, Hydrologist
U.S. Geological Survey-Water Resources Division
North Plaza Suite 234
435 Isom Road
San Antonio, Texas 78213
512/344-9731

Robert W. Bader, Geologist
Edwards Underground Water District
1615 N. St. Mary's Street
San Antonio, Texas 78212
512/222-2204

Donald D. Higgins, Engineering Assistant
Texas Department of Health - Solid Waste Management Program
212 Stumberg Street
San Antonio, Texas 78204
512/225-4343

Henry Karnei, Jr., Field Representative
Texas Department of Water Resources-Water Quality Division
321 Center Street
San Antonio, Texas 78222
512/226-3297

Mr. J. Dwyer
Cartographic and Architectural Branch
National Archieves
841 S. Pickett Street
Alexandria, VA 22304
703/756-6700

Mr. E. Reese
Modern Military Branch
National Archieves
8th and Pennsylvania Avenue
Washington, D.C.
202/523-3340

Sgt. Jernigan
Office of Air Force History
Bolling AFB
Washington, D.C.
202/767-5090

TABLE B.2
OUTSIDE AGENCY CONTACTS
(Continued)

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

APPENDIX C

TENANT ORGANIZATIONS AND MISSIONS

APPENDIX C

TENANT ORGANIZATIONS AND MISSIONS

DETACHMENT 3, 1923 COMMUNICATIONS GROUP

Detachment 3, 1923rd Communications Group provides communications services and support to all units assigned to Brooks AFB. The organization operates and maintains the base telephone exchange and operates the base telecommunications center which provides access into the AUTODIN system.

SAN ANTONIO REAL PROPERTY MAINTENANCE AGENCY (SARPMA)

The San Antonio Real Property Maintenance Agency is responsible for the construction, repair and maintenance at the five military bases in the greater San Antonio area. The Field Engineering Branches of SARPMA are located at each of the bases. The branch at Brooks works with the Brooks Staff Civil Engineering Division.

DETACHMENT 1018, AIR FORCE OFFICE OF SPECIAL INVESTIGATION

This unit is responsible for investigating all major crimes that occur on Brooks AFB. The detachment also investigates fraud of Air Force resources and counter-intelligence matters pertaining to the Air Force.

DETACHMENT 26, 6592 MANAGEMENT ENGINEERING TEAM

The detachment provides manpower, organization and management engineering services to all organizations of the Aerospace Medical Division.

6906th ELECTRONIC SECURITY SQUADRON

This organization has a twofold Defensive Command, Control and Communications Countermeasures (DC3CM) related mission. It provides both selected COMSEC (radio and telephone monitoring) and TEMPEST (the study of unintentional compromising signal emanations). The unit provides these services to the Air Force and DOD organizations throughout the world.

OTHER BROOKS TENANT ORGANIZATIONS

U.S. Coast Guard Reserve Unit

8075th Electronic Security Squadron (USAF Reserve)

APPENDIX D

SUPPLEMENTAL BASE FINDINGS INFORMATION

TABLE D.1
PESTICIDES CURRENTLY USED
AT BROOKS AFB

Type	Use	Current Approximate Annual Quantity
Roundup	Herbicide	24 gal
CGK-79	Herbicide	48 gal
Balan	Herbicide	240 lb(1)
Methane Arsonate	Herbicide	-
Fore	Fungicide	-
Thiophate-methyl	Fungicide	-
1 pradione	Fungicide	-
Chloroneb	Fungicide	-
Diazinon	Insecticide	600 lb(1)
Pyrethrins	Insecticide	11.5 lb(1)
Malathion	Insecticide	10 gal
Amdro	Insecticide	250 lb(1)
Chlordane	Insecticide	1 gal
Methyl Carbonate	Insecticide	81 lb
Dursban	Insecticide	2 gal
Baygon	Insecticide	2 gal
Boric Acid	Insecticide	15 lb
Maxforce	Insecticide	0.3 oz
Bacillus Thuringiensis	Insecticide	100 lb
Killmaster II	Insecticide	11.3 lb
Resmethrin	Insecticide	2.2 lb
Chlorpyrifos	Insecticide	-
Methoprene	Insecticide	6 lb
Warfarin	Rodenticide	50 lb(1)
Rozol Blue	Rodenticide	18 lb

(1)These pesticide quantities reflect pounds of finished product applied. The pounds of active ingredient is a fraction of the total; e.g., the concentration of Amdro's active ingredient is 0.88%.

Source: Installation documents and base personnel.

TABLE D.2
TRANSFORMERS CONTAINING PCB OILS
BROOKS AFB

No.	Facility Location	Serial Number	Volume (Gal)
1	100	84787	235
2	110	PCV-8601-08	248
3	125	6536893	410
4	130	6541476	280
5	130	6541477	280
6	140	7021308	162
7	150	7014086	270
8	150	7018212	70
9	155	7014203	115
10	159	7014084	357
11	1020*	7027518	175
12	165	PVC-8602-01	117
13	165	6536894	428
14	165	7014081	357
15	167	G857081	80
16	170	RAV-1440-1	115
17	170	7014082	270
18	170	7014085	357
19	175	7014083	357
20	176	E695765	99
21	180	84786	313
22	185	7014204	270
23	186	E695406	74
24	930	39771	231
			5670

*In storage at hazardous material site, but the unit is operational and could be returned to service.

Source: Installation documents and base personnel.

TABLE D.3
CAPACITORS CONTAINING PCB OILS
BROOKS AFB

No.	Facility Location	Serial Number	Volume (Gal)
1	145	W34808	2
2	145	W40926	2
3	145	W40927	2
4	145	W41080	2
5	145	W41081	2
6	145	W41083	2
7	*	--	-
8	145	W41086	2
9	145	W41087	2
10	145	W41089	2
11	145	W41092	2
12	145	W41093	2
13	145	W41097	2
			24

*Disposed of off base in 1984 by contract.

Source: Installation documents and base personnel.

TABLE D.4
SUMMARY OF LIQUID FUEL AND WASTE TANKS
BROOKS AFB

Facility No.	No. of Tanks	Total Storage Capacity (gal)	Above or Below Ground	Material Stored
110	1	2,000	Below	Diesel
150	1	1,500	Below	Diesel
930	1	2,000	Below	Diesel
1189	1	260	Below	Diesel
165	2	42,000	Below	Fuel oil
1110	2	20,000	Above (1)	Mogas
1115	1	3,000	Above (1)	Diesel
606	1	2,000	Below	Mogas
612	1	2,000	Below	Diesel
706	1	300	Below	Waste oil
706	1	6,000	Below	Gas/Regular
706	1	6,000	Below	Gas/Unleaded
706	1	4,000	Below	Gas/Super Unleaded
Landfill	1	500	Above (2)	Diesel
617	1	40		Diesel
615	1	40		Diesel
698	1	550	Below	Waste oil
706	1	500	Below	Waste oil
1126	1	400-500	Above (3)	Solvent
930	1	400	Above (3)	Sulfuric Acid
165	1	1,200	Above (8)	Sulfuric Acid
578	1	400 (4)	Above (3)	Sulfuric Acid
1020	1	1,500-2,000 (4)	Above/Below (5)	Abandoned (Empty)
1030	1	1,500-2,000 (4)	Above/Below (5)	Abandoned (Empty)
135	1	375	Below (5)	Acids (Empty)
135	1	375	Below (5)	Bases (Empty)
135	1	375	Below	Flammable Chemicals (Empty)
175E	2	8,000	Below (6)	Wastewater
175W	1	2,500	Below (6)	Not used
160	1	12,000-15,000 (4)	Above (3)(7)	Methylene Chloride

(1) Diked
(2) Portable tank
(3) Undiked
(4) Estimated
(5) Spill collection tanks
(6) Building basement
(7) Semienclosed area
(8) Diked, but tamped earth floor covered with limestone rock.
Source: Installation documents.

APPENDIX E

MASTER LIST OF SHOPS

APPENDIX E
MASTER LIST OF SHOPS

Name	Present Location	Handles Hazardous Materials	Generates Hazardous Wastes	Typical Disposal Methods
SCHOOL OF AEROSPACE MEDICINE (SAM)				
Radiation Biology	175E	Yes	Yes	Sanitary Sewer/ Landfill/Off Base Contractor/ In Process
Vulnerability Assessment	175E	Yes	No	In Process
	186	Yes	Yes	Sanitary Sewer/ In Process
Radiation Physics	175E	Yes	Yes	Off Base Contractor
Animal Resources	185/1001-1019/ 125	Yes	Yes	Sanitary Sewer/ In Process/ Incineration/ Silver Recovery
Pathology	125	Yes	Yes	Sanitary Sewer/ In Process/ Landfill/Off Base Contractor
Crew Systems	170	Yes	Yes	Sanitary Sewer/ In Process
Aeromedical Systems	170	Yes	Yes	Sanitary Sewer Landfill/Off Base Contractor/ In Process
Crew Protection	170	No	No	-
Systems Engineering	160/170	Yes	Yes	DPDO

APPENDIX E
(Continued)
MASTER LIST OF SHOPS

Name	Present Location	Handles Hazardous Materials	Generates Hazardous Wastes	Typical Disposal Methods
Internal Medicine	110	Yes	Yes	Sanitary Sewer/ In Process/ Landfill/Off Base Contractor
Dental Investigation	125	Yes	Yes	In Process/ Silver Recovery
Opthamology	110/130	Yes	Yes	Sanitary Sewer/ In Process
Flight Medicine	110	Yes	Yes	In Process/ Silver Recovery/ Sanitary Sewer
Neuropsychiatry	110	No	No	-
Epidemiology	930	Yes	Yes	Sanitary Sewer/ Incinerator/ Landfill/Off Base Contractor
Hyperbaric Medicine	160	Yes	Yes	DPDO/Landfill/ Off Base Contractor
Education	160	Yes	Yes	DPDO
Medical Illustrations	130	Yes	No	In Process
Photography	130	Yes	Yes	Sanitary Sewer/ Silver Recovery
Precision Measurement Instrumentation Lab	167	Yes	No	In Process

APPENDIX E
(Continued)
MASTER LIST OF SHOPS

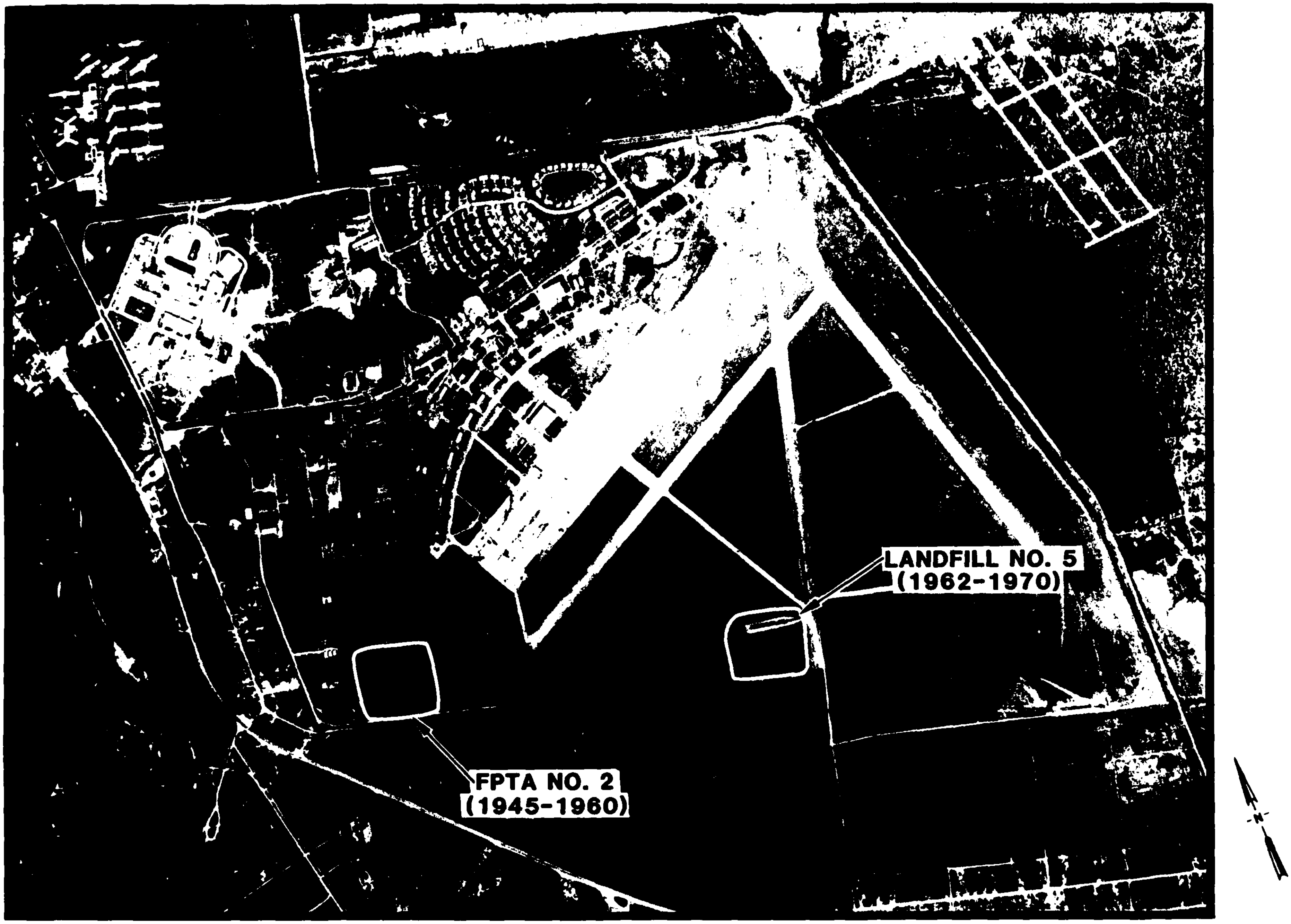
Name	Present Location	Handles Hazardous Materials	Generates Hazardous Wastes	Typical Disposal Methods
OCCUPATIONAL AND ENVIRONMENTAL HEALTH LABORATORY (OEHL)				
Radiation Services	140	Yes	Yes	Sanitary Sewer/ Off Base Contractor/In Process
Analytical Services	140	Yes	Yes	Sanitary Sewer/ Off Base Contractor/In Process
Consultant Services	175W/796	Yes	Yes	Landfill/Off Base Contractor
CLINIC BROOKS				
Dental Lab	615	Yes	Yes	In Process/ Sanitary Sewer/ Silver Recovery
Radiology	615	Yes	Yes	Sanitary Sewer/ Silver Recovery
Clinical Lab	615	Yes	Yes	Sanitary Sewer/ In Process/ Off Base Contractor
6570th AIR BASE GROUP				
Vehicle Maintenance	1102	Yes	Yes	DPDO/In Process/ Sanitary Sewer
Auto Hobby	698	Yes	Yes	DPDO/In Process
Packing & Crating	673	Yes	No	In Process

APPENDIX E
(Continued)
MASTER LIST OF SHOPS

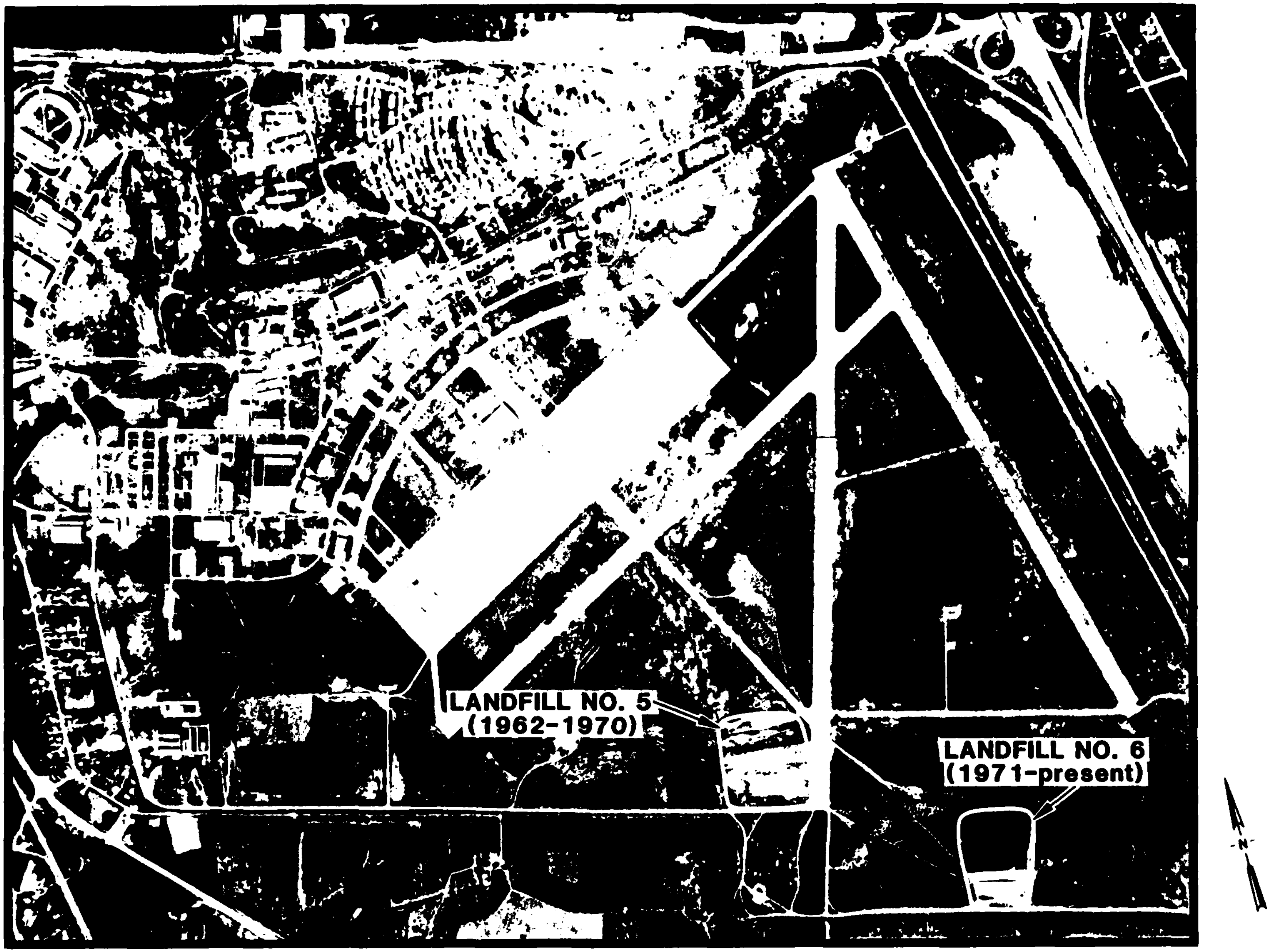
Name	Present Location	Handles Hazardous Materials	Generates Hazardous Wastes	Typical Disposal Methods
SAN ANTONIO REAL PROPERTY MANAGEMENT AGENCY (SARPMA)				
Climatic Control	633	Yes	Yes	Sanitary Sewer/ In Process/ DPDO
Carpentry/Paint	633	Yes	No	In Process
Pavements & Grounds	634	Yes	Yes	In Process/ DPDO
Sanitation/Pest Control	629	Yes	Yes	In Process/ Off Base Contractor
Sheetmetal/Plumbing	636	Yes	No	In Process
Smart Unit	-	Yes	No	In Process
Power Production	629	Yes	Yes	Sanitary Sewer/ DPDO
Exterior Electric	629	Yes	Yes	DPDO
Interior Electric	629	Yes	No	In Process
Heating & Cooling	165	Yes	Yes	DPDO/ In Process/ Sanitary Sewer
BASE EXCHANGE				
BX Service Station	706	Yes	Yes	Landfill/Off Base Contractor/DPDO

APPENDIX F

PHOTOGRAPHS

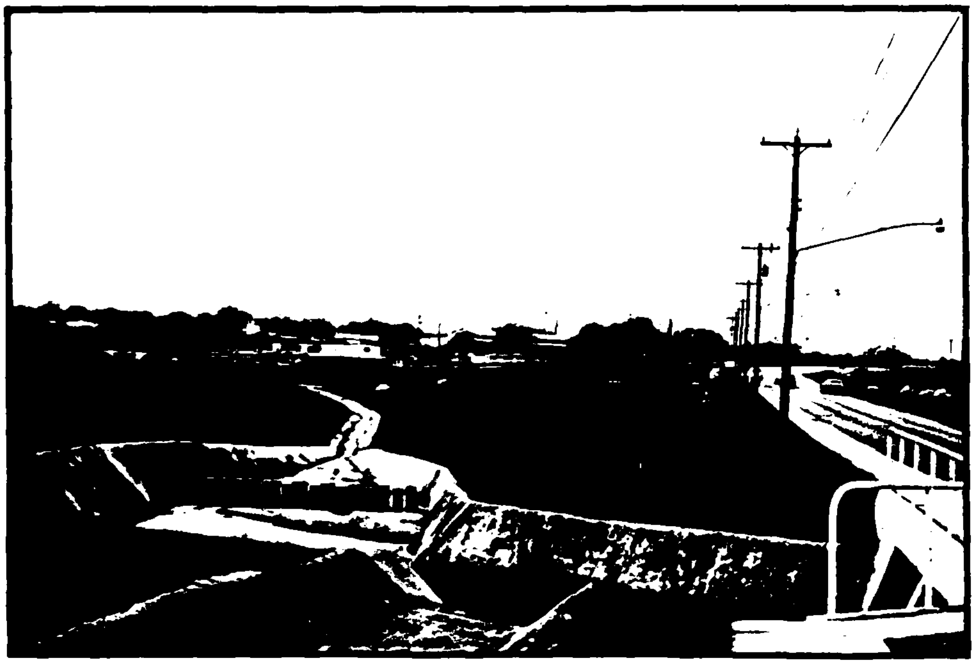


BROOKS AFB CIRCA 1962

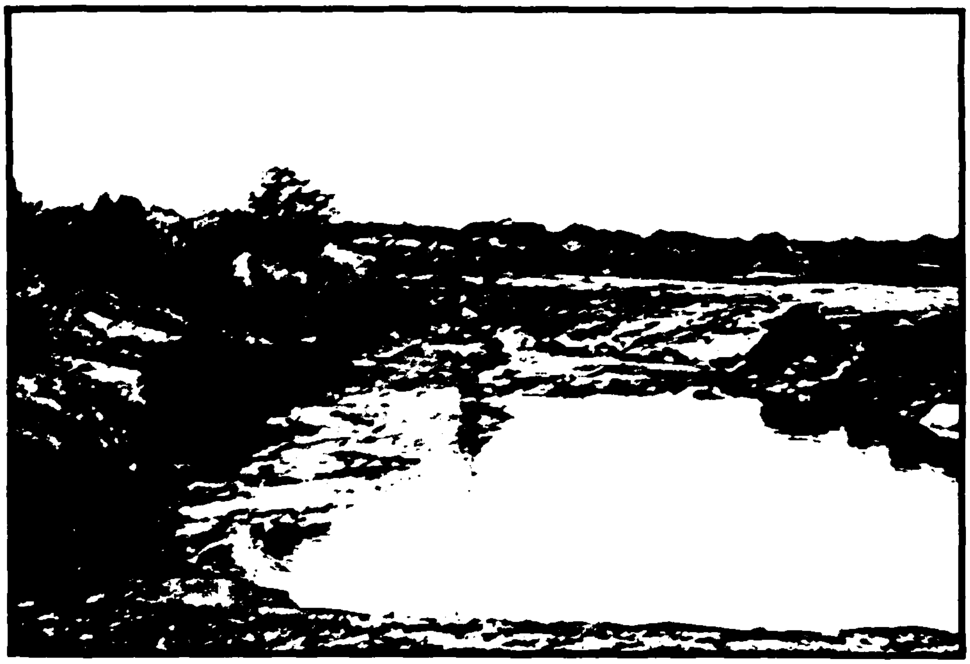


BROOKS AFB MARCH 1972

BROOKS AFB

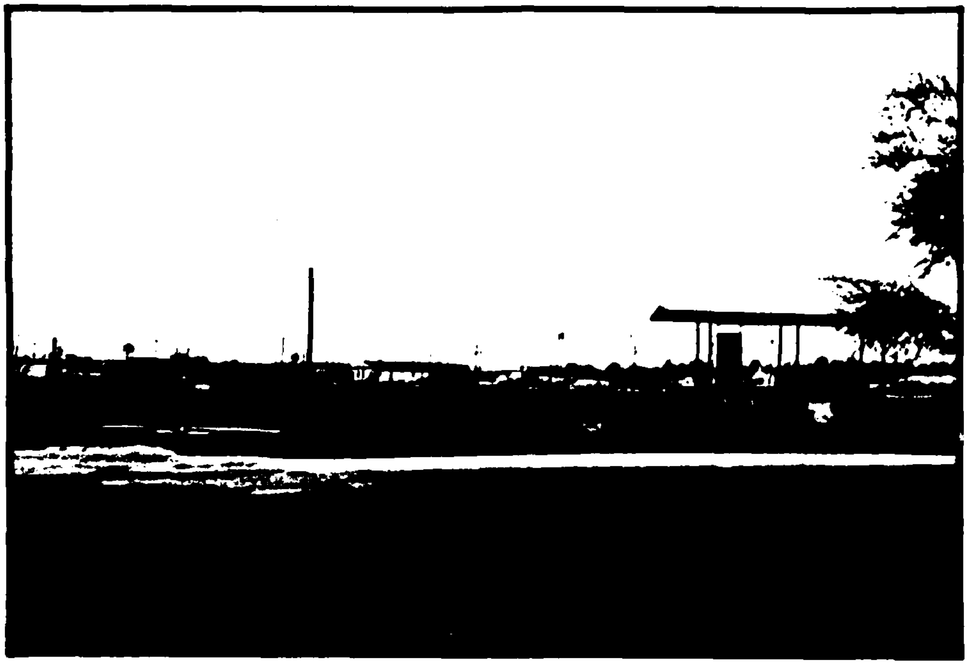


Landfill No. 1
(FACING WEST)

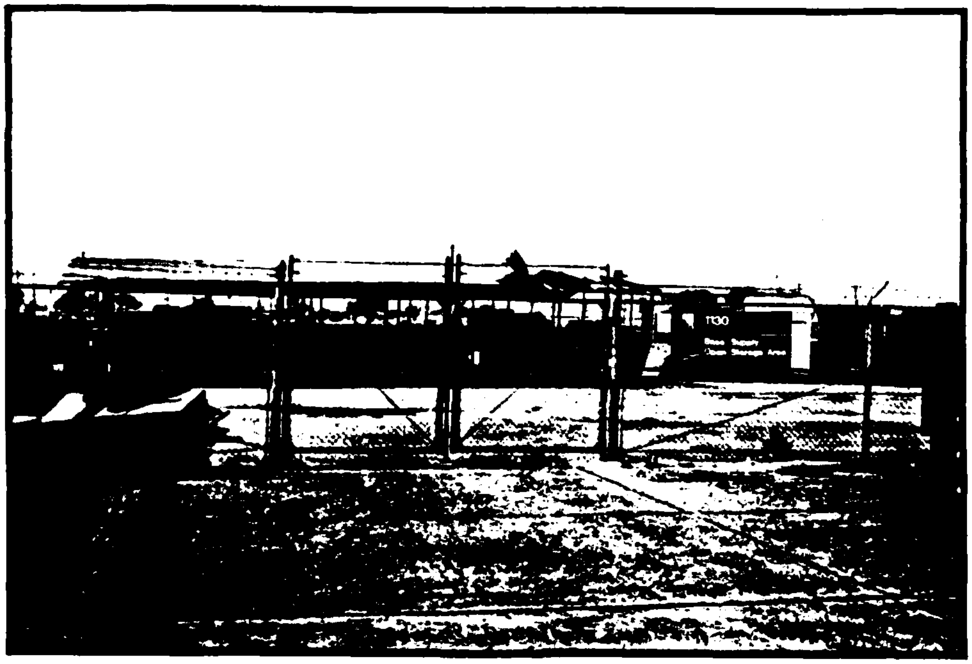


Landfill No. 6
(FACING WEST)

BROOKS AFB



Hazardous Waste – Storage Area
Facility 1020 and 1030
(FACING NORTH)



Base Supply Open Storage
Facility 1130
(FACING NORTH)

BROOKS AFB

FPTA No. 2
(FACING NORTH)

FPTA No. 2
(FACING SOUTH)

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.

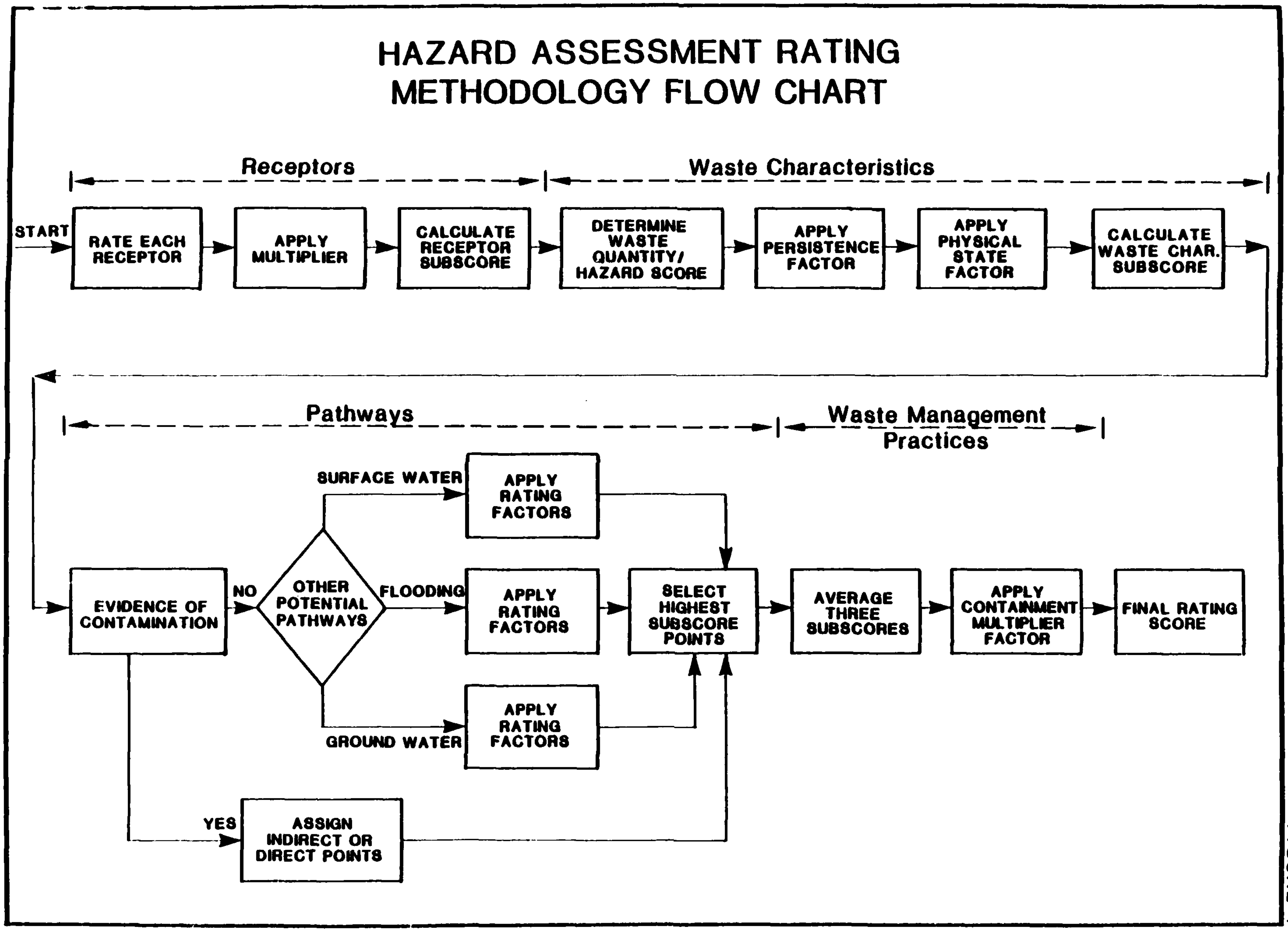

HAZARD ASSESSMENT RATING
METHODOLOGY FLOW CHART
Receptors
Waste Characteristics
START
RATE EACH RECEPTOR
APPLY MULTIPLIER
CALCULATE RECEPTOR SUBSCORE
DETERMINE WASTE QUANTITY/ HAZARD SCORE
APPLY PERSISTENCE FACTOR
APPLY PHYSICAL STATE FACTOR
CALCULATE WASTE CHAR. SUBSCORE
Pathways
Waste Management Practices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

FIGURE 1

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) ______

2. Flooding

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

Subscore (100 x factor score/3) ______

3. Ground-water migration

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

Subtotals ______ ______

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

C. Highest pathway subscore.

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

Pathways Subscore ______

IV. WASTE MANAGEMENT PRACTICES

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

Receptors ______
Waste Characteristics ______
Pathways ______

Total ______ divided by 3 = ______
Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

______ X ______ = ______

TABLE 1

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 wetlands; preserved *areas; presence of* economically important natural resources susceptible to contamination.	Major habitat of an endangered or threatened species; presence of *recharge area;* major wetlands.	10
F. Water quality/use designation of nearest surface water body	Agricultural or industrial use.	Recreation, propagation and management of fish and wildlife.	Shellfish propagation and harvesting.	Potable water supplies	6
G. Ground-Water use of uppermost aquifer	Not used, other sources readily available.	Commercial, industrial, or irrigation, very limited other water sources.	Drinking water, municipal water available.	Drinking water, no municipal water available; commercial, industrial, or irrigation, no other water source available.	9
H. Population served by surface water supplies within 3 miles downstream of site	0	1 - 50	51 - 1,000	Greater than 1,000	6
I. Population served by aquifer supplies within 3 miles of site	0	1 - 50	51 - 1,000	Greater than 1, 000	6

TABLE 1 (Continued)

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

TABLE 1 (Continued)

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

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 floodplain	In 10-year floodplain	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 casings, subsidence fissures, etc.)	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

Spills:

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

Surface Impoundments:

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

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

HAZARD ASSESSMENT METHODOLOGY FORMS

APPENDIX H

INDEX FOR HAZARD ASSESSMENT

METHODOLOGY FORMS

IRD ASSESSMENT RATING METHODOLOGY FORM

e of site:Liquid Fuel Sludge Disposal Area No. 1
ition:East of Bldg. 218
e of Operation:1950 to 1960
er/Operator:Brooks AFB
ments/Description:Approximately 6000 Gals. of Fuel Sludge
ied in Shallow Pits
e Rated by:R.M. Palazzolo and J.R. Absalon

RECEPTORS

ing Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
Population within 1,000 feet of site	3	4	12	12
Distance to nearest well	1	10	10	30
Land use/zoning within 1 mile radius	3	3	9	9
Distance to installation boundary	3	6	18	18
Critical environments within 1 mile radius of site	0	10	0	30
Water quality of nearest surface water body	1	6	6	18
Ground water use of uppermost aquifer	2	9	18	27
Population served by surface water supply within 3 miles downstream of site	0	6	0	18
Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			91	180

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

WASTE CHARACTERISTICS

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

1. Waste quantity (1=small, 2=medium, 3=large) 1
2. Confidence level (1=confirmed, 2=suspected) c
3. Hazard rating (1=low, 2=medium, 3=high) h

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

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

100 x 1.00 = 100

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

100 x 0.75 = 75

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	2	8	16	24
Surface permeability	2	6	12	18
Rainfall intensity	3	8	24	24
Subtotals			76	108
Subscore (100 x factor score subtotal/maximum score subtotal)				70
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	1	8	8	24
Direct access to ground water	0	8	0	24
Subtotals			32	114
Subscore (100 x factor score subtotal/maximum score subtotal)				28

C. Highest pathway subscore.

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

Pathways Subscore 70

IV. WASTE MANAGEMENT PRACTICES

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

Receptors			51	
Waste Characteristics			75	
Pathways			70	
Total	196	divided by 3 =		65 Gross total score

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

Gross total score x waste management practices factor = final score

65 x 1.00 = \ 65 \

FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of site:Landfill No. 5
Location:Southern Part of Base Adjacent to N/S Runway
Date of Operation:1962 to 1970
Owner/Operator:Brooks AFB
Comments/Description:Trench and Fill Disposal With
Daily Burning of Wastes
Site Rated by:R.M.Palazzolo 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	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	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	3	6	18	18
Subtotals			79	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 (1=small, 2=medium, 3=large) m
2. Confidence level (1=confirmed, 2=suspected) c
3. Hazard rating (1=low, 2=medium, 3=high) h

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

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

80 x 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	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	2	8	16	24
Surface permeability	2	6	12	18
Rainfall intensity	3	8	24	24
Subtotals			76	108
Subscore (100 x factor score subtotal/maximum score subtotal)				70
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	1	8	8	24
Direct access to ground water	0	8	0	24
Subtotals			32	114
Subscore (100 x factor score subtotal/maximum score subtotal)				28

C. Highest pathway subscore.

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

Pathways Subscore 70

IV. WASTE MANAGEMENT PRACTICES

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

Receptors		44
Waste Characteristics		64
Pathways		70
Total	178	divided by 3 = 59 Gross total score

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

Gross total score x waste management practices factor = final score

59 x 1.00 = \ 59 \

FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of site:Landfill No. 6
Location:Southern Part of Base Along Perimeter Road
Date of Operation:1971 to Present
Owner/Operator:Brooks AFB
Comments/Description:Trench and Fill Disposal of Waste Until 1983,
Currently Used For Disposal of Hardfill and Brush Burning
Site Rated by:R.M.Palazzolo 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	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	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	3	6	18	18
Subtotals			79	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 (1=small, 2=medium, 3=large) m
2. Confidence level (1=confirmed, 2=suspected) c
3. Hazard rating (1=low, 2=medium, 3=high) h

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

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

80 x 1 = 64

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

64 x 1 = 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	2	8	16	24
Net precipitation	0	6	0	18
Surface erosion	2	8	16	24
Surface permeability	2	6	12	18
Rainfall intensity	3	8	24	24
Subtotals			68	108
Subscore (100 x factor score subtotal/maximum score subtotal)				63
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	1	8	8	24
Direct access to ground water	0	8	0	24
Subtotals			32	114
Subscore (100 x factor score subtotal/maximum score subtotal)				28

C. Highest pathway subscore.

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

Pathways Subscore 63

IV. WASTE MANAGEMENT PRACTICES

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

Receptors		44	
Waste Characteristics		64	
Pathways		63	
Total	171	divided by 3 =	57 Gross total score

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

Gross total score x waste management practices factor = final score

57 x 1 = 57

FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of site: Fire Protection Training Area No. 2
Location: North of Perimeter Road Near Southwest Corner of the Base
Date of Operation: 1945 to 1960
Owner/Operator: Brooks AFB
Comments/Description: Waste oils , solvents and contaminated fuel burned in weekly training exercises;irrigation of site in recent years
Site Rated by: R.M.Palazzolo 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	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	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	3	6	18	18
Subtotals			79	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 (1=small, 2=medium, 3=large) s
2. Confidence level (1=confirmed, 2=suspected) c
3. Hazard rating (1=low, 2=medium, 3=high) h

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	1	6	6	18
Surface erosion	2	8	16	24
Surface permeability	2	6	12	18
Rainfall intensity	3	8	24	24
Subtotals			74	108
Subscore (100 x factor score subtotal/maximum score subtotal)				69
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	1	8	8	24
Direct access to ground water	0	8	0	24
Subtotals			32	114
Subscore (100 x factor score subtotal/maximum score subtotal)				28

C. Highest pathway subscore.

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

Pathways Subscore 69

IV. WASTE MANAGEMENT PRACTICES

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

Receptors		44	
Waste Characteristics		48	
Pathways		69	
Total	161	divided by 3 =	54 Gross total score

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

Gross total score x waste management practices factor = final score

54 x 1.00 = 54

FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of site: Landfill No. 3
Location: East of SAM Area on Base Golf Course
Date of Operation: Late 1940's to 1953
Owner/Operator: Brooks AFB
Comments/Description: Trench and fill disposal with burning of wastes;irrigation of site in recent years
Site Rated by: R.M.Palazzolo 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	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	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	3	6	18	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 (1=small, 2=medium, 3=large) s
2. Confidence level (1=confirmed, 2=suspected) s
3. Hazard rating (1=low, 2=medium, 3=high) h

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	1	6	6	18
Surface erosion	2	8	16	24
Surface permeability	2	6	12	18
Rainfall intensity	3	8	24	24
Subtotals			82	108
Subscore (100 x factor score subtotal/maximum score subtotal)				76
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	1	8	8	24
Direct access to ground water	0	8	0	24
Subtotals			32	114
Subscore (100 x factor score subtotal/maximum score subtotal)				28

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

Pathways Subscore 76

IV. WASTE MANAGEMENT PRACTICES

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

Receptors		51
Waste Characteristics		32
Pathways		76
Total	159 divided by 3 =	53 Gross total score

B. Apply factor for waste containment from waste management practices.
Gross total score x waste management practices factor = final score

53 x 1.00 = \ 53 \
FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of site: Landfill No. 4
Location: East of Landfill No. 3 on Base Golf Course
Date Of Operation: 1953 to 1962
Owner/Operator: Brooks AFB
Comments/Description: Trench and fill disposal with daily burning of wastes; irrigation of site in recent years
Site Rated by: R.M. Palazzolo 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	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	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	3	6	18	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 (1=small, 2=medium, 3=large) s
2. Confidence level (1=confirmed, 2=suspected) s
3. Hazard rating (1=low, 2=medium, 3=high) h

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	1	6	6	18
Surface erosion	2	8	16	24
Surface permeability	2	6	12	18
Rainfall intensity	3	8	24	24
Subtotals			82	108
Subscore (100 x factor score subtotal/maximum score subtotal)				76
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	1	8	8	24
Direct access to ground water	0	8	0	24
Subtotals			32	114
Subscore (100 x factor score subtotal/maximum score subtotal)				28

C. Highest pathway subscore.

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

Pathways Subscore 76

IV. WASTE MANAGEMENT PRACTICES

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

Receptors	51
Waste Characteristics	32
Pathways	76
Total 159 divided by 3 =	53 Gross total score

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

Gross total score x waste management practices factor = final score

53 x 1.00 = \ 53 \

FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of site: Landfill No. 1
Location: South Side of North Road Near Golf Course Pro Shop
Date Of Operation: 1930's to 1942
Owner/Operator: Brooks AFB
Comments/Description: Dump operation with daily burning of wastes; irrigation of site in recent years
Site Rated by: R.M.Palazzolo 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	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	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	3	6	18	18
Subtotals			79	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 (1=small, 2=medium, 3=large) s
2. Confidence level (1=confirmed, 2=suspected) s
3. Hazard rating (1=low, 2=medium, 3=high) h

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

II. 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	1	6	6	18
Surface erosion	2	8	16	24
Surface permeability	2	6	12	18
Rainfall intensity	3	8	24	24
Subtotals			82	108
Subscore (100 x factor score subtotal/maximum score subtotal)				76
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	1	8	8	24
Direct access to ground water	0	8	0	24
Subtotals			32	114
Subscore (100 x factor score subtotal/maximum score subtotal)				28

C. Highest pathway subscore.

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

Pathways Subscore 76

IV. WASTE MANAGEMENT PRACTICES

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

Receptors		44		
Waste Characteristics		32		
Pathways		76		
Total	152	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

IZARD ASSESSMENT RATING METHODOLOGY FORM

ame of site: Landfill No. 2
ocation: Southwest of Capehart Housing Area on Base Golf Course
ate of Operation: 1943 to Late 1940's
wner/Operator: Brooks AFB
omments/Description: Trench and fill disposal with daily burning of wastes;
rrigation of site in recent years
ite Rated by: R.M. Palazzolo and J.R. Absalon

. RECEPTORS

ating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
. Population within 1,000 feet of site	3	4	12	12
. Distance to nearest well	1	10	10	30
. Land use/zoning within 1 mile radius	3	3	9	9
. Distance to installation boundary	2	6	12	18
. Critical environments within 1 mile radius of site	0	10	0	30
. Water quality of nearest surface water body	1	6	6	18
i. Ground water use of uppermost aquifer	2	9	18	27
I. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			85	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 47

I. 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 (1=small, 2=medium, 3=large) s
2. Confidence level (1=confirmed, 2=suspected) s
3. Hazard rating (1=low, 2=medium, 3=high) h

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	2	8	16	24
Net precipitation	1	6	6	18
Surface erosion	2	8	16	24
Surface permeability	2	6	12	18
Rainfall intensity	3	8	24	24
Subtotals			74	108
Subscore (100 x factor score subtotal/maximum score subtotal)				69
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	1	8	8	24
Direct access to ground water	0	8	0	24
Subtotals			32	114
Subscore (100 x factor score subtotal/maximum score subtotal)				28

C. Highest pathway subscore.

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

Pathways Subscore 69

IV. WASTE MANAGEMENT PRACTICES

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

Receptors		47	
Waste Characteristics		32	
Pathways		69	
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 1.00 = 49

FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of site: Fire Protection Training Area No.3 & Liquid Fuel Sludge Disposal Area No.2
Location: Southeast Side of Aircraft Parking Area
Date of Operation: 1962 to 1963
Owner/Operator: Brooks AFB
Comments/Description: Site Used For Training in Fighting Grass Fires and For Ground Disposal of Liquid Fuel Sludges
Site Rated by: R.M.Palazzolo 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	2	6	12	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	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	3	6	18	18
Subtotals			73	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 41

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 (1=small, 2=medium, 3=large) s
2. Confidence level (1=confirmed, 2=suspected) c
3. Hazard rating (1=low, 2=medium, 3=high) h

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 1.00 = 60

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

60 x 0.75 = 45

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	2	8	16	24
Surface permeability	2	6	12	18
Rainfall intensity	3	8	24	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	1	8	8	24
Direct access to ground water	0	8	0	24
Subtotals			32	114
Subscore (100 x factor score subtotal/maximum score subtotal)				28

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		41	
Waste Characteristics		45	
Pathways		56	
Total	142	divided by 3 =	47 Gross total score

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

Gross total score x waste management practices factor = final score

47 x 1.00 = \ 47 \

FINAL SCORE

APPENDIX I

GLOSSARY OF TERMINOLOGY AND ABBREVIATIONS

APPENDIX I
GLOSSARY OF TERMINOLOGY AND ABBREVIATIONS

ABG: Air Base Group

ACFT MAINT: Aircraft Maintenance.

AF: Air Force.

AFB: Air Force Base.

AFESC: Air Force Engineering and Services Center.

AFFF: Aqueous Film Forming Foam, a fire extinquishing agent. AFFF concentrates includes fluorinated surfactants plus foam stabilizers diluted with water to a 3 to 5% solution.

AFR: Air Force Regulation.

AFSC: Air Force Systems Command.

Ag: Chemical symbol for silver.

AGE: Aerospace Ground Equipment.

Al: Chemical symbol for aluminum.

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.

AMD: Aerospace Medical Division.

ANTICLINE: A fold in which layered strata are inclined down and away from the axes.

ARGILLACEOUS: Composed of clay minerals or clay-sized particles.

ARENACEOUS: Sand-bearing or sandy; containing sand-sized particles.

ARTESIAN: Gr... water contained under hydrostatic pressure.

AQUICLUDE: Poorly permeable formation that impedes ground-water movement and does not yield to a well or spring.

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

AQUITARD: A geologic unit which impedes ground-water flow.

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.

ASTM: American Society of Testing Materials

ATC: Air Training Command

AUTOCLAVE: A method of sterilization by superheated steam under pressure.

AVGAS: Aviation Gasoline.

BA: Chemical symbol for barium.

BALCONES ESCARPMENT: The long, relatively continuous steeply sloping geomorphological feature formed by faulting that separates the Edwards Plateau (north) from the West Gulf Coastal Plain (south). The Edwards Plateau forms the upper escarpment surface, while the Coastal Plain defines the lower escarpment limits.

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.

CALCIUM 45: A radionuclide with a half life of 164 days.

CALICHE: Gravel, sand, silt or clay cemented by soluble calcium salts to form a crust or hard layer. A term used to describe a broad variety of "hard pan" conditions in the southwest U.S.

CAMS: Consolidated Aircraft Maintenance Squadron.

Cd: Chemical symbol for cadmium.

CE: Civil Engineering.

CERCLA: Comprehensive Environmental Response, Compensation and Liability Act.

CHERTY: A precipitated cryptocrystalline silicate rock material. Occurs chiefly as nodules or concretions within a host rock.

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.

CN: Chemical symbol for cyanide.

COBALT 57: A radionuclide with a half life of 267 days.

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.

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.

CONFINING UNIT: An aquitard or other poorly permeable layer which restricts the movement of ground water.

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.

DET: Detachment.

2,4-D: Abbreviation for 2,4-dichlorophenoxyacetic acid, a common weed killer and defoliant.

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.

DO: Dissolved oxygen.

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.

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.

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

EPA: U.S. Environmental Protection Agency.

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.

ESCARPMENT: A long, usually continuous cliff or relatively steep slope facing one general direction, breaking the continuity of the land by separating two level or gently sloping surfaces; produced by erosion or faulting.

ESS: Electronic Security Squadron.

FAA: Federal Aviation Administration.

FACILITY: 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.

FMS: Field Maintenance Squadron.

FPTA: Fire Protection Training Area.

FTW: Flying Training Wing.

FULLER'S EARTH: A porous colloidal aluminum silicate (clay) which has high natural adsorptive power.

GASOLINE: Commercial grade gasoline (as opposed to Mogas) for civilian vehicles; typically provided at BX service stations.

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

GUNK: Trademark for a series of soaps and compounds consisting of degreasing and decarbonizing solvents, acid and alkaline powders and liquids.

HALF-LIFE $T_{1/2}$: The time required for half the atoms present in radioactive substance to disintegrate.

HALOGEN: The class of chemical elements inlcuding 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.

HWAP: Hazardous Waste Accumulation Point.

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.

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*For purposes of this Phase I IRP report hazardous substances and hazardous wastes are considered synonymous.

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.

I-125: A radionuclide with a half life of 60 days.

IRP: Installation Restoration Program.

ISOPACH: Graphic presentation of geologic data, including lines of equal unit thickness that may be based on confirmed (drill hole) data or indirect geophysical measurement.

ISOTOPE: Two or more species of atoms of the same chemical element, with the same atomic number and place inthe periodic table, and nearly identical chemical properties, but with different atomic mass numbers and different physical properties; an example may be the isotope Carbon-14.

JP-4: Jet Propulsion Fuel Number Four, military jet fuel.

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 continuous 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.

LOX: Liquid oxygen.

LYSIMETER: A vacuum operated sampling device used for extracting pore water samples at various depths within the unsaturated zone.

m: Milli (10^{-3})

MAGNETOMETER (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.

MARL: An earthy substance consisting of 35-65% clay and 65-35% carbonate, formed as a result of calcium carbonate precipitation and clay particle sedimentation.

METALS: See "Heavy Metals".

ug/l: Micrograms per liter.

mg/l: Milligrams per liter.

MGD: Million gallons per day.

MICRO: u(10^{-6}).

MOGAS: Motor gasoline for military vehicles.

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.

MWR: Morale, Welfare and Recreation.

NCO: Non-commissioned Officer.

NCOIC: Non-commissioned Officer In-Charge.

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

NGVD: National Geodetic Vertical Datum of 1929.

Ni: Chemical symbol for nickel.

NOAA: National Oceanic and Atmospheric Administration.

NPDES: National Pollutant Discharge Elimination System.

NRC: Nuclear Regulatory Commission

OBCR: Off Base Contract Removal

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.

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.

OUTCROP: Zone or area of exposure where a geologic unit or formation occurs at or near land surface. "Outcrop area" is an important factor in hydrogeologic studies as this zone usually corresponds to the point where significant recharge occurs.

Pb: Chemical symbol for lead.

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

PD-680: Cleaning solvent (broad cut petroleum base nonchlorinated 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.

pico: 10^{-12}

PL: Public Law.

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.

POTENTIALLY ACTIVE FAULT: A fault along which movement has occurred within the last 25-million years.

ppb: Parts per billion by weight.

ppm: Parts per million by weight.

PRECIPITATION: Rainfall.

QUATERNARY MATERIALS: The second period of the Cenozoic geologic era. following the Tertiary, and including the last 2-3 million years.

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.

RESISTIVITY: See "Electrical Resistivity."

RIPARIAN: Living or located on a riverbank.

RM: Resource Management.

SAM: USAF School of Aerospace Medicine.

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

SARPMA: San Antonio Real Property Maintenance Agency

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.

SOLE SOURCE: As in aquifer. The only source of potable water supplies of acceptable quality available in adequate quantities for a significant population. Sole source is a legal term which permits use control of the aquifer by designated regulatory authorities.

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.

STRIKE: The compass direction or trend taken by a structural feature, such as bedding, folds, faults, etc. Strike is measured at a point when the specific feature intersects the topographic surface.

TAC: Tactical Air Command

TCE: Trichloroethylene, a solvent and suspected carcinogen.

TDS: Total Dissolved Solids, a water quality parameter.

TECTONIC (ally): Said of or pertaining to the forces and resulting structural or deformational features evident in the earth's crust. Tectonics usually deals with the broad architecture of the earth's outer crust.

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.

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 or disposal.

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

USAF: United States Air Force.

USAFSS: United States Air Force Security Service.

USDA: United States Department of Agriculture.

USEPA: United States Environmental Protection Agency.

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.

APPENDIX J

REFERENCES

APPENDIX J

REFERENCES

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APPENDIX K

INDEX OF REFERENCES TO POTENTIAL CONTAMINATION

SITES AT BROOKS AFB

APPENDIX K

INDEX OF REFERENCES TO POTENTIAL CONTAMINATION SITES AT BROOKS AFB

SITE	REFERENCES (PAGE NUMBERS)
Liquid Fuel Sludge Disposal Area No. 1	3, 5, 7, 4-27, 4-32, 4-34, 5-1, 5-2, 6-1, 6-2, 6-6, 6-9
Landfill No. 5	3, 5, 7, 4-22, 4-23, 4-24, 4-32, 4-34, 5-1, 5-2, 6-2, 6-5, 6-6, 6-9
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URITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

REPORT SECURITY CLASSIFICATION Unclassified	1b. RESTRICTIVE MARKINGS
SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution unlimited
DECLASSIFICATION/DOWNGRADING SCHEDULE	
PERFORMING ORGANIZATION REPORT NUMBER(S)	5. MONITORING ORGANIZATION REPORT NUMBER(S) IRP-I-BROOKS
NAME OF PERFORMING ORGANIZATION Engineering-Science	6b. OFFICE SYMBOL (If applicable)
7a. NAME OF MONITORING ORGANIZATION HQ AFESC/DEVP	
ADDRESS (City, State and ZIP Code) 57 Executive Park South, Suite 590 Atlanta, GA 30329	7b. ADDRESS (City, State and ZIP Code) Tyndall AFB, FL 32403
NAME OF FUNDING/SPONSORING ORGANIZATION HQ AFSC	8b. OFFICE SYMBOL (If applicable) DEM
9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER F08637 84 C0070	
c. ADDRESS (City, State and ZIP Code) Andrews AFB, MD 20334	10. SOURCE OF FUNDING NOS. PROGRAM ELEMENT NO. / PROJECT NO. / TASK NO. / WORK UNIT NO.
11. TITLE (Include Security Classification) Phase I-Records Search Installation Restoration Program; Brooks AFB, TX	
12. PERSONAL AUTHOR(S) Thoem, R.L.; Absalon, J.R.; Palazzolo, R.M.	

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Yr., Mo., Day)	15. PAGE COUNT
Final	FROM 10/84 TO 3/85	March 1985	208

16. SUPPLEMENTARY NOTATION
AFESC Project Officer: Vogel, Major R.A.

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB. GR.	Installation Restoration Program; Hazardous Waste Management; Past Solid Waste Disposal Sites; Ground Water Contamination

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

This report identified and evaluated several potentially hazardous waste disposal sites at Brooks AFB. Records of past waste handling and disposal practices were reviewed. Interviews with past and present installation employees were conducted to develop a history of waste disposal practices. The environmental setting for effectively receiving the wastes was evaluated including soils, geology, ground water, and surface water. Six landfills, a liquid fuel sludge disposal area, and a fire protection training area were found to have potential to create environmental contamination and follow-on investigations (Phase II) were recommended and outlined.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT UNCLASSIFIED/UNLIMITED ☒ SAME AS RPT. ☐ DTIC USERS ☐	21. ABSTRACT SECURITY CLASSIFICATION UNCLASS
22a. NAME OF RESPONSIBLE INDIVIDUAL	22b. TELEPHONE NUMBER (Include Area Code) / 22c. OFFICE SYMBOL

DD FORM 1473, 83 APR EDITION OF 1 JAN 73 IS OBSOLETE.

85 7 15 345

SECURITY CLASSIFICATION OF THIS PAGE