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INSTALLATION RESTORATION PROGRAM
PHASE I: RECORDS SEARCH
GRISSOM AFB, INDIANA

Prepared For

HQ SAC/DEPV
Offutt AFB, Nebraska

August 1985

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This report identified and evaluated several potentially hazardous waste disposal sites at Grissom 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 was evaluated including soils, geology, groundwater, and surface water. Three landfills, two fire protection training areas, waste oil storage pad and the fuel tank weathering site were found to have sufficient potential to create environmental contamination and follow-on investigations (Phase II) were recommended and outlined.

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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 Grissom Air Force Base under Contract No. F08637-83-G-0005.

INSTALLATION DESCRIPTION

Grissom Air Force Base is located in north-central Indiana, approximately 20 miles north of Kokomo and five miles southwest of Peru. The base is bordered by agricultural land on all sides.

The base comprises 3,005 acres of U.S. government-owned and easement land. There are no remote installation facilities associated with Grissom AFB.

Grissom AFB was activated in 1943 as a naval training station, Bunker Hill Naval Air Station (NAS), and remained an active naval training site throughout the remainder of World War II. In 1954 the base was reactivated as Bunker Hill AFB and was renamed Grissom AFB in 1968. Air Force units which have conducted missions at Grissom AFB include the following:

- 4433rd Air Base Squadron
- 323rd Fighter-Bomber Wing
- 319th Fighter Interceptor Squadron
- 68th Air Refueling Squadron of SAC

- o 4041st Air Base Group of SAC
- o 305th Bomb Wing of SAC
- o 305th Air Refueling Wing of SAC

At present the 305th Air Refueling Wing is the host unit at the base.

SUMMARY OF ENVIRONMENTAL SETTING

The environmental setting information for Grissom AFB indicated the following data are important when evaluating past hazardous waste disposal practices.

1. The mean annual precipitation for Grissom AFB is 34.36 inches; the net precipitation is approximately +2.4 inches and the one-year, 24-hour rainfall event is approximately 2.5 inches. These data indicate that there is an abundance of rainfall in excess of evaporation and that there is a potential for storms to create excessive runoff and leachate from infiltration.

2. The soils on the base are silty loams with moderate vertical permeability. These data indicate that recharge by precipitation infiltrating the soils will be moderate.

3. Surface water on the base is controlled by drainage courses and underground storm drains. According to base records and the Federal Emergency Management Agency, Grissom AFB has no 100-year encroachment.

4. Two aquifers underlie Grissom AFB. The uppermost aquifer exists within the unconsolidated glacial deposits to approximately 60 feet. The bedrock aquifer exists within consolidated rock to approximate depths of from 60 to 250 feet.

5. Ground water within the uppermost aquifer exists under unconfined conditions and typically within five feet of the ground

surface. The most permeable zone within the uppermost aquifer would be the top-of-the rock zone where highly weathered, fractured, jointed and solution rock may exist.

6. Ground water within the bedrock aquifer exists under confined conditions. The bedrock aquifer is continuous within the vicinity of the base and well yields are highest in wells which penetrate the interconnecting fractures, joint and solution channels.

7. Solution channels and sinkholes may exist within the Silurian age rocks underlying the base. These conditions would promote the rapid migration of ground water within the bedrock aquifer.

8. Ground water from the uppermost aquifer is not used on the base. Ground water from the bedrock aquifer is the primary source of potable water for the base.

9. There are no known federally or state listed endangered or threatened species which permanently inhabit Grissom AFB.

A review of these major findings indicates that pathways for the migration of hazardous waste related contamination exist. Contaminants present at ground surface would likely be discharged into local drainage alignments via the shortest flow path. The top-of-rock zone is expected to be the most permeable zone within the uppermost aquifer. Contaminants, if released, would be expected to migrate horizontally within this zone. Localized downward vertical migration of ground water and contaminants, if released, may occur within interconnecting fractures, joints or solution channels within the bedrock aquifer underlying the base.

METHODOLOGY

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

FINDINGS AND CONCLUSIONS

The areas found to have sufficient potential to create environmental contamination are listed in Table 1 and shown in Figure 1.

RECOMMENDATIONS

A program for proceeding with Phase II and other IRP activities at Grissom AFB is presented in Section 6. The recommended actions include geophysical surveys, soil borings, monitoring wells, and a sampling and analysis program to determine if contamination exists. This program may be expanded to define the extent and type of contamination if the initial steps reveal contamination. The Phase II recommendations are summarized in Table 2.

Landfill No. 3

Conduct geophysical surveys; install and sample one upgradient and three downgradient wells.

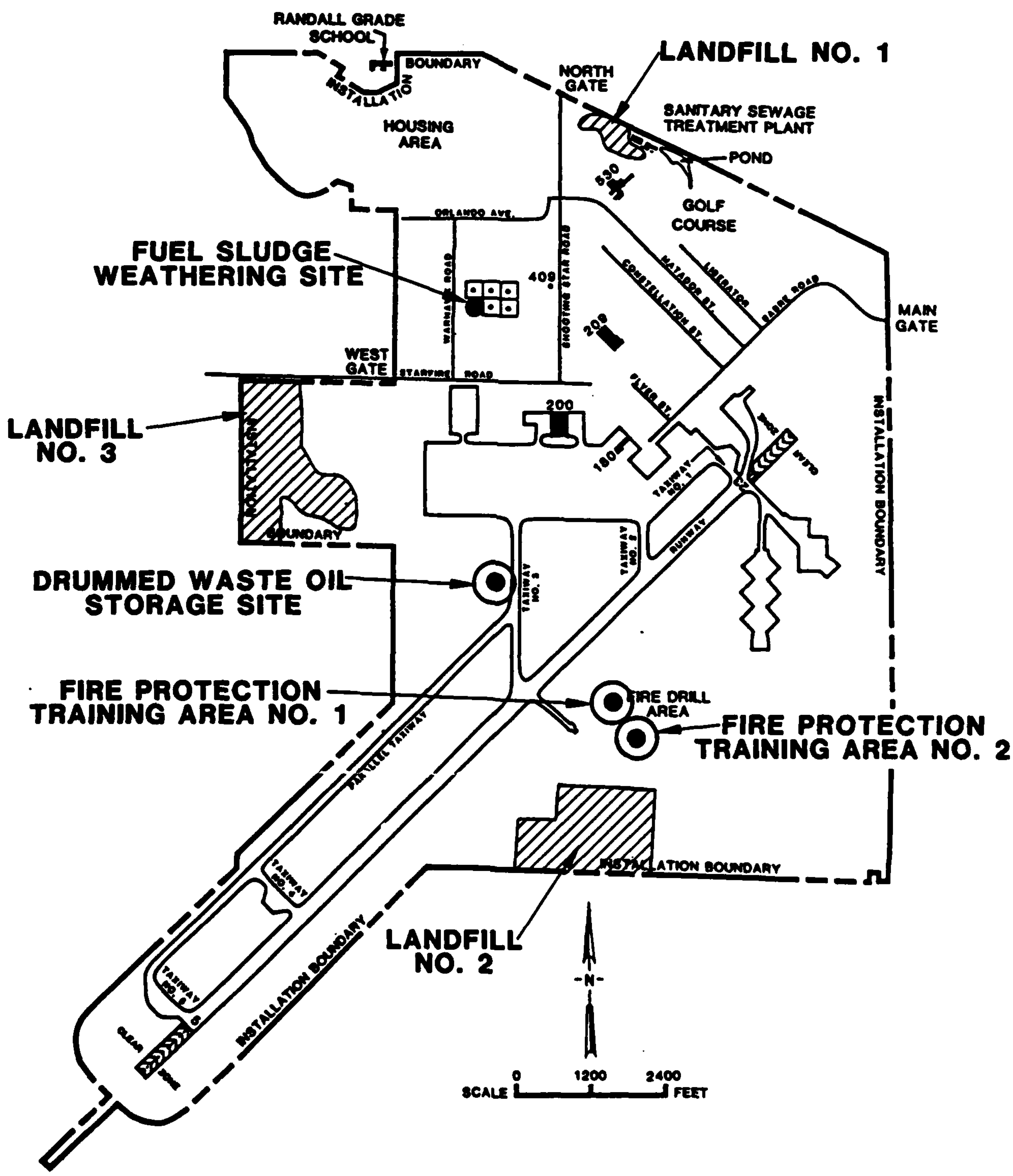
Waste Oil Storage Pad

Drill one soil boring; sample surface soil and selected depths below ground.

Landfill No. 2

Conduct geophysical surveys; install and sample one upgradient and three downgradient wells.

GRISSOM AFB
SITES OF POTENTIAL ENVIRONMENTAL CONTAMINATION



SOURCE: INSTALLATION DOCUMENTS

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

Rank	Site	Operation Period	HARM Score(1)
1	Landfill No. 3	1963 - '74	56
2	Waste Oil Storage Pad	1960's - 1982	54
3	Landfill No. 2	1958 - '63	51
4	Fire Protection Training Area No. 1	1950's - '82	51
5	Fire Protection Training Area No. 2	1982 - '84	48
6	Fuel Tank Sludge Weathering Site	1960's	46
7	Landfill No. 1	1940's(?) - '58	45

(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 2
RECOMMENDED MONITORING PROGRAM FOR PHASE II
AT GRISSOM AFB

Rank	Site	Rating Score	Recommended Monitoring	Sample Analyses	Comments
1	Landfill No. 3	56	Conduct geophysical surveys; install and sample 1 upgradient and 3 downgradient wells.	A	Continue monitoring if sampling indicates contamination. Additional wells may be necessary to assess extent of contamination.
2	Waste Oil Storage Pad	54	Drill one soil boring and sample at selected depths; sample surface soil.	B	Continue monitoring if sampling indicates contamination. Monitoring wells may be necessary if soil contamination extends to water table.
3	Landfill No. 2	51	Conduct geophysical surveys; install and sample 1 upgradient and 3 downgradient wells.	A	Continue monitoring if sampling indicates contamination. Additional wells may be necessary to assess extent of contamination.
4	FPTA No. 1	51	Conduct geophysical surveys; install and sample 1 upgradient and 3 downgradient wells. Drill one soil boring in the center of site; sample soil at selected depths.	C (ground water) B (soil)	Continue monitoring if sampling indicates contamination. Additional wells may be necessary to assess extent of contamination.

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

Rank	Site	Rating Score	Recommended Monitoring	Sample Analyses	Comments
5	FPTA No. 2	48	Conduct geophysical surveys; install and sample 1 upgradient and 3 downgradient wells. Drill one soil boring in the center of site; sample soil at selected depths.	C (ground water) B (soil)	Continue monitoring if sampling indicates contamination. Additional wells may be necessary to assess extent of contamination.
6	Fuel Tank Sludge Weathering Site	46	Drill one soil boring and sample at selected depths; sample surface soil.	B	Continue monitoring if sampling indicates contamination. Monitoring wells may be necessary if soil contamination extends to water table.
7	Landfill No. 1	45	Conduct geophysical surveys; install and sample 1 upgradient and 3 downgradient wells.	A	Continue monitoring if sampling indicates contamination. Additional wells may be necessary to assess extent of contamination.

Note: Sample Analyses List is provided in Table 6.2 of this report.

Fire Protection Training Area No. 1

Conduct geophysical surveys; install and sample one upgradient and three downgradient wells. Drill one soil boring in the center of the site; sample soil at selected depths.

Fire Protection Training Area No. 2

Conduct geophysical surveys; install and sample one upgradient and three downgradient wells. Drill one soil boring in the center of the site; sample soil at selected depths.

Fuel Tank Sludge Weathering Site

Drill one soil boring; sample surface soil and selected depths below ground.

Landfill No. 1

Conduct geophysical surveys; install and sample one upgradient and three downgradient wells.

SECTION 1

INTRODUCTION

BACKGROUND AND AUTHORITY

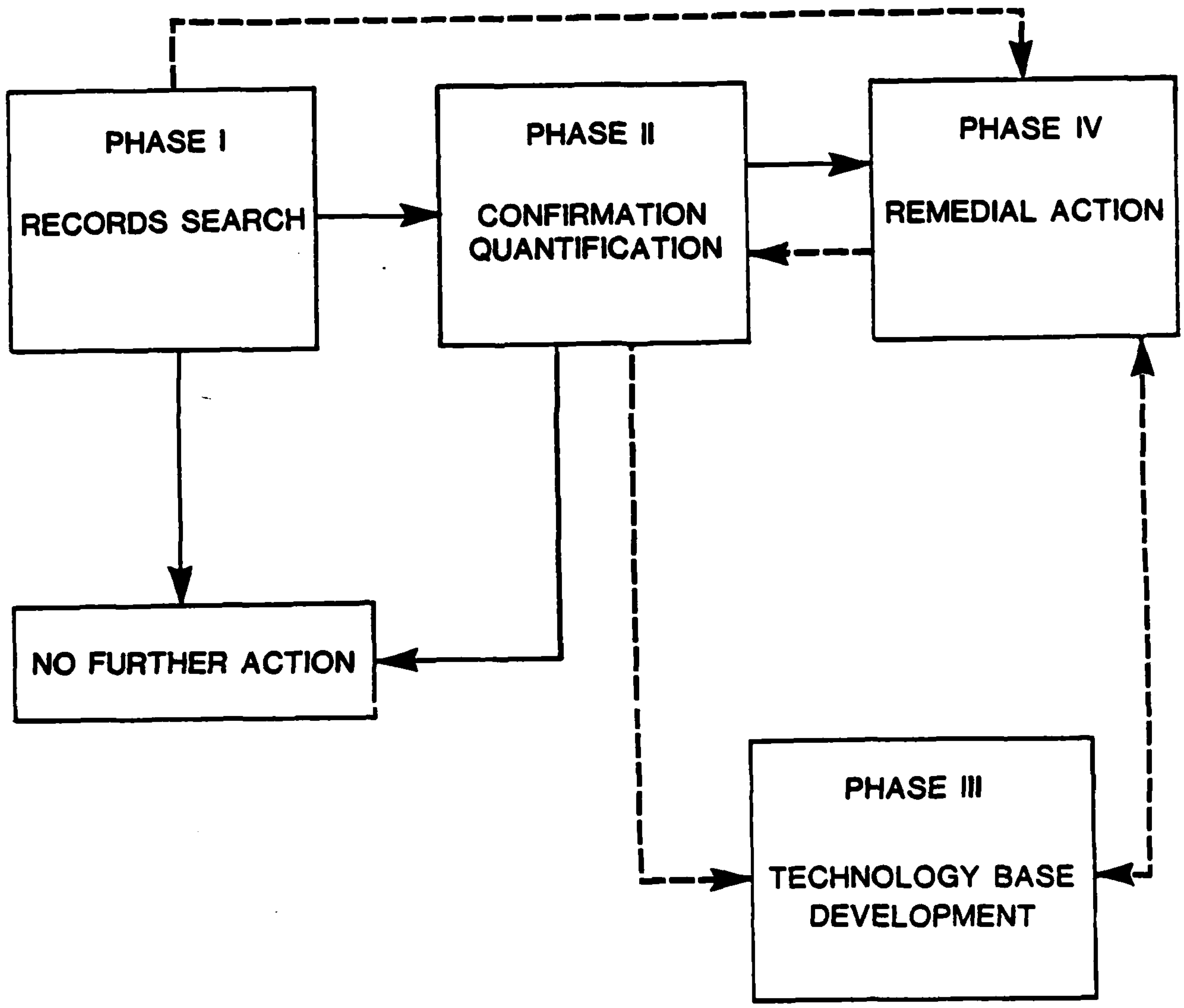
The United States Air Force, due to its primary mission of defense of the United States, has long been engaged in a wide variety of operations dealing with toxic and hazardous materials. Federal, state, and local governments have developed strict regulations to require that disposers identify the locations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

- o <u>Phase I - Installation Assessment/Records Search</u> - 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.
- o <u>Phase II - Confirmation/Quantification</u> - 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.
- o <u>Phase III - Technology Base Development</u> - 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.
- o <u>Phase IV - Operations/Remedial Actions</u> - 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 Grissom AFB under Contract No. F08637 84 R0040. This report contains a summary and an evaluation of the information collected during Phase I of the IRP and recommended follow-on actions. The land area included as part of the Grissom AFB study is the main base site of 3,005 acres. No remote annexes exist at Grissom AFB.

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 April 1985. The following team of professionals were involved:

- E. H. Snider, P.E., Chemical Engineer and Project Manager, 10 years of professional experience.
- B. D. Moreth, Environmental Scientist, 15 years of professional experience.
- H. D. Harman, Jr., P. G., Hydrogeologist, 10 years of professional experience.

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

METHODOLOGY

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

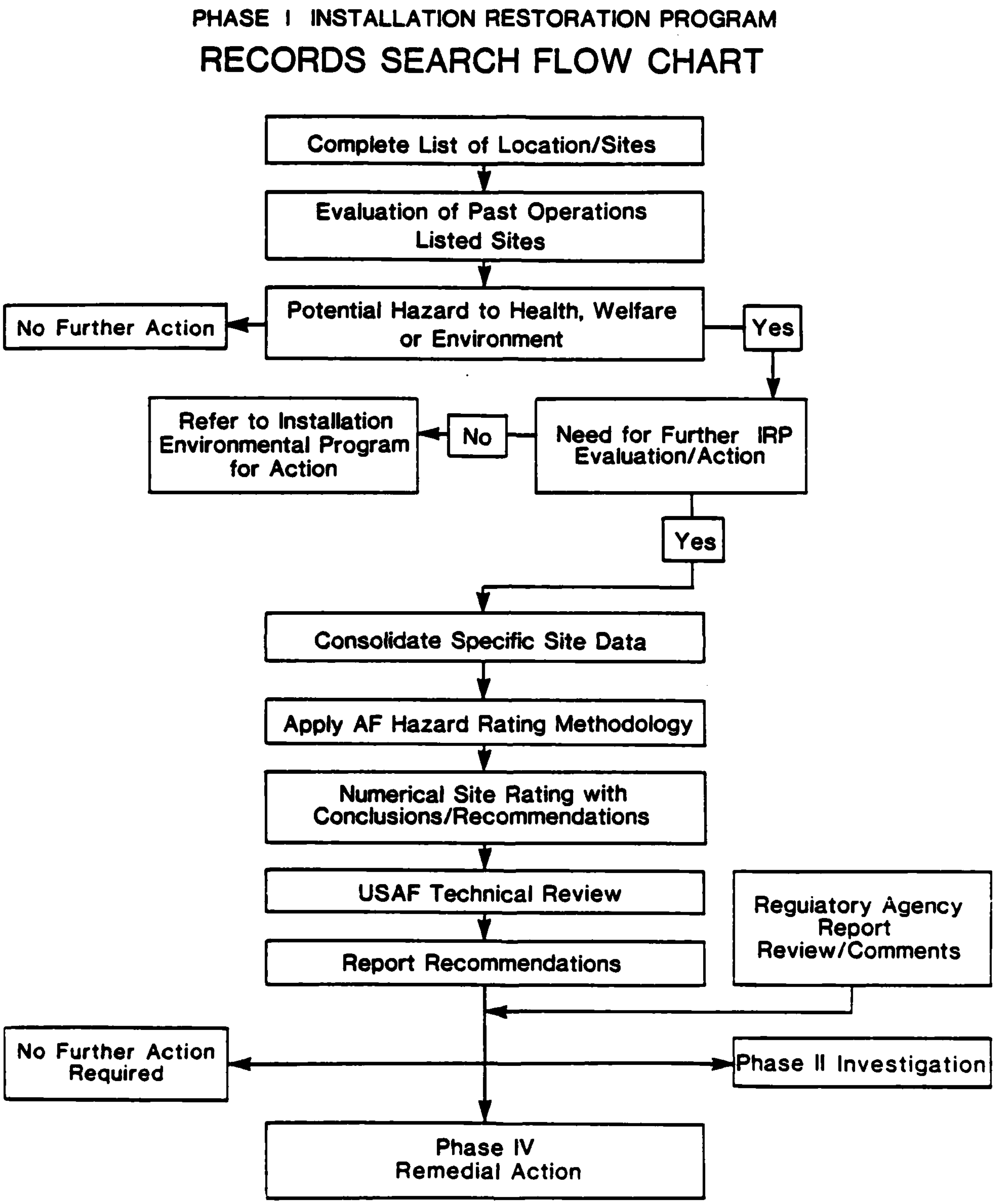
Concurrent with the employee interviews, the applicable federal, state and local agencies were contacted for pertinent study area related environmental data. The agencies contacted are listed below and in Appendix B.

- Cass County Surveyor
- Indiana State Board of Health
- Indiana State Department of Conservation
- Indiana State Department of Natural Resources
- Miama County Surveyor
- National Oceanic and Atmospheric Administration (NOAA), National Climatic Data Center
- U. S. Department of Agriculture (USDA), Soil Conservation Service
- U. S. Environmental Protection Agency (EPA)
- U. S. Geological Survey (USGS), Water Resources Division

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 received no further action. 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.



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SECTION 2

INSTALLATION DESCRIPTION

LOCATION, SIZE AND BOUNDARIES

Grissom Air Force Base is located in north-central Indiana, approximately 20 miles north of Kokomo and five miles southwest of Peru. The base is bordered by agricultural land on all sides (see Figures 2.1 and 2.2).

The base comprises 3,005 acres of land area (see Figure 2.3). There are no remote installation facilities associated with Grissom AFB.

Base History

Grissom AFB was activated in 1943 as a naval training station, Bunker Hill Naval Air Station (NAS), and remained an active naval training site throughout the remainder of World War II. Bunker Hill NAS was deactivated in 1946; many buildings were sold and moved off the site, and the station reverted to agricultural use.

In 1954, the site was reactivated as Bunker Hill Air Force Base (renamed Grissom Air Force Base in 1968). Major units housed at Bunker Hill soon after reactivation were the 4433rd Air Base Squadron, the 323rd Fighter-Bomber Wing, and the 319th Fighter Interceptor Squadron. The 323rd Fighter-Bomber Wing was deactivated in 1957.

In 1957 the Strategic Air Command (SAC) assumed control of the base; the base's mission included refueling as the 68th Air Refueling Squadron of the 4041st Air Base Group which also arrived in 1957. In 1959 the 305th Bomb Wing was transferred to Grissom; this unit remained until it was deactivated in 1970. During its time at the base the 305th Bomb Wing flew B-47 and B-58 aircraft.

In 1959 the 4041st Air Base Group was redesignated as the 305th Combat Support Group, with KC-135 refueling tanker aircraft assigned to the unit. In 1970, with the deactivation of the 305th Bomb Wing, the 305th Air Refueling Wing was created. At present the 305th Air Refueling Wing is the host unit at Grissom and KC-135 tankers remain the

FIGURE 2.1

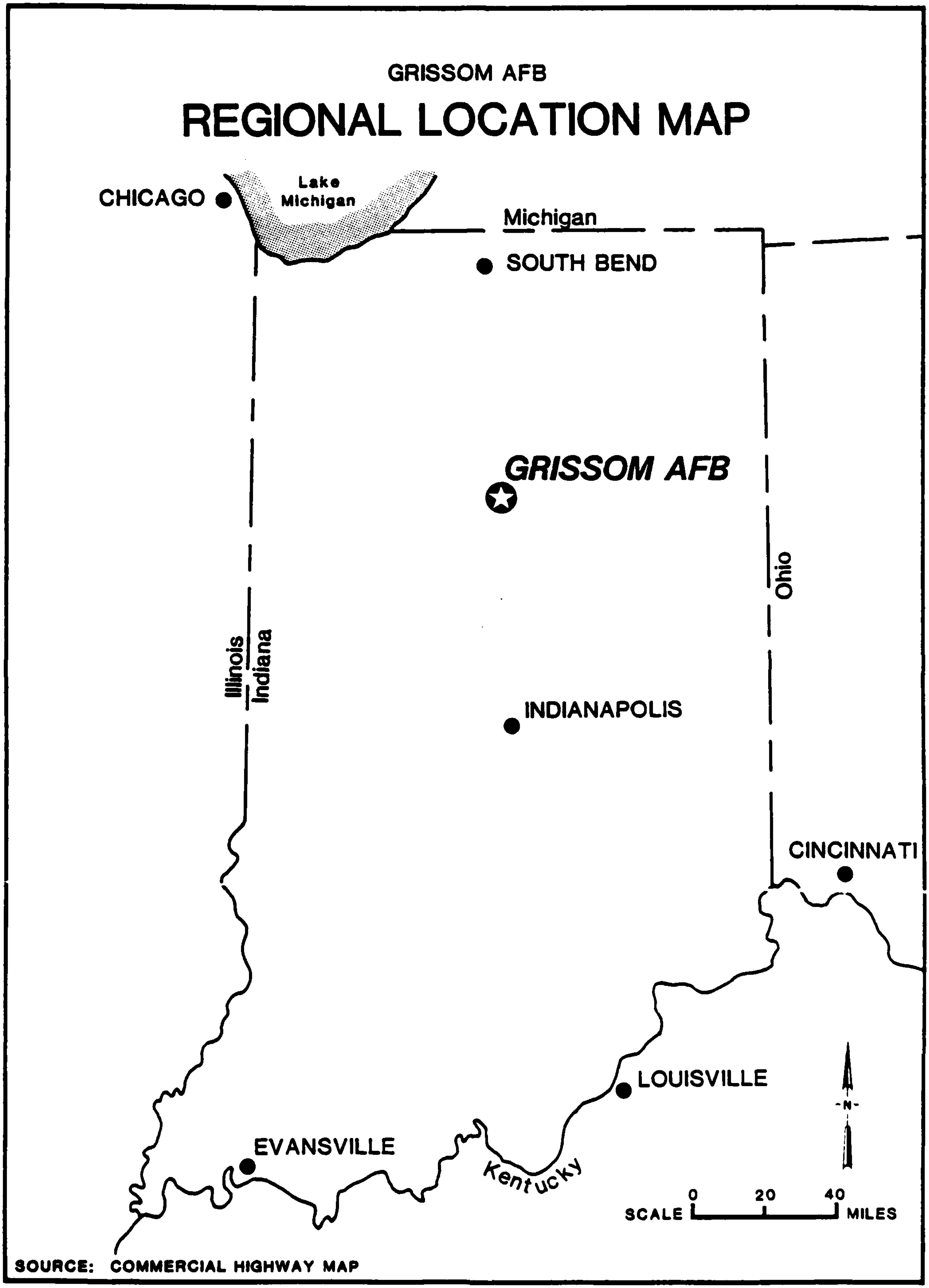

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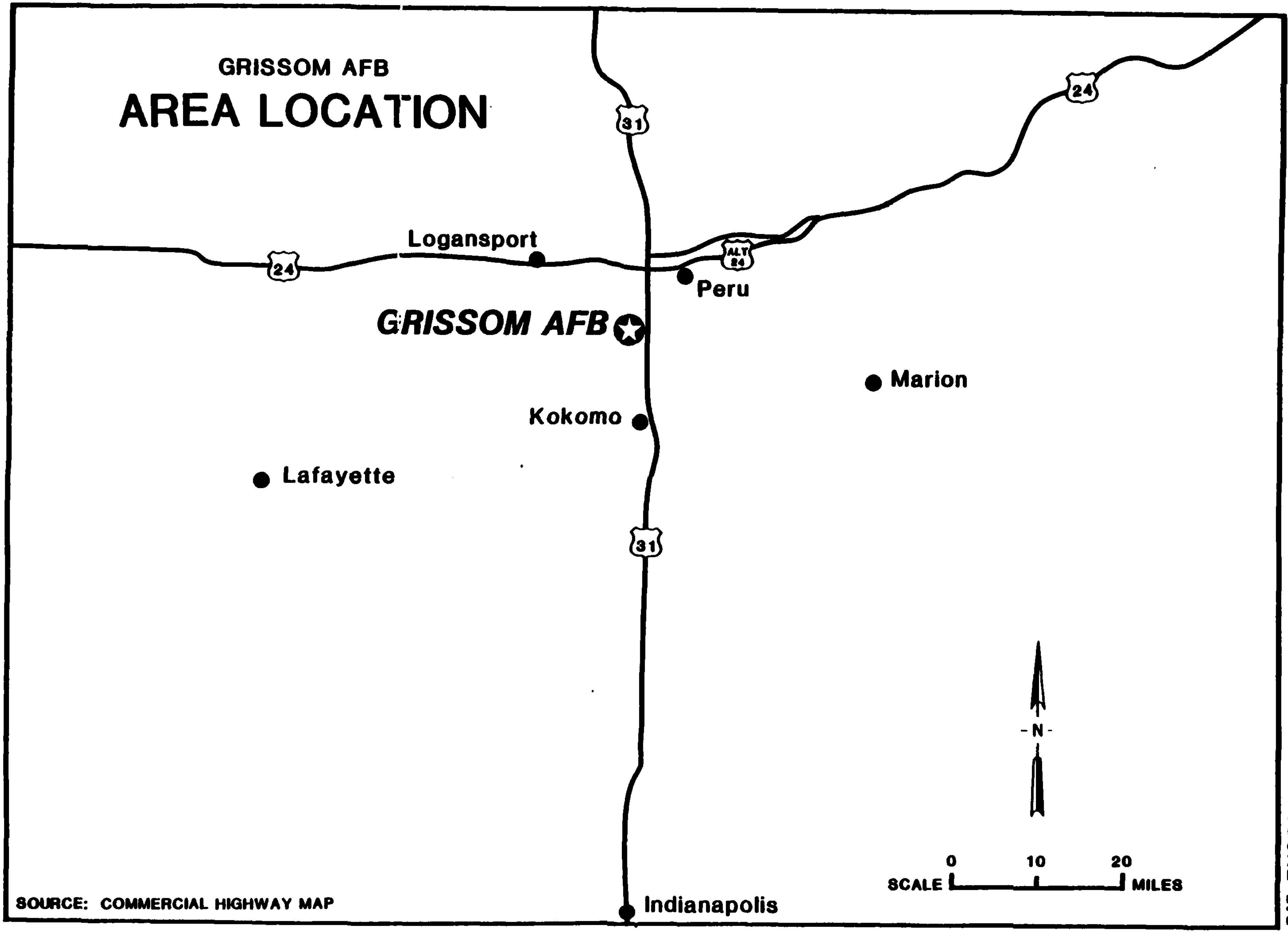
FIGURE 2.2



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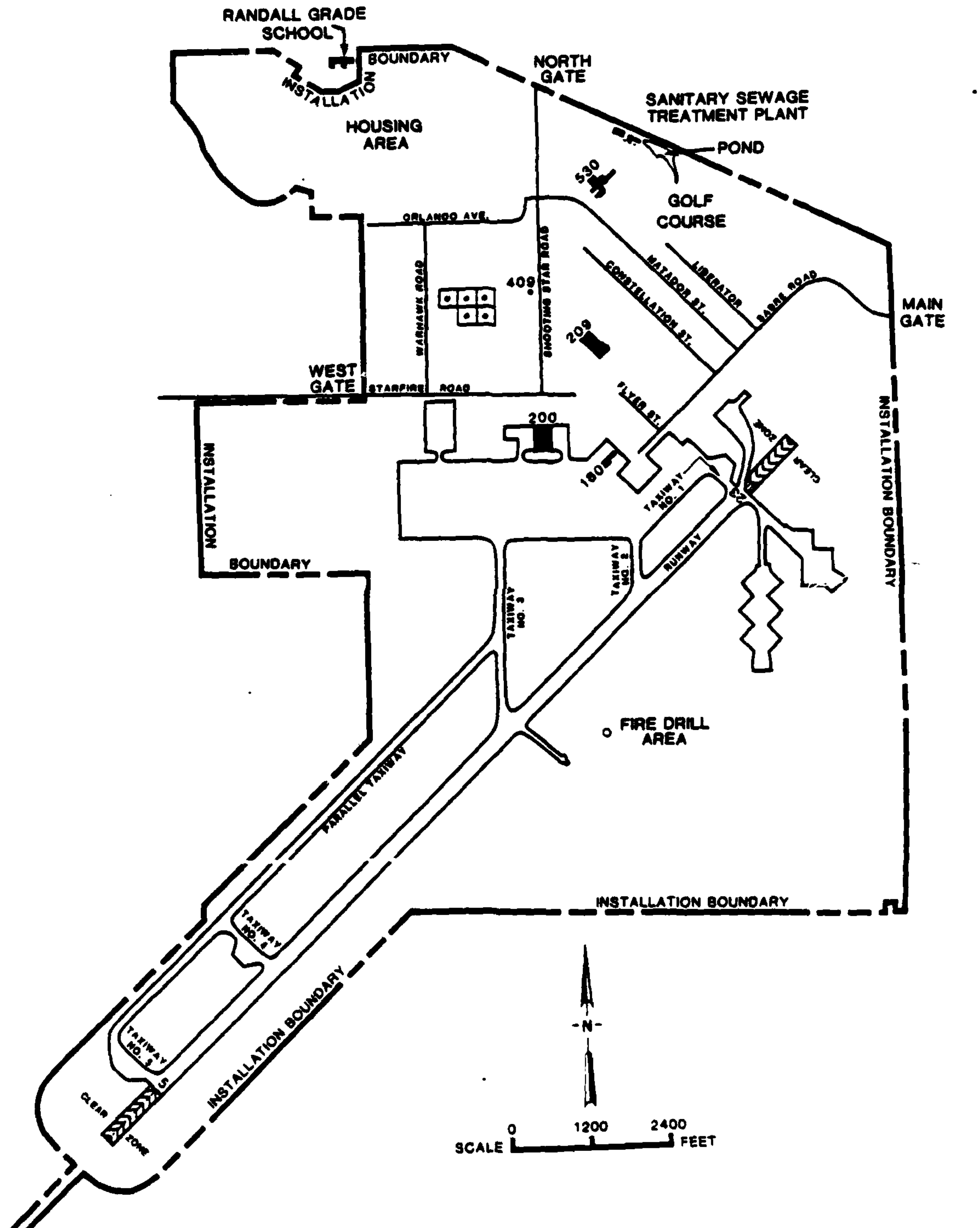
GRISSOM AFB

INSTALLATION SITE PLAN



SOURCE: INSTALLATION DOCUMENTS

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major aircraft at the base; a smaller number of A-10 aircraft are also assigned to the base.

Organization and Mission

The host unit at Grissom AFB is the 305th Air Refueling Wing. The primary mission of the 305th Air Refueling Wing is to provide non-stop, global air refueling missions in support of SAC directives. Major assigned units at Grissom AFB include the 70th Air Refueling Squadron, the 305th Air Refueling Squadron, the 305th Field Maintenance Squadron, 305th Organizational Maintenance Squadron, 305th Avionics Maintenance Squadron, 305th Combat Support Group, 305th Civil Engineering Squadron, 305th Supply Squadron, 305th Transportation Squadron, and USAF Hospital Grissom. These units have missions that are of importance to this report, because they are involved with the generation, accumulation, treatment, and disposal of hazardous wastes at Grissom AFB.

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

- 434th Tactical Fighter Wing, Air Force Reserve
- 931st Air Refueling Group, Air Force Reserve
- 1915th Information Systems Squadron (ISS)
- Detachment 26, 3rd Weather Wing
- Air Force Office of Special Investigations
- Department of Defense Investigative Service
- Air Force Liaison Office for Civil Air Patrol
- 71st Flying Training Wing
- Detachment 8, SAC Management Engineering Team
- American Red Cross
- Air Force Audit Agency

SECTION 3

ENVIRONMENTAL SETTING

The environmental setting of Grissom Air Force Base is described in this section with an emphasis on the identification of natural features that may promote the movement of hazardous waste contaminants. Environmental conditions pertinent to this study are summarized at the conclusion of this section.

METEOROLOGY

The Grissom AFB area has a climate typical of north-central Indiana as conditioned to some extent by the Great Lakes' influences (NOAA, 1983). Summers are relatively hot and humid, while winters are accompanied by snowfall and arctic cold weather. Selected meteorological data for Grissom AFB are summarized in Table 3.1.

Two climatic features of interest in determining the potential for contaminant movement are net precipitation and rainfall intensity. Net precipitation at Grissom AFB is approximately plus (+) 2.4 inches as determined from meteorological data. The mean annual precipitation at the base for the period of 1912 to 1983 was 34.36 inches (NOAA, 1984) and the mean annual lake evaporation for the area is estimated to be 32 inches (NOAA, 1983). The one-year, 24-hour rainfall event in the area of the base is estimated to be 2.5 inches (NOAA, 1963). Net precipitation is an indicator of the potential for leachate generation and is equal to the difference between precipitation and evaporation. Rainfall intensity is an indicator of the potential for excessive runoff and erosion. The one-year, 24-hour rainfall event is used to gauge the potential for runoff and erosion.

GEOGRAPHY

Grissom AFB, located in parts of Cass and Miami counties Indiana, is situated within the Tipton Till Plain section of the Interior Plains

TABLE 3.1

CLIMATIC CONDITIONS FOR GRISSOM AFB

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Temperature (°F) Mean Monthly	24.8	27.2	36.8	48.7	59.7	69.5	73.8	71.8	64.9	53.4	40.4	29.1
Total Precipitation (inches) Mean Monthly	2.35	1.80	3.04	3.37	3.54	3.60	3.34	3.01	2.76	2.67	2.48	2.4
Snowfall (inches) Mean Monthly	7.9	7.3	5.5	1.7	T	0.0	0.0	0.0	0.0	0.1	3.4	7.1

Note: T = Trace

Source: National Oceanic and Atmospheric Administration, 1984.

Period of Record: Temperature and precipitation (1912-1983); snowfall (1947-1983).

division of the Central Lowlands province of the United States (Figure 3.1). The Tipton Till Plain section is characterized by nearly level plains with gently rolling hills (Watkins and Rosenshein, 1963).

Topography

The topography of Grissom AFB is typical of the general regional topography. The base occupies land consisting of level plains with gently rolling hills, streams and small closed depressions. The topography is a reflection of a glacial deposited ground moraine which has been affected to some degree by the shape of the underlying bedrock surface.

The land surface elevations on the base vary from a high of approximately 810 feet above the National Geodetic Vertical Datum (NGVD) near the southeast base boundary to a low of approximately 780 feet NGVD near the northern base boundary.

The areas immediately surrounding Grissom AFB include agricultural lands to the north, west and south and agricultural/residential areas to the east.

Soils

The soils of Grissom AFB (Figure 3.2) are classified as silty loams. These silty loam soils are typically poorly drained, moderately permeable soils found on uplands or formed in silty loess underlain by loam glacial till. Table 3.2 summarizes some of the engineering properties of the Grissom AFB soils. Bedrock is generally deeper than 60 inches below ground surface (Deal, 1979).

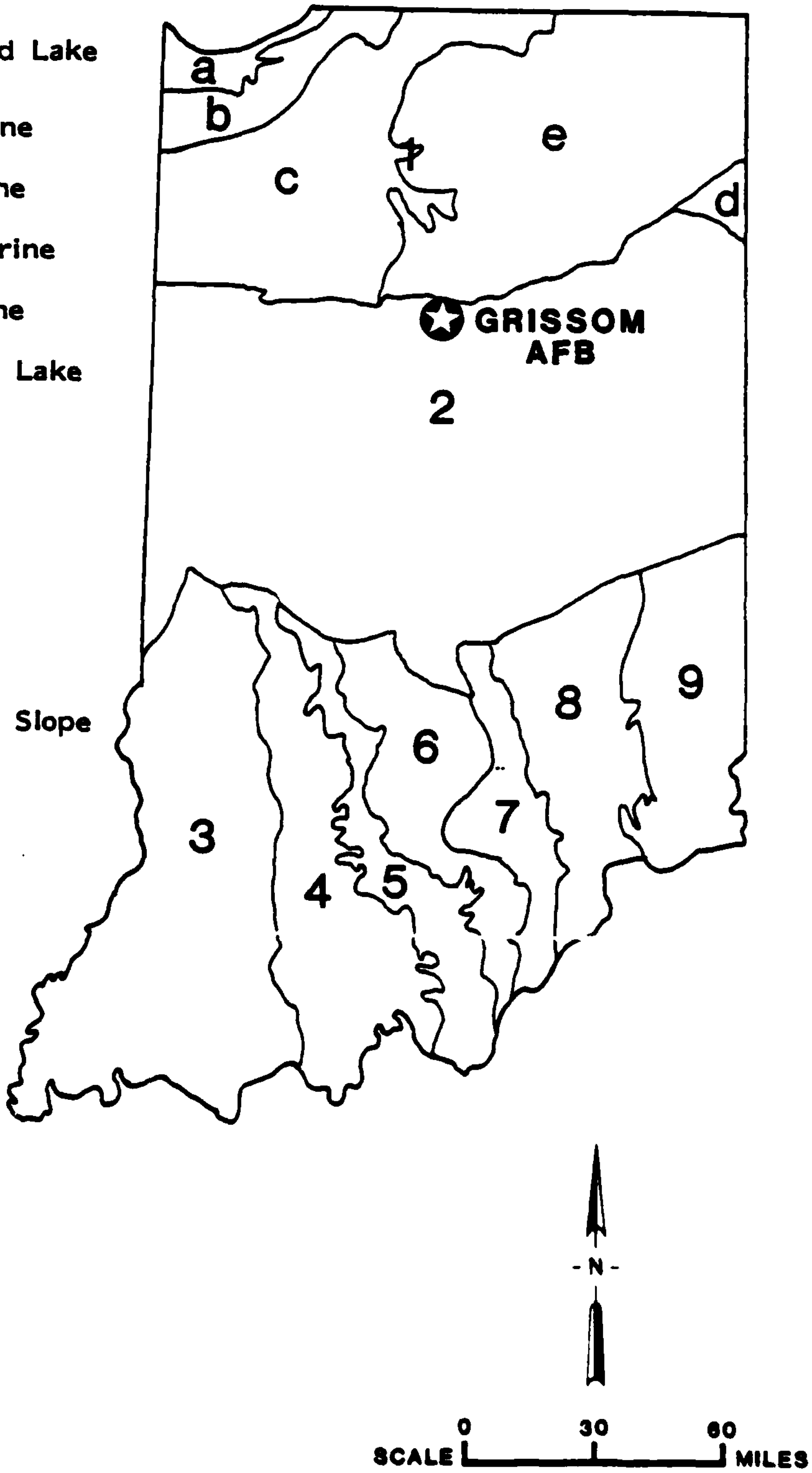
The soil property of concern in assessing the potential for surface water infiltration is vertical permeability. The vertical permeability values for the soils on the base range from a low of 4.23×10^{-5} centimeters per second to a high of 1.41×10^{-3} centimeters per second (Deal, 1979). These values indicate that the surface water will infiltrate at a moderate rate. Vertical permeability values generally decrease with depth resulting in rapid saturation of the soils following rains. The Soil Conservation Service (SCS) has ranked the base soils as generally having severe use limitations for landfills. The SCS has noted frequent flooding and poor drainage as reasons for those limitations (Deal, 1979).

GRISSOM AFB

PHYSIOGRAPHIC MAP OF INDIANA

LEGEND

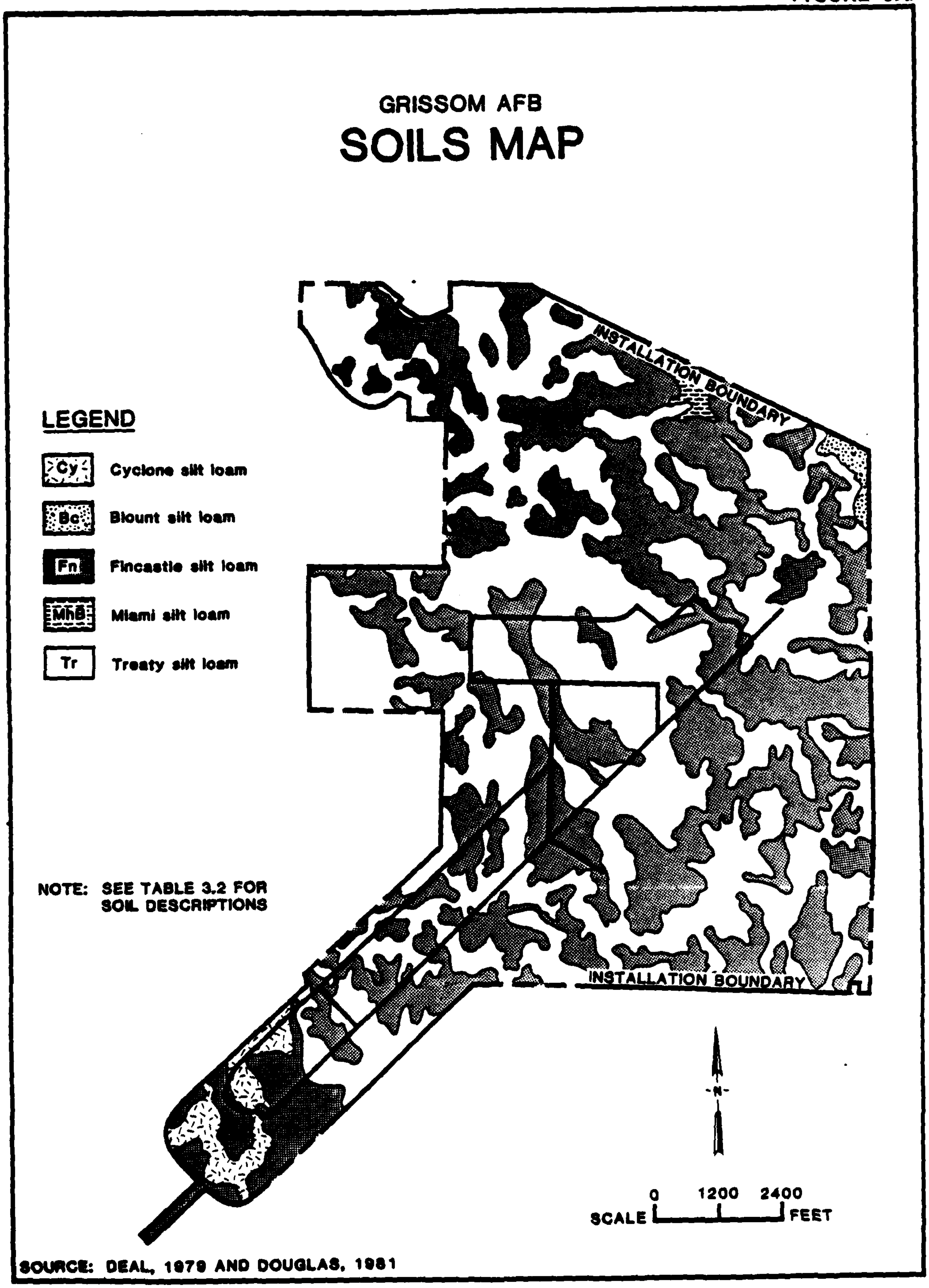
1. Northern Moraine and Lake Region
   a. Calumet Lacustrine Section
   b. Valparaiso Moraine Section
   c. Kankakee Lacustrine Section
   d. Maumee Lacustrine Section
   e. Steuben Morainal Lake Section
2. Tipton Till Plain
3. Wabash Lowland
4. Crawford Upland
5. Mitchell Plain
6. Norman Upland
7. Scottsburg Lowland
8. Muscatatuck Regional Slope
9. Dearborn Upland



SOURCE: MALOTT, 1922

ENGINEERING-SCIENCE

FIGURE 3.2



ES ENGINEERING-SCIENCE

TABLE 3.2
GRISSOM AFB SOILS

Symbol on Figure 3.2	Unit Description	Surface Soil Depth (inches)	Surface Soil Permeability (centimeters/second)	Selected Lower Soil Depth Depth (inches)	Selected Lower Soil Depth Permeability (centimeters/second)	Landfill Use Limitations
Bc	Blount silt loam, 0 to 2 percent slopes.	0-9	$4.23 \times 10^{-4} - 1.41 \times 10^{-3}$	9-60	$4.23 \times 10^{-5} - 4.23 \times 10^{-4}$	Severe; wetness
Cy	Cyclone silt loam, nearly level to gently sloping.	0-54	$4.23 \times 10^{-4} - 1.41 \times 10^{-4}$	54-60	$1.41 \times 10^{-4} - 4.23 \times 10^{-4}$	Severe; poorly drained; ponding.
Fn	Fincastle silt loam, 0 to 3 percent slopes.	0-11	$4.23 \times 10\text{-}4 - 1.41 \times 10^{-3}$	11-60	$1.41 \times 10^{-4} - 4.23 \times 10^{-4}$	Severe; poorly drained.
MhB	Miami silt loam, 2 to 6 percent slopes.	0-34	$4.23 \times 10^{-4} - 1.41 \times 10^{-3}$	34-60	$1.41 \times 10^{-4} - 4.23 \times 10^{-4}$	Slight; generally favorable.
Tr	Treaty silt loam, nearly level to gently sloping.	0-60	$4.23 \times 10^{-4} - 1.41 \times 10^{-3}$			Severe; poorly drained, subject to frequent flooding.

SOURCE: Deal, 1979 and Douglas 1981.

SURFACE WATER RESOURCES

Grissom AFB is located in the Wabash River Basin of north central Indiana. Within this basin, the base is located in the Pipe Creek drainage area (USGS, 1966). The streams of the base drain north and west toward their confluence points with tributaries of Pipe Creek.

Drainage

Drainage of Grissom AFB is controlled by open drainage courses and underground storm drains (Figure 3.3). Surface drainage not routed into the underground system drains chiefly into Government Ditch to the northwest, Little Deer Creek to the west and an unnamed tributary to Pipe Creek to the north.

In addition to the streams on the base, there is a pond located on the golf course. Drainage from the pond exits the base via Cline Ditch.

As drainage leaves the base it joins the area-wide drainage (Figure 3.4) flowing into Little Deer Creek via Bennett-Campbell Ditch to the west, Government Ditch to the northwest, an unnamed tributary of Pipe Creek to the north and another unnamed tributary to the east. These streams flow into Pipe Creek which flows in a northwesterly direction and joins the Wabash River approximately 6 miles downstream of the base.

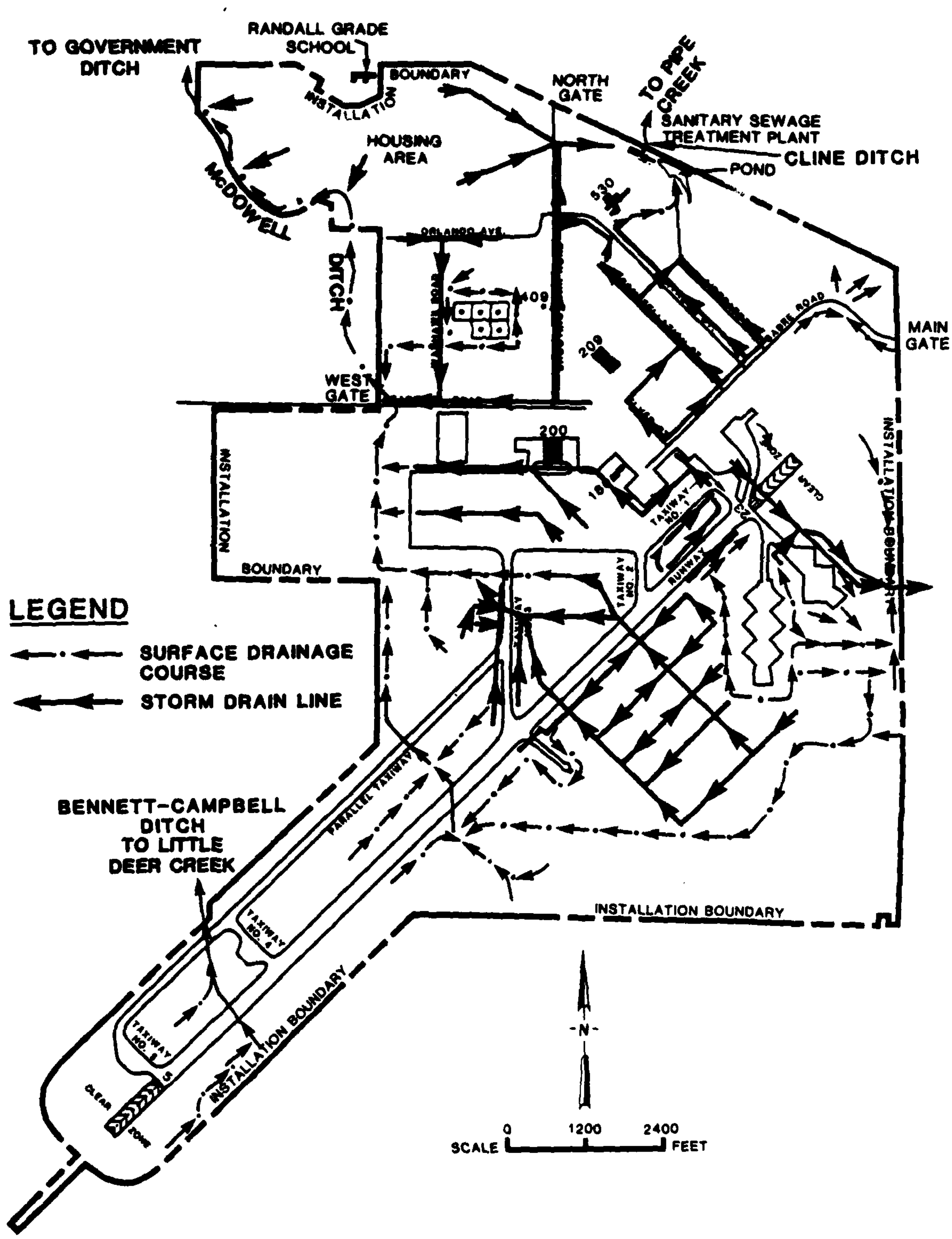
Grissom AFB, according to base records and the Federal Emergency Management Agency (FEMA), has no 100-year flood encroachment areas (FEMA, 1978 and FEMA, 1981).

Surface Water Quality

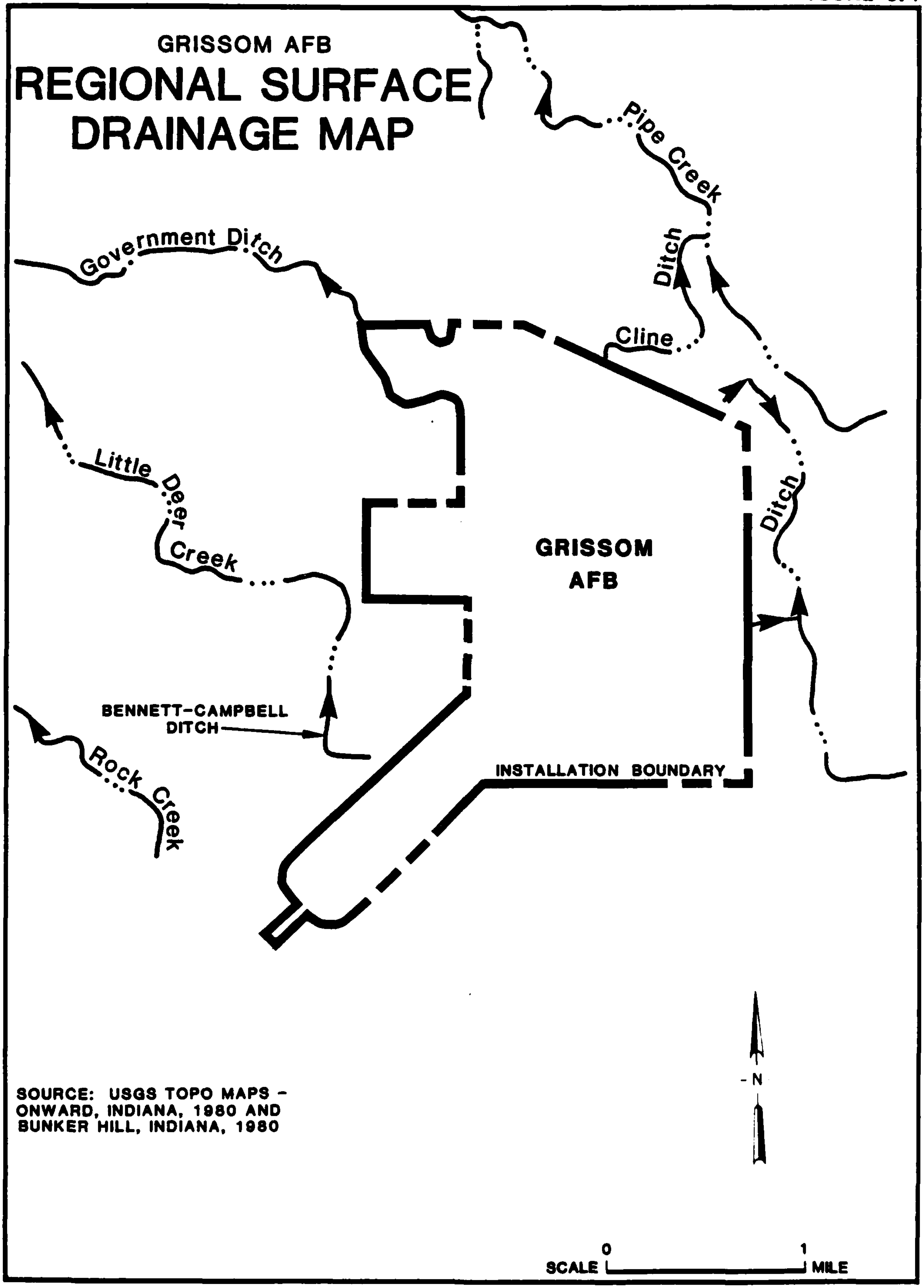
Grissom AFB has a National Pollutant Discharge Elimination System permit (NPDES) for discharge of storm waters and treated wastewater to tributaries of Pipe Creek. Surface water quality of the tributaries is monitored routinely by the base for permit compliance. The surface water sampling points are depicted on Figure 3.5. Generally, the quality of water discharged to local streams has been good. Table 3.3 summarizes the surface water monitoring data at Grissom AFB.

GRISSOM AFB

SURFACE DRAINAGE MAP



SOURCE: INSTALLATION DOCUMENTS



GRISSOM AFB
REGIONAL SURFACE DRAINAGE MAP
Pipe Creek
Government Ditch
Ditch
Cline
Little Deer Creek
Ditch
GRISSOM AFB
BENNETT-CAMPBELL DITCH
Rock Creek
INSTALLATION BOUNDARY
SOURCE: USGS TOPO MAPS - ONWARD, INDIANA, 1980 AND BUNKER HILL, INDIANA, 1980
N
SCALE 0 1 MILE

FIGURE 3.5

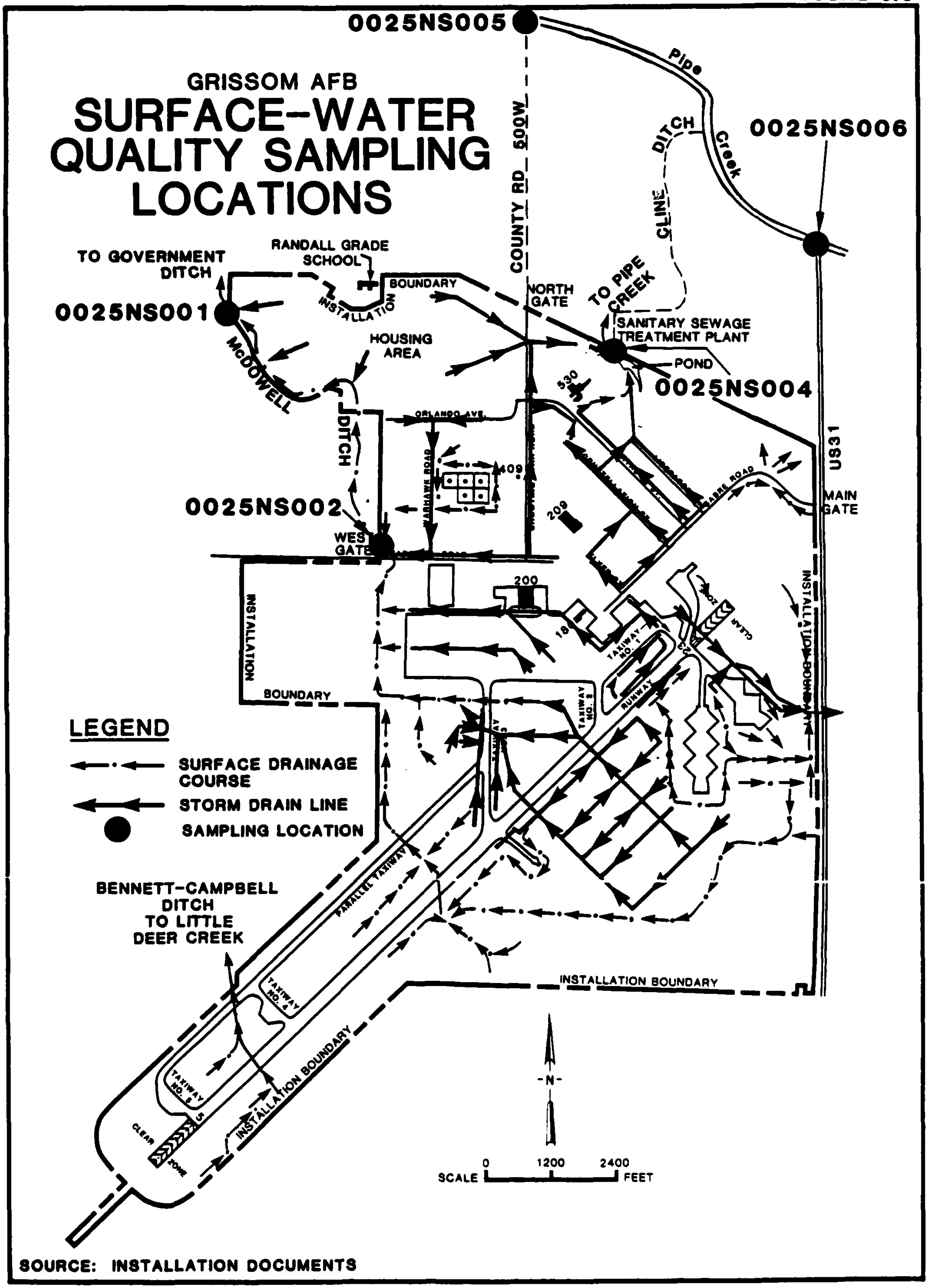

GRISSOM AFB
SURFACE-WATER QUALITY SAMPLING LOCATIONS
0025NS005
0025NS006
0025NS001
0025NS002
0025NS004
Pipe Creek
CLINE DITCH
COUNTY RD 500W
US31
TO GOVERNMENT DITCH
RANDALL GRADE SCHOOL
INSTALLATION BOUNDARY
HOUSING AREA
McDOWELL DITCH
NORTH GATE
TO PIPE CREEK
SANITARY SEWAGE TREATMENT PLANT
POND
ORLANDO AVE.
409
209
200
530
WEST GATE
MAIN GATE
TAXIWAY NO. 1
RUNWAY
PARALLEL TAXIWAY
TAXIWAY NO. 4
TAXIWAY NO. 5
CLEAR ZONE
LEGEND
SURFACE DRAINAGE COURSE
STORM DRAIN LINE
SAMPLING LOCATION
BENNETT-CAMPBELL DITCH TO LITTLE DEER CREEK
-N-
SCALE 0 1200 2400 FEET
SOURCE: INSTALLATION DOCUMENTS

TABLE 3.3
SELECTED SURFACE WATER QUALITY DATA
FOR GRISSOM AFB AND VICINITY

Sampling Station (See Figure 3.5 for Location)	Sampling Date (Mn/Dy/Yr)	pH (su)	Total Organic Carbon (mg/l)	Oil & Grease (mg/l)	Surfactants (mg/l)	Cadmium (mg/l)	Chromium (mg/l)	Lead (mg/l)	Phenols (mg/l)	Ammonia (mg/l)
Discharge or Water Quality Criteria		6.0-9.0	--	15	--	0.01	0.05	0.05	0.01	0.05
0025NS001 (McDowell Ditch Housing Area)	9/20/82	8.2	NA	0.3	NA	NA	NA	NA	NA	NA
	3/18/84	6.8	NA	0.3	NA	NA	NA	NA	NA	NA
	9/10/84	7.6	NA	0.4	NA	NA	NA	NA	NA	NA
0025NS002 (McDowell Ditch West Gate)	9/20/82	7.6	NA	0.3	0.1	NA	NA	NA	0.01	NA
	10/12/82	7.6	NA	<0.3	NA	NA	NA	NA	NA	NA
	3/18/84	6.8	NA	0.3	NA	NA	NA	NA	<0.01	NA
	4/26/84	7.6	NA	0.3	NA	<0.01	<0.05	<0.02	NA	NA
	6/15/84	NA	NA	3.1	<0.1	<0.01	<0.05	<0.02	NA	NA
	9/10/84	7.5	NA	<0.3	<0.1	NA	NA	NA	<0.01	NA
	10/10/84	7.6	NA	<0.3	NA	NA	NA	NA	NA	NA
	11/26/84	NA	NA	0.5	NA	NA	NA	NA	NA	NA
0025NS004 (Cline Ditch)	3/27/74	NA	NA	6.5	NA	<0.01	<0.05	<0.05	0.017	NA
	3/30/74	NA	NA	0.5	NA	<0.01	<0.05	<0.05	<0.001	NA
	4/1/74	NA	NA	<0.3	NA	<0.01	<0.05	<0.05	<0.001	NA
	9/20/82	8.2	NA	0.7	0.1	0.01	0.05	0.05	0.01	NA
	10/12/82	8.2	NA	<0.3	<0.1	<0.01	<0.05	0.052	<0.01	NA
	*6/9-10/83	7.5	4.0	5.6	NA	NA	NA	NA	NA	<0.1
	*8/16-17/83	8.2	NA	10.1	NA	NA	NA	NA	4.4	<0.1
	2/16/84	7.7	NA	<0.3	<0.1	<0.01	<0.05	<0.02	NA	NA
	3/18/84	6.8	NA	<0.3	<0.1	<0.01	<0.05	NA	NA	NA
	3/21/84	6.8	NA	0.6	NA	NA	NA	NA	NA	NA

TABLE 3.3
(CONTINUED)
SELECTED SURFACE WATER QUALITY DATA
FOR GRISSOM AFB AND VICINITY

Sampling Station (See Figure 3.5 for Location)	Sampling Date (Mn/Dy/Yr)	pH (su)	Total Organic Carbon (mg/l)	Oil & Grease (mg/l)	Surfactants (mg/l)	Cadmium (mg/l)	Chromium (mg/l)	Lead (mg/l)	Phenols (mg/l)	Ammonia (mg/l)
Discharge or Water Quality Criteria		6.0-9.0	--	15	--	0.01	^.05	0.05	0.01	0.05
0025NS004 (Cline Ditch) (Cont.)	4/11/84	7.0	NA	<0.3	NA	NA	NA	NA	NA	NA
	4/26/84	8.0	NA	0.8	<0.1	0.01	0.05	0.02	NA	NA
	5/15/84	6.8	NA	0.4	<0.1	0.01	0.05	0.02	NA	NA
	9/5/84	6.8	NA	<0.3	<0.1	NA	NA	NA	NA	NA
	9/10/84	8.2	NA	0.6	<0.1	NA	NA	NA	NA	NA
	10/10/84	8.0	NA	<0.3	<0.1	NA	NA	NA	NA	NA
	11/26/84	7.8	NA	<0.3	<0.1	NA	NA	NA	NA	NA
0025NS005 (Pipe Creek Downstream)	9/20/82	8.2	NA	0.3	0.1	NA	NA	NA	NA	0.2
	*6/9-10/83	8.0	NA	NA	NA	NA	NA	NA	NA	<0.1
	*8/16-17/83	8.1	NA	NA	NA	NA	NA	NA	NA	<0.1
	3/18/84	6.8	NA	NA	<0.1	NA	NA	NA	NA	NA
	9/10/84	7.8	NA	NA	<0.1	NA	NA	NA	NA	0.4
	12/17/84	8.1	NA	<0.3	<0.1	NA	NA	NA	<0.010	0.2
(0025NS006 Pipe Creek Upstream)	9/20/82	8.2	NA	0.3	0.1	NA	NA	NA	NA	0.2
	*6/9-10/83	8.0	NA	NA	NA	NA	NA	NA	NA	<0.1
	*8/16-17/83	8.0	NA	NA	NA	NA	NA	NA	NA	<0.1
	3/18/84	6.8	NA	NA	<0.1	NA	NA	NA	NA	NA
	9/10/84	8.0	NA	NA	<0.1	NA	NA	NA	NA	0.5

Notes: *Sampling by Indiana State Board of Health
Mn/Dy/Yr = Month/Day/Year
su = Standard Units
mg/l = Milligrams Per Liter
NA = Not Analyzed

Source: Installation Documents and Indiana State Board of Health

Surface Water Use

Surface water in the immediate vicinity of Grissom AFB, including Pipe Creek downstream of the base, is used for livestock watering, irrigation and the propagation of fish and wildlife.

GROUND-WATER RESOURCES

The ground-water resources in the immediate vicinity of Grissom AFB are abundant due to the presence of secondary openings produced by weathering and solution along the joints and bedding planes of the Liston Creek formation. The Liston Creek formation is the chief bedrock aquifer of the area. Additionally, the Liston Creek formation is overlain by unconsolidated glacial deposits of moderate permeability of sufficient thickness to store large quantities of ground water. Reports by Thornbury and Deane (1955), Watkins and Rosenshein (1963), and Hill (1981) describe the ground-water resources of the area.

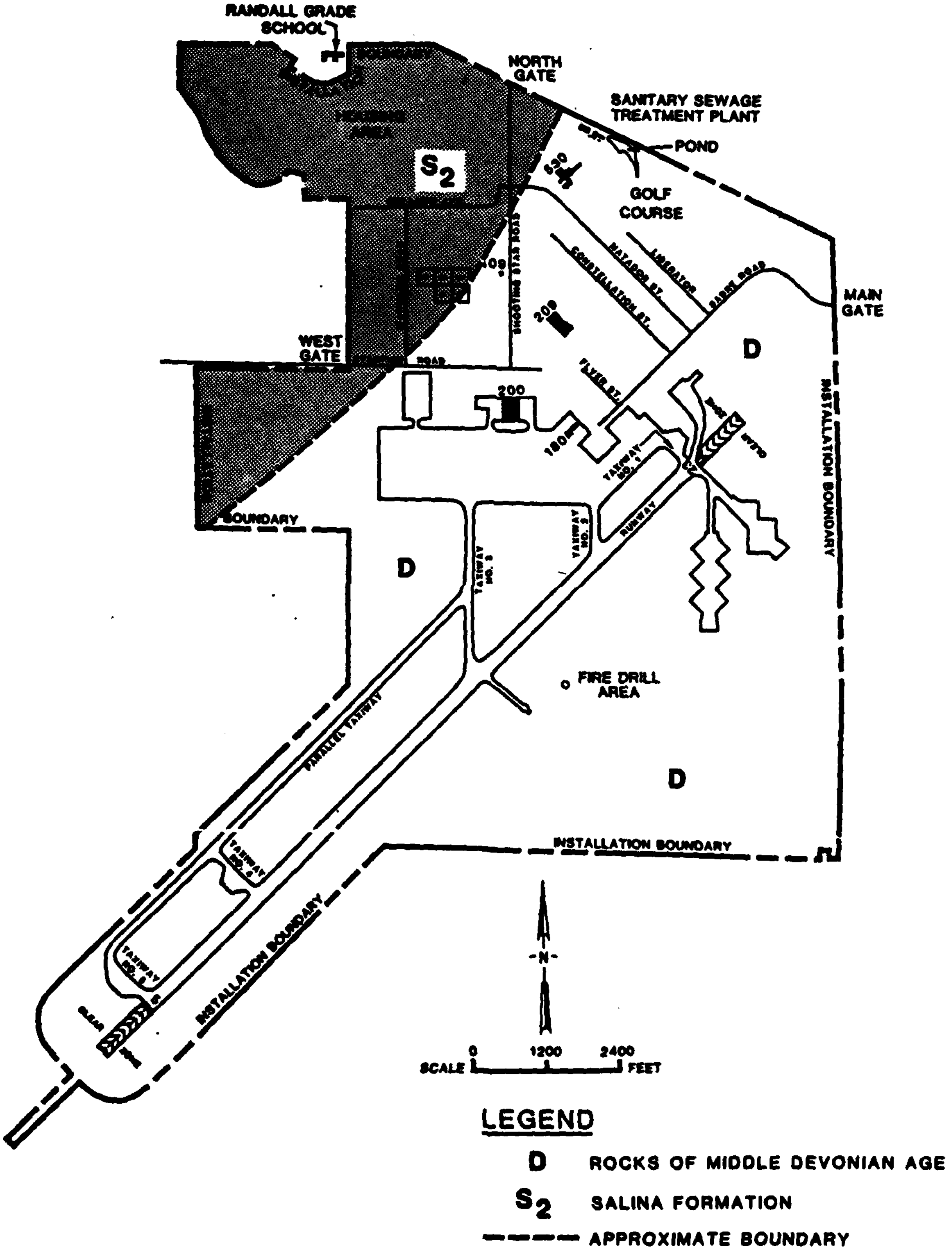
Hydrogeologic Units

Geologically, Grissom AFB is underlain by shales, limestones and dolomite of Silurian and Devonian age and unconsolidated glacial deposits and Recent alluvium of Quaternary age (Figure 3.6). The Silurian and Devonian rocks form the bedrock surface upon which younger geologic materials were deposited. The depth below land surface to these rocks in the vicinity of the base varies from surface exposures along Pipe Creek to depths of over 130 feet (Watkins and Rosenshein, 1963). Glacial deposits and alluvium overlie the rocks.

The unconsolidated deposits at the base include glacial deposits of Pleistocene and Recent alluvium. The Pleistocene glacial deposits consist mainly of a calcareous silty clay till containing sands and gravels which form the ground moraine that underlies the upland surface in the area. The Recent alluvial deposits are restricted to locations primarily along Pipe Creek and its tributaries (Watkins and Rosenshein, 1963). The general stratigraphy in the vicinity of the base is given in Table 3.4.

The bedrock surface underlying the base forms a narrow ridge trending northwest-southeast which is characterized by closed depressions formed in the rock (Watkins and Rosenshein, 1963). Watkins and Rosenshein suggest these depressions are sinkholes formed in the bedrock

GRISSOM AFB
GEOLOGIC MAP



SOURCE: WAYNE, JOHNSON AND KELLER, 1966

TABLE 3.4
HYDROGEOLOGIC UNITS AND THEIR WATER-BEARING
CHARACTERISTICS IN THE VICINITY OF GRISSOM AFB

System	Series	Hydrogeologic Unit	Hydrogeologic Classification	Approximate Thickness (feet)	Dominant Lithology	Water-Bearing Characteristics
Quaternary	Pleistocene and Recent	Unconsolidated Glacial Deposits	Localized Aquifer	100+	Till, chiefly calcareous silty clay; contains embedded sand and gravel; some thin glacio-fluvial sand and gravel	Readily transmits water locally. One well tapping gravel has yielded 51 gpm.
Devonian		Hamilton Group Limestones	Localized Aquifer	6.5	Limestone, massive and crystaline.	May transmit water locally.
Silurian	Cayugan	Kokomo Limestone (Saline Formation)	Localized Aquifer	60	Limestone and argillaceous limestone, inter-bedded, finely laminated	May transmit water locally.
	Niagaran	Liston Creek Limestone	Chief Bedrock Aquifer	60	Limestone and nodular cherty limestone, con-taining alternate thin chert layers	Readily transmits water. Wells yield between 9 and 1000 gpm.
		Mississinewa Shale	Confining Unit	130+	Shale, calcareous or argillaceous; fine grained limestone contains pyrite	Does not readily transmit water.

Notes: gpm = gallons per minute

Source: Watkins and Rosenshein (1961); Thornbury and Dean (1955); Wayne, et. al. (1966)

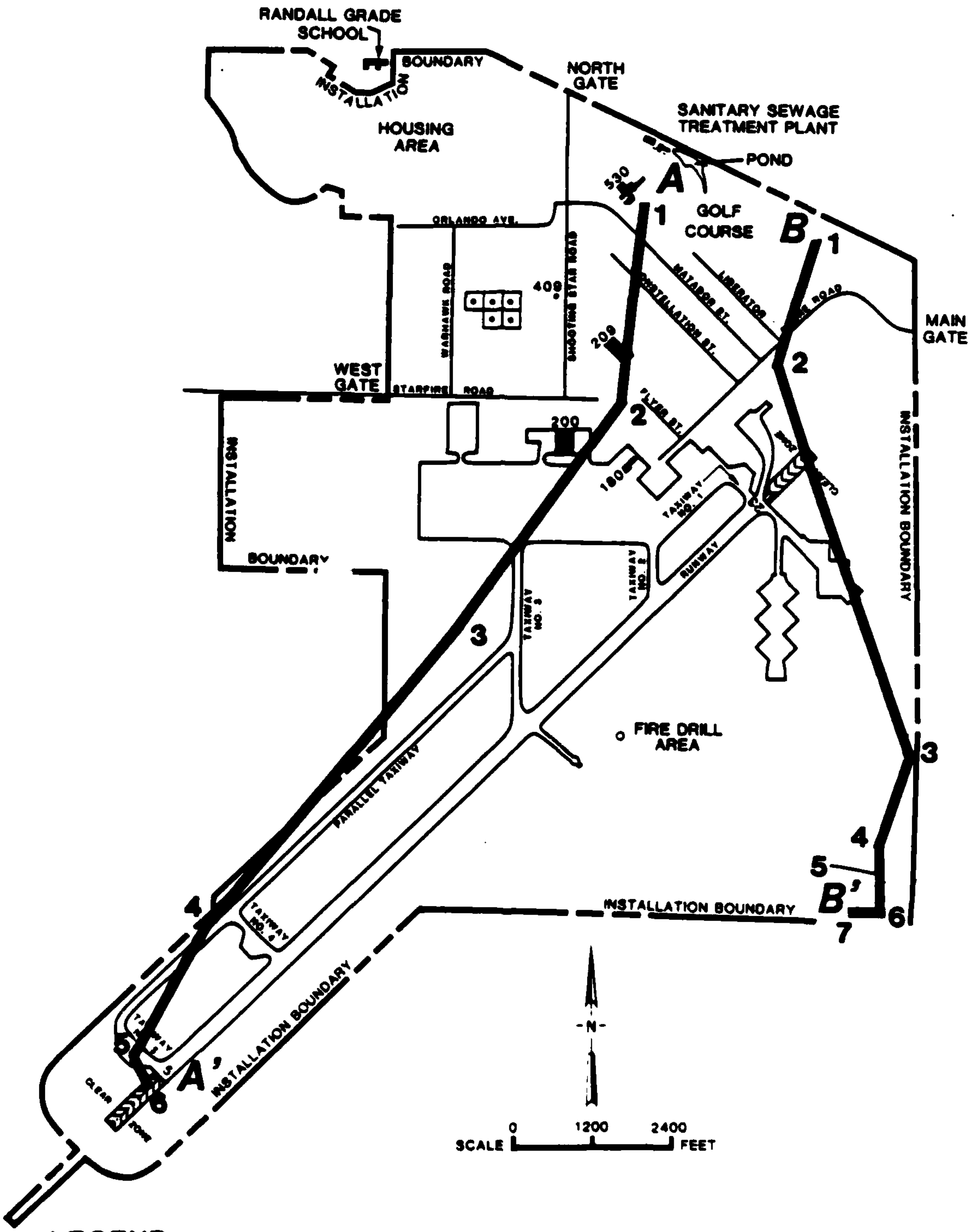
surface due to collapses in the subterranean drainage system within the Liston Creek formation.

The shallow geology and lithology of the base is illustrated by Figures 3.7, 3.8 and 3.9. Figure 3.7 shows the location of the hydrogeologic cross sections across portions of the base. Figure 3.8 illustrates cross section A-A' showing boring locations advanced into sandy loam, brown sandy clay, brown and blue sandy clay and yellow sandy clay. Although not all boring descriptions noted ground-water occurrences, four ground-water occurrences were noted. The water table is shallow, approximately 5 feet, in borings 1, 2, 4 and 5. The soils are of reasonably uniform thickness in most locations, but lenses of yellow sandy clay encountered at boring 3 and brown and blue sandy clay encountered at borings 1 and 2 are discontinuous in the shallow unconsolidated glacial deposits. Figure 3.9 illustrates cross section B-B' showing borings advanced into the unconsolidated glacial till deposits and the Liston Creek and Mississinewa formations underlying the base. No boring descriptions noted ground-water occurrences during the drilling program. The unconsolidated glacial till deposits are of reasonably uniform thickness across the base except at boring 1 where a lens of clayey sand and gravel was encountered. The Liston Creek and Mississinewa formations were encountered at all boring locations except at boring 3. This boring was not advanced to a depth which encountered the Mississinewa formation.

Hydrologically, Grissom AFB is located in an area of abundant ground-water supply. Due to weathering and solution activity along the joints and bedrock planes of the Liston Creek formation a well developed secondary porosity has evolved which yields ample supplies of water for the base. Additionally, the overlying glacial till deposits are of ample thickness to store large quantities of ground water which could offer a secondary water supply if the sand and gravel zones within the till layer were penetrated. One well tapping a gravel zone was reported to have yielded 51 gallons per minute (Watkins and Rosenshein, 1963). However, the Silurian age rocks of the Liston Creek and Mississinewa formations provide the primary source of ground water to the base. Wells tapping these bedrock formations have been reported to yield between 350 and 1,000 gallons per minute (Watkins and Rosenshein, 1963).

GRISSOM AFB

LOCATION OF HYDROGEOLOGIC CROSS-SECTIONS



LEGEND

A–A' CROSS-SECTION LOCATION

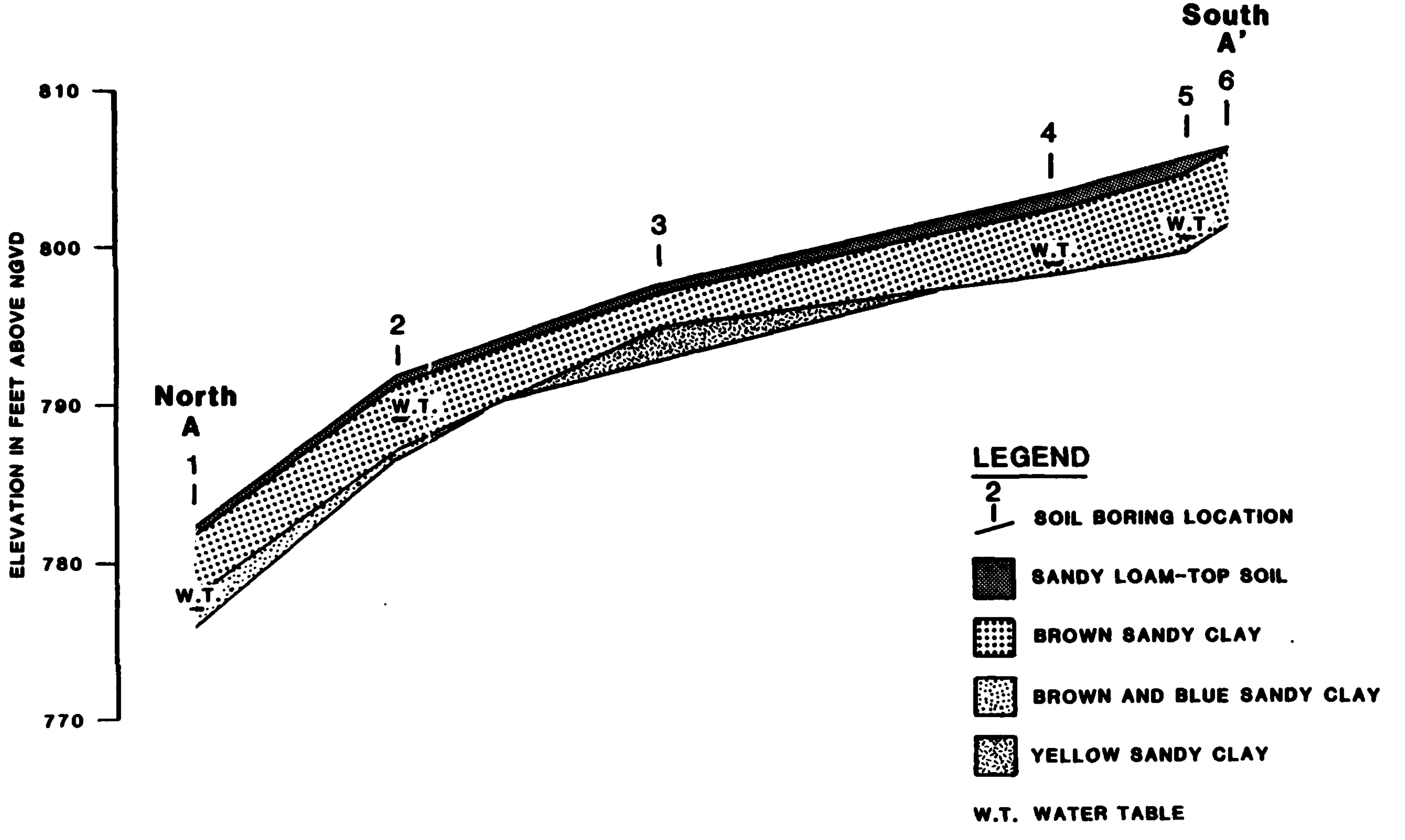
2 BORING LOCATION

SOURCE: INSTALLATION DOCUMENTS

NOTE: SEE FIGURES 3.8 & 3.9 FOR CROSS-SECTIONS

FIGURE 3.8

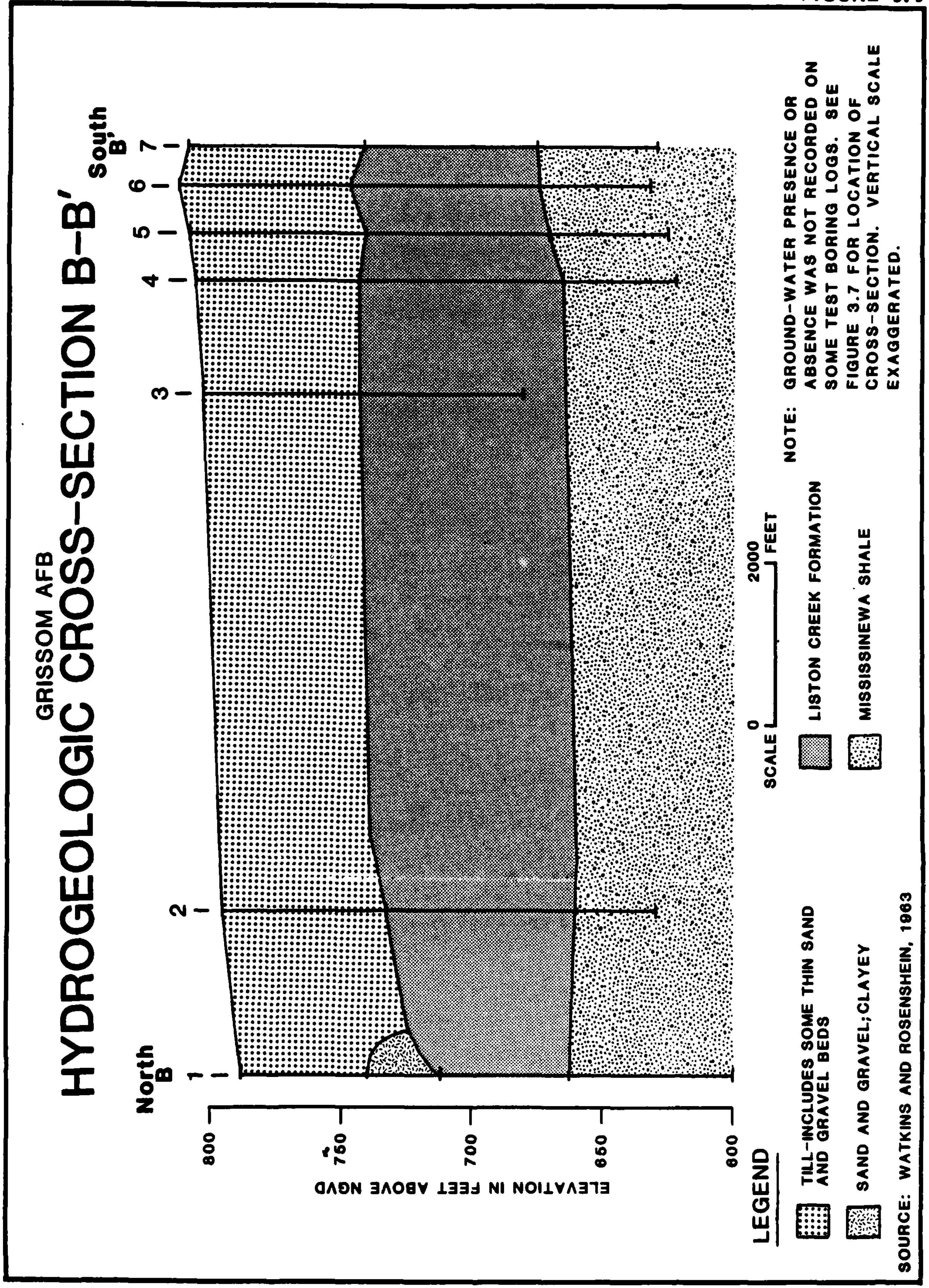
GRISSOM AFB
HYDROGEOLOGIC CROSS-SECTION A-A'



NOTE: GROUND-WATER PRESENCE OR ABSENCE WAS NOT RECORDED ON SOME TEST BORING LOGS. SEE FIGURE 3.7 FOR LOCATION OF CROSS-SECTION. VERTICAL SCALE EXAGGERATED.

SOURCE: INSTALLATION DOCUMENTS

FIGURE 3.9


GRISSOM AFB
HYDROGEOLOGIC CROSS-SECTION B–B'
North B
South B'
1
2
3
4
5
6
7
ELEVATION IN FEET ABOVE NGVD
800
750
700
650
600
SCALE
0
2000 FEET
LEGEND
TILL–INCLUDES SOME THIN SAND AND GRAVEL BEDS
SAND AND GRAVEL; CLAYEY
LISTON CREEK FORMATION
MISSISSINEWA SHALE
NOTE: GROUND-WATER PRESENCE OR ABSENCE WAS NOT RECORDED ON SOME TEST BORING LOGS. SEE FIGURE 3.7 FOR LOCATION OF CROSS-SECTION. VERTICAL SCALE EXAGGERATED.
SOURCE: WATKINS AND ROSENSHEIN, 1963

The uppermost aquifer underlying the base consists of the unconsolidated glacial till deposits and top-of-rock zone which is highly weathered in places. The top-of-rock zone may also contain abundant solution channels and jointing. Ground water within the uppermost aquifer exists under unconfined or water table conditions and normally will flow in the directions similar to those flow directions of local surface water. Migration rates within the clayey till zone are expected to be slow, but moderate to rapid in the sandy and gravelly soils. The most permeable zone of the uppermost aquifer would be the top-of-rock zone where coarse rock fragments as well as solution and jointed rock may be present. Ground water within the uppermost aquifer is recharged by local rainfall and may discharge as springs, inflow to streams, migrate horizontally off base or may migrate vertically downward into the solution channels and joints of the bedrock.

The bedrock aquifer underlying the base and in the immediate vicinity of the base consists of bedrock that has been fractured and jointed. Weathering along the joints and fractures has produced secondary porosity in the form of solution channels along the joints, fractures and bedding planes. The Liston Creek formation is the chief bedrock aquifer underlying the base. Ground-water migration within the bedrock aquifer is moderate but may be rapid depending upon the presence of interconnecting rock openings. The flow direction within the bedrock aquifer underlying the base is generally northward toward Pipe Creek, a natural discharge point for the ground water of the bedrock aquifer (Watkins and Bosenshein, 1963). Localized flow directional changes in 1961 were caused by high rates of ground-water withdrawal near base well number 6, (Figure 3.10). The present direction of ground-water flow is assumed to be similiar to that in 1961; that is, northward, except where localized pumpage has changed the flow directions. Localized flow direction changes are assumed to exist near base wells 6 and 7 which supply the majority of public water to the base.

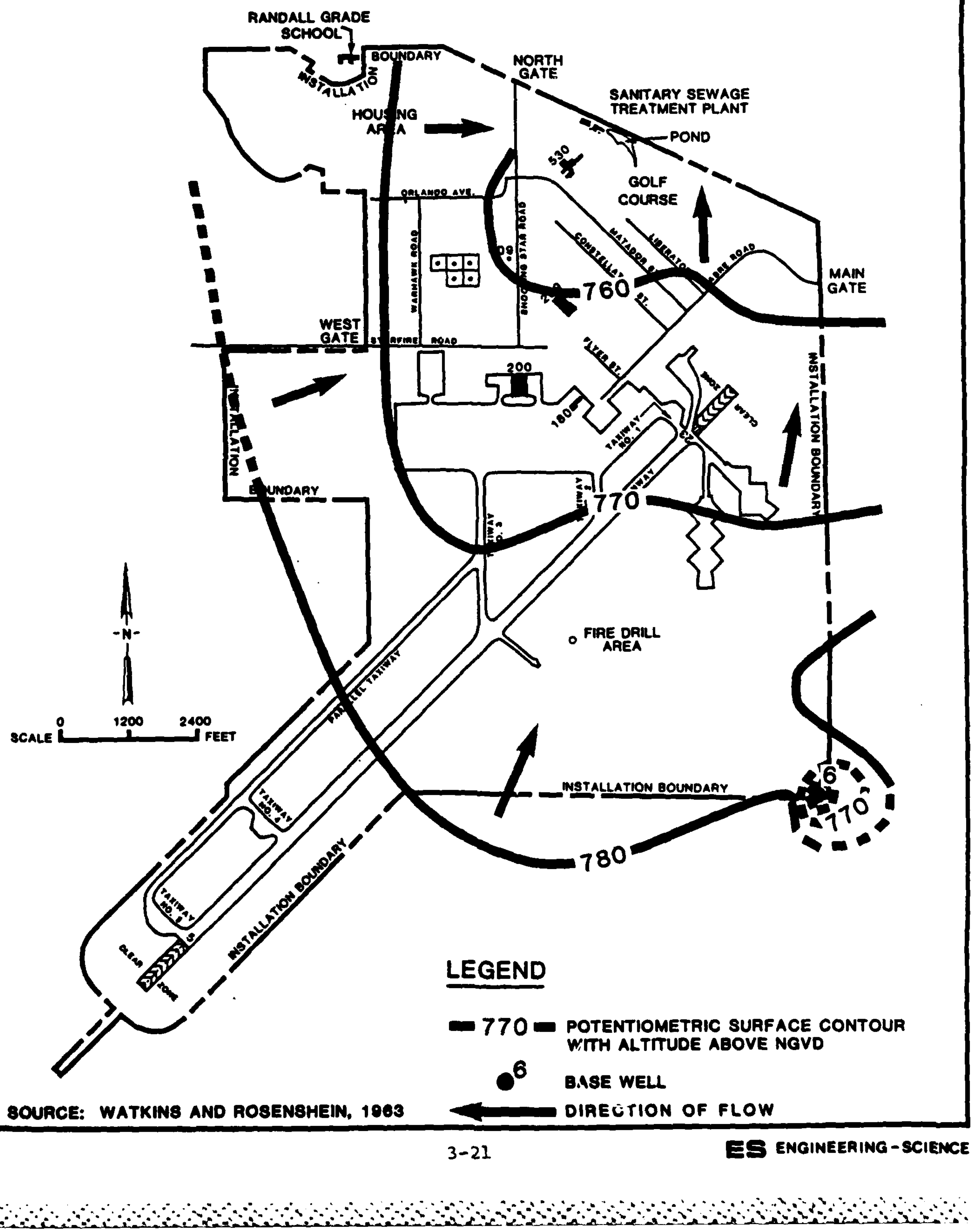
Ground-Water Quality

The ground-water quality within the uppermost aquifer is assumed to be relatively good. It is high in calcium and magnesium bicarbonate and very hard (Watkins and Rosenshein, 1963). The water quality of the bedrock aquifer supplying water to the base shows high concentrations of

GRISSOM AFB

POTENTIOMETRIC SURFACE CONTOUR MAP OF BEDROCK AQUIFER

(JULY 3, 1961)



SOURCE: WATKINS AND ROSENSHEIN, 1963

iron, calcium and magnesium, but with proper treatment is suitable for consumption (Baize Corporation, 1982).

Two ground-water parameters of concern within the bedrock aquifer are iron and manganese. Iron values have been high in base wells 1, 2, 5 and 8, while manganese values have exceeded the recommended drinking water standard (0.05 mg/l) in wells 1, 2 and 5. The parameter analyses are as follows:

Well No.	Sampling Date	Iron (mg/l)	Manganese (mg/l)
1	9/23/81	1.342	0.145
2	9/23/81	6.92	0.056
5	4/23/80	18.0	0.15
5	9/23/81	4.32	0.085
8	9/23/81	3.261	<0.05

Iron concentrations from the other base wells range from 0.1 to 1.3 mg/l. Manganese concentrations from the other base range from less than 0.02 to 0.4 mg/l. The source of the high concentrations of iron and manganese have not been identified, although it is suspected that the concentrations are naturally occurring.

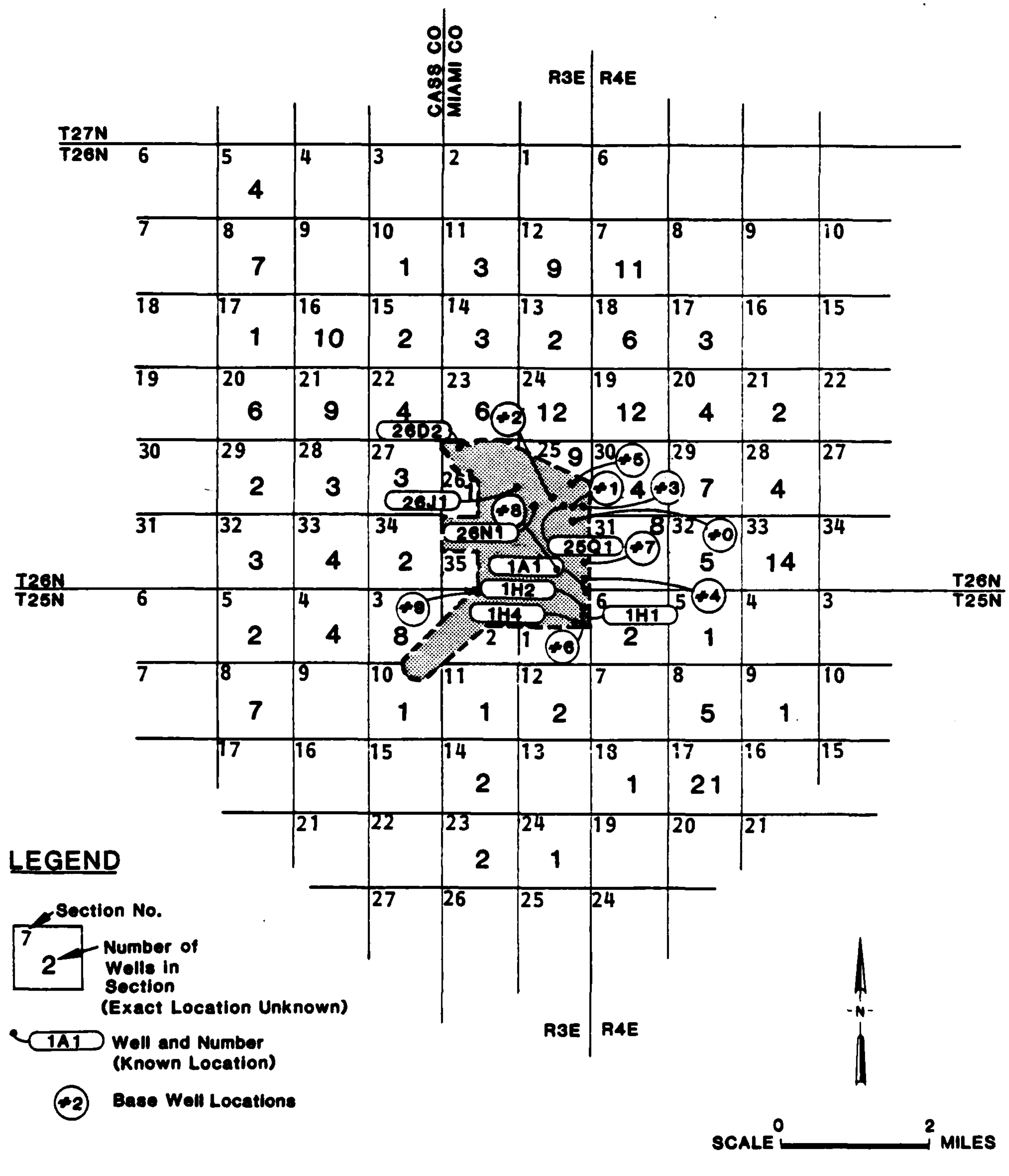
Ground-Water Use

Ground water from the uppermost aquifer is not used on Grissom AFB and is used only moderately in the immediate vicinity of the base. Figure 3.11 shows the location of known wells in the area and the number of wells in each land section where the exact well location is unknown. Ground water from the bedrock aquifer is used on the base as follows:

Wells	Water Supply Use
6 and 7	Main Base
8	Control Tower
9	Jet Engine Test Cell
1	Emergency Basis
0,2,3,4,5	Inactive But Not Abandoned

GRISSOM AFB

REGIONAL WELL LOCATION MAP



SOURCE: WATKINS and ROSENSHEIN, 1963 AND INSTALLATION DOCUMENTS

Ground water from the bedrock aquifer is also used off base for home and farm water supplies. The remainder of the wells with records from the Indiana Division of Water, Department of Natural Reosurces did not specify a detailed well location such that each well could be individually plotted on the map. Instead, the number of wells in each land section has been plotted. The well data available for the wells of the area is summarized in Appendix D, Table D.4. Of the local wells in use most are either domestic (serving residences and/or farms) or non-community (servicing the transient public, churches and schools).

BIOTIC ENVIRONMENT

A cooperative study between the U.S. Fish and Wildlife Service and the AFESC indicated no known occurrence of endangered or threatened species at Grissom AFB. The Indiana Department of Natural Resources Division of Fish and Wildlife Commission confirmed that there are no Federally or State listed threatened or endangered species which permanently inhabit Grissom AFB. Common wildlife found on the base may include doves, field sparrows, thrushes, woodpeckers, ducks, geese, cottontailed rabbits, squirrels, woodchucks, muskrats, mink, beaver, raccoon and white-tailed deer.

SUMMARY OF ENVIRONMENTAL SETTING

The environmental setting information for Grissom AFB indicated the following data as important when evaluating past hazardous waste disposal practices.

1. The mean annual precipitation for Grissom AFB is 34.36 inches; the net precipitation is approximately +2.4 inches and the one-year, 24-hour rainfall event is approximately 2.5 inches. These data indicate that there is an abundance of rainfall in excess of evaporation and that there is a potential for storms to create excessive runoff and leachate from infiltration.

2. The soils on the base are silty loams with moderate vertical permeability. These data indicate that recharge by precipitation infiltrating the soils will be moderate.

3. Surface water on the base is controlled by drainage courses and underground storm drains. According to base records and the Federal Emergency Management Agency, Grissom AFB has no 100-year encroachment.

4. Two aquifers underlie Grissom AFB. The uppermost aquifer exists within the unconsolidated glacial deposits to approximately 60 feet. The bedrock aquifer exists within consolidated rock to approximate depths of from 60 to 250 feet.

5. Ground water within the uppermost aquifer exists under unconfined conditions and typically within five feet of the ground surface. The most permeable zone within the uppermost aquifer would be the top-of-the rock zone where highly weathered, fractured, jointed and solution rock may exist.

6. Ground water within the bedrock aquifer exists under confined conditions. The bedrock aquifer is continuous within the vicinity of the base and well yields are highest in wells which penetrate the interconnecting fractures, joint and solution channels.

7. Solution channels and sinkholes may exist within the Silurian age rocks underlying the base. These conditions would promote the rapid migration of ground water within the bedrock aquifer.

8. Ground water from the uppermost aquifer is not used on the base. Ground water from the bedrock aquifer is the primary source of potable water for the base.

9. There are no known federally or state listed endangered or threatened species which permanently inhabit Grissom AFB.

A review of these major findings indicates that pathways for the migration of hazardous waste related contamination exist. Contaminants present at ground surface would likely be discharged into local drainage alignments via the shortest flow path. The top-of-rock zone is expected to be the most permeable zone within the uppermost aquifer. Contaminants, if released, would be expected to migrate horizontally within this zone. Localized downward vertical migration of ground water and contaminants, if released, may occur within interconnecting fractures, joints or solution channels within the bedrock aquifer underlying the base.

SECTION 4

FINDINGS

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

SATELLITE FACILITIES REVIEW

There are no satellite facilities associated with Grissom AFB, therefore a satellite facilities review was not performed.

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 Grissom AFB are grouped into the following categories:

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

The subsequent discussion addresses only those wastes generated at Grissom 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 and the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA). Compounds such as polychlorinated biphenyls (PCB) 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 and waste solvents are also included in the "hazardous waste" category.

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

Industrial Operations (Shops)

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

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

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

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

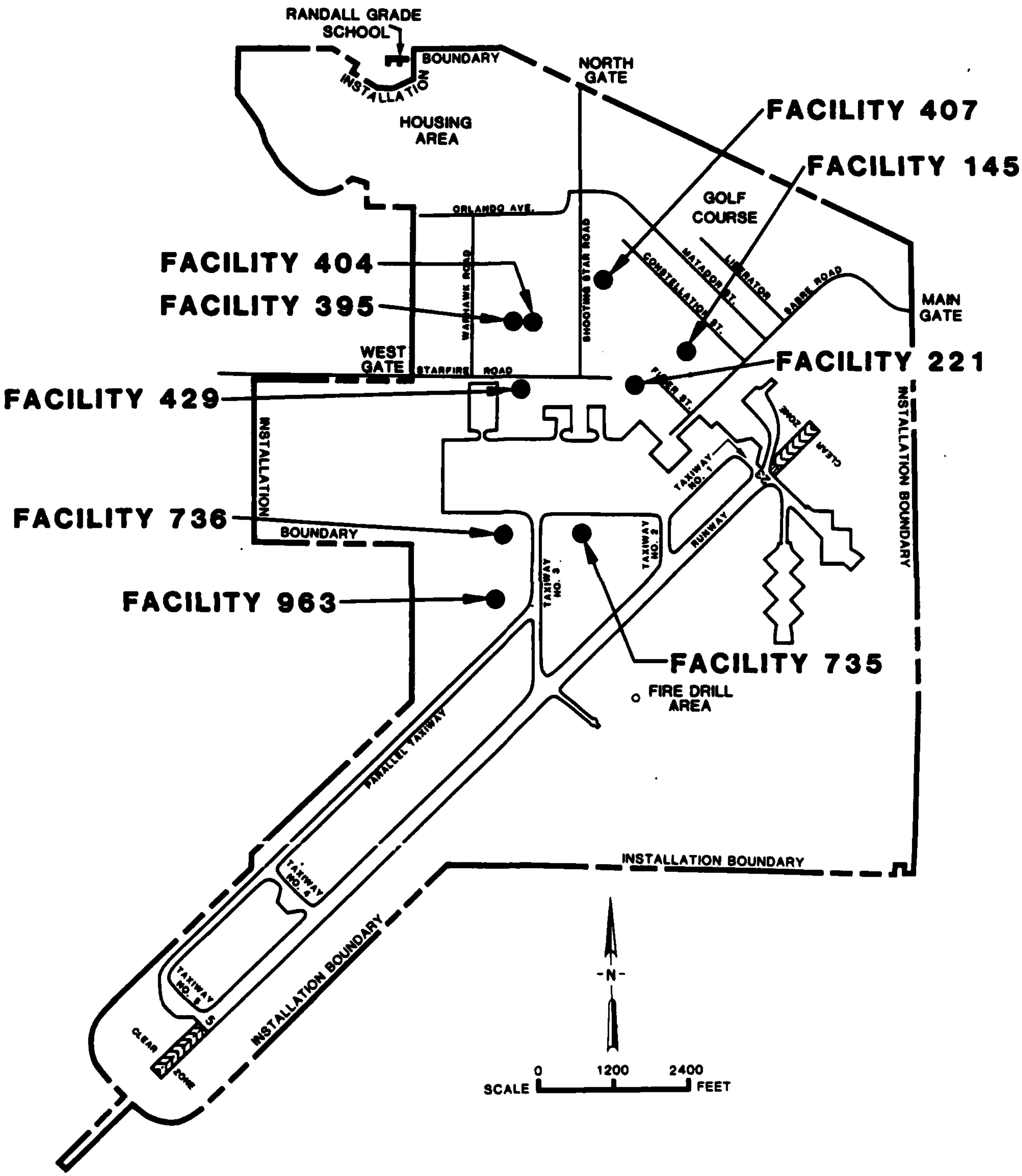
Until the early 1970's, much of the waste fuels, oils, and solvents from the shops was taken to the fire protection training area for use in training exercises. Since the early 1970's, the shops have disposed of the waste oils and solvents through the Defense Property Disposal Office (DPDO). Most non-flammables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

In Table 4.1, OBC refers to an off-base contractor, which would include resale/recycle/reclamation, off-base disposal by contract, or informal off-base disposal not involving contracts. Off-base contractors have removed waste liquids by pumping from holding tanks and holding drums or by remvoing the entire drum.

Waste Accumulation Areas

Currently shop waste materials are drummed and placed in the temporary facility, and waste oils are placed in one of the nine underground tanks (designated for waste fuel, waste oil, and waste synthetic fluids) at the facilities identified in Appendix D awaiting disposal by DPDO. Figure 4.1 shows the locations of these tanks. Oils from the oil-water separators identified in Appendix D are removed and disposed of by an off-base contractor. Some spillage is indicated on the ground at the 963 area, but evidence of major spills was not present. The underground tanks have not been cleaned or tested for leaks; however, there has been no reason to suspect tank leakage based upon present operations.

GRISSOM AFB
WASTE STORAGE LOCATIONS



NOTE: REFER TO APPENDIX D, TABLE D.3 FOR INFORMATION ON WASTE STORAGE LOCATIONS.

SOURCE: INSTALLATION DOCUMENTS

TABLE 4.1

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1950 1960 1970 1980)
USAF HOSPITAL GRISSOM				
DENTAL CLINIC	210	SPENT FIXER	60 GALS./YR.	1960 SILVER RECOVERY/SANITARY SEWER
		SPENT DEVELOPER	120 GALS./YR.	SANITARY SEWER
RADIOLOGY	530	SPENT FIXER	24 GALS./YR.	SILVER RECOVERY/SANITARY SEWER
		SPENT DEVELOPER	48 GALS./YR.	SANITARY SEWER
305 COMBAT SUPPORT GROUP (CSG)				
PHOTO LABORATORY	535	SPENT FIXER	120 GALS./YR.	SILVER RECOVERY/SANITARY SEWER
		SPENT DEVELOPER	240 GALS./YR.	SANITARY SEWER
AUTO HOBBY	145	WASTE OIL & PD-680 (TYPE II)	2,700 GALS./YR.	1962 DPDO → OBC
BASE SERVICE STATION	407	WASTE OIL	500 GALS./YR.	OBC
		BATTERIES & ACID (INTACT)	240 UNITS/YR.	OBC
305 AVIONICS MAINTENANCE SQUADRON (AMS)				
PMEL	427	WASTE MERCURY	10 LBS./YR.	1955 DPDO
305 SUPPLY SQUADRON (SUPS)				
FUELS LABORATORY	440	CONTAMINATED FUEL	10 GALS./YR.	DPDO

KEY

——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

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

OBC - OFF-BASE CONTRACTOR

DPDO - DEFENSE PROPERTY DISPOSAL OFFICE

TABLE 4.1 (CONT'D)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	CURRENT WASTE QUANTITY GENERATED	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1950 1960 1970 1980)
305 FIELD MAINTENANCE SQUADRON (FMS)				
CORROSION CONTROL	200	PAINT & SOLVENTS (METHYL ETHYL KETONE, TOLUENE, ETC)	330 GALS./YR.	1955 DPDO
		PAINT STRIPPER (COLD DIP)	660 GALS./YR.	DPDO
WASH RACK	985	PD-680 (TYPE II)	660 GALS./YR.	OIL/WATER SEPARATOR-OBC
		CARBON REMOVER (PHOSPHORIC ACID)	100 GALS./YR.	OIL/WATER SEPARATOR-OBC
		PAINT SLUDGE	24 GALS./YR.	SANITARY LANDFILL
AGE	425	WASTE ENGINE OIL	2,100 GALS./YR.	DPDO
		PD-680 (TYPE II)	2,400 GALS./YR.	DPDO
		SYNTHETIC OIL	960 GALS./YR.	DPDO
PROPULSION	190	PD-680 (TYPE II)	660 GALS./YR.	DPDO
		CARBON REMOVER	220 GALS./YR.	DPDO
		FINGERPRINT REMOVER (KETONE)	20 GALS./YR.	DPDO
		CALIBRATING FLUID	660 GALS./YR.	DPDO

KEY

——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

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

OBC - OFF-BASE CONTRACTOR

DPDO - DEFENSE PROPERTY DISPOSAL OFFICE

TABLE 4.1 (CONT'D)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	CURRENT WASTE QUANTITY GENERATED	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1950 – 1960 – 1970 – 1980)
PROPULSION (CONT'D)	190	HYDRAULIC FLUID	1,320 GALS./YR.	1955 DPDO
		ENGINE OIL	1,320 GALS./YR.	FPTA 1972 DPDO
BATTERY & ELECTRIC	200	LEAD BATTERY ACID	120 GALS./YR.	NEUTRALIZED TO SANITARY SEWER
		LEAD BATTERY CASES	120 CASINGS/YR.	DPDO
		NICKEL-CADMIUM BATTERIES (CASE & ACID)	800 CELLS/YR.	DPDO
NONDESTRUCTIVE INSPECTION	426	FLUORESCENT PENETRANT	200 GALS./YR.	1971 DPDO
		EMULSIFIER	250 GALS./YR.	DPDO
		SPENT FIXER	15 GALS./YR.	SILVER RECOVERY/ SANITARY SEWER
		SPENT DEVELOPER	30 GALS./YR.	SANITARY SEWER
		MAG INSPECTION OIL	80 GALS./YR.	DPDO
		TRICHLOROETHANE	24 GALS./YR.	DPDO
WHEEL & TIRE	436	PD-680 (TYPE II)	300 GALS./YR.	1955 DPDO
		HYDRAULIC FLUID	110 GALS./YR.	DPDO
PNEUDRAULICS	200	HYDRAULIC FLUID	1,440 GALS./YR.	1960 DPDO
		PD 680 (TYPE II)	220 GALS./YR.	DPDO

KEY

——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

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

OBC - OFF-BASE CONTRACTOR

DPDO - DEFENSE PROPERTY DISPOSAL OFFICE

FPTA - FIRE PROTECTION TRAINING AREA

TABLE 4.1 (CONT'D)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	CURRENT WASTE QUANTITY GENERATED	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1950 / 1960 / 1970 / 1980)
TEST CELL	741	CONTAMINATED FUEL	550 GALS./YR.	1960 DPDO
		ENGINE OIL	660 GALS./YR.	DPDO
		PD-680 (TYPE II)	10 GALS./YR.	DPDO
		CARBON REMOVER	10 GALS./YR.	DPDO
		HYDRAULIC FLUID	50 GALS./YR.	DPDO
305 ORGANIZATIONAL MAINTENANCE SQUADRON (OMS)				
NON-POWERED AGE	435	LUBE OIL	20 GALS./YR.	1955 DPDO
		HYDRAULIC FLUID	400 GALS./YR.	DPDO
		PD-680 (TYPE II)	60 GALS./YR.	DPDO
		TCE	20 GALS./YR.	DPDO
FLIGHTLINE	435	ENGINE OIL & HYDRAULIC FLUID	7,800 GALS./YR.	DPDO
		CONTAMINATED JP-4	15,600 GALS./YR.	DPDO

KEY

——— CONFIRMED TIME FRAME DATA BY SHOP PERSONNEL

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

OBC - OFF-BASE CONTRACTOR

DPDO - DEFENSE PROPERTY DISPOSAL OFFICE

TABLE 4.1 (CONT'D)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	CURRENT WASTE QUANTITY GENERATED	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL 1950 1960 1970 1980
INSPECTION	200	ENGINE OIL	1,300 GALS./YR.	1955 DPDO
		HYDRAULIC FLUID	520 GALS./YR.	DPDO
305 TRANSPORTATION SQUADRON (TRANS)				
VEHICLE MAINTENANCE/ FIRE TRUCK MAINTENANCE/ REFUELING MAINTENANCE	420/100/421	ENGINE OIL	2,860 GALS./YR.	DPDO
		PAINT THINNERS	1,300 GALS./YR.	DPDO
		PD-680 (TYPE II)	120 GALS./YR.	DPDO
		CARBURETOR CLEANER	60 GALS./YR.	OBC
		BATTERY CASES	360 CASES/YR.	DPDO
		BATTERY ACID	720 GALS./YR.	NEUTRALIZED TO SANITARY SEWER
		CONTAMINATED JP-4	480 GALS./YR.	DPDO
SPECIAL PURPOSE	33	WASTE OIL	3,640 GALS./YR.	DPDO
		PD-680 (TYPE II)	120 GALS./YR.	DPDO
		CARBURETOR CLEANER	60 GALS./YR.	OBC

KEY

—— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

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

OBC - OFF-BASE CONTRACTOR

DPDO - DEFENSE PROPERTY DISPOSAL OFFICE

TABLE 4.1 (CONT'D)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	CURRENT WASTE QUANTITY GENERATED	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1950 1960 1970 1980)
305 CIVIL ENGINEERING SQUADRON (CES)				
LIQUID FUELS MAINTENANCE	122	WASTE FUEL & TANK SLUDGE	2,400 GALS./YR.	1955 WEATHERED OR LANDFILLED; 1979 DPDO
PAINT	221	PAINT THINNERS	220 GALS./YR.	DPDO
		EMPTY LATEX, POLYURETHANE & ENAMEL PAINT CANS	160 CANS/YR.	SANITARY LANDFILL
EXTERIOR ELECTRIC	221	TRANSFORMERS & OIL (PCB & NON PCB)	2 UNITS/YR.	DPDO
POWER PRODUCTION	122	BATTERY ACID	48 GALS./YR.	NEUTRALIZED TO SANITARY SEWER
		BATTERY CASES	24 CASES/YR.	DPDO
		WASTE OIL & FUEL	750 GALS./YR.	DPDO
REFRIGERATION	122	CONDENSER OIL	110 GALS./YR.	DPDO
HEAT SHOP	122	HYDROCHLORIC ACID	125 GALS./YR.	NEUTRALIZED TO SANITARY SEWER
PAVEMENT & GROUNDS	122	EMPTY HERBICIDE CONTAINERS	25 CONTAINERS/YR.	TRIPLE RINSED/LANDFILLED 1975
ENTOMOLOGY	221	EMPTY PESTICIDE CONTAINERS	150 CONTAINERS/YR.	LANDFILL
		DILUTE TANK RINSATE	2,340 GALS./YR.	SANITARY SEWER

KEY

——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

- - - - ESTIMATED TIME FRAME DATA BY SHOP PERSONNEL

OBC - OFF-BASE CONTRACTOR

DPDO - DEFENSE PROPERTY DISPOSAL OFFICE

TABLE 4.1 (CONT'D)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	CURRENT WASTE QUANTITY GENERATED	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1950 1960 1970 1980)
931 AIR REFUELING GROUP				
THE 931 AIR REFUELING GROUP SHOP WASTES ARE DISPOSED OF THROUGH THE 305 FMS AND AMS SHOPS WITH WHICH THEY SHARE FACILITIES EXCEPT THE FOLLOWING:				
PHASE DOCK	437	WASTE OIL, HYDRAULIC FLUID, AND PD-680 (TYPE II)	3,000 GALS./YR.	1979 DPDO →
		WASTE JP-4	8,400 GALS./YR.	DPDO →
930 CONSOLIDATED AIRCRAFT MAINTENANCE SQUADRON (CAMS)				
CORROSION CONTROL/REPAIR & RECLAMATION/PHASE INSPECTION	S-11	PAINT REMOVER	220 GALS./YR.	1970 DPDO →
		WASTE PAINT	220 GALS./YR.	DPDO →
		PD-680 (TYPE II)	55 GALS./YR.	DPDO →
AGE POWERED AND NON POWERED	S-21	HYDRAULIC FLUID	55 GALS./YR.	DPDO →
		ENGINE OIL	200 GALS./YR.	DPDO →
		SYNTHETIC OIL	20 GALS./YR.	DPDO →
		PD-680	200 GALS./YR.	DPDO →
		WASTE FUEL	50 GALS./YR.	DPDO →

KEY

——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

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

OBC - OFF-BASE CONTRACTOR

DPDO - DEFENSE PROPERTY DISPOSAL OFFICE

TABLE 4.1 (CONT'D)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	CURRENT WASTE QUANTITY GENERATED	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL 1950 1960 1970 1980
AGE POWERED AND NON-POWERED (CONT'D)	S-21	BATTERY ACID	25 GALS./YR.	1970 NEUTRALIZED TO SANITARY SEWER
		BATTERY CASES	15 CASES/YR.	DPDO
PNEUDRAULICS	S-22	HYDRAULIC FLUID	60 GALS./YR.	DPDO
GUN RELEASE	S-22	PD-680 (TYPE II)	200 GALS./YR.	DPDO
AIRCRAFT GENERATION	S-19	WASTE JP-4	400 GALS./YR.	DPDO
71 FLYING TRAINING WING ACE				
MAINTENANCE	438	ENGINE OIL	60 GALS./YR.	1977 DPDO
		WASTE JP-4	120 GALS./YR.	DPDO

KEY

——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

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

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DPDO - DEFENSE PROPERTY DISPOSAL OFFICE

A waste oil drum storage pad is located at the west edge of a paved concrete apron north of the runway (at Facility 963 on Figure 4.1). This site was activated for this purpose in the 1960's, and its use was discontinued in 1982. During its period of use up to 150 waste oil drums were stored on the concrete pad and on the soil-covered area adjacent to the western edge of the pad. Interviewees reported that many drums were properly closed and others were open, allowing their contents to discharge during rainstorms. Since 1982 the waste oils have been stored in an underground waste oil storage tank adjacent to the site (Facility No. 963). At present this site shows oil stains on both the concrete pad and the nearby soil.

Battery cases and materials of a solid nature are placed in a holding area at Facility 684. These waste materials are recycled or contract disposed through DPDO.

Fuels Management

The Grissom AFB petroleum handling system includes substantial volumes of JP-4 jet fuel, diesel fuel, motor vehicle gasoline (Mogas), unleaded gasoline, #2 and #6 fuel oil, aircraft deicing fluid and PD-680 solvent. The capacity of the storage tanks is provided in Appendix D. The aircraft deicing fluid is currently delivered by rail; the remaining products are delivered by truck. The larger tanks, over 25,000 gallons, are cleaned every 3 years. Waste fuel from the cleaning is recycled if possible. If the contaminated fuel is not suitable for recycling it is placed in the waste tank and disposed of through an off-base contractor. Sludges and tank bottoms have been disposed of by an off-base contractor since 1977. Before 1977 the sludge was weathered and/or buried in diked areas and other areas on base, as discussed later in this section.

Spills and Leaks

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

Since the early 1970's several spills of record have occurred. In 1971, Tank No. 2 of the POL system was overfilled, resulting in the release of less than 1,000 gallons of JP-4. The fuel from this one-time incident flowed into Pipe Creek and was not recovered. Also a one-time incident occurred during the 1971 to 1973 time period, in which several hundred gallons of JP-4 reached Pipe Creek from the POL area and was recovered by damming of Pipe Creek. Finally, in 1977 the 275,000 gallon tank at the heating plant was overfilled, and approximately 1,500 gallons of fuel oil was collected in the oil-water separator serving the area. All of these incidents were one-time occurrences, and no present potential for environmental contamination is associated with these spills.

A few small spills involving PCB oils have occurred in the past several years. The soils at these sites were removed and analyzed and those which were greater than 0.5 ppm were disposed off-base by a contractor.

Pesticide Utilization

Pesticides have been used at Grissom AFB for controlling weeds, insects, rodents, and fungus. Pesticides used at the base are listed in Appendix D. Entomology mixes all of the pesticide chemicals used on base inside the Entomology Shop in Building 221. During the period of record this shop has been in the present location, along with the adjacent secure storage area. Empty containers are triple rinsed and punctured prior to disposal at an off-base landfill; prior to about 1974 these procedures were followed except that the triple rinsed and punctured containers were disposed of in Landfill No. 3 on-base. The spray equipment and miscellaneous entomology equipment are cleaned and rinsed in a shower stall in the Entomology Shop in Building 221 which is plumbed to the sanitary sewer.

Road and Grounds crews have used herbicides on the base and have performed their application for many years. Herbicide storage is and has been historically in a concrete block building adjacent to Building 122; mixing of herbicides has occurred in the Entomology Shop. The list of herbicides used by Road and Grounds is contained in Appendix D.

Golf Course maintenance is and has been performed from a facility adjacent to the course (Building 521) since 1973. Prior to 1973 golf course maintenance was conducted from the Pro Shop. Chemicals used in golf course maintenance are powdered and granular materials which are applied with drop spreaders. As a consequence, no mixing or excess prepared dilution disposal has been associated with golf course maintenance. Storage of golf course maintenance chemicals is in Building 520.

Excess chemicals which are out-of-date or are otherwise not consumed in process are transferred to DPDO for disposal. Diluted chemicals are consumed in process.

Fire Protection Training

Fire protection training at Grissom AFB has been conducted at two sites. These site locations are depicted in Figure 4.2. Each site is described separately in the following discussion.

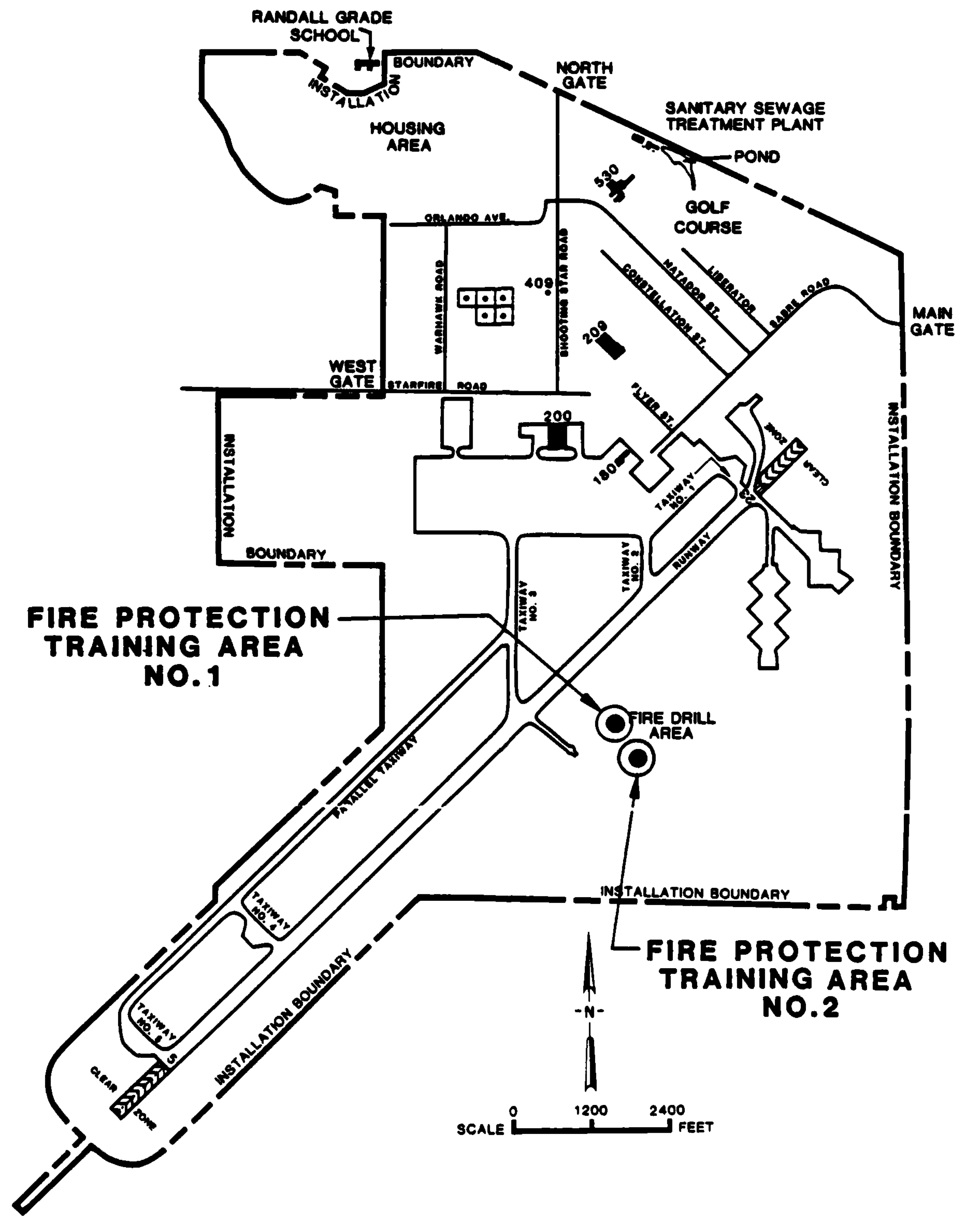
Fire Protection Training Area (FPTA) No. 1

Fire Protection Training Area No. 1 was located north of the control tower and south of the runway. This site was activated in approximately 1957 and was used until 1982. At this site during the 1950's and 1960's waste JP-4, waste oils, paint thinners, and other combustible fluids were burned in fire training exercises at a typical frequency of three exercises per month. Fuel was normally transported to the site in bowsers from the aircraft maintenance shops and was dumped without prewetting into the pit, which was a soil and gravel-covered area. Immediately after dumping a volume of up to 800 gallons (500 gallons after 1980), the fuel was ignited and extinguished. Extinguishing agents included AFFF, Halon 1211, CB, dry chemical, PKP, and protein foam. Unburned fuel collection and oil-water separation were not practiced at this site. During the early 1970's, waste combustible liquids were stored in 55-gallon drums at the site; this practice was discontinued after 1972. Since about 1974, only pure JP-4 has been used as the fuel in fire protection training exercises at the base and prewetting has been practiced. In 1982, fire protection training activities were moved to Fire Protection Training Area No. 2. Because of the nature and duration of the activities at the FPTA No. 1 site, a potential for contaminant migration exists.

Fire Protection Training Area (FPTA) No. 2

Fire Protection Training Area No. 2 is located northeast of the control tower and southeast of Fire Protection Training Area No. 1.

GRISSOM AFB
FIRE PROTECTION TRAINING AREAS



SOURCE: INSTALLATION DOCUMENTS

This site was used for fire protection training exercises from 1982 until late 1984, when its use was suspended for rehabilitation and upgrading of the site. At this site only pure JP-4 has been burned after prewetting the site base with water. Fuel is transported by tank truck to the site upon request and is dumped and immediately ignited and extinguished. Until the current upgrade, the site was a soil and gravel-covered area; unburned fuel collection and oil-water separation were not practiced. Since 1983, the fuel volume used has been 300 gallons. Extinguishing agents have included AFFF, Halon 1211, CB, dry chemical, and PKP. In late 1984, fire protection training activities at the site were suspended for a rehabilitation and upgrade of the site, including construction of unburned fuel collection and oil-water separation facilities, a polymer pit liner, and a new aircraft mock-up. Fire training activities are not being conducted at the base during this project. Because of the nature and duration of the activities at the site, a potential for contaminant migration exists for the site.

BASE WASTE DISPOSAL METHODS

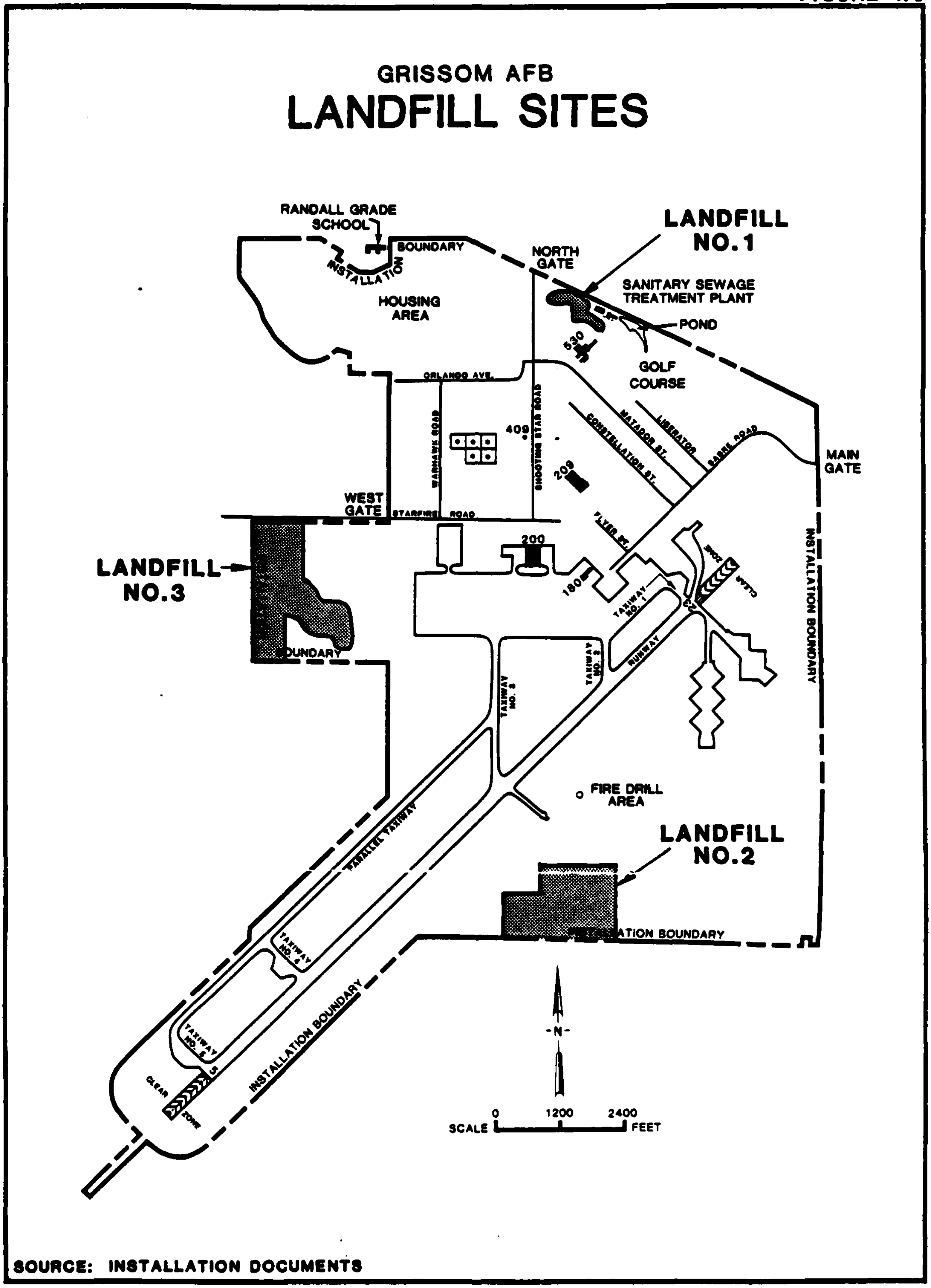
The facilities on Grissom AFB which have been used for the management and disposal of waste can be categorized as follows:

- Landfills
- Surface Impoundment
- Expended Munitions Disposal Area
- Sludge Weathering Area
- Oil-Water Separators
- Wastewater Treatment Plant
- Surface Water Drainage System

These facilities are discussed separately in the following subsections.

Landfills

Three on-base landfills at Grissom AFB have been used for disposal of refuse and some industrial waste materials. The locations of these landfills and their estimated boundaries are shown in Figure 4.3. Each landfill is described separately in the discussion which follows.


GRISSOM AFB
LANDFILL SITES
RANDALL GRADE SCHOOL
BOUNDARY
INSTALLATION
HOUSING AREA
NORTH GATE
LANDFILL NO.1
SANITARY SEWAGE TREATMENT PLANT
POND
530
GOLF COURSE
ORLANDO AVE.
WABHAWK ROAD
SHOOTING STAR ROAD
409
209
CONSTELLATION ST.
MATADOR ST.
LIBERATOR
SABRE ROAD
MAIN GATE
WEST GATE
STARFIRE ROAD
FLYER ST.
200
180
LANDFILL NO.3
BOUNDARY
TAXIWAY NO. 1
TAXIWAY NO. 2
TAXIWAY NO. 3
RUNWAY
CLEAR ZONE
INSTALLATION BOUNDARY
FIRE DRILL AREA
LANDFILL NO.2
ATION BOUNDARY
PARALLEL TAXIWAY
TAXIWAY NO. 4
TAXIWAY NO. 5
INSTALLATION BOUNDARY
N
0 1200 2400
SCALE FEET
SOURCE: INSTALLATION DOCUMENTS

Landfill No. 1

Landfill Number 1 was located at the northern end of the base west of the wastewater treatment plant. The landfill was reported to have been in use during the 1940's, during which time the base was a Naval Air Station. Waste materials bearing naval insignia have been unearthed during construction activities in the area, in particular at the number 4 hole at the base golf course. The landfill is estimated to have occupied approximately 10 acres.

During the 1950's the landfill was used for disposal of hardfill and construction rubble. No interviewees reported the disposal of normal base refuse or of industrial wastes in this landfill since the time Air Force control began; however, no records or interviews confirmed the use of an off-site landfill during this era. It is assumed that the limited base refuse produced during this period of low base population and extensive construction was probably deposited in the landfill, but the volumes were smaller than the volume of construction rubble.

The landfill was closed in 1958; at that time the landfill was moved to Landfill Number 2. At present the surface of Landfill No. 1 is level, and a soil-cement layer was installed to serve as a base for the North Coal Yard.

Landfill No. 2

Landfill No. 2 was located at the south end of the base south of the control tower. This landfill was opened in 1958, and was closed in 1963. The landfill, encompassing approximately 50 acres, received normal base refuse and some industrial waste materials in a trench-and-fill operation with trenches five to seven feet deep. Ground water infiltrated the trenches soon after opening because of the high groundwater table, typically three to five feet below surface. Normal base refuse and construction rubble were reported to be the largest volume wastes disposed in this landfill. Some volume of drummed waste fuel, oil, and chemicals were disposed of in the landfill; interviewees estimated less than 100 drums, many nearly empty, were disposed at this site.

When the landfill was closed in 1963, disposal of base refuse materials was moved to Landfill No. 3. At present the surface of Landfill No. 2 is level with a soil and grass cover.

Landfill No. 3

Landifll No. 3 was located at the western end of the base, and surrounds the firing range. This landfill was activated in 1963 and its use was discontinued in 1974. Since 1974, base refuse has been transported off-base for disposal by a contractor.

During its period of use, this landfill of approximately 50 acres received normal base refuse, construction hardfill and rubble, and industrial wastes. Interviewees reported the disposal of hundreds of drums in the landfill, many of which contained undetermined volumes of industrial wastes (oils, fuels, thinners, and other chemicals).

The landfill was a trench-and-fill operation with trenches five to seven feet in depth. Ground water infiltrated the trenches.

Since the closing of the landfill, it has received limited use for other material disposal. Since 1982, disposal of expended munitions has occurred in the southwest section of the landfill; this site is marked at present with a sign. In addition, digested sludge from the drying beds at the wastewater treatment plant is mixed with ash from the heating plant and disposed on the surface of the landfill in a surface reclamation program.

At present the landfill surface is moderately level, with little vegetation present. Sludge-ash mixtures and some hardfill are visible.

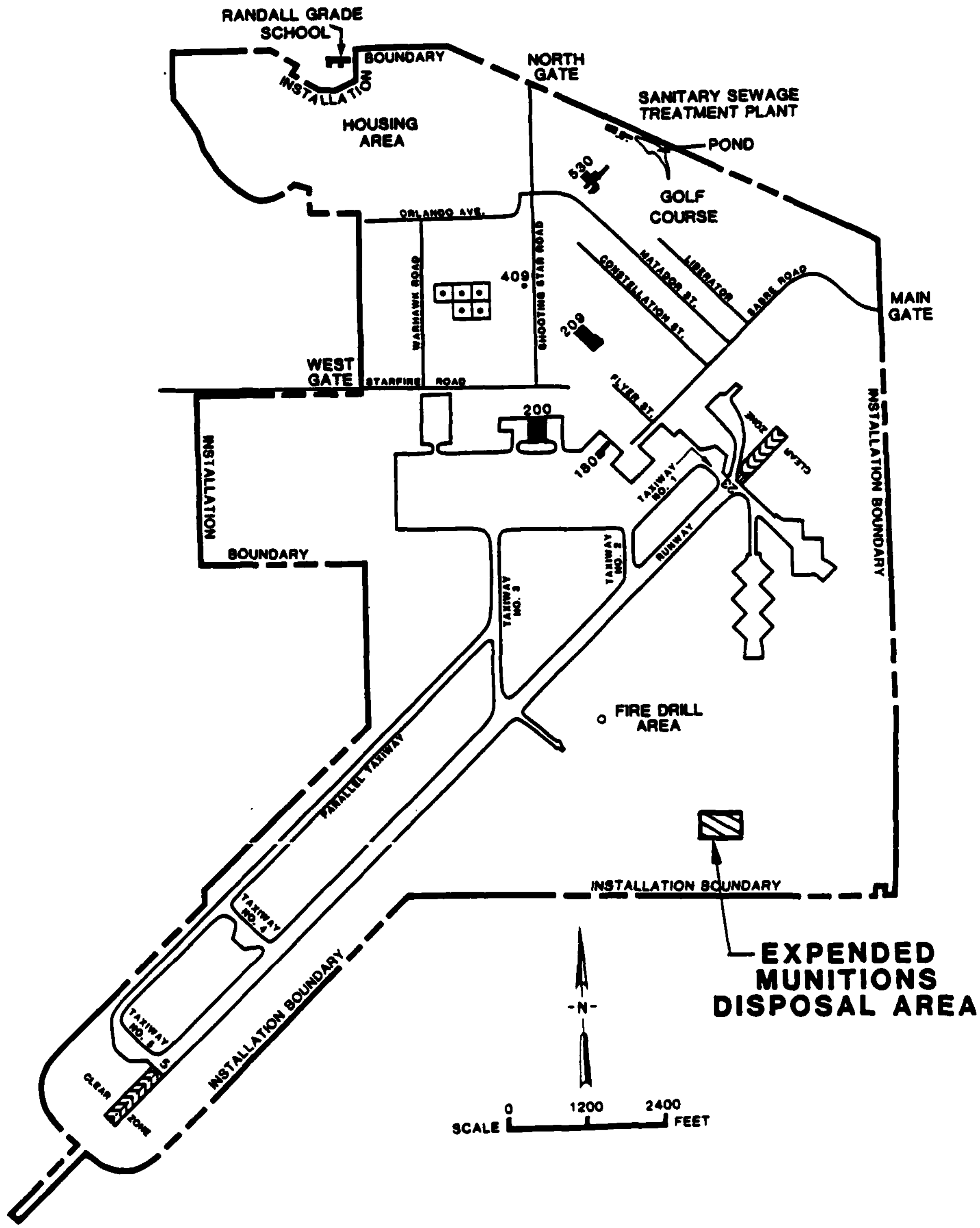
Surface Impoundment

One surface impoundment exists on Grissom Air Force Base. This impoundment is located on the golf course at the northern end of the base. The golf course pond receives surface drainage from adjacent golf course areas as well as lime slurry pumped to the pond directly from the base water treatment plant through an underground pipe. The pond edges appear gray-white because of the lime slurry present. This pond is cleaned every two to three years, and the sludge is removed and disposed of off-base by a contractor.

Expended Munitions Disposal Area

An expended munitions disposal area is located at the southeast corner of the base, east of Landfill No. 2 (Figure 4.4). This site, activated in 1958, consists of a metal furnace for incineration of expended munitions and a burial area nearby. Because of the swampy nature of the area, the use of this site was discontinued in 1978.

GRISSOM AFB
EXPENDED MUNITIONS DISPOSAL AREA



SOURCE: INSTALLATION DOCUMENTS

There is no evidence of disposal of waste materials other than incinerated expended munitions. At present the furnace and burial site are visible.

Sludge Weathering Area

A sludge weathering area is located in the main POL bulk storage area at the north of the base (Figure 4.5). On one occasion in the 1970's, a quantity of tank sludge estimated at 400 gallons was removed from the POL tanks during routine cleaning operations and was deposited in a trench south of Facility 406 and west of Facility 402. This sludge was allowed to weather at this location; final disposition of the sludge was not determined.

Oil-Water Separators

Nineteen oil-water separators are reported at Grissom AFB. The locations, volumes, and effluent discharge for these separators are shown in Appendix D, Table D.2. The separators are pumped out on an as-needed basis and the oil removed from the base by an off-base contractor. The separators are cleaned and inspected on a calendar basis. No incidents of note regarding operation of the oil-water separators were noted.

Wastewater Treatment Plant

Wastewater treatment on Grissom AFB is performed by the wastewater treatment plant located at the north of the base. Sanitary wastewaters and aqueous effluents from oil-water separators flow to the plant. The plant consists of primary clarification, activated sludge, secondary clarification, and chlorination with treated water discharged to Pipe Creek. Sludge from the plant is digested and dried in beds on-site. The dried sludge has been transported to off-site landfills and to Landfill No. 3 for surface reclamation. The plant treats an average of 1 MGD, and operates under an NPDES permit.

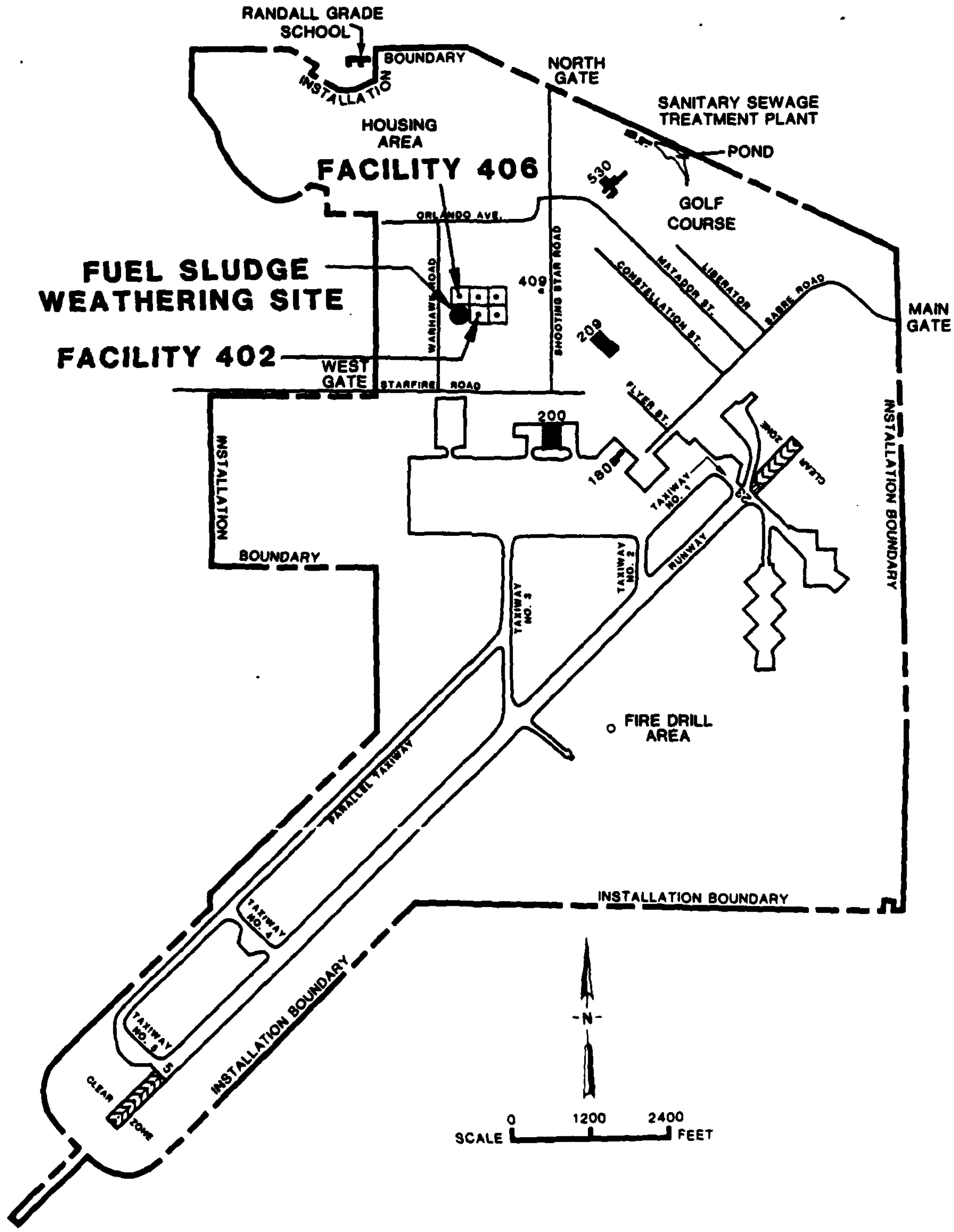
Surface Drainage System

As discussed earlier in Section 3, the surface drainage system at Grissom AFB consists of storm sewers and open ditches/channels that convey rainwater off the base. Open ditches drain water away from the areas between runways which connect to larger channels or underground

FIGURE 4.5

GRISSOM AFB

FUEL SLUDGE WEATHERING SITE



SOURCE: INSTALLATION DOCUMENTS

sewers. Stormwaters exit the base in the southwest to Little Deer Creek, via McDowell Ditch to Government Ditch to the northwest and by way of Cline Ditch to Pipe Creek to the north.

There have been six significant incidents of surface water pollution at Grissom AFB. The dates and causes of the incidents are as follows:

Stream	Date	Cause
Cline Ditch	3/27/74	#6 Fuel Oil Spill (see Table 3.3 for data)
Cline Ditch	3/26/77	FS-2 Fuel Spill
Cline Ditch	12/10/79	Surfactants
Pipe Creek	1/21/80	Accidental Raw Sewage Discharge
Cline Ditch	3/18/81	Foam
Cline Ditch	3/9/83	Elevated levels of Copper, Zinc & Manganese (Resulted in Fish Kill)

The fuel spills are addressed elsewhere in this section. The other incidents have minimal potential for present or future contaminant migration and hence are not considered further.

EVALUATION OF PAST DISPOSAL ACTIVITIES AND FACILITIES

Review of past waste generation and management practices at Grissom AFB has resulted in identification of 14 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 4.2 summarizes the results of the flow chart logic for each of the areas of initial concern.

TABLE 4.2
SUMMARY OF FLOW CHART LOGIC FOR AREAS OF
INITIAL HEALTH, WELFARE AND ENVIRONMENTAL CONCERN
AT GRISSOM 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
Fire Protection Training Area No. 1	Yes	Yes	Yes
Fire Protection Training Area No. 2	Yes	Yes	Yes
Fuel Tank Sludge Weathering Site	Yes	Yes	Yes
Waste Oil Storage Pad	Yes	Yes	Yes
Expended Munitions Disposal Site	No	No	No
Fuel Spill Sites	No	No	No
Wastewater Treatment Plant	No	No	No
Oil-Water Separators	No	No	No
Pesticide Utilization Sites	No	No	No
Surface Impoundment	No	No	No
Storm Water Drainage System	No	No	No

Source: Engineering-Science

Seven (7) of the 14 sites assessed did not warrant further evaluation. The rationale for omitting these sites from HARM evaluation is discussed below.

The fuel spill sites do not warrant further evaluation because the quantities of the spilled fuels not recovered were small and the spills were isolated one-time occurrences.

The wastewater treatment plant does not warrant further evaluation because it treats primarily sanitary wastewater. The effluent discharge meets NPDES requirements and sludge is digested and disposed either off-base or at the closed Landfill No. 3 site on base. Therefore, there is low potential for environmental contamination associated with the operation of the wastewater treatment plant.

The oil-water separators do not warrant further evaluation because they are monitored routinely and show a low potential for environmental contamination.

The pesticide utilization and disposal sites do not warrant further evaluation because the volumes of wastes disposed were reported to be minimal, with the majority of excess diluted pesticides consumed in process.

The surface impoundment (golf course pond) does not warrant further evaluation because the only waste material disposed in the pond is a lime sludge from the water softening at the base water treatment plant, a waste with low potential for environmental contamination.

The storm water drainage system at Grissom Air Force Base does not warrant further evaluation because the nature of the drainage shows low potential for environmental contamination.

The expended munitions disposal site was used for disposal of only incinerated expended munitions, a material with low potential for environmental contamination.

Sites Evaluated Using HARM

The remaining seven sites identified in Table 4.2 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 4.3.

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

TABLE 4.3
SUMMARY OF HARM SCORES FOR
POTENTIAL CONTAMINATION SITES
AT GRISSOM AFB

Rank	Site	Receptor Subscore	Waste Charac-teristics Subscore	Pathways Subscore	Waste Management Factor	HARM Score
1	Landfill No. 3	57	72	48	0.95	56
2	Waste Oil Storage Pad	52	54	56	1.00	54
3	Landfill No. 2	59	54	48	0.95	51
4	Fire Protection Training Area No. 1	50	54	48	1.00	51
5	Fire Protection Training Area No. 2	50	45	48	1.00	48
6	Fuel Tank Sludge Weathering Site	59	30	56	0.95	46
7	Landfill No. 1	68	18	56	0.95	45

NOTE: HARM Score = [(Recepters + Waste Characteristics + Pathways) x 1/3] x 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 Grissom AFB and a summary of the HARM scores for those sites.

LANDFILL NO. 3

There is sufficient evidence that the Landfill No. 3 site has potential for creating environmental contamination and a follow-on investigation is warranted. During the period of use, Landfill No. 3 received base refuse as well as sizable volumes of industrial wastes. This site received a HARM score of 56, in part because the waste characteristics subscore was high. The soils of the site are composed of silty loam and are poorly drained. The soil permeability is moderate. Ground water is assumed to be within five feet of the surface.

WASTE OIL STORAGE PAD

There is sufficient evidence that the Waste Oil Storage Pad site has potential for creating environmental contamination and a follow-on investigation is warranted. This site is visually contaminated with oil at present, and its history of use indicates some potential for release of hazardous wastes onto the ground in the past. This site received a HARM score of 54. The subscores for pathways, waste characteristics, and receptors were all moderate. The soils of the site are composed of silty loam and are poorly drained. Soil permeability is moderate. Ground water is assumed to be within five feet of the surface.

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

Rank	Site	Operation Period	HARM Score(1)
1	Landfill No. 3	1963 - '74	56
2	Waste Oil Storage Pad	1960's - 1982	54
3	Landfill No. 2	1958 - '63	51
4	Fire Protection Training Area No. 1	1950's - '82	51
5	Fire Protection Training Area No. 2	1982 - '84	48
6	Fuel Tank Sludge Weathering Site	1960's	46
7	Landfill No. 1	1940's(?) - '58	45

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

LANDFILL NO. 2

There is sufficient evidence that the Landfill No. 2 site has potential for creating environmental contamination and a follow-on investigation is warranted. During its period of use Landfill No. 2 was reported to have received both base refuse and some industrial wastes. This site received a HARM score of 51. The subscores for pathways, waste characteristics and receptors were all moderate. The soils of the site area are composed of silty loam and are poorly drained. Permeability is moderate. Ground water is assumed to be within five feet of the surface.

FIRE PROTECTION TRAINING AREA NO. 1

There is sufficient evidence that the Fire Protection Training Area No. 1 has potential for creating environmental contamination and a follow-on investigation is warranted. This site was used for fire training exercises for over 20 years, during which time waste and pure fuel, as well as waste oil, thinners, and other combustible wastes during the early period was applied directly to the ground and ignited. This site received a HARM score of 51. The subscores for pathways, waste characteristics and receptors were all moderate. The soils in this site area are composed of silty loam and are poorly drained. Permeability is moderate. Ground water is assumed to be within five feet of the surface.

FIRE PROTECTION TRAINING AREA NO. 2

There is sufficient evidence that the Fire Protection Training Area No. 2 has potential for creating environmental contamination and a follow-on investigation is warranted. This site has been used for fire protection training exercises for three years. During the period of use smaller volumes of fuel were applied than at Fire Protection Training Area No. 1, and prewetting of the site was practiced. This site received a HARM score of 48. The subscores for pathways, waste characteristics and receptors were all moderate. The soils in this site area are composed of silty loam and are poorly drained. Permeability is moderate. Ground water is assumed to be within five feet of the surface.

FUEL TANK SLUDGE WEATHERING SITE

There is sufficient evidence that the Fuel Tank Sludge Weathering site has potential for creating environmental contamination and a follow-on investigation is warranted. The use of the site for tank sludge weathering was a one-time incident, and the sludge was from a JP-4 fuel tank. As a consequence, no elevated metal concentrations are anticipated. This site received a HARM score of 46. The waste characteristics subscore was low; however, the receptors and pathways subscores were moderate. The soils in the site area are silty loam and are poorly drained. Permeability is moderate. Ground water is assumed to be within five feet of the surface.

LANDFILL NO. 1

There is sufficient evidence that the Landfill No. 1 site has potential for creating environmental contamination and a follow-on investigation is warranted. During the period of use of this landfill, only routine base refuse was known to be disposed. No other landfill sites were known to be in use at that time, so limited amounts of industrial wastes may have been disposed in the landfill but the volumes were estimated to be small. This site received a HARM score of 45. Although the waste characteristics subscore was low, the receptors subscore was high and the pathways subscore was moderate. There are three soil series in the site area and all are composed of silty loam. Drainage is poor for each series and permeability is moderate. Ground water is assumed to be within five feet of the surface.

SECTION 6

RECOMMENDATIONS

Seven sites were identified at Grissom AFB as having the potential for environmental contamination. These sites have been evaluated and rated using the HARM system which assesses their relative potential for contamination and provides the basis for determining the need for additional Phase II IRP investigations. The seven sites have sufficient potential to create environmental contamination and warrant a Phase II investigation.

RECOMMENDED PHASE II MONITORING

The subsequent recommendations are made to further assess the potential for environmental contamination from waste disposal areas at Grissom 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 will probably need to be expanded to define the extent and type of contamination. Geophysical surveys, consisting of electrical resistivity, electromagnetic and/or magnetometer techniques, are recommended prior to the monitoring well installations to attempt to delineate the horizontal and vertical extent of the site as well as any subsurface drums on site and/or leachate plumes migrating off site. Preliminary checks with geophysical techniques on and in the vicinity of the site should be made to determine the effectiveness of geophysics prior to a complete site survey. Soil sampling and ground-water monitoring well installations should be performed using the hollow-stem auger/split-spoon method. Split-spoon samples should be collected continuously. Wells should be installed using four-inch diameter Schedule 40 PVC threaded casing and screens. The screens should be open to the top twenty feet of the uppermost aquifer and at least two-feet above the water table to allow any fuel to enter the well. During soil sampling and well installations an organic vapor analyzer (OVA), HNU meter or equivalent and an explosimeter should be used. Selected soil samples and ground-water samples should be collected for chemical analyses. If the initial samples indicate contamination, additional wells may be required.

The recommended monitoring program for Phase II is summarized in Table 6.1 and described in more detail below.

1. Landfill No. 3 has a potential for environmental contamination and monitoring of this site is recommended. Prior to the installation of ground-water monitoring wells, surface geophysical techniques such as electrical resistivity and magnetometer surveys should be employed. The magnetometer should be employed in an attempt to locate the drums reportedly buried on site. The resistivity should be employed in an attempt to locate any subsurface leachate plumes migrating off site. The resistivity, if effective, should be used to guide the placement of one upgradient and three downgradient wells to characterize the ground-water quality and identify any contaminant migration. Since the site borders the installation boundary on the west and the assumed ground-water flow direction is northeast, the upgradient well should be located southeast of the site on base and in an assumed uncontaminated area between the installation north-south boundary and taxiway number 3. Samples from the wells should be analyzed for the parameters listed in Table 6.2, List A.

2. The Waste Oil Storage Pad has a potential for environmental contamination and monitoring of this site is recommended. One soil boring within the soil area of the western edge of the concrete pad should be drilled to an approximate depth of ten feet. Selected soil samples (approximately 3) should be analyzed for the parameters listed in Table 6.2, List B. One surface soil sample should also be obtained where the soil is visually stained.

TABLE 6.1
RECOMMENDED MONITORING PROGRAM FOR PHASE II
AT GRISSOM AFB

Rank	Site	Rating Score	Recommended Monitoring	Sample Analyses	Comments
1	Landfill No. 3	56	Conduct geophysical surveys; install and sample 1 upgradient and 3 downgradient wells.	A	Continue monitoring if sampling indicates contamination. Additional wells may be necessary to assess extent of contamination.
2	Waste Oil Storage Pad	54	Drill one soil boring and sample at selected depths; sample surface soil.	B	Continue monitoring if sampling indicates contamination. Monitoring wells may be necessary if soil contamination extends to water table.
3	Landfill No. 2	51	Conduct geophysical surveys; install and sample 1 upgradient and 3 downgradient wells.	A	Continue monitoring if sampling indicates contamination. Additional wells may be necessary to assess extent of contamination.
4	FPTA No. 1	51	Conduct geophysical surveys; install and sample 1 upgradient and 3 downgradient wells. Drill one soil boring in the center of site; sample soil at selected depths.	C (ground water) B (soil)	Continue monitoring if sampling indicates contamination. Additional wells may be necessary to assess extent of contamination.

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

Rank	Site	Rating Score	Recommended Monitoring	Sample Analyses	Comments
5	FPTA No. 2	48	Conduct geophysical surveys; install and sample 1 upgradient and 3 downgradient wells. Drill one soil boring in the center of site; sample soil at selected depths.	C (ground water) B (soil)	Continue monitoring if sampling indicates contamination. Additional wells may be necessary to assess extent of contamination.
6	Fuel Tank Sludge Weathering Site	46	Drill one soil boring and sample at selected depths; sample surface soil.	B	Continue monitoring if sampling indicates contamination. Monitoring wells may be necessary if soil contamination extends to water table.
7	Landfill No. 1	45	Conduct geophysical surveys; install and sample 1 upgradient and 3 downgradient wells.	A	Continue monitoring if sampling indicates contamination. Additional wells may be necessary to assess extent of contamination.

Note: Sample Analyses List is provided in Table 6.2 of this report.

TABLE 6.2
RECOMMENDED LIST OF ANALYTICAL PARAMETERS
GRISSOM AFB

LIST A

pH

Specific Conductance

Temperature

Total Organic Carbon

Priority Pollutant Organics

Metals for Which Primary Drinking Water Standards Exist

LIST B

pH

Oil and Grease

Purgeable Organics

LIST C

pH

Specific Conductance

Temperature

Total Organic Carbon

Priority Pollutants

3. Landfill No. 2 has a potential for environmental contamination and monitoring of this site is recommended. Prior to the installation of ground-water monitoring wells, surface geophysical techniques such as electrical resistivity and magnetometer surveys should be employed. The magnetometer should be employed in an attempt to locate the drums reportedly buried on site. The resistivity should be employed in an attempt to locate any subsurface leachate plumes migrating off site. The resistivity, if effective, should be used to guide the placement of one upgradient and three downgradient wells to characterize the ground-water quality and identify any contaminant migration. Since the site borders the southern installation boundary and the assumed direction of ground-water flow is north, the upgradient well should be located west of the site on base and in an assumed uncontaminated area. Samples from the wells should be analyzed for the parameters listed in Table 6.2, List A.

4. Fire Protection Training Area No. 1 has a potential for environmental contamination and monitoring of this site is recommended. One soil boring within the FTA should be drilled to an approximate depth of ten feet. Selected soil samples (approximately 3) should be analyzed for the parameters listed in Table 6.2, List B. Prior to the installation of ground-water monitoring wells resistivity surveys should be conducted in an attempt to locate any subsurface leachate plumes migrating off site. The resistivity, if effective, should be used to guide the placement of one upgradient and three downgradient wells to characterize the ground-water quality and identify any contaminant migration. The wells should be sampled for the parameters listed in Table 6.2, List C.

5. Fire Protection Training Area No. 2 has a potential for environmental contamination and monitoring of this site is recommended. One soil boring within the FTA should be drilled to an approximate depth of ten feet. Selected soil samples (approximately 3) should be analyzed for the parameters listed

in Table 6.2, List B. Prior to the installation of ground-water monitoring wells resistivity surveys should be conducted in an attempt to locate any subsurface leachate plumes migrating off site. The resistivity, if effective, should be used to guide the placement of one upgradient and three downgradient wells to characterize the ground-water quality and identify any contaminant migration. The wells should be sampled for the parameters listed in Table 6.2, List C.

6. The Fuel Tank Sludge Weathering Site has a potential for environmental contamination and monitoring of this site is recommended. Selected surface soil samples (approximately 3) should be analyzed for the parameters listed in Table 6.2, List B.

7. Landfill No. 1 has a potential for environmental contamination and monitoring of this site is recommended. Prior to the installation of ground-water monitoring wells, surface geophysical techniques such as electrical resistivity and magnetometer surveys should be employed. The magnetometer should be employed in an attempt to locate the drums reportedly buried on site. The resistivity should be employed in an attempt to locate any subsurface leachate plumes migrating off site. The resistivity, if effective, should be used to guide the placement of one upgradient and three downgradient wells to characterize the ground-water quality and identify any contaminant migration. Since the site borders the southern installation boundary and the assumed direction of ground-water flow is north, the upgradient well should be located west of the site on base and in an assumed uncontaminated area. Samples from the wells should be analyzed for the parameters listed in Table 6.2, List A.

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APPENDIX A

BIOGRAPHICAL DATA

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BIOGRAPHICAL DATA

Eric Heinman Snider

Manager, Industrial Waste Department

PII Redacted

[redacted]

Education

B.S. in Chemistry (Magna Cum Laude), 1973, Clemson University, Clemson, S.C.
M.S. in Chemical Engineering, 1975, Clemson University, Clemson, S.C.
Ph.D. in Chemical Engineering, 1978, Clemson University, Clemson, S.C.

Professional Affiliations

Registered Professional Engineer (Oklahoma No. 13499, Georgia No. 14228)
Diplomate, American Academy of Environmental Engineers
Certified Professional Chemist, A.I.C.
American Institute of Chemical Engineers
American Chemical Society
American Society for Engineering Education
Society of Automotive Engineers

Honorary Affiliations

Sigma Xi
Tau Beta Pi
Phi Kappa Phi
Who's Who in the South and Southwest, 1981
Outstanding Young Men of America, 1983

Experience Record

1971-1978 Texidyne, Inc., Clemson, S.C., Staff Chemist and Consultant. Responsible for overall management of laboratory facilities and some wastewater engineering studies. Performed incinerator performance studies. Participated in a study to examine feasibility of process wastewater recycle/reuse in textile finishing and dyeing operations.

Eric H. Snider (Continued)

1976-1977	Clemson University, Clemson, S.C., Chief Analyst on airborne fluoride monitoring project in Chemical Engineering Department, performed for Owen-Corning Fiberglas Corp., Toledo, Ohio.
1978-1982	The University of Tulsa, Tulsa, OK., Assistant Professor of Chemical Engineering and Associate Director, University of Tulsa Environmental Protection Projects (UTEPP) Program. Normal teaching duties; research centered on specialized petroleum refinery problems of water and solid wastes and oil-water emulsions. Supervised an industry-sponsored research program in the area of oil-water emulsion breaking technologies.
1982-1983	The University of Tulsa, Tulsa, OK., Associate Professor of Chemical Engineering and Director of UTEPP Program. Normal teaching duties; researched and wrote five monographs on environmental areas; including, incineration, flotation, gravity separation, screening/sedimentation, and equalization.
1983-1984	Engineering-Science, Senior Engineer. Responsible for a wide variety of waste treatment, chemical process, resource recovery, energy, incineration and air pollution control activities for industrial and governmental clients.
1984-Date	Engineering-Science, Manager of Industrial Waste Department. Responsible for managing a department consisting of chemical, civil, and environmental engineers and scientists performing a variety of projects for industrial and municipal clients.

Publications

32 technical publications, including five technical monographs.

Biographical Data

BRIAN D. MORETH

Environmental Scientist

PII Redacted

[redacted]

Education

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

Professional Affiliations

American Fisheries Society
Society of American Foresters
Wildlife Society

Honorary Affiliations

Phi Epsilon Phi
Phi Sigma
Xi Sigma Phi

Experience Record

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

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

Brian D. Moreth (Continued)

facilities for the State of New Jersey, and prepared revegetation plans for reservoir and strip mined lands.

Served as Task Force Leader for the Environmental Quality segment of Comprehensive Water Quality Management Plan for a seven-county area in northeast Pennsylvania, which involved preparing an inventory of all natural resources and environmentally sensitive and degraded areas.

1974-1980 Pennsylvania Game Commission, York County, Pennsylvania (concurrent position). Deputy Game Protector. Responsibile for enforcement of game, fish, forestry, and park laws of the Commonwealth of Pennsylvania. Assisted in public presentations including instruction of Hunter Safety Courses.

1980-Date Engineering-Science. Project Scientist. Involved in the development of environmental studies, inventories, and evaluations for municipal, industrial, and Federal government projects.

Served as Deputy Project Director of a third-party EIS for a central Florida phosphate mine. This involved preparation, direction and coordination of the multiple environmental facets associated with the construction of a new mine. The EIS process involved evaluation of wetlands on the proposed mine site. Examination of the functional aspects indicated that some wetlands had very limited productivity and could be mined and reclaimed without affecting the region's ecology.

Served as Project Scientist for site and record searches of several Air Force Bases evaluating hazardous waste disposal and any biological effects associated with it.

Assisted in development of peat mining and restoration plan for a private concern in North Carolina. A 20,000-acre tract was investigated for potential development. The site investigation included examination of vegetation and wildlife for defining the extent of wetlands.

Biographical Data

H. DAN HARMAN, JR.
Hydrogeologist

PII Redacted

[redacted]

Education

B.S., Geology, 1970, University of Tennessee, Knoxville, TN

Professional Affiliations

Registered Professional Geologist (Georgia NO.569)
National Water Well Association (Certified Water Well Driller No. 2664)
Georgia Ground-Water Association

Experience Record

1975-1977 Northwest Florida Water Management District, Havana, Florida. Hydrogeologist. Responsible for borehole geophysical logger operation and log interpretation. Also reviewed permit applications for new water wells.

1977-1978 Dixie Well Boring Company, Inc., LaGrange, Georgia. Hydrogeologist/Well Driller. Responsible for borehole geophysical logger operation and log interpretation. Also conducted earth resistivity surveys in Georgia and Alabama Piedmont Provinces for locations of water-bearing fractures. Additional responsibilities included drilling with mud and air rotary drilling rigs as well as bucket auger rigs.

1978-1980 Law Engineering Testing Company, Inc., Marietta, Georgia. Hydrogeologist. Responsible for ground-water resource evaluations and hydrogeological field operations for government and industrial clients. A major responsibility was as the Mississippi Field Hydrologist during the installation of both fresh and saline water wells for a regional aquifer evaluation related to the possible storage of high level radioactive waste in the Gulf Coast Salt Domes.

1980-1983 Ecology and Environment, Inc., Decatur, Georgia. NUS Corporation, Tucker, Georgia. Hydrogeologist. Responsible for project management of hydrogeological and geophysical investigations at uncontrolled hazardous waste sites. Also prepared Emergency Action Plans and Remedial Approach Plans for U.S. Environmental Protec-

H. Dan Harman, Jr. (Continued)
Page 2

1980-1983 tion Agency. Additional responsibilities included use of the MITRE hazardous ranking system to rank sites on the National Superfund List.

1983-Date Engineering-Science, Inc., Atlanta, Georgia. Hydrogeologist. Responsible for hydrogeological and geophysical investigations at inactive and active hazardous waste sites. Hydrogeological investigations include evaluation of existing groundwater monitoring systems, installation of new groundwater monitoring wells, ground water and soil sampling, preparation of Part B applications, closure and post-closure plans and hazard assessment ratings. Geophysical investigations include surface electrical resistivity and magnetometer surveys to aid in the delineation of waste site boundaries, contents, covers and underlying hydrogelogical features, as well as adjacent hydrogeological features and groundwater contamination plumes migrating from sites.

Publications and Presentations

"Geophysical Well Logging: An Aid in Georgia Ground-Water Projects," 1977, coauthor: D. Watson, The Georgia Operator, Georgia Water and Pollution Control Association.

"Use of Surface Geophysical Methods Prior to Monitor Well Drilling," 1981. Presented to Fifth Southeastern Ground-Water Conference, Americus, Georgia.

"Cost-Effective Preliminary Leachate Monitoring at an Uncontrolled Hazardous Waste Site," 1982, coauthor: S. Hitchcock. Presented to Third National Conference on Management of Uncontrolled Hazardous Waste Sites, Washington, D.C.

"Application of Geophysical Techniques as a Site Screening Procedure at Hazardous Waste Sites," 1983, coauthor: S. Hitchcock. Proceedings of the Third National Symposion and Exposition on Aquifer Restoration and Ground-Water Monitoring, Columbus, Ohio.

"Practical Application of Earth Resistivity Methods in Phase II of the Installation Restoration Program," 1984, coauthor: J. Baker. Presentation at the 13th Environmental Systems Symposium, American Defense Preparedness Association, Bethesda, Maryland.

"In Search of North Georgia's Ground Water: Application of Geophysics and Hydrogeology," 1984, coauthors: J. Baker and S. Yankee. The Georgia Operator, Georgia Water and Pollution Control Association.

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APPENDIX B

LIST OF INTERVIEWEES AND OUTSIDE AGENCY CONTACTS

TABLE B.1
LIST OF INTERVIEWEES

Most Recent Position	Years of Service at Grissom
1. NCOIC Metal Fabricating & Welding	2
2. Sheet Metal Worker	11
3. Foreman, Paint Shop	15
4. Pipe Fitter, Heat Shop	19
5. Foreman, Heat Plant	11
6. Asst. NCOIC Power Production	1
7. NCOIC Corrosion Control	1
8. Corrosion Control Technician	15
9. Electric Shop Work Leader	8
10. Shift Supervisor, Pneudraulics Shop	3
11. AGE Mechanic	14
12. AGE Superintendent	1
13. NCOIC NDI	1
14. Specialist NDI	3
15. Shop Chief NDI	15
16. FMS Maintenance Superintendent	2
17. FMS Maintenance Assistant Superintendent	8
18. Foreman Liquid Fuels Maintenance	18
19. NCOIC, Exterior Electric	5
20. CE Electric Superintendent	30
21. Foreman, Interior Electric	10
22. NOCIC Jet Engine Shop 305	5
23. 931 Jet Engine Shop Chief	15
24. 930 Engine Shop Foreman	8

TABLE B.1
LIST OF INTERVIEWEES
(Continued)

Most Recent Position	Years of Service at Grissom
25. NCOIC Test Cell	2
26. Maintenance Control Officer	5
27. Assistant Branch Chief OMS	3
28. Fuel Supply Superintendent	2
29. Fuels Lab Supervisor	3
30. Foreman Vehicle Maintenance	3
31. Mechanic Vehicle Maintenance	22
32. Manager Vehicle Maintenance	25
33. NCOIC Wheel & Tire	13
34. 931 OM Branch Chief	16
35. 931 Phase Dock Supervisor	16
36. 930 Aircraft Generation Branch Chief	21
37. 930 Equipment Maintenance Branch Chief	15
38. 930 Equipment Maintenance Section Chief	13
39. 930 Age Section Supervisor	5
40. Foreman, 930 Access Maintenance/Hydraulics	10
41. Ace Maintenance Foreman	8
42. AMS Maintenance Supt.	6
43. PMEL Branch Chief	2
44. PMEL Section Supervisor	2
45. BX Service Station Manager	2
46. Foreman Refrigeration shop	23
47. Auto Hobby Shop Manager	18
48. NCOIC Environmental Systems	11
49. 1915 ISS Maintenance Branch Chief	2
50. NCOIC Heavy Equipment	1

TABLE B.1
LIST OF INTERVIEWEES
(Continued)

Most Recent Position	Years of Service at Grissom
51. Supervisor Dental Clinic	2
52. X-Ray Technician	2
53. NCO Production Photo	1
54. Reproduction Branch Chief	1
55. Administrator, U.S. Army Reserve	11
56. NCOIC, Bioenvironmental	3
57. Technician, Bioenvironmental	3
58. Technician, Bioenvironmental	2
59. Assistant NCOIC Bioenvironmental	2
60. Entomology Shop Foreman	7
61. Superintendent Pavement & Grounds	23
62. NCOIC Heavy Equipment	1
63. Greenskeeper, Golf Course	19
64. Grounds Supervisor	20
65. Chief, Fire Department	7
66. Deputy Chief, Fire Department	4
67. Lead Fire Fighter	14
68. Assistant Chief for Training, Fire Department	3
69. Wastewater Treatment Plant Operator	1
70. Wastewater Treatment Plant Operator	19
71. Lead Fire Fighter	20
72. Engineering Technician	21
73. Water Treatment Plant Foreman	24
74. NCOIC, Water Treatment Plant	1
75. Real Property Officer	14
76. Chief, DPDO	23
77. Contract Programmer, Retired	30

TABLE B.1
LIST OF INTERVIEWEES
(Continued)

Most Recent Position	Years of Service at Grissom
78. Lead Fire Fighter, Retired	13
79. Environmental Coordinator	3
80. Heavy Equipment Operator, Retired	25
81. Deputy Chief of Operations, CE	29
82. Electrical Supervisor	30
83. Assistant Environmental Coordinator	1
84. Base Civil Engineer	1

TABLE B.2
OUTSIDE AGENCY CONTACTS
GRISSOM AFB

Cass County Surveyor Cass County Government Building 200 Court Park Logansport, Indiana 46974 (219) 722-5050	Margaret Ann Beckdol Surveyor
Indiana Department of Natural Resources Division of Fish and Wildlife State Office Building, Room 607 Indianapolis, Indiana 46204	Dave Turner Supervisor, Environmental Section
Indiana Department of Natural Resources Division of Water 2475 Directors Row Indianapolis, Indiana 46241 (317) 232-4160	Roy Funkhouser Hydrogeologist Debbie Smith Flood Control Technician
Indiana State Board of Health Division of Land Pollution Control 1330 West Michigan Street P. O. Box 1964 Indianapolis, Indiana 46206 (317) 243-5113	Jeff L. Blankenberger Inspector-Hazardous Waste Branch
Indiana State Board of Health Division of Water Pollution Control 1330 West Michigan Street P. O. Box 1964 Indianapolis, Indiana 46206 (317) 633-0795	Mark Stanifer Inspector, Permits Section John Winter Inspector, Water Quality Section Paul Cluxton Inspector, Compliance Section (317) 633-0737
Miami County Health Department Court House Peru, Indiana 46970 (317) 472-3901 Ext. 15	Raymond C. Flook Sanitarian
Miami County Surveyor Court House Peru, Indiana 46970 (317) 472-3901 Ext. 87	Greg Deeds Surveyor

TABLE B.2
(CONTINUED)
OUTSIDE AGENCY CONTACTS
GRISSOM AFB

Soil Conservation Service U.S. Department of Agriculture 1170 U. S. 24 West Peru, Indiana 46970 (317) 473-6110	Randy Moore District Conservationist
U. S. Environmental Protection Agency Region 5 State Programs Division 230 South Dearborn Street Chicago, Illinois 60604 (312) 353-2473	Ken Burch Chief, Indiana Section
U. S. Geological Survey Water Resources Division 6023 Guion Road Indianapolis, Indiana 46254 (317) 927-8640	Konrad Banaszak Chief, Project Section

APPENDIX C

TENANT ORGANIZATIONS AND MISSIONS

APPENDIX C

TENANT ORGANIZATIONS AND MISSIONS

434th Tactical Fighter Wing, Air Force Reserve. The 434th Tactical Fighter Wing provides combat crew training and training for support personnel to maintain air reservists in a ready status for special air operations in support of ground forces.

931st Air Refueling Group, Air Force Reserve. The 931st Air Refueling Group provides combat crew training and training for support personnel to maintain air reservists in a ready status.

1915th Information Systems Squadron (ISS). The 1915th ISS operates all airdrome navigational aids including radar approach control and the control tower, and also operates and maintains radio, telephone and teletype communication systems at Grissom AFB.

Detachment 26, 3rd Weather Wing. This unit provides meteorological data for base support, flight support and severe weather warning support.

Air Force Office of Special Investigations. The Air Force OSI is responsible for criminal counter-intelligence and special investigative services for all Air Force activities at Grissom AFB.

Department of Defense Investigative Service. This unit acts as the Air Force's link with the Indiana Civil Air Patrol which is responsible for emergency search and rescue for small aircraft and missing persons.

71st Flying Training Wing. The mission of the 71st Flying Training Wing is to provide proficiency flying training in T-37 aircraft for base-assigned pilots.

Detachment 8, SAC Management Engineering Team. Detachment 8, SAC Management Engineering Team provides management advisory service and studies of utilization of manpower for Grissom AFB.

American Red Cross. The American Red Cross provides emergency support services for military members and their families, provides volunteer group for the Blood Donor Program and Medical Clinic, and provides Water Safety Instruction.

Air Force Audit Agency. The mission of the Air Force Audit Agency is to evaluate the effectiveness and efficiency with which managerial responsibilities are carried out.

APPENDIX D

SUPPLEMENTAL BASE FINDINGS INFORMATION

TABLE D.1
LIST OF PESTICIDES

CE - Entomology

Malathion 90%
Malathion 57%
Diazinon
Diazinon Dust
Dursban 4E
Safrotin
Ficam-W
DDVP-Vapona
Baygon
Sevin
Phenothrin
Denatured Alch
Fuse Cartridges
Chlordane
Dursban 10 CR
Rodenticide Blocks
Rodenticide Bait
Bolt - Roach Bait
Killmaster 11
Avitrol
Precor 5E
Baygon Roach Bait
R-55 Repellant
Rat Bait-Pellets
Pyrethrum
Rodenticide

Roads and Grounds

2,4-D
DuPont Hyvar XL Bromacil

Golf Course Maintenance

Chlorone B
Dicambra
Iron-S
Dicot (2,4D)
Dursban
PCNB
Iprodione
Daconil
Triadimefon

TABLE D.2
OIL SEPARATORS

Facility Number	Location Relative to Facility	Usage	Volume (Gal)	Water Phase Disposition
11	20' NW	434th TFW Wash Rack Effluent	500	Sanitary Sewer
20	20' SE	East Aircraft Parking Ramp Storm Drainage	110,000	Storm Sewer to Cline Ditch
21	30' N	Wash Rack Effluent	750	Sanitary Sewer
122	10' NW	Wash Rack Effluent	1,100	Sanitary Sewer
145	30' SE	Auto Hobby Shop Drains	950	Sanitary Sewer
392	SW Corner	POL Tank Farm Storm Drainage	22,440	McDowell Ditch
407	40' SE	BX Service Station Floor Drains	950	Storm Sewer to Cline Ditch
420	N Side	Vehicle Maintenance Floor Drains	125	Sanitary Sewer
	S Side		250	Sanitary Sewer
425	SW Corner	AGE Floor Drains	411	Sanitary Sewer
428		Hangar 200 Wash Rack Drainage	5,623	Sanitary Sewer
434	N & S Sides	Nose Dock Floor Drains	2 - 195	Sanitary Sewer
435	N & S Sides	Ncse Dock Floor Drains	2 - 195	Sanitary Sewer
436	N & S Sides	Ncse Dock Floor Drains	2 - 195	Sanitary Sewer
437	N & S Sides	Nose Dock Floor Drains	2 - 195	Sanitary Sewer
438	N & S Sides	Ncse Dock Floor Drains	2 - 195	Sanitary Sewer
439	N & S Sides	Nose Dock Floor Drains	2 - 195	Sanitary Sewer
679	200' W of A Row	West Aircraft Parking Ramp Drain	13,500	McDowell Ditch
959	20' N	A-10 Run-up Pad	2,100	McDowell Ditch

TABLE D.3
OIL/FUEL STORAGE FACILITIES LISTING

Facility	Location	Number Tanks	Size (gal)
Aboveground Diked JP-4 Tanks			
400	Bulk Storage Area (#5)	1	630,000
401	Bulk Storage Area (#6)	1	630,000
402	Bulk Storage Area (#2)	1	630,000
403	Bulk Storage Area (#1)	1	630,000
406	Bulk Storage Area (#7)	1	1,050,000
Underground JP-4 Tanks			
424	Powered Support Equipment	1	2,000
735	South of Ramp	8	50,000
736	South of Ramp	6	50,000
788	Fire Pit	1	2,000
Underground MOGAS Tanks			
216	Water Plant	1	1,000
407	BX Service Station	2	4,000
419	Base Service Station	2	12,000
424	Powered Support Equipment	1	2,000
441	Hangar 200 West Ramp	1	10,000
Aboveground MOGAS Tanks			
121	C.E. Pavements & Grounds	1	1,000
392	Bulk Storage Area	1	25,000
522	Golf Course Maintenance Shed	1	1,000
Aboveground Diesel Tanks			
121	C.E. Pavements & Grounds	1	1,000
395	Bulk Storage Area	1	10,000
522	Golf Course Maintenance Shed	1	250
Underground Diesel Tanks			
424	Powered Support Equipment	1	2,000
442	Hangar 200 West Ramp	1	10,000
785	Alert Area	1	1,000
Aboveground De-Icing Fluid with Loading Fillstand and Unloading Header			
399	Bulk Storage Area	1	12,000

TABLE D.3
OIL/FUEL STORAGE FACILITIES LISTING
(Continued)

Facility	Location	Number Tanks	Size (gal)
Underground Waste Tanks			
145	Auto Hobby Shop (for oils)	1	300
221	CF Service Yard	1	500
395	Bulk Storage Area (for diesel and de-icing fluid)	1	1,000
404	Bulk Storage Area (for contaminated JP-4)		2,000
407	BX Service Station (waste oil)	1	3,500
429	CES Storage Yard	1	500
735	Pumphouse - Southeast of Ramp (contaminated JP-4)	1	2,000
736	Pumphouse - Southwest of Ramp (contaminated JP-4)	1	2,000
963	KC-135 Run-up Pad	1	2,000
POL Equipment			
413	Bottom Loading Fillstand - Bulk Storage Area (JP-4)	1	200
414	Bottom Loading Fillstand - Bulk Storage Area (JP-4)	1	200
416	Bottom Unloading Headers (JP-4)	1	200
Underground Aviation Gasoline Tank			
26	Aero Club Fuel Pump	1	1,000

TABLE D.4
SELECTED WATER WELL DATA FOR GRISSOM AFB AND VICINITY

Well Identification	Owner	Well Depth (FT)	Depth of Water Producing Zone Below Ground Surface (FT)	Yield (GPM)	Lithologic Unit Tapped By Well	Water Level Below Ground Surface (FT)	Well Use
0	Grissom AFB	NR	NR	NR	LS	NR	T
1	Grissom AFB	156	NR	350	LS	NR	N
2	Grissom AFB	150	NR	350	LS	NR	N
3	Grissom AFB	NR	NR	NR	NR	NR	N
4	Grissom AFB	NR	NR	NR	NR	NR	N
5	Grissom AFB	165	NR	350	LS	NR	P
6	Grissom AFB	180	NR	1,000	LS	NR	P
7	Grissom AFB	175	NR	1,000	LS	NR	P
8	Grissom AFB	NR	NR	20	LS	NR	P
9	Grissom AFB	NR	NR	20	LS	NR	P
25/3-1 59A	Bunker Hill AFB	182	NR	UKN	LS	19	T
25/3-1 59B	Bunker Hill AFB	183	NR	UKN	LS	15	T
25/3-1 59C	Bunker Hill AFB	180	NR	UKN	LS	18	T
25/3-1 59D	Bunker Hill AFB	182	NR	UKN	LS	20	T
25/3-1	Francis A. Kovacs	103	NR	20	LS	31	UKN

TABLE D.4
(Continued)
SELECTED WATER WELL DATA FOR GRISSOM AFB AND VICINITY

Well Identification	Owner	Well Depth (FT)	Depth of Water Producing Zone Below Ground Surface (FT)	Yield (GPM)	Lithologic Unit Tapped By Well	Water Level Below Ground Surface (FT)	Well Use
25/3-1-811	Robert L. Williams	102	NR	60	LS	25	UKN
25/3-1A1	U.S. Government	120	62	UNK	LS	20	O
25/3-1H1	U.S. Government	182	69	UKN	LS	18.5	O
25/3-1H2	U.S. Government	183	63	UKN	LS	18.3	O
25/3-1H3	U.S. Government	180	70	UKN	LS	18.3	P,O
25/3-1H4	U.S. Government	182	67	UKN	LS	19.7	O
25/3-2-800A	Bunker Hill AFB	125	NR	60	LS	24	UKN
25/3-2-800B	Jim Canton	225	NR	60	LS	15	UKN
25/3-2M1	U.S. Government	137	101	UKN	LS	13	UKN
25/3-3C1	R. H. Bevington	250	100	150	LS	8	IR
25/3-3C2	R. H. Bevington	NR	73	UKN	LS	12	D
25/3-3E1	R. E. Bevington	112	97	UKN	LS	15	D
25/3-3E2	R. E. Bevington	118	95	UKN	LS	14	D,S
25/3-3Q1	U.S. Government	17.9	NR	UKN	TL	NR	O
25/3-3R1	John Weaver	126	104	UKN	LS	NR	DES

TABLE D.4
(Continued)
SELECTED WATER WELL DATA FOR GRISSOM AFB AND VICINITY

Well Identification	Owner	Well Depth (FT)	Depth of Water Producing Zone Below Ground Surface (FT)	Yield (GPM)	Lithologic Unit Tapped By Well	Water Level Below Ground Surface (FT)	Well Use
25/3-3-799	Calvin Myers	112	NR	UKN	LS	15	UKN
25/3-3-800	Kenny Smith	81	NR	100	GR	14	UKN
25/3-3	J. A. Myers	160	NR	UKN	LS	21	UKN
25/3-4H1	Charles Carey	199	NR	UKN	LS	17	UKN
25/3-4Q1	Merrill Bevington	132	94	UKN	LS	24	D,S
25/3-4-790	Bill Garbert	62	NR	100	GR	13	UKN
25/3-4-800	Lee Lawe	202	NR	35	LS	12	UKN
25/3-5-790A	Jay Baker	87	NR	200	LS	6	UKN
25/3-5-790B	Charles Campbell	93	NR	100	LS	10	UKN
25/3-8A	Dr. C. L. Uiney	180	NR	17	LS	18	UKN
25/3-8B	Gene Pettay	68	NR	UKN	LS	9	UKN
25/3-8-800A	Erny's Fertilizer	184	NR	275	LS	20	UKN
25/3-8-800B	Erny's Fertilizer	122	NR	90	LS	15	UKN
25/3-8-800C	Erny's Fertilizer	110	NR	400	LS	17	UKN
25/3-8-800D	Erny's Fertilizer	224	NR	500	LS	20	UKN

TABLE D.4
(Continued)
SELECTED WATER WELL DATA FOR GRISSOM AFB AND VICINITY

Well Identification	Owner	Well Depth (FT)	Depth of Water Producing Zone Below Ground Surface (FT)	Yield (GPM)	Lithologic Unit Tapped By Well	Water Level Below Ground Surface (FT)	Well Use
25/3-8-793	Rick Foust	105	NR	35	LS	14	UKN
25/3-10	Zchring	NR	NR	UKN	LS	NR	UKN
25/3-10A1	U.S. Government	130	NR	UKN	LS	18	O
25/3-11-806	U.S.G.S.	24	NR	UKN	GR	10	UKN
25/3-11-808	Bunker Hill AFB	134	NR	UKN	LS	20	UKN
25/3-12A1	G. Childers	139	64	UKN	LS	14	D,S
25/3-12-790	Wayne Ladd	127	NR	35	LS	6	UKN
25/3-14-780A	Parker Shim	68	NR	15	LS	11	UKN
25/3-14-780B	Libby, McNeal & Libby	90	NR	100	LS	9	UKN
25/3-23-769	U.S.G.S.	19	NR	UKN	GR	14	UKN
25/3-23-780	Mary Amos	71	NR	30	LS	13	UKN
25/3-24-800	North Drive-in Theatre	97	NR	70	LS	10	UKN
25/4-5-815	Ralph Finster	112	NR	60	LS	46	UKN
25/4-6E1	R. Comerford	108	77	UKN	LS	22	S,O

TABLE D.4
(Continued)
SELECTED WATER WELL DATA FOR GRISSOM AFB AND VICINITY

Well Identification	Owner	Well Depth (FT)	Depth of Water Producing Zone Below Ground Surface (FT)	Yield (GPM)	Lithologic Unit Tapped By Well	Water Level Below Ground Surface (FT)	Well Use
25/4-6-802	John Ladd	150	NR	60	LS	27	UKN
25/4-8-821	Rick Miles	185	NR	70	LS	34	UKN
25/4-8-820A	Richard Ailer	120	NR	8	LS	31	UKN
25/4-8-820B	Ray Childers	93	NR	18	LS	45	UKN
25/4-8-C	Mike Ploor	122	NR	70	LS	30	UKN
25/4-8-D	J. J. J. Co.	202	NR	40	LS	32	UKN
25/4-9D1	O. Sullivan	127	76	UKN	LS	22	D
25/4-17-790A	Martin Thompson	90	NR	40	LS	+.5	UKN
25/4-17-790B	Arthur D. Mow	84	NR	20	LS	0	UKN
25/4-17-800A	William D. Reed	142	NR	15	LS	5	UKN
25/4-17-780A	American Cyanamid	100	NR	UKN	LS	10	UKN
25/4-17-790C	Roy Edwards	157	NR	50	LS	+2	UKN
25/4-17-790D	R. L. McFall	60	NR	100	LS	6	UKN
25/4-17-790E	Elsie Edwards	120	NR	10	LS	1	UKN
25/4-17-790F	Joe Steward	97	NR	40	LS	FL	UKN

TABLE D.4
(Continued)
SELECTED WATER WELL DATA FOR GRISSOM AFB AND VICINITY

Well Identification	Owner	Well Depth (FT)	Depth of Water Producing Zone Below Ground Surface (FT)	Yield (GPM)	Lithologic Unit Tapped By Well	Water Level Below Ground Surface (FT)	Well Use
25/4-17-790G	Gene Clark	102	NR	40	LS	3	UKN
25/4-17-A	Phillip Cowan	80	NR	75	LS	32	UKN
25/4-17-790H	Paul Stegall	143	NR	25	LS	12	UKN
25/4-17-795A	John Shine	95	NR	30	LS	8	UKN
25/4-17-790J	Ralph Sandifer	51	NR	75	LS	10	UKN
25/4-17-790K	Ralph Cloar	142	NR	1	LS	+1	UKN
25/4-17-790M	Arthur Case	37	NR	30	LS	10	UKN
25/4-17-790N	Glen Fry	116	NR	38	LS	GL	UKN
25/4-17-785A	Guy Gardner	115	NR	15	LS	3	UKN
25/4-17-780B	Frankie Werlick	172	NR	9	LS	2	UKN
25/4-17-790P	Frankie Werlick	75	NR	60	LS	9	UKN
25/4-17-790Q	M. C. Gordon	98	NR	UKN	LS	FL	UKN
25/4-17-780C	Dennis Shirley	132	NR	60	LS	0	UKN
25/4-18-780	John Pearcy	84	NR	100	LS	11	UKN
26/3-5A	Charles McClish	163	NR	35	LS	30	UKN

TABLE D.4
(Continued)
SELECTED WATER WELL DATA FOR GRISSOM AFB AND VICINITY

Well Identification	Owner	Well Depth (FT)	Depth of Water Producing Zone Below Ground Surface (FT)	Yield (GPM)	Lithologic Unit Tapped By Well	Water Level Below Ground Surface (FT)	Well Use
26/3-5B	Frank Ray	104	NR	80	LS	FL	UKN
26/3-5C	R. M. Bowyer	107	NR	UKN	LS	NR	UKN
26/3-5-660	C. E. Baker, I	57	NR	8	LS	NR	UKN
26/3-8-712	Jane Sholty	88	NR	UKN	LS	NR	UKN
26/3-8A	Lewis L. Glassburn	72	NR	10	LS	25	UKN
26/3-8-700	James Murray	167	NR	45	LS	30	UKN
26/3-8-710	Ronald L. Elifritz	81	NR	13	LS	24	UKN
26/3-8-740A	Thomas E. Conrad, Sr.	80	NR	55	GR	25	UKN
26/3-8-740B	Browning	161	NR	7	LS	35	UKN
26/3-8-632	Wilbur Zeig	104	NR	UKN	LS	15	UKN
26/3-10-730	Walt Raderstorf	102	NR	40	LS	28	UKN
26/3-11-740	Major Ellis	182	NR	35	LS	62	UKN
26/3-11-750A	Alvin Metzger	83	NR	35	GR	40	UKN
26/3-11-750B	Keith Vance	252	NR	12	LS	45	UKN
26/3-12P1	P. Kunkle	67	46	UKN	LS	NR	D,S

TABLE D.4
(Continued)
SELECTED WATER WELL DATA FOR GRISSOM AFB AND VICINITY

Well Identification	Owner	Well Depth (FT)	Depth of Water Producing Zone Below Ground Surface (FT)	Yield (GPM)	Lithologic Unit Tapped By Well	Water Level Below Ground Surface (FT)	Well Use
26/3-12-740A	James W. Franklin	74	NR	50	GR	48	UKN
26/3-12	Art Hanell	83	NR	50	GR	42	UKN
26/3-12-740B	Henry A. Sellers	92	NR	40	GR	46	UKN
26/3-12-740C	Elwood F. Hemminger	87	NR	20	GR	10	UKN
26/3-12-730	Lynn Waller	137	NR	15	LS	40	UKN
26/3-12-750	Criders Cars	130	NR	15	LS	34	UKN
26/3-12-740D	Willis	100	NR	20	GR	30	UKN
26/3-12-740E	John H. Guss	143	NR	110	LS	20	UKN
26/3-13	Max Schelbert	142	NR	60	LS	34	UKN
26/3-13/770	Homer Camble	125	NR	UKN	GR	40	UKN
26/3-14	Jerry Garber	155	NR	25	LS	NR	UKN
26/3-14-730	Normand Acord	85	NR	20	LS	13	UKN
26/3-14-780	Jerry Garber	155	NR	30	LS	25	UKN
26/3-15-760	James R. Hopper	72	NR	12	GR	21	UKN
26/3-15-750	John Mays	202	NR	17	LS	35	UKN

TABLE D.4
(Continued)
SELECTED WATER WELL DATA FOR GRISSOM AFB AND VICINITY

Well Identification	Owner	Well Depth (FT)	Depth of Water Producing Zone Below Ground Surface (FT)	Yield (GPM)	Lithologic Unit Tapped By Well	Water Level Below Ground Surface (FT)	Well Use
26/3-16-760	Mabel Smith	88	NR	30	LS	20	UKN
26/3-16P1	William Morris	89	71	UKN	LS	NR	D
26/3-16P2	Onward Lumber Co.	96	NR	UKN	LS	6	P
26/3-16P3	E. Hall	86	74	UKN	LS	NR	D
26/3-16P4	Lowell Wilson	84	74	UKN	LS	NR	D
26/3-16Q1	Fred Wouster	99	70	UKN	LS	NR	D
26/3-16Q2	Ed Grant	84	68	UKN	LS	NR	D
26/3-16Q3	Roy Perkins	83	70	UKN	LS	NR	D
26/3-16Q4	Paul Mays	84	66	UKN	LS	NR	D
26/3-16Q5	Harmon Wilson	96	72	UKN	LS	NR	D
26/3-17-770	Onward Fire Dept.	105	NR	30	LS	20	UKN
26/3-20-761	Earl Benson	120	NR	UKN	LS	4	UKN
26/3-20-760A	Carey Ice Cream	150	NR	UKN	LS	NR	UKN
26/3-20-745	Bob Layman	177	NR	UKN	LS	NR	UKN

TABLE D.4
(Continued)
SELECTED WATER WELL DATA FOR GRISSOM AFB AND VICINITY

Well Identification	Owner	Well Depth (FT)	Depth of Water Producing Zone Below Ground Surface (FT)	Yield (GPM)	Lithologic Unit Tapped By Well	Water Level Below Ground Surface (FT)	Well Use
26/3-20-760B	Sangrala Valley Boy's Home	136	NR	250	LS	22	UKN
26/3-20-760C	Cecil Mullens	51	NR	75	GR	0	UKN
26/3-20-750	S. V. Boy's Home	203	NR	60	LS	12	UKN
26/3-21-770A	Robert Ramer	88	NR	75	GR	24	UKN
26/3-21-778A	H. C. Austin	145	NR	10	LS	6	UKN
26/3-21-775A	John L. Minor	105	NR	60	GR	5	UKN
26/3-21-775B	Reish	46	NR	100	GR	10	UKN
26/3-21-760	Bobbie Davis	200	NR	15	LS	14	UKN
26/3-21-770B	S. V. Boy's Home	145	NR	300	GR	20	UKN
26/3-21-778B	H. C. Austin	115	NR	12	LS	12	UKN
26/3-21-770C	Bruce Downhour	74	NR	25	GR	23	UKN
26/3-21-778C	Shope	108	NR	45	LS	11	UKN
26/3-22J1	Mary Puterbaugh	83	78	UKN	LS	NR	D
26/3-22R1	Albert Armstrong	93	69	UKN	LS	NR	D,S

TABLE D.4
(Continued)
SELECTED WATER WELL DATA FOR GRISSOM AFB AND VICINITY

Well Identification	Owner	Well Depth (FT)	Depth of Water Producing Zone Below Ground Surface (FT)	Yield (GPM)	Lithologic Unit Tapped By Well	Water Level Below Ground Surface (FT)	Well Use
26/3-22-780	Albert Armstrong	94	NR	40	LS	NR	UKN
26/3-22-770	Lawrence Braden	129	NR	30	LS	20	UKN
26/3-23-770	Carl Graves	88	NR	10	LS	32	UKN
26/3-23-780A	Viral Bowyer	98	NR	60	LS	30	UKN
26/3-23-780B	Larry Newhouser	105	NR	30	LS	32	UKN
26/3-23-780C	Harrison G. Breedlove	150	NR	10	LS	40	UKN
26/3-23-780D	John Walker	123	NR	25	LS	19	UKN
26/3-23-780E	John Walker	105	NR	30	LS	19	UKN
26/3-24A1	G. W. Carson	99	83	UKN	LS	54	D
26/3-24-780A	Gus Doppes	183	NR	50	LS	29	UKN
26/3-24-745	Valley Trailer Ct.	133	NR	100	LS	24	UKN
26/3-24-750	Larry Turnbough	39	NR	UKN	GR	3	UKN
26/3-24-740	Jerry King	50	NR	12	LS	8	UKN
26/3-24A	William Meyer	149	NR	50	LS	+2	UKN
26/3-24B	Harry Flook	144	NR	20	LS	23	UKN

TABLE D.4
(Continued)
SELECTED WATER WELL DATA FOR GRISSOM AFB AND VICINITY

Well Identification	Owner	Well Depth (FT)	Depth of Water Producing Zone Below Ground Surface (FT)	Yield (GPM)	Lithologic Unit Tapped By Well	Water Level Below Ground Surface (FT)	Well Use
26/3-24-780B	Charles Jacker	97	NR	35	LS	58	UKN
26/3-24-770A	Larry Fry	160	NR	15	LS	35	UKN
26/3-24C	Earl Glassburr	82	NR	60	LS	30	UKN
26/3-24D	Randall Derby	124	NR	40	LS	22	UKN
26/3-24-770B	Dennis Weideman	190	NR	25	LS	41	UKN
26/3-25A1	State of Indiana	141	9	UKN	LS	+6	P
26/3-25D1	Indiana Bell Telephone Co.	65	52	UKN	GR	22	D
26/3-25Q1	U.S. Government	165	66	351	LS	28	O
26/3-25-780	E. L. Mattingly	82	NR	8	LS	30	UKN
26/3-25-770	Ralph Redd	142	NR	18	LS	22	UKN
26/3-25	Mailben's Inc.	185	NR	50	LS	25	UKN
26/3-25-775A	John Walker	90	NR	19	LS	35	UKN
26/3-25	U.S. Government	150	NR	350	LS	12	UKN
26/3-25-775B	John Walker	90	NR	30	LS	25	UKN

TABLE D.4
(Continued)
SELECTED WATER WELL DATA FOR GRISSOM AFB AND VICINITY

Well Identification	Owner	Well Depth (FT)	Depth of Water Producing Zone Below Ground Surface (FT)	Yield (GPM)	Lithologic Unit Tapped By Well	Water Level Below Ground Surface (FT)	Well Use
26/3-25-780	Harold Piper	113	NR	12	LS	35	UKN
26/3-25-790	Tri State Const.	105	NR	150	LS	NR	UKN
26/3-26D1	U.S. Government	77	64	UKN	LS	NR	O
26/3-26D2	Centex Const. Co.	100	66	UKN	LS	24	P
26/3-27A1	M&E Stoner	110	84	UKN	LS	17	D, S
26/3-27H1	Arthur Mays	200	83	UKN	LS	17	D
26/3-27-785	George Wright	157	NR	UKN	LS	14	UKN
26/3-28N1	G. J. Lees	90	65	UKN	LS	8	D
26/3-28F1	R. Erbaugh	103	NR	UKN	GR	NR	S
26/3-28-770	David Carey	130	NR	50	LS	15	UKN
26/3-29-775A	Herb Small	169	NR	60	LS	8	UKN
26/3-29-775B	Don Guy	169	NR	35	LS	5	UKN
26/3-32-782	L. Anderson	115	NR	UKN	LS	NR	UKN
26/3-32-778	F. Rush	142	NR	UKN	LS	29	UKN
26/32-790	Evertt Bowman	150	NR	100	LS	10	UKN

TABLE D.4
(Continued)
SELECTED WATER WELL DATA FOR GRISSOM AFB AND VICINITY

Well Identification	Owner	Well Depth (FT)	Depth of Water Producing Zone Below Ground Surface (FT)	Yield (GPM)	Lithologic Unit Tapped By Well	Water Level Below Ground Surface (FT)	Well Use
26/3-33K1	George Thompson	150	55	UKN	LS	21	UKN
26/3-33M1	G. Deish	106	NR	UKN	GR	NR	D, S
26/3-33	Helen Ogle	53	NR	75	GR	8	UKN
26/3-33-790	Dale Brock	88	NR	25	GR	6	UKN
26/3-34E1	NR	NR	NR	UKN	TL	NR	N
26/3-34M1	Harry Preiser	200	72	UKN	LS	8	UKN
26/3-35C1	U.S. Government	143	NR	UKN	LS	NR	O
26/3-35C2	U.S. Government	84	NR	UKN	LS	24	DES
26/3-35-800	Bunker Hill AFB	125	NR	100	LS	23	UKN
26/3-36-800A	Grissom AFB	175	NR	1000	LS	20	UKN
26/3-36-800B	Grissom AFB, Bldg #16	140	NR	75	LS	23	UKN
26/4-7N1	A. Kuehl	140	90	UKN	LS	45	D
26/4-7Q1	R. Lees	170	95	UKN	LS	52	D
26/4-7Q2	F. E. Lees	194	112	UKN	LS	NR	D

TABLE D.4
(Continued)
SELECTED WATER WELL DATA FOR GRISSOM AFB AND VICINITY

Well Identification	Owner	Well Depth (FT)	Depth of Water Producing Zone Below Ground Surface (FT)	Yield (GPM)	Lithologic Unit Tapped By Well	Water Level Below Ground Surface (FT)	Well Use
26/4-7-775	Lloyd Oldfather	171	NR	100	LS	38	UKN
26/4-7-770A	Ray Poff	92	NR	40	GR	88	UKN
26/4-7-770B	Glen Hedrick	161	NR	12	LS	45	UKN
26/4-7-770C	Robert Harshman	174	NR	50	LS	44	UKN
26/4-7A	Harvey Garber	169	NR	60	LS	45	UKN
26/4-7B	Brothers Const. Co.	97	NR	50	LS	44	UKN
26/4-7-745	E. D. Schmidt	146	NR	15	LS	21	UKN
26/4-7-730	Ralph Weist	170	NR	30	LS	66	UKN
26/4-17A	Harry Coblentz	107	NR	60	GR	58	UKN
26/4-17-782	K. B. Kreag	150	NR	30	LS	37	UKN
26/4-17-800	Mike Coblentz	104	NR	30	GR	53	UKN
26/4-18A	F. L. Fobes	149	NR	12	LS	36	UKN
26/4-18-785	Stan Conaway	97	NR	50	LS	52	UKN
26/4-18B	Arnold Zapf	122	NR	60	LS	49	UKN
26/4-18-782	Donald Collins	162	NR	35	LS	33	UKN

TABLE D.4
(Continued)
SELECTED WATER WELL DATA FOR GRISSOM AFB AND VICINITY

Well Identification	Owner	Well Depth (FT)	Depth of Water Producing Zone Below Ground Surface (FT)	Yield (GPM)	Lithologic Unit Tapped By Well	Water Level Below Ground Surface (FT)	Well Use
26/4-18-790	Ray Meyers	184	NR	60	LS	57	UKN
26/4-18-775	Marion Elliott	187	NR	20	LS	44	UKN
26/4-19D1	B. Marine	68	64	UKn	LS	44	N
26/4-19E1	C. Murry	95	72	UKN	LS	25	D
26/4-19A	Bill Weichlein	114	NR	23	LS	47	UKN
26/4-19-784	Raymond Meyers	98	NR	75	LS	54	UKN
26/4-19-789	Raymond Meyers	98	NR	30	LS	54	UKN
26/4-19B	Michael J. Flynn	180	NR	35	LS	42	UKN
26/4-19-780	Ken Bedwell	77	NR	5	GR	62	UKN
26/4-19C	Harry C. Lee	104	NR	15	LS	55	UKN
26/4-19D	Raymond Meyers	82	NR	60	LS	36	UKN
26/4-19E	Raymond Meyers	98	NR	40	LS	49	UKN
26/4-19F	Major Babbitt	91	NR	35	LS	43	UKN
26/4-19-780	Don Orman	105	NR	20	LS	45	UKN
26/4-28-793	Virgil Alwine	176	NR	60	LS	66	UKN

TABLE D.4
(Continued)
SELECTED WATER WELL DATA FOR GRISSOM AFB AND VICINITY

Well Identification	Owner	Well Depth (FT)	Depth of Water Producing Zone Below Ground Surface (FT)	Yield (GPM)	Lithologic Unit Tapped By Well	Water Level Below Ground Surface (FT)	Well Use
26/4-28A	Bunker Hill Fish & Game Club	94	NR	50	LS	31	UKN
26/4-28B	Fred Deckard	202	NR	20	LS	48	UKN
26/4-28-800	Elmo Krinkle	172	NR	100	LS	47	UKN
26/4-29F1	H. Golding	94	65	UKN	LS	36	D
26/4-29A	LMK Enterprises	165	NR	25	LS	58	UKN
26/4-29-799	E. Schamerlock	181	NR	100	LS	50	UKN
26/4-29-775	John Scott	122	NR	60	LS	28	UKN
26/4-29B	Grabers Bros. Const.	110	NR	30	LS	60	UKN
26/4-29-760	Dennis Harrell	135	NR	75	LS	24	UKN
26/4-29-770	Garold Armstrong	97	NR	8	LS	17	UKN
26/4-20-797	S. Basley	186	NR	125	LS	51	UKN
26/4-20-800	Judy Johnson	113	NR	100	LS	36	UKN
26/4-20-797	Clingman	190	NR	50	LS	50	UKN
26/4-20-795	Harry Coblentz	120	NR	100	LS	49	UKN

TABLE D.4
(Continued)
SELECTED WATER WELL DATA FOR GRISSOM AFB AND VICINITY

Well Identification	Owner	Well Depth (FT)	Depth of Water Producing Zone Below Ground Surface (FT)	Yield (GPM)	Lithologic Unit Tapped By Well	Water Level Below Ground Surface (FT)	Well Use
26/4-21-795	Gable	166	NR	100	LS	35	UKN
26/4-21-A	Omer Stubler	120	NR	30	LS	50	UKN
26/4-30M1	Siranoff Vegetable Oil Co.	140	60	40	LS	43	I
26/4-30N1	C. E. Hutchcroft	99	58	UKN	LS	17	UKN
26/4-30-730	Don Dyer	145	NR	40	LS	35	UKN
26/4-30-790	Porter Swafford	185	NR	35	LS	65	UKN
26/4-31-800	Jay Gilbreath	105	NR	35	LS	35	UKN
26/4-31D1	Milligan & Dunn	175	58	155	LS	25	P
26/4-31-805	Stanley Courtney	141	NR	UKN	LS	37	UKN
26/4-31-790A	Jesse Abplanalp	140	NR	100	LS	20	UKN
26/4-31-A	Stanley Hesley	174	NR	35	LS	38	UKN
26/4-31-B	Clyde Lee Hickerson	150	NR	60	LS	39	UKN
26/4-31-805	Jay Gilbreath	249	NR	18	LS	30	UKN
26/4-31-790B	John McCurtain	141	NR	28	LS	30	UKN

TABLE D.4
(Continued)
SELECTED WATER WELL DATA FOR GRISSOM AFB AND VICINITY

Well Identification	Owner	Well Depth (FT)	Depth of Water Producing Zone Below Ground Surface (FT)	Yield (GPM)	Lithologic Unit Tapped By Well	Water Level Below Ground Surface (FT)	Well Use
26/4-32F1	C. McConnelly	815	NR	UKN	LS	NR	O
26/4-32-810	Bunker Hill Water Works	190	NR	UKN	LS	48	UKN
26/4-32-A	Bunker Hill W. W.	262	NR	UKN	LS	NR	UKN
26/4-32-B	Bunker Hill Parsonage	166	NR	UKN	LS	45	UKN
26/4-32-C	Edna Fish	149	NR	UKN	LS	43	UKN
26/4-33-A	Richard Haslon	182	NR	7	LS	45	UKN
26/4-33-B	Bob Williams	97	NR	100	LS	28	UKN
26/4-33-802	James Caldwell	133	NR	15	LS	30	UKN
26/4-33-800A	Steve Whybrew	85	NR	45	GR	29	UKN
26/4-33-C	Homer E. Williams	145	NR	25	LS	38	UKN
26/4-33D	Wayne Pownall	197	NR	7	LS	85	UKN
26/4-33E	John Rinehuls	135	NR	80	LS	40	UKN
26/4-33-800B	Louis McCall	69	NR	25	LS	14	UKN

TABLE D.4
(Continued)
SELECTED WATER WELL DATA FOR GRISSOM AFB AND VICINITY

Well Identification	Owner	Well Depth (FT)	Depth of Water Producing Zone Below Ground Surface (FT)	Yield (GPM)	Lithologic Unit Tapped By Well	Water Level Below Ground Surface (FT)	Well Use
26/4-33-800C	Louis McCall	97	NR	50	LS	29	UKN
26/4-33-800D	Jim Kunkle	74	NR	12	GR	33	UKN
26/4-33-800E	Robert Scutter	136	NR	12	LS	39	UKN
26/4-33-790A	D. L. Turner	117	NR	20	LS	35	UKN
26/4-33-F	Alfred M. Woddell	157	NR	40	LS	25	UKN
26/4-33-790B	Marvin Walker	75	NR	10	GR	30	UKN

TABLE D.4
(Continued)
SELECTED WATER WELL DATA FOR GRISSOM AFB AND VICINITY

Well Identification	Owner	Well Depth (FT)	Depth of Water Producing Zone Below Ground Surface (FT)	Yield (GPM)	Lithologic Unit Tapped By Well	Water Level Below Ground Surface (FT)	Well Use

D = Domestic
DES = Destroyed
FL = Flowing
GL = Ground Level
GR = Gravel
I = Industrial
IR = Irrigation
LS = Limestone
N = Not Used

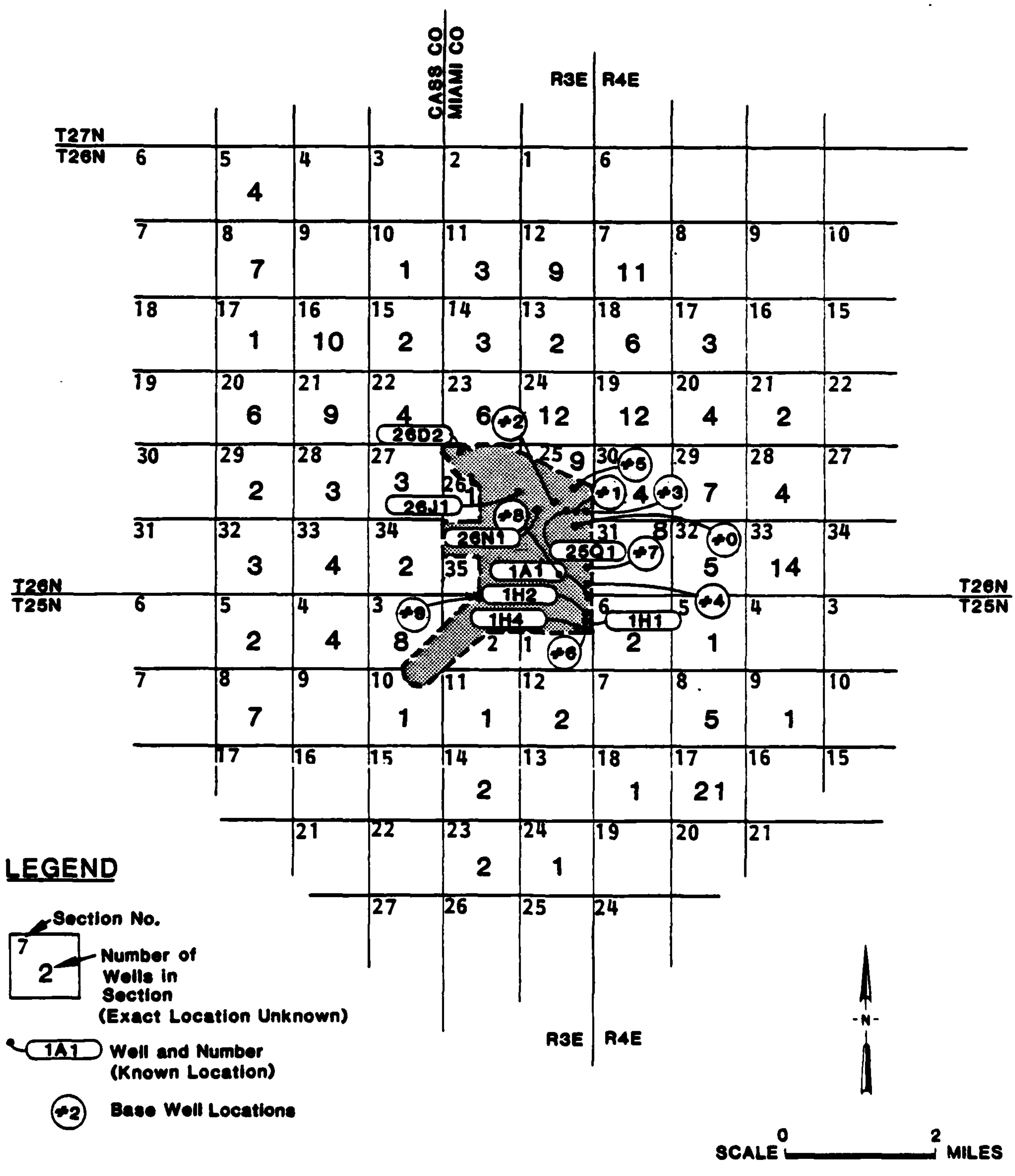
NR = Not Recorded
O = Observation
P = Public Supply
S = Stock
T = Water Well Test Hole
TL = Till
UKN = Unknown

26/4-33-800 = (Township/Range - Section - Well Number)

Source: Installation Documents and Indiana Department of Natural Resources

GRISSOM AFB

REGIONAL WELL LOCATION MAP



SOURCE: WATKINS and ROSENSHEIN, 1963 AND INSTALLATION DOCUMENTS

APPENDIX E

MASTER LIST OF SHOPS

APPENDIX E
MASTER LIST OF SHOPS

Name	Present Location	Handles Hazardous Materials	Generates Hazardous Wastes	Typical TSD Methods
USAF Hospital, Grissom				
Dental Lab Clinic	210	Yes	Yes	Silver Recovery
Hospital Radiology	530	Yes	Yes	Silver Recovery
305 Combat Support Group (CSG)				
Photo Lab	535	Yes	Yes	Silver Recovery
Auto/Wood Hobby	145	Yes	Yes	Contractor Disposal
Arts & Crafts	575	Yes	No	--
Reproduction	310	Yes	No	--
Combat Arms Range	137	Yes	No	--
Graphics	535	Yes	No	--
Base Service Station	407	Yes	Yes	Contractor Disposal
305 Avionics Maintenance Squadron (AMS)				
PAACS	427	Yes	No	--
Radar	427	Yes	No	--
Radio	427	Yes	No	--
Doppler Radar	427	Yes	No	--
PMEL	427	Yes	Yes	DPDO

APPENDIX E
MASTER LIST OF SHOPS
(Continued)

Name	Present Location	Handles Hazardous Materials	Generates Hazardous Wastes	Typical TSD Methods
305 Avionics Maintenance Squadron (AMS)(Continued)				
Instrument	427	No	No	--
Auto Pilot	427	Yes	No	--
305 Air Refueling Wing (AREFW)				
Life Support	109	Yes	No	
305 Supply Squadron (SUPS)				
Fuels Lab	440	Yes	Yes	DPDO
305 Field Maintenance Squadron (FMS)				
Corrosion Control	200	Yes	Yes	O/W Separator and DPDO
Structural Repair	426	Yes	No	--
AGE	425	Yes	Yes	DPDO
Fuel Sys. Repair	434	Yes	No	--
Propulsion	190	Yes	Yes	DPDO
Battery & Electric	200	Yes	Yes	DPDO & Neutralized to Sewer
Nondestructive Insp.	426	Yes	Yes	DPDO & Silver Recovery

APPENDIX E
MASTER LIST OF SHOPS
(Continued)

Name	Present Location	Handles Hazardous Materials	Generates Hazardous Wastes	Typical TSD Methods
305 Field Maintenance Squadron (FMS) (Continued)				
Welding	426	Yes	No	--
Wheel & Tire	436	Yes	Yes	DPDO
Survival Equipment	109	Yes	No	--
Pneudraulics	200	Yes	Yes	DPDO
Jet Engine Test Cell	741	Yes	Yes	DPDO
Environmental Systems	200	Yes	No	--
Machine Shop	426	Yes	No	--
305 Organizational Maintenance Squadron (OMS)				
Flightline Branch	435	Yes	Yes	DPDO
Insp. Branch	439	Yes	Yes	DPDO
Maintenance	431	No	No	--
Transportation	439	No	No	--
Non-Powered Age	435	Yes	Yes	DPDO
Bench Stock	436	Yes	No	--
780 AME	436	Yes	No	--

APPENDIX E
MASTER LIST OF SHOPS
(Continued)

Name	Present Location	Handles Hazardous Materials	Generates Hazardous Wastes	Typical TSD Methods
305 Transportation Squadron (TRANS)				
Gen. Veh. Maint.	420	Yes	Yes	DPDO & Contractor Disposal
Refueling Maint.	421	Yes	Yes	DPDO
Fire Dept/Veh. Maint.	100	Yes	Yes	DPDO
Pack. & Crating	219	Yes	No	--
Special Purpose	33	Yes	Yes	DPDO
305 Civil Engineering Squadron (CES)				
Liquid Fuels Maint.	122	Yes	Yes	DPDO
Paint Shop	221	Yes	Yes	DPDO
Pavement & Grounds	122	Yes	No	--
Carpentry	221	No	No	-
Water Treatment Plant	216	No	No	--
Refrigeration	122	Yes	Yes	DPDO
Sewage Treatment Plant	512	Yes	No	--
Power Production	122	Yes	Yes	DPDO
Plumbing	221	Yes	No	--

APPENDIX E
MASTER LIST OF SHOPS
(Continued)

Name	Present Location	Handles Hazardous Materials	Generates Hazardous Wastes	Typical TSD Methods
305 Civil Engineering Squadron (CES) (Continued)				
Interior Electric	221	Yes	No	--
Exterior Electric	221	Yes	Yes	DPDO
Welding & Sheet Metal	221	No	No	--
Heavy Equipment	122	Yes	No	--
Heat Plant	223	Yes	No	--
Entomology	221	Yes	Yes	Rinsed Reused/ Wash down to Sanitary Sewer
Heat Shop	221	Yes	Yes	Neutralized to Sewer
931 Air Refueling Group				
The 931 Air Refueling Group shop wastes are disposed of through the 305 FMS and AMS Shops with which they share facilities except the following:				
Phase Dock	437	Yes	Yes	DPDO
1915 Informational Systems Squadron (ISS)				
Telecommunications	159	Yes	No	--
Nav Aids	S-16	Yes	No	--
Radio	S-16	Yes	No	--
Weather	S-14	Yes	No	--
Radar	S-18	Yes	No	--

APPENDIX E
MASTER LIST OF SHOPS
(Continued)

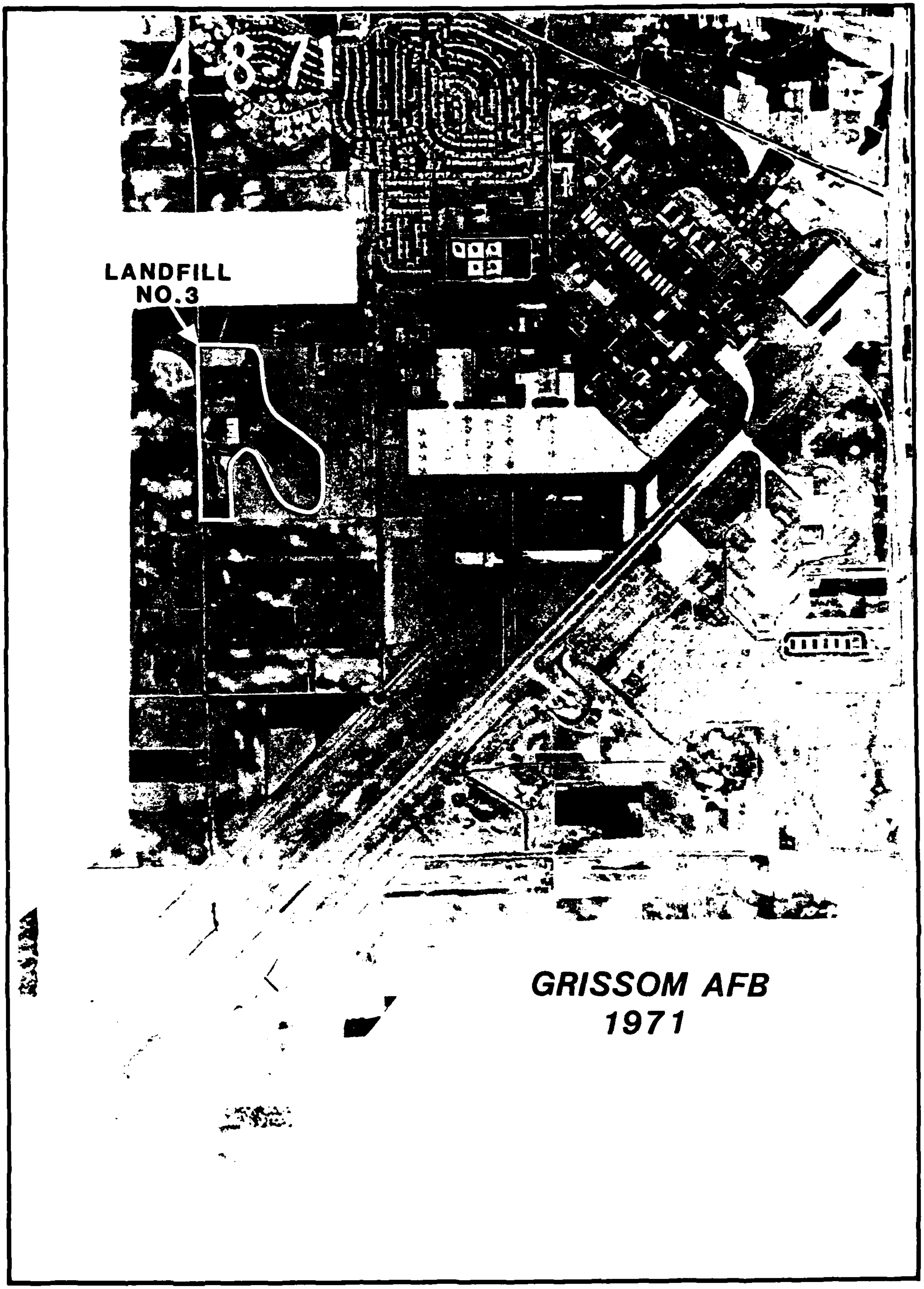
Name	Present Location	Handles Hazardous Materials	Generates Hazardous Wastes	Typical TSD Methods
930 Consolidated Aircraft Maintenance Squadron (CAMS)				
Fuel Systems	435	Yes	No	--
Corrosion Control	S-11	Yes	Yes	DPDO
Structural Repair	22	Yes	No	--
AGE Powered & Nonpowered	21	Yes	Yes	DPDO
Jet Engine Shop	190	Yes	Yes	DPDO
Electric	22	Yes	Yes	Neutralized to Sewer
Metal Processing/ Welding	22	Yes	No	--
Survival Equip.	109	Yes	No	--
Repair & Reclamation	S-11	Yes	Yes	DPDO
Comm/Nav	32	Yes	No	--
Inst/Auto Pilot	32	Yes	No	--
ECM	32	Yes	No	--
Sensor Photo	32	Yes	No	--
Phase Inspection	S-11	Yes	Yes	DPDO
Pneudraulics	22	Yes	Yes	DPDO
EGRESS	22	No	No	--

APPENDIX E
MASTER LIST OF SHOPS
(Continued)

Name	Present Location	Handles Hazardous Materials	Generates Hazardous Wastes	Typical TSD Methods
930 Consolidated Aircraft Maintenance Squadron (CAMS) (Continued)				
Environmental	22	Yes	No	--
Gun Release	22	Yes	Yes	DPDO
Loading	22	No	No	--
Machine Shop	22	Yes	No	--
Aircraft Generation	19	Yes	Yes	DPDO
Munitions Storage		No	No	--
71 Flying Training Wing ACE				
Maintenance	438	Yes	Yes	DPDO

APPENDIX F

PHOTOGRAPHS

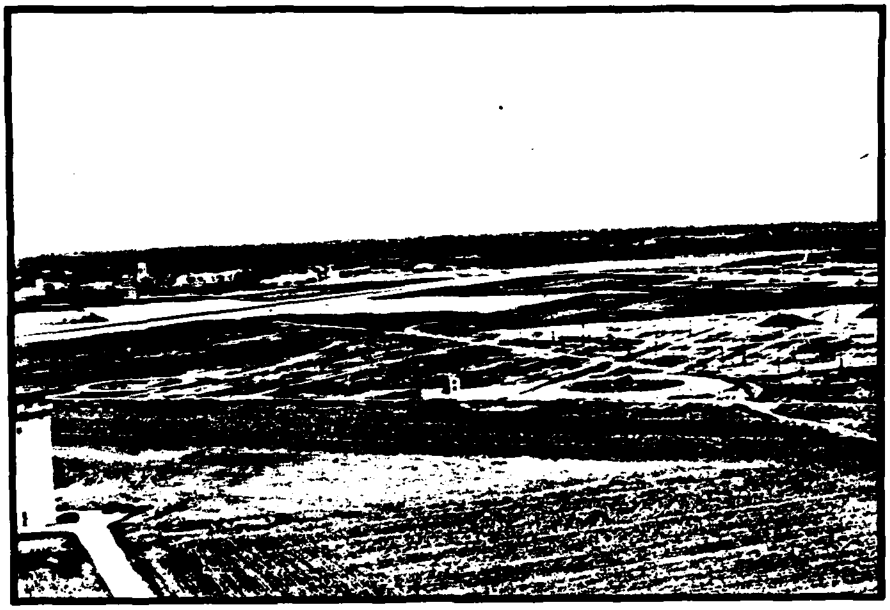

A-8-71
LANDFILL
NO.3
GRISSOM AFB
1971

GRISSOM AFB

Landfill No. 3
(FACING SOUTH)

Fire Protection Training Area No. 2
(FACING SOUTH)

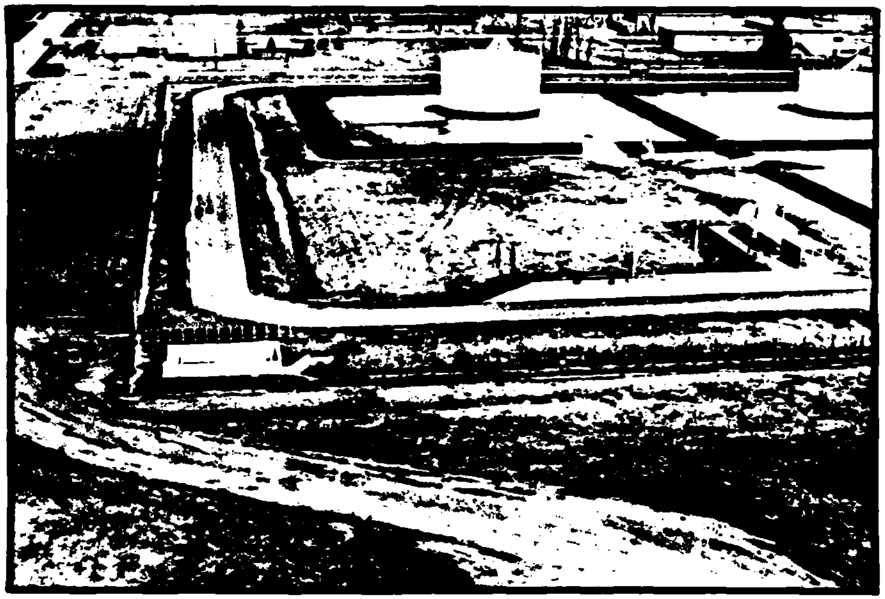
ES ENGINEERING-SCIENCE



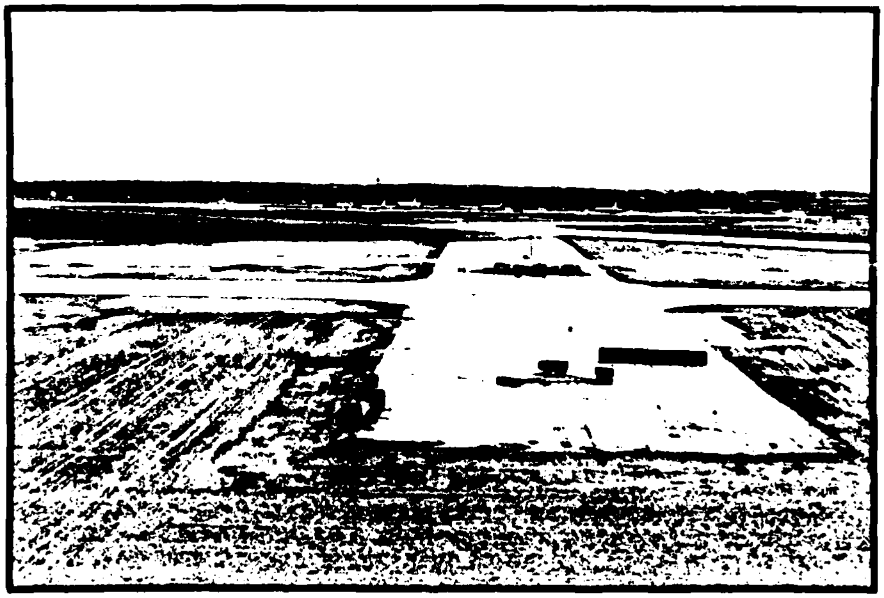
Fire Protection Training Area
No. 1 (left) and No. 2 (right)
(FACING NORTHEAST)

Landfill No. 1
(FACING NORTH)

GRISSOM AFB



Sludge Weathering Site
(FACING NORTH)



Waste Oil Storage Pad
(FACING EAST)

GRISSOM AFB

Landfill No. 2
(FACING WEST)

APPENDIX G

USAF INSTALLATION RESTORATION PROGRAM HAZARD ASSESSMENT RATING METHODOLOGY

APPENDIX G

USAF INSTALLATION RESTORATION PROGRAM
HAZARD ASSESSMENT RATING METHODOLOGY

BACKGROUND

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

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

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

The first site rating model was developed in June 1981 at a meeting with represenatives from USAF Occupational and Environmental Health Laboratory (OEHL), Air Force Engineering and Services Center (AFESC), Engineering-Science (ES) and CH2M Hill. The basis for this model was a system developed for EPA by JRB Associates of McLean, Virginia. The JRB model was modified to meet Air Force needs.

After using this model for 6 months at over 20 Air Force installations, certain inadequacies became apparent. Therefore, on January 26 and 27, 1982, representatives of USAF OEHL, AFESC, various major commands, Engineering-Science, and CH2M Hill met to address the inadequacies. The result of the meeting was a new site rating model designed to present a better picture of the hazards posed by sites at Air Force installations. The new rating model described in this presentation is referred to as the Hazard Assessment Rating Methodology.

PURPOSE

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

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

DESCRIPTION OF MODEL

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

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

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

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

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

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

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

FIGURE 1

HAZARD ASSESSMENT RATING METHODOLOGY FLOW CHART

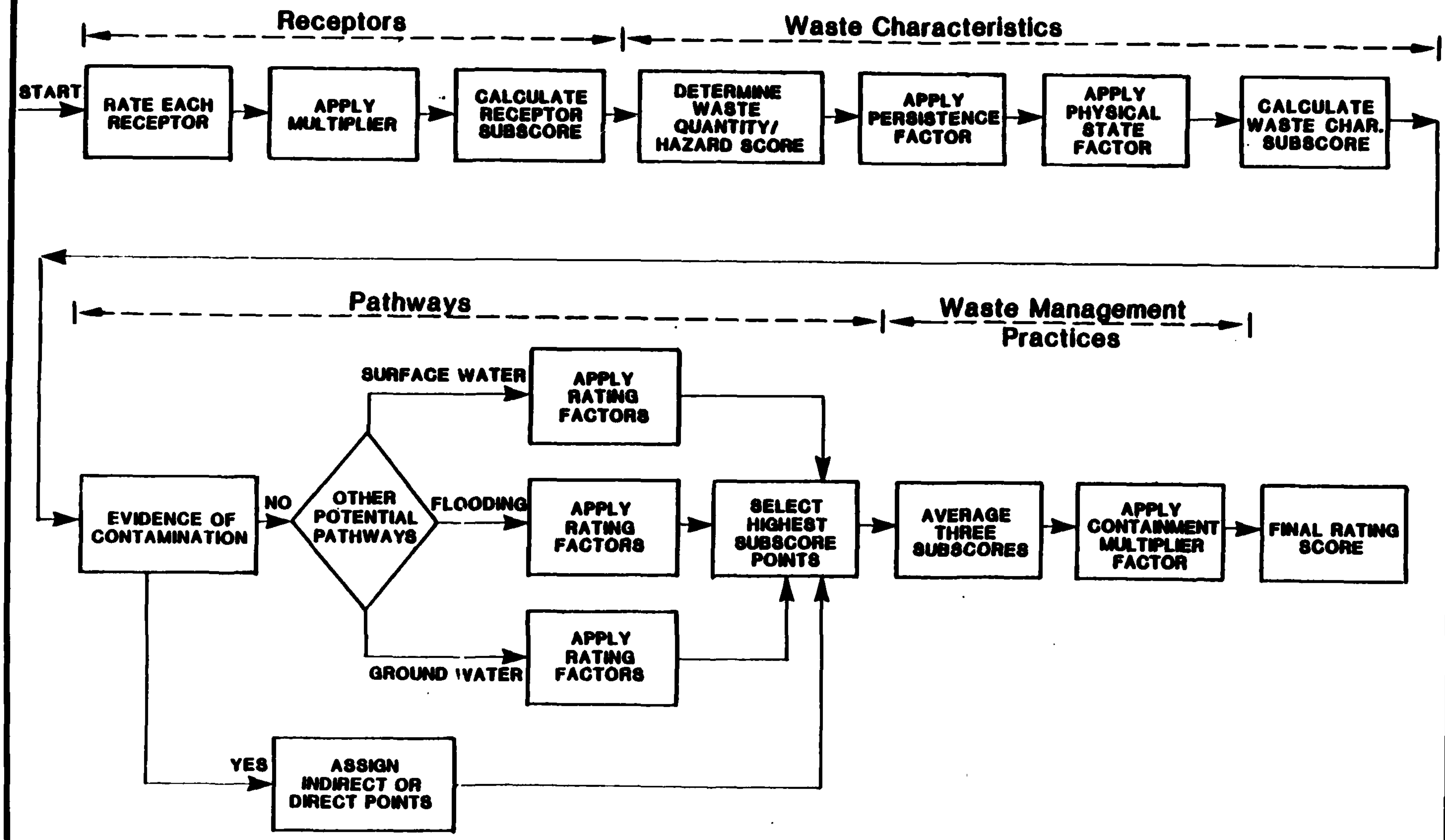


FIGURE 2

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE ______________________

LOCATION ______________________

DATE OF OPERATION OR OCCURRENCE ______________________

OWNER/OPERATOR ______________________

COMMENTS/DESCRIPTION ______________________

SITE RATED BY ______________________

I. RECEPTORS

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

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

II. WASTE CHARACTERISTICS

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

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

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

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

______ X ______ = ______

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

______ X ______ = ______

FIGURE 2 (Continued)

III. PATHWAYS

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

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

Subscore ______

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

1. Surface water migration

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

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

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

Subscore (100 x factor score/3) ______

3. Ground-water migration

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

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

C. Highest pathway subscore.

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

Pathways Subscore ______

IV. WASTE MANAGEMENT PRACTICES

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

Receptors ______
Waste Characteristics ______
Pathways ______

Total ______ divided by 3 = ______
Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

______ X ______ = ______

TABLE 1

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

I. RECEPTORS CATEGORY

Rating Factors	Rating Scale Levels 0	1	2	3	Multiplier
A. Population within 1,000 feet (includes on-base facilities)	0	1 - 25	26 - 100	Greater than 100	4
B. Distance to nearest water well	Greater than 3 miles	1 to 3 miles	3,001 feet to 1 mile	0 to 3,000 feet	10
C. Land Use/Zoning (within 1 mile radius)	Completely remote (zoning not applicable)	Agricultural	Commercial or industrial	Residential	3
D. Distance to installation boundary	Greater than 2 miles	1 to 2 miles	1,001 feet to 1 mile	0 to 1,000 feet	6
E. Critical environments (within 1 mile radius)	Not a critical environment	Natural areas	Pristine natural areas; minor 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

SITE HAZARD ASSESSMENT RATING FORMS

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of site: Landfill No.1
Location:North end of base west of WTP
Date of Operation: 1940's - 1958
Owner/Operator: Grissom AFB
Comments/Description: Site of present north coal yard.

Site Rated by: EHS, BDM, HDH

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	3	10	30	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	2	6	12	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			123	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 68

II. WASTE CHARACTERISTICS

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

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

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

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

20 x 0.90 = 18

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

18 x 1.00 = 18

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	0	8	0	24
Surface permeability	1	6	6	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	3	8	24	24
Net precipitation	1	6	6	18
Soil permeability	1	8	8	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			38	114
Subscore (100 x factor score subtotal/maximum score subtotal)				33

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	68
Waste Characteristics	18
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 0.95 = 45

FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of site: Landfill No.2
Location: South end of base
Date of Operation: 1958-1963
Owner/Operator: Grissom AFB
Comments/Description: South end of control tower.

Site Rated by: EHS, BDM, HDH

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to installation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	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	1	6	6	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			106	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 59

II. WASTE CHARACTERISTICS

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

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

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 0.90 = 54

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

54 x 1.00 = 54

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	0	8	0	24
Surface permeability	1	6	6	18
Rainfall intensity	3	8	24	24
Subtotals			52	108
Subscore (100 x factor score subtotal/maximum score subtotal)				48
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	1	6	6	18
Soil permeability	1	8	8	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			38	114
Subscore (100 x factor score subtotal/maximum score subtotal)				33

C. Highest pathway subscore.

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

Pathways Subscore 48

IV. WASTE MANAGEMENT PRACTICES

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

Receptors		59		
Waste Characteristics		54		
Pathways		48		
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 0.95 = \ 51 \

FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of site: Landfill No.3
Location: West end of base.
Date of Operation: 1963-1974
Owner/Operator: Grissom AFB
Comments/Description: Largest on base: most used for industrial as well as refuse.
Site Rated by: EHS, BDM, HDH

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	2	10	20	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to installation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	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	2	6	12	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			102	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 57

II. WASTE CHARACTERISTICS

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

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

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 0.90 = 72

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

72 x 1.00 = 72

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	0	8	0	24
Surface permeability	1	6	6	18
Rainfall intensity	3	8	24	24
Subtotals			52	108
Subscore (100 x factor score subtotal/maximum score subtotal)				48
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	1	6	6	18
Soil permeability	1	8	8	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			38	114
Subscore (100 x factor score subtotal/maximum score subtotal)				33

C. Highest pathway subscore.

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

Pathways Subscore 48

IV. WASTE MANAGEMENT PRACTICES

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

Receptors	57		
Waste Characteristics	72		
Pathways	48		
Total 177	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 0.95 = 56

FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of site: Fire Protection Training Area No. 1
Location: North of Control Tower.
Date of Operation: 1957-1982
Owner/Operator: Grissom AFB
Comments/Description: Unlined area.

Site Rated by: EHS, BDM, HDH

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	2	10	20	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to installation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	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	1	6	6	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			90	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 50

II. WASTE CHARACTERISTICS

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

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

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 0.90 = 54

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

54 x 1.00 = 54

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	0	8	0	24
Surface permeability	1	6	6	18
Rainfall intensity	3	8	24	24
Subtotals			52	108
Subscore (100 x factor score subtotal/maximum score subtotal)				48
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	1	6	6	18
Soil permeability	1	8	8	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			38	114
Subscore (100 x factor score subtotal/maximum score subtotal)				33

C. Highest pathway subscore.

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

Pathways Subscore 48

IV. WASTE MANAGEMENT PRACTICES

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

Receptors	50	
Waste Characteristics	54	
Pathways	48	
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

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of site: Fire Protection Training Area No.2
Location: East of Control Tower.
Date of Operation:1982-1984
Owner/Operator: Grissom AFB
Comments/Description: Unlined area presently undergoing rehabilitation.

Site Rated by: EHS, BDM, HDH

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	2	10	20	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to installation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	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	1	6	6	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			90	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 50

II. WASTE CHARACTERISTICS

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

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

Factor Subscore A (from 20 to 100 based on factor score matrix) 50

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

50 x 0.90 = 45

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

45 x 1.00 = 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	2	8	16	24
Net precipitation	1	6	6	18
Surface erosion	0	8	0	24
Surface permeability	1	6	6	18
Rainfall intensity	3	8	24	24
Subtotals			52	108
Subscore (100 x factor score subtotal/maximum score subtotal)				48
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	1	6	6	18
Soil permeability	1	8	8	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			38	114
Subscore (100 x factor score subtotal/maximum score subtotal)				33

C. Highest pathway subscore.

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

Pathways Subscore 48

IV. WASTE MANAGEMENT PRACTICES

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

Receptors		50	
Waste Characteristics		45	
Pathways		48	
Total	143	divided by 3 =	48 Gross total score

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

Gross total score x waste management practices factor = final score

48 x 1.00 = 48

FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of site: Waste Oil Storage Pad
Location:South of ramp, north of runway, west of taxiway No.3
Date of Operation: 1960's - 1982
Owner/Operator: Grissom AFB
Comments/Description: Concrete area with additional storage on ground.

Site Rated by: EHS, BDM, HDH

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	2	10	20	30
C. Land use/zoning within 1 mile radius	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	1	6	6	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			93	180

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

II. WASTE CHARACTERISTICS

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

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

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

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

60 x 0.90 = 54

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

54 x 1.00 = 54

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	0	8	0	24
Surface permeability	1	6	6	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	3	8	24	24
Net precipitation	1	6	6	18
Soil permeability	1	8	8	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			38	114
Subscore (100 x factor score subtotal/maximum score subtotal)				33

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		52	
Waste Characteristics		54	
Pathways		56	
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: Fuel Tank Sludge Weathering Site
Location: POL Tank Area.
Date of Operation: 1960's
Owner/Operator: Grisson AFB
Comments/Description: Used on one occasion.

Site Rated by: EHS, BDM, HDH

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	2	4	8	12
B. Distance to nearest well	3	10	30	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	1	6	6	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			107	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 59

II. WASTE CHARACTERISTICS

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

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

Factor Subscore A (from 20 to 100 based on factor score matrix) 50

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

50 x 0.80 = 40

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

40 x 0.75 = 30

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	0	8	0	24
Surface permeability	1	6	6	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	3	8	24	24
Net precipitation	1	6	6	18
Soil permeability	1	8	8	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			38	114
Subscore (100 x factor score subtotal/maximum score subtotal)				33

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		59		
Waste Characteristics		30		
Pathways		56		
Total	145	divided by 3 =	48	Gross total score

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

Gross total score x waste management practices factor = final score

48 x 0.95 = 46

FINAL SCORE

APPENDIX I

GLOSSARY OF TERMINOLOGY, ABBREVIATIONS, AND ACRONYMS

APPENDIX I

GLOSSARY OF TERMINOLOGY, ABBREVIATIONS, AND ACRONYMS

ABG: Air Base Group.

AF: Air Force.

AFB: Air Force Base.

AFCS: Air Force Communications Service.

AFESC: Air Force Engineering and Services Center.

AFFF: Aqueous Film Forming Foam, a fire extinquishing agent.

AFR: Air Force Regulation.

AFS: Air Force Station.

AGE: Aerospace Ground Equipment.

ALLUVIUM: Materials eroded, transported and deposited by streams.

AMS: Avionics Maintenance Squadron

ANG: Air National Guard.

ARTESIAN: Ground water which is under pressure significantly greater than atmospheric, and its upper limit is the bottom of a bed of distinctly lower hydraulic conductivity than that of the material in which the artesian water occurs.

AQUIFER: A geologic formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield significant quantities of water to a well or spring.

ARRS: Aerospace Rescue and Recovery Squadron.

ATC: Air Training Command.

AVGAS: Aviation Gasoline.

BEE: Bioenvironmental Engineer.

BES: Bioenvironmental Engineering Section.

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.

CE: Civil Engineering.

CERCLA: Comprehensive Environmental Response, Compensation and Liability Act.

CES: Civil Engineering Squadron.

CIRCA: About; used to indicate an approximate date.

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

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.

CONSOLIDATED ROCK: Competent or solid rock.

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.

CRS: Component Repair Squadron.

CSG: Combat Support Group.

DET: Detachment.

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

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

DOD: Department of Defense.

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

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

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.

EMS: Equipment Maintenance Squadron.

EOD: Explosive Ordnance Disposal.

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

EPA: U.S. Environmental Protection Agency.

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

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

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.

GAFB: Grissom Air Force Base.

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

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.

GPM: Gallons per minute.

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

HARM: Hazard Assessment Rating Methodology.

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.

HQ: Headquarters.

HWMF: Hazardous Waste Management Facility.

HYDRAULIC CONDUCTIVITY: A quantitive measure of the ability of porous material to transmit water.

ICBM: Intercontinental Ballistic Missile.

ILS: Instrument Landing System.

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

IRP: Installation Restoration Program.

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

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.

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

MAC: Military Airlift Command.

MAINT: Recording System Maintenance.

MAPS: Mobile Aerial Part Squadron.

MEK: Methyl Ethyl Ketone.

MGD: Million Gallons per Day.

MOGAS: Motor gasoline.

MONITORING WELL: A well used to measure ground-water levels and to obtain samples.

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

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

NCO: Non-commissioned Officer.

NCOIC: Non-destructive Inspection.

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

NGVD: National Geodetic Vertical Datum of 1929.

NPDES: National Pollutant Discharge Elimination System.

OIC: Officer-In-Charge.

OMS: ORGANIZATIONAL MAINTENANCE SQUADRON.

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

OSI: Office of Special Investigations.

OVA: Organic Vapor Analyzer.

O/W SEPARATOR: Oil and water separator.

O&G: Symbols for oil and grease.

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

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

PERMEABILITY: The capacity of a porous rock, soil or sediment for transmitting a fluid without damage to the structure of the medium.

PD-680: Cleaning solvent.

pH: Negative logarithm of hydrogen ion concentration.

PL: Public Law.

PMEL: Precision Measurement Equipment Lab.

POL: Petroleum, Oils and Lubricants.

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

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

PPB: Parts per billion by weight.

PPM: Parts per million by weight.

PRECIPITATION: Rainfall.

PVC: Polyvinyl chloride.

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.

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

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

RECON: Reconnaissance.

RPIE: Real Property Installed Equipment.

SAC: Strategic Air Command.

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

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

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

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

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).

SPS: Security Police Squadron

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.

TAC: Tactical Air Command.

TACC: Tactical Air Control Center.

TASS: Tactical Air Support Squadron.

TAW: Tactical Airlift Wing.

TCA: 1,1,1,-Tetrachloroethane.

TCE: Trichloroethylene, a solvent and suspected carcinogen.

TDS: Total Dissolved Solids.

TILL: Unstratified and unsorted glacial drift deposited directly by glacier ice.

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.

TTW: Technical Training Wing.

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

UNCONSOLIDATED SEDIMENTS: Loose sediments; not cemented nor consolidated.

USAF: United States Air Force.

USATHMA: United States Army Toxic and Hazardous Materials Agency.

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.

APPENDIX J

REFERENCES

APPENDIX J

REFERENCES

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APPENDIX K

INDEX OF REFERENCES TO POTENTIAL

CONTAMINATION SITES AT GRISSOM AFB

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INDEX OF REFERENCES TO POTENTIAL CONTAMINATION SITES AT GRISSOM AFB

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