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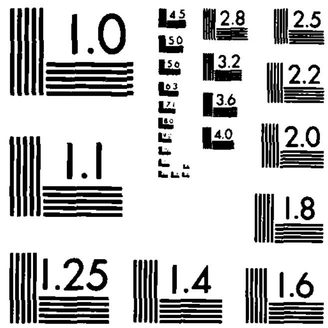

MICROCOPY RESOLUTION TEST CHART
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AD-A158 780

INSTALLATION RESTORATION PROGRAM
PHASE I: RECORDS SEARCH

GRAND FORKS AIR FORCE BASE
NORTH DAKOTA

Prepared for:

UNITED STATES AIR FORCE
STRATEGIC AIR COMMAND
Deputy Chief of Staff
Engineering and Services
Offutt AFB, Nebraska 68113

Submitted by:

REYNOLDS, SMITH AND HILLS, INC.
Jacksonville, Florida

ENVIRONMENTAL SCIENCE AND ENGINEERING, INC.
Englewood (Denver), Colorado

April, 1985

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Records Search Grand Forks AFB ND

The search of USAF, state and federal agencies' records and interviews with past and present base personnel and agency representatives was conducted to identify past hazardous waste generation and disposal practices at Grand Forks AFB ND. The AFB is located approximately 15 miles west of the City of Grand Forks in Grand Forks County, North Dakota. A number of subinstallations associated with the base were also reviewed. These include the Finley Air Station, Cavalier Radar Site, Defense Fuel Point in Grand Forks and the missile launch and control facilities located throughout the countryside within a 75-mile radius of the base. Petroleum storage, waste disposal and spills account for the most frequent and severe problems. Follow-on recommendations included site cleanup and closure, confirmation studies in the vicinity of past spill sites, and enhanced protection of local surface waters

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ADDENDUM I TO GRAND FORKS AFB IRP PHASE I REPORT April 1985

The following pen and ink changes are provided to identify and correct minor errors within the subject document.

PAGE	LINE	CHANGES
4	21	Insert "reportedly," before "An" change "An" to "an"
4-7	14	Change "all the high voltage" to read "all low, medium and high voltage systems"
4-17	29	Change "discarged" to "discharged"
4-23	24	Change "began to be contract" to "are contractor"
4-25	13	Insert ", now inactive," after "landfill"
4-25	23	Change "landfill" to "EOD Range"
4-27	7	Delete rest of sentence after "propped" and insert "a control switch in the "on" position while transfer-ring fuel oil to storage."
4-27	10	Change "cleanded" to "cleaned"
4-28	7	After "1982" delete "a"
4-31	2	Change "priolr" to "prior"
4-31	18	Change "durmmed" to "drummed"
4-31	19	Change "offiste" to "offsite"
4-33	-	At end of table, insert "Note: See Appendix E for Hazard Assessment Rat-ing Methodology (HARM) explanation."
5-1	13	After "period" insert "it was reported that"
5-1	15	After "1972 was" insert "reportedly"

NOTICE

This report has been prepared for the U.S. Air Force by Environmental Science and Engineering, Inc., for the purpose of aiding in the implementation of the Air Force Installation Restoration Program. It is not an endorsement of any product. The views expressed herein are those of the contractor and do not necessarily reflect the official views of the publishing agency, the U.S. Air Force, or the Department of Defense.

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EXECUTIVE SUMMARY

The Department of Defense (DOD) has developed the Installation Restoration Program (IRP) to identify and evaluate past hazardous material disposal sites on DOD property, control the migration of hazardous contaminants, and control hazards to health and human welfare that may result from these past disposal operations. The IRP has four phases consisting of Phase I, Initial Assessment/Records Search; Phase II, Confirmation and Quantification; Phase III, Technology Base Development/Evaluation of Remedial Action Alternatives; and Phase IV, Operations/Remedial Actions. The IRP will be the basis for response actions of Air Force installations under the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, Executive Order 12316, and 40 CFR 300 Subpart F (National Oil and Hazardous Substances Contigency Plan). CERCLA is the primary legislation governing remedial action at past hazardous waste disposal sites. Environmental Science and Engineering, Inc. was retained by the United States Air Force (USAF) to conduct the Phase I, Initial Assessment/Records Search for Grand Forks Air Force Base (GFAFB) and its subinstallations under Contract No. FO 8637-83-G0010-5008.

INSTALLATION DESCRIPTION

GFAFB is located in eastern North Dakota, approximately 15 miles west of the city of Grand Forks in Grand Forks County, North Dakota. The base accommodates two strategic combat wings, a combat support group, and a number of smaller detachments on its 4,830 acres. A number of subinstallations are associated with the base. One hundred and fifty missile launch facilities (LFs) and fifteen launch control facilities (LCFs) occupy a total of 1,816 acres owned by the USAF and distributed throughout the countryside within a 75 mile radius of GFAFB. The Finley Air Force Station (AFS), Cavalier AFS Radar Site, and Defense Fuel Point in Grand Forks are also under the limited jurisdiction of GFAFB.

The major portion of GFAFB was constructed between 1956 and 1960 and functioned as an Air Defense Command Facility until 1963. In 1963 the base was transferred to the Strategic Air Command (SAC) for use as a heavy bomber base. In 1964 a Strategic Missile Wing was assigned to the base. The first Minuteman II missiles arrived in 1965. Since 1966 GFAFB has functioned with the dual mission of missile and bomber operations.

The 321st Strategic Missile Wing (SMW) is the host unit for GFAFB. The 319th Bombardment Wing (BMW) and 321st Combat Support Group are the other major units at the base. Several smaller detachments provide services in support of the missions of the larger units.

ENVIRONMENTAL SETTING

The environmental data reviewed for this investigation indicate the following major points that are relevant to the evaluation of past hazardous waste management practices at GFAFB and its subinstallations:

- The GFAFB region has a dry subhumid climate cha acterized by a wide temperature range, variable precipitation, and rigorous winters. The mean annual daily temperature is about 50 °F, but with a range of -43 °F to 109 °F.
- Mean monthly precipitation ranges from 3.0-in during May to 0.5-in in February. Annual snow accumulation averages about 3 ft.
- The base and its subinstallations lie within the Central Lowland physiographic province. The area consists of a lowland prairie upon a gently rolling glacial moraine. The average elevation above mean sea level is about 850 ft.
- The Turtle River is the closest perennial stream to GFAFB and flows through the extreme northwest corner of the base. Most of the drainage from the base and from the sewage lagoons, located 1.5 miles east of the base proper, empty into Kelly Slough which flows into the Turtle River.
- Paleozoic and Mesozoic sediments underlie a thin deposit of glacial materials at GFAFB. Glacial materials underlie the base and all of its subinstallations.
- Soils in the Grand Forks region are generally silty loams. Saline soils commonly occur in the northern portions of the area.

- Ground water is obtained both from bedrock and glacial drift deposits. Regional ground water flow is toward the east.
- The North Dakota State Department of Health has designated the Turtle River as Class II; a stream which may be intermittent, but with treatment it shall meet the requirements for municipal use, and shall be of sufficient quality for irrigation, propagation of wildlife and fish, and for recreation.
- Most water available from aquifers in the region is highly saline and is not generally suitable for irrigation or human consumption.
- No threatened or endangered species regularly inhabit either GFAFB or any of its subinstallations.

METHODOLOGY

The objective of Phase I was to identify the potential for environmental contamination resulting from past waste disposal practices at GFAFB and its subinstallations, and to assess the potential for contaminant migration. Activities performed in the Phase I study included review of site records; interviews with personnel familiar with past waste generation and disposal activities; determination of quantities and locations of current and past hazardous waste treatment, storage, and disposal; performance of field inspections; and development of conclusions and recommendations.

FINDINGS AND CONCLUSIONS

The major industrial operations at GFAFB and its subinstallations relate to the maintenance of aircraft, missiles, ground vehicles, and support facilities for the 321st SMW, 319th BMW, and 321st Combat Support Group. Operations include engine repairs/overhauls; electrical, hydraulic, and fuel systems repairs; painting; metal plating/finishing; missile system maintenance; aircraft maintenance; fuel supply handling; and additional support activities. With the exception of fuel handling at the Defense Fuel Point in Grand Forks, only limited operations activities are conducted at subinstallations.

The main types of waste generated are fuels, oils, solvents, paint, paint strippers, metal plating treatment solutions, and small amounts of explosives and pesticides. Waste fuel, oil, and solvents include JP-4, engine oil, PD680, and acetone which are derived primarily from periodic maintenance and engine repair. The general trend in waste disposal practices since the establishment of the base has been from largely unsegregated disposal in base landfills toward extensive segregation and contract disposal.

This investigation identified three areas on GFAFB subject to contamination and potential contaminant migration as a result of past waste disposal practices (Figure ES-1). A fourth location, Cavalier AFS was included as a site of potential contamination because of the large quantities of materials containing PCBs which are stored and used at the site. Each of these areas was evaluated using the Hazard Assessment Rating Methodology (HARM) system. The HARM Scores for these sites are presented in Table ES-1.

Area 1 -- Firefighter Training Area

This area includes the old burn pit and underground used oil storage tank, both of which pose potential sources of contamination. The pit is not equipped with a drainage system to collect excess fuel used in training. An estimated 50 percent of the fuel used at the pit may have leaked into the surrounding soil. Approximately 12,000 gallons/year of fuel was used at this pit. The underground tank installed in 1972 was abandoned in 1980 after it was found leaking and significant contamination of surrounding soils was reportedly discovered.

Area 2 -- Landfills

Old and inactive landfills located in the northcentral portion of GFAFB reportedly contain sludges, cleaning residues, and solvents from base operations. These substances were apparently placed in these areas prior to implementation of disposal regulations in 1980.

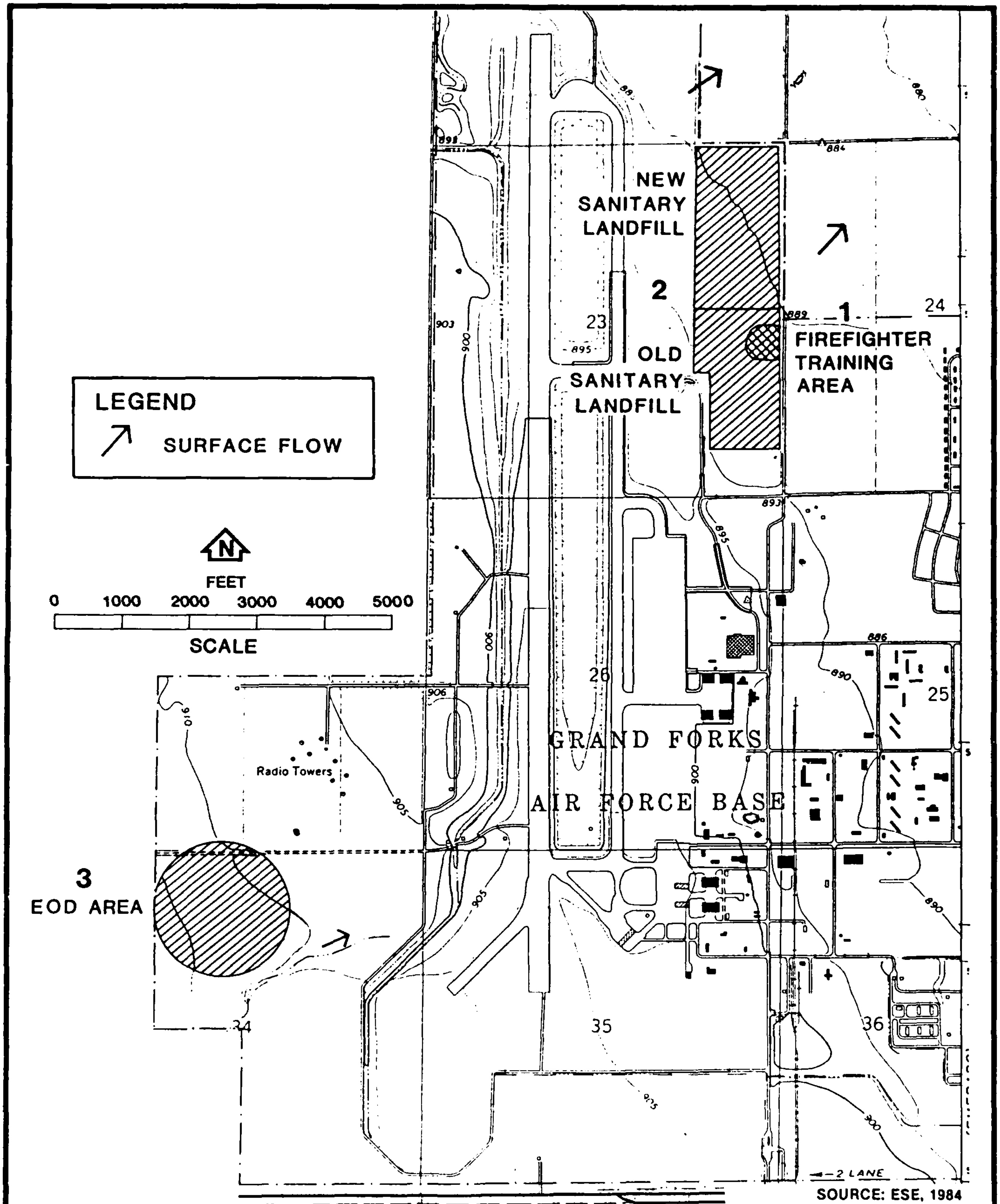


Figure ES-1
AREAS OF POTENTIAL CONTAMINATION

INSTALLATION RESTORATION PROGRAM
Grand Forks Air Force Base

Table ES-1. Summary of HARM Scores

Rank	Site	Receptors Subscore	Waste Characteristics Subscore	Pathways Subscore	Waste Management Factor	Total Score
1.	Firefighter Training Area	41	64	60	0.95	52
2.	Landfill Area	35	48	53	0.95	43
3.	EOD Area	37	25	60	1.0	41
4.	Cavalier AFS	36	60	46	0.1	5

Area 3 -- Explosive Ordinance Disposal

The range is used to explode by burning unserviciable munitions, starter cartridges, and other small devices. Pits within the area are used to bury used starter cartridges after burning. Bioassay tests on soils in the area indicate measurable levels of toxicity to plants, possibly resulting from the presence of metals.

Area 4 -- Cavalier AFS

Large quantities of equipment and replacement components containing PCBs are stored and handled at the site. Items are kept in conforming storage, with the exception of PCB containing transformers which are in the process of being removed from the site.

1.0 INTRODUCTION

This document presents the results of Phase I of the U.S. Air Force's (USAF) Installation and Restoration Program (IRP) for Grand Forks Air Force Base (GFAFB) near Grand Forks, North Dakota. Abbreviations, acronyms, and technical terminology contained herein are explained in Appendix A.

1.1 BACKGROUND

Due to its primary mission, the USAF has long been engaged in 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 disposal site and take action to eliminate the 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 U.S. Environmental Protection Agency (EPA) and under Section 3012, state agencies are required to inventory past disposal sites and make the information available to the requesting agencies. To assure compliance with these hazardous waste regulations, the Department of Defense (DOD) developed the IRP. The current DOD IRP policy is contained in Defense Environmental Quality Program Policy Memorandum (DEQPPM) 81-5, dated December 11, 1981 and implemented by USAF message, dated January 21, 1982. DEQPPM 81-5 reissued and amplified all previous directives and memoranda on the IRP. 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 will be the basis for response action on USAF installations under the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as clarified by Executive Order 12316, and 40 CFR 300 Subpart F (National Oil and Hazardous Substances Contingency Plan). CERCLA is the primary legislation governing remedial action at past hazardous waste disposal sites.

1.2 PURPOSE, AUTHORITY, AND SCOPE OF THE ASSESSMENT

The IRP has been developed as a four-phase program, as follows:

Phase I - Initial Assessment/Records Search

Phase II - Confirmation and Quantification

Phase III - Technology Base Development

Phase IV - Operations/Remedial Actions

Environmental Science and Engineering, Inc. (ESE) conducted the records search at GFAFB and its subinstallations: Cavalier Air Force Station (AFS) Radar Site, Finley AFS Radar Site, and the Defense Fuel Point in Grand Forks. Project funding was provided by the Strategic Air Command (SAC). This report contains a summary and evaluation of the information collected during Phase I of the IRP and recommendations for any necessary Phase II action.

The objective of Phase I was to identify the potential for environmental contamination from past waste disposal practices at GFAFB and its subinstallations, and to assess the potential for contaminant migration. Activities performed in the Phase I study included the following:

1. Review of site records;
2. Interviews with personnel familiar with past generation and disposal activities;
3. Inventory of wastes;
4. Determination of estimated quantities and locations of current and past hazardous waste treatment, storage and disposal;
5. Definition of the environmental setting at the base;
6. Review of past disposal practices and methods;
7. Performance of field and aerial inspections;
8. Gathering of pertinent information from federal, state, and local agencies;
9. Assessment of potential for contaminant migration; and
10. Development of conclusions and recommendations for follow-on action.

ESE performed the onsite portion of the records search during August 1984. The following team of professionals was involved:

- Jackson B. Sosebee, Jr., Chemist/Geologist and Team Leader, 12 years of professional experience.
- Douglas P. Reagan, Ph.D., Ecologist, 14 years of professional experience.
- Douglas A. Dean, Environmental Engineer, 2 years of professional experience.

Detailed information on these individuals is presented in Appendix B.

1.3 METHODOLOGY

The methodology utilized in the GFAFB records search began with a review of past and current industrial operations conducted at the base. Information was obtained from available records, such as shop files and real property files, as well as interviews with past and current base employees from the various operating areas. Interviewees included current and past Air Force personnel, Bioenvironmental Engineering Section (BES), tenant organizations on the base, and regional government agencies. A list of interviewees by position and approximate years of service is presented in Appendix C.

The next step in the activity review was to determine the past management practices regarding the use, storage, treatment, and disposal of hazardous materials from the various operations 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 ground tour of the identified sites were then made by the ESE Project Team to gather site-specific information including: (1) visual evidence of environmental stress; (2) the presence of nearby drainage ditches or surface water bodies; and (3) visual inspection of these water bodies for any obvious signs of contamination or leachate migration.

Using the process shown in Figure 1.3-1, a decision was then made, based on all of the above information, regarding the potential for hazardous material contamination at any of the identified sites. If no potential

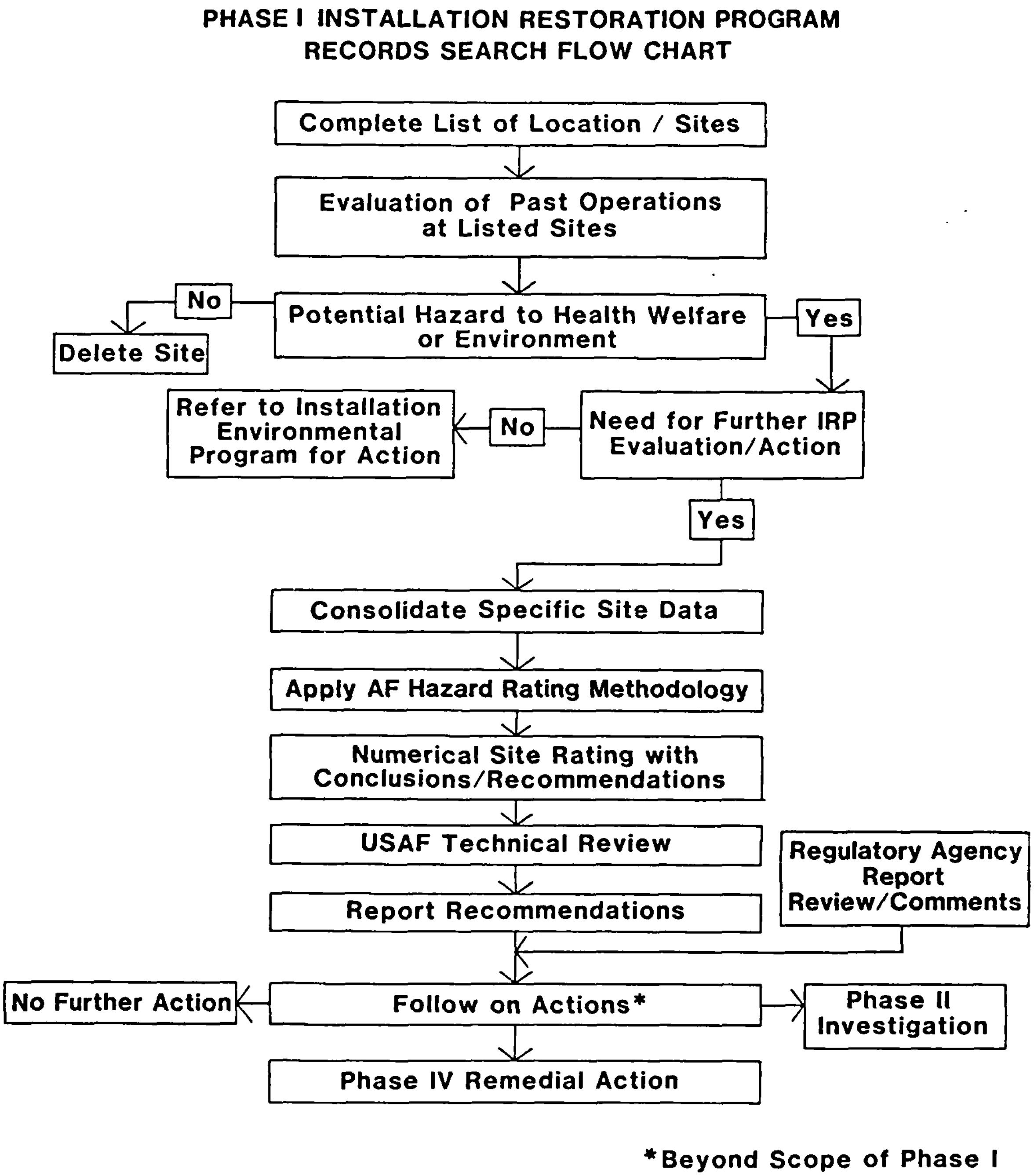


Figure 1.3-1
IRP RECORD SEARCH FORMAT

INSTALLATION RESTORATION PROGRAM
Grand Forks Air Force Base

existed, the site was deleted from further consideration. If potential for contamination was identified, the potential for migration of the contamination was assessed based on site-specific conditions. If there were no further environmental concern, the site was deleted. If the potential for contaminant migration existed, the site was evaluated and prioritized using the Hazard Assessment Rating Methodology (HARM). A discussion of the HARM system is presented in Appendix E. The sites, which were evaluated using the HARM procedures, were also reviewed with regard to future land use restrictions.

2.0 INSTALLATION DESCRIPTION

2.1 LOCATION/SIZE

GFAFB is located in eastern North Dakota, approximately 15 miles west of the city of Grand Forks in Grand Forks County, North Dakota (Figure 2.1-1). The base proper occupies all or part of Sections 14, 23, 24, 25, 26, 27, 34, 35, and 36 of T152N, R53W. The base accommodates two strategic combat wings, a combat support group, and a number of smaller detachments on its 4,830 acres. An additional 320 acres of base property are situated 1.5 miles east of the base proper in the southeast quarter of Section 29 T152N, R52W and are developed into sewage lagoons. Runways, taxiways, aprons, and munitions storage areas occupy the southern and western portion of the base. The remaining area is comprised of maintenance shops, operations, housing, and recreation areas (Figure 2.1-2).

A number of subinstallations are associated with the base proper. One hundred and fifty missile launch facilities (LFs) and fifteen launch control facilities (LCFs) occupy a total of 1,816 acres owned by the USAF and distributed throughout the countryside north, west, and south of GFAFB (Figure 2.1-3). The Finley AFS Radar Site (75 acres) and the 650 acre Cavalier AFS Radar Site (Figure 2.1-4) are located 55 miles and 90 miles respectively from GFAFB (Figure 2.1-1). An additional facility, the Defense Fuel Point (11 acres), is located in the city of Grand Forks.

Finley AFS began operations as a national defense long-range radar installation in 1951 under the Air Defense Command. The site is currently in caretaker status under the USAF Tactical Air Command as part of the 25th Air Division.

Cavalier AFS became operational in 1975. The Attack Characterization was operation in early 1977 under the Army and was transferred to the USAF in October 1977. The unit became part of the Space Command in 1983. The primary mission of this facility is to provide warning and attack assessment. The unit also conducts operations to provide spacetrack data to the North American Aerospace Defense Command (NORAD).

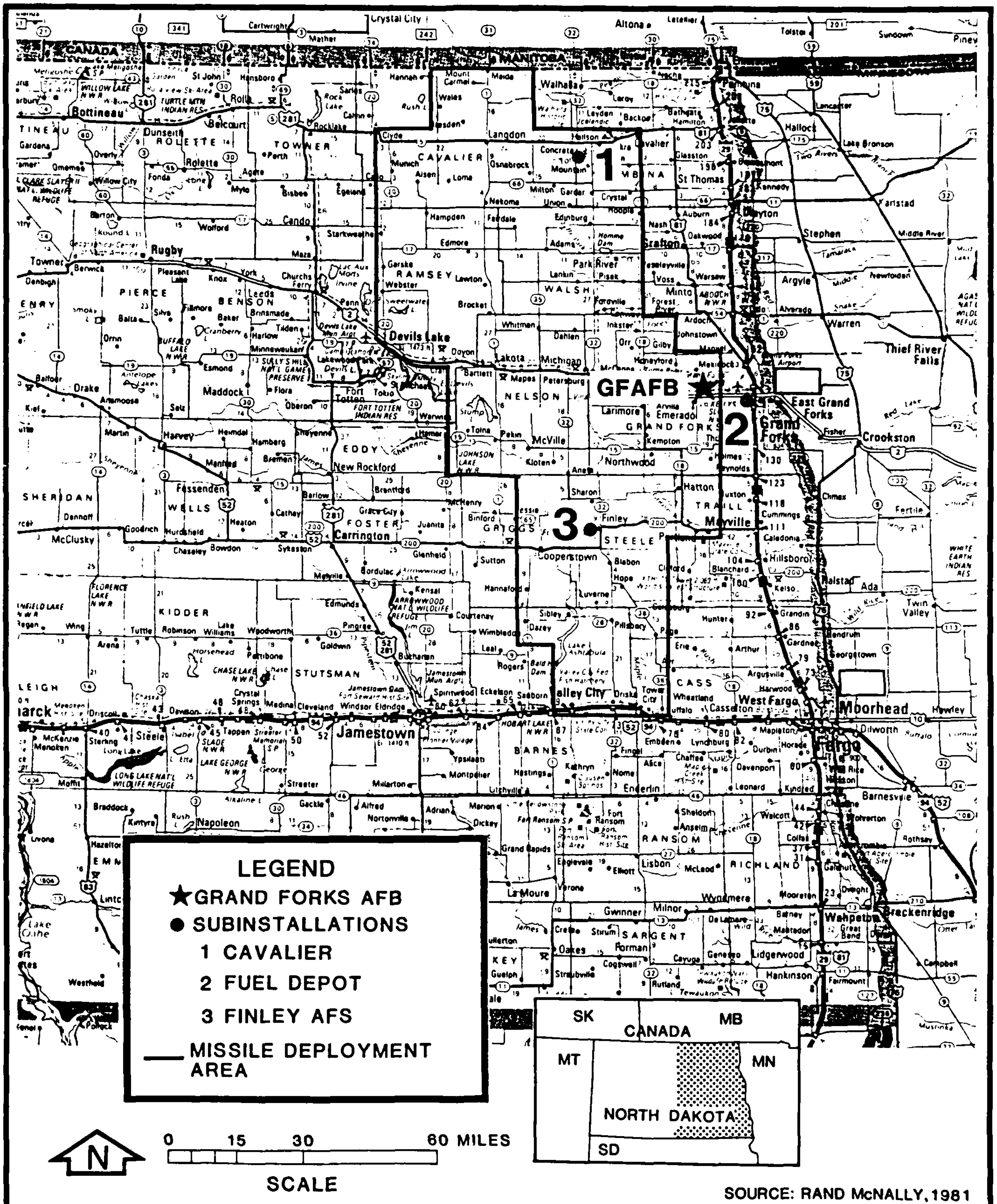


Figure 2.1-1
LOCATION MAP -
GFAFB AND SUBINSTALLATIONS

INSTALLATION RESTORATION PROGRAM
Grand Forks Air Force Base

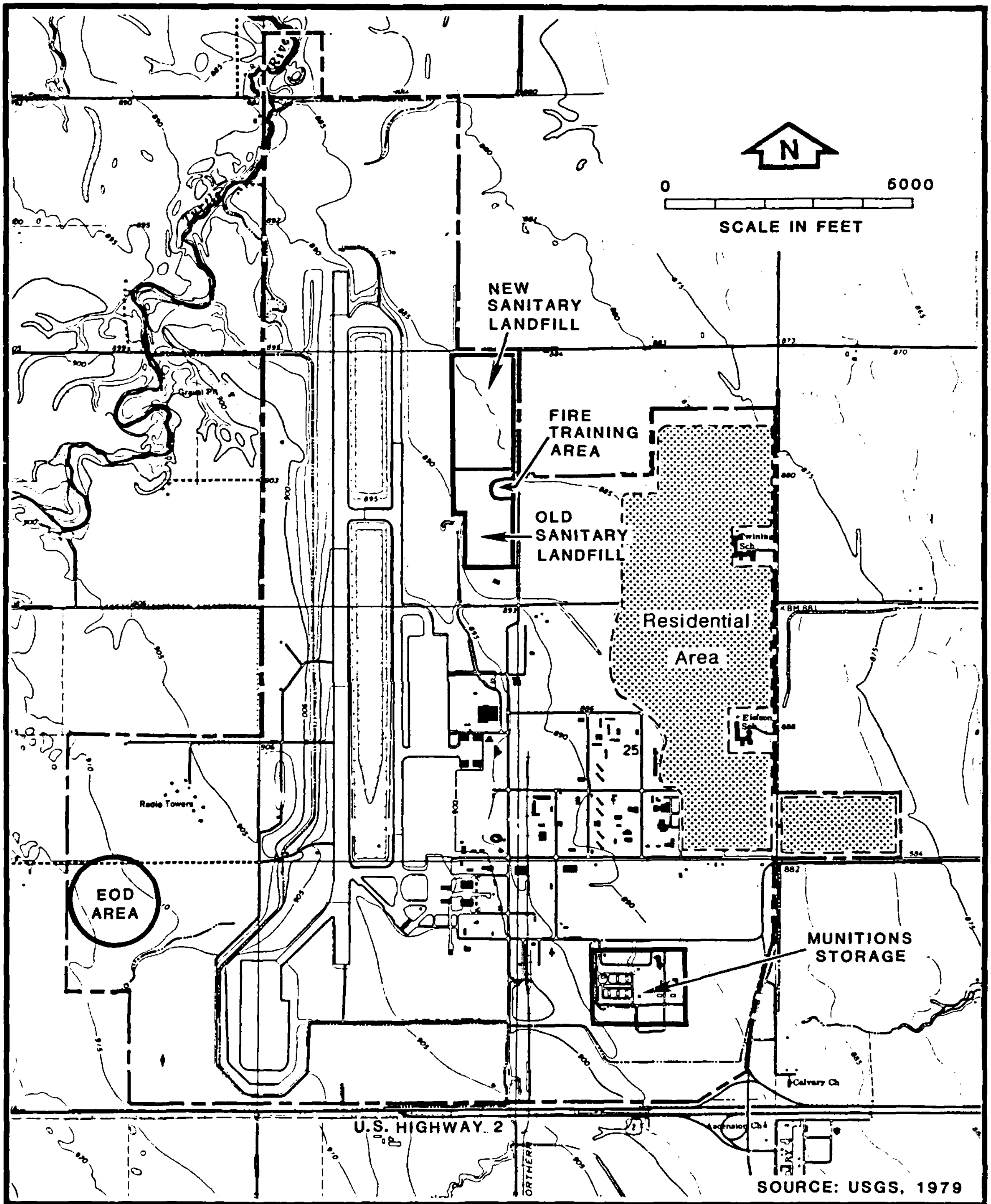
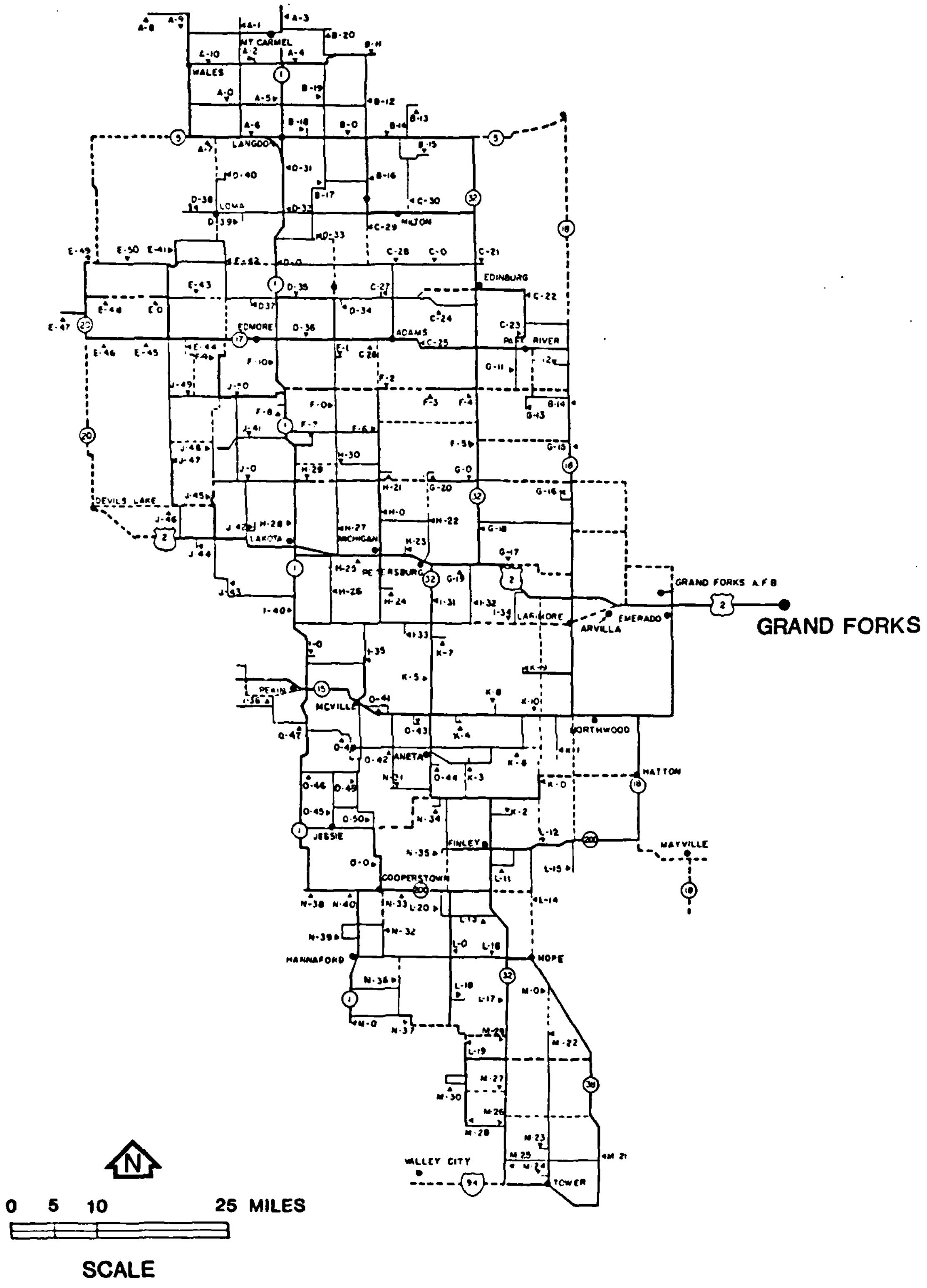


Figure 2.1-2
GENERAL BASE PLAN

INSTALLATION
RESTORATION PROGRAM
Grand Forks Air Force Base



SOURCE: GFAFB, 1979

Figure 2.1-3
MISSILE DEPLOYMENT AREA

INSTALLATION
RESTORATION PROGRAM
Grand Forks Air Force Base

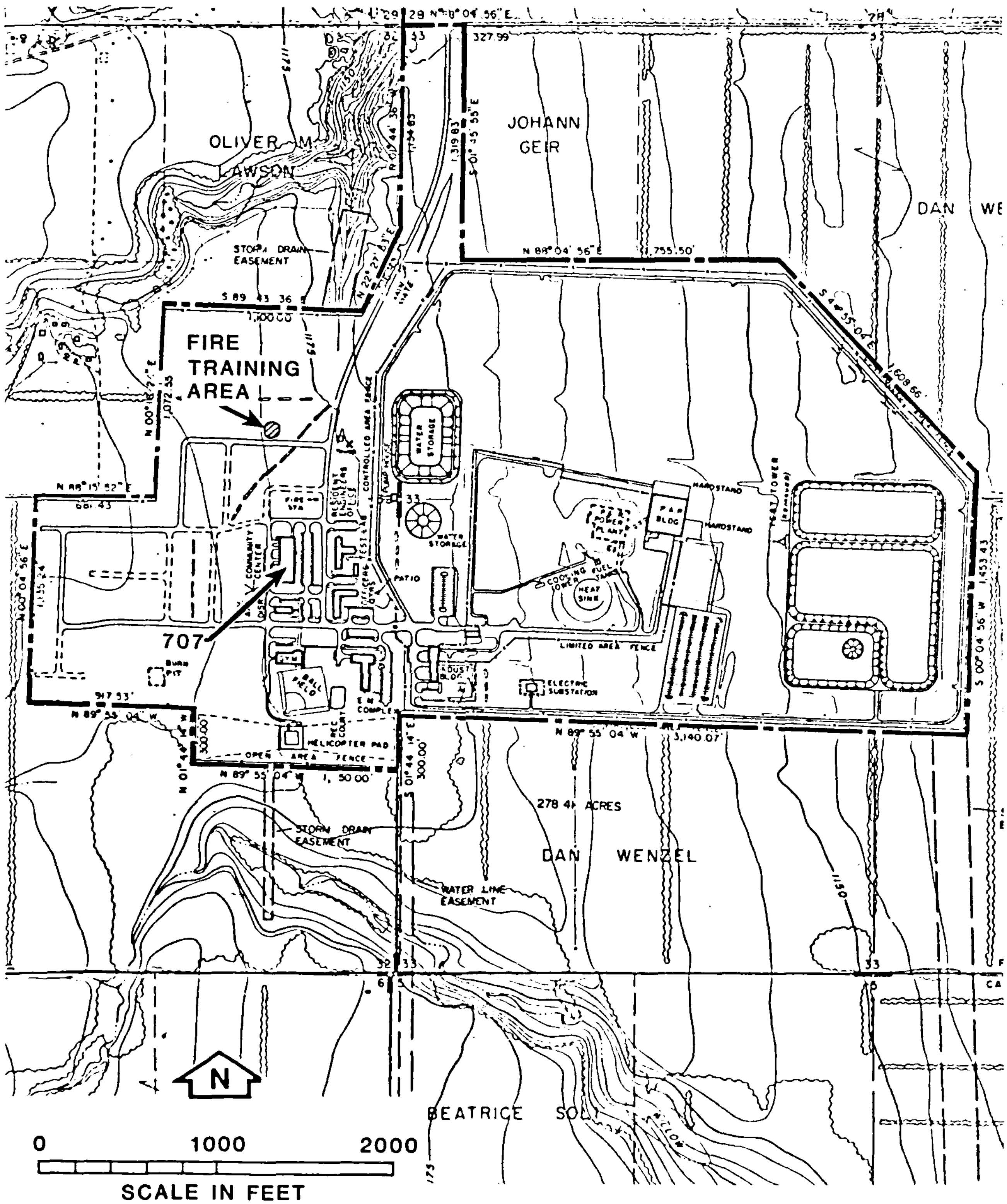


Figure 2.1-4
CAVALIER AFS RADAR SITE

INSTALLATION RESTORATION PROGRAM
Grand Forks Air Force Base

In addition to 4,830 acres owned by the USAF at GFAFB, there are 592 acres of leases and easements directly connected to the base, 17 acres of pipeline easements between the Defense Fuel Point and GFAFB, and 16,238 acres of easements associated with the LFs and LCFs. Major outgrants at GFAFB include 1,042 acres for hay and grazing. Small outgrants are provided on base for two schools and for the NW Bell Telephone Company.

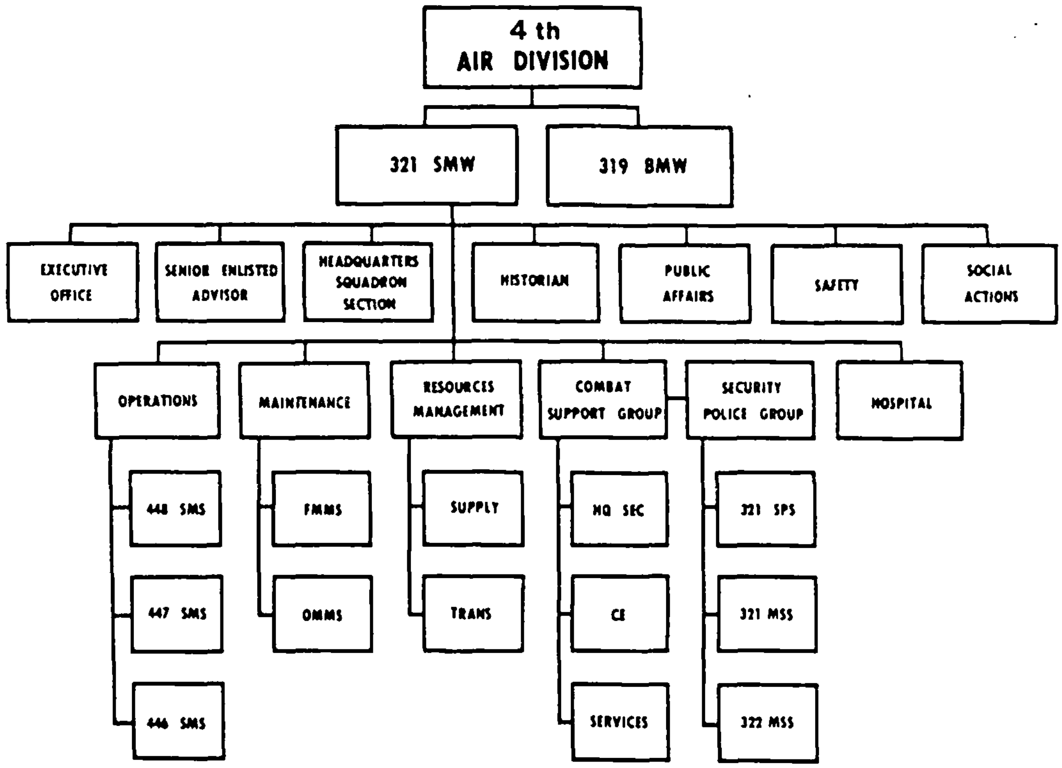
2.2 HISTORY

GFAFB is one of the newer USAF installations. The major portion of the original base was constructed between 1956 and 1960 and functioned as an Air Defense Command Facility until 1963. In June 1963 the base was transferred to the SAC for use as a heavy bomber (B-52) base. On October 4, 1964 a Strategic Missile Wing (SMW) was assigned to the base. The first Minuteman II Intercontinental Ballistic Missile (ICBM) arrived in August 1965. The Missile Wing was officially turned over to the SAC of the USAF on December 7, 1966. Since that date the base has functioned with the dual mission of missile and bomber operations. The Air Defense Command's 460th Fighter Interceptor Squadron remained on base until deactivation in July 1974.

In 1971 the 321 SMW became the host wing at GFAFB and the first Minuteman III missiles were emplaced near GFAFB. Realignment of the 321st SMW and 319th Bombardment Wing (BMW) under the newly activated 57th Air Division was accomplished in 1975. On May 1, 1982 as part of a realignment action, the 321st SMW was reassigned from the 57th Air Division, Minot AFB, North Dakota to the 4th Air Division, Francis E. Warren AFB, Wyoming.

2.3 ORGANIZATION AND MISSION

The 321st SMW is the host unit for GFAFB. Major organizations and tenant units assigned to the base are shown on Figure 2.3-1. The primary mission of the 321st SMW is to maintain a constant state of readiness and execute assigned Strategic Missile ICBM operations directed by higher headquarters. For the 319th BMW the primary mission is to achieve and maintain a constant alert posture and ability to react immediately, upon command, as a deterent to foreign aggression. The mission of the 321st



TENANT UNITS:

2152 CS (AFCC)
DET 3, 37 ARRS (MAC)
DET 12, AFIT (ATC)
DET 15,9 WS (MAC)
DET 18, SACMET (SAC)

DET 318,AF AREA AUDIT OFFICE (USAF)
DET 1313, AFOSI (USAF)
AMERICAN RED CROSS
AREA DEFENSE COUNCIL (USAF)
DEFENSE INVESTIGATIVE SERVICE (DOD)

DEFENSE LOGISTICS AGENCY (DOD)
FTD 419 OLA (ATC)
OLAD AF COMMISSARY (AFCOMS)
NORTHWESTERN BELL

SOURCE: GFAFB INSTALLATION DOCUMENT

Figure 2.3-1
GFAFB ORGANIZATION

INSTALLATION RESTORATION PROGRAM
Grand Forks Air Force Base

Combat Support Group is to provide base support services to the 321st SMW, to the 319th BMW, and to tenant units at GFAFB.

One of the six Minuteman Wings in SAC, the 321st SMW provides 150 Minuteman III missiles of SAC's total missile deterent force of 1,000 Minuteman and 523 Titan II missiles. Two-man missile combat crews control the Minuteman missiles from 15 dispersed and hardened LCFs. Each LCF controls 10 dispersed Minuteman missiles.

2.4 MAJOR TENANTS

A number of tenant organizations provide services in support of the primary missions of the 321st SMW and 319th BMW. The responsibilities of major tenant organizations at GFAFB are as follows:

- 9th Weather Squadron, Detachment 15--Provide weather support for all phases of air and ground operations;
- 2152nd Communications Squadron (AF Communications Service)--to provide air traffic control service;
- Air Force Institute of Technology, Detachment 12--to provide an Air Force funded educational program to Minuteman Launch Control Officers as part of the Minuteman education program;
- Air Force Audit Agency--provide auditing, reviewing, appraising, and furnishing of reports to assist Air Force management operations;
- SAC Management Engineering Team--determine manpower requirements and systematically improve distribution and utilization of manpower resources;
- 37th Aerospace Rescue and Recovery Squadron, Detachment 3--to provide helicopter support for the 321st SMW;
- Defense Investigative Service, Resident Agency--to conduct personnel security investigations in accordance with executive orders and DOD directives;
- Air Force of Special Investigations, Detachment 1313--to provide counterintelligence and criminal investigative support for GFAFB and its associated sites;

- American Red Cross--concerned with being of service to military members and their dependents in such areas as loans and counseling;
- United States Air Force Postal Courier Service, Operating Location 25AG--to provide postal service to all assigned personnel and to support all of GFAFB and U.S. Army units in the area with mail deliveries and directory service;
- Field Training Detachment 421, Operating Location A--to provide maintenance training to the 319th BMW and OJT advisory service to the 319th BMW and 321st Combat Support Group; and
- Defense Supply Agency--to dispose of property in a manner which will assure the maximum federal utilization through withdrawl or transfer.

3.0 ENVIRONMENTAL SETTING

3.1 METEOROLOGY

The GFAFB is situated in a dry subhumid climate characterized by a wide temperature range, variable precipitation, and rigorous winters. Records from 1900 to 1940 indicate the coldest recorded temperature was -43 degrees Fahrenheit (°F) and the warmest was 109°F. Temperature and precipitation data for the period 1951 to 1977 are summarized in Table 3.1-1.

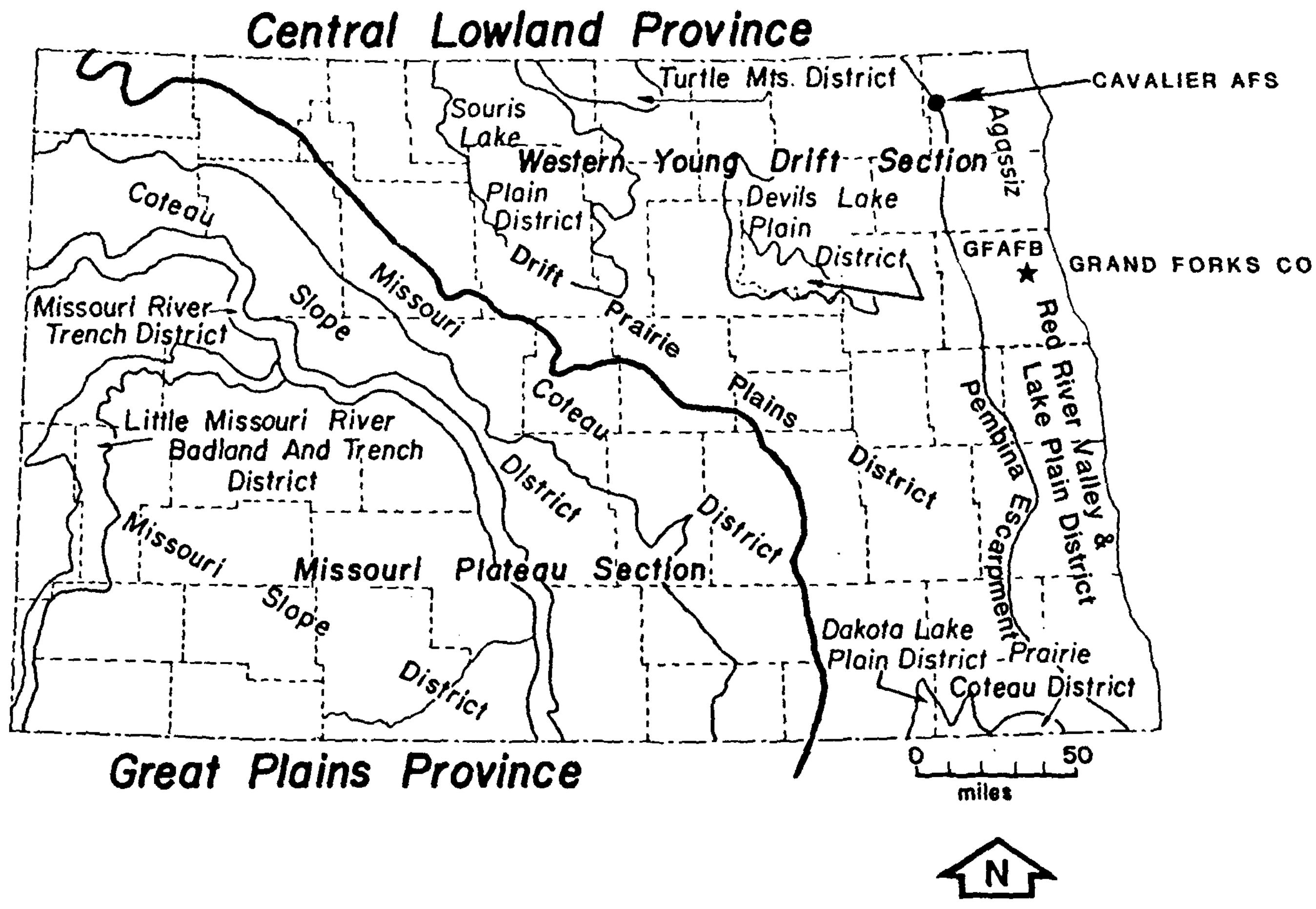
The average daily maximum annual temperature is about 50 °F with the highest average recorded daily maximum monthly temperature of 69 °F occurring during July. The average annual daily minimum annual temperature was about 29 °F with the lowest average daily minimum recorded temperature of 2.5 °F occurring during January. The annual average daily temperature is approximately 39 °F.

The average monthly precipitation ranges from greater than 3.0-in during June to less than 0.5 in during February. The average annual precipitation is about 18.5-in, three-fourths of which occurs from May to September. Snowfall averages slightly less than 3 ft each year. The prevailing wind direction is from the northwest (USSCS, 1981).

3.2 GEOGRAPHY

3.2.1 PHYSIOGRAPHY

The GFAFB lies within the Agassiz Lake Plain District of the Western Young Drift section of the Central Lowland Physiographic province (Figure 3.2-1) (Hansen and Kume, 1970). The Western Young Drift section is a lowland prairie upon a gently rolling glacial ground moraine. It is occassionaly interrupted by ridges of end moraine and flat outwash plains. Strandline deposits associated with glacial Lake Agassiz form low, narrow linear ridges with a northwesterly trend. The average elevation above sea level is about 890 ft with a maximum local relief of about 25 ft.



SOURCE: HANSEN & KUME, 1970.

Figure 3.2-1
PHYSIOGRAPHIC UNITS OF NORTH DAKOTA

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Table 3.1-1. Temperature and Precipitation for Grand Forks, North Dakota 1951 to 1977

Month	Temperature °F Average Daily			Precipitation Inches	
	Max.	Min.	Ave.	Ave.	Ave. Snowfall
January	12.1	-7.0	2.5	0.78	8.5
February	19.8	0.1	10.0	0.49	4.7
March	31.6	12.8	22.2	0.76	6.8
April	50.4	30.8	40.6	1.34	2.6
May	66.9	41.3	54.1	1.97	0.3
June	76.1	51.7	63.9	3.03	0.0
July	81.6	55.8	68.7	2.89	0.0
August	80.3	53.8	67.1	2.51	0.0
September	68.1	43.7	55.9	2.03	0.0
October	56.2	33.8	45.0	1.12	0.4
November	34.8	18.2	26.6	0.82	5.7
December	19.4	2.2	10.8	0.68	6.6
Annual	49.8	28.7	39.0	18.42	35.6

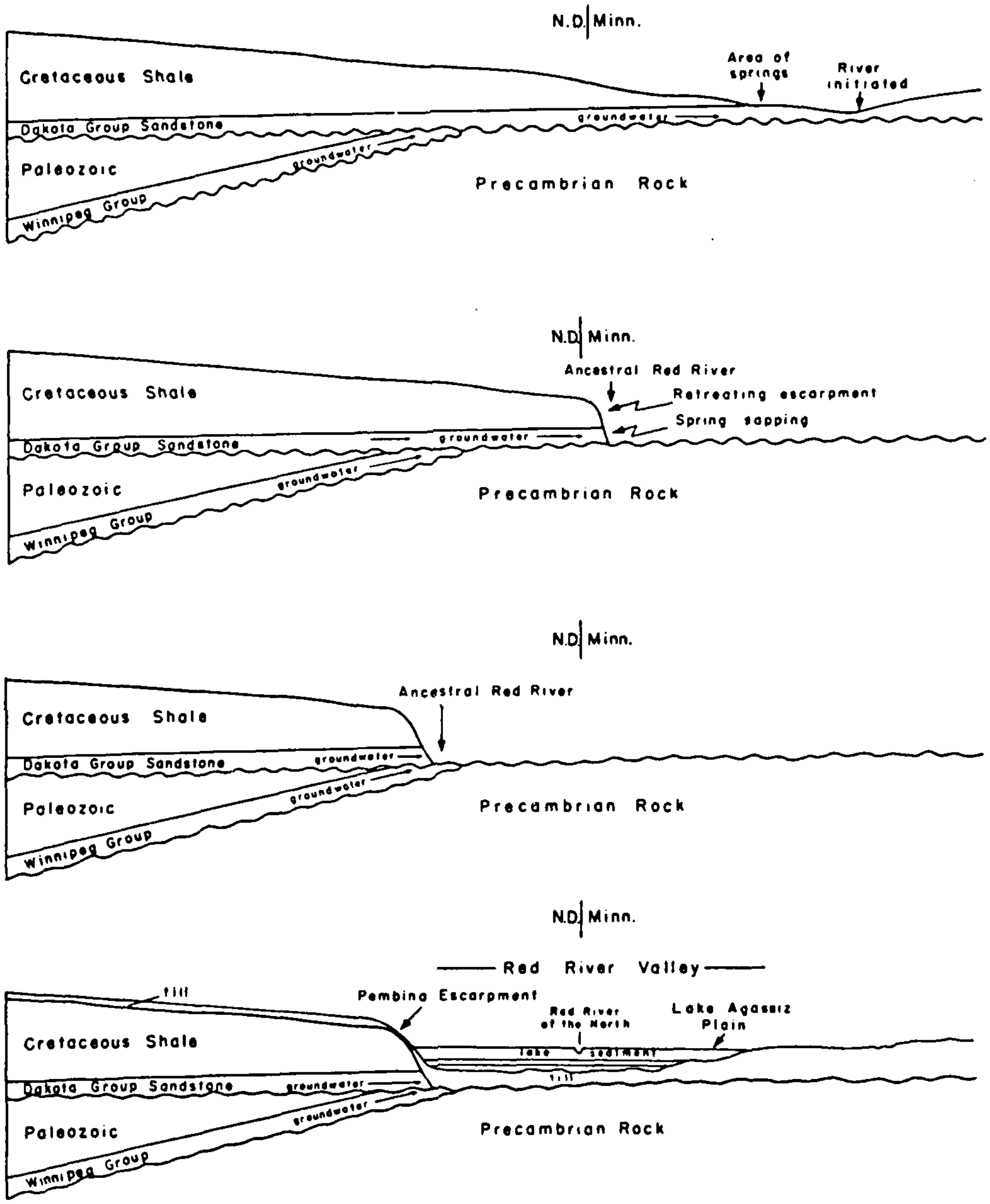
Source: USGS, 1981

The GFAFB is also located in the Red River Valley topographic area which corresponds to the Agassiz Lake Plain physiographic division. The Red River Valley is not a true river valley in the traditional sense, but a geomorphic expression of a considerable variety of geologic processes (Figure 3.2-2). These processes include the movement of ground water through underlying rock strata, differential erosion, modification by glaciers, and recent wind and stream forming events. Prior to glaciation, the river became incised until it reached Precambrian rock, then shifted its course westward as it eroded away Cretaceous shale and sand, thereby forming the Pembina Escarpment. When glaciers deposited a layer of till over the area, the river erosion temporarily ceased. Lake Agassiz sediment now covers the Red River Valley. The modern Red River of the North flows on top of this lake plain (Bluemle, 1977). The Pembina Escarpment was probably altered by glacial processes but exists today as the western extent of Glacial Lake Agassiz sediments, about 10 miles west of GFAFB (Bluemle, 1977). The present location of the Red River of the North is 25 miles east of GFAFB, representing the North Dakota-Minnesota state line.

3.2.2 SURFACE WATER HYDROLOGY

Natural surface water features on GFAFB are limited to a small stretch of the Turtle River that flows across the northwestern portion of the base and across a network of drainage ditches (Figure 3.2-3). In general, surface water runoff west of the taxiway and drainage from the maintenance apron drainage (just east of the runway) is routed through drainage ditches that flow north by way of the West Drainage Ditch and into the Turtle River. The remainder of the surface flows on the base is directed to the North and South Drainage Ditches which flow into Kelly Slough. An oil/water separator is located on the West Drainage Ditch to eliminate oily waste originating on the flight line, taxiway and runway. A second oil/water separator is located on the South Drainage Ditch below the larger fuel storage tanks.

The Turtle River channel is very sinuous and generally flows in a northeasterly direction (Figure 3.2-4). It eventually empties into the Red River of the North which flows north to Lake Winnipeg in Canada. The



SOURCE: BLUEMLE, 1977.

Figure 3.2-2
ORIGIN OF THE
PEMBINA ESCARPMENT

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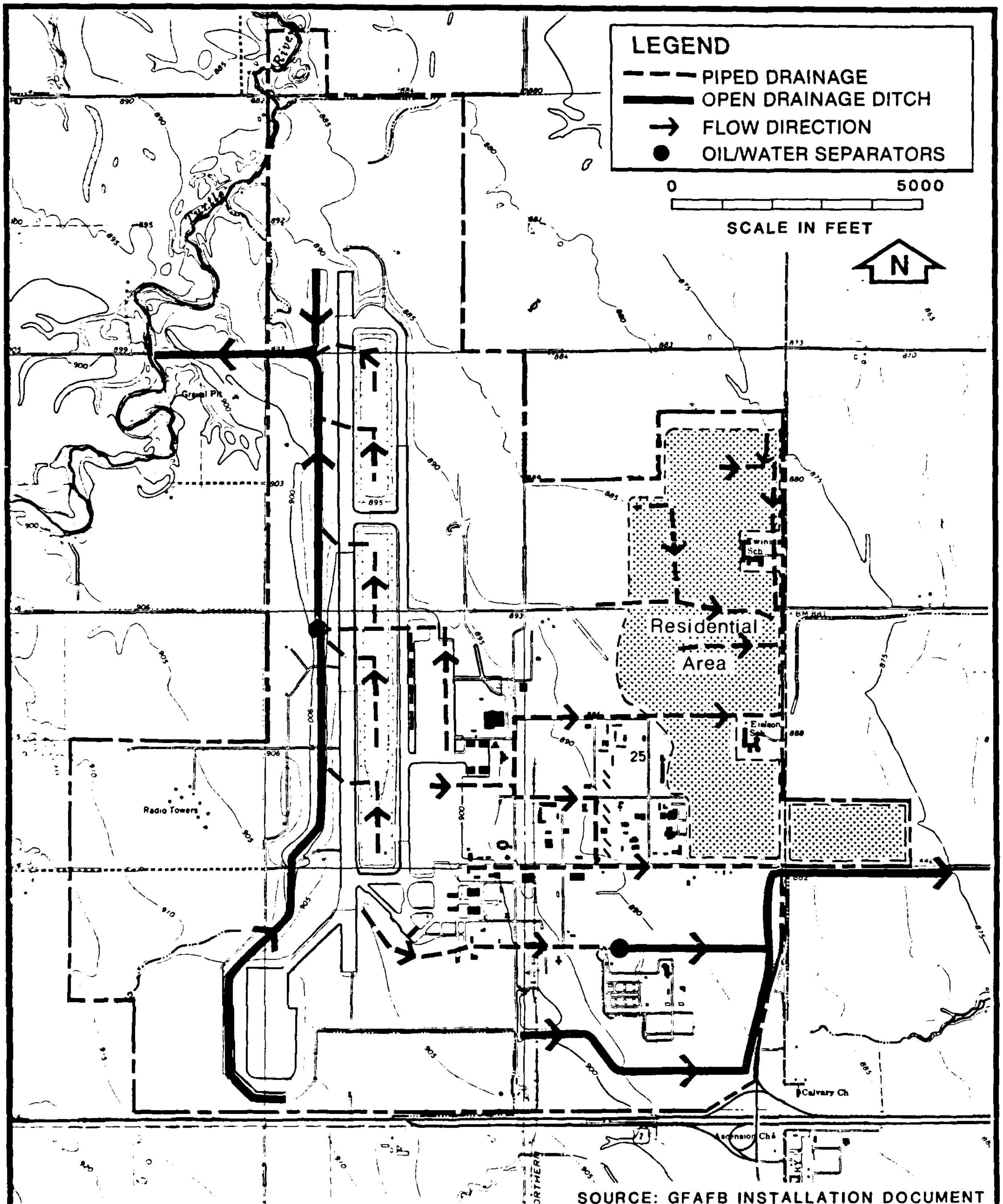

Figure 3.2-3
SURFACE WATER DRAINAGE AND PRIMARY STORM DRAINAGE SYSTEM

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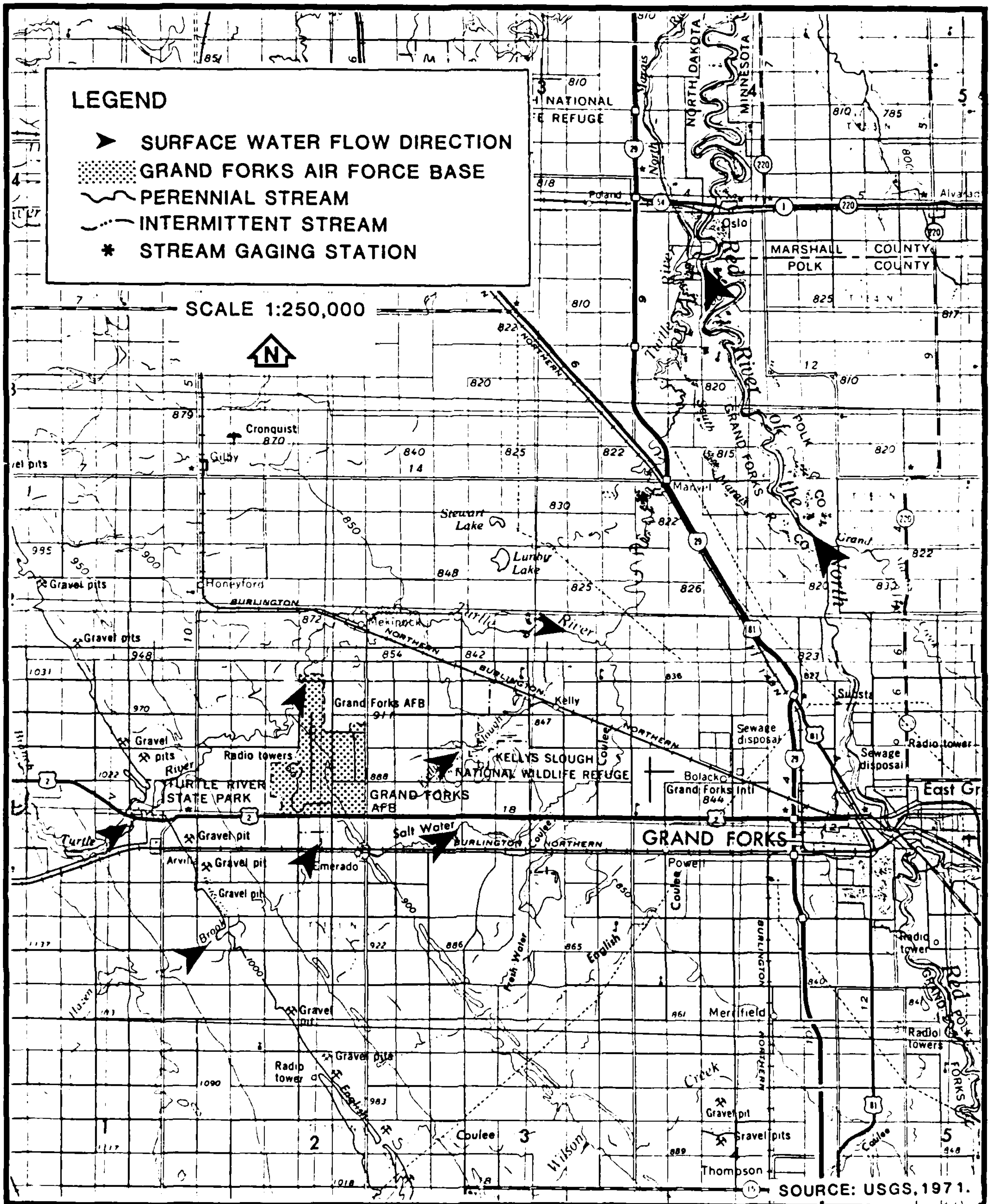

Figure 3.2-4
STREAM DRAINAGE PATTERNS

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Red River drainage basin is part of the Hudson River drainage system. At Manvel, North Dakota, approximately 10 miles northeast of GFAFB, the mean discharge of the Turtle River is 50.3 cubic feet per second (cfs). Peak flows result from spring runoff in April, and minimum flows (or no flow in some years) occur in January and February (USGS, 1983).

Kelly Slough also flows northeasterly into the Turtle River. Downstream of GFAFB, Kelly Slough occupies a wide, marshy floodplain with a poorly defined stream channel. Ponded water occurs in its flood plain and behind small earth dams on intermittent streams adjacent to the study area. No significant permanant lakes exist near the base.

3.3 GEOLOGY

3.3.1 GEOLOGIC SETTING

General Bedrock Stratigraphy

The Paleozoic rocks of GFAFB area are underlain by Precambrian rocks consisting of granites and metamorphic rocks of the amphibolite series (Table 3.3-1). These rocks are greater than 2.5 billion years old.

Ordovician marine sediments were deposited unconformably on the crystalline and metamorphic Precambrian basement formations. The Ordovician rocks are divided into two groups, the underlying Winnipeg Group and the overlying Big Horn Group. The Winnipeg Group consists of three members: the Black Island, Ice Box, and Rough Lock Formations. The basal Black Island Formation is a thin coarse-grained sandstone. Its overlying formation, the Ice Box Formation, consists of non-calcareous and fissile shale, limestone, and sandstone. The youngest formation of the Winnipeg Group, the Rough Lock Formation, is a calcareous shale and limestone.

The Red River Formation, a crystalline to granular dolomitic limestone, is the lower member of the Ordovician Big Horn Group. Deposited conformably on the Red River Formation is the Stony Mountain Formation, a shale interbedded with fossiliferous dolomite.

Table 3.3-1. Bedrock Stratigraphic Column

Era	System	Group	Formation	Lithology
Mesozoic	Cretaceous	Dakota	Fall River-Lakota	sandstone, shale siltstone, and claystone
		Unc.		
	Jurassic			siltstone
		Unc.		
Paleozoic	Ordovician	Bighorn	Stony Mountain	dolomite and shale
			Red River	dolomite and limestone
		Winnipeg	Roughlock	Shale
			Icebox	shale, sandstone and limestone
			Black Island	sandstone
		Unc.		
	Precambian			granite and Amphibolite

Source: Hansen and Kune, 1970.

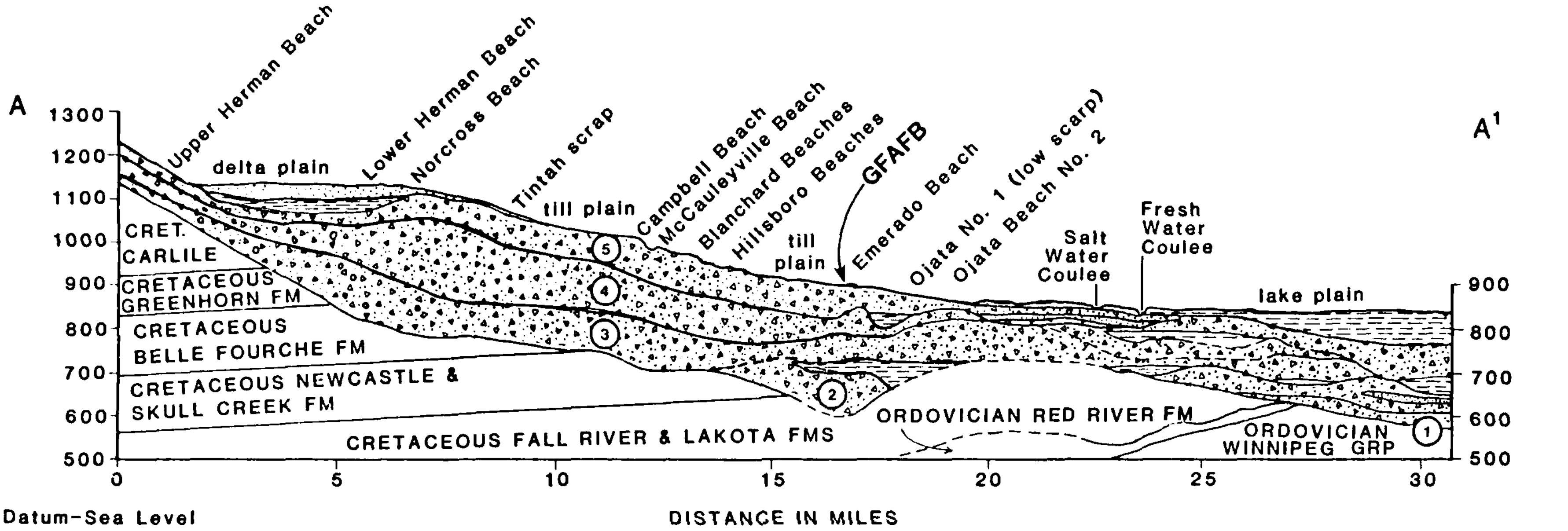
The Mesozoic rocks in Grand Forks County consist of several Cretaceous formations of the Dakota, Colorado, and Montana Groups, and possibly an undifferentiated Jurassic rock unit. Except for the basal Cretaceous, these rock units were deposited in a marine environment. The basal Cretaceous rocks are probably a mixture of continental and marine beds. The Mesozoic rocks thin eastward by erosion and deposition.

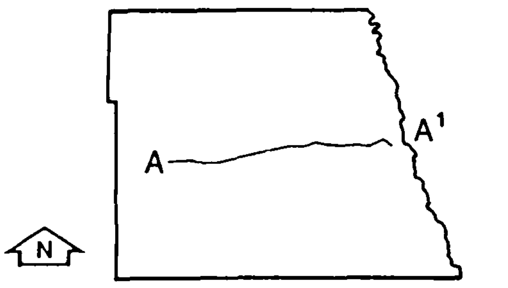
Only the early sediments of the Cretaceous Dakota Group exist below GFAFB. The undifferentiated Fall River-Lakota Formation is the Cretaceous bedrock unit underlying GFAFB. In northern Grand Forks County, this formation consists of basal, pale red and light gray claystones and siltstones interbedded with fine-grained quartzose sandstones. The basal beds are overlain by interbedded gray shales and siltstones and fine- to coarse-grained quartzose sandstones. Clay makes up most of the matrix in the sandstones. Minor constituents in this section are small crystals of pyrite, fragments of coal and carbonized wood, and spherulites of light-grownish-gray siltstone. The uppermost unit is a clean quartzose sandstone. The Fall River-Lakota interval varies in thickness from 200 ft in the northern part of the county to more than 285 ft in the southern part of the county.

The bedrock topography in Grand Forks County was formed mostly during late Tertiary and early Quaternary time. There is no record in the county of the very latest Cretaceous and earliest Tertiary rocks that are present in western North Dakota. The streams that formed the bedrock topography in Grand Forks County may have removed this record. A stratigraphic cross section of Grand Forks County is presented in Figure 3.3-1, and a map of bedrock topography is presented in Figure 3.3-2.

<u>General Glacial Stratigraphy</u>

The late Wisconsin glacial drift is the most extensive surface lithology in Grand Forks County and is approximately 225 ft thick below GFAFB (Hansen and Kume, 1970). The most recent four of five drift sheets that covered the county are believed to underlie the base. The drift consists of three basic lithologic groups: (1) till, (2) sand and gravel, and (3) clay and silt. Most of the drifts contain varying percentages of each





LOCATIONS OF CROSS SECTIONS

GLACIAL DRIFT LITHOLOGY

QUATERNARY Pleistocene — CLAY-SILT — SAND-GRAVEL — TILL(boulder-clay)

1. Buried brownish-gray to olive gray till and associated olive gray and light brownish-gray sandy lake clay and silt.
2. Buried olive-olive-gray silty till, olive-gray lake silt, and clay that occurs generally in the deeply buried preglacial river valleys.
3. Extensive-buried olive-gray and brownish-gray, gravelly to silty till that may be partially oxidized.
4. Extensive buried olive gray, sandy to silty till that contains lenses of sand and gravel and lake silts and clays.
5. Surficial olive gray silty till overlain by the clays and silts of glacial Lake Agassiz.

SOURCE: HANSEN & KUME, 1970

Figure 3.3-1
STRATIGRAPHIC CROSS-SECTION OF
GRAND FORKS COUNTY, NORTH DAKOTA

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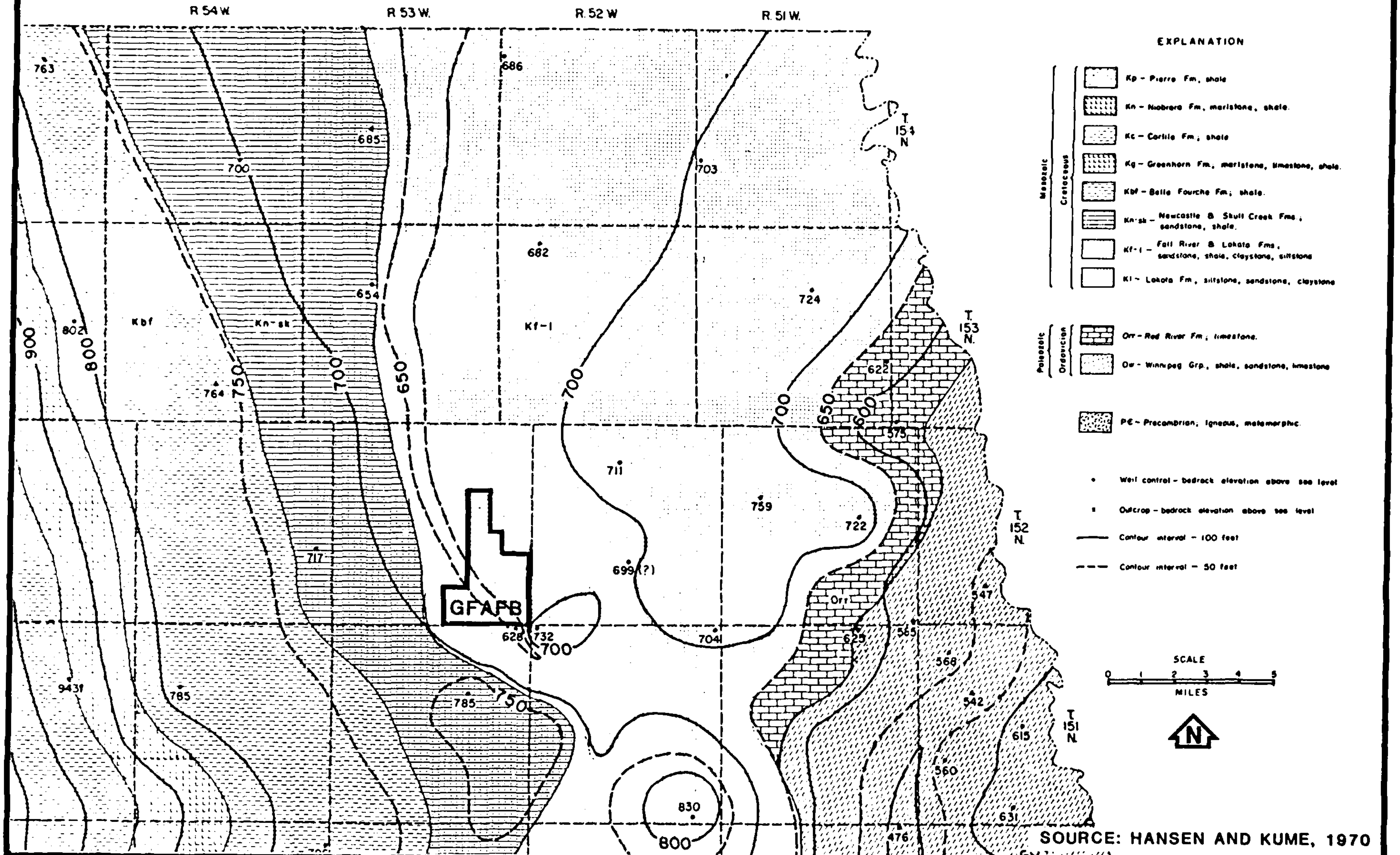

Figure 3.3-2
BEDROCK SUBCROP AND TOPOGRAPHIC MAP
OF GRAND FORKS COUNTY

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lithologic group. Glacial deposits at GFAFB are generally described as silty and clayey till with discontinuous lenses of sands and gravel.

The most recent drift sheet is composed of till overlain by clays and silts of glacial Lake Agassiz. Lake sediments were deposited along the axis of the Red River Valley, where the greatest thickness of glacial ice had existed. The water levels rose in Lake Agassiz until the area now occupied by the city of Grand Forks was submerged under more than 330 ft of water.

Strandline deposits associated with the fluctuating lake levels are indicated by narrow ridges of sand and gravel and wave-cut scarps in some unique locations (Hansen and Kume, 1970). They trend northwest-southeast in Grand Forks County. Most of the gravel content is found in the upper parts of the ridges and the grain size decreases downward. The fine material was washed out of the till by the erosive action of the water and deposited as offshore laminated sediments. Sediment between the strandlines consists of ground moraine eroded to a flat surface by Lake Agassiz (Figure 3.3-3). The Emerado strandline is present on GFAFB, but due to the shallowness of the glacial lake in this area and the low slope of the land, the erosive action along the ancient beach was negligible (Hansen and Kume, 1970).

3.3.2 SOILS

The soils at GFAFB are generally silty loams, with saline soils commonly occurring in the northern half of the base. The base has more than 26 mapped soil types in more than 20 soil series (Figure 3.3-4 and Table 3.3-2). The 13 most abundant soil series represented are briefly described as follows (USSCS, 1981):

<u>Antler</u>: Found in nearly level areas between beach ridges. This series is somewhat poorly drained and moderately slowly permeable (0.2 to 0.6-in/hour). These soils formed in glaciolacustrine deposits overlying till.

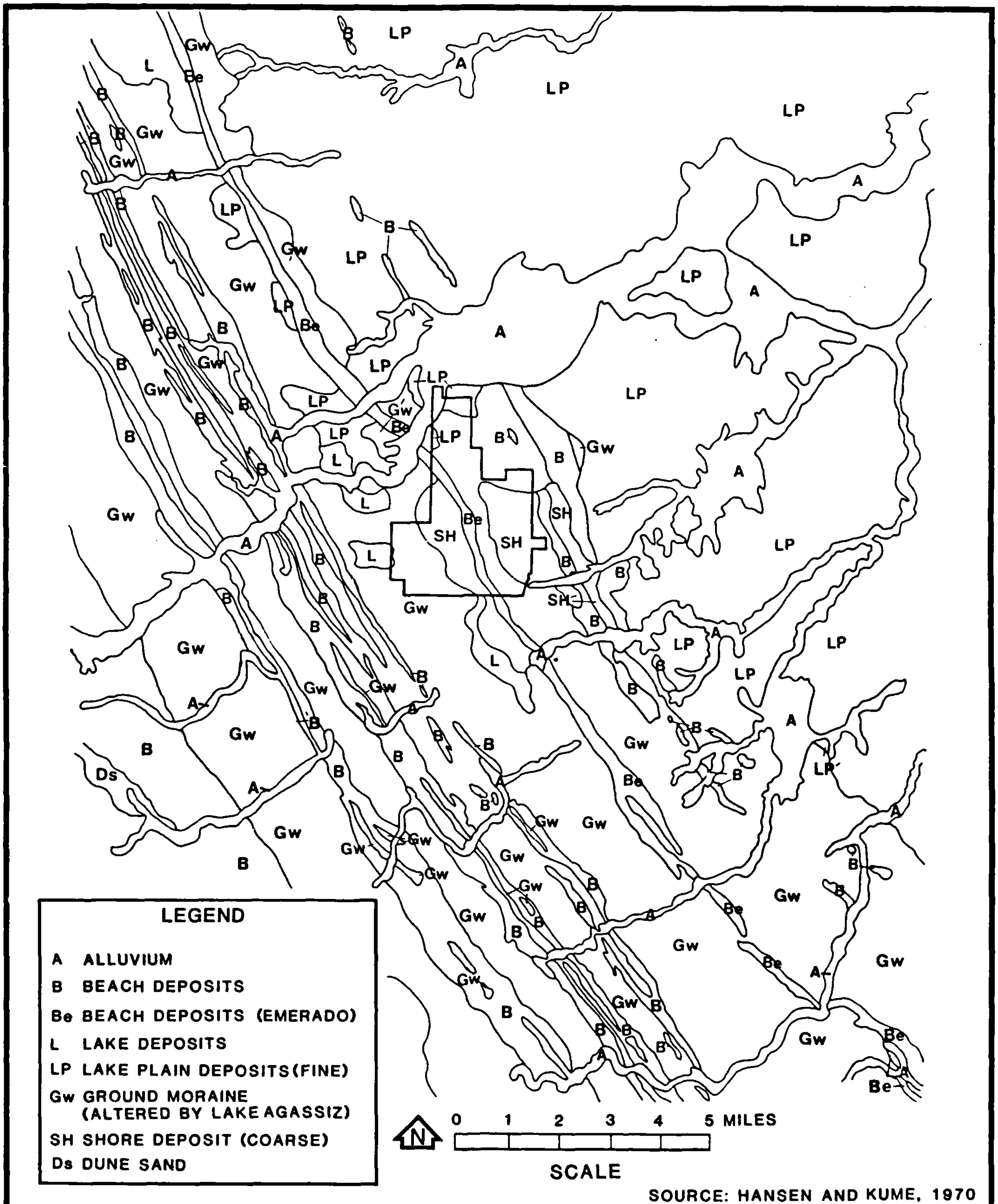

Figure 3.3-3
SURFICIAL GEOLOGY AND LANDFORM MAP

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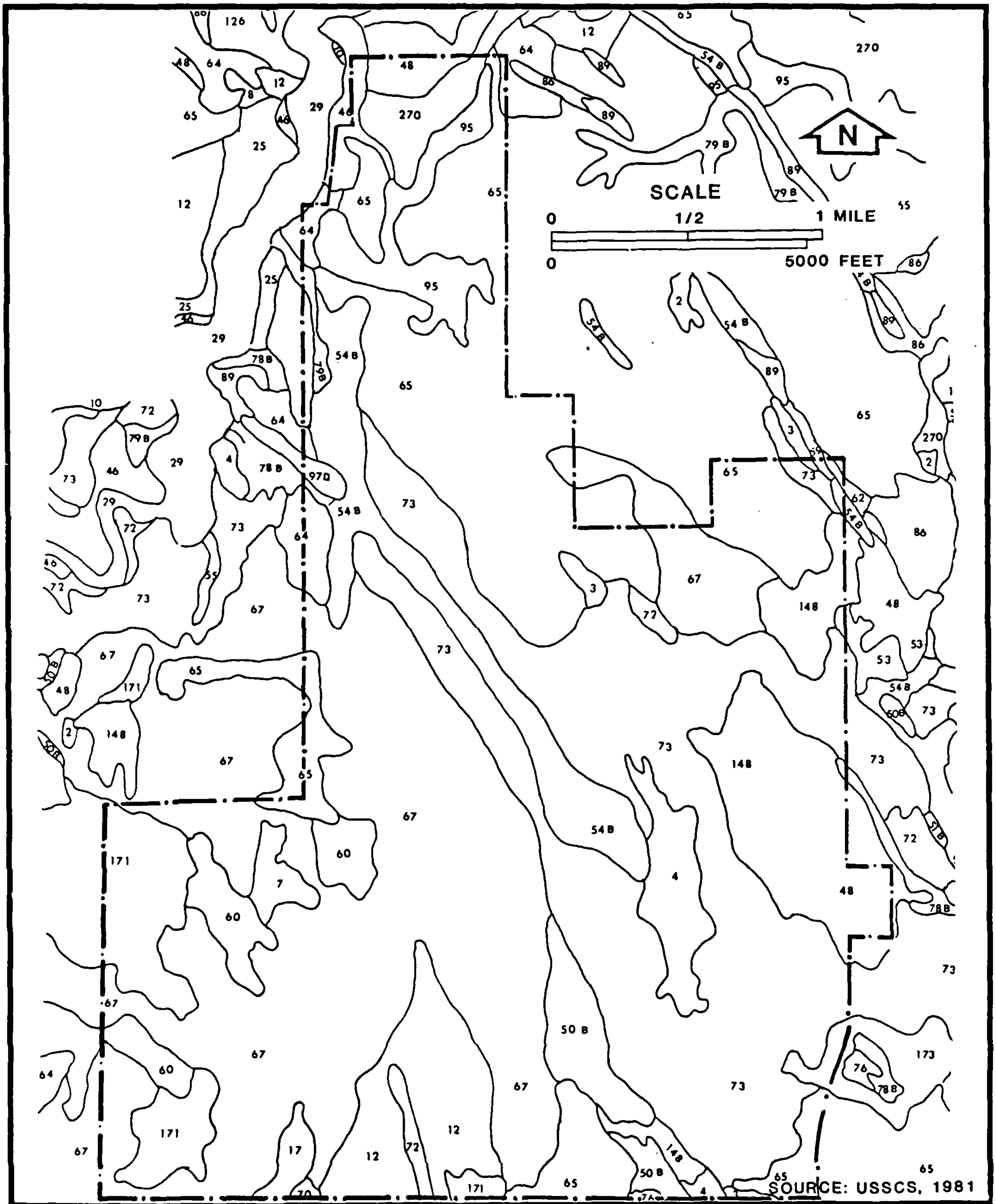

Figure 3.3-4
GFAFB SOILS MAP
(SEE TABLE 3.3-1 FOR SOIL NAMES)

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Table 3.3-2. Soils Found On and Near GFAFB

Soil Number	Soil Name
2	Parnell silt loam
3	Vallers loam
4	Averson loam
10	Lamoure silty clay loam
12	Svea loam
25	Overly silty clay loam
46	LaDelle silt loam
50b	Hecla fine sandy loam
51b	Hecla-Maddock fine sandy loam
53	Hamar sandy loam
54b	Embden fine sandy loam
60	Grimstad fine sandy loam
64	Antler silt loam
67	Gilby loam
72	Gardena silt loam
73	Glydon silt loam
79b	Zell-LaDelle silt loam
89	Renshaw loam
126	Bearden silty clay loam
148	Wydmere-Tiffany fine sandy loam
171	Antler-Tonka silt loam
270	Bearden silty clay loam (saline)

Source: U.S. Soil Conservation Service, 1981.

Arveson: These soils are nearly level and consist of deep, poorly drained, moderately rapidly permeable (2.0 to 6.0-in/hour) soils found on beaches and delta plains. They formed in medium textured and moderately coarse texture sediments overlying coarse textured glaciofluvial and glaciolacustrine deposits.

Bearden: These soils are level, deep, poorly drained, moderately slowly permeable (0.2 to 0.6-in/year) soils on glacial lake plains. They formed in medium and moderately fine textured glaciolacustrine deposits.

Embden: This series consists of level to gently sloping, deep, moderately well drained soils on delta plains and beaches. The permeability is moderately rapid (2.0 to 6.0-in/hour) and the soil formed in moderately coarse textured glaciofluvial and glaciolacustrine deposits.

Gilby: The nearly flat soils of this series are deep, poorly drained, and moderately slowly permeable (0.2 to 0.6-in/hour). They formed in glaciolacustrine deposits overlying till in areas between beach ridges. They are medium and moderately fine textured.

Glyndon: The Glyndon Series consists of deep poorly drained moderately permeable (0.6 to 2.0-in/hour), level soils on glacial lake plains. They formed in medium textured glaciolacustrine deposits.

Grimstad: This series consists of deep, poorly drained soils in level areas between beach ridges. They are moderately coarse and coarse textured glaciolacustrine deposits. Permeability varies from rapid (6.0 to 20.0-in/hour) in the upper part to moderate (0.6 to 2.0-in/hour) in the lowest part.

Hecla: These are gently sloped, deep, and moderately well drained soils. They formed in coarse textured glaciofluvial and glaciolacustrine deposits on delta plains and beaches. The soils are rapidly permeable (6.0 to 20.0-in/hour).

Ojata: These soils are nearly level, deep, poorly drained, moderately slowly permeable (0.2 to 0.6-in/hour) and very strongly saline. They formed in medium and moderately fine textured glaciolacustrine deposits in areas between beach ridges.

Svea: The level to moderately sloped soils of this series consist of deep, moderately well drained, moderately slowly permeable (0.2 to 0.6-in/hour) glaciolacustrine deposits overlying till. They are found on till plains and between beach ridges.

Tiffany: The nearly level Tiffany Series consists of deep, poorly drained, moderately permeable (0.6 to 2.0-in/hour) soils on delta plains, glacial lake plains and in areas between beach ridges. These soils formed in moderately coarse and medium textured glaciofluvial and glaciolacustrine deposits.

Tonka: Deep, nearly level, poorly drained soils are characteristic of this series. The permeability is slow (0.06 to 0.2-in/hour). These soils formed in medium and moderately fine textured colluvium overlying till on till plains and in areas between beach ridges.

Vallers: Deep level, poorly drained soils in seepy areas are characteristic of this series. Typically, the upper 8-in is dark loamy soil and it becomes more clayey and calcareous to a depth of 44-in. The Vallers soil is moderately slowly permeable with a high water table above or within two feet of the ground surface. The soil formed on till plains and in areas between beach ridges.

Wyndmere: This series consists of nearly level, deep, poorly drained, moderately rapid permeable (2.0 to 6.0-in/hour.) soils on beaches and delta plains. They formed in moderately coarse and coarse textured glaciofluvial and glaciolacustrine deposits.

3.3.3 GEOHYDROLOGY

Ground water supplies in the area are obtained from both saturated bedrock and saturated glacial drift deposits. The Precambrian rocks contain only small amounts of water in joints or fractures, and it is doubtful that substantial quantities of water could be obtained from them. The preglacial sedimentary rocks in Grand Forks County overlying the Precambrian contain at least three aquifers. These occur in rocks of Ordovician age and in the Dakota Group and Pierre Formation of Cretaceous age. In the vicinity of GFAFB, the Dakota sandstone is the only bedrock aquifer utilized as a ground water source.

Below GFAFB the Dakota aquifer is generally 50 to 80 ft thick and is composed of a well-sorted coarse-grained sandstone. Most of the wells tapping the Dakota aquifer in eastern Grand Forks Counlty flow at the surface, although flow rates and artesian water levels appear to be declining. Water produced from the Dakota is used primarily for livestock watering because it is very saline (Kelley and Paulson, 1970).

The glacial drift in Grand Forks County is composed mainly of clay-rich till which has a low permeability and which will yield only small quantities of ground water. However, in places the drift is composed of sand and/or gravel. Where saturated with water, these deposits form aquifers of varying importance depending on size, permeability, access to recharge, and the quality of water. Five major aquifers in the Grand Forks County drift are described by Kelley and Paulson (1970). In addition to the major drift aquifers, small quantities of ground water are obtainable from a variety of water-bearing deposits associated with the glacial drift that, either for reason of small storage volume or low permeability, are grouped under the heading "minor drift aquifers."

The Emerado Aquifer is a major drift aquifer underlying GFAFB (Figure 3.3-5). The aquifer has an areal extent of approximately 15 square miles. Generally the aquifer interfingers with glacial till, which also confines it above and below. The principal lithology is medium- to coarse-grained poorly-sorted sand. Water in the Emerado Aquifer is confined under pressure. Below GFAFB, the specific capacity of the aquifer was computed to be about 10 gallons per minute per foot of drawdown, and the transmissivity may be in the order of magnitude of about 15,000 gallons per day per foot (Kelley and Paulson, 1970).

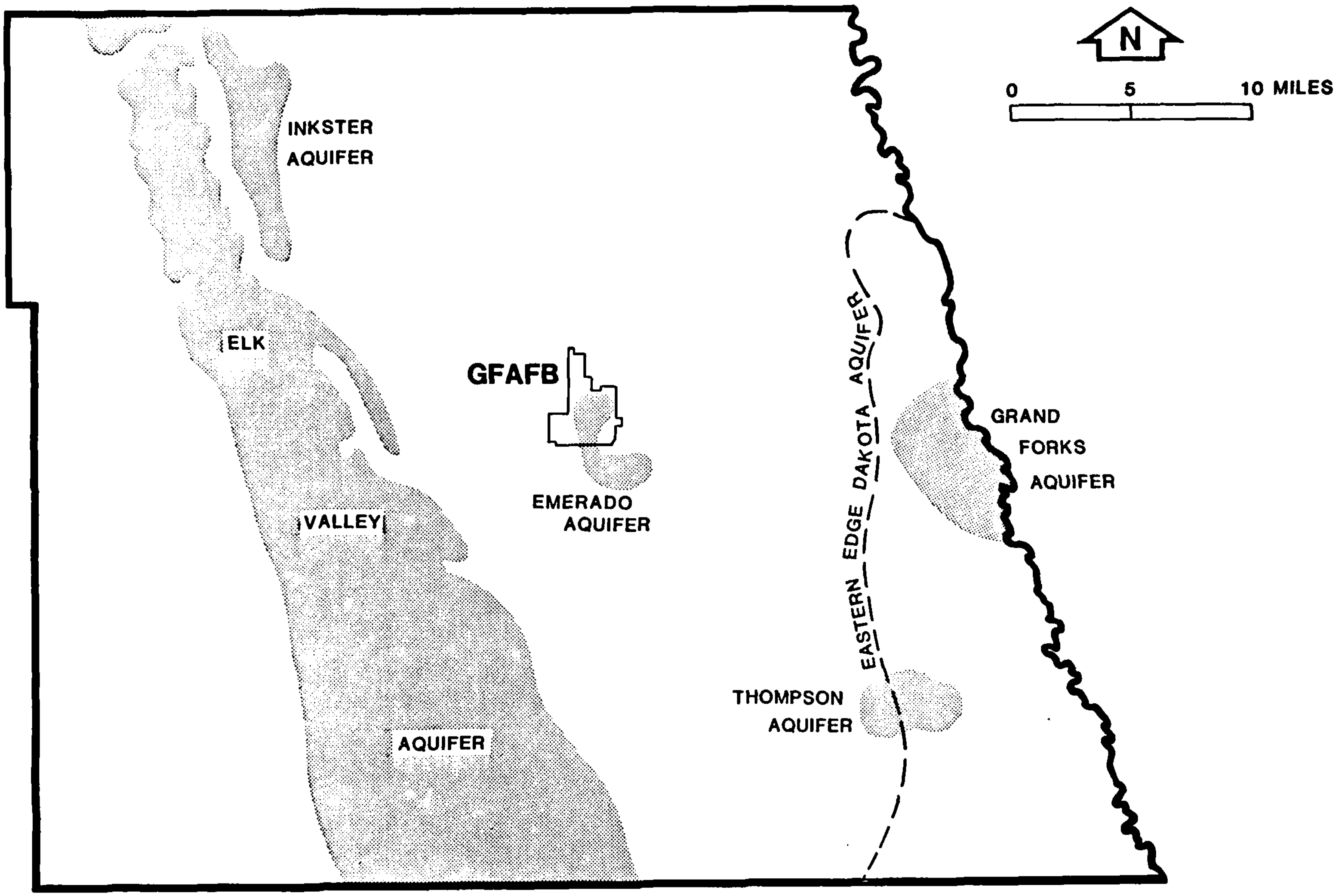

Figure 3.3-5
MAJOR GLACIAL DRIFT AQUIFERS IN GRAND FORKS, NORTH DAKOTA

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Minor glacial drift aquifers occur in the Lake Agassiz beach deposits, in Lake Agassiz silt deposits, in small sand and gravel bodies in the glacial till, and in the till.

The Lake Agassiz beaches are long, narrow deposits of sand and gravel that mark the various stages of the former glacial lake (see Figure 3.3-3). In Grand Forks County the average thickness of the beach deposits is less than 10 ft, but the thickness ranges from 1-20 ft. The beach ridges are preferred as building sites, and numerous farmsteads have been constructed on them. Many of these farms are dependent solely upon the beach deposits for their water supply. Generally there is an abrupt rise in water level that coincides with the spring thaw, and this usually is followed by a declining water table during the remainder of the year. Since direct infiltration of precipitation is the only source of recharge to these aquifers, the water table may flucturate 3-4 ft annually. During prolonged dry periods, wells tapping these aquifers may go dry. The water tables in all of the beach aquifers are rather shallow, usually less than 10 ft below land surface. Consequently, substantial quantities of ground water are discharged from the aquifer by evapotranspiration. Also, large quantities of water are discharged as springs and seeps. Infiltration from rainfall and snowmelt moves downward through the beach deposits and laterally along the contact with the underlying clay or till toward seepage zones along the east-facing slopes. A lenticular outwash deposit associated with the Emerado Strandline trends northwest-southeast through the center of GFAFB. Its potential for production of ground water is probably small due to limited thickness and recharge.

The eastern and central parts of Grand Forks County are mainly covered by lacustrine deposits that may have accumulated in the deeper waters of Lake Agassiz. In most places these deposits consist of clay having very low permeability, but locally the upper part of the deposit is composed of silt. The silt facies is generally less than 10 feet thick, but where present, it may yield small quantitites of water to large-diameter wells. Ground water in the silt deposits is under water-table conditions, and generally the water level is only a few feet below land surface. The low specific yield of these sediments causes large fluctuations in the water table in response to minor amounts of precipitation, and abrupt rises and declines of the water table occur during the year.

Most of the small bodies of sand and gravel interspersed with and isolated in the glacial till are water-bearing and are capable of yielding small supplies of water for domestic and livestock needs. Many of the rural residents of the county obtain their water supplies from these small aquifers.

Wells that fail to penetrate any significant thickness of sand and gravel but, nonetheless, yield small quantities of water, are not uncommon in Grand Forks County. The water is yielded from the till and, although the rate of yield is very low, the quantities are often sufficient to yield small supplies for domestic or livestock needs. The permeability of glacial till is increased considerably by the presence of joints or other fractures. Joints serve as paths through which water can move more freely. A well that intersects a joint system usually yields greater quantities of water than a well in unjointed till. The joints in the till are not apparent at the surface, however, and little is known about their distribution.

3.4 WATER QUALITY

3.4.1 SURFACE WATER

GFAFB is drained by ditches that route water either to the Turtle River or to Kelley Slough as described in Section 3.3.2.

The Turtle River receives surface water runoff from the western portion of GFAFB. The North Dakota State Department of Health (NDSDH) has designated the Turtle River to be a Class II stream which means it may be intermittent, but when flowing the quality of the water shall be such that after treatment, it shall meet the chemical, physical and bacteriological requirements of the NDSDH for municipal use. Table 3.4-1 lists the water quality criteria for surface water in North Dakota. The designation also states that it shall be of sufficient quality to permit use for irrigation and for propagation of life for resident fish species, boating, swimming, and other water recreation.

Table 3.4-1. Specific Standards of Surface Water Quality North Dakota State Department of Health Regulation 61-29-02 (1977)

Substance or Characteristic	Class of Stream I	IA	II	III
	Limitation mg/l***			
Ammonia	0.02	0.02	0.02	0.10
Arsenic	0.05	0.05	0.05	0.10
Barium	1.0	1.0	1.0	1.0
Boron	0.5	0.5	0.5	0.75
Cadmium	0.01	0.01	0.01	0.01
Chloride	100	175	250	250
Chromium	0.05	0.05	0.05	0.05
Copper	0.05	0.05	0.1	0.1
Cyanide	0.005	0.005	0.005	0.1
Lead	0.05	0.05	0.05	0.1
Nitrate	1.0	1.0	1.5	1.5
Phosphate	0.1	0.1	0.2	0.2
Zinc	1.0	1.0	2.0	2.0
Selenium	0.01	0.01	0.01	0.01
Polychlorinated Biphenyls (μg/l)	0.001	0.001	0.001	0.001
Dissolved Oxygen	5.0	5.0	5.0	5.0
Phenols	0.01	0.01	0.01	0.01
Sulfate	250	450	450	750
Total Chlorine Residual	0.01	0.01	0.01	0.01
Mercury	0.002	0.002	0.002	0.002
pH (Standard Units)	7.0-8.5	7.0-8.5	6.0-9.0	6.0-9.0
Temperature*	85°F	85°F	85°F	85°F
Fecal Coliform**				
Sodium	50 percent of total cations as meq/l			

* - The maximum increase shall not be greater than 5°F above natural background conditions.

** - The fecal coliforms (f.c.) shall not exceed a geometric mean of 200 f.c./100 ml based on a minimum of five samples obtained during separate 24 hour periods of any 30 day period nor shall 10 percent of total samples exceed 400 f.c./100 ml. This standard shall apply only during May 1 - September 30.

*** - Unless otherwise indicated.

The Turtle River is sampled by the U.S. Geological Survey (USGS) about 10 miles northeast of GFAFB at Manvel, North Dakota (Figure 3.2-4). Table 3.4-2 is a record of the water quality data collected during the period 1982 to 1984. The data indicate that certain parameters are very dependent on the season and stream flow volume. Concentrations of ammonia, boron, chloride, phosphorus, and sulfate were consistently in excess of Class II water quality standards.

The storm drainage flowing from the western portion of GFAFB and into the Turtle River is sampled by base personnel. Among the parameters sampled, only ammonia exceeded Class II standards. The very low flow in this drainage (0-0.1 million gallons per day) suggests that the ditch exerts a negligible effect on Turtle River water quality.

Kelly Slough ultimately drains the surface runoff from the east half of GFAFB. Kelly Slough is not classified by NDSHD but must meet the general standards that apply to all surface waters of the state. Kelly Slough does not have a USGS water sampling station but surface water effluent from the sewage lagoons east of the base and drainage ditches exiting the base are monitored and sampled periodically by Air Force personnel. A review of the data for the drainage ditches indicates that the concentration of ammonia consistently exceeds state standards. In isolated instances, elevated concentrations of phenols and lead and low levels of dissolved oxygen were observed. The lead and dissolved oxygen levels are typical of streams carrying runoff from streets and parking lots. The total flow from these ditches is quite small, and the ditches would not be expected to exert an adverse effect on Kelly Slough. Data for the sewage lagoon effluent is restricted to NPDES regulated parameters. The data indicate that the effluent has an elevated ammonia level relative to water quality standards, as would be expected.

3.4.2 GROUND WATER QUALITY

The chemical quality of ground water is dependent upon the amount and types of dissolved gases, minerals, and organic material leached by water from enclosing rocks during flow from recharge to discharge areas.

Table 3.4-2. Water Quality Data, Turtle River 10 Miles Northeast of GFAFB (downstream)

Parameter/Units	1982 April 5	1982 April 12	1982 April 27	1982 May 4	1982 May 12	1982 June 14	1982 August 3	1983 April 5	1983 May 3	1984 April 9	1984 May 9
Ammonia (N) (mg/l)	--	--	--	0.054	--	0.03	--	0.116	0.029	0.336	0.097
Arsenic (μg/l)	--	--	--	--	--	5.9	--	--	7.1	--	2.5
Barium (μg/l)	--	--	--	--	--	100	--	--	50	--	360
Boron (μg/l)	130	260	320	--	600	--	1,300	--	--	--	--
Cadmium (μg/l)	--	--	--	--	--	1.3	--	--	0.79	--	0.62
Chloride (mg/l)	110	280	320	325	700	775	1,100	150	380	280	570
Chromium (μg/l)	--	--	--	--	--	0.9	--	--	1.54	--	2.32
Copper (μg/l)	--	--	--	--	--	5.6	--	--	2.6	--	3.3
Discharge (CFS)	495	319	64	--	32	--	19	--	--	--	--
Dissolved Oxygen (mg/l)	--	--	--	11.7	--	7.80	--	12.5	10.4	13.1	12.0
Fecal Colform (Cols/100 ml)	K10	K3	K2	<10	30	220	490	--	10.0	--	--
Fecal Streptococci (Cols/100 ml)	760	K1000	K0	--	K120	--	315	--	--	--	--
Fluoride (mg/l)	0.1	0.3	0.4	--	0.5	--	0.9	--	--	--	--
Hardness (mg/l)	211	293	424	500	733	894	787	217	538	400	718
Iron (mg/l)	0.100	0.055	0.020	0.082	0.030	0.21	0.030	0.37	0.35	0.50	0.88
Lead (μg/l)	--	--	--	--	--	1.0	--	--	12.0	--	3.3
Manganese (μg)	78	230	230	--	670	--	60	78	269	400	360
Nitrogen (NO_2 and NO_3) (mg/l)	2.2	75	<0.10	--	<0.10	--	<0.10	--	--	--	--
Nitrate (N) (mg/l)	--	--	--	0.026	--	0.016	--	0.271	0.38	0.643	0.053
pH	7.6	8.1	7.9	7.5	7.8	7.9	8.3	7.6	7.9	7.9	8.0
Total Phosphate (P) (mg/l)	--	--	--	0.280	--	--	--	0.392	0.144	0.176	0.196
Phosphorus	0.240	0.160	0.050	--	0.050	--	0.450	--	--	--	--
Selenium (μg/l)	--	--	--	--	--	0.2	--	--	0.26	--	0.14
Silica	17	14	16	--	12	--	21	--	--	--	--
Sodium (mg/l)	78	170	220	262	430	667	670	99	256	200	378
Sodium Absorption Ratio	2.4	4.5	4.8	5.09	7.1	9.7	11.0	2.92	4.81	4.36	6.13
Sulfate (mg/l)	100	200	260	271	410	616	560	129	311	282	573
Suspended Sediment	35	42	43	--	50	--	--	--	--	--	--
Total Dissolved Solids (mg/l)	--	--	--	1,200	--	2,550	--	537	1,300	1,040	1,930
Specific Conductance (umhos/cm)	800	1,480	1,860	2,090	3,260	4,559	4,550	919	2,060	1,642	3,119
Temperature	0.5°C	1.0°C	12.5°C	16.0°C	12.0°C	20.0°C	24.0°C	1.0°C	16.0°C	7.0°C	12.0°C

-- = no data

Table 3.4-3 lists the EPA National Interim Primary and Secondary Drinking Water Regulations for maximum contaminant levels.

Even though the Dakota bedrock aquifer has produced more water than any other aquifer in Grand Forks County, the water is very saline and generally unsatisfactory for domestic and most industrial uses. Its primary use is for livestock watering. It is a sodium chloride type with total dissolved solids concentrations of about 4,400 parts per million (ppm). The water generlly contains excessive chloride, iron, sulfate, total dissolved solids, and fluoride. The water from the Dakota is highly toxic to most domestic plants and small grain crops, and in places the water is too highly mineralized for use as livestock water.

Water from wells tapping the Emerado aquifer near GFAFB is generally of poor quality because of upward leakage of poor quality water from underlying bedrock aquifers. It is a sodium sulfate type water with excessive hardness, chloride, sulfate, and total dissolved solids (Table 3.4-4).

Water from the Lake Agassiz beach aquifers is usually of good chemical quality. The water is a calcium bicarbonate type that is relatively soft. The total dissolved solids content ranges from 308 to 1,490 ppm with an averge concentration of about 726 ppm. Most of the water from beach aquifers is satisfactory for use on lawns and gardens.

Water from the Lake Agassiz silt deposits is normally of poor quality. Total dissolved solids usually exceed 2,000 ppm, is extremely hard, and is a calcium sulfate type.

Water from small sand and gravel aquifers in the area usually exhibit water quality charcteristics similar to the Dakota Aquifer.

Most of the water from the till aquifers is of poor chemical quality. The water is very hard and, in places, is reported to be objectionable for domestic use because of high iron and/or sulfate content.

Table 3.4-3. Maximum Contaminant Levels According to the National Interim Primary and Secondary Drinking Water Regulations

Contaminant	Standard (mg/l)*
I. Primary Standards:	
Inorganic Contaminants	
Arsenic	0.05
Barium	1.0
Cadmium	0.010
Chromium	0.05
Lead	0.05
Mercury	0.002
Nitrate	10.0
Selenium	0.01
Silver	0.05
Organic Contaminants	
Endrin	0.0002
Lindane	0.004
Methoxychlor	0.10
Toxaphene	0.005
2,4-Dichlorophenoxyacetic Acid	0.1
2,4,5-TP Silvex	0.01
Total Trihalomethanes	0.10
Radionuclides	
Gross Alpha Particle Activity	15 (pCi/l)
Radium-226 + Radium-228	5 (pCi/l)
Tritium	20,000 (pCi/l)
Strontium-90	8 (pCi/l)
II. Secondary Standards	
Chloride	250
Color	15 (color units)
Copper	1.0
Corrosivity	(Non-corrosive)
Foaming Agents	0.5
Iron	0.3
Manganese	0.05
Odor	3 (TON)†
pH	6.5 - 8.5
Sulfate	250
Total Dissolved Solids	500
Zinc (Zn)	5

* - Unless specified in parentheses ( ).
† TON = Threshold Odor Number.

Table 3.4-4. Ground Water Quality Data of the Emerado Aquifer One Mile South of GFAFB

Parameter	USGS Well Location*	
	151-53-1ccc	151-53-1dcd
Specific Conductance (umhos)	2700	3040
pH (standard units)	7.70	7.6
Temperature (°F)	49.00	54.0
Sodium	289.00	342.0
Sodium Absorption Ration	4.30	4.8
Silica	27.00	12.0
Iron	0.22	17.0
Calcium	205.00	252.0
Magnesium	79.00	81.0
Potassium	17.00	17.0
Bicarbonate	264.00	368.0
Carbonate	0.00	0.0
Sulfate	733.00	961.0
Chloride	368.00	305.0
Fluoride	0.30	0.0
Nitrate	5.40	1.1
Boron	0.97	1.2
Total Dissolved Solids	1,850.00	2,170.0
Hardness	835.00	960.0

* - Concentration (μg/l unless otherwise stated).

Source: Kelly, 1968.

3.5 BIOTA

GFAFB is located in the tall grass prairie region of eastern North Dakota. The development of facilities within base boundaries has resulted in the disturbance of natural habitats over most of the base.

Grassland habitat is present adjacent to runways, munitions storage bunkers, and in the reclaimed landfill area. Native grasses such as blue grama grass (Bouteloua gracilis) and western wheatgrass (Agropyron smithii) occur in these areas, but introduced species and weedy annual species are more abundant. Non-native species present in these areas include barnyard grass (Echinochloa crusgalli), downy brome (Bromus tectorum), green foxtail (Setaria viridis), prairie cordgrass (Spartina pectinata), and Kentucky bluegrass (Poa pratensis).

Approximately 43 acres of riparian forest habitat occur along a 3,000 ft. stretch of the Turtle River channel in the northern portion of the base within an area named Bright Image Park. This location is under consideration for development as a multiple use recreational area, but 80 percent of the area is within an Air Installation Compatible Use Zone which precludes recreational development at this time. Dominant trees include basswood (Tilia americana), boxelder (Acer negundo), bur oak (Quercus macrocarpa), and green ash (Fraxinus pennsylvanica). Introduced species such as Russian olive, spruce, and junipers have been planted to provide windbreaks and landscaping near base facilities. Mature tree stands provide suitable habitat for a number of wildlife species.

With the exception of Bright Image Park, suitable habitat for wildlife species is limited. Species which inhabit the site are common in similar habitats throughout the region. Mammals which occur in habitats on the base include mink (Mustela vison), red fox (Vulpes fulva), ground squirrels (Citellus spp.), muskrat (Ondatra zibethica), whitetail jackrabbit (Lepus townsendi), white-footed mice (Peromyscus spp.), and whitetail deer (Odocoileus virginianus).

Bird species which inhabit developed areas of the base are typical of disturbed habitats and zones of human habitation throughout the Midwest. The rock dove (Columba livia), mourning dove (Zenaidura macroura), house sparrow (Passer domesticus) and eastern kingbird (Tyrannus tyrannus) are common in these habitats. Forest areas are inhabited by species such as the common flicker (Colaptes auratus), common crow (Corvus branchyrhynchos), black-capped chickadee (Parus atricapillus), and American robin (Turdus migratorius). Raptors such as the red-tailed hawk (Buteo jamaicensis) and northern harrier (Circus cyaneus) occur throughout the region but unlikely to spend much time on the site due to the limited extent of suitable habitat and the intensity of human activities over most of the base area.

Turtle River State Park is located 3 miles west of GFAFB and is upriver from the base. The park contains grassland and riparian forest habitat similar to that found on the base in the Bright Image Park.

Kelly's Slough National Wildlife Refuge is 3 miles east of the base and is downstream from the outflow of the base's sewage lagoons. The sewage lagoons and refuge contain areas of open water and bordering wetland habitat dominated by cattails (Typha spp.), sedges (Carex spp.), and smartweeds (Polygonum spp.) which provide nesting and foraging habitat for a variety of waterfowl and shorebirds. The refuge is managed by the U. S. Fish and Wildife Service primarily for migratory waterfowl.

Amphibian and reptile species which inhabit the base and surrounding area are also common throughout the region. The tiger salamander (Ambystoma tigrinum), toads (Bufo spp.), wood frog (Rana sylvatica), plains garter snake (Thamnophis radix), and painted turtle (Chrysemys picta) are species typically found in habitats on the base.

No threatened or endangered plant or animal species are known to inhabit the base. Highly mobile migratory species such as the bald eagle and peregrine falcon (federally listed endangered species) have been observed in the surrounding region. These species may ocassionally occur in the vicinity of the GFAFB but are unlikely to visit the base due to the limited extent of suitable habitat and because of the high degree of human activities associated with base operations.

4.0 FINDINGS

To assess hazardous waste management at GFAFB, past and current waste generation and disposal methods were reviewed. This section presents a summary of hazardous waste generated by base operations, a description of waste disposal methods, an identification of the on-base disposal sites, and an evaluation of the potential for environmental contamination. This information was obtained by a review of files and records, interviews with current and former GFAFB employees, and site inspections.

4.1 ACTIVITY REVIEW

A dual-wing Strategic Air Command Base, GFAFB is home for the 321 Strategic Missile Wing (SMW) which commands 150 Minuteman Inter-Continental Ballistic Missiles, and also home of the 319 Bombardment Wing (BMW) which maintains and operates B-52 heavy bomber and KC-135 tanker aircraft. Supporting these units are the 321 Combat Support Group (CSG), the USAF hospital and approximately twenty other SAC and tenant organizations.

The installation generates approximately 188,000-gal per year of predominately liquid waste material. Reclaimable JP-4, which is removed from aircraft during maintenance, accounts for approximately 144,000 gal (77 percent) of this total figure. Wastes are largely the by-product of aircraft and automobile maintenance and operation activities. GFAFB operations described in this section are those which handle, store or dispose potentially toxic or hazardous materials. These operations include industrial and laboratory operations and activities in which pesticides; polychlorinated biphenyls (PCBs); petroleum, oils, lubricants (POL); and explosives are handled. No large scale manufacturing operations have been conducted at GFAFB. Rather, the industrial operations described in the following subsections are primarily maintenance-support functions provided for base facilities, airacraft, missiles, vehicles and ground equipment.

Table 4.1-1 lists the facilities and areas which were screened for investigation prior to the site visit. The list of facilities to be

Table 4.1-1. Areas Screened for Team Investigation

Organization/Area Screened for Investigation	Facility/ Activity	Selected for Team* Investigation
1. 321st SMW		
A. Field Missile Maintenance Squadron	Missile Maintenance	Yes
	Battery Shop	No
	Pneudraulics	No
	Facility 306 Tank	Yes
B. Organization Missile Squadron	Missile Handling	No
Transportation Squadron	Motor Pool Area	Yes
	Waste Oil Tanks	Yes
C. Supply Squadron	Fuels Management	Yes
2. 319th BMW		
A. Avionics Maintenance Squadron	Fire Cotnrol Shop	Yes
	Electronic CM	No
B. Field Maintenance Squadron	Propulsion Branch	No
	AGE	Yes
	Pneudraulics	Yes
	Corrosion Control	Yes
	Wheel/Tire Shop	Yes
	Repair/Reclamation	Yes
C. Organization Maintenance Squadron	Flightline	Yes
D. Munitions Maintenance Squadron	Maintenance	No
	Storage	No
	EOD Range	Yes
3. 321st CSG		
A. Headquarters Squadron	Audio-Visual Services	Yes
	Small Arms Range	Yes
	Auto Hobby Shop	Yes

Table 4.1-1. Areas Screened for Team Investigation

Organization/Area Screened for Investigation	Facility/ Activity	Selected for Team* Investigation
4. 321st CES		
A. Electric Power Production	Drain Batteries	Yes
B. Exterior Electric	Transformer Servicing	Yes
C. Water and Waste	Neutralization of Acid	Yes
D. Paint Shop	Paint Thinning	Yes
E. Entomology	Pesticide Handling	No
F. Interior Electric	Maintenance	No
5. Det. 7, 37th ARRS	Maintenance	No
6. Other Areas of Concern		
A. Landfill	Potential Contamination	Yes
B. Fire Training Area	Training Exercises	Yes
C. Pole Yard	Former Transformer Storage	Yes
D. DPDO Complex	Hazardous Waste Storage	Yes
E. DOD Fuel Terminal	Fuel Storage, Past Spill	Yes
F. POL Storage Area	POL Storage	Yes
G. Heating Plant	Reported Past Spill	Yes
H. Finley Radar Site	Maintenance	Yes
I. Cavalier	Maintenance	Yes
	Fire Training	Yes
	PCB Storage/Handling	Yes

* Areas were selected for team investigation based on three criteria: 1) potential for contamination, 2) potential for contaminant migration, and 3) potential for other environmental problems including those which were beyond the scope of this study.

screened were those identified as being hazardous waste generators in the 321 SMW Hazardous Waste Management Plan (OPLAN 463-84). Entomology was included for investigation although it was not listed in the hazardous waste inventory. Other areas were considered for investigation based on information gathered from base records or from interviews. The team did not investigate facilities which had adequate records, no indication of problems, and handled only small quantities of hazardous materials and/or materials which presented relatively low hazard potential.

4.1.1 INDUSTRIAL OPERATIONS

This section describes the industrial activities within each unit which generate hazardous wastes, waste POL, and aircraft detergents. A master list of shops is provided in Appendix D. Actual quantities and disposal practices are discussed in Section 4.2.

321st SMW

Industrial operations in the 321st SMW occur in four squadrons. The Field Missile Maintenance Squadron (FMMS), Organizational Missile Maintenance Squadron (OMMS), Supply Squadron, and Transportation Squadron.

The 321st FMMS industrial operations are located primarily in Building 306. The largest waste generator is Periodic Maintenance which maintains all systems at the launch control facilities. Waste diesel oil, lube oils, hydraulic fluids and spill oil are generated from this activity. Battery shops at Building 306 drain batteries resulting in waste battery acid. The Pneudraulics Shop, which performs hydraulic work on smaller units such as generators, generates small quantities of waste hydraulic fluid.

The primary mission of 321st OMMS is to maintain the missiles at the sites. Small quantities of lube oils and PD-680 result from missile handling operations. Sodium chromate is generated from maintenance on missile coolant systems.

The 321st Transportation Squadron provides transportation service to all GFAFB units. The Vehicle Maintenance Section performs complete maintenance and overhauls for the registered vehicles at GFAFB. Operations performed by this unit include oil changes, degreasing, engine tuneup, major repairs, painting, and battery replacement. Waste lube oils, synthetic oils, PD-680, and battery acid are generated from these operations.

Within the Fuels Management Branch of the Supply Squadron, Fuels Operations (Building 545) handles large quantities of JP-4 collected throughout the base. Approximately 80 percent of the fuel is reclaimed and issued to the AGE branch or the Fire Department for training drills. The remaining 20 percent is disposed of as waste.

<u>319th BMW</u>

The 319th BMW is supported by Organizational, Field, Avionics and Munitions Maintenance Squadrons. Operations are conducted for the B-52 Stratofortress and KC-135 Stratotanker, as well as for ground equipment used within the wing.

319th Organizational Maintenance Squadron (OMS) provides organization level maintenance support (aircraft inspection and servicing operations) for assigned B-52 and KC-135 aircraft. Maintenance of aircraft fuel systems involves the downloading of large quantities (12,000 gal/mon) of JP-4. This fuel is reclaimed and redistributed by Fuels Management. Synthetic lubricants are also generated by the 319th OMS operations.

The 319th Field Maintenance Squadron (FMS) handles a wide cross section of maintenance ranging from intermediate repair of jet engines to servicing of aerospace ground equipment (AGE). The squadron has several shops located in Buildings 605-609 which generate waste. The AGE Branch in Building 607 maintains flightline support equipment. This includes mechanical overhauls, lube changes and general mechanical repair. PD-680, petroleum- and synthetic-based oils and lubricants are generated as waste. A Pneudraulic Shop in Building 607 uses PD-680 and hydraulic fluid in the maintenance of aircraft and support equipment hydraulic systems. The Wheel and Tire Shop uses PD-680 for cleaning purposes.

Corrosion Control in Building 605 paints and strips aircraft and performs corrosion control inspections. Methyl ethyl ketone (MEK) is used for cleaning and the rinsing of spray paint guns from painting operations. Paint strippers used at this shop were analyzed and found to contain methylene chloride, phenol, sodium, water thickeners and surface active agents. The Propulsion Branch within the FMS performs maintenance on aircraft engines. Waste generated from routine tasks include synthetic lubricants, hydraulic fluids, PD-680 and JP-4.

The 319th Avionics Maintenance Squadron (AMS) is primarily responsible for keeping the numerous electronic systems of base aircraft in a constant state of readiness. Within the 319th AMS, the Fire Control Shop in Building 607 uses PD-680 and 1,1,1-trichloroethane in degreasing gun barrels. The G-model gun tank, used in cleaning gunbarrels, began operations in mid-1982.

The 319th Munitions Maintenance Squadron (MMS) is devoted to the care and maintenance of the munitions stored in the base arsenal. The squadron uses small quantities of lube oils and hydraulic fluids for maintaining unit equipment. Unservicable munitions are destroyed at the Explosive Ordnance Disposal (EOD) Range.

321st Combat Support Group (CSG)

The 321st CSG is responsible for providing support for all operational units at GFAFB. Under the 321st CSG are three squadrons: The 321st Headquarters (HQ) Squadron, the 321st Civil Engineering Squadron (CES) and the 321st Services Squadron. The 321st HQ Squadron provides administrative support for Personnel, Base Operations, Morale and Recreation Activities and other base functions. Within the Recreation Division, the Auto Hobby Shop (Building 310) is used by current and retired base employees. Petroleum-based oil and PD-680 is generated from the minor maintenance of vehicles at the shop. Audio-Visual Services has a Photo Shop in Building 533 which generates waste photo fixer in film processing.

Under the 321st Services Squadron, the base service station performs oil changes, tuneups, and brake jobs and other minor maintenance for personal vehicles. Waste oil is generated from oil changes, and Saf-T-Clean® solvent is used in lieu of PD-680 or other solvents. Brake shoes are returned to dealer for the core charge.

The 321st CES is responsible for the maintenance, repair and operation of all facilities on GFAFB and its associated taxiways and aprons, industrial buildings and family housing units. The CES has several shops located in or in proximity to Building 410. The Paint Shop at Building 410 has two vats for washing paint brushes and cans. Only small quantities of diesel used in cleaning are handled as waste. The Plumbing Shop is responsible for inspection and maintenance on the two large oil/water separators (40,000-gal capacity) at GFAFB. At Exterior Electric the overall assignment is to maintain all the high voltage on the base. The Power Production Shop maintains power generators throughout GFAFB. Associated wastes include sulfuric acid and PD-680. The base demineralizer water plant (Building 610) generates approximately 900-gal/mon of neutralized waste sulfuric acid solution. Other materials used in-process within the 321st CES include difluoromethane used in fire extinguisher maintenance and freon in refrigeration.

Det. 7, 37th Aerospace Rescue and Recovery Squadron (ARRS)

Minor maintenance is performed on helicopters at this squadron, such as lube changes. Waste synthetic fuels and JP-4 are also generated at this squadron.

Defense Property Disposal Office (DPDO)

The DPDO at GFAFB is one of 27 disposal offices operating out of the Ogden, Utah, Regional Headquarters. It functions as a disposal facility for several federal and state agencies east of Bismarck, North Dakota, including GFAFB, Cavalier AFS, and Finley AFS. The DPDO assumes accountability of hazardous waste from receipt of required documents. After the waste is properly identified and contained, DPDO will assume custody and contract for the removal of PCB and hazardous waste.

Heads of all hazardous waste generating activities appoint an accumulation point manager for their organization. The manager insure that all waste generated by the organization is properly collected, identified, containerized, stored and transferred to DPDO. The DPDO coordinates its duty of offsite removal of waste with the several accumulation point managers. The only waste generated by DPDO is small quantities of solvent used for cleaning.

Heating Plant

The heating plant at GFAFB uses electricity to operate. From 1967 until 1982, the plant used #6 oil as fuel which presently serves as the backup fuel.

Blowdown from the boilers occurs approximately once per month and is pumped to the sewage system. The boilers are air-cleaned once annually. The only waste reportedly generated at the heat plant is small quantities of JP-4 (5 gal/mo) which is used in parts cleaning.

Cavalier Radar Sensor Site

The Cavalier Radar Sensor Site is located at Concrete, North Dakota. Primary operations occurring at this site include radar, vehicle maintenance, fire training exercises, power plant, and water treatment plant operations. A sewage lagoon handles all sanitary liquid wastes and sanitary refuse is contract-hauled by a private contractor. Hazardous wastes and salvagable materials are sent to DPDO at GFAFB.

Various equipment (filters, transformers, capacitors) located in the radar and power plant building have been identified to contain PCBs. This equipment is handled, stored and disposed in accordance with the Standard Operating Procedure (SOP-RSC-004) established for the site. In addition, a program is currently underway to phase out PCB oil using silicon oil as replacement.

Waste oil (300 gal/mo) is generated from the service of approximately 40 vehicles. Generators at the power plant also receive service resulting in waste oil. PCB contaminated oil is disposed of through DPDO as a hazardous waste. Uncontaminated oil is contract-hauled by an oil recycler. Solvents used in vehicle and general facility maintenance includes 1,1,1-trichloroethane, paint thinner, and mineral spirits. Waste solvents are collected in drums and sent to DPDO as a hazardous waste.

Diesel fuel is used in fire training exercises. Between 50 and 100 gal are used for each of the quarterly exercises. During exercises, the pit bordered by an earthern berm, is flooded with water prior to the introduction of the deisel fuel. Almost all of the fuel is burned. Grass growing in the pit indicates a lack of contamination in the area.

Finley Radar Site

The Finley Radar Site began operation in 1950. However, the site has been on caretaker status since 1979.

Waste oil is generated from oil changes at the vehicle hobby shop and maintenance shop. The oil is drummed and picked up by an oil recycler out of Minneapolis, Minnesota. The power plant was also a source of waste oil generation prior to 1979. Occasional painting, plumbing, and other facility maintenance account for small quantities of liquid waste at the site. Refuse is hauled to the city landfill.

Other Operations

Training activities at GFAFB include firefighter training. Fire training exercises are conducted regularly using jet fuel (JP-4) as fuel and using water and aqueous film forming foam (AFFF) as a suppressant. This area is discussed further in Section 4.3.

4.1.2 FUELS/OILS HANDLING AND STORAGE

The types of POL used and stored at GFAFB include heating fuel oil (FO), JP-4, motor gasoline (MOGAS), diesel fuel (DF), petroleum-based solvents, hydraulic fluids and lubricating oils.

The type of storage used is underground (UG) tanks, or aboveground (AG) storage in tanks, bowsers or servicing vehicles. Most POL storage facilities with capacities above 660 gal are UG tanks (Figure 4.1-2). Aboveground tankage includes FO and JP-4 AG tanks with diked walls for containment, servicing vehicles used to dispatch JP-4 and other POL to various on-base storage facilities tanks at launch control facilities, and various FO storage tanks.

Table 4.1-2 is a list of POL storage tanks by location. Most POL storage tanks on GFAFB are used to store heating oil. In addition to the tanks listed on Table 4.1-2, approximately 1875 fuel oil tanks are located in family housing. Propane is also used for heating at GFAFB, and apporoximately 30 AG propane storage tanks ranging in capacity from 100 to 18,000 gal, are located throughout the base. Motor gasoline and diesel fuel are brought on base by truck and rail car, and unloaded in the storage area near Fuels Management (Building 545). Fuel handling equipment is parked near Building 545 and inspected regularly. A work request has been submitted to have all underground tanks and oil separators inspected in accordance with the EPA"s leaking underground storage tank (LUST) program. The work is expected to be completed within two years.

In addition to on-base POL storage, the DOD operates a fuel terminal on the northwest edge of the City of Grand Forks. From this terminal most of the JP-4 used at GFAFB is supplied via a nine-in pipeline which runs west from the terminal to GFAFB, a distance of approximately 15 miles. Four large tanks are located at the DOD Fuel Terminal, with capacities of 55,000 barrels (2) and 80,000 barrels (2). A 3 ft high earthen dike surrounds each tank.

4.1.3 FUEL OIL STORAGE AND DISPOSAL

Fuel oil (#2) is used as a backup fuel at the heating plant. The plant converted from fuel oil to electricity in 1982. The smaller FO tanks located at buildings throughout the base are used to store FO for heating purposes. The oil is consumed in-process and does not generate waste, except for possible leaks or spillage around transfer points.

4.1.4 JP-4 STORAGE AND DISPOSAL

JP-4 is stored at GFAFB primarily in tanks located at the Fuels Management Storage Area and the SAC Ramp storage tanks. The 9-in UG fuel pipeline transfers fuel to both of these areas. Spill prevention is

Table 4.1-2. POL Storage Tanks by Location

POL Type	Capacity (1000 gal)	Location/ Bldg. No.	Tank† Type	Containment
DF	0.3	102	UG	UG
DF	1	109	NS	
FO	1	120	UG	UG
FO	1.8	121	UG	UG
FO	1.5	125	UG	UG
FO	0.56	200	UG	UG
MOGAS	10 (x3)	200	UG	UG
FO	1 (x2)	211	UG	UG
FO	1	239	UG	UG
MOGAS	10 (x3)	240	UG	UG
FO	0.56	240	UG	UG
FO	0.26	301	NS	
FO	1	302	UG	UG
Waste Oils	2	306	UG	UG
FO	5	310	UG	UG
Waste Oil	0.28	310	UG	UG
FO	1 (x2)	310	UG	UG
Waste Oil	2	317	UG	UG
FO	15	317	UG	UG
FO	30	317	NS	
FO	30 (x2)	317	NS	
Lube Oil	8	400	NS	
FO	25,000*	404	AG	diked
FO	2,500*	405	AG	diked
DF	4	415	UG	UG
MOGAS	20	415	UG	UG
MOGAS	10	416	UG	UG
MOGAS	1	416	UG	UG
Waste Oil	0.5 (x2)	416	UG	UG
DF	0.28	423	NS	
FO	0.27	425	AG	none
FO	0.27	429	AG	none
FO	0.55	452	UG	UG
DF	16.8	501	UG	UG
MOGAS	50	504	UG	UG
DF	15	505	UG	UG
FO	5,000*	506	AG	diked
Waste Oil	2	507	UG	UG
JP-4	25,000*	508	AG	diked
JP-4	30,000*	510	AG	diked
DF	0.18	519	UG	UG
FO	8.5	520	UG	UG

Table 4.1-2. POL Storage Tanks by Location (Continued, Page 2 of 3)

POL Type	Capacity (1000 gal)	Location/ Bldg. No.	Tank† Type	Containment
MOGAS	5	520	NS	
DF	5	520	NS	
FO	8.5	521	UG	UG
DF	0.8	529	UG	UG
DF	0.4	531	AG	none
FO	0.27	539	AG	none
MOGAS	5	540	AG	
JP-4	2.5	541	NS	
FO	5	545	UG	UG
MOGAS	5	551	AG	
FO	3	606	UG	UG
MOGAS	2	607	UG	UG
JP-4	2 (x2)	607	NS	
MOGAS	1	607	UG	UG
FO	2	608	UG	UG
JP-4	50 (x8)	611	UG	UG
JP-4	50 (x8)	612	UG	UG
DF	0.18	615	UG	UG
DF	0.28	616	UG	UG
FO	1	620	AG	
FO	20	621	UG	UG
FO	8.5	622	UG	UG
FO	0.53	633	AG	none
DF	0.3	634	UG	UG
DF	4	635	UG	UG
FO	1	701	UG	UG
FO	1	702	UG	UG
FO	1	714	UG	UG
FO	2.5	714	UG	UG
FO	20	714	UG	UG
FO	1	715	UG	UG
FO	0.3	716	UG	UG
FO	5	716	UG	UG
FO	5	722	UG	UG
FO	2	722	NS	
FO	5	730	UG	UG
FO	0.56	735	UG	UG
FO	0.28	804	AG	
FO	15	807	UG	UG
FO	3	807	UG	UG
FO	1	811	UG	UG
MOGAS	0.3	817	AG	

Table 4.1-2. POL Storage Tanks by Location (Continued, Page 3 of 3)

POL Type	Capacity (1000 gal)	Location/ Bldg. No.	Tank† Type	Containment
MOGAS	0.25	821	UG	UG
DF	0.3	822	UG	UG
MOGAS	1	831	UG	UG
MOGAS	0.27	832	NS	
MOGAS	0.26	836	AG	
FO	0.56	846	UG	UG
FO	0.56	848	UG	UG
FO	2	849	UG	UG
FO	0.56	850	UG	UG
FO	0.56	851	UG	UG
FO	1.5	851	UG	UG

* Barrels

† NS = Not Specified
AG = Aboveground
UG = Underground

accomplished by earthen dikes at Fuels Management and UG storage at the SAC Ramp. Both areas are considered controlled areas.

Contaminated JP-4 is generated as a result of fueling and de-fueling operations in Hangars 600-603 and maintenance operations in FMS shops. Fuels become mixed or contaminated with water or other usually non-hazardous foreign matter. Fuels are collected in 450 gal steel tanks on trailers (bowsers) and in 5,000 gal capacity tank trucks. Fuel samples are taken to Fuels Management to be analyzed for contaminants. The method of reuse is based on the degree of contamination. The Base Fuels Management Officer determines the manner in which reclaimed engine fuels will be recycled. Fuels which contain less than 10 percent by volume of oil can be used for fire training or AGE equipment. Past accounting records indicate that recycling has been accomplished in the following order of priority. Approximately 71 percent of the total average annual generation was returned to the bulk-storage supply systems for reuse as aircraft fuel. Twenty-one percent was placed in UG tanks at AGE and used in ground equipment. Five percent was used by the base Fire Department in fire training exercises. Four percent is mixed with other combustible liquids (e.g., lubricating oils) in the central collection waste tank.

4.1.5 WASTE POL STORAGE AND DISPOSAL

Waste POL at GFAFB includes waste petroleum-based oils (19,000 gal/yr), synthetic-based fluids (3,200 gal/yr), antifreeze (2,000 gal/yr) and petroleum based solvents.

Waste POL is accumulated at several locations on base. Fixed waste oil storage includes a central collection tank at Building 306, two UG storage tanks in the motor pool area, an UG tank and AG containers at the base Auto Hobby Shop and 15 scattered oil/water separators on-site. The waste oil is purchased and collected from the locations at least monthly by a contractor employing a pump and tank truck. It is transported off-site by the contractor for recycling.

All portable waste containers and fixed waste tankage, including oil separators, are inspected weekly by waste generators for leaks, spills, and other malfunctions. The sludges collected from oil separators and grit chambers must be analyzed for hazardous constituents before proper disposal can be accomplished. The sludges found hazardous are disposed of at off-site EPA approved facilities. In the past, those found non-hazardous were disposed (usually by contractors) at nearby off-site landfills. Because the State of North Dakota has recently prohibited disposal of oil or oil-related wastes in state landfills, alternate disposal methods are being investigated. Prior to RCRA it is suspected these sludges and also sewage lagoon sludges may have been customarily disposed in base on-site landfills.

4.1.6 PCB HANDLING AND STORAGE

PCB transformers at GFAFB are identified by nameplate inspection for in-service transformers or by PCB analyses for leaking and out-of-service transformers. If a transformer does not have a nameplate, or if there is no specific information available to indicate the type of dielectric fluid inside, the transformer is assumed to be a PCB-contaminated transformer (i.e., PCB concentration of 50-500 ppm). The base Bioenvironmental Engineer arranges to have the transformers sampled to confirm the PCB classification of the unit. Once this is accomplished, the transformer can be labeled accordingly.

The base maintains six confirmed PCB transformers in-service. Some in-service base electrical equipment has not been tested for PCB.

The Exterior Electric Shop in Building 418 currently stores and reworks transformers. The shop handles PCB transformer coolant oil at the rate of 5-gal/mon. When the shop receives an unserviceable transformer, the oil remains in the casing and both are sent to DPDO. If the transformer is leaking, the oil is drained from the casing, drummed and oil and casing are sent to DPDO. PCB- and PCB-contaminated materials are stored at the DPDO in the hazardous waste and PCB storage area until they are contract hauled to a hazardous waste Management Facility.

No record was found of PCB spills or on-base disposal of transformer oil. However, electric shop personnel reported that transformers taken out of service before 1979 were stored in the pole yard and drained prior to being turned over to DPDO. This oil may have been mixed with other waste oil generated, but this procedure was not documented.

The DPDO handles PCB items for other federal and state agencies east of Bismarck, North Dakota. The Cavalier AFS Radar Site generates the most transformers and capacitors handled by DPDO. The site is currently phasing out the PCB oil in transmitters by using silicon oil as a replacement. Cavalier AFS has a conforming storage facility for PCB materials that are eventually sent to GFAFB for ultimate disposal. PCB transformers, filters and spare parts have been identifed and are listed in the PCB Standard Operating Procedures established for the site. The Cavalier AFS site personnel insures that all PCB-contaminated materials are kept in a locked storage room until transfer to DPDO.

4.1.7 PESTICIDE USE/HANDLING

Pesticides are applied to trees, shrubs, residential areas, and building foundations, and are used for mosquito control. Herbicides are routinely applied to roadways, open areas, the golf course, lagoon banks, and around buildings. Soil sterilants are used at the missile sites along fence lines of secure areas. Both contractor and Roads and Grounds personnel have been utilized in the application of soil sterilants at missile sites. There have been some complaints of crop damage from sterilants in fields adjacent to the missile sites.

Pesticides are stored in Building 522, and herbicides are stored in Building 520. Herbicides were stored in Building 411 in the period of 1973 to 1975. Mixing operations are performed at the wash rack east of Building 522. Empty containers are tripled-rinses and disposed of as solid waste with the rinse water used in subsequent mixing.

4.2 HAZARDOUS WASTE GENERATION/DISPOSAL

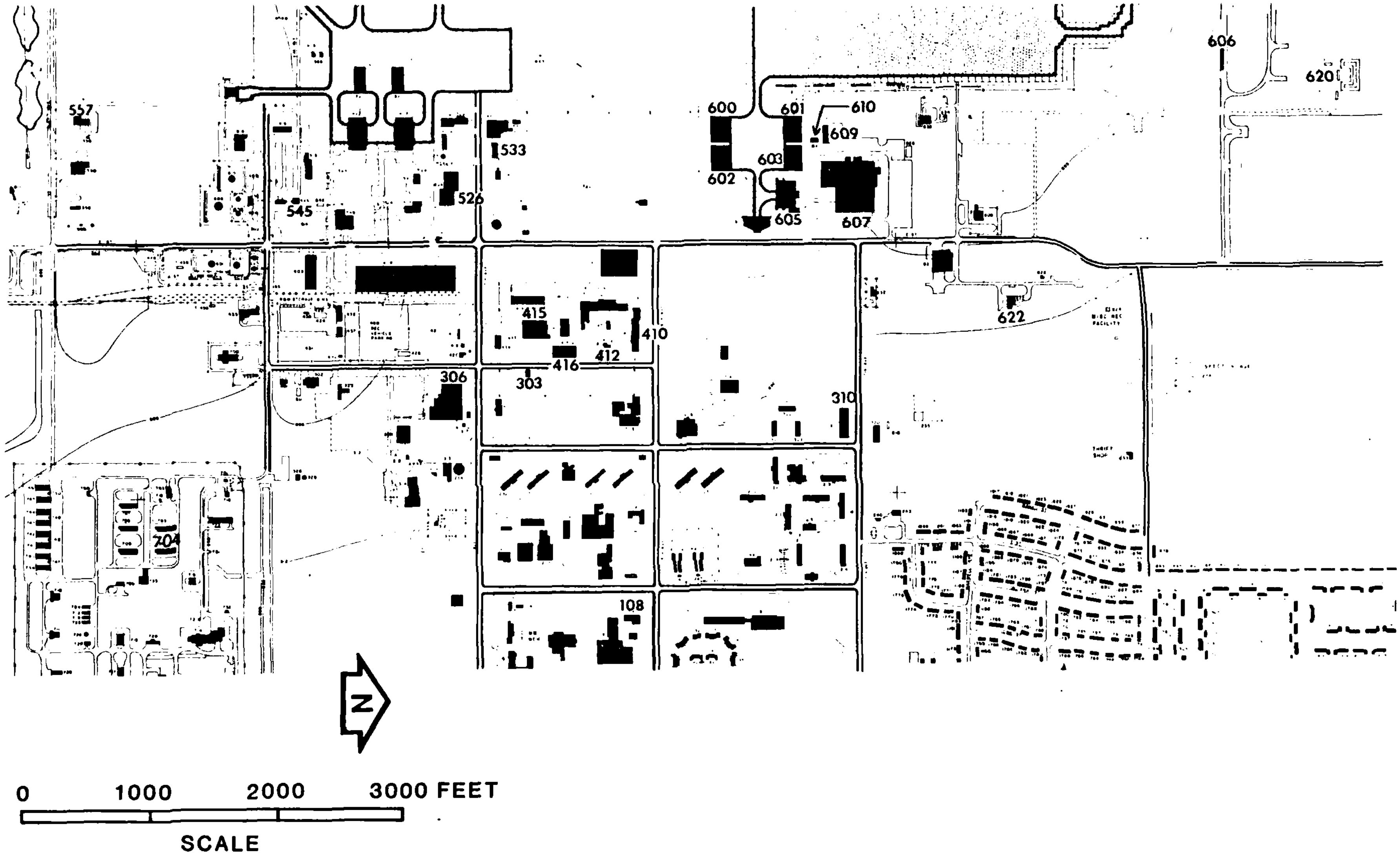
4.2.1 GENERATING OPERATIONS

GFAFB engineering personnel provided a Hazardous Waste Management Plan which contained a hazardous waste inventory. This listing was used to make a preliminary assessment of the types and quantities of waste generated by the various operations. Interviews were conducted with personnel from each of the waste generation points. Telephone contacts were made with operations which generated comparitively smaller quantities of waste. In each interview, personnel were asked to verify or update the types and quantities of waste generated as reported in the inventory. By locating personnel who had long employment histories, information was obtained on how waste disposal practices had changed over the years. These interviews provided the information on disposal methods presented in Section 4.2.2.

Information obtained on the major waste generating operations is summarized in Table 4.2-1. The locations of numbered buildings referenced in Table 4.2-1 are shown on Figure 4.2-1. All of the wastes, both hazardous and nonhazardous, have been included to provide a complete picture of the range and quantity of waste generated which require controlled disposal.

The installation generates approximately 188,000 gallons per year of predominately liquid waste material. Wastes are largely the by-product of aircraft and automobile maintenance and operation. Approximately 81 percent of the total annual generation consists of contaminated jet fuel which is reclaimed for reuse. Petroleum and synthetic lubricating and hydraulic fluids, sold to contractors for use as heating fuel, account for approximately 27,250 gal (14 percent) of the total. Less than 1 percent includes reclaimed precious metals which are recycled. The remaining 8 percent (15,250 gal) consists of hazardous waste currently regulated either under TSCA or RCRA. The wastes include 60 gal annually of PCB dielectric oil, 660 gal of MEK solvent, 240 gal of spent paint stripper, 480 gal of 1,1,1-trichlorethane solvent, and over 3,800 gal of PD-680 solvent. Sulfuric acid (approximately 10,000 gal/year) is neutralized and discarged into the storm sewer.

Hazardous wastes are accumulated at designated accumulation points throughout the base. Each accumulation point has an assigned manager who insures that all wastes being turned in are identified and containerized to meet DPDO disposal requirements.



SOURCE: GFAFB INSTALLATION DOCUMENT

Figure 4.2-1
OPERATIONS AREA GFAFB

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Table 4.2-1. Industrial Operations (Shops)--Waste Generation

Shop Name	Location (Bldg. No.)	Waste Material	Waste Quantity (gal/yr)*	Waste Management Practice (1960 → 1980)
I. 321st SMW				
A. 321st FMMS				
1. Shops Maintenance Branch				
a. Battery Shop	306	Battery Acid	60	NEUT/SS | NEUT/SS
2. Facility Maintenance Branch				
a. Periodic Maintenance Team	306	Diesel Oil	1200	DC/FTA | DC | DC/CD | CD
		Lube Oils	7800	DC/FTA | DC | DC/CD | CD
		Hydraulic Fluids	20	DC/FTA | DC | DC/CD | CD
		Spilled Oil	2400	DC/FTA | DC | DC/CD | CD
		Antifreeze	240	SS | DC/CD | CD
		Sodium Chromate	24	NEUT/SS | LF | CD
b. Pneudraulics Shop	306	Hydraulic Fluids	12	DC/FTA | DC | DC/CD | CD
B. 321st OMMS				
1. MHT Branch				
a. Missile Handling	606	Lube Oils	24	DC/FTA | DC | DC/CD | CD
		PD-680	24	DC/LF | DC/CD | CD
C. 321st Transportation Squadron				
1. Vehicle Maintenance	416	Lube Oils	4800	DC/FTA | DC | DC/CD | CD
		Contaminated MOGAS	120	DC/FTA | DC | DC/CD | CD
		Synthetic Fluids	96	DC/FTA | DC | DC/CD | CD
		Hydraulic Fluids	960	DC/FTA | DC | DC/CD | CD
	415	PD-680	300	DC/LF | DC/CD | CD
		Antifreeze	1200	SS | DC/CD | CD
		Battery Acid	600	NEUT/SS | NEUT/SS
2. Special Purpose Section	416	Lube Oils	2400	DC | DC/CD | CD
		PD-680	480	DC | DC/CD | CD
		Antifreeze	480	SS | DC/CD | CD
3. Refueling Maintenance	303	Reclaimed JF	240	FTA/DC | CD/FTA/R | R
		Diesel Oil	240	FTA/DC | DC | DC/CD | CD
		Antifreeze	24	SS | DC/CD | CD
		Spill Oil	15	FTA/DC | DC | DC/CD | CD
D. 321st Supply Squadron				
1. Fuels Management Branch				
a. Fuels Operations	545	Spill Oil	108	FTA/DC | DC | DC/CD | CD
		Sulphuric	12	NEUT/SS | NEUT/SS
		Isopropyl Alcohol	36	LF | CD

Table 4.2-1. Industrial Operations (Shops)--Waste Generation (Continued, Page 2 of 3)

Shop Name	Location (Bldg. No.)	Waste Material	Waste Quantity (gal/yr)*	Waste Management Practice 1960 – 1970 – 1980
II 319th BMW				
A. 319th AMS				
1. Mission Systems Branch				
a. Fire Control Shop	607	PD-680	240	CD
		1,1,1-trichloroethane	480	CD
B. 319th FMS				
1. Aerospace Systems Branch				
a. Pneudraulic Shop	607	PD-680	300	DC/LF | DC/CD | CD
		Hydraulic Fluid	240	DC/FTA | DC | DC/CD | CD
b. Repair/Reclamation Shop	602	Hydraulic Fluid	100	DC/FTA | DC | DC/CD | CD
		Naptha	25	DC/LF | DC/CD | CD
c. Wheel/Tire Shop	609	PD-680	600	DC/LF | DC/CD | CD
2. Aerospace Ground Equipment	607	Lube Oils	300	DC/FTA | DC | DC/CD | CD
		Synthetic Fluids	120	DC/FTA | DC | DC/CD | CD
		Hydraulic Fluid	120	DC/FTA | DC | DC/CD | CD
		PD-680	60	DC/LF | DC/CD | CD
		Antifreeze	48	SS | DC/CD | CD
		JP-4	100	FTA/DC | CD/FTA/R | R
3. Fabrication Branch				
a. Corrosion Control	605	Paint Remover	240	LF | CD
		MEK	660	LF/DC | CD
4. Propulsion Branch	526	Synthetic Fluids	600	DC/FTA | DC | DC/CD | CD
		Hydraulic Fluids	120	DC/FTA | DC | DC/CD | CD
		PD-680	600	DC/LF | DC/CD | CD
M37 - Test Cell	622	Reclaimed JF	720	FTA/DC | CD/FTA/R | R
C. 319th OMS				
1. Maintenance	600 - 603	Reclaimed JF	144,000	FTA/DC | CD/FTA/R | R
		Synthetic Fluids	300	DC/FTA | DC | DC/CD | CD
D. 319th MMS				
1. Munitions Supervision Branch	557	Lube Oils	24	DC/FTA | DC | DC/CD | CD
		Hydraulic Fluids	220	DC/FTA | DC | DC/CD | CD
	704	Unservicable Munitions	17	MUNITIONS DISPOSAL AREA

Table 4.2-1. Industrial Operations (Shops)--Waste Generation (Continued, Page 3 of 3)

Shop Name	Location (Bldg. No.)	Waste Material	Waste Quantity (gal/yr)*	Waste Management Practice 1960–1980
III. 321st CSG				
A. HQ Squadron				
1. Audio Visual Services	533	Photo Fixer	240	SS / SS
2. Small Arms Range	620	Rifle Bore Cleaner	60	LF / CD
3. Recreation				
a. Auto Hobby Shop	310	Lube Oils	2400	DC/FTA / DC / DC/CD / CD
		PD-680	120	DC / DC/CD / CD
B. 321st CES				
1. Electric Power	412	Sulphuric	60	NEUT/SS / NEUT/SS
		PD-680	120	DC / DC/CD / CD
2. Exterior Electric	418	Transformer Coolant Oil	360	DC/FTA / DC / DC/CD / CD
		PCB-contaminated oil	60	DC/FTA / DC / DC/CD / CD
3. Water and Waste	610	Sulfuric	10,000	NEUT/SS / NEUT/SS
4. Paint Shop	410	Diesel	40	DC/FTA / DC / DC/CD / CD
IV. Det. 3, 37th ARRS				
1. Maintenance	519	Reclaimed JF	300	FTA/DC / CD/FTA/R / R
		Synthetic Fuels	216	DC/FTA / DC / DC/CD / CD
		Hydraulic Fuels	24	DC/FTA / DC / DC/CD / CD
V. USAF Hospital				
1. Dental Services	108	Mercury	3 lbs/yr	R / R
VI. CAVALIER AFS				
1. Vehicle Maintenance	--	Lube Oil	3600	CD / CD
		1,1,1-trichloroethane	120	EVAP
2. Power Plant	--	Lube Oil	600	CD
VII. FINLEY RADAR SITE				
1. Vehicle Maintenance	--	Lube Oil	600	CD / CD

* All Quantities expressed in gal/yr unless noted.
______ Data confirmed by Shop Personnel.
_ _ _ _ Estimated from Secondary Sources.
FTA - Firefighter Training Area.
CDP - Chemical Disposal Pits.
CD - Contract Disposal via DPDO or Service Contract for Recycling.
EVAP - In-process evaporation.
Tank - Held in underground Holding Tank pending Contract Disposal.
LF - Burried in/or Base Landfill.
SS - Sanitary Sewer.
R - Recycled/Reclaimed.
DC - Used in dust control.
NEUT - Neutralized.

DPDO will not accept hazardous waste that is not properly identified. Generally, the characteristics and properties of routinely-generated wastes are known. When they are not known, or when wastes have become mixed, sampling and analysis may be necessary. For any given waste, sampling procedures and analysis parameters, testing methods and frequencies will be specified by the Bioenvironmental Engineer. Generators, through their accumulation point managers, contacts the Bioenvironmental Engineer to obtain these procedures. Analyses of samples are performed by certified laboratories. Generators receive copies of the waste analysis data to maintain in files until facility closure.

The fire suppressant currently used at GFAFB is difluoromethane. From 1962 to present, chlorobromomethane (CB) was used. CB is currently being phased out of use at GFAFB. Fire suppressants are used on the flightline for fire protection and at the burn pit in fire training exercises. Fire department personnel report that carbon tetrachloride was used as a fire suppressant before CB; however, this information could not be substantiated.

4.2.2 DISPOSAL METHODS

The information obtained on waste disposal practices is summarized graphically in Table 4.2-1. Since GFAFB first began operation, waste management trends have advanced from the unsegregated disposal of fuel and oil for road stabilization to the segregated recycling of fuel and oil and contract disposal of hazardous waste.

By the early 1960's, the city of Grand Forks collected and utilized contaminated fuels and oils for dust control. The points of collection were three oil/water separators, four UG tanks, and two drum storage locations. Solvents, thinners, strippers and other liquid wastes were mixed with the waste POL. At the Fire Training Area, contaminated JP-4 was used in fire training exercises along with other contaminated fuel (e.g., MOGAS) and waste lubricating oils. Prior to 1970, no restrictions were placed on the type of fuel used in fire training. Paint residue and paint strippers used in Corrosion Control were discharged to an oil/water separator. When this separator was pumped around 1974, the sludges were buried in the base landfill. Since base operations began until about 1981, tank cleaning sludges were weathered in the southwest corner of GFAFB.

In 1970, fuel used in fire training was required to be of less than 10 percent heavier hydrocarbon contamination. A 50,000 gal UG tank was installed at the Fire Training Area in 1972 to allow the segregation of JP-4 from other liquid wastes. The 50,000 gal tank was used to collect waste oils and fluids used in Grand Forks city road stabilization, while a 500 gal bowser was used by the Fire Department to intercept JP-4 suitable for fire training. During the early 1970's, waste which was not mixed in the POL storage tank was directed to the landfill or the sewer. Sodium chromate reportedly went to a UG neutralization tank east of Building 610, which fed directly into the storm sewer.

During the mid 1970's, contractors began to purchase much of the fuel and oil for recycling purposes. By 1980, 61 percent of the contaminated JP-4 was sold to contractors. The majority of mixed wastes was still donated to the city, although a portion was sold to contractors.

The 50,000 gal tank was used until 1980, when a leak was discovered. The use of the tank was immediately terminated and the 2,000 gal UG tank at Building 306 became the central collection point for waste POL. The wastes collected in this tank, as well as other designated POL collection points, began to be contract pumped for recycling offbase.

In 1980, the DPDO began to manage hazardous wastes, starting with PCB's. During this period, GFAFB began to implement widespread segregation of industrial wastes. DPDO sectioned off several metal storage sheds within the hazardous waste storage area for storage of specific hazardous wastes (Figure 4.2-2). In addition to hazardous wastes, hazardous materials (e.g., thinners which have exceeded shelf life) are received by DPDO on a routine basis. These materials are sold at local auctions, sealed bids

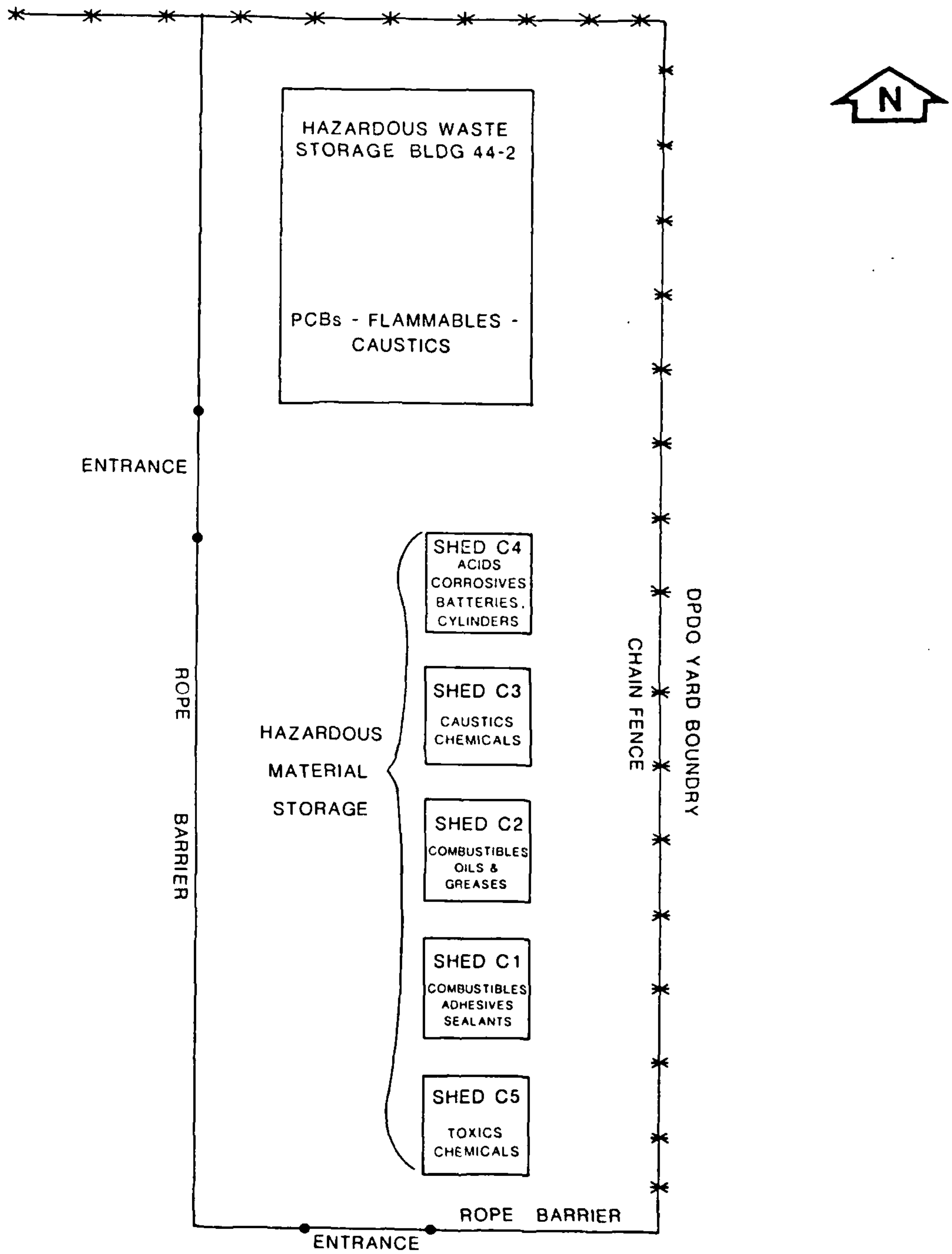

Figure 4.2-2
DPDO HAZARDOUS MATERIALS/
WASTE STORAGE AREA

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or donated. If a few months after receipt the material has not been reissued, donated or sold, it is disposed of as a hazardous waste.

Since 1983, sludges from tank cleanings and oil separators have been tested for hazardous constituents. Those sludges found hazardous are disposed of at off-site EPA approved facilities. Because the state of North Dakota has recently prohibited disposal of oil or oil-related wastes in state landfills, alternate disposal methods for non-hazardous sludges are currently being investigated.

Solid waste generated at base industrial zones was placed into the southern portion (now inactive) of the 80 acre permitted landfill (Figure 4.2-3). The older northern portion of this landfill is currently active but disposal is restricted to small amounts of base-generated construction debris and brush. An older landfill located south of the present permitted area and containing the Firefighter Training Area probably contains sludges, cleaning residues, and solvents. These substances were reportedly placed in this landfill prior to the development of controlling regulations.

The EOD Range is used to burn or detonate unserviceable munitions, starter cartridges, flares, and explosives. Detonations occur every month, and burning operations are conducted every 3 to 6 months. Both operations are supervised by Conventional Munitions Maintenance Personnel. Expended starter cartridges are burned and buried in the landfill after inspection to insure that they are empty.

In April 1982, soil samples were taken from the vicinity of the Munitions Disposal Area, west of the Alert Pad. The samples were analyzed for pentachlorophenol (PCP) and for biological growth effects. Results of analysis showed 20 μg/kg PCP in the soil, which is a non-hazardous level of PCP. However, bio-assay results indicated that the soils in the immediate area of the disposal site was toxic, such that the test plants could not grow.

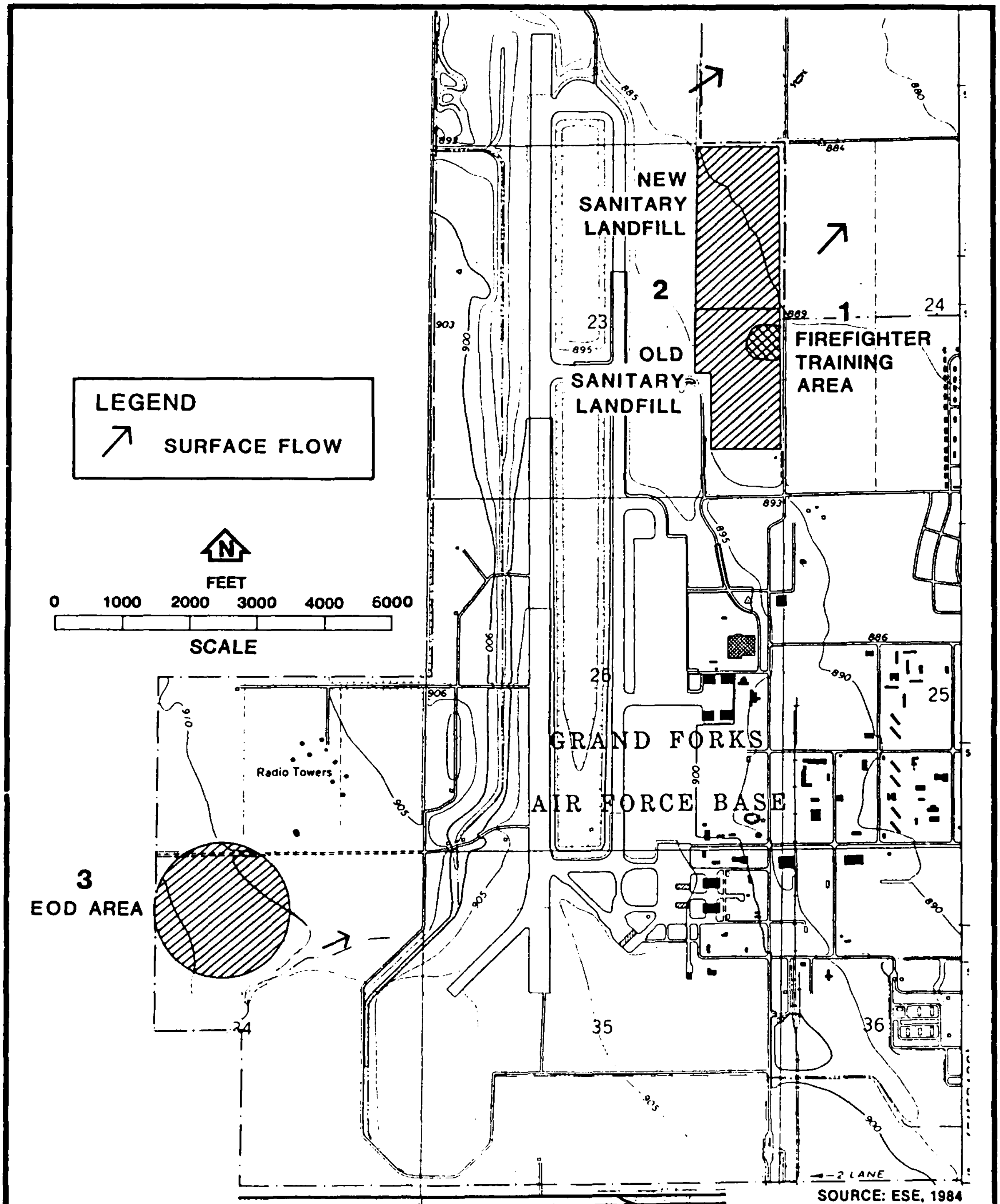

Figure 4.2-3
AREAS OF POTENTIAL
CONTAMINATION

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Prior to 1967 when it converted to fuel oil, the Heating Plant was coal-fired, and the ash was disposed in the base landfill.

4.2.3 SPILLS OR INCIDENTAL DISCHARGES

The following is a list of major spill incidents or incidental discharges that have occurred at GFAFB and related properties.

1. About 1975, a spill incident occurred behind the heating plant when an operator propped a switch on which transferred No. 2 fuel oil to storage. The operator left the area and upon returning discovered a large volume of fuel had overflowed from storage. Most of the spilled fuel was cleanded up, but some of the fuel reportedly entered the storm drain which runs along the east side of the base, eventually to Kelly's Slough. Exact quantities of fuel spilled and other details of the incident were not available. Onsite inspection of drain and discharge indicated no apparent environmental damage.
2. In 1981, a water line was being dug near the burn pit area when contamination of the area was discovered. The contamination was suspected to have occurred as a result of a leak in the 50,000 gal tank used at the site. The use of the tank was terminated, and an attempt was made to clean up the area by burning off the liquid, which was primarily contaminated fuel and oil. It is reported that after about two days of burning at the site the cleanup operation was aborted. No additional cleanup attemps were reported. Exact details of this incident were difficult to substantiate.
3. On April 28, 1982 a fuel leak was discovered in the JP-4 pipeline between Grand Forks and the GFAFB. The leak occurred in the off-base section of pipeline that crosses the upper reaches of Kelly's Slough, part of which is a National Wildlife Refuge. Emergency response was immediately initiated by the contracted operators of the Defense Logistics Agency/Defense Fuels Supply Center who are responsible for notification and emergency response for spills emanating from this section of the pipeline. Excavation of the pipe began the next day, and revealed that several areas along the pipe showed signs of

deterioration. The pipe was drained and approximately one-half mile of new pipe was installed within about three weeks after discovery of the leak. During the three weeks, the trench was left open to air out, and the earth from the trench was spread out to dry. The official loss of fuel from the leak was 38,000 gal of JP-4.

4. On September 17, 1982 a diesel fuel leaked from a supply line under K-6 Equipment Building floor. The leak was contained within the building and posed no threat to the environment. 9,578 gal of fuel and 500 gal of water were removed over a three-day period by CE Liquid Fuels. The fuel was filtered, containerized and returned to the base supply system.

Site inspection during Phase I of the IRP Program (August, 1984) and/or adequate documentation did not indicate a need for additional investigation of any reported spills or incidential discharges.

4.3 AREAS OF POTENTIAL CONTAMINATION

Areas of potential contamination included a.l facilities where hazardous materials are handled, used, transported or disposed of on GFAFB and its subinstallations. The evaluation of these areas included document reviews, interviews with knowledgeable personnel, and site visits. The major facilities evaluated in this investigation are described below.

This study identified three areas at GFAFB subject to contamination by industrial and/or hazardous wastes as a result of handling and disposal practices. Figures 4.2-2 illustrate the locations of these area.

Firefighter Training Area

The fire training area includes two specific areas of concern; the old burn pit and th POL underground storage facility.

The old burn pit was used in fire training drills for many years. The pit was located in the corner of the present burn pit, at the north-central part of the base. The pit was not equipped with a drainage system to catch excess fuel used in training. An estimated 50 precent of the fuel used at the burn pit was actually consumed. According to the Fire Department personnel employed during this period, approximately 12,000 gal/yr of contaminated POL was used at the old burn pit. In addition, chlorobromomethane (CB) was used as fire suppressant from 1967 to present. Prior to 1967, carbon tetrachloride was reportedly used as a fire suppressant.

The underground tank which was installed in 1972 was drained and filled with sand in 1980 after significant contamination of surrounding soils was discovered by workers. An attempt was made to burn off the waste POL in the soil, but this effort was terminated after two days.

Landfills

Old and inactive landfills located in the northcentral portion of GFAFB reportedly contain sludges, cleaning residues, and solvents from base operations. These substances were apparently placed in these areas prior to the implementation of disposal regulations. There is a potential for contamination of both soil and ground water in the vicinity which could result in offbase migration of contaminants.

Explosive Ordnance Disposal

The range is used to explode by burning unserviceable munitions, starter cartridges, and other small devices. Pits within the area are used to bury used starter cartridges. Bioassay tests on soils in the area indicate measurable levels of toxicity to plants, possible resulting from the presence of metals from ordance disposal. There is also a potential for contaminant migration from the area via the ground water.

Small Arms Range

The small arms range at GFAFB is equipped with an earthern backstop which receives lead slugs fired in training exercises. When the concentration of lead slugs becomes great enough to cause excessive richocheting, the lead is filtered out from the backstop and sent to DPDO, and the dirt replaced. In July, 1983 the lead concentration of the backstop soil was analyzed and found to be 3064 μg/g. Recommendations were made as to the proper disposal of the backstop soil if it is replaced, and further samples are being taken to determine if the soil must be considered a toxic waste. Further recommendations will be made pending the results of the sampling and analyses.

Past practice of disposing backstop soil was to spread the soil in the base landfill. The landfill will be given a HARM rating and recommendations for Phase II studies. Based on the fact that lead concentrations in the soil are within the range of concentrations typically found in garden and roadside soils (Kabatha-Pendias and Pendias, 1984), the small arms ranges was not considered to require additional study at this time.

DOD Fuel Terminal

The DOD fuel terminal in the city of Grand Forks is the storage site for JP-4 used at GFAFB. The fuel is transported to the base via a 9-inch underground pipeline. Each tank is surrounded by an earthen dike for secondary spill containment, and the area appears adequately protected from unauthorized entrance. There is no record of spills occuring within the diked areas. Liquid Fuels Management at GFAFB is responsible for the care and routine maintenance of the tanks.

The fuel leak which occurred in 1982 (Section 4.2-3) was repaired within three weeks after discovery of the leak. During the three weeks, the trench was left open to air out, and the earth from the trench was left to dry. In addition to the half-mnile of pipeline replacement, Defense Fuels inspected the remainder of the pipeline for deterioration. It is reported that the cleanup measures were performed quickly and efficiently and that a minimal amount of enviornmental damage was sustained.

Pole Yard

The pole yard is approximately one acre in size and is located north of the hangar comples. This large open earth area has traditionally served as a storage area for sand piles, electrical equipment, construction equipment and other miscellaneous items. The area is slightly elevated, and surface runoff drains northeast to a drainage ditch.

Electric shop personnel have reported that transformers taken out of service priolr to 1979 were stored in the pole yard and drained prior to being turned over to DPDO. No records of PCB contamination in pole yard soils could be located.

Tank Storage

The base utilizes both aboveground and belowground tanks throughout the base site and at lauch control facilities. The large aboveground tanks are diked, and no major spills have been recorded with the exception of the one overfill incident which occurred behind the heating plant (Section 4.2.3.1). The underground tanks are inventoried and monitored for major leaks. A program is currently underway to inspect all underground tanks (including those at LCFs) and oil separators. The program is expected to be accomplished within 2 years. The suspected leak discovered near the fire training area is included in the discussion of that site.

Finley Radar Site

A source of potential contamination at Finley is the waste oil generated from vehicle maintenance. Currently, used lubricating oils are durmmed and hauled offiste by an oil recycler. The method of handling used oil prior to recycle was possibly dust control, but this could not be substantiated.

Underground tankage at Finley AFS includes a gasoline storage tank, a tank for case loader oil, and fuel oil tanks located at housing. The remaining POL storage is reportedly aboveground. No past spills or oil-soaked areas have been reported for this site. The site has been on caretaker status since 1979.

Cavalier Firefighter Training Area

The area is bermed and is equipped with a water supply to flood the pit prior to the introduction of diesel fuel for burning. Between 50 and 100 gal of fuel are burned during each of the quarterly training sessions. Most of the fuel is burned on each occasion. Grass was observed growing in the pit area and no evidence of contamination was noted during the February 1985 site visit.

Cavalier Hazardous Waste Storage

Hazardous materials are kept in conforming storage in Building 105 at Cavalier AFS. Large transformers containing PCBs were in the process of being disposed of through appropriate procedures at the time of the site visit in February 1985. Small components containing PCBs were maintained according to standard procedures in the supply storage area.

4.4 HAZARD ASSESSMENT

Four areas of potential contamination were determined to require rating with the HARM system, based on the decision tree presented in Figure 1.3-1. The Firefighter Training Area, Sanitary Landfill, Cavalier AFS, and EOD Area were the the sites selected for evaluation (Figure 4.2-2). Other areas of hazardous waste storage were eliminated from further consideration due to lack of evidence for potential contamination and migration.

Each of the sites discussed in Section 4.3 was rated using HARM methodlogy. HARM scores for each site are summarized in Table 4.4-1. The process of rating potential hazards using the HARM system is described in detail in Appendix F. Basically the method uses numerical ratings for a number of discrete variables in order to calculate subscores for three categories: (1) risk of human exposure (Receptors), (2) the nature and quantity of waste (Waste Characteristics), and (3) the potential migration routes (Pathways).

Evaluation of some variables within the Receptor subscore required some judgement in using the available information. In particular, the distance to the nearest well and the population served by the groundwater in the vicinity could not be established with certainty. Instead of deleting this critical factor from the subscore calculation, guidence provided in the National Oil and Hazardous Substances Contingency Plan (40 CFR 300) for use of the EPA Hazard Ranking System (HRS) was applied since this system was the basis for HARM. Specifically, occupied

Table 4.4-1. Summary of HARM Scores

Rank	Site	Receptors Subscore	Waste Characteristics Subscore	Pathways Subscore	Waste Management Factor	Total Score
1.	Firefighter Training Area	41	64	60	0.95	52
2.	Landfill Area	35	48	53	0.95	43
3.	EOD Area	37	25	60	1.0	41
4.	Cavalier AFS	36	60	46	0.1	5

dwellings which are not within the service area of any public water supply and which had no other reported water source were assumed to have a private well. Populations were estimated by map inspection, ground tours of the surrounding area and from aerial surveys. An average of 4 persons per household was assumed.

Waste characteristics were evaluated based on information obtained in interviews with base personnel. In instances where the waste was a mixture of substances with differing characteristics, the most critical waste was used for each variable. For example, a mixture of metal treatment sludegs and waste solvents might be be treated high for flammability due to the solvents and high for persistence because of the metal component in the sludge.

For the Pathway subscore, environmental factors such as rainfall intensity and net precipitation were evaluated using standard references such as the Climatic Atlas of the United States (USDC, 1979). Erosion potential was based on direct observation and soil characteristics for the region (USSCS, 1974). Depth to groundwater was based on available boring logs, geologic data, and interviews.

The three subscores are averaged to produce a final score for each site. This score is then multiplied by a factor to account for waste management practices to provide the final site rating score. HARM provides only three choices, 1.0, 0.95, and 0.1 to indicate no containment, limited containment, and fully contained and in compliance.

5.0 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 contaminant migration from these sites. The conclusions are based on the assessment of information collected from the Project Team's field inspection; review of records and files; review of the environmental setting; and interviews with base personnel, past employees, and state and local officials.

Firefighter Training Area

This area contains two specific areas of concern. An old burn pit near the corner of the present burn pit was used for many years. The original pit was not equipped with a drainage system to catch the excess fuel. During this period approximately 12,000 gal/year of contaminated POL was used at the pit, an estimated 50 percent of which seeped into the ground. The UG tank which was installed in 1972 was abandoned in 1981 after significant levels of contamination were discovered in surrounding soils. The HARM score for this site is 52.

Landfills

From 1956 to late 1982 solid wastes were disposed of in onbase landfills. Few restrictions were placed on materials placed in the landfill areas during the 1950s and 60s. Sludges and cleaning residues were placed in the pits, and it is likely that solvents and paints were similarly handled. The HARM score for this site is 43.

EOD Range

The range is used to burn or explode unservicible munitions and other explosive devices. A potential for metal contamination exists. Bioassay studies on soils from the area indicate that the immediate area is toxic to plants. The HARM score for this site is 41.

Cavalier AFS

The principal concerns at this site are the handling and storage of equipment containing PCBs. Large quantities of parts are currently in use and in storage at the site. All items are in conforming storage with the exception of transformers which are in the process of being removed from the site. The HARM score for this site is 5.1.

No additional sites of potential concern with respect to contamination or contaminant migration were identified on GFAFB or its subinstallations.

AD-A158 780 INSTALLATION RESTORATION PROGRAM PHASE I RECORDS SEARCH 2/2
GRAND FORKS AIR F..(U) ENVIRONMENTAL SCIENCE AND
ENGINEERING INC DENVER CO J B SOSEBEE ET AL. APR 85

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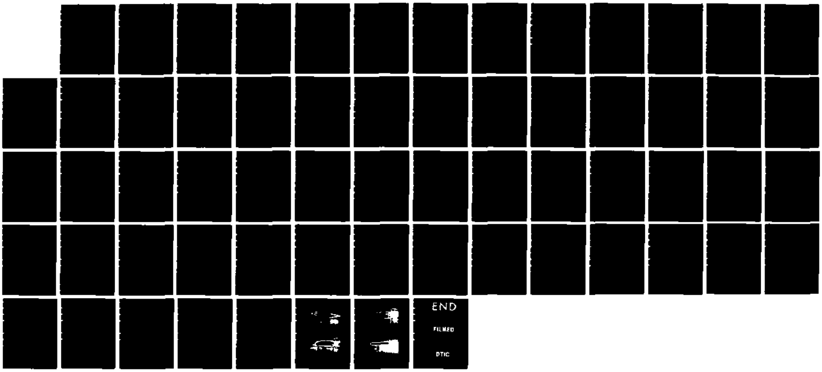

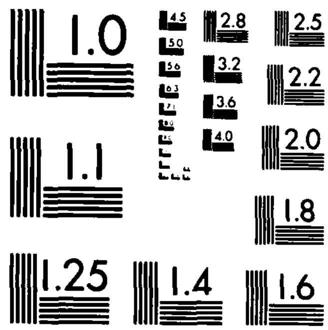

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

6.0 RECOMMENDATIONS

The information gathered through interviews and research were sufficient to locate and categorize the onbase disposal sites. A Phase II monitoring program is recommended to accomplish the following objectives:

1. Obtain information regarding aquifer characteristics below GFAFB. Such information would include stratigraphy, direction of ground water flow, and permeability.
2. Determine the nature and extent of surface water, ground water, soil, and sediment contamination that might have resulted from past storage, handling, and disposal practices.

6.1 PHASE II MONITORING RECOMMENDATIONS

The following actions are recommended to further assess the potential for environmental contamination from waste disposal areas at GFAFB. The recommended actions are intended to be used as a general guide in the development and implementation of the Phase II study. The recommendations include the approximate number of ground water monitoring wells, type(s) of samples to be collected (e.g., soil, water, sediment) and suspected contaminants for which analyses should be performed. The number of ground water monitoring wells recommended corresponds to the number of wells required to adequately determine whether contaminants are present and if they are migrating from a given source. The final number of ground water monitoring wells required to determine the extent of and define the movement of contaminants from each site will be determined as part of the Phase II investigation.

Recommended ground water monitoring should be performed periodically in order to assess contaminant migration under different variable hydrologic regimes. After 1 year of monitoring, the data should be evaluated to determine the need for further action (if any). All drilling activities should be conducted by a North Dakota-licensed water well driller. All monitor wells should be constructed of threaded-joint casing and factory-slotted screen. Under no circumstances should PVC primer or PVC glue be used for the construction of well casing or bailers. Multi-level well clusters should be installed over the upper 100 ft of saturated glacial materials. The uppermost wells should be installed in the first water-bearing unit encountered or to a maximum depth of 50 ft and extend approximately 1 ft above the water table. These wells need to be screened above the water table to detect non-miscible, floating contaminants, such as petroleum products. Additional monitoring wells in each cluster should be designed according to data obtained during soil sampling and borehole logging. At a minimum, an additional well should be installed at a depth below the shallow monitor well, extending to a maximum depth of 100 ft. If contaminants are detected in the 50 to 100 ft interval, a third well should be completed with a screened interval from 100 ft to the top of bedrock. Each well cluster should be completed with appropriate bentonite seals such that samples taken from wells within each cluster are representative of unique water bearing units. This will facilitate in determining the potential for vertical stratification of possible ground water contaminants. During drilling, Shelby tube samples should be taken to provide soils data and vertical permeability measurements. Borehole geophysical logging of all GFAFB wells is recommended to facilitate stratigraphic analysis. The top of the filter pack should be bentonite-sealed, and the annulus should be grouted to the surface. The well should be protected with pipe fitted with locking caps. The well should be developed to the fullest extent possible and surveyed both vertically and horizontally by a registered surveyor to obtain accurate well location distances and water level elevations. Water levels should be measured after recovery from well development and at the time of sampling. At a minimum, slug tests should be conducted to determine horizontal permeability and to provide data for evaluation of flow rates.

Prior to initiation of any Phase II field activities, a detailed work plan should be prepared. This work plan should provide specific procedures to be followed in well construction, well logging, well installation, well development, surveying, water level measurements, aquifer testing, sampling, laboratory analysis, quality control, and reporting. All samples except those from the EOD area should be analyzed at a minimum for total petroleum hydrocarbons, halogenated and nonhalogenated solvents, metals, PCBs, and pesticides, using EPA-approved procedures. The solvent analytes should include at a minimum TCE, benzene, MIBK, carbon tetrachloride, MEK, methylene chloride, and acetone. The metal analytes should include cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, silver, and zinc. EOD area samples should be analyzed for these metals. The recommended parameters include those compounds known or suspected to have been placed in the disposal sites. Certain additional parameters for which drinking water standards exist are included. It is recommended that chemical analysis for metals include both total and dissolved fractions to quantify which metals are mobile, as well as the total amount of metal sorbed onto suspended materials and, hence, potentially available for leaching. Because the oil and grease analysis by EPA Method 413.2 does not differentiate between extractables of biological origin or the mineral oils and greases of POL origin, the EPA Infrared (IR) Spectrophotometric Method for total recoverable petroleum hydrocarbons (EPA Method 418.1) is recommended for assessing POL contamination. Halogenated and nonhalogenated solvents, PCBs, and pesticides may be analyzed by EPA Methods 624 and 625 or comparable methods. All water samples should be analyzed for pH, temperature, conductivity, and oxidation-reduction potential at the time of sampling.

For the EOD Range and the Firefighter Training Area, it is recommended that four monitoring well clusters be installed around each of the sites 90 degrees from each other with respect to the center of the sites.

It is also recommended that a composite soil sample be obtained from the upper 3 feet of soil in the Firefighter Training and EOD sites. Proposed soil sampling holes will be terminated b fore reaching 3 ft in depth if a liner or buried object is encountered. These samples will be used to evaluate the potential hazard posed by near surface soil contamination.

In the vicinity of the GFAFB landfill, it is recommended that six monitor well clusters be installed. At a minimum, a shallow and intermediate monitor well should be completed at each cluster site. Three of the sites are located along the east boundary and one is located along the north boundary of the landfill. These four sites are downgradient of the landfill, thereby intercepting ground water that has flowed beneath or through the landfill. Background water quality can be catagorized by completion of a cluster at the southwest corner of the landfill. A sixth site, located along the west boundary of the landfill, will provide data on spatial variations in water flow and quality (Figure 6.1-1).

At each cluster a borehole should first be drilled to a depth of 100 ft. Continuous core samples should be taken to the base of the first water-bearing unit and, thereafter, one meter samples should be taken at major changes in lithology. These core samples should be analyzed to determine hydrologic and attenuation properties.

Table 6.1-1 summarizes the recommended monitoring for GFAFB Phase II investigations.

6.2 LAND USE GUIDELINES

Careful consideration should be given to the uses made of the disposal areas for the following reasons:

1. To provide the continued protection of human health, welfare, and the environment;
2. To insure that the migration of potential contaminants is not promoted through improper land uses;
3. To facilitate the compatible development of future USAF facilities; and
4. To allow for identification of property which may be proposed for excess or outlease.

In general, activities which would tend to disrupt the waste cells should be avoided so as not to facilitate contaminant migration. Such activities include foundation and drainage ditch construction. To avoid trapping any volatile compounds that may be released from the disposal areas, structures should not be placed over the sites.

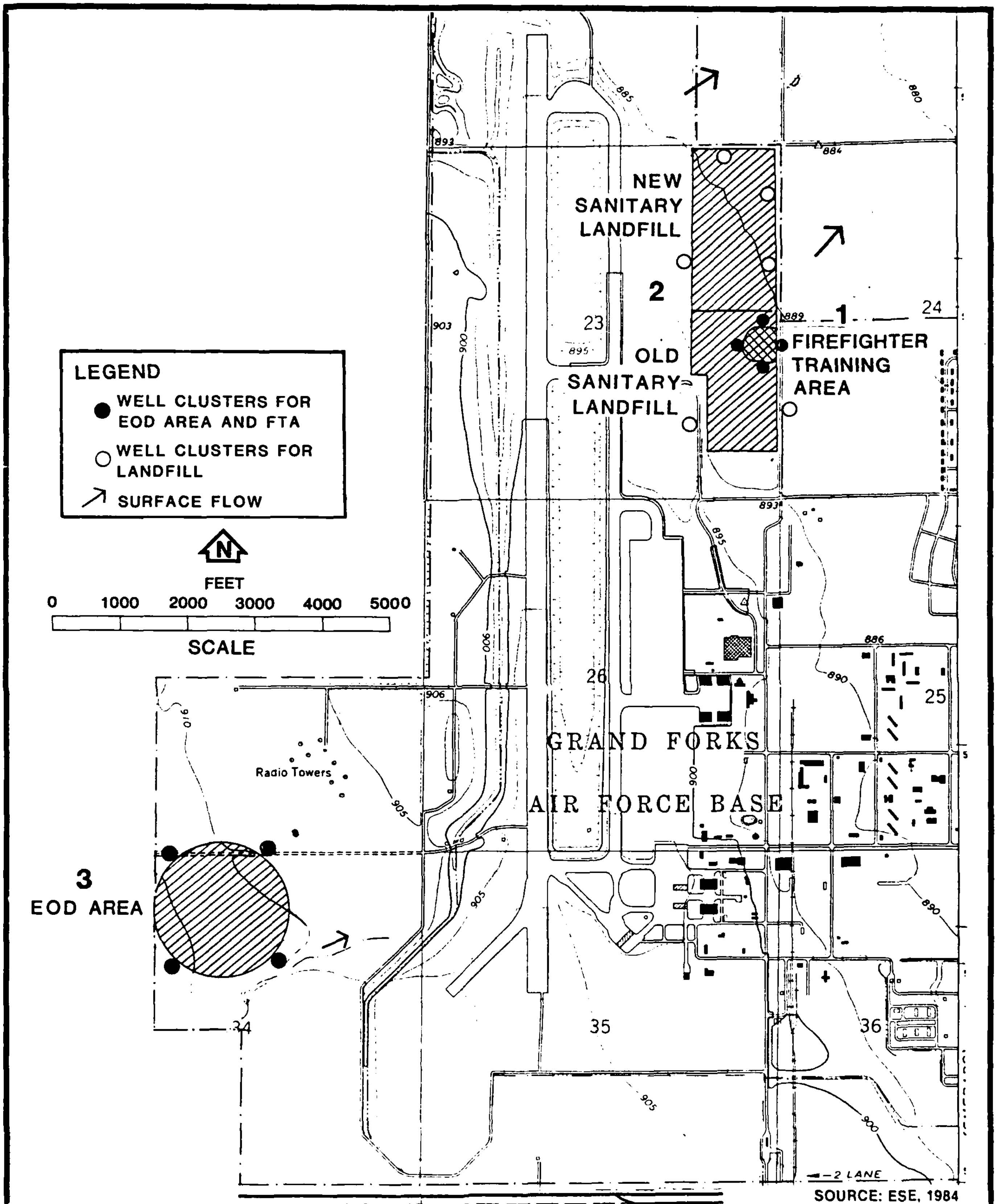

Figure 6.1-1
RECOMMENDED MONITORING LOCATIONS

INSTALLATION RESTORATION PROGRAM
Grand Forks Air Force Base

Table 6.1-1. Summary of Recommended Monitoring for GFAFB Phase II Investigations.

Site	HARM Score	Recommended Sampling	Recommended Analysis
Firefighter Training Area	52	Install four well clusters at 90° from each other with respect to center of site (Figure 6.1-1). Sample the upper three feet of soil.	Total petroleum, hydrocarbons, halogenated solvents, metals, and PCB's and pesticides.
Sanitary Landfill	43	Install six well clusters around the perimeter of the landfill (Figure 6.1-1). Sample soil to the base of the first permeable unit and thereafter at changes in lithology.	Total petroleum, hydrocarbon, halogenated and non-halogenated solvents metals, PCB's, and pesticides.
EOD Area	39	Install four well clusters at 90° from each other with respect to the center of the site (Figure 6.1-1). Sample the upper three feet of soil.	Metals
Cavalier AFS	5	None	None

Source, ESE, 1984.

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APPENDIX A

GLOSSARY OF TERMINOLOGY, ABBREVIATIONS AND ACRONYMS

APPENDIX A
GLOSSARY OF TERMINOLOGY, ABBREVIATIONS, AND ACRONYMS

AD	Air Division
ADCOM	Aerospace Defense Command
AFB	Air Force Base
AFFF	Aqueous Film Forming Foam
AFS	Air Force Station
AG	Aboveground
AGE	Aerospace Ground Equipment
AMS	Avionics Maintenance Squadron
Aquiclude	Geologic unit which impedes ground water flow
Aquifer	A geologic formation, group of formations, or part of a formation capable of yielding water to a well or spring
ARRS	Aerospace Rescue and Recovery Squadron
BES	Bioenvironmental Engineering Section
BMW	Bombardment Wing
Cadmium	A metal used in batteries and other inudstrial applications; highly toxic to humans and aquatic life
Carbon tetrachloride	A solvent commonly in use until the 1960s; a suspected human carcinogen
CB	Chlorobromomethane
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CES	Civil Engineering Squadron
cfs	Cubic feet per second

Chromium	A metal used in plating, cleaning, and other industrial applications; highly toxic to aquatic life at low concentrations, toxic to humans at higher levels
Contaminated fuel	Fuel which does not meet specifications for recovery or recycle
Contamination	Degradation of natural water quality to the extent that its usefulness is impared; degree of permissible contamination depends on intended use of water
CSG	Combat Support Group
DEF	Fire Protection Branch
DEQPPM	Defense Environmental Quality Program Policy Memorandum
DF	Diesel fuel
Disposal of hazardous waste	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, be emitted into the air, or be 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
Effluent	Liquid waste discharged in its natural state or partially or completely treated from a manufacutring or treatment process
EOD	Explosive Ordnance Disposal
EPA	U.S. Environmental Protection Agency

APPENDIX A
(Continued, Page 3 of 5)

ESE	Environmental Science and Engineering, Inc.
°F	Degrees Fahrenheit
FIS	Fighter Interceptor Squadron
FMMS	Field Missile Maintenance Squadron
FMS	Field Maintenance Squadron
FO	Fuel oil
ft	Feet
gal	Gallon
GFAFB	Grand Forks Air Force Base
Ground water	Water beneath the land surface in the saturated zone that is under atmospheric or artesian pressure
HARM	Hazard Assessment Rating Methodology
Hazardous waste	As defined in RCRA, a solid waste or combination of solid wastes which become 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, disposed of, or otherwise managed.
HQ	Headquarters
HRS	Hazard Ranking System
in	Inches
Infiltration	Movement of water through the soil surface into the ground

APPENDIX A
(Continued, Page 4 of 5)

IRP	Installation Restoration Program
IR	Infrared
JP-4	Jet fuel used in T-37 and T-38 aircraft
LCF	Launch Control Facility
Lead	A metal additive to gasoline and used in other industrial applications; toxic to humans and aquatic life; bioaccumulates
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
LF	Launch Facility
LUST	Leaking Underground Storage Tank
MEK	methyl ethyl ketone, a solvent used in paint thinner, stripper, and a wide variety of industrial applications; toxic to humans at high levels; toxic to aquatic life
MMS	Munitions Maintenance Squadron
MOGAS	Motor gasoline
NDSHD	North Dakota State Department of Health
NORAD	North American Aerospace Defense Command
NWR	National Wildlife Refuge
OMS	Organizational Maintenance Squadron
PCB	Polychlorinated biphenyls, liquid used as a dielectric in electrical equipment; suspected human carcinogen; bioaccumulates in the food chain and causes toxicity to higher trophic levels
PCP	Pentachlorophenol
POL	Petroleum, oils, lubricants
ppm	Parts per million

APPENDIX A
(Continued, Page 5 of 5)

PVC	Polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
SAC	Strategic Air Command
SMW	Strategic Missile Wing
SPF	Strategic Projection Force
Spill	An unplanned release or discharge of a hazardous waste onto or into air, land, or water
SRAM	Short Range Attack Missile
TCE	Trichloroethylene, a commonly used degreasing solvent; toxic to aquatic life and a suspected human carcinogen
UG	Underground
Upgradient	In the direction of increasing hydraulic static head; the direction opposite to the prevailing flow of ground water
USAF	U.S. Air Force
USGS	U.S. Geological Survey
USSCS	U.S. Soil Conservation Service
Water table	Surface of a body of unconfined ground water at which the pressure is equal to that of the atmosphere
ybp	Years before present

APPENDIX B

TEAM MEMBER BIOGRAPHICAL DATA

JACKSON B. SOSEBEE, JR., M.S.

Professional Resume

Areas of Specialization

Environmental Chemistry, Pollutant Fate Studies, Environmental Impact Analysis

Experience

Project Manager and Senior Chemist, Project Operations, ESE, Denver, Colorado, 1981 to present. Department Manager, Environmental Chemistry Department, ESE Gainesville, Florida 1974 to 1980.

Project Director, assessments of environmental fate and effects of potentially hazardous chemicals under Section 4 of TSCA for U.S. EPA.

Project Manager, environmental evaluation of proposed slow-speed diesel power generation sites to define scope of regulatory requirements and assess potential siting problems.

Project Manager, environmental survey of two U.S. Army depot activities in New Mexico (Ft. Wingate Depot Activity) and Arizona (Navajo Depot Activity) to determine levels of contaminants and potential for contaminant migration.

Project Manager, environmental licensing of two-unit coal-fired power plant in coastal zone of Florida. Program included identification of regulatory requirements, development of plan of study, and environmental studies.

Department Manager, responsible for supervision of 11 professional and technical laboratory personnel involved in environmental chemistry analyses and evaluation of data.

Project Manager, areawide water quality management study of the Tampa Bay Region. Study addressed water quality, socioeconomic, recreational, and ecological conditions.

Project Manager, water quality management study of Lake Sidney Lanier, Georgia, including water chemistry, plankton, and benthic macroinvertebrate measurements.

Project Manager, water quality study of Charlotte Harbor, Florida, and associated canals.

Project Manager, water quality and bioassay study of Black Warrior River below Cordova, Alabama, following spill of industrial wastewater.

Subproject Manager for numerous studies relating to water quality, pesticide and PCB analysis, wastewater characterization, and sediment chemistry.

Research Assistant, Chemistry Department, University of Montana, Missoula, Montana, 1974

Responsible for procedure development, field sampling, and analysis of phenolic compounds in the Clark Fork River.

Graduate Research, University of Montana, Missoula, Montana, 1971 to 1974

Conducted monitoring of carbon monoxide in the Missoula Valley, Montana.

Analysis and monitoring of flouride levels in the biota near Garrison, Montana.

Developed mathematical model of dissolved oxygen levels in the Clark Fork River; conducted field confirmation of model.

Mathematical modeling of atmospheric emissions originating from coal-fired power plants.

Graduate Teaching Assistant, Department of Chemistry, University of Montana, 1972 to 1974.

Education

M.S.	1974	Environmental Studies	University of Montana
B.S.	1969	Chemistry	Texas Tech University

Affiliations

American Chemical Society (ACS)

American Society for Testing and Materials (ASTM)--Biological Effects and Environmental Fate (Subcommittee Chairman)

Society for Environmental Toxicology and Chemistry

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ESE PROFESSIONAL RESUME

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SPECIALIZATION

Terrestrial Ecology, Wildlife Population Biology and Habitat Analysis, Endangered Species Studies, Environmental Impact Assessment

RECENT EXPERIENCE

Senior Ecologist and Project Manager, ESE, Denver, Colorado, 1982 to Present.

Conducted terrestrial habitat analyses for dredge disposal sites on the upper Mississippi River.

Evaluated and designed ecological and land use portions of the Offsite Monitoring Program for Rocky Mountain Arsenal, Denver, Colorado.

Designed ecological monitoring program for EPA Superfund hazardous waste disposal site in Michigan.

Currently preparing environmental assessment for airport master plan in northern Utah.

Head, Terrestrial Ecology Division, Center for Energy and Environment Research, San Juan, Puerto Rico 1980 to 1982.

Principal Investigator, DOE sponsored Rain Forest Cycling and Transport Program. Coordinated program, managed field station, and conducted research on lizards and mannals in the Luquillo Mountains, Puerto Rico.

Principal Investigator, inventory of the Puerto Rican boa (endangered species) in the Caribbean National Forest, Puerto Rico.

Project Manager, baseline terrestrial ecology of coal/oil fired power plan sites in western Puerto Rico.

Scientist and Project Manager, NUS Corporation (1974 to 1976, Pittsburgh, Pennsylvania; 1976 to 1979, Denver Colorado)

Ecology Task Manager, regional siting study for radioactive waste disposal facility, Permian Basin (Colorado, Kansas, New Mexico, Oklahoma, Texas).

Project Manager, environmental impact assessment of well fields and pipelines, Maricopa County, Arizona.

Ecology Task Manager, environmental impact assessment of waste isolation pilot plant, southeastern New Mexico.

Wildlife Ecologist, environmental impact assessment for Senegal River Basin Development Project in Mali, Mauritania, and Senegal. Work included baseline studies, endangered species surveys, impact evaluation, and design of detailed mitigation plan for establishing two new national parks (including administrative infrastructure) in cooperation with the International Unions for the Conservation of Nature.

Project Manager, construction phase ecological monitoring at nuclear power plant site, Buckeye, Arizona.

Project Manager, environmental impact assessment of switching station sites in southern California.

Ecology Task Manager, environmental impact assessment for uranium mill in southwestern Colorado.

Ecology Task Manager, environmental impact assessment and black-footed ferret survey of underground trona mine in southwestern Wyoming.

Wildlife Ecologist, environmental impact assessment for nuclear power plants at sites in southern California, southern Texas, northern Ohio, Wisconsin, and New York.

Wildlife Ecologist, environmental impact assessment for three underground coal mines, Price Utah.

Wildlife Ecologist, environmental impact assessment for surface coal mine in southwestern Wyoming.

Wildlife Ecologist for evaluation of system concept and deployment of MX missle in Arizona, Nevada, New Mexico, and Texas.

Wildlife Ecologist, regional siting study for nuclear power plants, Washington and Oregon.

Wildlife Ecologist, *in situ* uranium mine feasibility study, central Wyoming.

Wildlife Ecologist, environmental impact assessment for three underground borax mine sites, Death Valley, California.

Wildlife Ecologist, feasibility study for surface coal mine site, southwestern Wyoming.

Wildlife Ecologist, environmental baseline studies for oil shale development, northwestern Colorado.

Wildlife Ecologist, right-of-way surveys for transmission line corridors (340 mi.) in southern California.

Principal Investigator, survey and determination of threatened and endangered species of amphibians and reptiles in Arkansas.

Education

Ph.D.	Zoology (Ecology)	1972	University of Arkansas
M.S.	Biology	1967	University of New Mexico
B.A.	Biology	1964	Hartwick College, New York

Affiliations

Adjunct Scientist - Center for Energy and Environment Research, San Juan, Puerto Rico.

Research Coordinator - Wright-Ingraham Institute, Colorado Springs, Colorado.

Castle Rock Planning Commission, Castle Rock, Colorado.

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Ecological Society of America

Sigma Xi

Publications

Reagan, D. P. 1984. Ecology of the Puerto Rican boa (*Epicrates inornatus*) in the Luquillo Mountains of Puerto Rico. Caribbean J. Sci. (in press).

Reagan, D. P. (with G. Rodriguez) 1984. Bat Predation by the Puerto Rican boa, *Epicrates inornatus*. Copeia 1984: 219-220.

Reagan, D. P. 1984. Foraging Behavior of *Anolis stratulus* in the Rain Forest Canopy. Occas. Pap. Center for Energy and Environment Research, San Juan, Puerto Rico (in press).

Reagan, D. P. Species Distribution in Three-dimensional Habitats: the Rain Forest Anoles of Puerto Rico (manuscript submitted to the American Naturalist).

Reagan, D. P. Seasonal Competition for Food by Caribbean Anoles. (manuscript submitted to Copeia).

Reagan, D. P. (with R.B. Waide). 1983. Competition between West Indian Anoles and Birds. Amer. Natur. 121:133-138.

Reagan, D. P., R. W. Garrison, and R. B. Waide. 1983. Preliminary Evaluation of Tropic Structure in a Puerto Rican Rain Forest. Proc. Octabo Symposio de los Rucursos Naturales, San Juan, Puerto Rico.

Reagan, D. P. (with A. Estrada-Pinto, R. W. Garrison, R. B. Waide, and C. P. Zucca). 1983. Flora and Fauna of the El Verde Field Station. Center for Energy and Environment Research Publ. CEER-T-159, San Juan, Puerto Rico.

Reagan, D. P. 1982. Aspects of Ecosystem Organization Relevant to the Evaluation of Stress in a Tropical Rain Forest. Proc. DOE Symp. on Energy and Environmental Processes in Terrestrial Systems, Gaithersburg, Maryland.

Reagan, D. P. and C. P. Zucca. 1982. Inventory of the Puerto Rican Boa (Epicrates inornatus) in the Caribbean National Forest. Center for Energy and Environment Research Publ. CEER-T-136, San Juan, Puerto Rico.

Reagan, D. P. 1980. Environmental Implications of Biomass and Other Alternative Fuels Usage in Puerto Rico. Proc. Symp. of Fuels and Feedstocks from Tropical Biomass, San Juan, Puerto Rico.

Reagan, D. P. 1978. Right-of-way selection studies NUSletter 12(3): 18-21, NUS Corp., Rockville, Maryland.

Reagan, D. P. 1974. Threatened Native Amphibians of Arkansas, p. 93-100. In C. T. Crow (ed.). Arkansas Natural Area Plan. Arkansas Dept. Planning, Little Rock, Arkansas.

Reagan, D. P. 1974. Threatened Native Reptiles of Arkansas. p. 101-105. In C. T. Crow (ed.). Arkansas Natural Area Plan. Arkansas Dept. Planning, Little Rock, Arkansas.

Reagan D. P. 1974. Habitat Selection in the Three-toed Box Turtle, Terrapene carolina triunguis. Copeia 1974(2):512-527.

Reagan, D. P. 1974. Simulating Biological Processes. Amer. Biol. Teacher 36: 554-556.

Reagan, D. P. 1974. Population Biology in the Laboratory. Carolina Biological Supply Co., Burlington, North Carolina. 9p.

Reagan, D. P. 1973. Cave Life of the Ozarks. Ozark Soc. Bull. 7:4-7.

Reagan, D. P. 1972. Ecology and Distribution of the Jemez Mountains Salamander, Plethodon neomaxicanus. Copeia 1972: 486-492.

Reagan, D. P. 1971. A Multivariate Statistical Analysis of Shell Dimensions of the Three-toed Box Turtle, Terrapene carolina triunguis. Swanews 1971(2):12 (abstract).

Reagan D. P. and R. DeFrancesco. 1968. Survey of the Minor Invertebrate Phyla of the Upper Gulf of California. University of Arizona Marine Ecology Studies 4(1):1-23.

Papers in Preparation

Reagan, D. P., R. W. Garrison, and R. B. Waide. Food web relationship and animal community organization in an insular tropical rain forest.

Reagan, D. P. (with R. W. Garrison). Good resource partitioning in Puerto Rican rain forest anoles.

Reagan, D. P. Invertebrate predation and food loops in the food web of a Puerto Rican rain forest.

Reagan, D. P. Courtship behavior of the giant anole, Anolis cuvieri.

Reagan, D. P., J. C. Gillingham, and D. Clark. Cross predation among Puerto Rican anoles (Anolis supp.).

Reagan, D. P. Nest construction by Anolis stratulus in tabonuco rain forest on Puerto Rico.

Reagan, D. P. Chapter on reptiles and synthesis chapter for book on food web organzation in a tropical rain forest.

ENVIRONMENTAL SCIENCE AND ENGINEERING, INC.

DOUGLAS A. DEAN *Professional Resume*

Areas of Specialization

Environmental Engineering, Water and Waste Treatment Processes, Pulp and Paper Technology, and Treatability Studies

Experience

Environmental Engineer, Water/Waste Treatment Department, ESE, Gainesville, Florida, July 1983 to present.

Air Force Records Search, Project Engineer--Assessment of current and past handling and disposal practices for toxic/hazardous materials on U.S. Air Force installations. Includes an evaluation of the potential for offiste migration of toxic materials.

Martin Electronics Treatment Plant Operating Permit, Subproject Manager--Tasks included the development of all permitting data, evaluating the facility for compliance with state regulations, and serving as a liaison between client and the state regulatory agency.

Pratt Whitney Water Treatment Plant Evaluation, Project Engineer--Conducted bench-scale testing to determine optimum treatment process for THM precursor removal. Short-term chlorination was examined with respect to free chlorine demand, THM formation potential, and color removal.

Miami Beach Public Notification Report, Project Engineer--Responsible for developing a public notification and remedial action strategy to be used during water contamination incidents.

Power Company Hazardous Waste Inventories, Project Engineer--Responsibilities included onsite investigations of current waste generation and disposal practices occurring at power plants and operation facilities, and evaluation of the potential liabilities to the company as a result of these wastes.

Tampa Electric Company, Project Engineer--Responsible for conducting bench-scale coagulation/settling tests to evaluate the removal of iron from the slag pond at Tampa Electric's Big Bend station. Activities included jar test screening and optimization of various combinations of coagulants and polymers, settling column testing, an assessment of feasibility of various alternatives for treatment, and recommendation of the preferred treatment alternative.

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Okeechobee Water Works, Okeechobee, Florida, Project Engineer--Conducted a THM process control study for the 2.8 MGD combined coagulation/softening plant. Tasks involved reviewing existing plant records for existing process evaluation and potential for upgrade, jar testing to determine optimum coagulation for the removal of color, and THM sampling and analyses. THM control alternatives most likely to meet regulatory requirements were identified and evaluated.

Bonita Springs Water Utility, Bonita Springs, Florida, Project Engineer--Participated in a municipal water plant upgrading study. Responsibilities included the performance of jar test to determine optimum softening conditions, and the collection of THM samples throughout plant.

U.S. EPA Effluent Limitations Guidelines for the Pesticide Industry, Project Engineer--Responsible for developing the technical support used to establish U.S. EPA's effluent guidelines for the pesticide industry. Evaluated industry comments and data and incorporated new information into the data base. Analyzed treatment and treatability information pertinent to the industry for the purpose of determining plant-specific pollutant concentrations deemed achievable for each pesticide manufactured.

V.A. Medical Center, Gainesville, Florida, September through December 1982, Research Associate--Responsibilities included preparing medication and electrolyte-free diets for animals involved in a metabolic research study. Instructed four full-time hospital technicians in the proper care and handling of laboratory facilities and specimens.

University of Florida Engineering Department, Gainesville, Florida, May through September 1982, Research Coordinator--Conducted a literature search and review of Florida's phosphate industry. Examined the various environmental problems and treatment technologies common to the industry, especially in regards to clay slimes. Designed a one-credit course outline using the information gathered from the review. Activities included extensive computer work on a program used in the supervisor's graduate level class.

Georgia-Pacific Corporation, Palatka, Florida, September through December 1980, Environmetnal Technician--Environmental activities included air stack monitoring of the lime kiln and recovery boiler, daily sampling and measurement of flow and conventional pollutants in the oxidation ponds, and recording data

D-MRAF.1/DAD
09/12/84

into the monthly records. Measured oxygen content of empty vessels prior to maintenance to determine if hazardous vapors are present. Quality control task included sampling and analyses for soluble sulfides in lime mud and washwaters, and bench-scale research on the optimization of tall oil yields.

St. Regis Paper Company, Cantonment, Florida, May through August 1979, Student Technician--Assisted chemical engineers on a pilot study of the conversion of black liquor to a char with a high heating value. Project elements included collecting and filtering samples taken during pilot runs, and recording thermocouple readings to calculate heat losses across the tubular reactor. Wrote a report estimating the specific heat of black liquor at critical temperatures and pressures.

Education

B.S. 1982 Environmental Engineering University of Florida

Affiliations

American Water Works Association

Honors

Received Presidential Recognition Certificate for Outstanding Contribution from Florida, May 1982.

APPENDIX C

LIST OF INTERVIEWEES
LIST OF OUTSIDE CONTACTS

APPENDIX C
LIST OF INTERVIEWEES
(Page 1 of 3)

Position	Years of Service
Environmental Coordinator	4
OIC, BES	1
NCOIC, Entomology	1
Grounds Forman	17
Conventional Munitions Inspector	3
Cavalier O and M Superintendent--Facility Engineer	14
Chief, Weather Station Operations	15
Missile Engineer	4
Chief, Realty Office	24
Exterior Electric	10
Civilian, Liquid Fuels	4
Civilian, Liquid Fuels	9
Civilian, Plumbing	10
Civilian, Paint Shop	11
NCOIC, Motor Pool	1
Civilian, Motor Pool	15
NCO, Motor Pool	16
NCOIC, Power Production	2
Civilian, Water and Waste	10
NCO, Corrosion Control	5
NCOIC, Wheel/Tire	1
NCOIC, AGE (BMW)	2
Civilian, Auto Hobby Shop	17
Retired Deputy BCE	25
NCO, Collection Tank 309 Manager	4
BCE	10
DPDO Manager	10
Civilian, Heat Plant	26
Civilian, Heat Plant	23
NCO, Fuels Management	2
Civilian, Fire Department	10
NCO, Photo Lab	8
NCO, Munitions Maintenance	1

APPENDIX C
LIST OF OUTSIDE CONTACTS
(Page 2 of 3)

Neil M. Knatterud, Manager
Waste Management Program
North Dakota State Department of Health
Bismarck, North Dakota 58505
701-224-2366

Water Resources Division
U. S. Geological Survey
Bismarck, North Dakota 58501
701-255-4011

Milton Lindvig, Director
Hydrology Division
North Dakota State Water Commission
Bismarck, North Dakota
701-224-2754

Federal Facilities Coordinator
U.S. EPA, Region VIII
Denver, Colorado
303-293-1710

U. S. Geological Survey Library
Denver, Colorado
303-234-4133

Arthur Lakes Library
Colorado School of Mines
Golden, Colorado 80401
303-273-3680

David Janes, Manager
Devil's Lake Wetlands Management Distrcit
U. S. Fish and Wildlife Service
Devil's Lake, North Dakota
701-662-8611

Dr. R. D. Crawford
Biology Department
University of North Dakota
Grand Forks, North Dakota
701-777-2621

Mike McKenna, Game Biologist
North Dakota Game and Fish Department
Bismarck, North Dakota
701-224-4877

APPENDIX C
LIST OF OUTSIDE CONTACTS
(Page 3 of 3)

Planning and Zoning Office
Grand Forks County
Grand Forks, North Dakota
701-780-8248

North Dakota Geological Survey
University of North Dakota
Grand Forks, North Dakota

Albert Simpson Historical Research Center
Maxwell AFB, Alabama

National Archives and Records Service
Cartographic and Architectural Branch
Alexandria, Virginia

Washington National Records Center
Suitland, Maryland

U.S. Air Force History Office
Bolling AFB
Washington, D.C.

APPENDIX D

MASTER LIST OF SHOPS

APPENDIX D
MASTER LIST OF SHOPS
(Page 1 of 7)

Facility/Shop	Location	Handles Hazardous Materials	Produces Hazardous Waste
319 AMS			
Fire Control Shop	607	Yes	Yes
Instrument	607	No	No
Photo	607	No	No
PMEL	516	Yes	Yes
Air Crew Training Devices	607	No	No
Bomb Nav.	607	No	No
Doppler	607	No	No
ECM	607	Yes	Yes
Radar	607	No	No
Auto Pilot	607	No	No
319th BMW			
Life Support	607	No	No
319th FMS			
Fuel Cell	613	Yes	No
AGE	607	Yes	Yes
Corrosion Control	605	Yes	Yes
Egreso	609	No	No
Envioronmental Systems	607	No	No
Machine Shop	607	Yes	Yes
NDI	605	Yes	No
Structural Repair	607	No	No

APPENDIX D
MASTER LIST OF SHOPS

Facility/Shop	Location	Handles Hazardous Materials	Produces Hazardous Waste
Weld[illegible]	607	No	No
Repair a[illegible] [illegible]eclamation	602	Yes	Yes
Pneudrau[illegible]	607	Yes	Yes
Propulsi[illegible]	526	Yes	No
Electric/Battery	607	Yes	No
Engine Test Cell	622	No	No
Wheel and Tire	609	No	No
319th MMS			
Mark XII	714	No	No
Missile Systems Checkout	737	No	No
Ammo Maintenance	757	Yes	No
SRAM	730	Yes	No
Equipment Maintenance	557	Yes	Yes
ALCHM Release	621	Yes	Yes
Weapons Loading	621	No	No
Weapons Maintenance	730	No	No
319th OMS			
Support Maintenance	523	Yes	Yes
Tanker Maintenance	601	Yes	No
321st CES			
Electric Power	412	Yes	No
Grounds	522	Yes	No

APPENDIX D
MASTER LIST OF SHOPS

Facility/Shop	Location	Handles Hazardous Materials	Produces Hazardous Waste
Liquid Fuels	418	No	No
Interior Electric	418	No	No
Central Heat Plant	423	No	No
Plumbing Shop	418	Yes	No
Pavements	522	No	No
WIRT	411	No	No
Welding	411	No	No
Refrigeration/A/C	418	Yes	No
SMART Shop	411	No	No
Missile Pavements and Grounds	522	Yes	No
Vehicle Control	411	No	No
Carpentry Shop	411	No	No
Entomology	522	No	No
Equipment Shop	522	No	No
Exterior Electric	418	Yes	Yes
Fire Department	503	No	No
Power Pro	412	Yes	Yes
Fire Ext. Maintenance	530	Yes	No
Heat Shop	418	No	No
Masonary Shop	411	No	No

APPENDIX D
MASTER LIST OF SHOPS

Facility/Shop	Location	Handles Hazardous Materials	Produces Hazardous Waste
321st CSG			
Water and Waste	610	Yes	No
Arts and Crafts	320	No	No
Photo Lab	533	Yes	No
Auto Hobby Shop	310	Yes	No
Firing Range	620	Yes	No
Paint Shop	410	No	No
321st FMMS			
Power/Electric Shop	306	Yes	No
Equipment Control	314	No	No
Facility Maintenance	306	No	No
PMF	306	Yes	Yes
Pneudraulics	306	Yes	Yes
Vehicle Control	304	Yes	Yes
Corrosion Control	306	Yes	No
321st OMS			
Bomber Maintenance	600	Yes	No
321st OMMS			
MHT Branch	606	Yes	Yes
Electro-Mechanical	314	No	No
Missile Maintenance	314	No	No

APPENDIX D
MASTER LIST OF SHOPS
(Page 5 of 7)

Facility/Shop	Location	Handles Hazardous Materials	Produces Hazardous Waste
321st TRANS			
Special Equipment	416	Yes	Yes
Refueling Maintenance	303	Yes	Yes
Packing and Crating	408	No	No
Allied Trades	413	Yes	No
Battery	415	Yes	No
General Purpose	415	Yes	Yes
Vehicle Maintenance	415,416	Yes	Yes
Air Freight	522	No	No
321st SUP			
Storage, Fuel, Distribution Lab	545	Yes	Yes
2152 COMM			
Radion	635	No	No
Antenna Maintenance	306	No	No
Weather Maintenance	523	No	No
Cable Maintenance	548	No	No
Missile Radio	306	No	No
Navigator Aids Maintenance	635	No	No

APPENDIX D
MASTER LIST OF SHOPS
(Page 6 of 7)

Facility/Shop	Location	Handles Hazardous Materials	Produces Hazardous Waste
HOSPITAL			
Dental Lab	108	Yes	No
Dental X-Ray	108	No	No
Surgery	109	No	No
Medical X-Ray	109	Yes	No
MWR			
Bowling Center	202	No	No
64th FTW			
ACE	523	No	No
37th ARRS			
Maintenance	519	Yes	No
Transient Maintenance Shop	523	Yes	No
Helicopter Pad	519	Yes	No
Cavalier AFS			
Power Production	820	Yes	Yes
Plumbing	820	Yes	No
Carpentry/Paint	720	Yes	Yes
Vehicle Motor Pool	730	Yes	Yes
Fire Department	702	Yes	No
Supply	730	Yes	No
Machine	820	Yes	Yes

APPENDIX D
MASTER LIST OF SHOPS
(Page 7 of 7)

Facility/Shop	Location	Handles Hazardous Materials	Produces Hazardous Waste
Welding	820	No	No
Sanitation	820	No	No
Custodial	820	No	No
Sample Lab	820	Yes	No
Radar Maintenance	820	Yes	Yes

APPENDIX E

USAF IRP HAZARD ASSESSMENT RATING METHODOLOGY

USAF INSTALLATION RESTORATION PROGRAM

HAZARD ASSESSMENT RATING METHODOLOGY

BACKGROUND

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

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

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

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

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

PURPOSE

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

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

DESCRIPTION OF MODEL

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

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

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

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

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

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

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

FIGURE 1

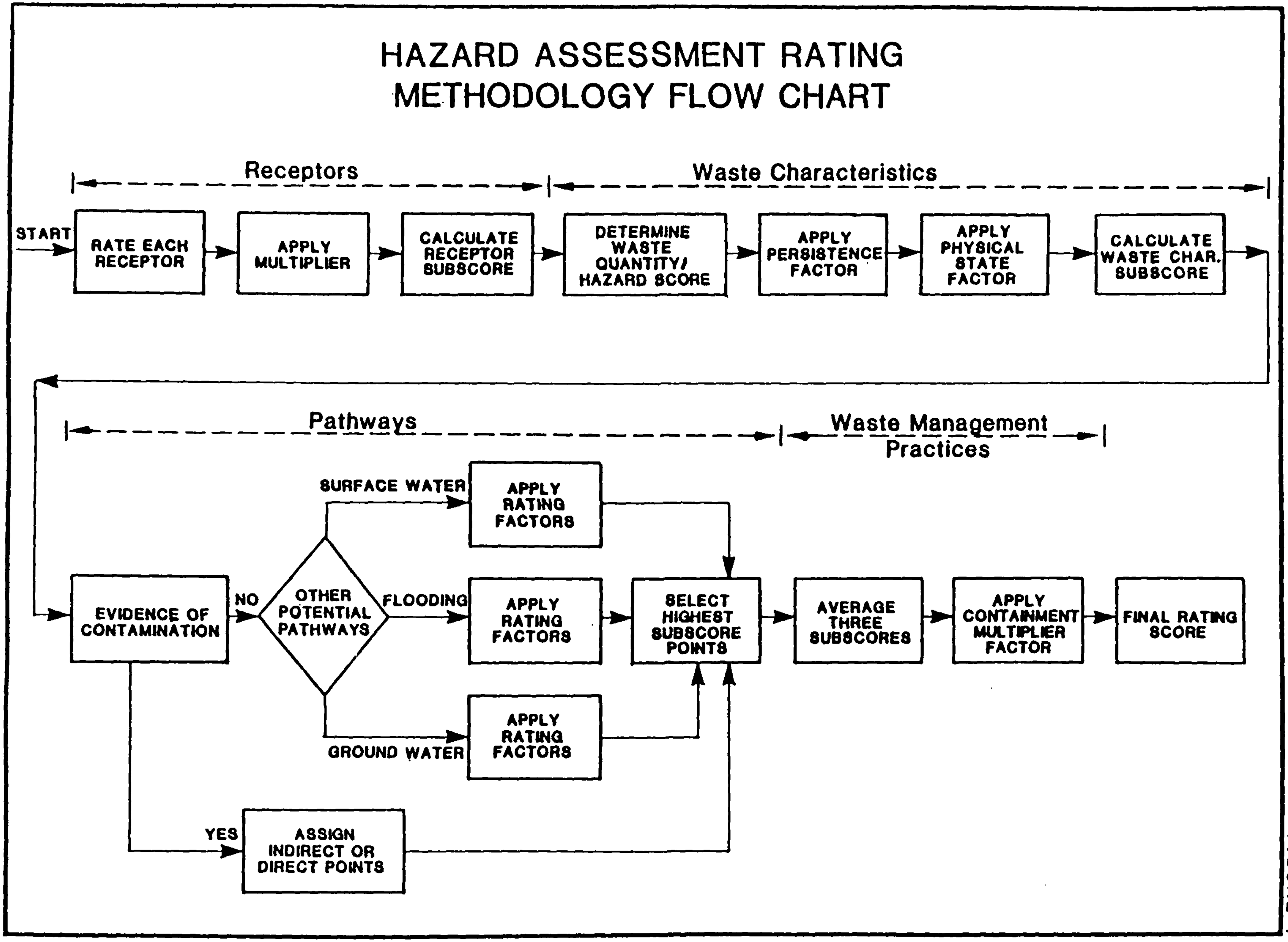

HAZARD ASSESSMENT RATING
METHODOLOGY FLOW CHART
Receptors
Waste Characteristics
START
RATE EACH RECEPTOR
APPLY MULTIPLIER
CALCULATE RECEPTOR SUBSCORE
DETERMINE WASTE QUANTITY/ HAZARD SCORE
APPLY PERSISTENCE FACTOR
APPLY PHYSICAL STATE FACTOR
CALCULATE WASTE CHAR. SUBSCORE
Pathways
Waste Management Practices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

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 ______ = ______

III. PATHWAYS

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

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

Subscore ______

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

1. Surface water migration

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

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

2. Flooding

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

Subscore (100 x factor score/3) ______

3. Ground-water migration

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

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

C. Highest pathway subscore.

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

Pathways Subscore ______

IV. WASTE MANAGEMENT PRACTICES

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

Receptors ______
Waste Characteristics ______
Pathways ______

Total ______ divided by 3 = ______
Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

______ X ______ = ______

TABLE 1

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

I. RECEPTORS CATEGORY

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

TABLE 1 (Continued)

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

II. WASTE CHARACTERISTICS

A-1 Hazardous Waste Quantity

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

A-2 Confidence Level of Information

C = Confirmed confidence level (minimum criteria below)

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

S = Suspected confidence level

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

A-3 Hazard Rating

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

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

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

TABLE 1 (Continued)

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

II. WASTE CHARACTERISTICS (Continued)

Waste Characteristics Matrix

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

Notes:
For a site with more than one hazardous waste, the waste quantities may be added using the following rules:
Confidence Level
- o Confirmed confidence levels (C) can be added
- o Suspected confidence levels (S) can be added
- o Confirmed confidence levels cannot be added with suspected confidence levels

Waste Hazard Rating
- o Wastes with the same hazard rating can be added
- o Wastes with different hazard ratings can only be added in a downgrade mode, e.g., MCM + SCH = LCM if the total quantity is greater than 20 tons.

Example: Several wastes may be present at a site, each having an MCM designation (60 points). By adding the quantities of each waste, the designation may change to LCM (80 points). In this case, the correct point rating for the waste is 80.

B. Persistence Multiplier for Point Rating

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

C. Physical State Multiplier

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

TABLE 1 (Continued)

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

III. PATHWAYS CATEGORY

A. Evidence of Contamination

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

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

B-1 POTENTIAL FOR SURFACE WATER CONTAMINATION

Rating Factor	Rating Scale Levels 0	1	2	3	Multiplier
Distance to nearest surface water (includes drainage ditches and storm sewers)	Greater than 1 mile	2,001 feet to 1 mile	501 feet to 2,000 feet	0 to 500 feet	8
Net precipitation	Less than -10 in.	-10 to + 5 in.	+5 to +20 in.	Greater than +20 in.	6
Surface erosion	None	Slight	Moderate	Severe	8
Surface permeability	0% to 15% clay ($>10^{-2}$ cm/sec)	15% to 30% clay (10^{-2} to 10^{-4} cm/sec)	30% to 50% clay (10^{-4} to 10^{-6} cm/sec)	Greater than 50% clay ($<10^{-6}$ cm/sec)	6
Rainfall intensity based on 1 year 24-hr rainfall	<1.0 inch	1.0-2.0 inches	2.1-3.0 inches	>3.0 inches	8

B-2 POTENTIAL FOR FLOODING

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

B-3 POTENTIAL FOR GROUND-WATER CONTAMINATION

Rating Factor	0	1	2	3	Multiplier
Depth to ground water	Greater than 500 ft	50 to 500 feet	11 to 50 feet	0 to 10 feet	8
Net precipitation	Less than -10 in.	-10 to +5 in.	+5 to +20 in.	Greater than +20 in.	6
Soil permeability	Greater than 50% clay ($>10^{-6}$ cm/sec)	30% to 50% clay (10^{-4} to 10^{-6} cm/sec)	15% to 30% clay (10^{-2} to 10^{-4} cm/sec)	0% to 15% clay ($<10^{-2}$ cm/sec)	8
Subsurface flows	Bottom of site greater than 5 feet above high ground-water level	Bottom of site occasionally submerged	Bottom of site frequently submerged	Bottom of site located below mean ground-water level	8
Direct access to ground water (through faults, fractures, faulty well casings, subsidence fissures, etc.)	No evidence of risk	Low risk	Moderate risk	High risk	8

TABLE 1 (Continued)

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

IV. WASTE MANAGEMENT PRACTICES CATEGORY

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

B. WASTE MANAGEMENT PRACTICES FACTOR

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

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

Guidelines for fully contained:

Landfills:

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

Spills:

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

Surface Impoundments:

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

Fire Proection Training Areas:

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

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

APPENDIX F

HAZARD ASSESSMENT RATING METHODOLOGY FORMS

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Sanitary Landfill

Location: Eastern Portion of Section 23, T152N R53W

Date of Operation or Occurrence: 1957 to 1982, Construction waste only until present

Owner/Operator: USAF - GFAFB

Comments/Description: Sanitary landfill with some industrial waste

Site Rated By: J.B. Sosebee and D.P. Reagan

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest well	1	10	10	30
C. Land use/zoning within 1-mile radius	1	3	3	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1-mile radius of site	2	10	20	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	0	9	0	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground water supply within 3 miles of site	1	6	6	18
SUBTOTALS			63	180
Receptors subscore (100 x factor score subtotal/maximum score subtotal)				35

II. WASTE CHARACTERISTICS

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

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

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 80 x 0.8 = 48

C. Apply physical state multiplier:
Subscore B x Physical State Multiplier = Waste Characteristics Subscore 48 x 1.0 = 48

HAZARD ASSESSMENT RATING METHODOLOGY FORM
(Continued, Page 2 of 2)

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, proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore --

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

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
1. Surface water migration				
Distance to nearest surface water	2	8	16	24
Net precipitation	2	6	12	18
Surface erosion	1	8	8	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
SUBTOTALS			50	108
Subscore (100 x factor score subtotal/maximum score subtotal)				46
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	2	6	12	18
Soil permeability	1	8	8	24
Subsurface flows	1	8	8	24
Direct access to ground water	1	8	8	24
SUBTOTALS			60	114
Subscore (100 x factor score subtotal/maximum score subtotal)				53

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3 above. Pathways Subscore 53

IV. WASTE MANAGEMENT PRACTICES

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

Receptors	35
Waste Characteristics	48
Pathways	53
TOTAL	136 divided by 3 = 45 Gross total score

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

45 x 0.95 = 43

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Firefighter Training Area

Location: SE Quarter of Section 23; T152N R53W

Date of Operation or Occurrence: 1959 to Present, Upgraded in 1973

Owner/Operator: USAF - GFAFB

Comments/Description: Mostly JP-4 with some oil and grease

Site Rated By: J.P. Sosebee and D.P. Reagan

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest well	1	10	10	30
C. Land use/zoning within 1-mile radius	1	3	3	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1-mile radius of site	2	10	20	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	0	9	0	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground water supply within 3 miles of site	1	6	6	18
SUBTOTALS			73	180

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

II. WASTE CHARACTERISTICS

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

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

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 0.8 = 64

C. Apply physical state multiplier:
Subscore B x Physical State Multiplier = Waste Characteristics Subscore
64 x 1.0 = 64

HAZARD ASSESSMENT RATING METHODOLOGY FORM
(Continued, Page 2 of 2)

III. PATHWAYS

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

Subscore --

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

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
1. Surface water migration				
Distance to nearest surface water	3	8	24	24
Net precipitation	2	6	12	18
Surface erosion	1	8	8	24
Surface permeability	2	6	12	18
Rainfall intensity	1	8	8	24
SUBTOTALS			64	108
Subscore (100 x factor score subtotal/maximum score subtotal)				59
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	2	6	12	18
Soil permeability	2	8	16	24
Subsurface flows	1	8	8	24
Direct access to ground water	1	8	8	24
SUBTOTALS			68	114
Subscore (100 x factor score subtotal/maximum score subtotal)				60

C. Highest pathway subscore

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

Pathways Subscore 60

IV. WASTE MANAGEMENT PRACTICES

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

Receptors	41
Waste Characteristics	64
Pathways	60
TOTAL	165 divided by 3 = 55 Gross total score

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

55 x 0.95 = 52

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: EOD Area

Location: Northern part of Section 34, Southern Part of Section 27, T152N R53W

Date of Operation or Occurrence: 1960 - present

Owner/Operator: USAF - GFAFB

Comments/Description: Residues from detonated explosives

Site Rated By: J.B. Sosebee and D.P. Reagan

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	1	10	10	30
C. Land use/zoning within 1-mile radius	1	3	3	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1-mile radius of site	2	10	20	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	0	9	0	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground water supply within 3 miles of site	1	6	6	18
SUBTOTALS			67	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 37

II. WASTE CHARACTERISTICS

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

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

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 1.0 = 50

C. Apply physical state multiplier:
Subscore B x Physical State Multiplier = Waste Characteristics Subscore
50 x 0.5 = 25

HAZARD ASSESSMENT RATING METHODOLOGY FORM
(Continued, Page 2 of 2)

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, proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore --

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

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
1. Surface water migration				
Distance to nearest surface water	2	8	16	24
Net precipitation	2	6	12	18
Surface erosion	1	8	8	24
Surface permeability	2	6	12	18
Rainfall intensity	1	8	8	24
SUBTOTALS			56	108
Subscore (100 x factor score subtotal/maximum score subtotal)				52
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	2	6	12	18
Soil permeability	2	8	16	24
Subsurface flows	1	8	8	24
Direct access to ground water	1	8	8	24
SUBTOTALS			68	114
Subscore (100 x factor score subtotal/maximum score subtotal)				60

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3 above. Pathways Subscore 60

IV. WASTE MANAGEMENT PRACTICES

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

Receptors 37
Waste Characteristics 25
Pathways 60
TOTAL 122 divided by 3 = 41 Gross total score

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

41 x 1.0 = 41

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Cavalier AFS
Location: 15 miles west of Cavalier, North Dakota
Date of Operation or Occurrence: 1975 - present
Owner/Operator: USAF Space Command
Comments/Description: Radar Installation
Site Rated By: D.P. Reagan

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest well	1	10	10	30
C. Land use/zoning within 1-mile radius	1	3	3	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1-mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	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	0	6	0	18
SUBTOTALS			65	180
Receptors subscore (100 x factor score subtotal/maximum score subtotal)				36

II. WASTE CHARACTERISTICS

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

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

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

B. Apply persistence factor:
Factor Subscore A x Persistence Factor = Subscore B 1.0 x 60 = 60

C. Apply physical state multiplier:
Subscore B x Physical State Multiplier = Waste Characteristics Subscore 60 x 1.0 = 60

HAZARD ASSESSMENT RATING METHODOLOGY FORM
(Continued, Page 2 of 2)

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, proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore --

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

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
1. Surface water migration				
Distance to nearest surface water	0	8	0	24
Net precipitation	2	6	12	18
Surface erosion	0	8	0	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
SUBTOTALS			26	108
Subscore (100 x factor score subtotal/maximum score subtotal)				24
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				3
3. Ground water migration				
Depth to ground water	2	8	16	24
Net precipitation	2	6	12	18
Soil permeability	1	8	8	24
Subsurface flows	1	8	8	24
Direct access to ground water	1	8	8	24
SUBTOTALS			52	114
Subscore (100 x factor score subtotal/maximum score subtotal)				46

C. Highest pathway subscore

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

Pathways Subscore 46

IV. WASTE MANAGEMENT PRACTICES

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

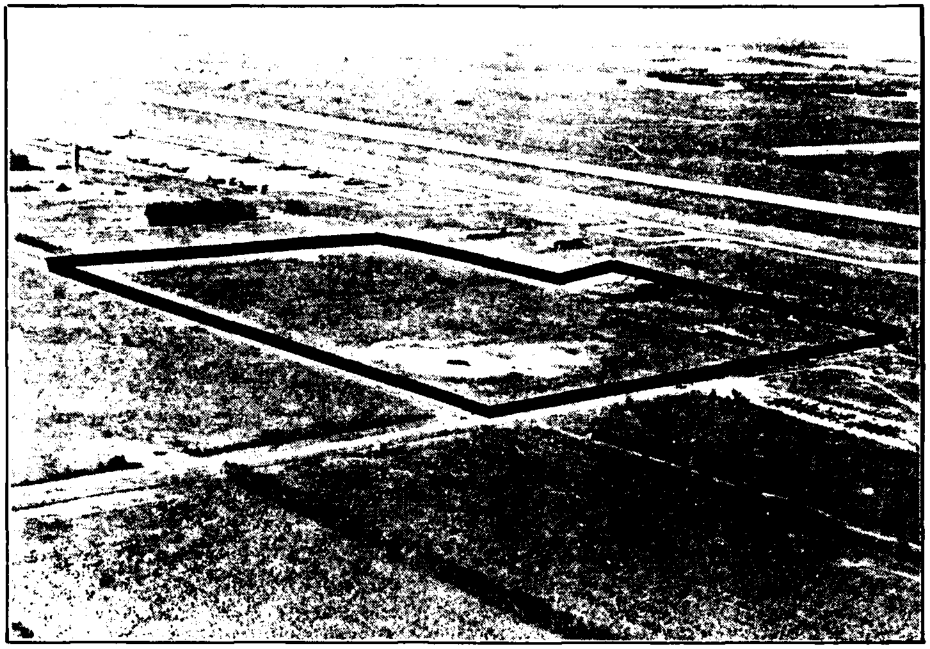
Receptors	36
Waste Characteristics	60
Pathways	46
TOTAL	152 divided by 3 = 51 Gross total score

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

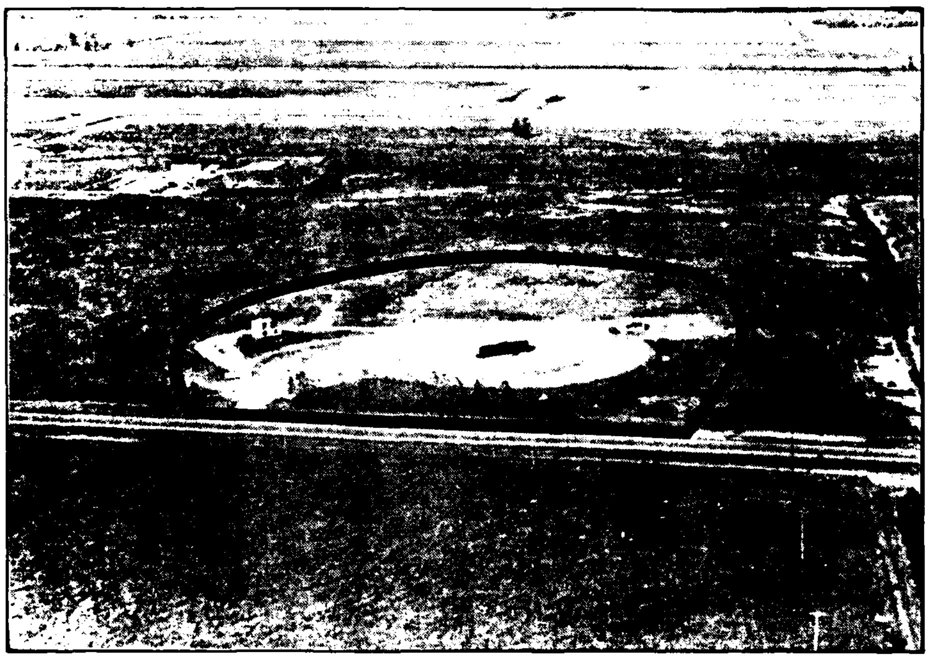
51 x 0.1 = 5.1

APPENDIX G

PHOTOGRAPHS OF DISPOSAL/SPILL SITES

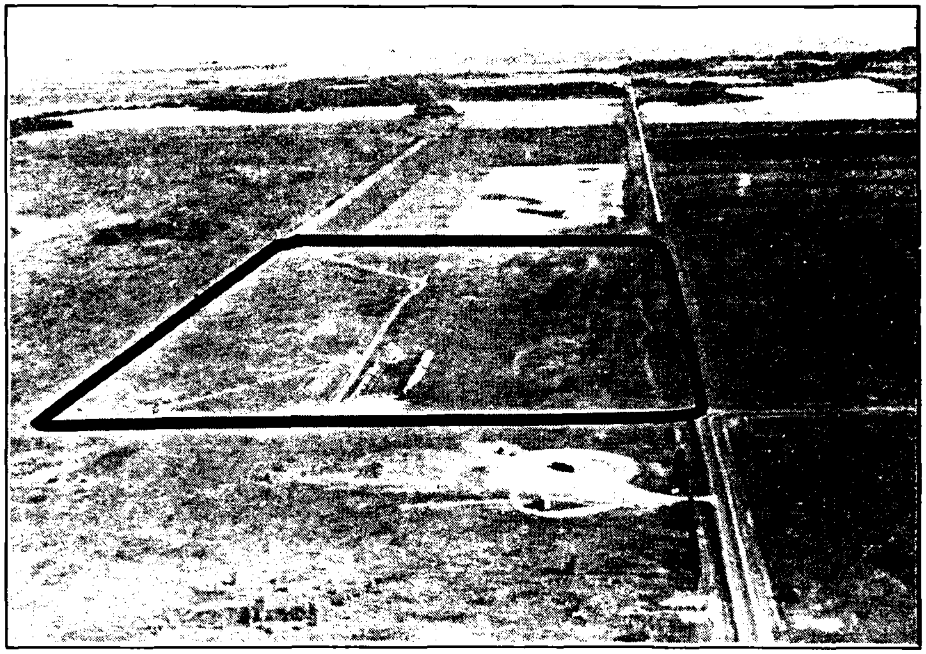


INACTIVE SANITARY LANDFILL

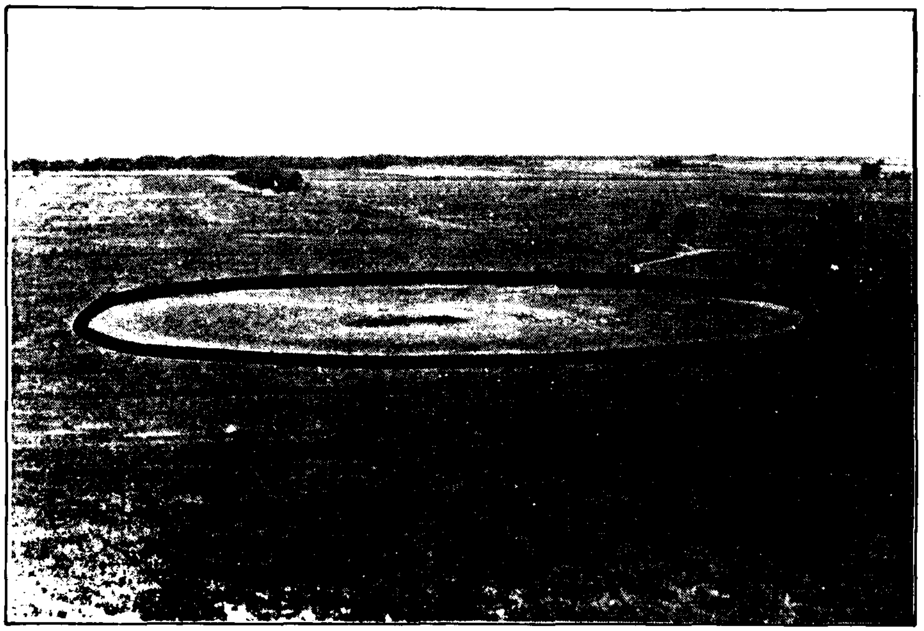


FIREFIGHTER TRAINING AREA

AREA OF POTENTIAL CONTAMINATION	INSTALLATION RESTORATION PROGRAM **Grand Forks Air Force Base**



RECENT SANITARY LANDFILL



EOD AREA

AREAS OF POTENTIAL CONTAMINATION

INSTALLATION RESTORATION PROGRAM
Grand Forks Air Force Base

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