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This report identified and evaluated several potentially hazardous waste disposal sites at K I Sawyer AFB. Records of past waste handling and disposal practices were reviewed. Interviews with past and present installation employees were conducted to develop a history of waste disposal practices. The environmental setting was evaluated including soils, geology, ground water, surface water. The POL area, two fire protection training areas, four landfills, one hardfill, one drainage pond, two drainage pits, the DPDO, and the Wells Terminal Annex were found to have sufficient potential to create environmental contamination and follow-on investigations (Phase II) were recommended and outlined.

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INSTALLATION RESTORATION PROGRAM
PHASE I: RECORDS SEARCH

K.I. SAWYER AFB
Michigan

Prepared For

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

September 1985

Prepared By
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K. I. SAWYER AFB

TABLE OF CONTENTS

		PAGE
	LIST OF FIGURES	iv
	LIST OF TABLES	vi
	EXECUTIVE SUMMARY	-1-
SECTION 1	INTRODUCTION	
	Background and Authority	1-1
	Purpose and Scope	1-2
	Methodology	1-5
SECTION 2	INSTALLATION DESCRIPTION	
	Location, Size and Boundaries	2-1
	Base History	2-6
	Organization and Mission	2-6
SECTION 3	ENVIRONMENTAL SETTING	
	Meteorology	3-1
	Geography	3-3
	Topography	3-3
	Soils	3-3
	Surface Water Resources	3-7
	Drainage	3-7
	Surface Water Quality	3-11
	Surface Water Use	3-12
	Ground-Water Resources	3-16
	Hydrogeologic Units	3-16
	Ground-Water Quality	3-25
	Ground-Water Use	3-25
	Biotic Environment	3-30
	Summary of Environmental Setting	3-31
SECTION 4	FINDINGS	
	Installation Hazardous Waste Activity Review	4-1
	Industrial Shops	4-2
	Waste Accumulation and Storage Areas	4-16
	Fuels Management	4-20
	Spills and Leaks	4-20
	Pesticide Utilization	4-22
	Fire Protection Training	4-23
	Installation Waste Disposal Methods	4-25
	Landfills/Hardfills	4-25
	Incinerators	4-30
	Explosive Ordnance Disposal Area	4-30

TABLE OF CONTENTS
(Continued)

		PAGE
	Drainage Ponds/Pits	4-31
	Sanitary Sewer System	4-33
	Surface Drainage System	4-34
	Oil/Water Separators	4-34
	Sludge Disposal Areas	4-37
	Satellite Facilities Review	4-37
	Calumet AFS	4-37
	Wells Terminal Annex	4-41
	Evaluation of Past Disposal Activities and Facilities	4-45
	Sites Eliminated from Further Evaluation	4-47
	Sites Evaluated Using HARM	4-47
SECTION 5	CONCLUSIONS	
	Wells Terminal Annex	5-1
	Drainage Pond No. 2	5-3
	POL Area	5-3
	Landfill No. 1	5-4
	Landfill No. 2	5-4
	Drainage Pit No. 3	5-5
	Landfill No. 3	5-5
	Fire Protection Training Area No. 1	5-6
	Fire Protection Training Area No. 2	5-6
	Hardfill Area No. 2	5-6
	Landfill No. 4	5-7
	Drainage Pit No. 1	5-7
	DPDO Yard	5-7
SECTION 6	RECOMMENDATIONS	
	Phase II Monitoring Recommendations	6-1
	Wells Terminal Annex	6-3
	Drainage Pond No. 2	6-13
	POL Area	6-14
	Landfill No. 1	6-15
	Landfill No. 2	6-16
	Drainage Pit No. 3	6-16
	Landfill No. 3	6-16
	Fire Protection Training Area No. 1	6-17
	Fire Protection Training Area No. 2	6-17
	Hardfill Area No. 2	6-18
	Landfill No. 4	6-18
	Drainage Pit No. 1	6-19
	DPDO Yard	6-19

TABLE OF CONTENTS
(Continued)

PAGE

APPENDIX A BIOGRAPHICAL DATA

APPENDIX B LIST OF INTERVIEWEES AND OUTSIDE AGENCY CONTACTS

APPENDIX C TENANT ORGANIZATIONS AND MISSIONS

APPENDIX D SUPPLEMENTAL BASE FINDINGS INFORMATION

APPENDIX E MASTER LIST OF SHOPS

APPENDIX F PHOTOGRAPHS

APPENDIX G USAF INSTALLATION RESTORATION PROGRAM HAZARD ASSESSMENT RATING METHODOLOGY

APPENDIX H SITE HAZARD ASSESSMENT RATING FORMS

APPENDIX I GLOSSARY OF TERMINOLOGY AND ABBREVIATIONS

APPENDIX J REFERENCES

APPENDIX K INDEX OF REFERENCES TO POTENTIAL CONTAMINATION SITES AT K. I. SAWYER AFB

LIST OF FIGURES

NO.	TITLE	PAGE
1	Sites of Potential Environmental Contamination	-5-
2	Site of Potential Environmental Contamination - Wells Terminal Annex	-6-
1.1	Installation Restoration Program	1-3
1.2	Phase I Installation Restoration Program - Records Search Flow Chart	1-7
2.1	Regional Location Map	2-2
2.2	Area Location Map	2-3
2.3	Installation Site Plan	2-4
2.4	Area Location - Calumet AFS	2-5
3.1	Base Location	3-4
3.2	Soils Map	3-5
3.3	Surface Drainage Map	3-8
3.4	Regional Drainage Map	3-10
3.5	Surface Water Quality Sampling Locations	3-13
3.6	Regional Distribution of Glacial Deposits	3-17
3.7	Regional Bedrock Geologic Map	3-18
3.8	Location of Hydrogeologic Cross-Section	3-20
3.9	Hydrogeologic Cross-Section	3-21
3.10	Regional Potentiometric Surface Contours of the Glacial Aquifer	3-23
3.11	Base Well Location Map	3-28
3.12	Regional Well Location Map	3-29
4.1	Storage Areas	4-18

LIST OF FIGURES
(Continued)

NO.	TITLE	PAGE
4.2	DPDO Yard	4-19
4.3	Spill and Leak Areas	4-21
4.4	Fire Protection Training Areas	4-24
4.5	Disposal Sites	4-27
4.6	Drainage Pond/Pit Locations	4-32
4.7	Sewage Treatment Plant	4-35
4.8	Sewage Treatment Plant Operations	4-36
4.9	Sludge Disposal Areas	4-38
4.10	Site Map Calumet AFS	4-39
4.11	Hardfill Areas - Calumet AFS	4-42
4.12	Site Plan-Wells Terminal Annex	4-44
4.13	Waste Pit Location - Wells Terminal Annex	4-46
6.1	Sites Recommended for Environmental Monitoring	6-11
6.2	Areas Recommended for Environmental Monitoring - Wells Terminal Annex	6-12

LIST OF TABLES

NO.	TITLE	PAGE
1	Sites Evaluated Using the HARM	-7-
3.1	Climatic Conditions	3-2
3.2	Soils Classification	3-6
3.3	Selected Surface - Water Quality Data	3-14
3.4	Hydrogeologic Units and Their Water-Bearing Characteristics in the Vicinity of K. I. Sawyer AFB	3-19
3.5	Trichloroethylene Data Summary	3-26
3.6	Well 8 Analytical Results	3-27
4.1	Industrial Operations (Shops)	4-4
4.2	Landfill Site Information Summary	4-26
4.3	Summary of Flow Chart Logic for Areas of Initial Health Welfare and Environmental Concern	4-48
4.4	Summary of HARM Scores for Potential Contamination Sites	4-49
5.1	Sites Evaluated Using HARM	5-2
6.1	Recommended Monitoring Program for Phase II	6-4
6.2	Recommended List of Analytical Parameters	6-10

EXECUTIVE SUMMARY

The Department of Defense (DOD) has developed a program to identify and evaluate past hazardous material disposal sites on DOD property, to control the migration of hazardous contaminants, and to control hazards to health or welfare that may result from these past disposal operations. This program is called the Installation Restoration Program (IRP). The IRP has four phases consisting of Phase I, Installation Assessment/Records Search; Phase II, Confirmation/Quantification; Phase III, Technology Base Development; and Phase IV, Remedial Actions. Engineering-Science was retained by the United States Air Force to conduct the Phase I, Initial Assessment/Records Search for K. I. Sawyer Air Force Base (AFB) under Contract No. F08637 84 C0070.

INSTALLATION DESCRIPTION

K. I. Sawyer AFB is located in the Upper Peninsula of Michigan, approximately 20 miles south of Marquette, Michigan. The main base consists of 5,278 acres comprised of runways and airfield operations, industrial operations, housing and recreational facilities, and undeveloped land. The base is surrounded on all sides by forested land. Remote installation facilities include the Calumet Air Force Station (AFS) comprising 104 Acres. This site is located 22 miles northeast of Calumet, Michigan. The mission of the station is to provide long range surveillance radar data and ground to air communications. Another remote annex included in the study was the Wells Terminal Annex, a 40 acre site near Escanaba, Michigan. This annex is the main terminal for jet fuel delivered to the base.

K. I. Sawyer AFB was first established as K. I. Sawyer County Airport in 1949 although the airport site was not used for commercial aviation. Joint use between Marquette County and the U. S. Government began in 1955. The site was transferred to Air Force control in 1956 and non-military operations were terminated in 1957.

In the late 1950's , several fighter and bomber wings were stationed at K. I. Sawyer AFB. In 1963, the 410th Bombardment Wing (BWM) was created by the redesignation of an earlier bombardment unit, and in 1964 an air refueling mission was added. At present the 410th BMW is the host unit at the base; the 2001st Information Systems Squadron (ISS) and the 87th Fighter Interceptor Squadron (FIS) are other major units at the base. Aircraft in use at the base include the B-52H bomber, KC-135 tanker, T-33 and T-37 trainers, and F-106 fighter aircraft. The mission of the 410th Bombardment Wing is to act as a deterrent force in times of peace and, in the event of war, to act as a strike force to destroy enemy targets.

ENVIRONMENTAL SETTING

The environmental setting information for K. I. Sawyer AFB and Wells Terminal Annex indicated the following data as important when evaluating past hazardous waste disposal practices.

1. The mean annual precipitation for K. I. Sawyer AFB and Annexes is 34.0 inches; the net precipitation is approximately + 9.0 inches and the one-year, 24-hour rainfall event is approximately 2.0 inches. These data indicate that there is an abundance of rainfall in excess of evaporation and that there is a potential for storms to generate high runoff and ground-water recharge.

2. The soils on the base are sandy loam to sands with moderate to high vertical permeability. These data indicate that recharge by precipitation infiltrating the soils will be high.

3. Two aquifers exist at the K. I. Sawyer AFB. The uppermost aquifer consists of the unconsolidated glacial outwash deposit to depths of 300 feet. The bedrock aquifer exists at depths from 60 to 300 feet.

4. Ground-water underlying K. I. Sawyer and within the uppermost aquifer exists under semi-confined to confined conditions at depths as shallow as 5 feet. The most permeable zone within the upper aquifer is the top of the weathered rock zone and within the stratified sands and gravels.

5. Ground water underlying the base and within the bedrock aquifer exists under confined conditions. The bedrock aquifer is continuous in the vicinity of the base. This aquifer is seldom tapped due to the excellent aquifer which overlies the bedrock aquifer.

6. Ground-water contamination by organic chemicals at K. I. Sawyer AFB within the upper aquifer has been recorded at well 8.

7. The ground water within the uppermost aquifer at K. I. Sawyer AFB is thought to discharge to Silver Lead Creek.

8. The uppermost aquifer at K. I. Sawyer AFB is the principal source of potable water for the base. The bedrock aquifer is seldom used.

9. There are no known federally or state-listed endangered or threatened species which permanently inhabit K. I. Sawyer AFB or its satellite facilities.

10. The soils at the Wells Terminal Annex consist of loam and sand that are poorly drained, possess a high water table and are subject to frequent flooding.

11. Two aquifers are present at the Wells Terminal Annex. The uppermost aquifer consists of unconsolidated glacial lake deposits to depths of 50 feet. The bedrock aquifer exists from depths of 60 to 350 feet.

12. Ground water at the Wells Terminal Annex within the uppermost aquifer exists under unconfined conditions typically within 5 feet of the ground surface. The most permeable zone within the upper aquifer is the top-of-the-rock zone where highly weathered, fractured, jointed and solution rock may exist.

13. The bedrock aquifer at the Wells Terminal Annex exists under confined conditions. The bedrock aquifer is continuous within the vicinity of the study area and wells with the highest yields penetrate the interconnecting fractures, joints and solution channels.

14. The bedrock aquifer at the Wells Terminal Annex is the primary source of potable water for the area.

METHODOLOGY

During the course of this project, interviews were conducted with installation personnel (past and present) familiar with past waste disposal practices; file searches were performed for past hazardous waste activities; interviews were held with local, state and federal agencies; and field surveys were conducted at suspected past hazardous waste activity sites. These sites have been assessed using a Hazard Assessment Rating Methodology (HARM) which takes into account factors such as site characteristics, waste characteristics, potential for contaminant migration and waste management practices.

FINDINGS AND CONCLUSIONS

Thirteen sites (Figure 1 and 2) were initially identified as potentially containing hazardous contaminants and having the potential for contaminant migration resulting from past activities. The details of the rating procedure are presented in Appendix G and the results of the assessment are given in Table 1. The rating system is designed to indicate the relative need for follow-on investigation.

FIGURE 1

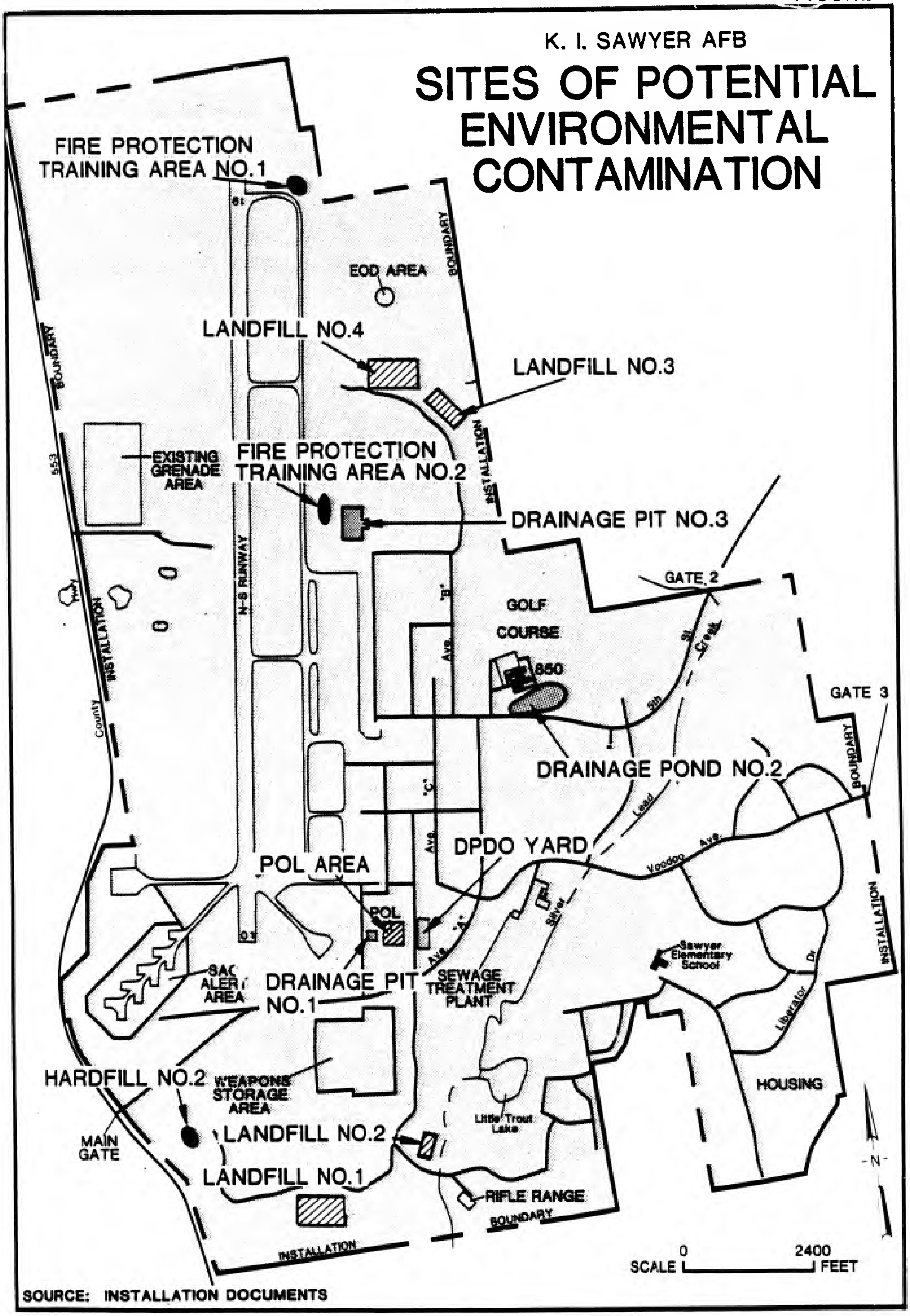

K. I. SAWYER AFB
SITES OF POTENTIAL ENVIRONMENTAL CONTAMINATION
FIRE PROTECTION TRAINING AREA NO.1
EOD AREA
BOUNDARY
LANDFILL NO.4
LANDFILL NO.3
EXISTING GRENADE AREA
FIRE PROTECTION TRAINING AREA NO.2
INSTALLATION
DRAINAGE PIT NO.3
N-S RUNWAY
GATE 2
GOLF COURSE
850
GATE 3
County
DRAINAGE POND NO.2
DPDO YARD
POL AREA
POL
Voodoo Ave.
SAC ALERT AREA
DRAINAGE PIT NO.1
SEWAGE TREATMENT PLANT
Sawyer Elementary School
HARDFILL NO.2
WEAPONS STORAGE AREA
HOUSING
MAIN GATE
LANDFILL NO.2
Little Trout Lake
LANDFILL NO.1
RIFLE RANGE
N
SCALE 0 2400 FEET
SOURCE: INSTALLATION DOCUMENTS

FIGURE 2

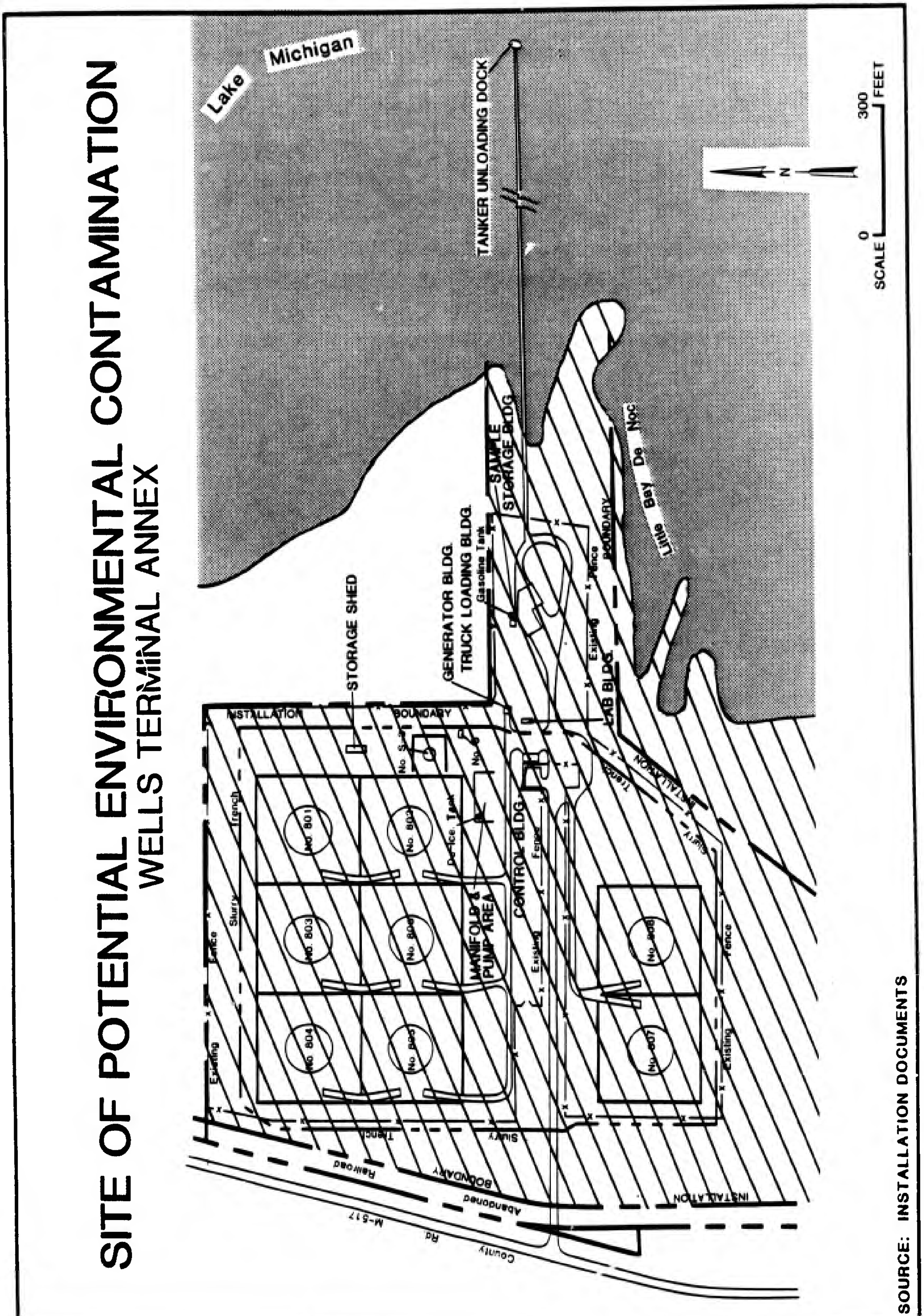

SITE OF POTENTIAL ENVIRONMENTAL CONTAMINATION
WELLS TERMINAL ANNEX
Lake Michigan
TANKER UNLOADING DOCK
SCALE
0
300
FEET
N
Little Bay De Noc
SAMPLE STORAGE BLDG.
GENERATOR BLDG.
TRUCK LOADING BLDG.
Gasoline Tank
STORAGE SHED
LAB BLDG.
CONTROL BLDG.
MANIFOLD & PUMP AREA
No. 801
No. 802
No. 803
No. 804
No. 805
No. 806
No. 807
No. 808
INSTALLATION BOUNDARY
Existing Fence
Slurry Trench
Abandoned Railroad
M-517
County Rd
SOURCE: INSTALLATION DOCUMENTS

TABLE 1
SUMMARY OF HARM SCORES FOR
POTENTIAL CONTAMINATION SITES
AT K. I. SAWYER AFB

Rank	Site	Receptor Subscore	Waste Charac-teristics Subscore	Pathways Subscore	Waste Management Factor	HARM Score
1	Wells Terminal Annex	81	72	80	1.0	78
2	Drainage Pond No. 2 (Hospital Area)	69	100	56	1.0	75
3	POL Area	64	80	80	1.0	75
4	Landfill No. 1	66	100	48	1.0	71
5	Landfill No. 2	64	80	56	1.0	67
6	Drainage Pit No. 3 (Bldg. 740)	63	80	48	1.0	64
7	Landfill No. 3	64	80	41	1.0	62
8	Fire Protection Training Area No. 1	61	80	41	1.0	60
9	Fire Protection Training Area No. 2	61	64	41	1.0	55
10	Hardfill Area No. 2	64	60	41	1.0	55
11	Landfill No. 4	61	60	41	1.0	54
12	Drainage Pit No. 1 (Test Cell)	63	50	46	1.0	53
13	DPDO Yard	63	40	46	1.0	50

Source: Engineering-Science

RECOMMENDATIONS

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

- o Wells Terminal Annex - Geophysics to characterize the study area followed by installation of wells along the perimeter of the site and at one upgradient location. Soil sampling up to 15 feet below grade. Sediment sampling from nearby surface waters. Sample existing drinking water well. Resurvey Southern boundary.

- o Drainage Pond No. 2 - Conduct composite water and sediment samples from the pond and Silver Lead Creek. Perform a soil boring in the golf course area up to 15 feet below grade. Install four monitoring wells around site.

- o POL Area - Geophysics to characterize the study area. Install and sample monitoring wells.

- o Landfills No. 1 through No. 4 - Geophysics to characterize the study area. Install and sample one upgradient well and one downgradient well for each 250 feet of downgradient frontage. Sample surface water and sediments upgradient and downgradient from the sites.

- o Drainage Pit No. 3 - Geophysics to characterize the study area. Install and sample one upgradient and three downgradient wells.

- o Fire Protection Training Areas No. 1 and No. 2 - Geophysics to characterize the study area. Install and sample one upgradient and three downgradient wells. Perform a minimum of three test borings to 15 feet, sampling at 3-foot intervals.

- Hardfill Area No. 2 - Perform three borings to a depth of 20 ft. below grade, sample at 3-foot intervals.
- Drainage Pit No. 1 - Perform two soil borings to 15 feet below grade, sample at 3-foot intervals.
- DPDO Yard - Perform three soil borings up to 15 feet below grade, sample at 3-foot intervals.

SECTION 1

INTRODUCTION

BACKGROUND AND AUTHORITY

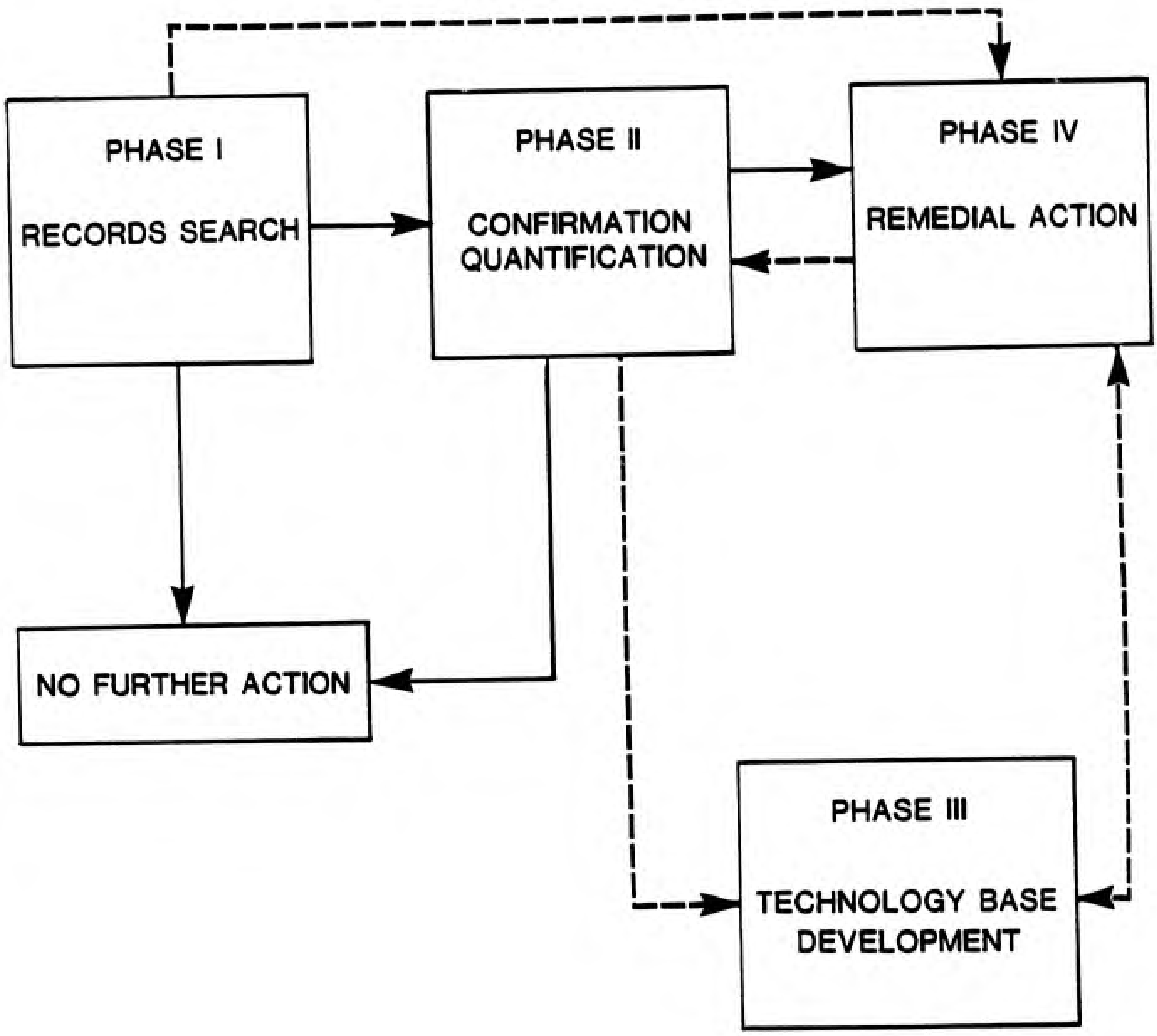
The United States Air Force, due to its primary mission of defense of the United States, has long been engaged in a wide variety of operations dealing with toxic and hazardous materials. Federal, state, and local governments have developed regulations that require disposers of waste to identify the locations and contents of past disposal sites and take action to eliminate hazards in an environmentally responsible manner. The primary Federal legislation governing disposal of hazardous waste is the Resource Conservation and Recovery Act (RCRA) of 1976, as amended. Under Section 6003 of the Act, Federal agencies are directed to assist the Environmental Protection Agency (EPA) and under Section 3012, state agencies are required to inventory past disposal sites, and Federal agencies are required to make the information available to the requesting agencies. To assure compliance with these hazardous waste regulations, the Department of Defense (DOD) developed the Installation Restoration Program (IRP). The current DOD IRP policy is contained in Defense Environmental Quality Program Policy Memorandum (DEQPPM) 81-5, dated 11 December 1981 and implemented by Air Force message dated 21 January 1982. DEQPPM 81-5 reissued and amplified all previous directives and memoranda on the Installation Restoration Program. DOD policy is to identify and fully evaluate suspected problems associated with past disposal practices of hazardous waste and resulting contamination, and to control hazards to health and welfare that resulted from these past practices. The IRP is the basis for response actions on Air Force installations under the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, clarified by Executive Order 12316. CERCLA is the primary legislation governing remedial action at past hazardous waste disposal sites.

PURPOSE AND SCOPE

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

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

U.S. AIR FORCE INSTALLATION RESTORATION PROGRAM



SOURCE: AFESC

Engineering-Science was retained by the United States Air Force to conduct the Phase I Records Search at K. I. Sawyer Air Force Base (AFB) under Contract No. F08637 84 C0070. This report contains a summary and an evaluation of the information collected during Phase I of the IRP and recommended follow-on actions. The land area included as part of this study is as follows:

Main Base	5,278 Acres
Calumet Air Force Station (AFS)	104 Acres
Wells Terminal Annex	40 Acres

The activities performed as a part of the Phase I study scope included the following:

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

Engineering-Science performed the on-site portion of the records search during June 3-7, 1985. The following team of professionals was involved:

- E. H. Snider, P.E., Manager of Industrial Waste Department and Project Manager, 10 years professional experience.
- S. K. Minicucci, Chemical/Environmental Engineer, 4 years professional experience.

- S. J. Tiffany, Enivironmental Engineer, 4 years professional experience.
- J. N. Baker, Geologist, 9 years professional experience.

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

METHODOLOGY

The methodology utilized in the K. I. Sawyer AFB Records Search began with a review of past and present industrial operations conducted at the installation. Information was obtained from available records such as shop files and real property files, as well as interviews with 103 past and present base employees from various operating areas. Those interviewed included current and past personnel associated with civil engineering, fuels management, roads and grounds maintenance, fire protection, real property, history, and various shop personnel. A listing of interviewee positions with approximate years of service is presented in Appendix B.

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

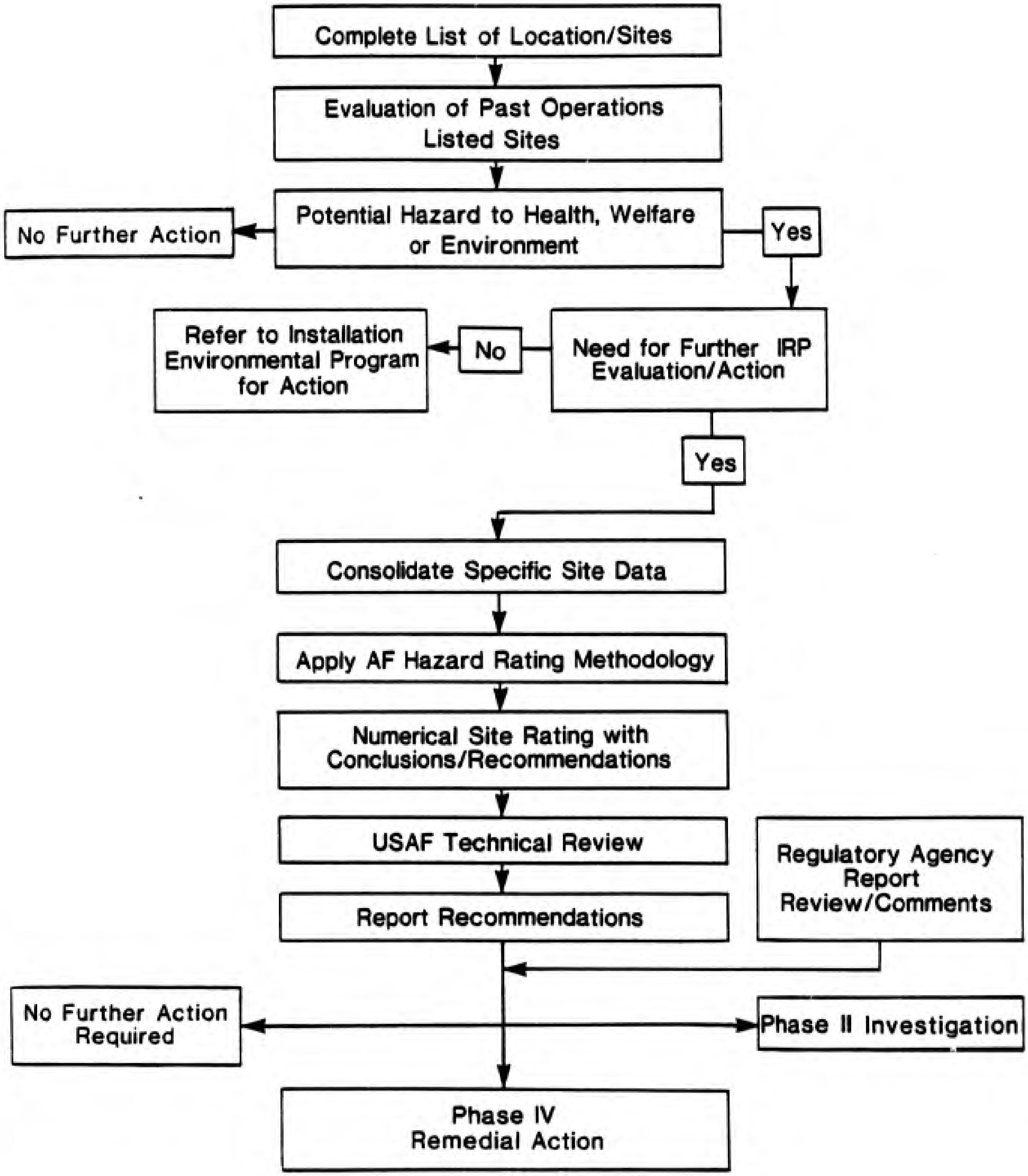
The next step in the activity review was to identify all sources of hazardous waste generation and to determine the past management practices regarding the use, storage, treatment, and disposal of hazardous materials from the various sources on the base. Included in this part of the activities review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

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

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

PHASE I INSTALLATION RESTORATION PROGRAM

RECORDS SEARCH FLOW CHART



Source: AFESC

SECTION 2

INSTALLATION DESCRIPTION

LOCATION, SIZE AND BOUNDARIES

K.I. Sawyer AFB is located in the Upper Peninsula of Michigan, approximately 20 miles south of Marquette, Michigan (see Figure 2.1). The base is bordered by undeveloped forested land on all sides (see Figure 2.2).

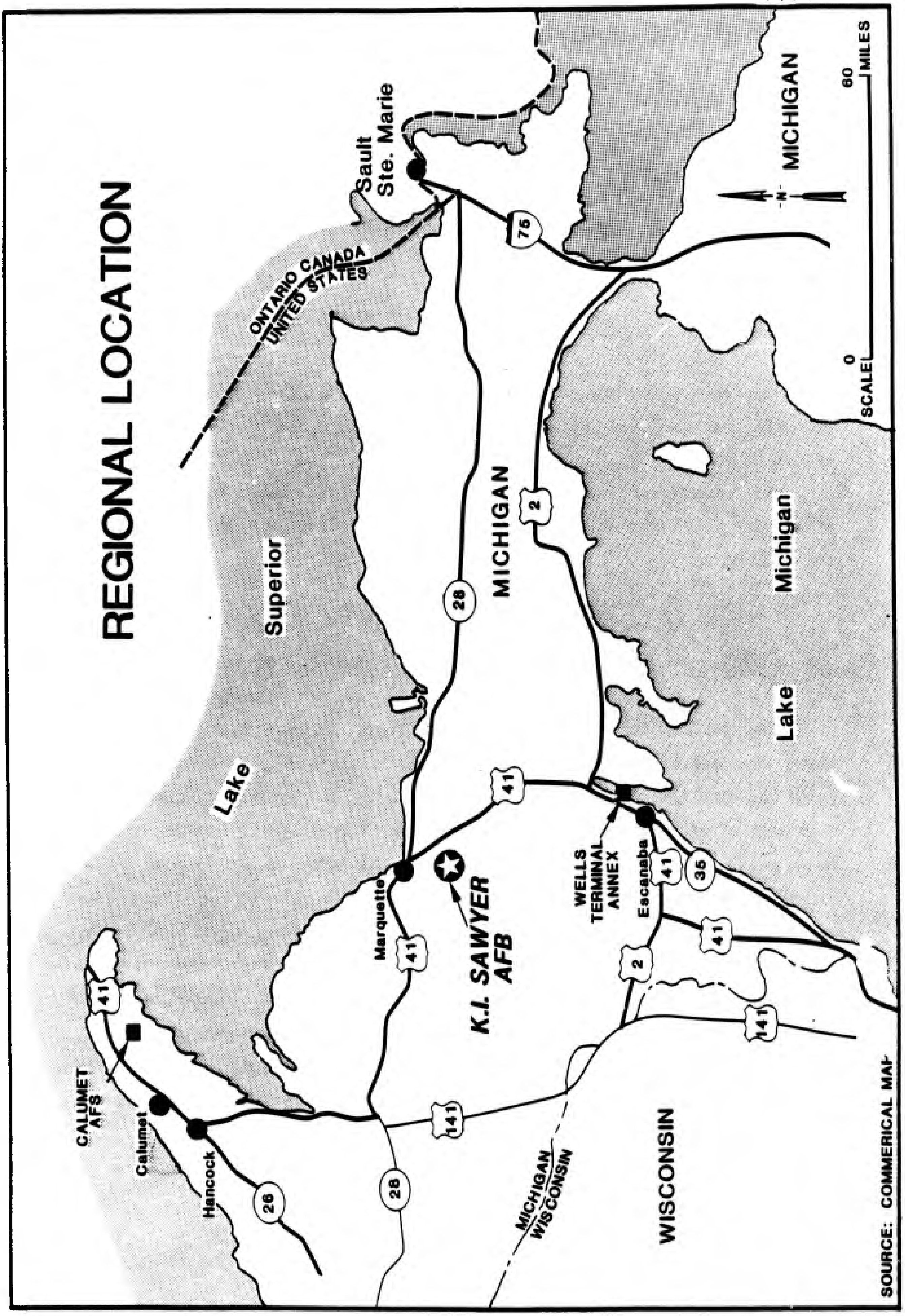
The base comprises 5,278 acres of U.S. government owned and easement land (see Figure 2.3). Remote installation facilities consist of the following:

- o Calumet Air Force Station 104 acres
- o Wells Terminal Annex 40 acres

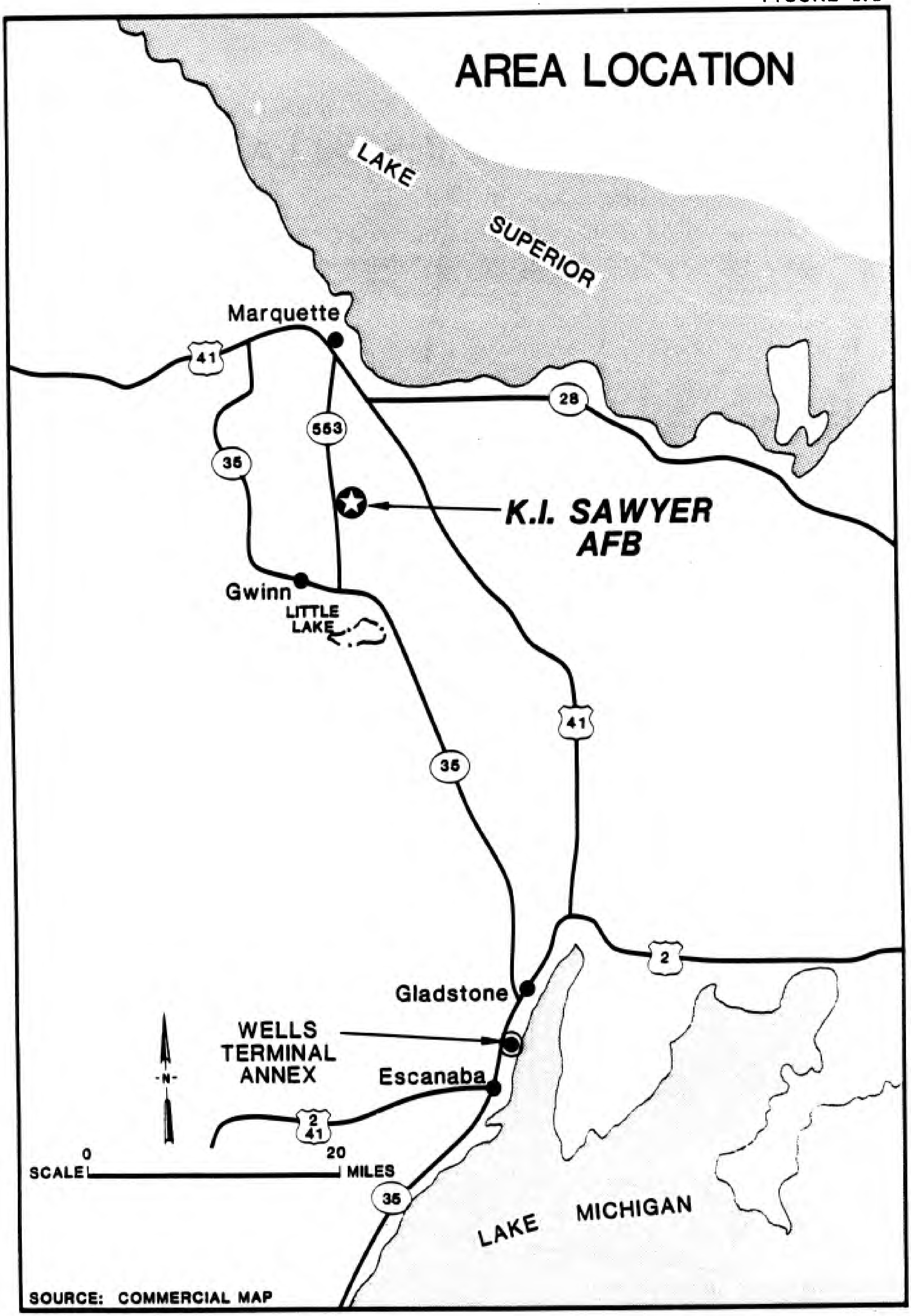
The two remote installation facilities, Calumet Air Force Station (AFS) and Wells Terminal Annex, are also discussed in detail in this report. The Calumet AFS is located 22 miles northeast of Calumet, Michigan at the top of Mt. Horace Greeley (Figure 2.4). It is approximately 150 miles from K.I. Sawyer AFB. The site is surrounded on all sides by undeveloped forested lands. The station does not come under the command of K. I. Sawyer but the base provides its support services.

Wells Terminal Annex is located midway between the towns of Gladstone and Escanaba, Michigan (see Figure 2.2), approximately 50 miles from K.I. Sawyer AFB. The annex is in the township of Wells, Delta County. It is surrounded to the north and south by wooded areas and some small industries, to the west by Highway 517 and a residential area and to the east by Little Bay de Noc.

FIGURE 2.1



REGIONAL LOCATION
Lake Superior
Lake Michigan
MICHIGAN
WISCONSIN
ONTARIO CANADA
UNITED STATES
MICHIGAN
WISCONSIN
Sault Ste. Marie
Marquette
K.I. SAWYER AFB
WELLS TERMINAL ANNEX
Escanaba
CALUMET AFS
Calumet
Hancock
28
41
2
75
141
26
35
N
SCALE
0
60
MILES
SOURCE: COMMERICAL MAP



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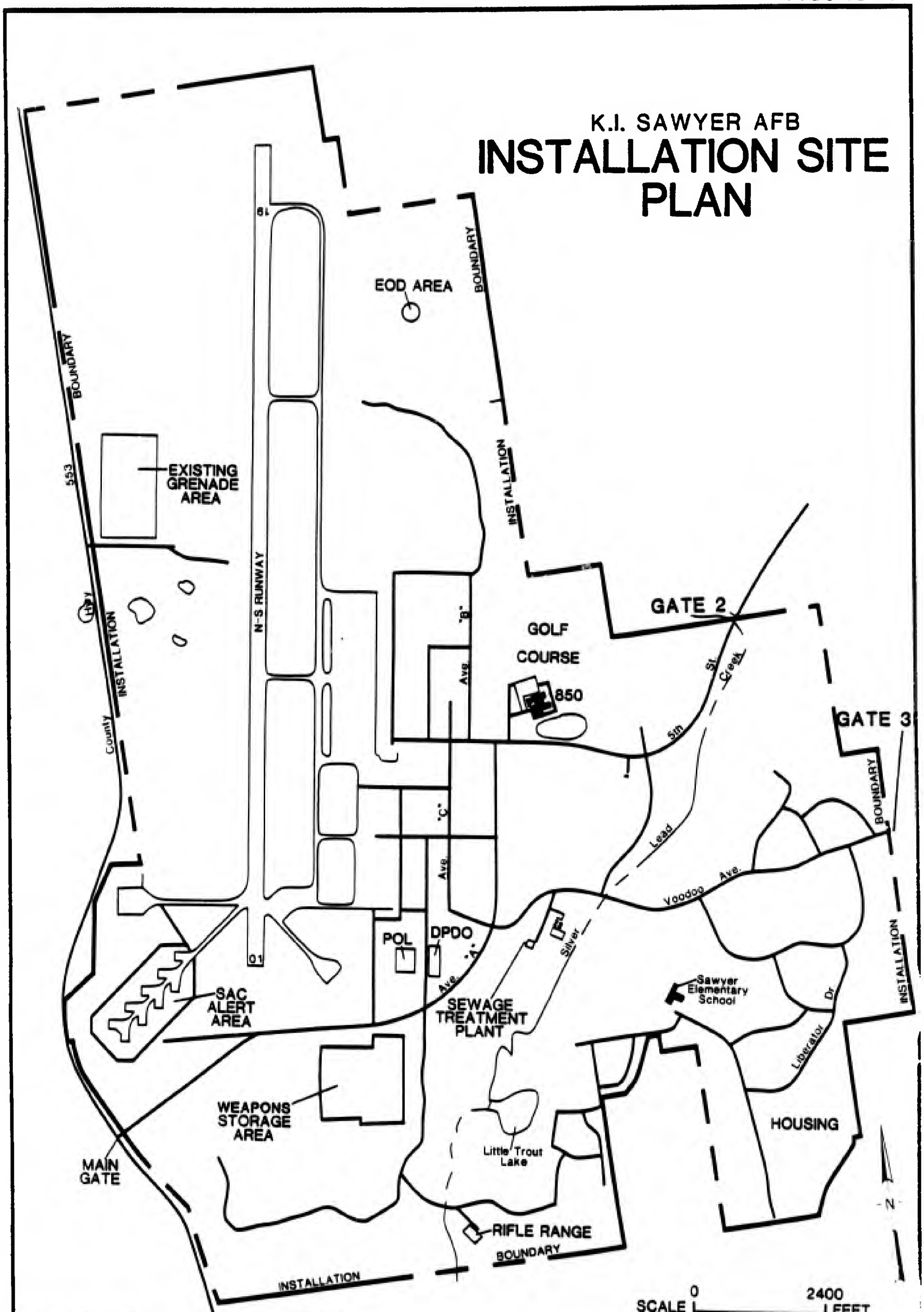
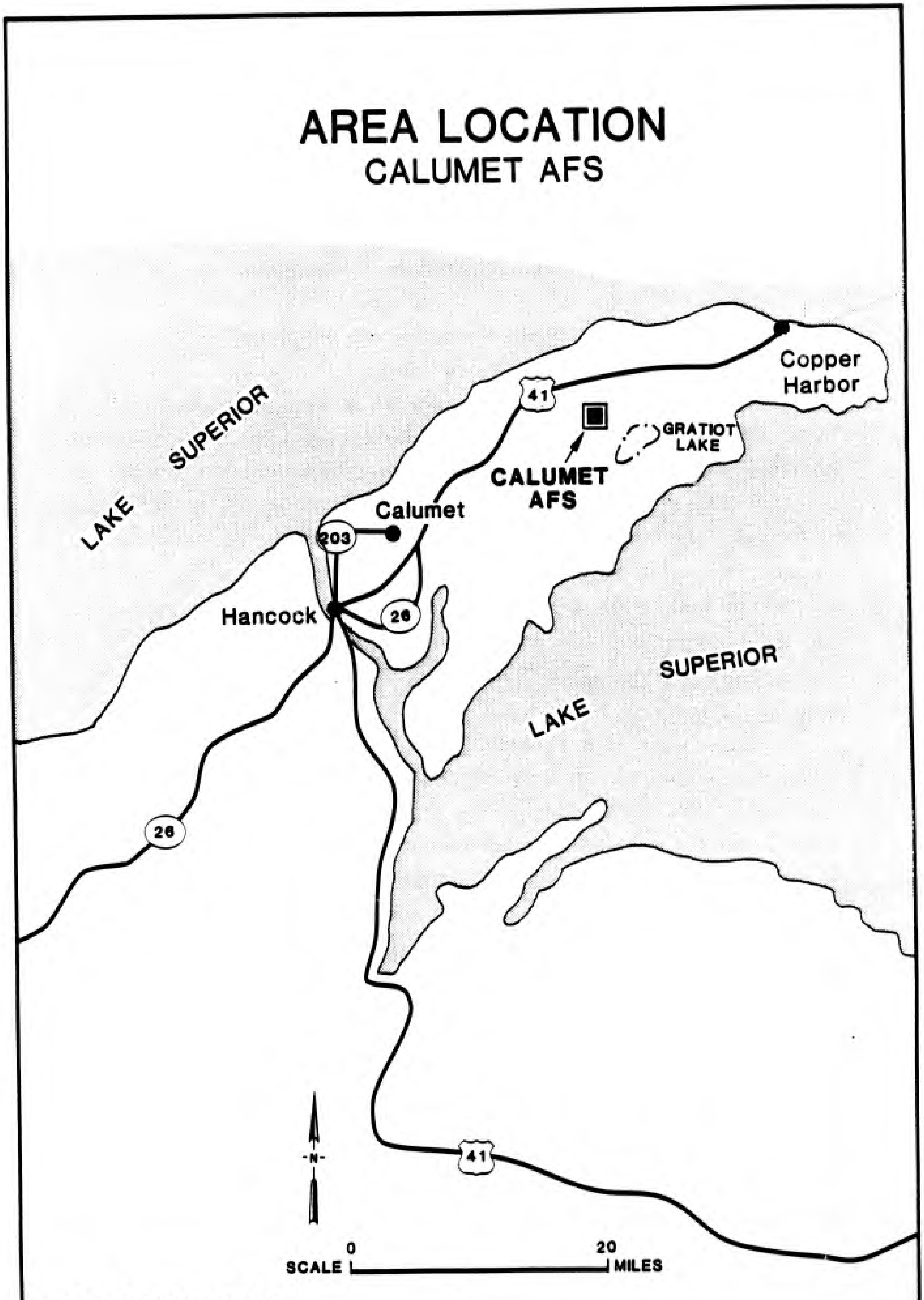


SOURCE: INSTALLATION DOCUMENTS



SOURCE: COMMERCIAL MAP

BASE HISTORY

The site which is presently K.I. Sawyer AFB was first established as K.I. Sawyer County Airport in 1949 as a municipal airport for Marquette County, Michigan. However, the airport site was not used for commercial aviation. Joint use between the county and the U.S. government began in 1955 when a runway and other Air Force facilities were constructed. The site was transferred to Air Force control in 1956, and non-military operations were terminated in 1957.

Shop activities which generated wastes began about 1957. In the late 1950's, several fighter and bomber wings were stationed at K. I. Sawyer AFB. In 1963, the 410th Bombardment Wing (BMW) was created by the redesignation of an earlier bombardment unit, and in 1964 an air refueling mission was added. At present the 410th BMW is the host unit at the base; the 2001st Information Systems Squadron (ISS) and the 87th Fighter Interceptor Squadron (FIS) are other major units at the base. Aircraft in use at the base include the B-52H bomber, KC-135 tanker, T-33 and T-37 trainers, and F-106 fighter aircraft.

ORGANIZATION AND MISSION

The host unit at K.I. Sawyer Air Force Base is the 410th BMW. Several major assigned units at the base include the 46th Air Refueling Squadron, flying KC-135 tanker aircraft; and the 644th Bombardment Squadron, flying B-52H bomber aircraft. Several maintenance, supply, and transportation activities at the base are of importance to this report, since they are involved with the accumulation, treatment, and disposal of hazardous wastes at K.I. Sawyer AFB. These include the 410th Avionics Maintenance Squadron, the 410th Field Maintenance Squadron, the 410th Munitions Maintenance Squadron, the 410th Organizational Maintenance Squadron, the 410th Supply Squadron, the 410th Civil Engineering Squadron, and the 410th Transportation Squadron. Other units present in recent years have been the 87th FIS, flying T-33 and F-106 aircraft, and the 71st Flying Training Wing (FTW), Air Training Command (ATC), flying T-37 aircraft. The 87th FIS is scheduled for deactivation in September 1985.

The Calumet AFS is hosted by the 665th Radar Squadron. The mission of the 665th is to provide long range surveillance radar data and ground-air-ground communications in support of the air defense role of the 24th NORAD Region and 24th Air Division (ADTAC). The surveillance and communications subsystems include the AN/FPS-27A Search Radar, the AN/FYQ-47 Common Digitizer, the AN/GKA-5 Time Division Data Link, AN/GRT-22 and AN/GRR-24 radio transmitters and receivers.

Wells Terminal Annex, although Air Force owned, is operated by the Defense Fuels Support Group out of Escanaba, Michigan. This site is used for transfer operations of jet fuel supplied to K.I. Sawyer AFB and other fuel products to government agencies throughout the state.

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

- 87th Fighter Interceptor Squadron
- 71st Flying Training Wing
- 2001st Information Systems Squadron
- 225th Field Training Detachment
- Air Force Audit Agency
- Detachment 24, 26th Weather Squadron
- Detachment 512, Air Force Office of Special Investigations
- Detachment 29, 3904th Management Engineering Squadron (SACMET)
- Defense Property Disposal Office (DPDO)
- Defense Investigative Agency, DOD

SECTION 3

ENVIRONMENTAL SETTING

The environmental setting of K. I. Sawyer AFB and Wells Terminal Annex are described in this section with an emphasis on the identification of natural features that may promote the movement of hazardous waste contaminants. Calumet AFS was not described in detail due to the fact that no areas having the potential for contaminant migration were identified at the station. Environmental conditions pertinent to this study are summarized at the conclusion of this section.

METEOROLOGY

K. I. Sawyer AFB has a climate typical of the Upper Peninsula of Michigan as conditioned to some extent by influences of the Great Lakes. A stabilizing effect produced by the Great Lakes coupled with prevailing westerly winds produces cool summers and milder winters than those experienced in surrounding states at identical latitudes. Selected meteorological data for K. I. Sawyer AFB are summarized in Table 3.1.

Two climatic features of interest in determining the potential for contaminant movement are net precipitation and rainfall intensity. Net precipitation is an indicator of the potential for leachate generation and is equal to the difference between precipitation and evaporation. Rainfall intensity is an indicator of the potential for high runoff and erosion. The one-year, 24-hour rainfall event is used to gauge the potential for runoff and erosion. Net precipitation at K. I. Sawyer AFB is approximately plus (+) 9.0 inches as determined from meteorological data. The mean annual precipitation at the base for the period of 1956 to 1984 is 34.0 inches (NOAA, 1984) and the mean annual lake evaporation for the area is estimated to be 25 inches (NOAA, 1983). The one-year, 24-hour rainfall event in the area of the base is estimated to be 2.0 inches (NOAA, 1963).

TABLE 3.1
CLIMATIC CONDITIONS FOR K. I. SAWYER AFB

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Temperature (°F)												
Mean Monthly	12	15	24	37	49	59	65	63	54	45	31	19
Total Precipitation (inches)												
Mean Monthly	2.1	1.8	2.2	2.6	3.1	3.5	3.4	3.3	4.0	2.9	2.6	2.5
Snowfall (inches)												
Mean Monthly	29	23	21	7	1	T	T	0	T	4	17	31

NOTE: T = TRACE

SOURCE: National Oceanic and Atmospheric Administration, 1984.

Period of Record: 1956-1984

GEOGRAPHY

K. I. Sawyer AFB is located in a rural sector of Marquette County in the central portion of the Upper Peninsula of Michigan, approximately 20 miles south of Lake Superior and the city of Marquette and 50 miles north of Lake Michigan. The base is situated in the Superior Upland Physiographic Province of the United States (Figure 3.1) and is characterized as a submaturely dissected, recently glaciated peneplain formed over crystalline bedrock (Fenneman and Johnson, 1930).

Topography

The topography of K. I. Sawyer AFB is typical of the regional topography. Upland areas east of the base, typical of the outer Marquette Moraine, exhibit extensive dissection while low areas, west and south of the Outer Marquette Moraine have a gently rolling to nearly flat appearance. The flat areas have a pitted appearance due to the presence of numerous kettles associated with glacial outwash plains. Ponds and lakes are common surface water features and area streams are well developed within local channels. Local relief is generally the result of erosional activity or stream channel development. Surface elevations at K. I. Sawyer AFB range from approximately 1090 feet along Silver Lead Creek to over 1260 feet immediately northwest of the main runway's north end (U. S. Geological Survey Topographic Map, Gwinn Quadrangle, 1975).

The Wells Terminal Annex located at the mouth of the Escanaba River is situated on nearly flat modern alluvium and artificial fill material. Relief on the order of 20 feet is apparent along the Escanaba River and the shoreline of Little Bay De Noc. In these areas, the land surface slopes to 580 feet, National Geodetic Vertical Datum of 1927 (NGVD).

Soils

The soils at K. I. Sawyer AFB (Figure 3.2 and Table 3.2) have been broadly mapped by the USDA, Soil Conservation Service. The information presented in this section is based upon preliminary data and maps obtained from the Marquette County Soil Conservation Service. The soils at K. I. Sawyer AFB have been classified as sandy loams to sands which are characteristically excessively drained granular materials formed in till, outwash, moraine or lake bed planes (Upper Peninsula Resource Conservation and Development Council, 1972). Table 3.2 summarizes some

FIGURE 3.1

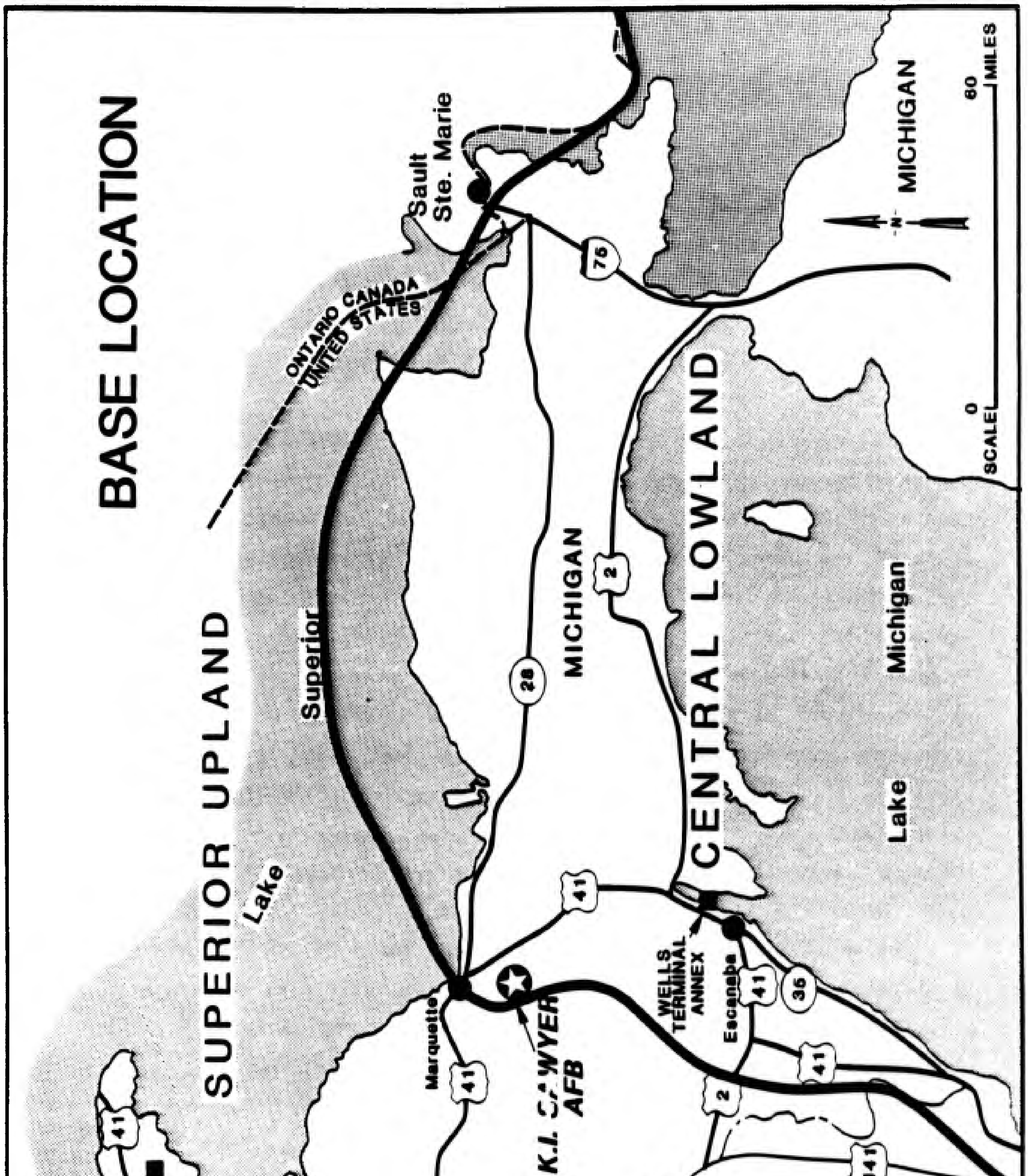
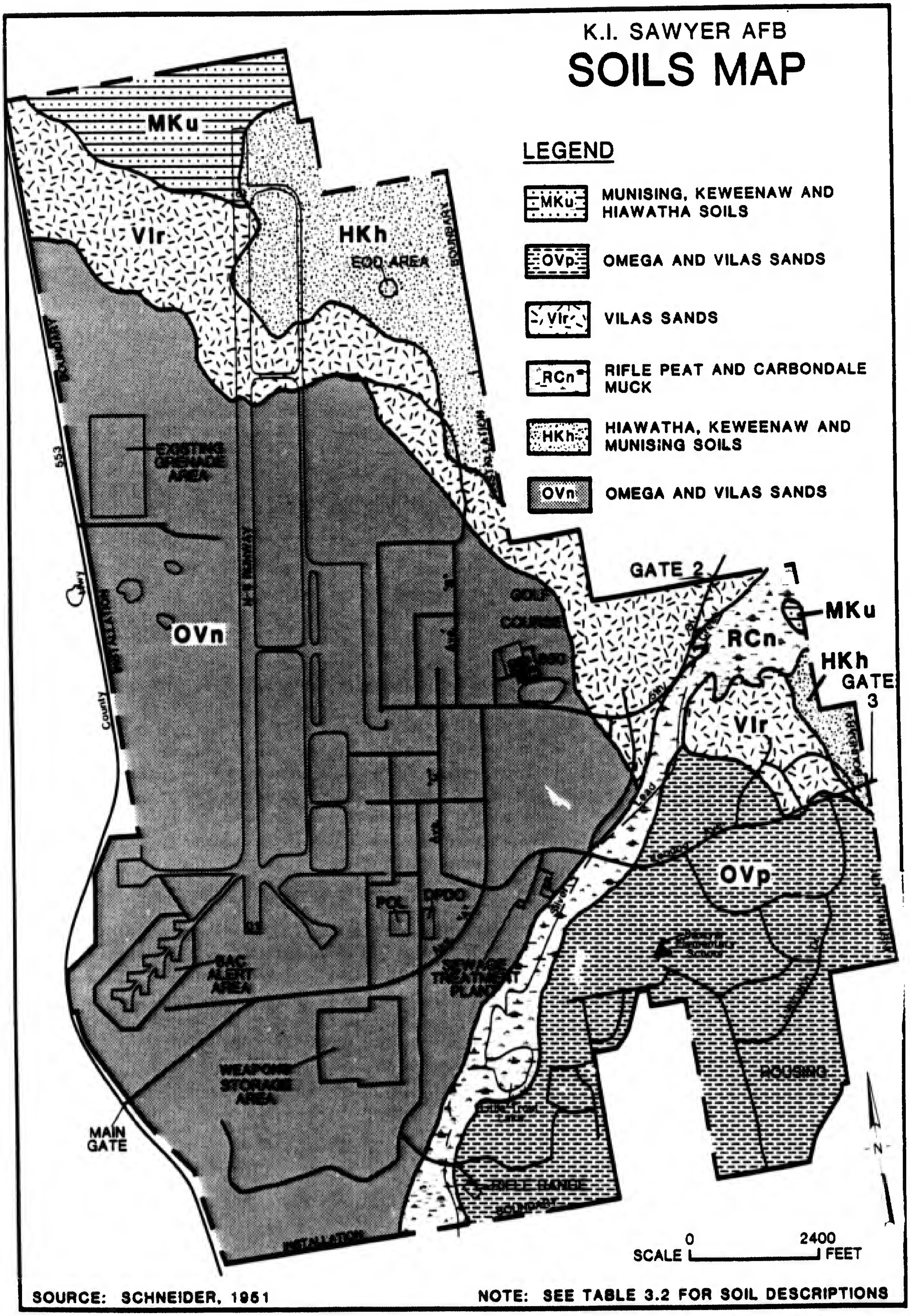

BASE LOCATION
SUPERIOR UPLAND
CENTRAL LOWLAND
Lake
Superior
Lake
Michigan
MICHIGAN
MICHIGAN
WISCONSIN
ONTARIO CANADA
UNITED STATES
MICHIGAN
WISCONSIN
Sault
Ste. Marie
Marquette
AFB
CALUMET
AFS
Calumet
Hancock
WELLS
TERMINAL
ANNEX
Escanaba
41
28
26
141
2
75
35
N
SCALE
0
60
MILES
LEGEND
REGIONAL DIVISION
SOURCE: FENNEMAN, 1930

FIGURE 3.2



SOURCE: SCHNEIDER, 1961

NOTE: SEE TABLE 3.2 FOR SOIL DESCRIPTIONS

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TABLE 3.2
SOIL CLASSIFICATION

Map Symbol	Unit Name	Dominant Soil Condition	Disposal Facility Constraints
HKh	Hiawatha, Keweenaw and Munising soils (hilly) slopes 0->25%	Surface-loamy sandy to fine sandy loam. Substratum-sand and cemented sandy clay loam drift.	Moderate to severe permeability.
MKu	Munising, Keweenaw and Hiawatha soils (undulating) slopes	Surface-loamy sand to fine sandy loam. Substratum-palm reddish cemented light sandy clay loam at 2 to 5 feet.	Moderate to severe permeability.
OVn	Omega and Vilas sands (nearly level) slopes	Surface-sand. Substratum-medium and coarse sand.	Severe permeability.
OVp	Omega and Vilas sands (pitted plain) slopes 0-3%	Surface-sand. Substratum-coarse and medium sand.	Severe permeability
RCn	Rifle peat and carbondale muck (nearly level)	Surface-brownish black woody peat which has undergone decomposition. Substratum-brown woody peat which has undergone little or no decomposition; raw fibrous peat in places.	Severe wetness. Water table at or near surface.
VIr	Vilas sand (rolling) slopes 0->25%	Surface-sand to loamy sand. Substratum-medium to coarse sand with gravel and light sandy clay loam pockets.	Severe permeability

Source: Schneider, 1951 and Ottoson, et. al., 1985 (Preliminary Data) of the available engineering properties of the K. I. Sawyer AFB soils. Bedrock is generally deeper than 60 inches.

The soil property of concern in assessing the potential for surface water infiltration is vertical permeability. These permeability values have not been determined for the base soils by the Soil Conservation Service. However, the sandy loam and sands which are present at the base will have moderate to high infiltration rates. Vertical permeability values will generally decrease at depth resulting in rapid saturation of the soils following rains. These soils will generally have severe use limitations for landfills.

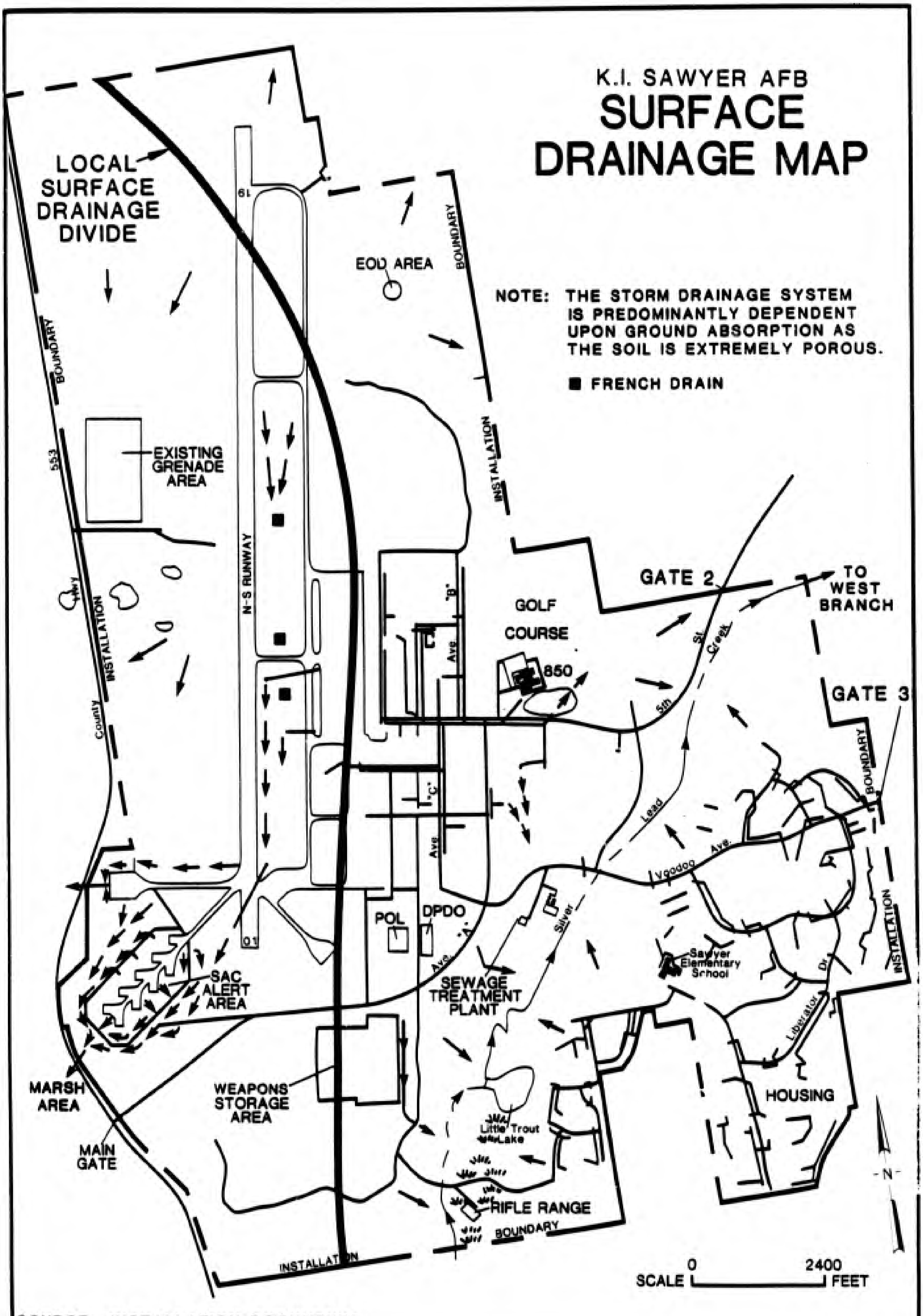
Soils present at the Wells Terminal Annex have been mapped in detail by the USDA, Soil Conservation Service. Modern soils found within the annex boundary include alluvium deposited by the Escanaba River and hardfill material used to build up the surrounding area. The alluvium tends to be material ranging from loam to sand with increasing depths that are typically poorly drained, possesses a high water table and is subject to flooding. The hardfill material consists of earth or trash, or both that has been used to build up low-lying areas and add surface area suitable for use. This soil material is too variable to be described without a site specific soil investigation.

SURFACE WATER RESOURCES

The K. I. Sawyer AFB drainage boundary is divided between the Chocolay River Basin and the Escanaba River Basin of the Upper Peninsula of Michigan. The Chocolay River flows into Lake Superior and the Escanaba River flows into Lake Michigan. The majority of the base is located within the Chocolay River Basin, and the two streams that originate on base, Silver Lead Creek and Big Creek, drain into this basin.

Drainage

Drainage control at K. I. Sawyer AFB relies predominantly on the extreme permeability of the organic topsoil and the glacial outwash extending below the topsoil. In addition, there is an underground storm drainage system (Figure 3.3). Drainage from the north end of the runway and the Explosives Ordinance Disposal Area (EOD) flows northeast toward Big Creek. The remainder of the runway is connected by drainage pipes to an outfall southwest of the SAC alert apron where surface water moves



SOURCE: INSTALLATION DOCUMENTS

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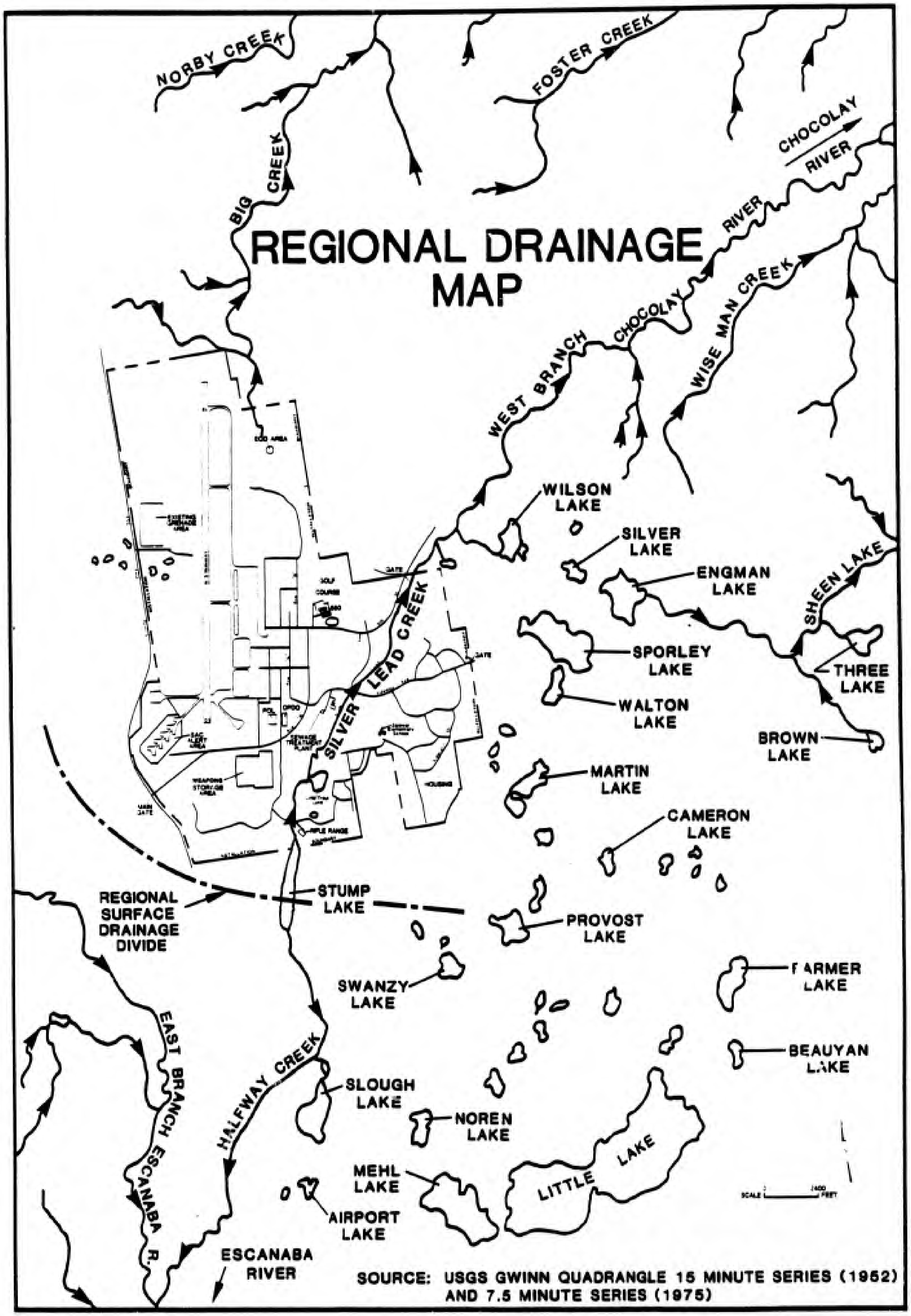
toward the East Branch of the Escanaba River. The housing area is drained by a system of pipes with drain water flowing to a number of outfalls primarily in the direction of Silver Lead Creek. Surface water from the industrial and flightline areas drains west toward several ponds and a swampy area while surface water from the hospital area drains into Silver Lead Creek.

Additional surface water resources on or in the vicinity of the base include four ponds located west of the runway, Little Trout Lake north of the rifle range, Stump Lake south of the rifle range and wetland areas south of the base boundary (USGS, 1975). A surface water divide cuts across Stump Lake, with a stream exiting at its south end (Halfway Creek) leading to the Escanaba River, and Silver Lead Creek flowing from the north end toward Little Trout Lake and the Chocolay River (see Figures 3.3 and 3.4). The wetland area occupies approximately seven acres between the two lakes and east of Silver Lead Creek (Ayres, et. al. 1982).

As drainage leaves the base via Big Creek and Silver Lead Creek it joins the area-wide drainage flowing into the Chocolay River. Big Creek flows in a north-northeast direction encompassing a drainage area over seventeen square miles. Silver Lead Creek flows in a northeasterly direction through K. I. Sawyer AFB. Shortly after exiting the base, it is joined by an unnamed tributary and becomes the West Branch of the Chocolay River with a drainage area over five square miles at that point. Approximately seven miles downstream it joins with the East Branch of the Chocolay River, forming the Chocolay River. Principal regional drainage is shown in Figure 3.4.

Land management studies for K. I. Sawyer AFB do not indicate any problems associated with flooding, even after the spring thaw. Given the topographic location, the position relative to the surface water divide, and the soil porosity, it would appear that the only area on base likely to be affected by flooding would be the low wetland area between Stump Lake and Little Trout Lake. Base documents report that under normal conditions the surface of the ground is dry forty minutes after the heaviest downpour (Fishburn, 1978).

The surface drainage control at the Wells Terminal Annex located at the mouth of the Escanaba River is assumed to be poor due to the



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presence of a high ground-water table and an area subject to frequent flooding. Surface drainage flows horizontally toward the Escanaba River or east to Little Bay de Noc.

Surface Water Quality

The quality of surface water within a drainage basin is dependent primarily on the following factors: type of rocks and soils, topography, vegetation, climate, and the level of human activities near the area. In the K. I. Sawyer AFB vicinity, the water quality in both the Chocolay River Basin and Escanaba River Basin is good. The average dissolved-solids concentration and specific conductance are less than 150 milligrams per liter and 220 umhos, respectively (Grannemann, 1979). Samples taken at Big Creek approximately six miles north of K. I. Sawyer AFB, from 1964 to 1969, indicate that the surface water quality does not vary greatly over time and distance (dissolved solids concentrations range from 85 to 116 milligrams per liter and specific conductivity values from 124 to 190 umhos). Measurements on the East Branch of the Escanaba River taken from 1955 to 1977 at Gwinn, approximately four miles south of Stump Lake, had a greater range variation with dissolved solids concentrations from 52 to 328 milligrams per liter and specific conductivity values ranging from 30 to 273 umhos. The relatively consistent values for the data at Big Creek is indicative of a strong influence by ground-water inflow, moderating the seasonal variations. Both the East Branch of the Escanaba River and Silver Lead Creek are usually clear with some turbidity occurring only during the spring thaw.

Copper and mercury concentrations within the Chocolay River Basin have occasionally exceeded recommended maximum concentrations for some marine organisms, possibly as a result of mining operations occurring in the area. Other trace metals have been within acceptable limits (Grannemann, 1979). Analyses of the dissolved solids in the surface waters at the K. I. Sawyer AFB have determined that the solids are a calcium-magnesium bicarbonate type substance, indicative of natural ground-water discharge.

The Michigan Water Resources Commission has classified the East Branch of the Escanaba River, Silver Lead Creek, Big Creek and the Chocolay River according to their usage (MWRC, 1981). Each has been designated safe for public water supply, industrial water supply, total body contact recreation, cold water fish, agriculture, and commercial (navigation) use.

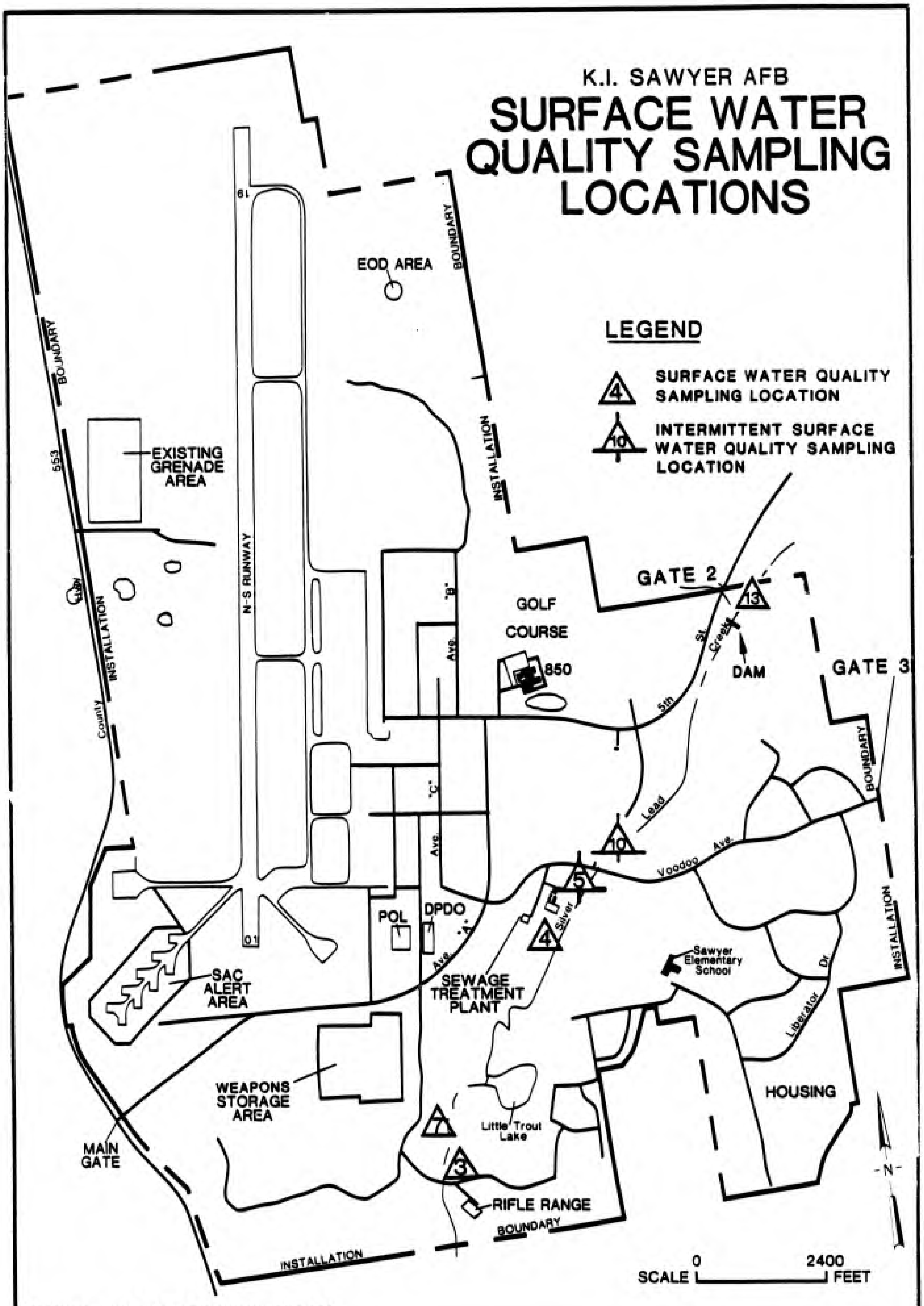
Surface water sampling on the base is presently conducted at six stations along Silver Lead Creek. Two are south of Little Trout Lake, the third is south of the sewage treatment plant, the fourth one is just north of the confluence of the sewage treatment plant effluent and Silver Lead Creek, the fifth station is at the Voodoo Avenue Bridge and the last station is at the fence where the creek exits the base property (Figure 3.5). Intermittent samplings at locations along Silver Lead Creek have been performed to determine the source of trichloroethylene (TCE) contamination downstream of the wastewater treatment plant. After collecting several surface water samples along the course of Silver Lead Creek, TCE was found to be present in water quality samples downstream of the dam on Silver Lead Creek. The presence of TCE in elevated concentrations in the ground water, (see Ground-Water Quality Section) coupled with measurable concentrations of TCE in the surface water, would suggest that contaminated ground water is discharging to Silver Lead Creek along that section of the creek. The results of selected surface water sampling data are listed in Table 3.3 and performance data for the wastewater treatment plant are summarized in Appendix D, Table D.1. Base documents indicate there have been occasional periods where the sewage treatment plant effluent has exceeded 5 day Biochemical Oxygen Demand (BOD) and suspended solids discharge limitations, but the effluent has been within limits for pH, total phosphorus, and fecal coliform bacteria.

The surface water quality of the Escanaba River at the Wells Terminal Annex is considered to be good. Rapid flow of surface water from many tributaries to the Escanaba River provides thorough mixing of the river water minimizing variations in the water composition (Sinclair, 1960).

Surface Water Use

Surface water in the immediate vicinity of K. I. Sawyer AFB and the Wells Terminal Annex is used for recreational activities and for the propagation of fish and wildlife.

FIGURE 3.5



SOURCE: INSTALLATION DOCUMENTS

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TABLE 3.3
SELECTED SURFACE WATER QUALITY DATA
FOR K.I. SAWYER AFB

Station Identification	Date	Ammonia (mg/l)	Kjeldahl Nitrogen (mg/l)	Nitrate (mg/l)	Nitrite (mg/l)	Oils & Greases (mg/l)	Organic Carbon (mg/l)	Phenols (ug/l)	Chromium VI (ug/l)	Residue, Filtrables (mg/l)	Trichloro-ethylene (ug/l)
Site 3 Snow Route Bridge	3-15-83	0.4	1.4	0.2	<0.02	0.6	5	<10	<50	108	<1
	6-20-83	<0.2	1.2	<0.1	<0.02	<0.3	13	<10	<50	170	<0.1
	10-25-83	<0.2	<1	<0.1	<0.02	<0.3	6	<10	<50	128	<0.1
	12-12-83	—	—	—	—	0.4	—	<10	<50	120	2.0
	3-14-84	0.9	2.5	0.11	<0.02	0.6	6	<10	<50	120	ND
	6-25-84	0.4	5.3	0.1	<0.02	0.3	11	<10	<50	144	<0.1
	8-30-84	<0.2	0.4	<0.1	<0.02	<0.3	<1	20	<50	115	0.2
	11-7-84	0.3	0.6	<0.1	<0.02	<0.3	2.0	<10	<50	114	—
	12-18-84	—	—	—	—	—	—	—	—	—	ND
	3-25-85	—	—	—	—	—	—	—	—	—	0.3
Site 7 Old Sanitary Landfill	3-15-83	0.6	1.7	0.2	<0.02	0.6	6.0	<10	<50	123	<0.5
	6-20-83	0.3	1.8	<0.1	<0.02	0.5	14.0	<10	<50	—	<0.1
	10-25-83	<0.2	<1.0	<0.1	<0.02	0.6	6.0	<10	<50	119	<0.1
	12-12-83	0.3	2.7	<0.1	<0.02	0.4	2	<10	<50	93	<0.1
	3-14-84	0.8	2.1	0.14	<0.02	0.6	7	<10	<50	111	ND
	6-25-84	0.3	—	0.2	<0.02	<0.3	8	<10	<50	118	<0.1
	8-30-84	0.3	1.2	<0.1	<0.02	<0.3	<1	<10	<50	127	TR
	11-7-84	0.3	0.8	0.1	<0.02	<0.3	6.0	<10	<50	126	—
	3-25-85	—	—	—	—	—	—	—	—	—	0.3
Site 5 Below Sewage Treatment Plant	3-15-83	6.0	6.0	0.8	<0.02	0.7	6.0	<10	<50	182	<1.0
	6-20-83	3.0	3.4	1.7	0.04	1.1	16.0	<10	<50	168	<0.2
	10-25-83	2.1	2.5	3.4	0.1	1.2	5.0	<10	<50	185	<0.1
	12-12-83	5.0	5.7	1.4	0.025	0.6	3.0	<10	<50	152	<0.1
	3-14-84	4.2	5.8	0.94	<0.02	0.6	7.0	<10	<50	145	ND
	6-25-84	2.7	5	1.9	<0.02	<0.3	9.0	<10	<50	194	<0.1
	8-30-84	3.6	5.3	2.4	<0.02	0.3	3.0	<10	<50	222	0.3
	11-7-84	3.6	5.5	2.0	0.09	<0.3	6.0	<10	<50	212	—
	3-25-85	—	—	—	—	—	—	—	—	—	<0.2

TABLE 3.3
(Continued)
SELECTED SURFACE WATER QUALITY DATA
FOR K.I. SAWYER AFB

Station Identification	Date	Ammonia (mg/l)	Kjeldahl Nitrogen (mg/l)	Nitrate (mg/l)	Nitrite (mg/l)	Oils & Greases (mg/l)	Organic Carbon (mg/l)	Phenols (ug/l)	Chromium VI (ug/l)	Residue, Filtrables (mg/l)	Trichloro-ethylene (ug/l)
Site 13 Silver Lead Creek	6-20-83	--	--	--	--	--	--	--	--	--	14.3
(Exiting Base at Fence)	10-25-83	0.2	<1.0	1.4	<0.02	0.5	3.0	<10	<50	151	4.0
	12-12-83	1.1	1.2	1.2	<0.02	0.4	2.0	<10	<50	144	3.8
	3-14-84	1.7	2.9	1.38	<0.02	0.6	5.0	<10	<50	141	ND
	6-25-84	0.5	3.0	1.0	<0.02	0.8	13.0	<10	<50	206	5.0
	7-5-84	--	--	--	--	--	--	--	--	--	5.0
	9-4-84	0.4	1.5	1.8	<0.02	<0.3	3.0	<10	<50	189	5.6
	11-7-84	0.9	1.7	2.3	<0.02	<0.3	4.0	<10	<50	155	--
	12-18-84	--	--	--	--	--	--	--	--	--	4.9
	3-25-85	--	--	--	--	--	--	--	--	--	4.4
Site 10 Silver Lead Creek					Trichloroethylene						
at Voodoo Hill*					(ug/l)						
	6-20-83	10-25-83	12-12-83	3-14-84	5-1-84	6-25-84	8-30-84	12-18-84	3-25-85		
	<0.1	<0.1	<0.1	5.0	ND	0.3	0.5	ND	<0.2		

ND = none detected
TR - trace
* - sampled for trichloroethylene only
-- not analyzed

Source: Installation documents

GROUND-WATER RESOURCES

K. I. Sawyer AFB is located within the Sands Plain ground-water resource area of the Upper Peninsula. The ground-water resources in the immediate vicinity of the base are abundant due to the presence of several hundred feet of stratified sand and gravel that comprise the glacial outwash aquifer underlying a thin layer of organic topsoil. These deposits are porous and free draining to a depth of more than 100 feet (Ayres, et al, 1982) and provide ample supplies of ground water from which the base obtains its water supply.

Hydrogeologic Units

Geologically, the K. I. Sawyer AFB area is underlain primarily by unconsolidated Pleistocene age glacial outwash deposits (Figure 3.6) and consolidated Cambrian and Precambrian age sandstone and igneous and metamorphic rocks (Figure 3.7). The Precambrian and Cambrian rocks form the bedrock surface upon which younger geologic materials were deposited. The depth below land surface to these rock units in the vicinity of the base varies from 100 to 300 feet (Grannemann, 1984). Glacial outwash deposits overlie the bedrock surface of the area.

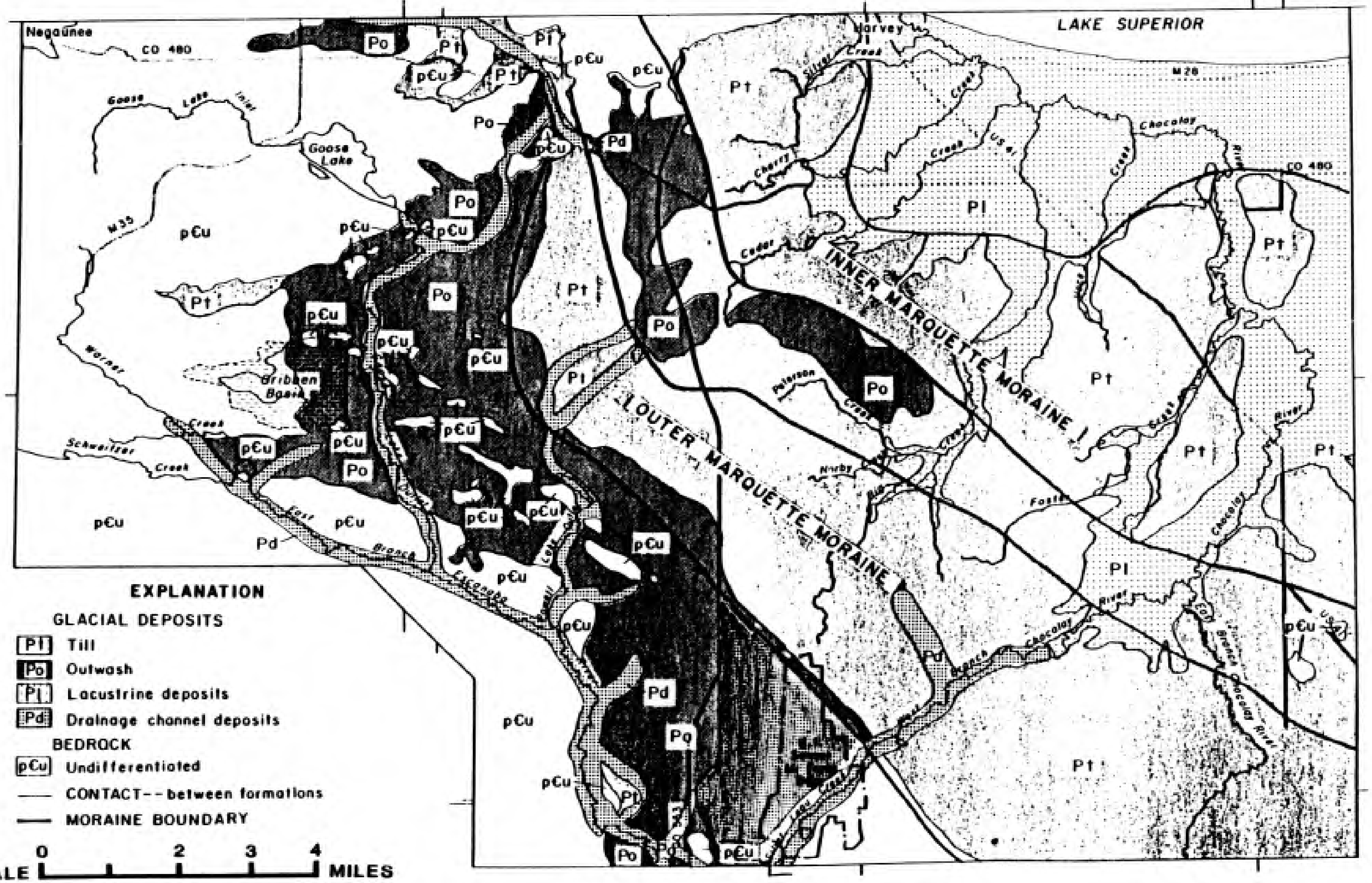
The unconsolidated deposits at the base include glacial outwash and minor amounts of glacial till of Pleistocene age and recent alluvium. The Pleistocene glacial deposits consist mainly of fine to coarse sands and gravels containing trace amounts of silt and clay which form the outwash that underlies the upland surface in the area. The recent alluvial deposits are restricted to locations primarily along Silver Lead Creek and its tributaries. The general stratigraphy in the vicinity of the base is presented in Table 3.4. No fault or fracture systems are present in the immediate vicinity of K. I. Sawyer AFB.

The bedrock surface underlying the base slopes to the northeast toward Big Creek where a major valley extends from K. I. Sawyer AFB to Lake Superior. This valley was formed as a result of erosion by ancient streams and glacial ice (Grannemann, 1984). As a result of the last glaciation (Wisconsinian Stage) the valley was filled with glacial till and outwash deposits as the glacier retreated north toward Lake Superior.

The shallow geology and lithology of the base are illustrated by Figures 3.8 and 3.9. Figure 3.8 shows the location of the hydrogeologic

FIGURE 3.6

REGIONAL DISTRIBUTION OF GLACIAL DEPOSITS

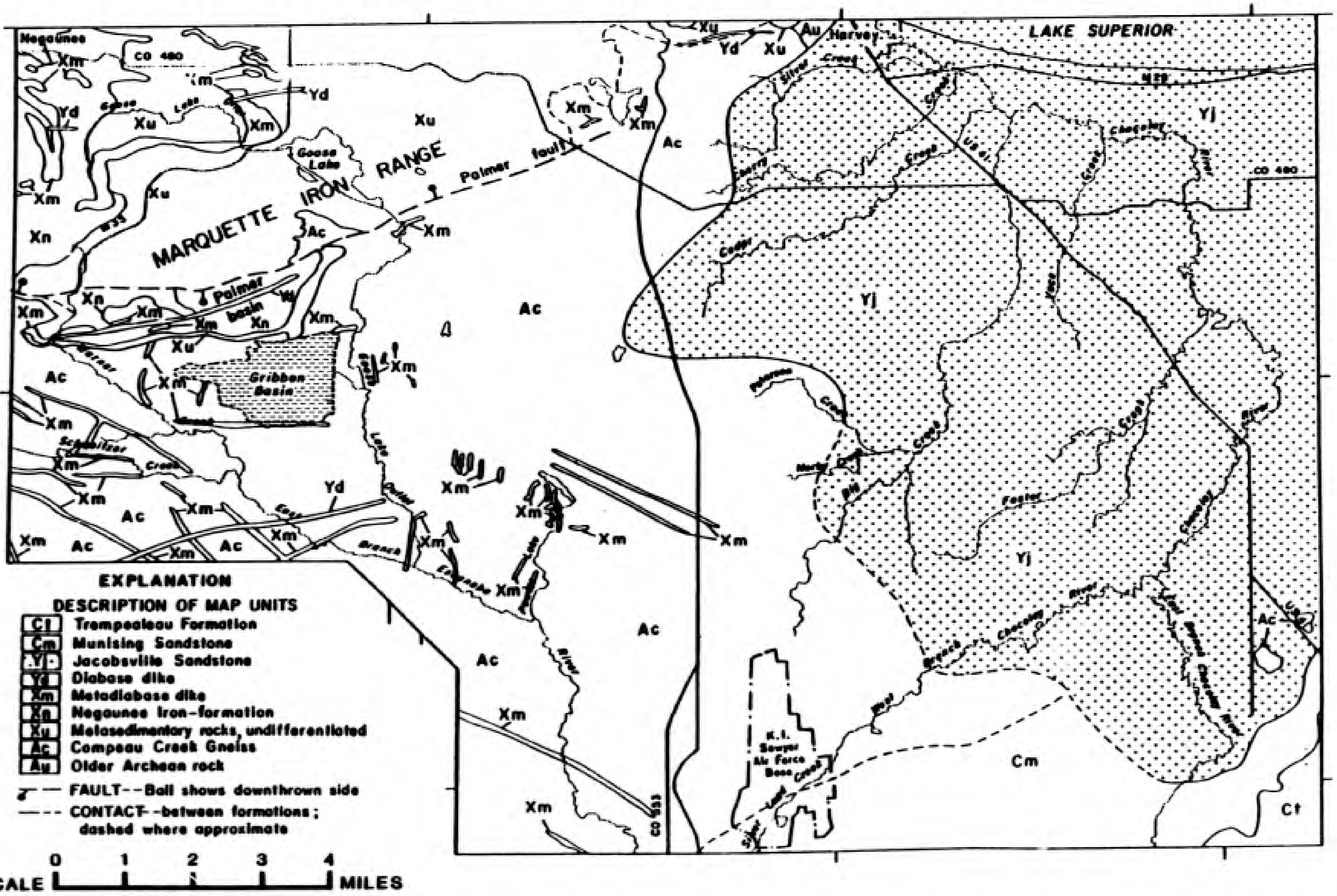


SOURCE: MODIFIED FROM GRANNEMANN, 1984

NOTE: SEE TABLE 3.4 FOR EXPLANATION

FIGURE 3.7

REGIONAL BEDROCK GEOLOGIC MAP



SOURCE: MODIFIED FROM GRANNEMANN, 1984

NOTE: SEE TABLE 3.4 FOR EXPLANATION

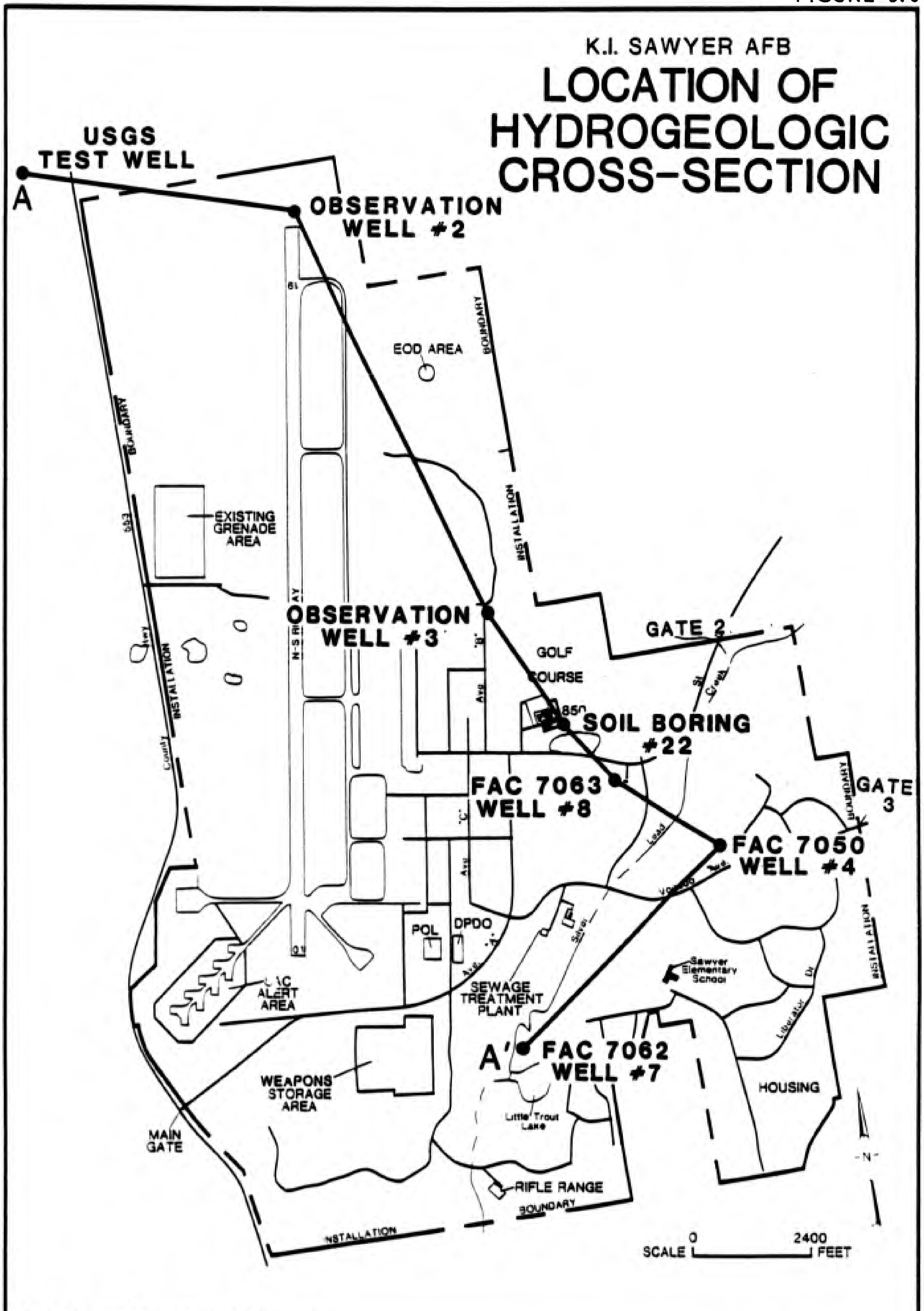
TABLE 3.4

HYDROGEOLOGIC UNITS AND THEIR WATER-BEARING CHARACTERISTICS IN THE VICINITY OF KI SAWYER AFB

Age	Hydrogeologic Unit	Hydrogeologic Classification	Approximate Thickness	Dominant Lithology	Water-Bearing Characteristics
Pleistocene	Glacial Outwash	Chief Aquifer	Up to 300 ft.	Stratified sand and gravel.	Readily transmits water. Wells yield up to 1000 gpm.
	Glacial Moraines	Localized Aquifer	Up to 300 ft.	Unstratified clay, silt, sand, gravel and boulders.	Does not readily transmit water. May provide sufficient amount for domestic use.
	Glacial Lakebeds	Localized Aquifer	10 to 30 ft.	Stratified layers of fine sand, silt, and clay.	Locally transmits water where there are sufficient amounts of sand.
Cambrian	Munising Sandstone	Localized Aquifer	Up to 200 ft.	Conglomerate overlain by light-colored sandstone.	Yields small amounts of water. Seldom used due to availability from overlying glacial deposits.
Precambrian	Jacobsville Sandstone	Localized Aquifer	1 to 100 ft.	Red to red-brown sandstone, occasional beds of shale and conglomerates.	Yields small amount of water. Seldom used due to availability from overlying glacial deposits.
	Metamorphosed Granite	Confining Unit	Undetermined	Quartzite, schist, gneiss, granite, diorite, iron-bearing rocks.	Water bearing capacity low. Seldom used due to availability from overlying glacial deposits.

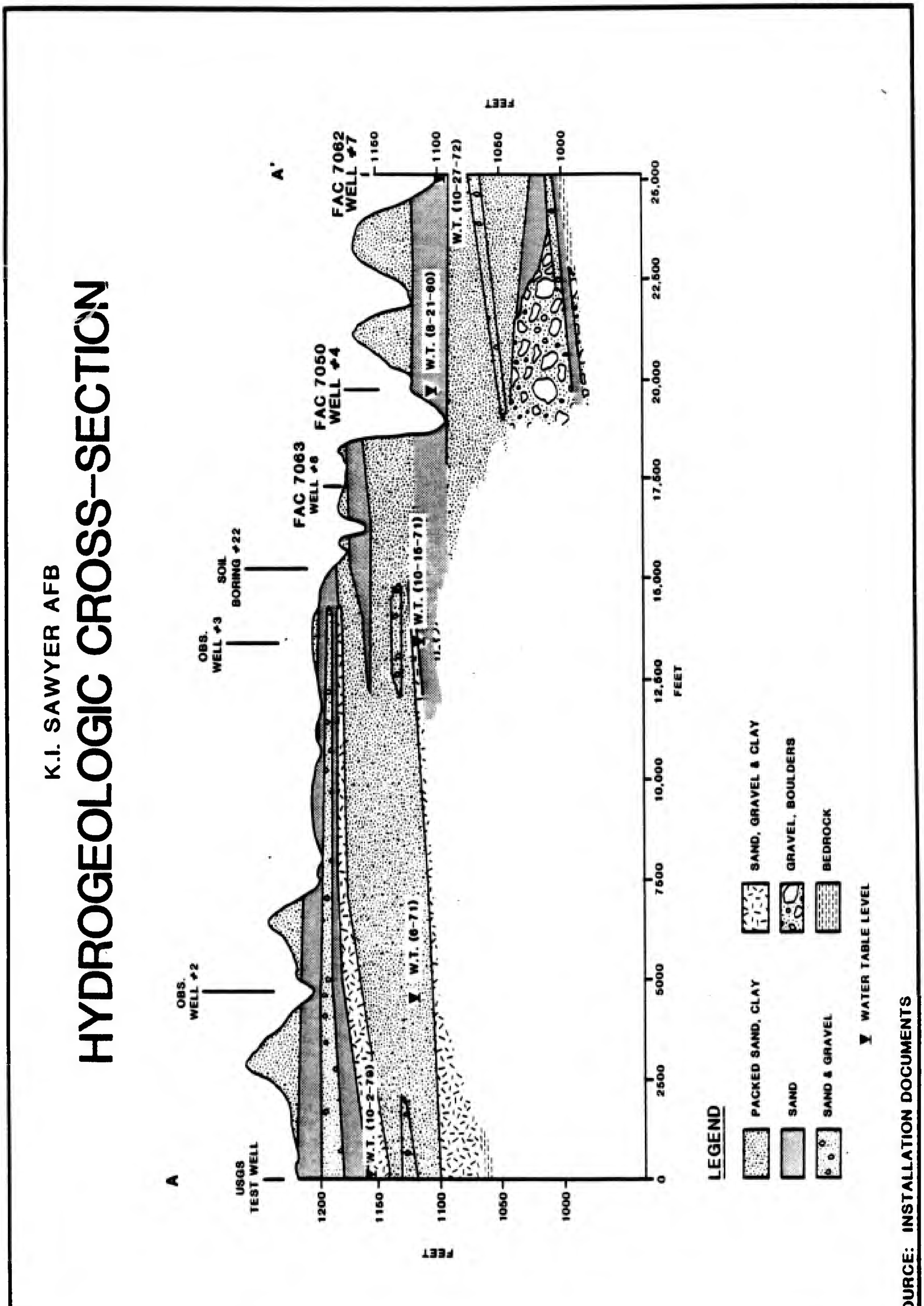
Sources: N. G. Grannemann, 1984, F. R. Twenter, 1981.

FIGURE 3.8



SOURCE: INSTALLATION DOCUMENTS

ES ENGINEERING-SCIENCE



SOURCE: INSTALLATION DOCUMENTS

cross section across portions of the base. Figure 3.9 illustrates cross section A-A' showing boring locations advanced into the unconsolidated glacial outwash deposits. The water table was reached by each well. Records suggest that ground-water levels at these locations have remained relatively stable over the years (Ayres, et. al., 1982).

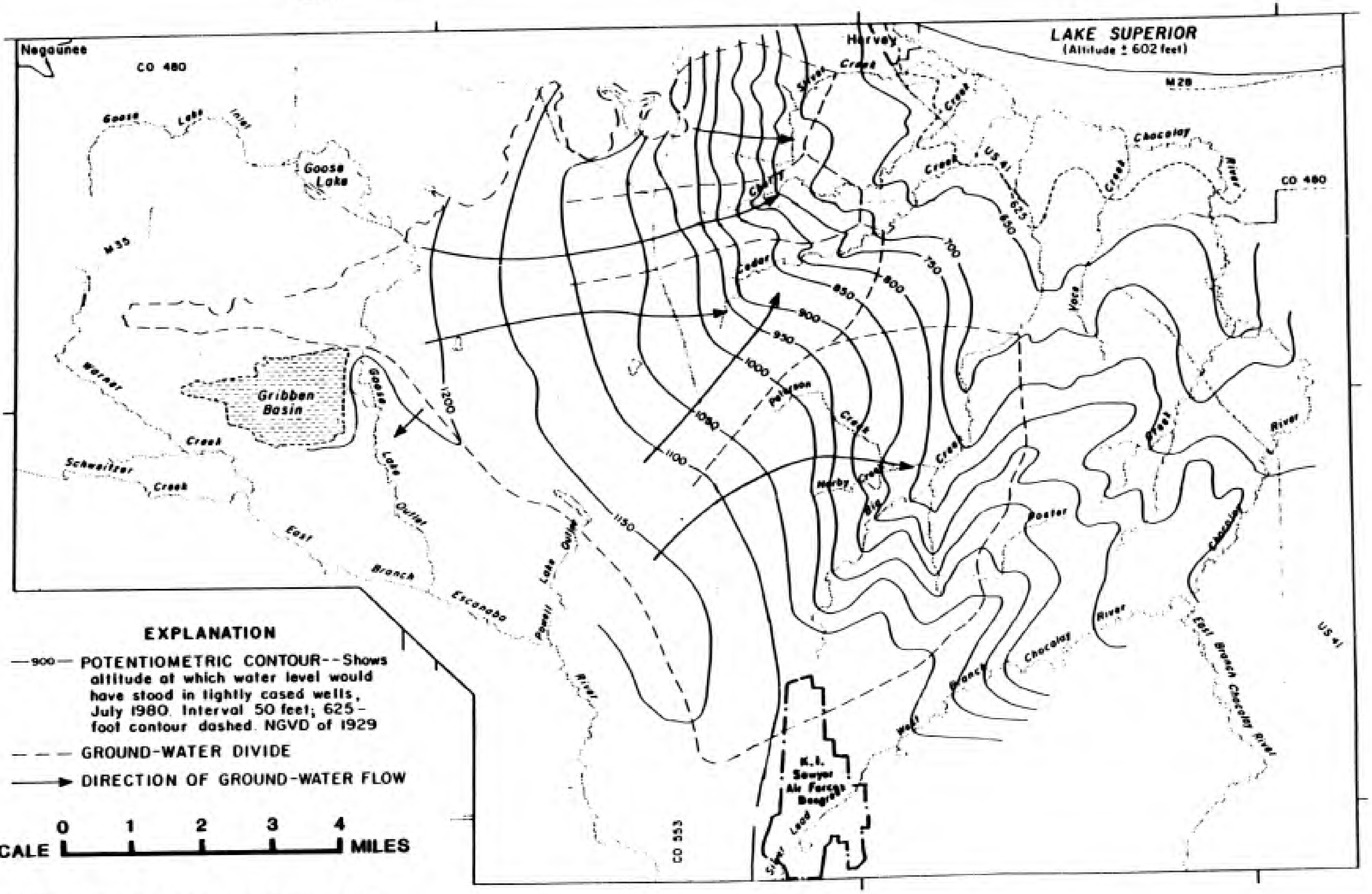
Hydrogeologically, K. I. Sawyer AFB is located in an area of abundant ground-water supply. The principal source of ground water for the region is derived from the unconsolidated glacial outwash deposits which yield ample supplies of water for the base. Additionally, the glacial outwash deposits overlie bedrock aquifers of moderate permeability capable of storing large quantities of ground water. Because these units underlie an excellent aquifer they are seldom tapped for water supplies. Wells tapping the outwash aquifer on the base have been reported to yield between 150 and 1,000 gallons per minute, drawing on the average 1.3 million gallons per day (Tweener, 1981).

An examination of the installation geomorphic setting suggests the base lies within a ground-water recharge zone. The base is constructed on nearly level, sandy upland where ground-water elevations typically exceed the local surface water elevations by several feet. Recharge of these aquifers occurs by precipitation and snowmelt infiltrating the sandy soils at a rate of approximately 15 inches per year (Grannemann, 1984), the excess ground water discharges as springs to Little Trout Lake and other nearby lakes, inflow into local streams, or may migrate horizontally off base.

Most of the ground water is contained within and migrates through the unconsolidated glacial deposits of the Sands Plain area downgradient toward Lake Superior. The occurrence and movement of ground water in the vicinity of the base is closely related to that of the surface water (Grannemann, 1984). The area streams typically have high base flows and low flood peaks. In addition, some area lakes have no obvious outlets, indicative of a surface expression of the ground-water table. These factors are indicative of the close connection between the ground water and the surface water. The flow direction within the glacial outwash aquifer underlying the base is generally northeast and east toward Silver Lead Creek, a natural discharge point for the outwash aquifer (see Figure 3.10). Localized flow direction changes are assumed to

FIGURE 3.10

REGIONAL POTENTIOMETRIC SURFACE CONTOUR OF THE GLACIAL AQUIFER



EXPLANATION

—900— POTENTIOMETRIC CONTOUR--Shows altitude at which water level would have stood in tightly cased wells, July 1980. Interval 50 feet; 625-foot contour dashed. NGVD of 1929

– – – GROUND-WATER DIVIDE

——▶ DIRECTION OF GROUND-WATER FLOW

SCALE 0 1 2 3 4 MILES

SOURCE: MODIFIED FROM GRANNEMANN, 1984

exist near base wells 4, 5 and 7 which supply the majority of public water to the base. According to Grannemann (1981), water from the base wells have shown an increase in dissolved solids concentrations in the past several years which may indicate pumping has altered the ground-water flow under the base. Selected data for base wells used as public water supply are presented in Appendix D, Table D.2.

Ground water within the uppermost aquifer generally occurs under unconfined or water table conditions, but may exist under confined or artesian conditions. Aquifer tests performed on base indicate a semi-confining to confining condition existing within the glacial outwash aquifer with a horizontal hydraulic conductivity of 30 to 50 feet per day and a storage coefficient of 0.0001 to 0.007 (Grannemann, 1984).

Underlying the glacial outwash deposits in the vicinity of K. I. Sawyer AFB are the consolidated rock units of the Precambrian Age Compeau Creek Gneiss and the Cambrian Age Munising Sandstone. Because these units underlie an excellent aquifer they are seldom tapped for water supplies and little is known about their hydraulic characteristics. Specific capacity tests performed on the Munising Sandstone aquifer have yielded information suggesting horizontal hydraulic conductivities of 8 feet per day (Grannemann, 1984). Migration of water within the bedrock aquifers are moderate, but may be rapid depending upon the presence of interconnecting rock openings. The flow direction within the bedrock aquifers underlying the base is generally northeast toward Lake Superior.

The Wells Terminal Annex, located at the mouth of the Escanaba River, is underlain by glacial lake deposits that are predominantly sands of moderate permeability which locally contain clay and silt of low permeability (Sinclair, 1960). This unit is approximately 10 to 50 feet thick in the study area. Shallow hydrogeologic conditions in the vicinity of the site suggest the lake deposits are generally saturated with water except where modifications have been performed to make the land usable. In general the lake deposits are sandy and of sufficient permeability to provide adequate supplies of water for domestic use.

The Glacial Lake Deposits are underlain by the Ordovician age Trenton and Black River limestones (Sinclair, 1960). These units are characterized by thin, irregular beds of grey to buff colored limestone and dolomite interbedded with thin shale layers 300 feet thick. Hydrogeologically these rock units yield small amounts of hard water which locally are high in sodium and chloride content. The movement of ground water within these units is to the east toward Lake Michigan.

Ground-Water Quality

The ground-water quality within the uppermost aquifer underlying the base is relatively good. The best ground-water supplies are derived from the glacial outwash deposits. The bedrock aquifers usually furnish highly mineralized water. A review of ground-water quality data (Grannemann, 1984) based upon chemical analyses of samples obtained from representative study area glacial deposit wells indicate that dissolved solids concentrations range from 26 to 352 milligrams per liter while the dissolved solids concentrations in samples obtained from bedrock aquifer wells ranged from 69 to 4040 milligrams per liter.

One ground-water parameter of concern within the outwash aquifer is TCE, which has been found in base wells 4, 5 and 7 (see Table 3.5). Well number 8 was installed in 1974 to a depth of 186.5 feet as a test well to locate an additional ground-water supply for the base. This well was not developed and tied into the base water system at that time. In 1984 the well was pumped and tested and scheduled to be tied into the base water system by 1985. During this testing TCE and other organic constituents were detected in the well. The results of this testing are presented in Table 3.6. The source of the high TCE concentrations have not been identified.

Generally the quality of the ground-water at the Wells Terminal Annex is considered to be acceptable within the glacial lake deposits. The Trenton and Black River formations also produce acceptable quality water which may be hard and locally contain high concentrations of sodium and chloride. No site specific ground-water quality data are available for the Wells Terminal Annex.

Ground-Water Use

Ground water from the uppermost aquifer is used on K. I. Sawyer AFB as the primary supply of water for the base and surrounding communities. Figure 3.11 shows the location of the base wells and Figure 3.12 shows the location of known wells in the area and number of wells present in

TABLE 3.5
TRICHLOROETHYLENE DATA SUMMARY

Sampling Date	Well 4 (ug/l)	Well 5 (ug/l)	Well 7 (ug/l)
2-21-78	<1.5	<1.5	2.6
2-29-79	4.7	<1.5	<1.5
6-27-79	10.1	10.8	1.8
6-26-80	ND	ND	ND
9-24-80	<1.0	<1.0	<1.0
12-16-80	<1.0	<1.0	<1.0
3-17-81	<1.0	<1.0	<1.0
9-15-81	0.4	0.5	<0.2
12-15-81	<0.5	<1.0	<1.0
3-15-82	<1.0	<1.0	NA
6-15-82	<1.0	<1.0	<0.5
3-15-83	<1.0	<1.0	<1.0
6-20-83	<0.1	<0.1	0.3
9-14-83	<0.1	<0.1	<0.1
12-12-83	<0.1	0.3	0.2
3-14-84	ND	ND	ND
6-25-84	ND	0.5	0.4
7-24-84	<0.1	<0.1	0.6
8-23-84	0.3	<0.2	NA
9-05-84	ND	0.5	0.4
10-25-84	NA	NA	ND
12-04-84	<0.2	<0.2	0.3
1-10-85	NA	ND	NA
2-05-85	ND	NA	ND
3-12-85	NA	ND	NA
4-16-85	0.2	0.2	0.2

ND: Not Detected
NA: Not Analyzed

Source: Installation Documents

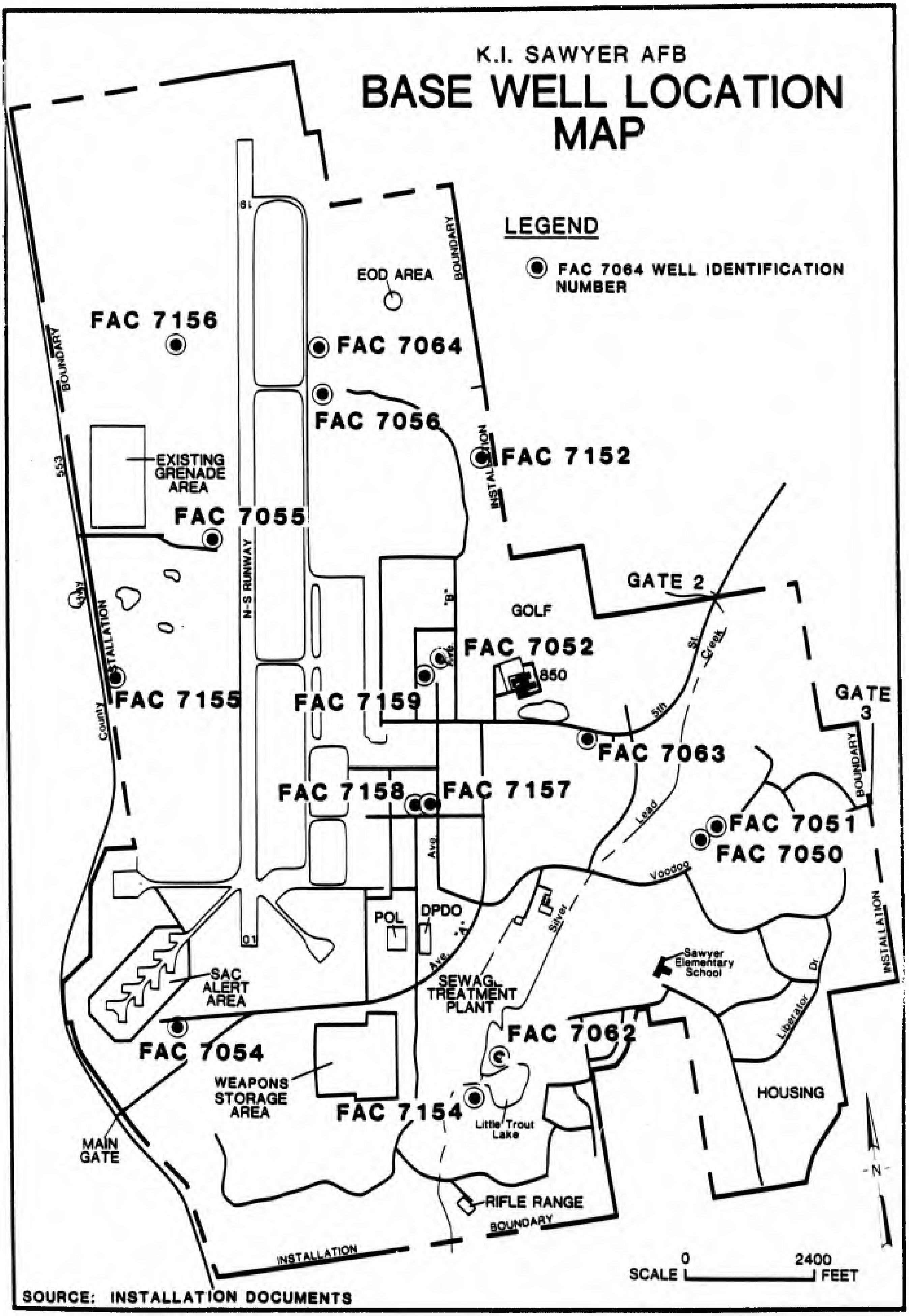
TABLE 3.6
WELL 8 ANALYTICAL RESULTS

Date	Sample Depth (ft)	1,1 Dichloro-ethane (ug/l)	1,2 Dichloro-ethane (ug/l)	Tetrachloro-ethane (ug/l)	1,1,1 Trichloro-ethane (ug/l)	Trichloro-ethylene (ug/l)	Vinylidene Chloride (ug/l)	Benzene (ug/l)	Chloro-form (ug/l)	Chloro-benzene (ug/l)	Tetrachloro-ethylene (ug/l)
24 May 84 (1)	uk	--	2.0	2.0	111	1280	2.0	--	--	--	--
26 June 84 (1)	uk	--	2.0	4.0	110	790	3.0	--	--	--	--
26 June 84 (2)	uk	--	--	1.9	6.7	431	--	--	--	--	--
26 June 84 (3)	uk	--	--	ND	87	340	--	--	--	--	--
25 April 84 (4)	82 (5)	11.7	5.4	--	--	6.9	--	1.4	--	--	--
25 April 84 (4)	162 (5)	--	2.5	--	125	1045	--	--	--	--	2.8
25 April 84 (4)	92 (6)	--	2.4	--	120	1007	--	--	1.2	--	2.5
25 April 84 (4)	92 (7)	--	2.3	--	119	963	--	--	--	0.77	1.4

NOTE:

(1) Analysis performed by Michigan Department of Public Health.
(2) Analysis performed by USAF OEHL.
(3) Analysis performed by US Army Corps of Engineers.
(4) Analysis performed by USGS (Source: Norman G. Granneman, USGS).
(5) Analysis performed on ground water sample prior to pumping.
(6) Analysis performed on ground water sample after two hours pumping.
(7) Analysis performed on ground water sample after five hours pumping.
uk = unknown
nd = not detected
-- = not analyzed

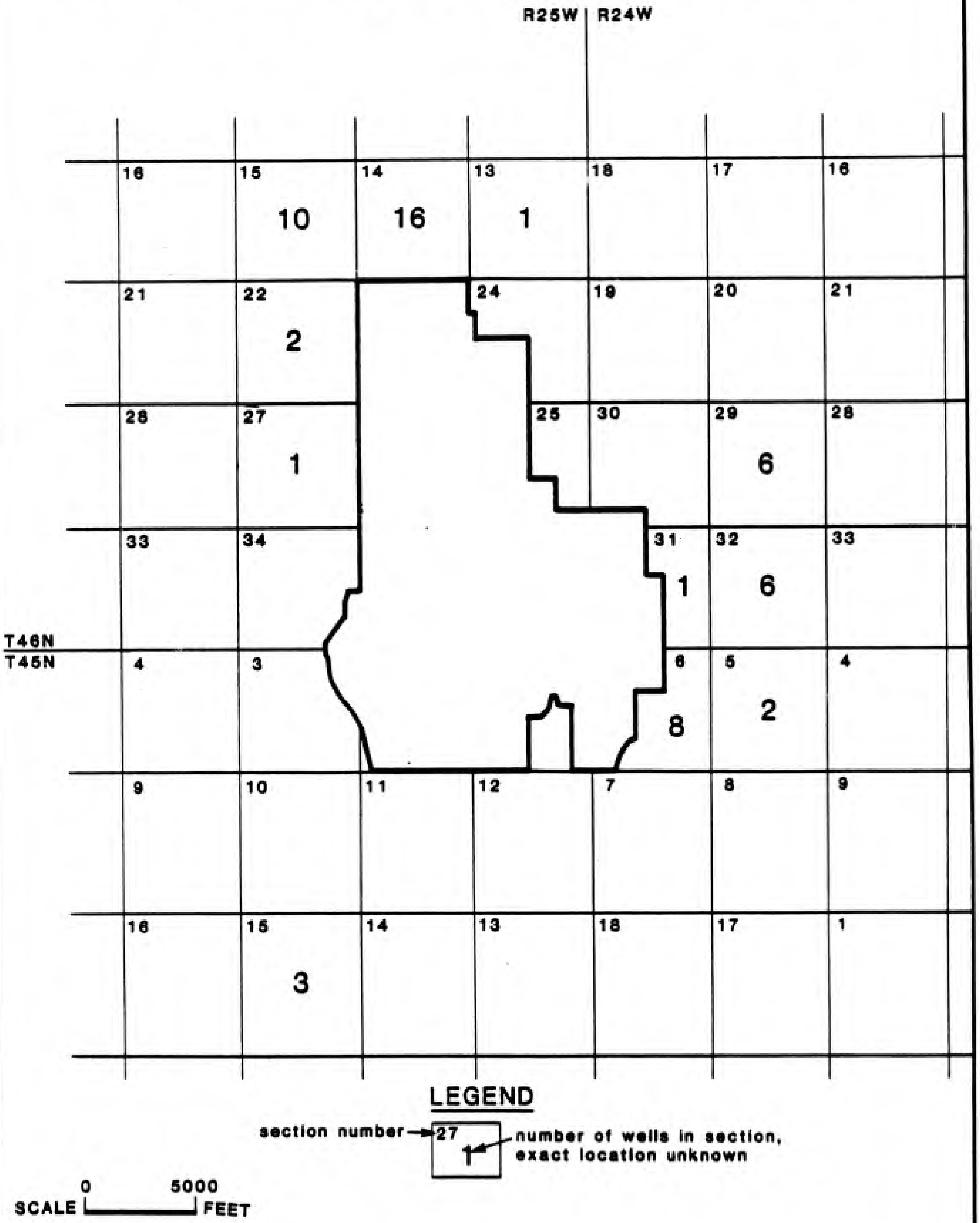
FIGURE 3.11



SOURCE: INSTALLATION DOCUMENTS

FIGURE 3.12

REGIONAL WELL LOCATION MAP



SOURCE: INSTALLATION DOCUMENTS

each land section where the exact well location is unknown. Ground water from the outwash aquifer is used on the base as follows:

Wells	Water Supply Use
4, 5 and 7	Primary
6	Emergency Basis
1, 2, 3, and 8	Inactive

Ground water from the outwash aquifer is also used off base for home and farm supplies. The remainder of the wells with records from the Michigan Department of Natural Resources did not specify a detailed well location such that each well in each section could be individually plotted on the map. Instead, the number of wells in each land section has been plotted. Appendix D, Table D.3 summarizes the well data available for the wells of the area. Of the local wells in use most are either domestic (serving residences and/or farms) or non-community (serving the transient public, churches and schools).

Ground water from the uppermost aquifer in the vicinity of the Wells Terminal Annex is used for home water supplies. The annex currently utilizes ground water as its primary source of drinking water.

BIOTIC ENVIRONMENT

The land management plan for K. I. Sawyer AFB states that there are 1,805 acres of fish and wildlife land areas on base. Representative wildlife species include deer, bear, snowshoe hare, fox, coyote, racoon, skunk, woodchuck, porcupine, mink, and bobcat. Muskrat, beaver and otter may also reside in the area. In addition to a variety of song-birds, woodcock, ruffled grouse and spruce grouse may be found. Silver Lead Creek and the East Branch of the Escanaba River are cold water trout streams. (Ayres, et al, 1982). No threatened or endangered species are known to permanently inhabit K. I. Sawyer AFB or its satellite facilities. The existence of open lands with grasses, woodlands with both hardwood and pine, and wetland promotes the continued existence and growth of wildlife on the base.

SUMMARY OF ENVIRONMENTAL SETTING

The environmental setting information for K. I. Sawyer AFB and Wells Terminal Annex indicated the following data as important when evaluating past hazardous waste disposal practices.

1. The mean annual precipitation for K. I. Sawyer AFB and Annexes is 34.0 inches; the net precipitation is approximately + 9.0 inches and the one-year, 24-hour rainfall event is approximately 2.0 inches. These data indicate that there is an abundance of rainfall in excess of evaporation and that there is a potential for storms to generate high runoff and ground-water recharge.

2. The soils on the base are sandy loam to sands with moderate to high vertical permeability. These data indicate that recharge by precipitation infiltrating the soils will be high.

3. Two aquifers exist at K. I. Sawyer AFB. The uppermost aquifer consists of the unconsolidated glacial outwash deposit to depths of 300 feet. The bedrock aquifer exists at depths from 60 to 300 feet.

4. Ground water underlying K. I. Sawyer AFB and within the uppermost aquifer exists under semi-confined to confined conditions at depths as shallow as 5 feet. The most permeable zone within the upper aquifer is the top of the weathered rock zone and within the stratified sands and gravels.

5. Ground water underlying the base and within the bedrock aquifer exists under confined conditions. The bedrock aquifer is continuous in the vicinity of the base. This aquifer is seldom tapped due to the excellent aquifer which overlies the bedrock aquifer.

6. Ground-water contamination by organic chemicals at K. I. Sawyer AFB within the upper aquifer has been recorded at well 8.

7. The ground water within the uppermost aquifer at K. I. Sawyer AFB is thought to discharge to Silver Lead Creek.

8. The uppermost aquifer at K. I. Sawyer AFB is the principal source of potable water for the base. The bedrock aquifer is seldom used.

9. There are no known federally or state-listed endangered or threatened species which permanently inhabit K. I. Sawyer AFB or its satellite facilities.

10. The soils at the Wells Terminal Annex consist of loam and sand that are poorly drained, possess a high water table and are subject to frequent flooding.

11. Two aquifers are present at the Wells Terminal Annex. The uppermost aquifer consists of unconsolidated glacial lake deposits to depths of 50 feet. The bedrock aquifer exists from depths of 60 to 350 feet.

12. Ground water at the Wells Terminal Annex within the uppermost aquifer exists under unconfined conditions typically within 5 feet of the ground surface. The most permeable zone within the upper aquifer is the top-of-the-rock zone where highly weathered, fractured, jointed and solution rock may exist.

13. The bedrock aquifer at the Wells Terminal Annex exists under confined conditions. The bedrock aquifer is continuous within the vicinity of the study area and wells with the highest yields penetrate the interconnecting fractures, joints and solution channels.

14. The bedrock aquifer at the Wells Terminal Annex is the primary source of potable water for the area.

A review of these major findings indicates that pathways for the migration of hazardous waste-related contamination exist. Contaminants present at ground surface would likely infiltrate the highly permeable soils or be discharged into local drainage alignmerts via the shortest pathway. The top-of-rock zone and sand and gravel zone are expected to be the most permeable within the uppermost aquifer. Contamination, if released, would be expected to migrate vertically and horizontally within these zones. Localized downward vertical migration of ground water and contaminants, if released, may occur within interconnected fractures, joints or solution channels within the bedrock aquifer underlying the base or its satellite facilities.

SECTION 4

FINDINGS

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

INSTALLATION HAZARDOUS WASTE ACTIVITY REVIEW

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

The sources of hazardous waste at K.I. Sawyer AFB are grouped into the following categories:

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

The subsequent discussion addresses only those wastes generated at K.I. Sawyer AFB which are either hazardous or potentially hazardous. Potentially hazardous wastes are grouped with and referenced as "hazardous wastes" throughout this report. A hazardous waste, for this report, is defined by, but not limited to, the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA). Compounds such as polychlorinated biphenyls (PCB) which are listed in the Toxic Substances Control Act (TSCA) are also considered hazardous. For the purpose of this study, waste petroleum products such as contaminated fuels, waste oils and waste nonchlorinated solvents are also included in the "hazardous waste" category.

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

Industrial Operations (Shops)

Information on industrial operations at K.I. Sawyer AFB was obtained from installation files and interviews. This information was used to determine which operations handle hazardous materials and which ones generate hazardous wastes. The Bioenvironmental Engineering Section (BES) provided a listing of industrial shops as well as individual shop files indicating past waste generation and hazardous material disposal practices. Summary information on all installation shops is provided as Appendix E, Master List of Shops.

There are 12 main units conducting industrial operations at K.I. Sawyer AFB:

- 410 Avionics Maintenance Squadron
- 410 Civil Engineering Squadron
- 410 Field Maintenance Squadron
- 410 Organizational Maintenance Squadron
- 410 Transportation Squadron
- 410 Munitions Maintenance Squadron
- 87 Fighter Interceptor Squadron
- 410 Supply Squadron
- 410 Combat Support Group
- USAF Hospital, K.I. Sawyer
- 2001 Information Systems Squadron
- 410 Security Police Squadron

For the shops identified as generating hazardous wastes, file data were reviewed and personnel were interviewed to determine the types and quantities of materials handled and present and past disposal methods. This information is summarized in Table 4.1.

Most shops were established in the late 1950's, when the base began operations. Hazardous wastes were generated from the onset of shop activities; however, due to the low proportion of long term shop employees, little information is available regarding the generation and disposal of these materials prior to 1970. Interviews with civilian personnel present at the base in earlier years were performed and this information was used to develop the time lines shown in Table 4.1.

Wastes generated at K.I. Sawyer AFB consist primarily of contaminated jet fuel (JP-4), waste solvents (including paint strippers and thinners), waste oil and other petroleum products, acids, and paints.

Most waste jet fuel generated by shop and fueling/defueling operations has been sent to Base Fuels Operations (POL) to be analyzed for contamination. Uncontaminated JP-4 is returned to the bulk fuel supply system, while contaminated fuel is either sent directly to the Fire Department for use in fire training exercises or stored in a 5000-gallon underground tank at Building 609 (Refueling Truck Maintenance) prior to disposal off-base by contract. These practices have been in effect for at least 10 years. Prior to this, waste JP-4 was handled by individual shops or squadrons and was often used by the Fire Department.

Since 1970, approximately half the waste solvents (primarily PD-680) generated by K.I. Sawyer shop activities have been collected in bowsers and drums in the shop areas and disposed off-base by contract. A few shops historically released PD-680 to the industrial sewer. Prior to the mid-1970's and the installation of the industrial sewer, these wastes were released to the storm sewer. Currently shops hold waste PD-680 for disposal off-base by contract. Additionally, a small amount of PD-680 is released to the industrial sewer following pretreatment in oil/water separators.

For at least the last 10-15 years, waste paint thinner has been sent to the DPDO prior to off-base disposal. Paint remover, generated as a waste by three shops, was either collected for disposal off-base by contract (since 1984 most of this quantity has been sent to the DPDO), or released to the industrial sewer (storm sewer prior to the mid-1970's).

TABLE 4.1
INDUSTRIAL OPERATIONS (Shops)
Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL 1955 1965 1975 1985
410 AVIONICS MAINTENANCE SQUADRON				
PMEL	708	MERCURY	20 LB/YR.	1958 LANDFILL/OBC - - - - ▸+ - - DPDO ——▸
ELECTRONIC COUNTER MEASURE	725	SILICON-BASE COOLANT	55 GALS./YR.	1960 LANDFILL/ STORM SEWER - - - ▸+ - - DPDO - - ▸
		TRICHLOROETHANE	2 PINTS/YR.	STORM SEWER - - - ▸+ - - DPDO - - ▸ 1983
DEFENSE FIRE CONTROL	725	PD-680	120 GALS./YR.	LANDFILL/ STORM SEWER - - - ▸+ - - OBC - - ▸
		HYDRAULIC FLUID	12 GALS./YR.	LANDFILL/OBC - - - ▸+ - - OBC - - ▸
410 CIVIL ENGINEERING SQUADRON				
ENTOMOLOGY	531	EMPTY CANS & CONTAINERS	100 CONTAINERS/YR.	1960 - - - TRIPLE RINSE & DISPOSED IN LANDFILL/DPDO ——▸
PAINT SHOP	531	PAINT THINNER	200 GALS./YR.	1961 LANDFILL/OBC - - - ▸+ - - DPDO - - ▸
		LATEX	50 GALS./YR.	LANDFILL /OBC - - - ▸+ - - DPDO - - ▸
CENTRAL HEATING PLANT	521	NO. 6 FUEL OIL	156 GALS./YR.	1958 - - - BURN WITH COAL ——▸
		WASTE OIL	165 GALS./YR.	- - - BURN WITH COAL ——▸
POWER PRODUCTION	530	WASTE OIL	850 GALS./YR.	OBC/LANDFILL - - - ▸+ OBC ——▸

KEY

——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

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

OBC = DISPOSAL, TREATMENT OR REUSE OFF-BASE BY CONTRACT

DPDO = DEFENSE PROPERTY DISPOSAL OFFICE

TABLE 4.1 (CONT'D)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1955 / 1965 / 1975 / 1985)
410 CIVIL ENGINEERING SQUADRON (cont'd)				
PAVEMENTS & GROUNDS SECTION	533	DEGREASER SOAP	1650 GALS./YR.	1959 STORM SEWER; INDUSTRIAL SEWER
		OIL/HYDRAULIC FLUID	480 GALS./YR.	LANDFILL/OBC; OBC
REFRIGERATION	709 (530 prior to 1977)	COMPRESSOR OIL	60 GALS./YR.	1956 LANDFILL/OBC; OBC
EXTERIOR ELECTRIC	530	PCB-CONTAMINATED TRANSFORMER FLUID	1500 GALS./YR.	OBC; DPDO
		NON-PCB TRANSFORMER FLUID	100 GALS./YR.	LANDFILL/OBC; DPDO
410 FIELD MAINTENANCE SQUADRON				
PNEUDRAULICS	725	PD-680	1300 GALS./YR.	1960 LANDFILL/STORM SEWER; OBC
		HYDRAULIC FLUID	350 GALS./YR.	LANDFILL/OBC; OBC
REPAIR/RECLAMATION	615	PAINT REMOVER	990 GALS./YR.	1959 LANDFILL/STORM SEWER; OBC; DPDO
		PD-680 (AND MINIMAL AMOUNTS OF TOLUENE)	345 GALS./YR.	LANDFILL/STORM SEWER; OBC
AGE	610	JP-4 (CONTAMINATED)	1800 GALS./YR.	1961 FPTA/OBC

KEY

——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

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

OBC = DISPOSAL, TREATMENT OR REUSE OFF-BASE BY CONTRACT

DPDO = DEFENSE PROPERTY DISPOSAL OFFICE

FPTA = FIRE PROTECTION TRAINING AREA

TABLE 4.1 (CONT'D)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1955 – 1965 – 1975 – 1985)
410 FIELD MAINTENANCE SQUADRON (cont'd)				
AGE (cont'd)		HYDRAULIC FLUID	480 GALS./YR.	1961 LANDFILL/OBC → OBC
		TRANSMISSION FLUID	10 GALS./YR.	LANDFILL/OBC → OBC
		LUBE OIL	180 GALS./YR.	LANDFILL/OBC → OBC
		PD-680	600 GALS./YR.	STORM SEWER → OBC
		CARBON REMOVER	12 GALS./YR.	STORM SEWER → OWS/INDUSTRIAL SEWER
		AIRCRAFT ALKALINE SOAP	1320 GALS./YR.	STORM SEWER → OWS/INDUSTRIAL SEWER
		SULFURIC ACID ELECTROLYTE	300 GALS./YR.	NEUTRALIZED & DILUTED TO SEWER
CORROSION CONTROL	613	PD-680	300 GALS./YR.	1962 STORM SEWER → SANITARY SEWER → INDUSTRIAL SEWER
		CARBON REMOVER	300 GALS./YR.	STORM SEWER → INDUSTRIAL SEWER
		PAINT REMOVER	420 GALS./YR.	STORM SEWER → INDUSTRIAL SEWER
		PAINT THINNER, EPOXY PRIMER & PAINT	800 GALS./YR.	LANDFILL/SEWER → DPDO
		AIRCRAFT ALKALINE SOAP	600 GALS./YR.	STORM SEWER → INDUSTRIAL SEWER
NDI/LAB	725	AIRCRAFT ENGINE OIL	20 GALS./YR.	1960 FPTA/OBC → OBC
		1,1,1,-TRICHLOROETHANE	30 GALS./YR.	LANDFILL/STORM SEWER → OBC

KEY

——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

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

OBC = DISPOSAL, TREATMENT OR REUSE OFF-BASE BY

OWS = OIL/WATER SEPARATOR

DPDO = DEFENSE PROPERTY DISPOSAL OFFICE

FPTA = FIRE PROTECTION TRAINING AREA

TABLE 4.1 (CONT'D)
INDUSTRIAL OPERATIONS (Shops)
Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1955 – 1965 – 1975 – 1985)
410 FIELD MAINTENANCE SQUADRON (cont'd)				
NDI/LAB (cont'd)	725	FLUORESCENT PENETRANTS & EMULSIFIERS	110 GALS./YR.	1960 STORM SEWER - - - -▸ DILUTED TO INDUSTRIAL SEWER - - - →
		CUTTING FLUID	80 GALS./YR.	STORM SEWER - - - -▸ INDUSTRIAL SEWER - - - →
TEST CELL	741 (744 prior to 1977)	JET ENGINE OIL	240 GALS./YR.	FPTA/OBC - - - -▸ OBC - - - →
		PD-680	12 GALS./YR.	LANDFILL/ STORM SEWER - - - -▸ OBC - - - →
		HYDRAULIC FLUID	2 GALS./YR.	LANDFILL/OBC - - - -▸ OBC - - - →
BEARING ROOM	725	CARBON REMOVER	12 GALS./YR.	LANDFILL/ STORM SEWER - - - -▸ DPDO - - - →
		PD-680	48 GALS./YR.	LANDFILL/ STORM SEWER - - - -▸ OBC - - - →
		SYNTHETIC ENGINE OIL	8 GALS./YR.	LANDFILL/OBC - - - -▸ OBC - - - →
		FINGERPRINT REMOVER	4 GALS./YR.	LANDFILL/OBC - - - -▸ DPDO - - - →
FILTER LAB	725	PD-680	120 GALS./YR.	LANDFILL/ STORM SEWER - - - -▸ OBC - - - →
		CARBON REMOVER	12 GALS./YR.	LANDFILL/ STORM SEWER - - - -▸ DPDO - - - →

KEY

———— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

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

OBC = DISPOSAL, TREATMENT OR REUSE OFF-BASE BY CONTRACT

DPDO = DEFENSE PROPERTY DISPOSAL OFFICE

FPTA : FIRE PROTECTION TRAINING AREA

TABLE 4.1 (CONT'D)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1955, 1965, 1975, 1985)
410 FIELD MAINTENANCE SQUADRON (cont'd)				
FILTER LAB, (cont'd)	725	TRICHLOROETHYLENE	400 GALS./YR.	1960 LANDFILL/STORM SEWER 1975
		SODIUM HYDROXIDE	60 GALS./YR.	NEUTRALIZED & DILUTED TO SEWER; DPDO
ENGINE CONDITIONING	725	JET ENGINE OIL	240 GALS./YR.	FPTA/OBC; OBC
		HYDRAULIC FLUID	12 GALS./YR.	FPTA/OBC; OBC
ENVIRONMENTAL SYSTEMS	725	COMPRESSOR OIL	18 GALS./YR.	LANDFILL/OBC; OBC
410 ORGANIZATIONAL MAINTENANCE SQUADRON				
SUPPORT BRANCH	627 (in Dock 2 prior to 1984)	HYDRAULIC FLUID	150 GALS./YR.	FPTA/OBC; OBC
		PD-680	10 GALS./YR.	LANDFILL/STORM SEWER; OBC
		SODIUM HYDROXIDE	1500 GALS./YR.	NEUTRALIZED TO STORM SEWER; NEUTRALIZED TO INDUSTRIAL SEWER 1984
PHASE INSPECTION	615	PD-680	150 GALS./YR.	LANDFILL/STORM SEWER; OBC; DPDO

KEY

———— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

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

OBC = DISPOSAL, TREATMENT OR REUSE OFF-BASE BY CONTRACT

DPDO = DEFENSE PROPERTY DISPOSAL OFFICE

FPTA = FIRE PROTECTION TRAINING AREA

TABLE 4.1 (CONT'D)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1955 – 1965 – 1975 – 1985)
410 ORGANIZATIONAL MAINTENANCE SQUADRON (cont'd)				
TANKER BRANCH	614	SYNTHETIC ENGINE OIL	250 GALS./YR.	1959 FPTA/OBC ----→ OBC ----→
410 TRANSPORTATION SQUADRON				
WARM BARN	604	AIRCRAFT & ALKALINE SOAP	60 GALS./YR.	1961 STORM SEWER ----→ OWS/INDUSTRIAL SEWER ——→
VEHICLE MAINTENANCE (INCLUDES ALLIED TRADES, DQ & A)	608	GREASE, HYDRAULIC FLUID & TRANSMISSION FLUID	100 GALS./YR.	LANDFILL/OBC ----→ OBC ——→
		MOTOR OIL	60 GALS./YR.	LANDFILL/OBC ----→ OBC ——→
		CLEANING COMPOUND	50 GALS./YR.	STORM SEWER ----→ OBC ----→
		PD-680	50 GALS./YR.	LANDFILL ----→ OBC ----→
		ANTIFREEZE	350 GALS./YR.	STORM SEWER ----→ OBC ——→

KEY

——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

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

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DPDO = DEFENSE PROPERTY DISPOSAL OFFICE

FPTA = FIRE PROTECTION TRAINING AREA

OWS = OIL/WATER SEPARATOR

TABLE 4.1 (CONT'D)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1955 – 1965 – 1975 – 1985)
410 TRANSPORTATION SQUADRON (cont'd)				
VEHICLE MAINTENANCE (cont'd)	608	SULFURIC ACID ELECTROLYTE	500 GALS./YR.	1961 NEUTRALIZED TO STORM SEWER (estimated) → NEUTRALIZED TO INDUSTRIAL SEWER (confirmed)
		PAINTS & THINNERS	165 GALS./YR.	LANDFILL/OBC (estimated) → DPDO (estimated → confirmed)
HEAVY EQUIPMENT MAINTENANCE	530	ANTIFREEZE & SOME HYDRAULIC FLUID	1200 GALS./YR.	1956 STORM SEWER (estimated) → OBC (confirmed)
		AIRCRAFT SOAP	2800 GALS./YR.	STORM SEWER (estimated) → OWS/INDUSTRIAL SEWER (confirmed)
		PD-680	300 GALS./YR.	STORM SEWER (estimated) → OBC (estimated → confirmed)
REFUELING TRUCK MAINTENANCE	609	JP-4, MOGAS, DIESEL MOTOR OIL, AND ANTIFREEZE	1200 GALS./YR.	1958 FPTA/OBC (confirmed) → OBC (confirmed)
410 MUNITIONS MAINTENANCE SQUADRON				
SRAM	323	SOLVENTS (NAPHTHA, ALCOHOL MEK, TOLUENE, ETC.)	55 GALS./YR.	1972 (estimated) → DPDO (confirmed)
EQUIPMENT MAINTENANCE BRANCH	740	AIRCRAFT SOAP	220 GALS./YR.	1962 FLOOR DRAIN DISCHARGING TO GROUND (estimated → confirmed)
		AIR SHOW GEL (DEGREASER)	110 GALS./YR.	FLOOR DRAIN DISCHARGING TO GROUND (estimated → confirmed)
		HYDRAULIC FLUID	660 GALS./YR.	FPTA/OBC (estimated) → OBC (estimated)

KEY

——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

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

OBC = DISPOSAL, TREATMENT OR REUSE OFF-BASE BY CONTRACT

OWS = OIL/WATER SEPARATOR

DPDO = DEFENSE PROPERTY DISPOSAL OFFICE

FPTA = FIRE PROTECTION TRAINING AREA

TABLE 4.1 (CONT'D)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL 1955 1965 1975 1985
410 MUNITIONS MAINTENANCE SQUADRON (cont'd)				
EQUIPMENT MAINTENANCE BRANCH (cont'd)	740	BRAKE FLUID	90 GALS./YR.	1962 LANDFILL/OBC → OBC
		NAPHTHA	60 GALS./YR.	LANDFILL/OBC → OBC
		PD-680	600 GALS./YR.	STORM SEWER → OBC
MUNITIONS MAINTENANCE	311	SOLVENTS (PRIMARILY PD-680; SMALL AMOUNTS OF MEK, IPA, TOLUENE)	25 GALS./YR.	LANDFILL/ STORM SEWER → INDUSTRIAL SEWER → DPDO
87 FIGHTER INTERCEPTOR SQUADRON				
PHOTO LAB	422	FIXER	180 GALS./YR.	1971 SILVER RECOVERY TO STORM SEWER → SILVER RECOVERY TO INDUSTRIAL SEWER
		DEVELOPER	230 GALS./YR.	STORM SEWER → INDUSTRIAL SEWER
		FLATTENER	50 GALS./YR.	STORM SEWER → INDUSTRIAL SEWER
		DEVELOPER CLEANER	26 LB./YR.	STORM SEWER → INDUSTRIAL SEWER
AGE	431	PD-680	520 GALS./YR.	1968 DPDO → OBC
		SULFURIC ACID ELECTROLYTE	50 GALS./YR.	NEUTRALIZED TO STORM SEWER → NEUTRALIZED TO INDUSTRIAL SEWER
		MOGAS	25 GALS./YR.	FPTA → OBC/FPTA

KEY

——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

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

OBC = DISPOSAL, TREATMENT OR REUSE OFF-BASE BY CONTRACT

DPDO = DEFENSE PROPERTY DISPOSAL OFFICE

FPTA = FIRE PROTECTION TRAINING AREA

TABLE 4.1 (CONT'D)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL 1955 1965 1975 1985
87 FIGHTER INTERCEPTOR SQUADRON (cont'd)				
CORROSION CONTROL	422	PAINT & PAINT THINNER	110 GALS./YR.	1971 DPDO (estimated) →
		AIRCRAFT ALKALINE SOAP	780 GALS./YR.	INDUSTRIAL SEWER (estimated) →
		PAINT STRIPPER	175 GALS./YR.	OBC (estimated) →
		CORROSION REMOVER	2 GALS./YR.	DPDO (estimated) →
MISSILE MAINTENANCE	403	FIXER	6 GALS./YR.	SILVER RECOVERY TO SEWER (estimated) →
ARMAMENT SYSTEMS	420	PD-680	1200 GALS./YR.	OBC (estimated) →
HUSH HOUSE	436 (in 414 prior to 1982)	JET ENGINE OIL	100 GALS./YR.	1982 → OBC
		JP-4	100 GALS./YR.	1982 → OWS/OBC
		PD-680	100 GALS./YR.	1982 → OWS/OBC
TEST CELL (OPERATED BY 62nd SQUADRON 1958-1971)	414	JET ENGINE OIL	100 GALS./YR.	1958 DISPOSAL TO GROUND (estimated); OBC (confirmed) 1982
		JP-4	100 GALS./YR.	STORM SEWER (estimated); OBC (confirmed) 1982
		PD-680	100 GALS./YR.	STORM SEWER (estimated); OBC (confirmed) 1982
F-106 FLIGHT	421	JET ENGINE OIL	50 GALS./YR.	1971 OBC (estimated) →

KEY

——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

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

OBC = DISPOSAL, TREATMENT OR REUSE OFF-BASE BY CONTRACT

OWS = OIL/WATER SEPARATOR

DPDO = DEFENSE PROPERTY DISPOSAL OFFICE

FPTA = FIRE PROTECTION TRAINING AREA

TABLE 4.1 (CONT'D)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1955 – 1965 – 1975 – 1985)
87 FIGHTER INTERCEPTOR SQUADRON (cont'd)				
JET ENGINE SHOP (OPERATED BY 62nd SQUADRON PRIOR TO 1971)	402	JET ENGINE OIL	500 GALS./YR.	FPTA/OBC - - - - → OBC ——→
		PD-680, CARBON REMOVER AND AND JP-4 (90% PD-680)	55 GALS./YR.	LANDFILL/ STORM SEWER - - - - → DPDO ——→
INSPECTION SECTION	421	PD-680	120 GALS./YR.	1971 OBC - - - - →
		JET ENGINE OIL	60 GALS./YR.	OBC - - - - →
		HYDRAULIC FLUID	30 GALS./YR.	OBC - - - - →
410 SUPPLY SQUADRON				
BASE FUELS LAB	406	ETHER	36 GALS./YR.	1969 OBC - - - - →
		ISOPROPYL ALCOHOL	6 GALS./YR.	OBC - - - - →
		POTASSIUM DICHROMATE	9 GALS./YR.	NEUTRALIZED TO SEWER - - - - → DPDO →
		JP-4	1200 GALS./YR.	FPTA/OBC - - - - →

KEY

——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

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

OBC = DISPOSAL, TREATMENT OR REUSE OFF-BASE BY CONTRACT

DPDO = DEFENSE PROPERTY DISPOSAL OFFICE

FPTA = FIRE PROTECTION TRAINING AREA

TABLE 4.1 (CONT'D)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1955 – 1965 – 1975 – 1985)
410 COMBAT SUPPORT GROUP				
ARTS & CRAFTS CENTER	825	FIXER	5 GALS./YR.	1981 INDUSTRIAL SEWER
		DEVELOPER	5 GALS./YR.	INDUSTRIAL SEWER
AUTO HOBBY SHOP	824	ENGINE OIL	800 GALS./YR.	1966 FPTA/OBC; OBC
		ANTIFREEZE	125 GALS./YR.	STORM SEWER; INDUSTRIAL SEWER
		BRAKE FLUID	5 GALS./YR.	STORM SEWER; INDUSTRIAL SEWER
		AIRCRAFT SOAP	800 GALS./YR.	STORM SEWER; INDUSTRIAL SEWER
		PD-680	800 GALS./YR.	STORM SEWER; INDUSTRIAL SEWER 1985
AUDIO VISUAL	601	FIXER	120 GALS./YR.	1958 STORM SEWER; SILVER RECOVERY TO STORM SEWER; INDUSTRIAL SEWER
		DEVELOPER	120 GALS./YR.	STORM SEWER; INDUSTRIAL SEWER
SMALL ARMS RANGE	866	AGITENE SOLVENT	3 GALS./YR.	1983 DPDO

KEY

——— CONFIRMED TIME-FRAME DATA BY [illegible] PERSONNEL

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

OBC = DISPOSAL, TREATMENT OR REUSE OFF-BASE BY CONTRACT

DPDO = DEFENSE PROPERTY DISPOSAL OFFICE

TABLE 4.1 (CONT'D)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1955 – 1965 – 1975 – 1985)
USAF HOSPITAL K.I. SAWYER				
DENTAL X-RAY	850	FIXER	48 GALS./YR.	1960 STORM SEWER ----→ SILVER RECOVERY TO STORM SEWER ----→ SILVER RECOVERY TO INDUSTRIAL SEWER
		DEVELOPER	144 GALS./YR.	STORM SEWER ----→ INDUSTRIAL SEWER
MEDICAL X-RAY	850	FIXER	160 GALS./YR.	STORM SEWER ----→ SILVER RECOVERY TO STORM SEWER ----→ SILVER RECOVERY TO INDUSTRIAL SEWER
		DEVELOPER	480 GALS./YR.	STORM SEWER ----→ INDUSTRIAL SEWER
410 SECURITY POLICE SQUADRON				
ARMORY	611	CARBON REMOVER	10 GALS./YR.	1956 LANDFILL/OBC ----→ DPDO

KEY

——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

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

OBC = DISPOSAL, TREATMENT OR REUSE OFF-BASE BY CONTRACT

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Virtually all waste oils, hydraulic fluid, brake fluid, and transmission fluid generated by shop operations have been collected in drums and bowsers located in shop areas. The contents of some of these containers have been disposed off-base by contract. The remainder has been taken to Refueling Truck Maintenance (Building 609) and emptied into a 5000-gallon underground intermediate storage tank. When full, this tank has been pumped out for disposal off-base by contract. Contractors have been used for disposal of these materials since at least 1970. Prior to this time most of this waste was either burned by the Fire Department or landfilled.

Waste acid and alkaline solutions have generally been disposed by neutralization and subsequent dilution to the industrial sewer (storm sewer prior to the mid-1970's). Neutralization of sulfuric acid electrolyte contained in batteries is centralized in two locations; the FMS AGE shop (Building 610) and the Vehicle Maintenance complex (Building 608).

Waste Accumulation and Storage Areas

Waste materials generated by shop and fueling/defueling activities are stored at several locations on base. Shops accumulate their wastes in drums, bowsers, or small underground vats or tanks at designated waste accumulation points (See Appendix D, Table D.4). These accumulation point wastes are either: (1) regularly pumped out for disposal off-base by contract; (2) taken by shop personnel to a 5000-gallon underground tank supervised by Refueling Truck Maintenance (later pumped out for disposal off-base by contract; or (3) taken to the DPDO.

Inspection of several of the drum storage areas indicated that most drums are stored on pallets or over concrete, and one shop had recently constructed a concrete containment area for drum storage. Visual evidence of past overflows was observed at some of the drum storage areas; however, only minimal amounts appear to have been released. No leaks or spills have been known to occur as a result of use of the 5000-gallon tank near Building 609. This tank has been used for intermediate storage for at least 25 years and is pressure tested every three years to ensure its integrity.

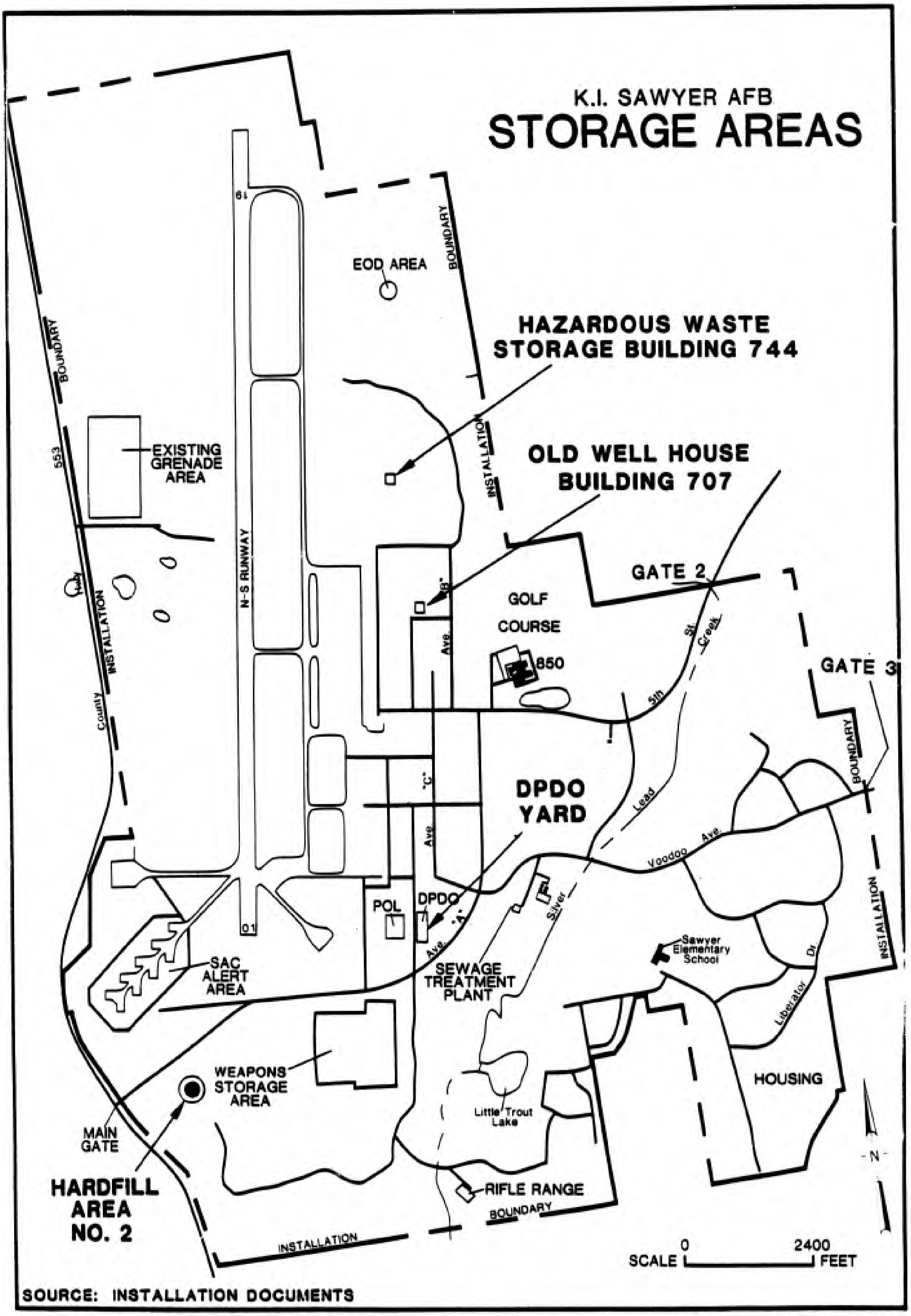
Several areas at the base have been used for long term storage of hazardous materials and wastes. These areas include the DPDO yard, a hardfill located near the main gate, building 744 and building 707 (See Figure 4.1). These sites are discussed below.

The Defense Property Disposal Office (DPDO), has always been located in Building 417, across from the POL storage area. The DPDO has been responsible for hazardous waste disposal since 1980. Prior to this time DPDO was used as a storage yard for wastes that could be reclaimed. Waste oil was stored on a sandy area of the yard. Up to 60 drums were located in this area at one time. These drums were noted to often be leaking or broken open. This oil was given or sold to the State Department of Natural Resources to be used in road oiling. In the late 1970's underground tanks were utilized to store oil and drums were no longer sent to DPDO.

Transformers were often stored in the DPDO yard prior to final disposal. It was noted that this equipment was sometimes broken up and oil from transformers often leaked or was dumped to the surrounding soil. Interviews with base personnel indicated that transformers were often cracked open and the oil emptied to the surrounding soil in the yard. Figure 4.2 shows the location, within the DPDO yard, of the transformer storage site. The DPDO yard currently maintains an area for storage of drummed hazardous materials awaiting final disposal by off-base contract (see Figure 4.2).

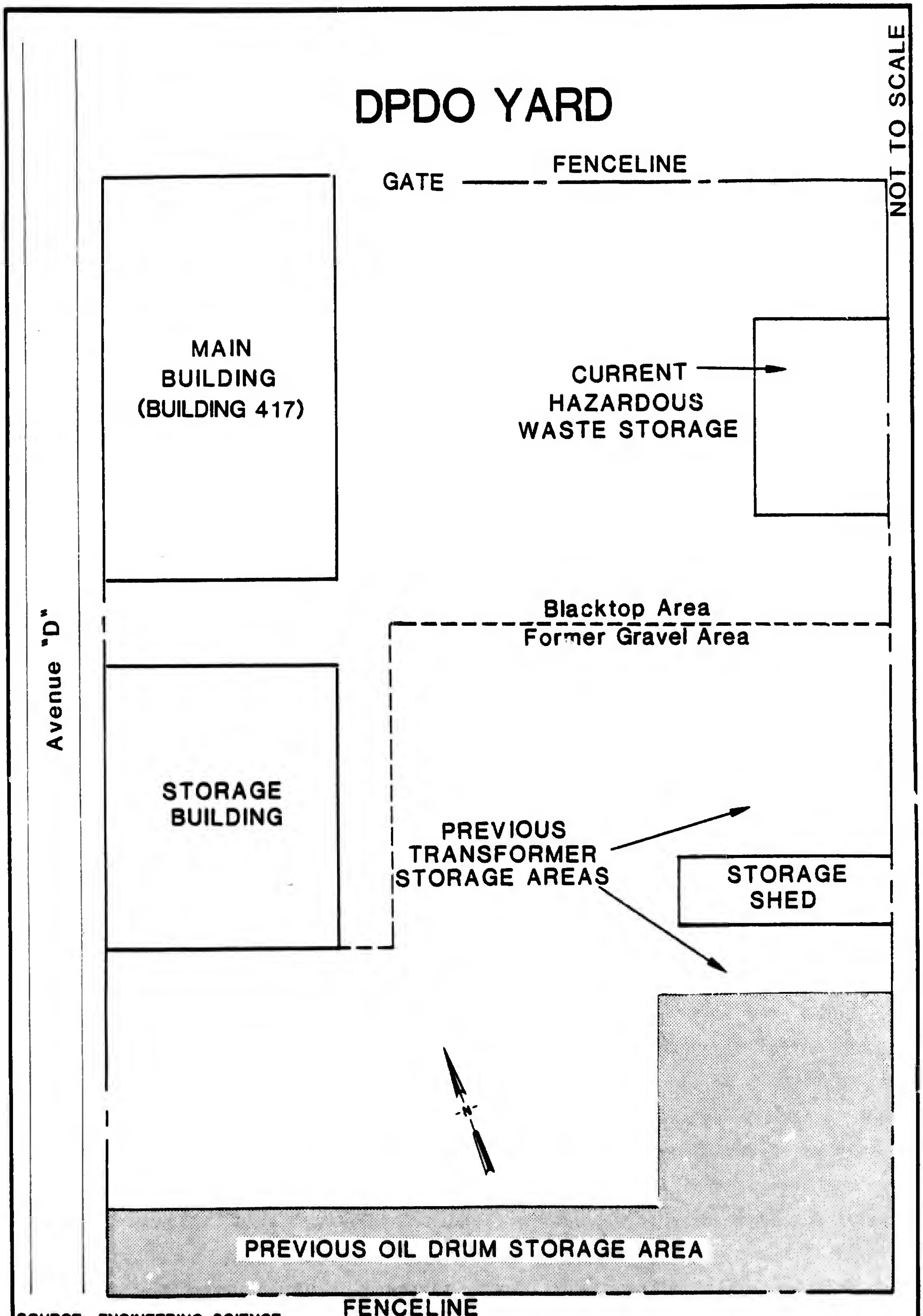
A hardfill area located near the main gatehouse was used to store transformers from the early 1960's until approximately 1970. This site is discussed and evaluated in the Disposal Sites section.

Since 1979, all PCB-containing or PCB-contaminated transformers have been kept in a separate hazardous waste storage area, Building 744. Each transformer is labelled and stored in a concrete bermed area inside Building 744. Leaking transformers are placed in drums and labelled appropriately. Except for small amounts of 1,1,1-trichloroethane, no other materials are stored in this building. Operation of the building is the responsibility of the Civil Engineering Squadron; however, the DPDO is responsible for coordinating the disposal of stored materials. Use of the facility will cease in fiscal year 1987, when a new hazardous waste storage area will be constructed at the DPDO.



ES ENGINEERING-SCIENCE

FIGURE 4.2



SOURCE: ENGINEERING-SCIENCE

Building number 707 has been used to store various types of hazardous materials. Insecticides, including DDT were routinely stored at this location. This building was originally built to house well number 3. This well was never used and has been capped. There was no indication that spills or leaks occurred in this area.

Fuels Management

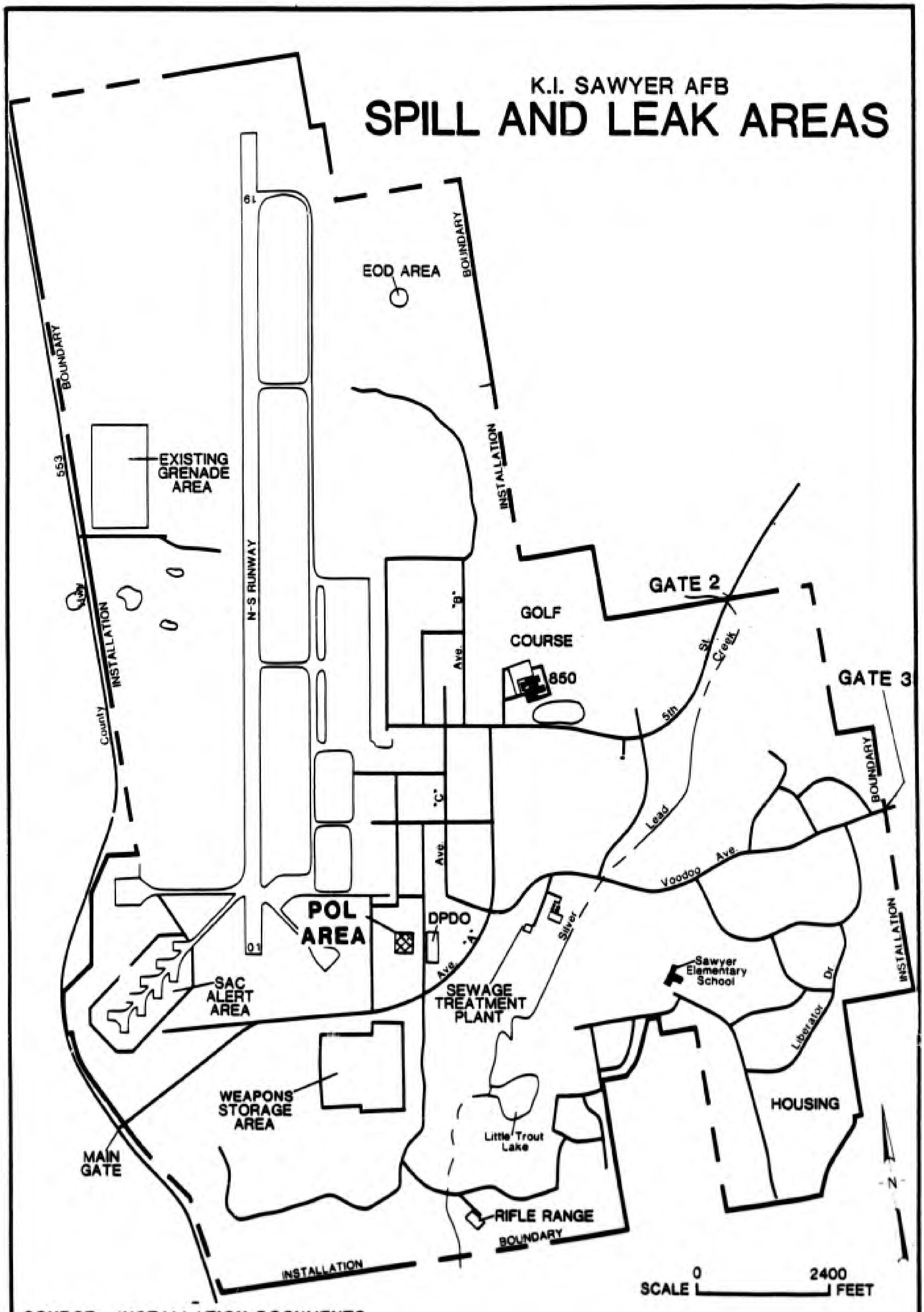
The K.I. Sawyer AFB fuels management system consists of over 35 storage tanks located throughout the base. A description of all known diesel fuel, automobile gas, jet fuel, fuel oil, lubricating oil, deicer, and waste petroleum tanks is presented in Appendix D, Table D.5. All petroleum products except JP-4 are transported onto the base in tank trucks. JP-4 is transported onto the base by an eight-inch diameter underground pipeline from the Wells Terminal Annex near Escanaba, Michigan. JP-4 is transferred from the storage tanks to the aircraft parking ramps and refueling areas by an underground hydrant system.

Fuel storage tanks are inspected annually. An interval of three to five years is typical for cleaning of tanks. A small amount of sludge is generated in these tanks and is placed in the oil holding tank of the oil/water separator in the POL area (Facility No. 411) for removal off-base by contract.

Spills and Leaks

Base records and interviews with present and past base personnel indicate that five significant fuel leaks have occurred during and since the 1970's. Base records also indicate that many minor spills and leaks of lesser significance have occurred. These spills were either allowed to evaporate, were removed by liquid fuels maintenance or the fire department, or were washed down (usually from the aircraft parking apron) and flowed to the pond near the hospital. In the mid-1970's the POL area was upgraded by addition of a concrete base in the diked areas to contain spills and leaks.

The description which follows shows that all significant spills and leaks of record have occurred at or very near the POL bulk storage area. The general area of these fuel spills is shown in Figure 4.3. Locations of the individual spill incidents are not shown in Figure 4.3 since the spill sites are considered to be a single area designated the POL area. This area also includes an oil/water separator described subsequently.



SOURCE: INSTALLATION DOCUMENTS

The first major spill of record occurred in 1970, in the diked area of Tank Number 5 in the POL area. In this incident, approximately 15,000 gallons of JP-4 spilled and soaked into the soil base of the diked area. No fuel was recovered.

In the second spill of record, approximately 35,000 gallons of JP-4 spilled onto the diked area of Tank Number 5 and soaked into the soil base of the diked area. No fuel was recovered in this incident.

The third major spill incident of record occurred in 1979, and took place at the southeast edge of the POL area. The main JP-4 line from the Wells Terminal Annex enters the POL area at the southeast corner, and approximately 5,000 gallons of JP-4 spilled onto the ground at this location. Limited fuel recovery occurred, and the majority of the fuel (exact volume unknown) was not recovered. The fourth significant spill occurred at this site in 1981, resulting in the release of an undetermined quantity of fuel, estimated to be less than 2,000 gallons.

The fifth spill incident of record occurred in 1984, in the Tank Number 5 diked area. This spill involved about 8,000 gallons of JP-4. About 7,200 gallons were recovered, and most of the remaining fuel evaporated.

Pesticide Utilization

Pesticides have been used at K.I. Sawyer AFB for controlling weeds, fungus, insects, and rodents. Pesticides used at the base are listed in Appendix D, Table D.6. The Entomology Shop is responsible for application of insecticides, and performs mixing in and adjacent to the Entomology Shop in Building 531. The Pavement and Grounds Section is responsible for application of herbicides throughout the base and for application of herbicides and fungicides at the base golf course. This section performs mixing outside Building 533 for herbicides and outside Building 786 for golf course chemicals. In practice at both Entomology and Pavement and Grounds areas, container rinse water has been used as dilution water. Empty containers have been triple rinsed, punctured, and disposed with normal base refuse or sent to the DPDO. Residual pesticides in diluted form are used at the various areas where the material is being applied. Pesticides are currently stored in a small storage shed near the sewage treatment plant. This shed has no dikes or containment facilities.

Fire Protection Training

Fire protection training at K.I. Sawyer AFB has been conducted at two sites. These site locations are depicted in Figure 4.4. Each site is described in the following discussion.

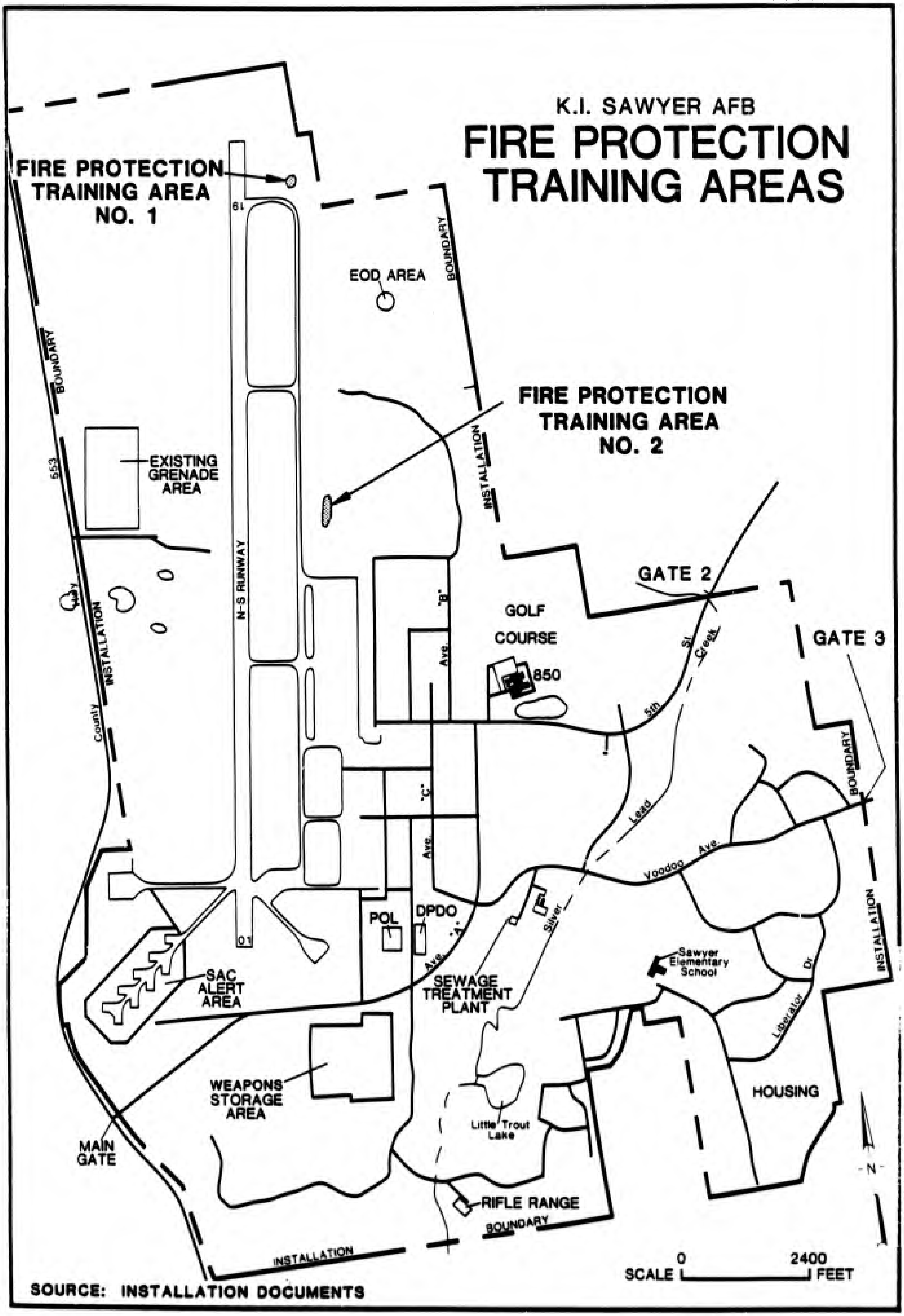
Fire Protection Training Area (FPTA) No. 1

Fire Protection Training Area No. 1 was located at the northern end of the base, north of the primary taxiway. This site was activated in approximately 1958 and was used until the early 1970's. At this site fuel was stored in 55-gallon drums adjacent to (east of) the site; drums were emptied onto a soil-covered area and the fuel was ignited for training exercises. Extinguishing agents used were protein foam and carbon dioxide. Fuels included contaminated JP-4, pure JP-4, AVGAS, and small quantities of hydraulic fluid, oils, and paint thinners-degreasers. Pre-wetting was not practiced routinely at this site. Unburned fuel collection and oil/water separation systems were not installed at the site. Burn frequency averaged four times per month, with fuel volumes of 300 to 2,000 gallons per training exercise. During the early 1970's fire protection training was moved to site number 2, described later. At present the site of FPTA No. 1 is level, and is in the Clear Zone off the north end of the runway.

Fire Protection Training Area (FPTA) No. 2

FPTA No. 2 is located in the northeast portion of the base, east of the primary taxiway. This site was activated in the early 1970's and is the present site of fire training exercises. As originally constructed, the site was a soil-covered area with no unburned fuel recovery and collection. Limited pre-wetting was conducted at the site. Burn frequencies averaged three to four times per month, with 300 to 500 gallons of pure and contaminated JP-4 used for each exercise. As originally operated, the fuels were stored in drums adjacent to (east of) the site; pure JP-4 was brought to the site by tank truck as required. Extinguishing agents used at the site have included protein foam, carbon dioxide, Aqueous Film Forming Foam (AFFF), and chlorobromomethane (CB).

In 1982 the site was modified by construction of a concrete pad with aircraft mockup at the site. In addition, a fuel-water drain system was installed, with pit drainage transported by pipe to an oil/water separator at the site. Since 1982, upon completion of each training


K.I. SAWYER AFB
FIRE PROTECTION TRAINING AREAS
FIRE PROTECTION TRAINING AREA NO. 1
FIRE PROTECTION TRAINING AREA NO. 2
EOD AREA
BOUNDARY
INSTALLATION
EXISTING GRENADE AREA
553
County
N-S RUNWAY
19
01
GATE 2
GATE 3
GOLF COURSE
850
'B'
'C'
'A'
Ave.
5th
St.
Creek
Lead
Voodoo Ave.
Silver
POL
DPDO
SAC ALERT AREA
SEWAGE TREATMENT PLANT
Sawyer Elementary School
Liberator Dr
HOUSING
WEAPONS STORAGE AREA
Little Trout Lake
MAIN GATE
RIFLE RANGE
N
SCALE 0 2400 FEET
SOURCE: INSTALLATION DOCUMENTS

exercise, the liquid remaining on the concrete pad has been transferred to the oil/water separator and the fuel phase burned off. The water phase has been discharged through a pipe to an underground leach bed near the site.

INSTALLATION WASTE DISPOSAL METHODS

The facilities at K.I. Sawyer AFB which have been used for the management and disposal of waste can be categorized as follows:

- o Landfills/Hardfills
- o Incinerators
- o Explosives Ordnance Disposal
- o Drainage Ponds/Pits
- o Sanitary Sewer System
- o Surface Drainage System
- o Oil/Water Separators
- o Sludge Disposal Areas

Landfills/Hardfills

The majority of general refuse at K.I. Sawyer AFB has been disposed at various landfill and hardfill sites on base property. Limited records exist regarding the disposal sites at the base. The majority of information collected regarding disposal sites was obtained through interviews with current and retired employees. A description and evaluation of each site is presented herein. Table 4.2 summarizes pertinent information for each of the landfill sites. The approximate location of each landfill/hardfill area is shown in Figure 4.5.

Landfill No. 1

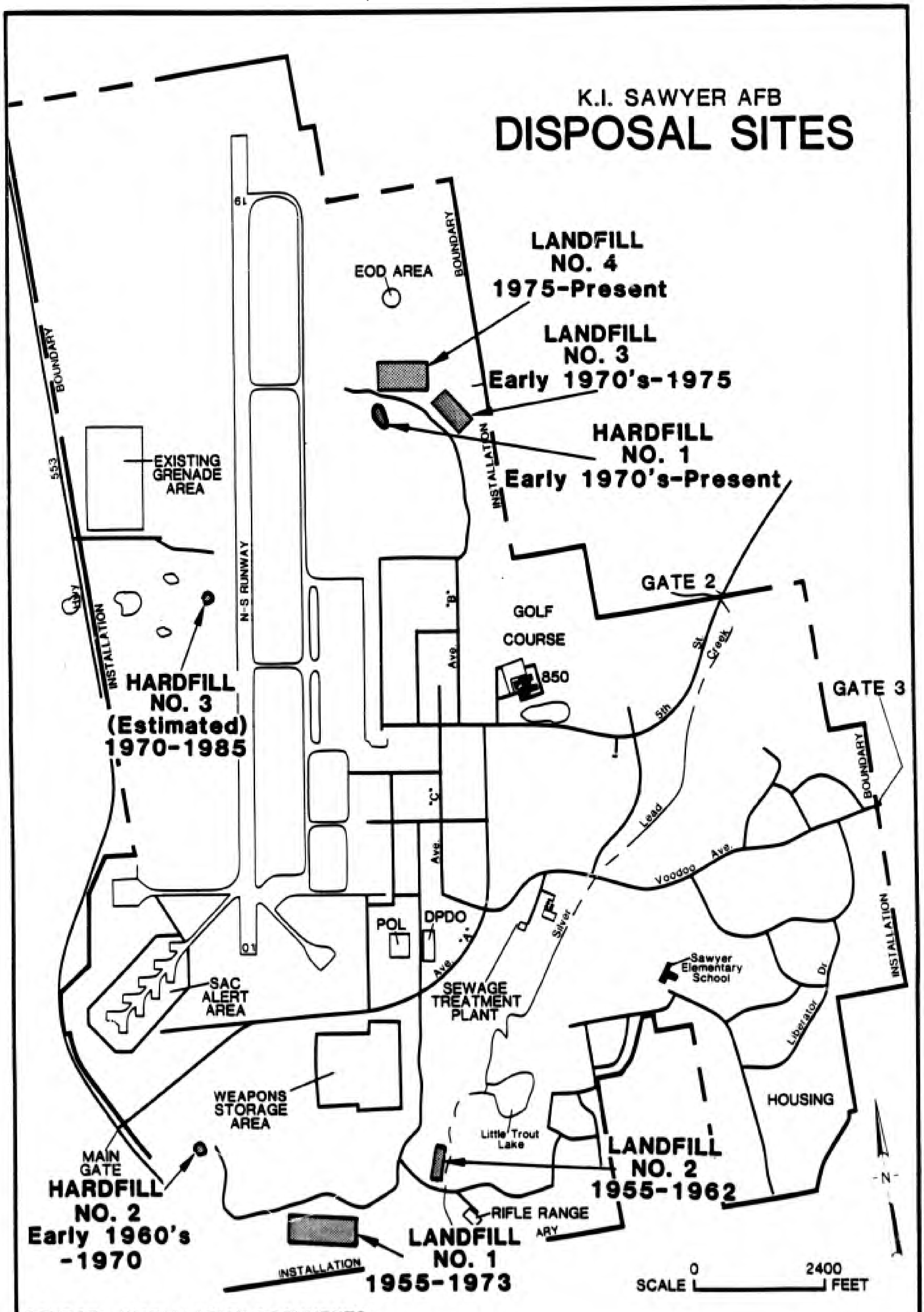
Landfill No. 1 is located just south of the Weapons Storage Area (WSA), to the south of the dirt access road. This site was first used from approximately 1955 to 1957. During this time period only one trench was used. Burning was performed weekly. As the base became more developed and the flightline more active, burning was stopped due to interference with flightline activities. Daily cover was then performed.

This area was again used as a landfill from approximately 1963 until 1973. No burning was performed in the landfill at this time. Materials were brought to the site, disposed of, and covered daily.

TABLE 4.2
LANDFILL SITE INFORMATION SUMMARY

Site	Operating Period	Approximate Size (acres)	Type of Waste	Method of Operation	Closure Status
Landfill No. 1	1955-1957 and 1963-1973	10.3	Waste paints, solvents, acids, fertilizer, asphalt, asbestos, housing refuse, DDT, hardfill, sludge from STP.	Daily fill and cover. Some burning in early years of operation. Trench size: up to 40 feet deep, 12 feet wide and 400-800 ft. long. Trenches ran east to west.	Area covered with soil and ash. Grass is growing sparsely in some areas. Some breakthrough has occurred.
Landfill No. 2	1955-1962	2.4	Household refuse, hardfill, shop waste, capacitors, transformers.	Daily fill and cover. Area of approximately 400 feet by 100 feet.	Area covered with soil, hardfill. Small trees & grass present.
Landfill No. 3	Early 1970's until 1975	9.65	Household refuse, sewage sludge, some shop waste.	Daily fill and cover. One large trench approximately 400 feet long, 30 feet deep and 14 feet wide.	Area covered with soil. No vegetative growth.
Landfill No. 4	1975 to Present	4.6	Household refuse, sewage sludge, small quantities of shop waste.	Daily fill and cover. Trenches ran north to south and were approximately 400 feet long, ten feet wide and up to 25 feet deep.	Covered with sandy soil. One open pit for sewage sludge. One open pit for refuse.

FIGURE 4.5



SOURCE: INSTALLATION DOCUMENTS

ES ENGINEERING-SCIENCE

Trenches were estimated to be up to 40 feet deep, twelve feet wide (at the base) and from 400 to 800 feet long. Trenches ran from east to west. Items identified as having been disposed into this fill area include waste paint, solvents, sulfuric acid, fertilizer, asphalt, capacitors, runway paint, asbestos, and housing refuse. A large quantity of hardfill was also disposed in this area. There were several reports that drums of DDT had been buried in the center to southeast section of the landfill. The exact quantity could not be determined but may have been up to 50 drums. These drums apparently held DDT in liquid form and many of the drums may have burst during the landfilling operation. Wastes collected from industrial shop operations were routinely brought to this site and disposed. The total quantity of industrial waste disposed is expected to be high. This waste would include paint thinners, oils, contaminated fuel, solvents and paints. Additionally, sludge from the sewage treatment plant was brought to this area for disposal.

The area is currently covered with soil and ash. Grass is growing sparsely in some areas. There is evidence of some breakthrough of debris in small areas of the site. The southern end of the landfill had been surveyed and marked for a portion of a new access road to the base. This road was to go directly over the southern edge of the landfill but is in the process of being rerouted.

Landfill No. 2

Landfill No. 2, located to the west of Silver Lead Creek and southeast of the WSA, was operated from approximately 1955 through 1962. During the site's first two years of operation it was used primarily for disposal of hardfill generated from base development operations. The area used for fill was originally a natural swamp. The total area for landfill was approximately 400 feet long by 100 feet wide. Trenches were not dug; the swampy area was simply filled in. The site was used frequently from 1957 until 1962 for disposal of household refuse. Shops on base were just starting operations during this time period and small quantities of shop waste were brought to this site. Although routine burning was not done, the landfill did catch fire on several occasions. Routine practice was to fill and cover daily. Capacitors and at least one transformer were known to be placed in this area.

The area is currently covered with hardfill, small trees and grass. There was an unconfirmed report of leachate running from this area to the creek.

Landfill No. 3

Landfill No. 3 was used for general disposal of base refuse from the early 1970's through 1975. The site is located east of Taxiway F, along the eastern boundary of the base. The site was operated as one large trench approximately 400 feet long and up to 30 feet deep. The trench was approximately 14 feet wide at its base and 30 feet wide at the top and ran east to west. Waste material buried here consisted primarily of household refuse and sewage sludge. Small quantities of drummed, industrial waste were also buried here. No burning was performed in this area. The site operated using daily fill and cover.

The site is currently covered with sandy soil and is devoid of vegetative growth.

Landfill No. 4

Landfill No. 4 has been used from approximately 1975 to the present. The site is located west of Landfill No. 3 and east of Taxiway F. This site has been used primarily for disposal of refuse from dumpsters and family housing areas. Several pits have been used for disposal of undigested sewage sludge. This sludge undergoes minimal dewatering before being dumped to these pits and on several occasions has reportedly overflowed to the surrounding forested area.

No shop waste has been sent to this landfill area since approximately 1980. Before that time small quantities may have been brought to this site and drums have been noted to be present in the landfill.

Trenches at this fill area run north to south and are approximately 400 feet long, ten feet wide, and up to 25 feet deep. This site is currently covered with sandy soil. One pit is operational for sludge disposal and one pit is currently being used for disposal of general refuse.

Hardfill Area No. 1

Hardfill No. 1 is located directly across from the current landfill area (Landfill No. 4). This site has been used since the early 1970's for disposal of construction rubble and other hardfill. No general refuse or shop waste is known to be buried in the area.

Hardfill Area No. 2

Hardfill Area No. 2 is located approximately 1500 feet southeast of the main gate. This site was used for disposal of hardfill materials from the early 1960's until approximately 1970. In addition to disposal of hardfill material, the site was used as a storage area for transformers. Transformers were kept on racks in this area. Many leaked to the ground. Some were cleaned and/or drained to the ground surrounding the racks. Many of these transformers were known to have contained PCB's.

No general refuse or shop waste was known to have been sent to this area.

Hardfill Area No. 3

Hardfill Area No. 3 is located west of the runway just south of Transmitter Road. The exact years of operation of the area could not be determined; however it is suspected that it has been used primarily in the last 15 years. There was no evidence to indicate the presence of any industrial or sanitary refuse.

Incinerators

Two permitted incinerators are in operation at K.I. Sawyer AFB. A pathological waste incinerator (Facility 850) operates at the base hospital; this unit uses propane as auxiliary fuel, and the ash is disposed with normal base refuse. A second incinerator, Facility 5031, is used for incineration of classified documents. This incinerator also uses propane as the auxiliary fuel, and ash from the incinerator is disposed with normal base refuse.

Explosive Ordnance Disposal Area

The Explosive Ordnance Disposal (EOD) area at K.I. Sawyer AFB is located approximately 1,000 feet north of the existing sanitary landfill. The EOD area consists of a "burn kettle" for the incineration of small arms ammunition. Larger explosives (e.g., starter cartridges) are detonated in small excavated pits. Inert residual material from burn operations are disposed in a munitions residue landfill at the edge of the EOD area. This landfill is approximately 20 feet by 40 feet by 15 feet deep, and until its capacity was exhausted in early 1985, was the only disposal area utilized by EOD personnel. A second, similarly sized pit, excavated adjacent to the first, is now receiving munitions residues.

Drainage Ponds/Pits

Three drainage ponds/pits at K.I. Sawyer AFB were identified as potentially receiving waste materials in the past. They are: (1) a pit located behind Building 414, the old 87th FIS Test Cell; (2) a pond located south of the USAF hospital (Building 850); and (3) a drainage pit across the road from Building 740 (See Figure 4.6).

Drainage Pit No. 1

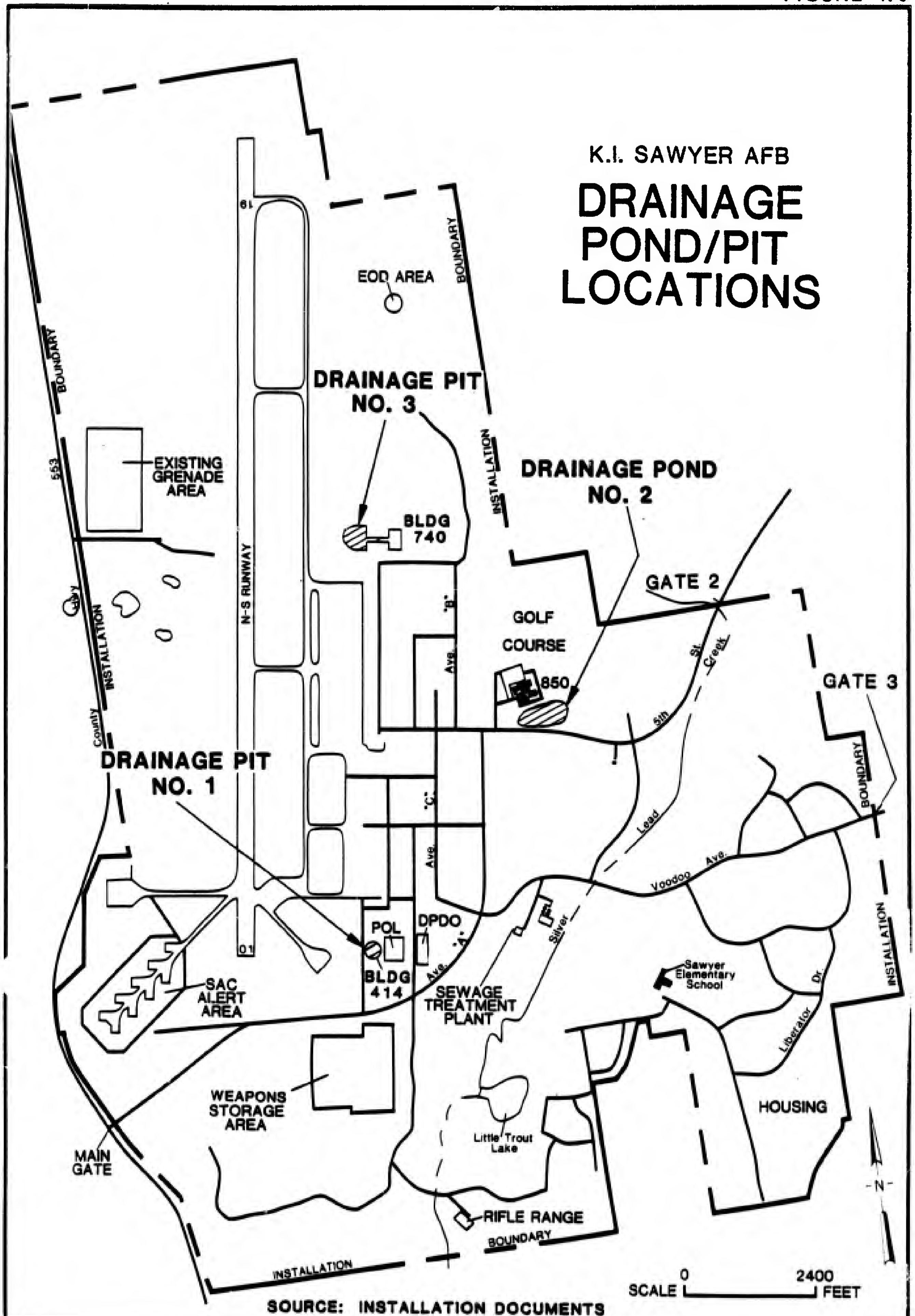
This pit is located behind Building 414 and was used as a test cell by the 87th FIS until the Hush House was completed in 1981. The pit is approximately 4 feet by 15 feet and is approximately 2 feet deep. The pit appeared to be stained with oil. No vegetation was observed growing within the pit. The open end of a six-inch diameter pipe projecting into the pit appeared to originate from or around Building 414; however, its point of origin could not be conclusively determined. Base personnel indicated that an old oil/water separator was located in this area and may have been connected to the pit. Shop personnel reportedly dumped shop waste to this area. The exact types and amount of waste materials that may be been placed in this pit are not known; however, waste materials generated by test cell activities are listed in Table 4.1 (under 87 FIS Hush House).

Drainage Pond No. 2

A pond located just south of building 850 has been used as an outfall for storm drainage from the base. Before entering the pond, stormwater passes through an oil/water separator and is then discharged into this area. The separator was installed in 1973; prior to then, stormwater entered the pond directly. In the past, this pond has been the outfall area for portions of the base storm sewer system. Wastes discharged to the storm sewer from hanger areas and some industrial areas flowed directly into the pond. The pond was noted to often be discolored and to have an oil sheen on the surface. In approximately 1970, hangar sewer flows were diverted to an industrial lagoon. The pond was noted to originally extend eastward into the golf course area but was diked to help contain the water.

The timelines in Table 4.1 indicate those wastes which were suspected or confirmed to have been disposed to the storm sewer system during this timeframe. Wastes including trichloroethane, PD-680, soap,

FIGURE 4.6



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paint remover, antifreeze, various solvents, JP-4, and photographic chemicals were thought to have been disposed in various quantities to the storm sewer and ultimately to the drainage pond.

Drainage Pit No. 3

Drainage Pit No. 3 currently receives alkaline aircraft soap and "air show gel" (a petroleum-based degreaser) that is released to the floor drain in Building 740 (Equipment Maintenance Branch). This building currently houses a washrack which is used by the Equipment Maintenance Branch. Liquids collected by this floor drain pass under Avenue G, and are released to a low-lying, scrubby area. Information regarding past waste disposal practices of the Branch was not available for the years preceding 1982, and thus it could not be determined what volumes of other waste materials generated by the shop (hydraulic and brake fluids, naphtha, and PD-680) may have been released to the drain in the past.

Sanitary Sewer System

The sanitary sewerage collection system for K.I. Sawyer AFB consists of a gravity flow collection system, pump stations, and a sewage treatment plant. Six septic tanks and associated filter beds are also located at the base. Three of these tanks are for emergency use only.

Collection of sanitary sewage on base is accomplished by a network of sewer pipes ranging from 6 to 10 inches in diameter. In general, gravity flow carries the sewage to the treatment plant from the cantonment, industrial and flightline areas. Four inch force mains are in use in the outlying WSA and SAC alert areas to discharge sewage from these areas into the gravity flow system. A similar system is used in the housing area.

Prior to the mid-1970's, floor drains from hangars, aprons, and some industrial shop areas were not hooked into the sanitary sewage system. This waste went to the storm sewer system and was eventually discharged to the ground. Currently the only floor drain not connected to the sewer system is in building 740 (previously discussed as Drainage Pit 3). All other industrial areas have sewer lines leading to an industrial lagoon adjacent to the sewage treatment plant (STP). This lagoon is aerated to provide additional means of removal for volatile organic compounds. All other sewer lines lead directly to the STP.

During periods of low flow the waste in the lagoon is treated in the STP.

The STP at K.I. Sawyer AFB has been operating since the mid-1950's (see Figure 4.7). Imhoff tanks were first used, supplemented later with sand filters. In 1960 trickling filters were installed; this system was rapidly overloaded and was not successful. Rotating biological contactors (RBC's) were installed next. The system currently in use at the base is shown in Figure 4.8. The plant is currently undergoing a major construction project to further treat sludge produced in the plant. This sludge is currently undigested and is hauled to waste pits at the landfill. The State of Michigan has required further treatment before land application can be performed. Figure 4.8 shows the proposed process for treatment of sludge as a dashed line.

The treatment plant has a capacity of approximately 1.5 million gallons per day. The plant typically treats 800,000 gallons per day. Effluent is discharged to Silver Lead Creek. The plant has exceeded its permit for total suspended solids and BOD on several occasions. Table D.1, Appendix D, gives a summary of the plant water quality data.

Surface Drainage System

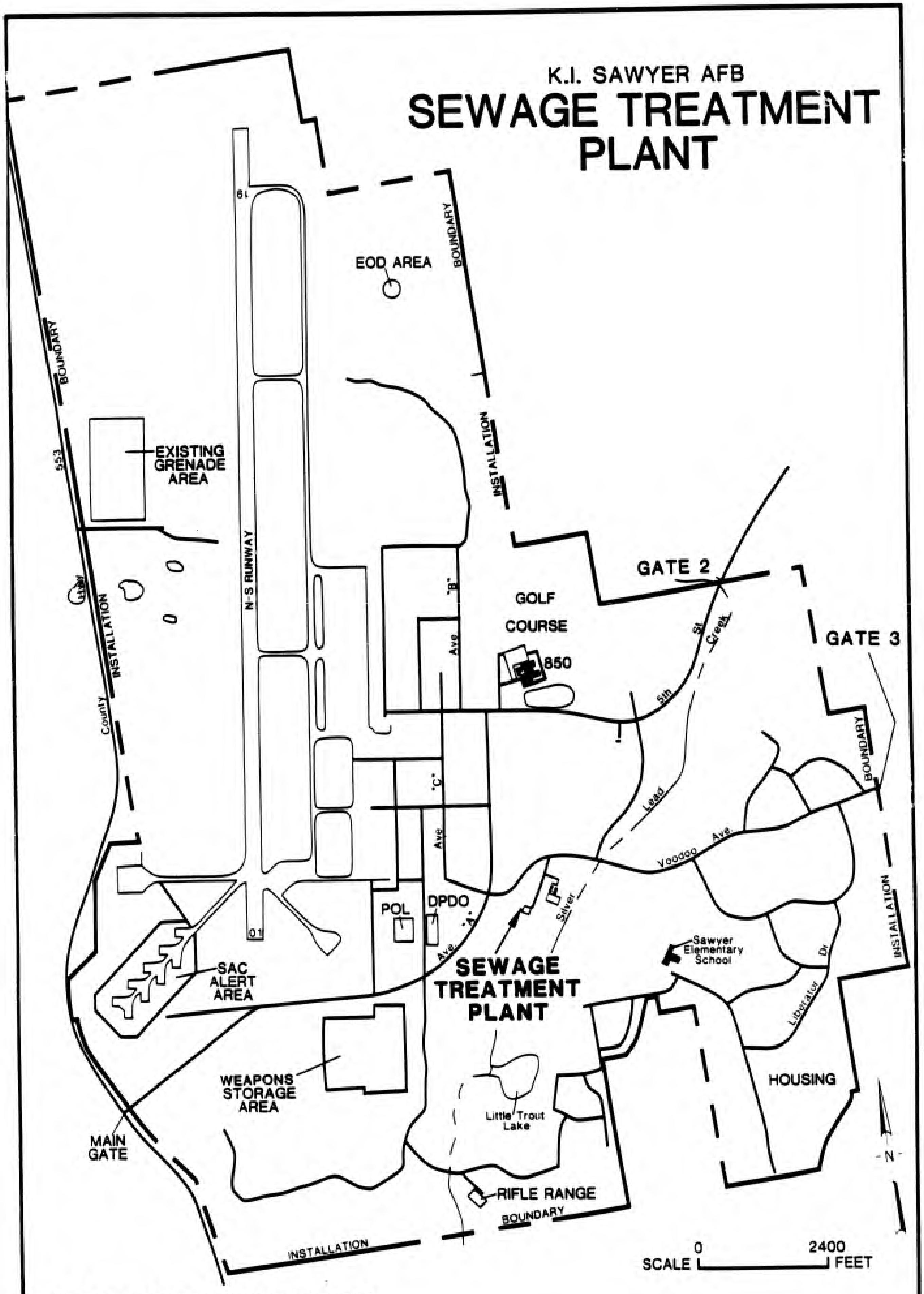
The storm drainage system at K.I. Sawyer AFB depends primarily upon ground absorption. Soil in the base area is extremely porous and in normal conditions the surface of the ground is dry very quickly after even the heaviest downpour.

The north end of the industrial area, flightline area and the hospital area are drained by a network of pipes, varying in size from 12 to 36 inches. Drain water flows east in these pipes to a ground surface outfall located near the hospital and golf course area. This area has been discussed further in a previous section. The Capehart housing area is drained by a network of pipes, varying in size from 8 to 33 inches. Drain water flows through these pipes to a number of ground surface outfalls located throughout the area.

Oil/Water Separators

According to K.I. Sawyer AFB records, there are six pretreatment devices located on the base (See Appendix D, Table D.7). The oil phase is removed from these separators on a scheduled basis and is disposed off-base by contract.

FIGURE 4.7



SOURCE: INSTALLATION DOCUMENTS

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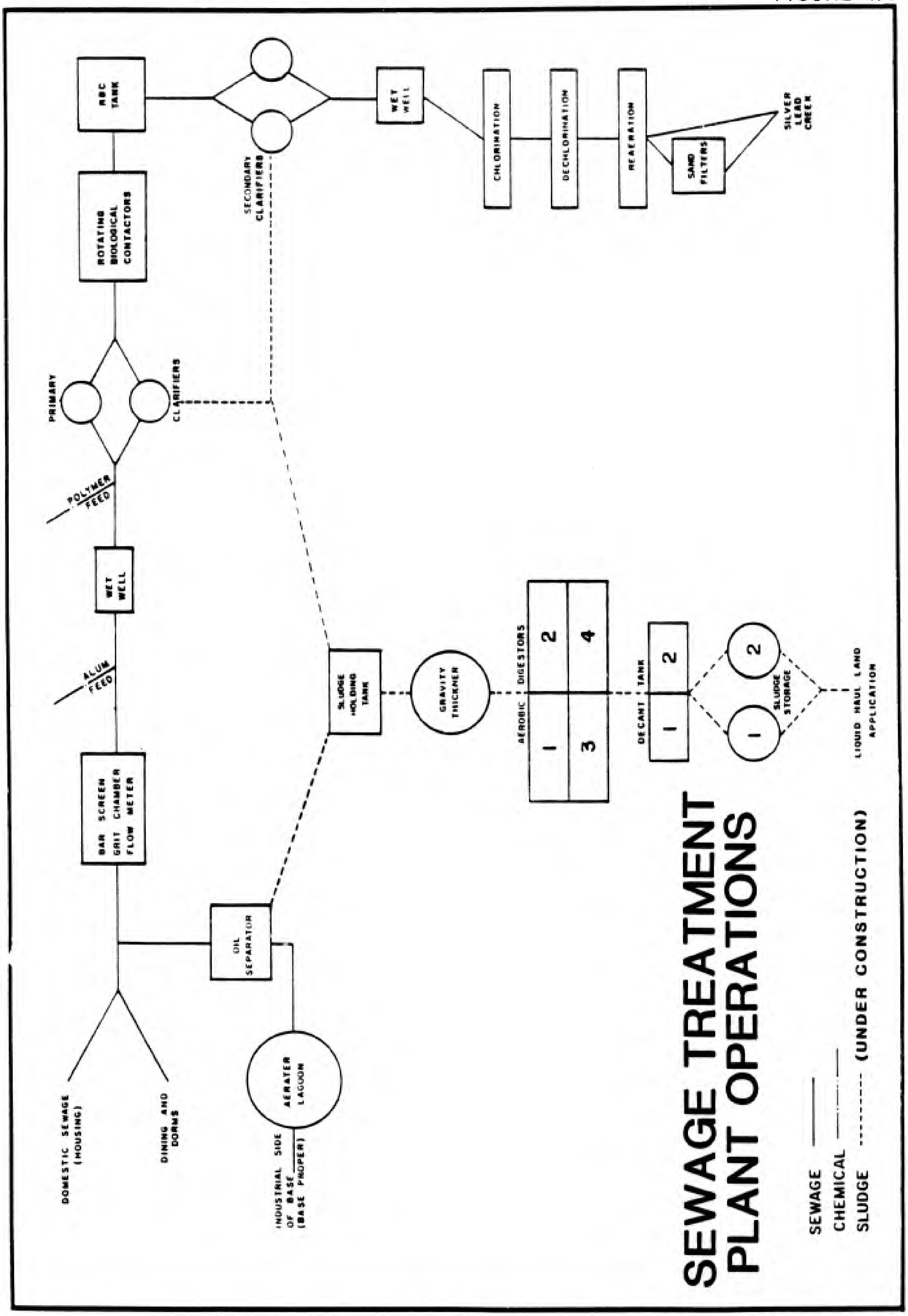
FIGURE 4.8



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The separator located in the POL area (Facility No. 411) discharges the water phase to an adjacent gravel-lined pit approximately 20 feet in diameter from which the water soaks into the soil. Interviews with base personnel indicate a recurring malfunction of the separator which allows the oil phase to pass to this gravel-lined pit. This separator and pit system have been in operation since about 1975.

Sludge Disposal Areas

Sewage treatment plant sludge has been disposed at various locations throughout the base (see Figure 4.9). This sludge has always been undigested/unstabilized. Landfill number 1 was used for disposal of dried sludge up until 1978. Sludge was placed on top of the already closed landfill and allowed to weather. The current landfill site (Landfill No. 4) has been used extensively for sludge disposal. Large pits were dug and sludge (with a low solids content) was dumped into these pits. Liquid often overflowed to the surrounding area. This practice is ongoing at Landfill No. 4. Landfill No. 3, directly adjacent to this area was also periodically used for sludge disposal. Land near the STP was also utilized in the past for disposal of sludge.

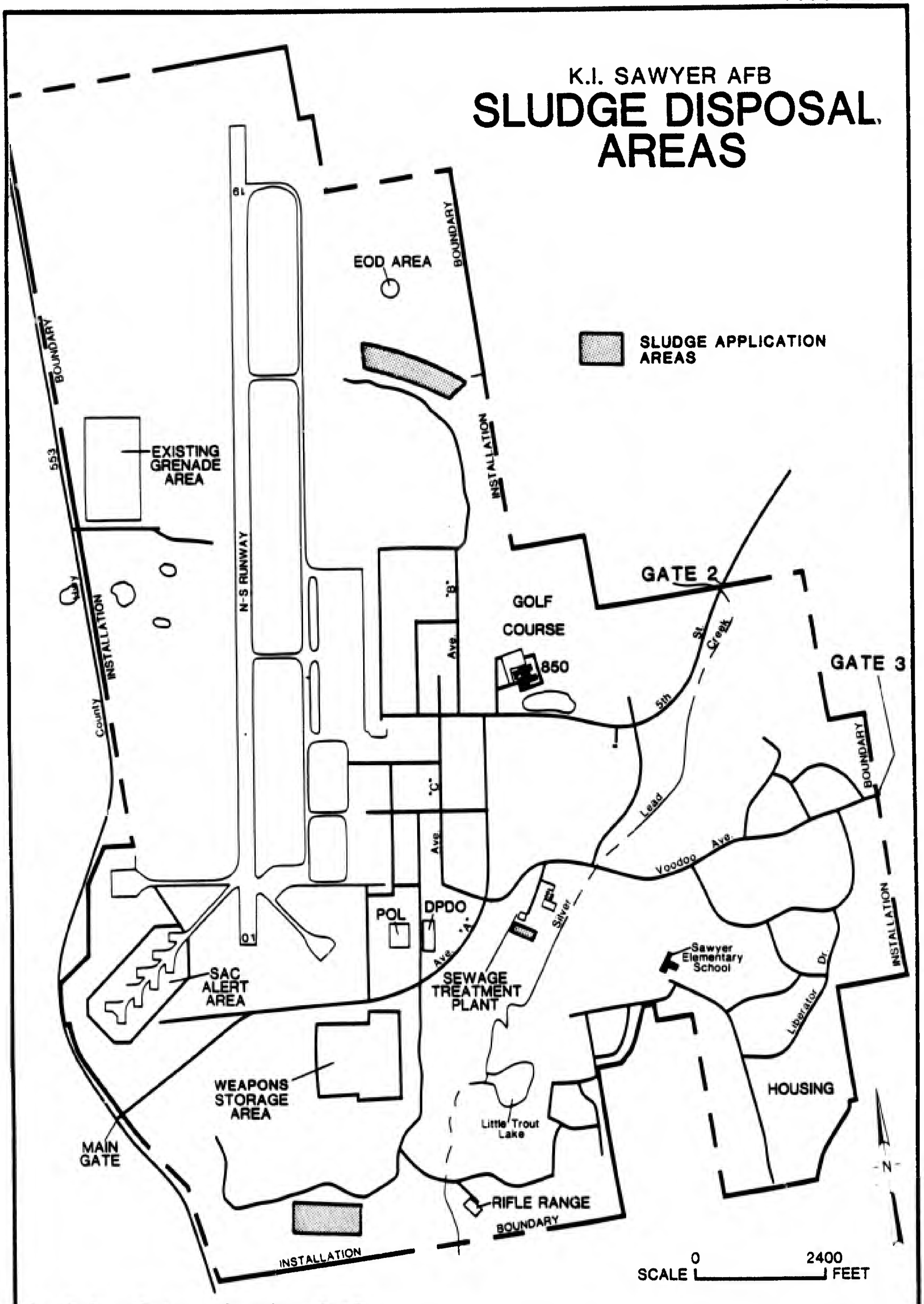
Sludge from the STP has a low metals content since there is very little shop activity to generate such waste.

SATELLITE FACILITIES REVIEW

Calumet Air Force Station

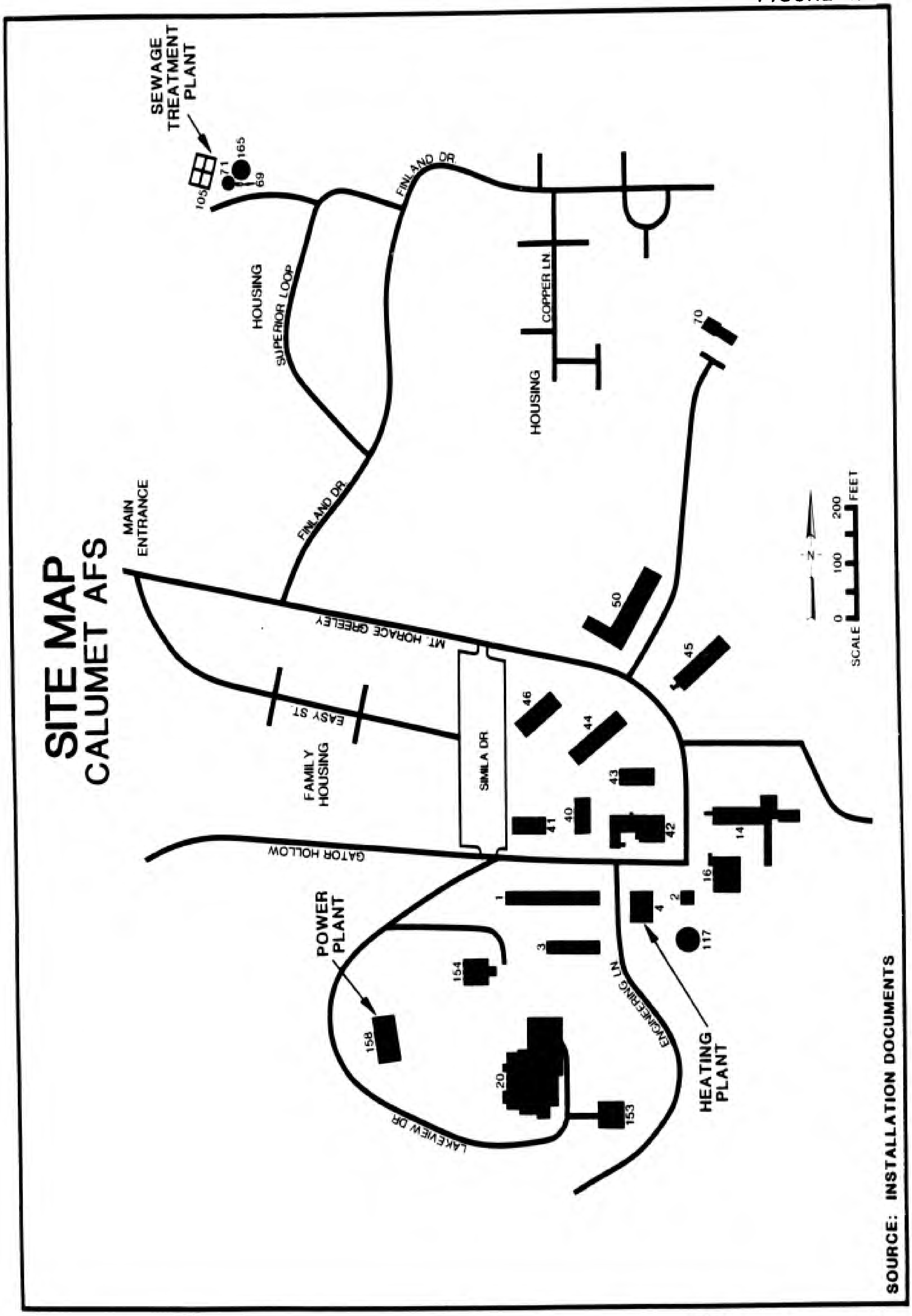
The Calumet AFS has been used since the early 1950's to provide radar data and ground/air communications. The station includes over forty housing units, a power plant, a heating plant, a motor pool, various recreational and mess facilities, a medical aid station, and various radar and ground/air radio equipment (see Figure 4.10). Very little industrial activity has been performed at the station. Industrial shop areas are discussed individually below.

The power plant (Building 158) has generated small quantities of lube oil, ethylene glycol, solvents and diesel fuel as waste products. These wastes have been routinely disposed of together in 55-gallon drums. In the past, these drums were either emptied into one of several underground storage tanks or held until disposal could be arranged through K.I. Sawyer AFB. The base would arrange for these wastes to be



SOURCE: INSTALLATION DOCUMENTS

FIGURE 4.10



SITE MAP
CALUMET AFS
SEWAGE TREATMENT PLANT
MAIN ENTRANCE
HOUSING
FAMILY HOUSING
POWER PLANT
HEATING PLANT
FINLAND DR.
SUPERIOR LOOP
COPPER LN
MT. HORACE GREELEY
EASY ST.
SIMILA DR
GATOR HOLLOW
ENGINEERING LN
LAKEVIEW DR
105
71
165
69
70
50
45
46
44
43
40
41
42
14
16
1
2
4
3
117
154
158
20
153
N
0
100
200
FEET
SCALE
SOURCE: INSTALLATION DOCUMENTS

removed and disposed off-base by contract. Some oil was used locally for dust control. The quantity of waste generated in the power plant has always been very low. Since the DPDO took over the role of waste management in the early 1960's these wastes have been carefully controlled. Wastes are currently disposed off-base by contract.

The heating plant has generated only very small quantities of waste. These wastes have always been disposed by utilizing the disposal tanks in the motor pool area. There are a total of forty-five, underground fuel oil tanks (275-gallon) in the housing area. The heating plant itself has four 50,000-gallon #2 fuel oil tanks (underground). Buildings 30, 49 and 70 each have aboveground storage tanks. These tanks have been checked periodically for the presence of water, which would indicate a leak. Routine pressure testing has not been performed in the past.

The station has a small auto hobby shop for the use of the families assigned to this site. A drum has routinely been used for waste disposal (ethylene glycol and motor oil) in the shop. Approximately two drums per year are sent for disposal. These wastes are not segregated. These wastes were previously stored in an underground storage tank outside the building. Waste was routinely pumped out for recycle by an off-base contract. A high water content was discovered in waste from this tank and suspecting a leak, the station stopped using the tank. The Vehicle Maintenance Shop adjoins the Auto Hobby Shop. Until recently all waste from this shop was also placed in the underground storage tank. Use of this tank was discontinued approximately one year ago and the storage tank has been emptied and abandoned in place. It is estimated that about 4 drums of oil and 1 drum of ethylene glycol will be disposed of per year through DPDO.

Table D.8, Appendix D, gives a complete list of all storage tanks either currently used or abandoned at the station. The fuel tanks at the station were cleaned in the mid-1960's. Approximately 20 gallons of sludge were collected. This sludge was mixed with sand and allowed to weather in the area currently used as the ball diamond.

A small sewage treatment plant has operated at the station since approximately 1959. Before that time septic fields were used. The treatment system in use consists of solids settling and aerobic digestion with subsequent chlorination of the effluent. Sludge is dried in enclosed drying beds and subsequently applied to the land. The plant treats an average of 30,000 gallons per day. The effluent is discharged to Buffalo Creek and is tested routinely. No incidents have been associated with this discharge.

Water supply to the station has been provided by two deep wells located near Gratiot Lake with a total capacity of approximately 89,000 gallons per day. The water is chlorinated in the distribution line. Drinking water is routinely tested for coliform with a detailed analysis run every three years. This water supply has been of consistently good quality.

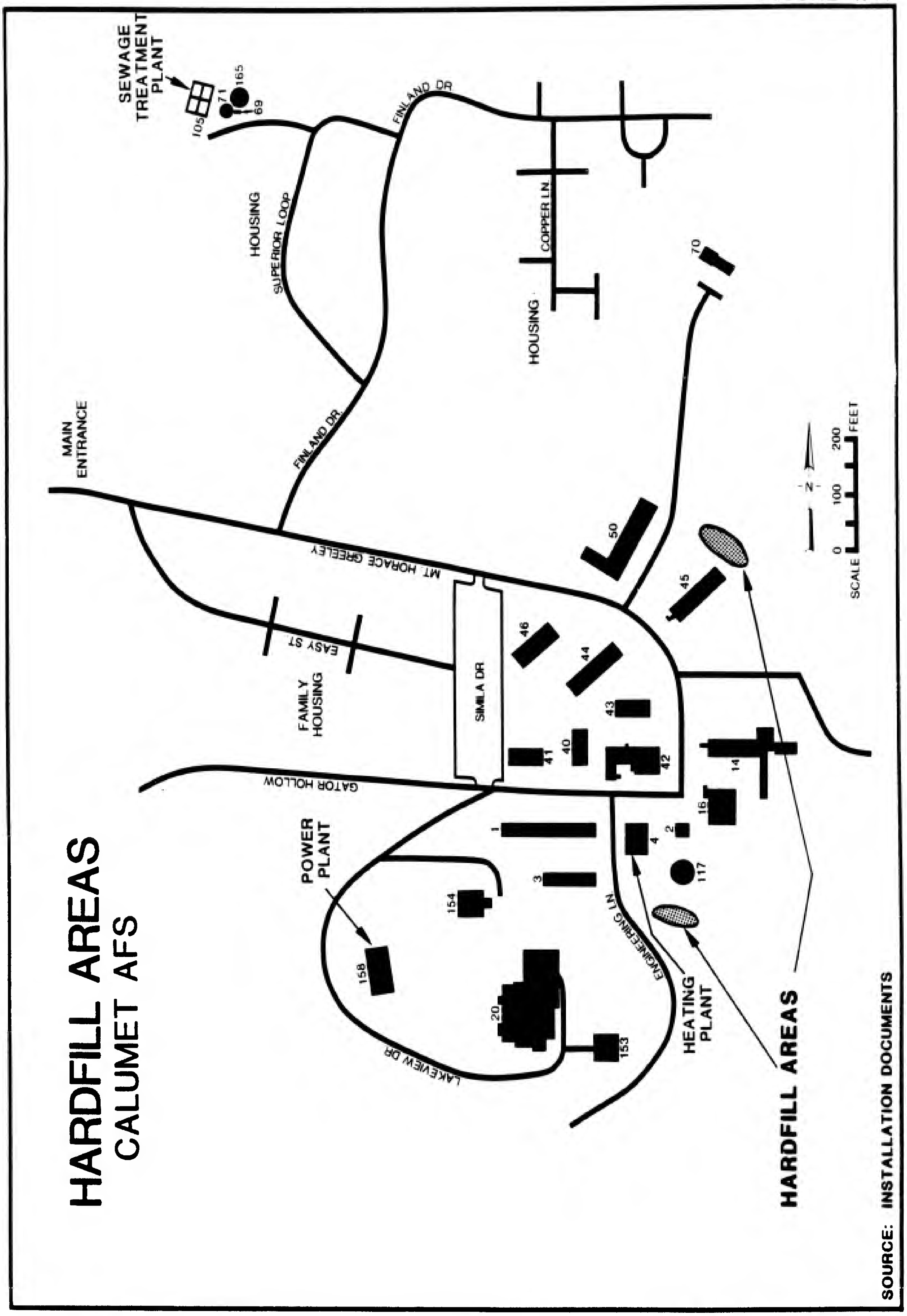
No evidence was found to indicate that a landfill has ever been operated at the station. The hard bedrock base the station is located on has made it virtually impossible to dig to a depth that would be suitable for operation of a landfill. Refuse routinely has been taken to the Calumet Township Landfill. Two hardfill areas are available (see Figure 4.11) for disposal of construction rubble, wood, etc. These areas have also been used for fire training. Training exercises have consisted of igniting wood or a small container of gasoline and immediately extinguishing the fire.

There was one unconfirmed report of a low level radioactive disposal area operated near the main entrance to the site. This area was thought to be used for disposal of low level radioactive radar tubes. Disposal in sanitary landfills is currently an approved disposal method for this type of tube and thus no potential for future contamination is expected to exist.

In summary, the Calumet AFS was not found to contain any known areas which might present a potential for environmental contamination. Wastes have been properly managed since the site was first opened.

Wells Terminal Annex

The Wells Terminal Annex was first commissioned to be built in 1957 with USAF funding and was completed in 1959. Since that time the site has been owned by a variety of companies. The Air Force purchased the property in 1980 and has owned it since that time. The Defense Fuels Support Group in Escanaba operates the site.



HARDFILL AREAS
CALUMET AFS

SOURCE: INSTALLATION DOCUMENTS

The site has been used for a variety of purposes in the past. From the early 1900's until about 1940 the site was operated as a chemical plant by several companies. This plant utilized waste lumber to produce numerous industrial chemicals, alcohol and oils as well as charcoal pig iron. The site was also used for iron ore smelting.

Since 1959 the Annex has been used solely for fuel transfer operations. Fuel is delivered by barge or great lakes tankers and is transferred to one of eight 80,000 barrel holding tanks (see Figure 4.12). Each tank is manifolded separately. Fuel is pumped directly to K.I. Sawyer AFB through a pipeline system owned and operated by the National Pipeline Co. Approximately 3.5 million gallons of JP-4 are piped monthly to the base. Smaller quantities of JP-4 received at the annex are sent by tank truck to the base. AVGAS and diesel fuel have been delivered to the base in the past by truck but this fuel is currently not in use.

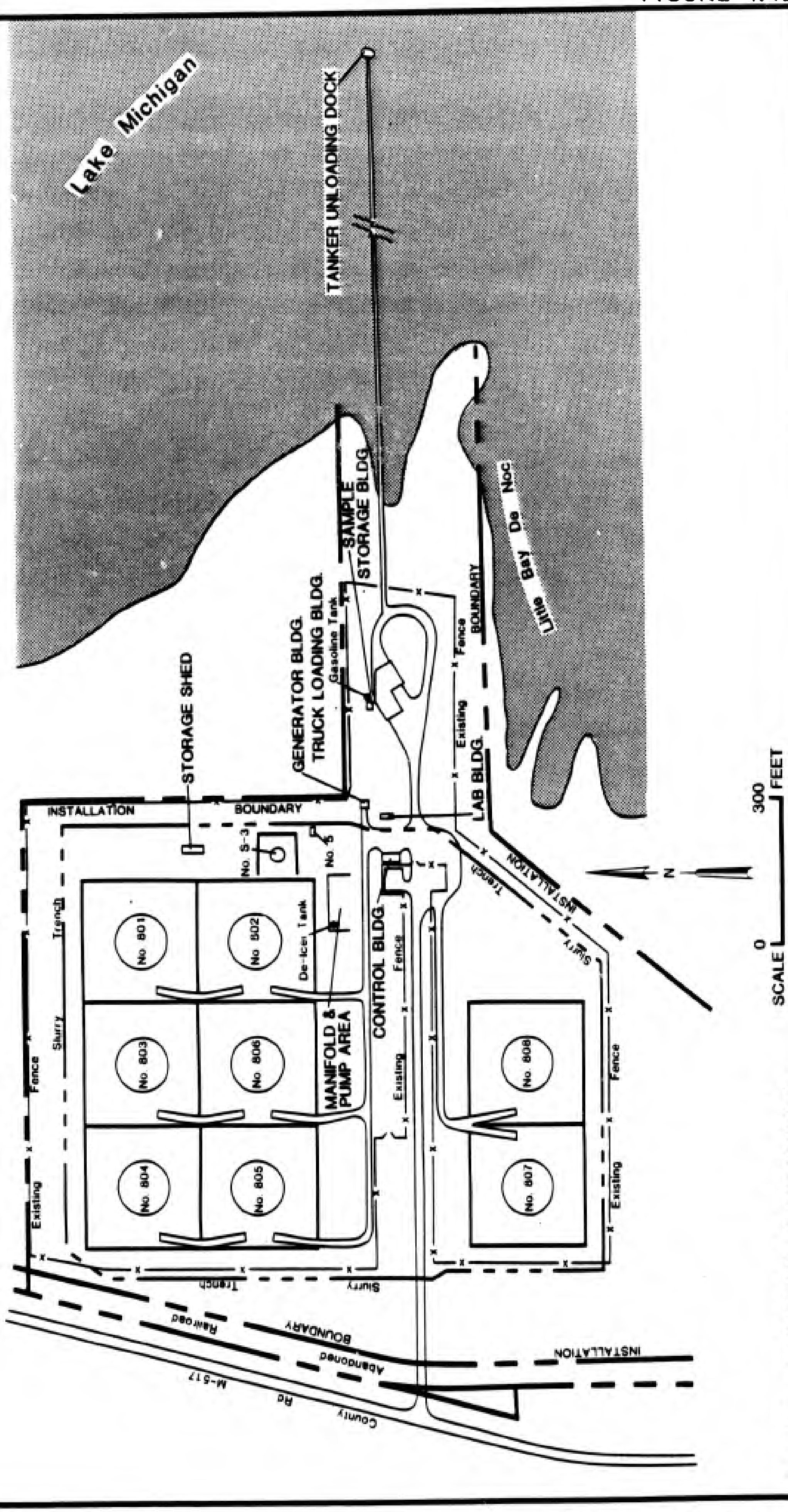
Each holding tank is diked by an earthen berm. A drainage system is currently being put into place. A holding pond for discharge of water from this system has been built and is currently filled with water due to rainfall. The diked area had no visible contamination. An underground collection system for fuel spilled during transfer operations and sampling is located on the north side of the site. All fuel collected by this system is routed to a small tank (S-3), and is tested for reuse.

There are two underground storage tanks located at the annex. One tank, of 1,000 gallon capacity, is currently in use for storage of diesel fuel. The second tank, 500 gallon capacity, is capped and abandoned in place.

At the time of the site visit, construction was underway for a fire protection system. Tank cleaning was also being performed by a contractor at the time of the visit. The tanks had not been cleaned prior to this time. All wash water and waste from this operation was being taken off-site for disposal.

No major spills or leaks of fuel have occurred on Air Force property. Several breaks have occurred in the supply line leading to the base. The tank area has been contained by a 21 foot deep slurry wall so as to contain any potential spills. Construction of this slurry wall

SITE PLAN
WELLS TERMINAL ANNEX



SOURCE: INSTALLATION DOCUMENTS

has created problems with drainage of water from the site and a special drainage system has been put in place to help alleviate this problem.

The chemical plant previously located on the property apparently produced creosote waste which was piped to the bay for discharge. A pit is located in the southeast corner of the site, just outside the fenceline (see Figure 4.13). The pit apparently burned and smoldered for several years until high water levels extinguished the fire. In addition to this area, there are areas inside the fenceline that have evidence of chemical seepage, most likely as a result of past site use. Apparently the slurry wall contained the ground water at the site and caused chemical waste products that had seeped into the soil to move to the surface. Construction workers building the trench noted this material throughout the soil. A sample was tested and the waste was determined to be creosote. No action has been taken to contain or remove this waste. Pockets of the substance were noted in pooled water at the annex.

A hardfill site is located to the south of the holding pond, outside the fenceline (see Figure 4.13). This pit was apparently used for disposal of construction rubble when the land was cleared in the 1950's. There is no evidence to indicate that any hazardous materials were placed in this area.

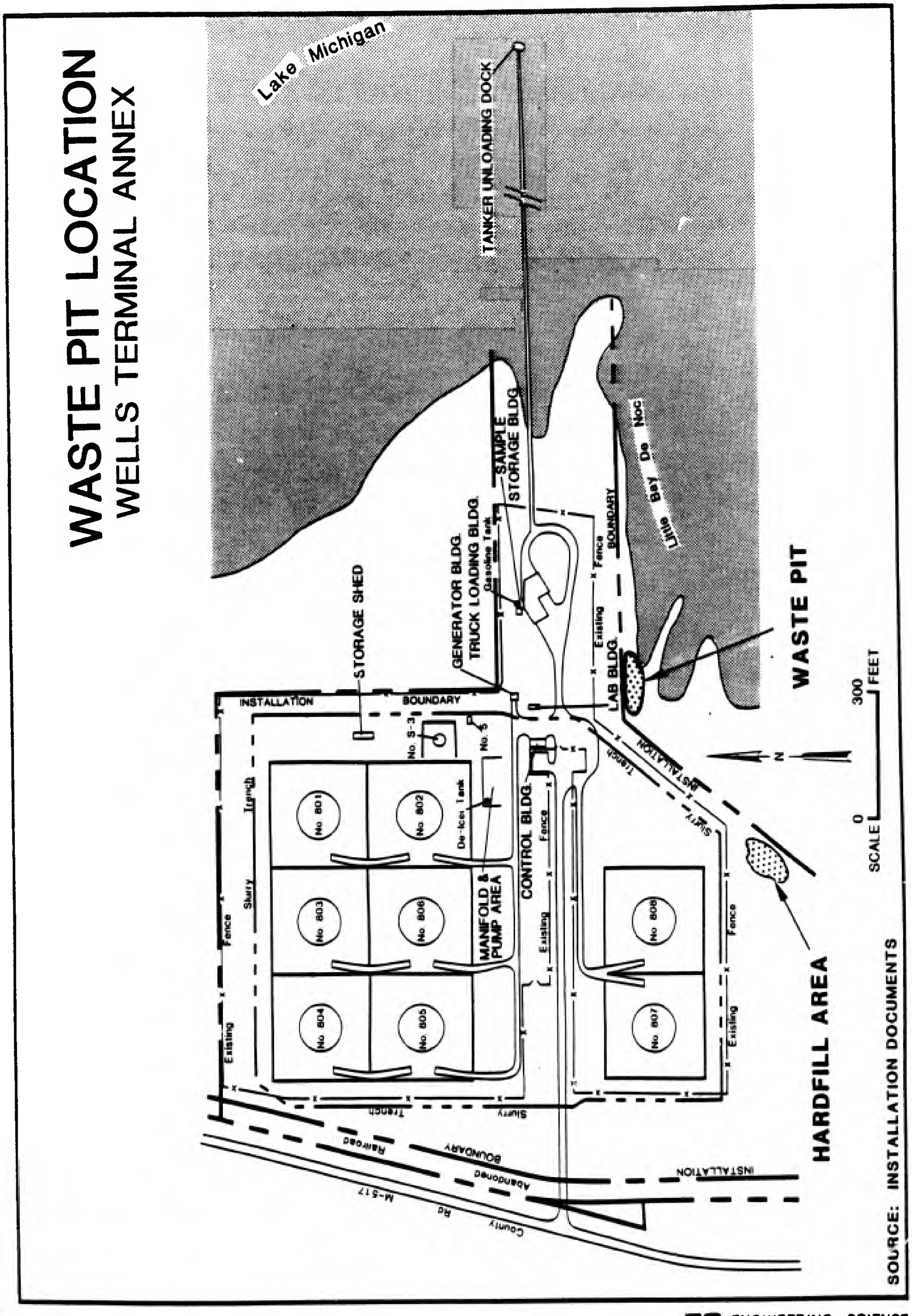
Two wells are currently located at the annex. Well number 1 is sixty feet deep. The water was recently tested and found to contain animal feces. A new well, 300 feet deep was installed. Water quality from this well has been good. Homes in the surrounding area have individual wells for their personal use. The annex has a septic tank for sanitary sewage. All solid waste refuse is taken off-site to the Gladstone Landfill.

EVALUATION OF PAST DISPOSAL ACTIVITIES AND FACILITIES

Review of past waste generation and management practices at K.I. Sawyer AFB has resulted in identification of 19 sites and/or activities which were considered as areas of concern for potential contamination and migration of contaminants.

The sites of initial concern were evaluated using the Flow Chart presented in Figure 1.2. Sites not considered to have a potential for

FIGURE 4.13



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contamination were deleted from further evaluation. The sites which have potential for contamination and migration of contaminants were evaluated using the Hazard Assessment Rating Methodology (HARM). Table 4.3 summarizes the results of the flow chart logic for each of the areas of initial concern.

Sites Eliminated from Further Evaluation

Six of the 19 sites assessed did not warrant further evaluation. The rationale for omitting these sites from HARM evaluation is discussed below.

The hardfill area (No. 1) across from the current landfill and the hardfill area west of the runway (No. 3) were both evaluated to determine if hazardous materials had been placed in either area. All evidence indicated that these sites have been used primarily for hardfill materials and no indication of hazardous waste disposal was found. No significant potential for environmental contamination is expected and no follow on investigation is warranted.

Building 707 and the hazardous waste storage shed at Building 744 have both been used to store hazardous materials and wastes in the past. There was no evidence to indicate that spills or leaks occurred and no potential for environmental contamination was noted.

The EOD area has been used for landfill of spent munitions since the base began operations. Materials disposed to this area are spent munitions that pose no threat to the environment.

Undigested sewage sludge has been applied to several areas of the base. The sludge does not contain a high metals content and no environmental contamination of a chemical origin is expected to exist.

Sites Evaluated Using HARM

The remaining 13 sites identified in Table 4.3 were evaluated using the Hazard Assessment Rating Methodology. The HARM process takes into account characteristics of potential receptors, waste characteristics, pathways for migration, and specific characteristics of the site related to waste management practices. Results of the HARM analysis for the sites are summarized in Table 4.4.

The procedures used in the HARM system are outlined in Appendix G and the specific rating forms for the 13 sites at K.I. Sawyer AFB are presented in Appendix H. The HARM system is designed to indicate the relative need for follow-on action.

TABLE 4.3
SUMMARY OF FLOW CHART LOGIC FOR AREAS OF
INITIAL HEALTH, WELFARE AND ENVIRONMENTAL CONCERN
AT K. I. SAWYER AFB

Site	Potential Hazard to Health, Welfare or Environment	Need for Further IRP Evaluation/ Action	HARM Rating
Landfill No. 1	Yes	Yes	Yes
Landfill No. 2	Yes	Yes	Yes
Landfill No. 3	Yes	Yes	Yes
Landfill No. 4	Yes	Yes	Yes
Hardfill No. 1	No	No	No
Hardfill No. 2	Yes	Yes	Yes
Hardfill No. 3	No	No	No
POL Area	Yes	Yes	Yes
Wells Terminal Annex	Yes	Yes	Yes
Fire Protection Training Area No. 1	Yes	Yes	Yes
Fire Protection Training Area No. 2	Yes	Yes	Yes
DPDO Yard	Yes	Yes	Yes
Hazardous Waste Storage, Bldg. 744	No	No	No
Hazardous Waste Storage, Bldg. 707	No	No	No
Drainage Pond No. 2 (Hospital Area)	Yes	Yes	Yes
Drainage Pit No. 1 (Test Cell)	Yes	Yes	Yes
Drainage Pit No. 2 (Bldg. 740)	Yes	Yes	Yes
Explosives Ordnance Area	No	No	No
Sludge Application Areas	No	No	No

Source: Engineering-Science

TABLE 4.4
SUMMARY OF HARM SCORES FOR
POTENTIAL CONTAMINATION SITES
AT K. I. SAWYER AFB

Rank	Site	Receptor Subscore	Waste Characteristics Subscore	Pathways Subscore	Waste Management Factor	HARM Score
1	Wells Terminal Annex	81	72	80	1.0	78
2	Drainage Pond No. 2 (Hospital Area)	69	100	56	1.0	75
3	POL Area	64	80	80	1.0	75
4	Landfill No. 1	66	100	48	1.0	71
5	Landfill No. 2	64	80	56	1.0	67
6	Drainage Pit No. 3 (Bldg. 740)	63	80	48	1.0	64
7	Landfill No. 3	64	80	41	1.0	62
8	Fire Protection Training Area No. 1	61	80	41	1.0	60
9	Fire Protection Training Area No. 2	61	64	41	1.0	55
10	Hardfill Area No. 2	64	60	41	1.0	55
11	Landfill No. 4	61	60	41	1.0	54
12	Drainage Pit No. 1 (Test Cell)	63	50	46	1.0	53
13	DPDO Yard	63	40	46	1.0	50

Source: Engineering-Science

SECTION 5
CONCLUSIONS

The goal of the IRP Phase I study is to identify sites where there is potential for environmental contamination resulting from past waste disposal practices and to assess the probability of contamination migration from these sites. The conclusions given below are based on field inspections; review of records and files; review of the environmental setting; interviews with base personnel, past employees and local, state and federal government employees; and assessments using the HARM system. Table 5.1 contains a list of the potential contamination sources identified at K. I. Sawyer AFB and a summary of the HARM scores for those sites. Only potential sites identified in Section 4 and determined to warrant further investigation are presented in this section.

WELLS TERMINAL ANNEX

The Wells Terminal Annex has been used for fuel transfer and storage since 1959. It has been owned by several companies and has been owned by the Air Force since 1980. From the early 1900's, until about 1940, this site was operated as a chemical plant. The plant utilized waste lumber to produce various industrial products. The site was also used for iron ore smelting in this time period. The chemical plant was known to produce a creosote waste which it discharged directly to the bay.

The addition of a 21-foot deep slurry trench around the POL tank area has resulted in movement of contaminants, remaining in the underlying soil and most likely the result of past site use, to the ground surface. Construction workers building this trench noted this material throughout the soil. A sample was reported to contain creosote. Pockets of this waste material were noted in pooled water throughout the site.

TABLE 5.1
SITES EVALUATED USING THE
HAZARD ASSESSMENT RATING METHODOLOGY
K. I. SAWYER AFB

Rank	Site	Operation Period	HARM[(1)] Score
1	Wells Terminal Annex	1957-Present	78
2	Drainage Pond No. 2 (Hospital Area)	1956-Present	75
3	POL Area	1957-Present	75
4	Landfill No. 1	1955-1973	71
5	Landfill No. 2	1955-1962	67
6	Drainage Pit No. 3 (Bldg. 740)	1956-1985	64
7	Landfill No. 3	Early 1970's-1975	62
8	Fire Protection Training Area No. 1	1958-1970	60
9	Fire Protection Training Area No. 2	Early 1970's-Present	55
10	Hardfill Area No. 2	Early 1960's until approx. 1970	55
11	Landfill No. 4	1975-Present	54
12	Drainage Pit No. 1 (Test Cell)	1957-Present	53
13	DPDO Yard	1961-Present	50

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

To date, no action has been taken to determine the exact nature and extent of contamination at this site. The terminal uses ground-water wells to supply drinking water, as do the local residents. The site is located at the mouth of the Escanaba River adjacent to Little Bay De Noc and underlain by a combination of modern alluvium, hardfill and glacial lake deposits. These soils are predominantly sands that are typically poorly drained, possess a high water table and subject to flooding. Surface drainage control is assumed to be poor due to the presence of a high ground-water table and an area subject to frequent flooding. Surface drainage flows horizontally toward the Escanaba River or east to Little Bay De Noc. The potential for contamination exists and further action is recommended for this site. The site received a harm rating of 78.

DRAINAGE POND NO. 2

Drainage Pond No. 2 (hospital area) has been used as a storm sewer outfall area since the base first began operations. This pond is located south of the hospital, along Fifth Street. Prior to the mid 1970's hangars, aprons and many industrial shops were not hooked into the sanitary sewer lines. Instead, all waste (other than sanitary waste) went to the storm sewer line and this line discharged at drainage pond No. 2. The quantity of waste disposed through this system was estimated to be high. There were several noted occurrences of discharges to this line that resulted in gross discoloration and obvious contamination of the pond. An oily film was often seen on the top of the pond.

The drainage pond is assumed to be hydraulically connected to the ground-water table and because of the quantity of wastes discharged to this pond, the site holds a potential for environmental contamination and follow-on investigation is warranted. The site received a HARM score of 75.

POL AREA

The POL Area has been active since the base was established in the late 1950's. Several significant spills of fuel products have occurred in this area. In addition, an oil/water separater located in the area has reportedly discharged oil as well as water to the surrounding soil.

This site is underlain by highly permeable sandy soils and the existing oil/water separator may provide a direct pathway for ground-water contamination. Because of the number and significance of the spills and oil discharge to the area, the site has a potential for environmental contamination and follow-on investigation is warranted. The site received a HARM score of 75.

LANDFILL NO. 1

Landfill No. 1 is located south of the WSA. This site was operated as a landfill from 1955 until approximately 1973. During this time period virtually all waste materials that could not be reused or sold were disposed in this landfill. Wastes materials included such things as runway paint, solvents, DDT, housing refuse, fertilizers and large quantities of hardfill. Many wastes were in liquid form. Trenches were dug to depths of 40 feet and were up to 800 feet long. Currently the site is covered with sandy soil and small patches of grass. Break-through of landfilled material is evident in some areas.

The site is underlain by unconsolidated glacial outwash deposits which consist of highly permeable sandy soils which hold a potential for environmental contamination and follow-on is warranted. This site received a final HARM rating of 71.

LANDFILL NO. 2

Landfill No. 2, located west of Silver Lead Creek and southeast of the WSA, was operated from approximately 1955 through 1962. The site was originally a swampy area. No trenches were dug; the low area was simply filled in. The site was used to dispose of hardfill only for its first few years of operation. From 1957 till approximately 1962 it was used for disposal of household refuse, shop waste, and other base refuse. In 1962 the site was closed, but it is still occasionally used for hardfill disposal.

This site is underlain by unconsolidated glacial outwash deposits and modern alluvium which consists primarily of peat and muck. These soils are characteristically wet and associated with ground-water table conditions at or near the surface. This site holds a potential for environmental contamination due to its close proximity to surface waters in the area and the nature and quantity of waste disposed here. Follow-on investigation is warranted. The site received a HARM rating of 67.

DRAINAGE PIT NO. 3

Drainage Pit No. 3 is a drainage ditch that currently receives alkaline aircraft soap and "air show gel" (a petroleum-based degreaser) released to the floor drain in Building 740 (Equipment Maintenance Branch). Liquids collected by this floor drain pass under Avenue G, and are released to a low-lying, scrubby area. Information regarding past waste disposal practices of the Equipment Maintenance Branch was not available for the years preceding 1982, and thus it could not be determined what quantities of other waste materials generated by the shop (hydraulic and brake fluids, naphtha, and PD-680) may have been released to the drain in the past. Although these wastes are currently handled through the DPDO, small quantities that are not recoverable are discharged to this site.

The soils at the site are typically medium to coarse grained sands. Because the quantity of waste discharged in the past is unknown, follow-on investigation is warranted. This site received a HARM rating of 64.

LANDFILL NO. 3

Landfill No. 3, located east of Taxiway F, was used for general disposal of base refuse from the early 1970's through 1975. Waste material buried here consisted primarily of household refuse and sewage sludge. Small quantities of drummed industrial waste were also buried here.

This site is underlain by glacial outwash deposits which consist of moderate to highly permeable sandy loam. Due to the permeable nature of the surrounding soils, the close proximity of surface waters and the unknown nature and quantity of wastes disposed here, a potential for contamination exists and follow-on investigation is warranted. This site received a HARM rating of 62.

FIRE PROTECTION TRAINING AREA NO. 1

This site is located at the northern end of the base, north of the primary taxiway. It was in use from approximately 1958 until the early 1970's. Fuel stored near the site was emptied to the ground and ignited. Fuels used included contaminated and clean JP-4, AVGAS, and smaller quantities of hydraulic fluid, oils and paint thinners. Burn frequency averaged four times per month with fuel volumes of 300 to 2,000 gallons per training excercise. This site, also underlain by glacial outwash deposits, is located in an area where the soils are predominantly sandy loam of moderate to high permeability. Surface drainage is assumed to flow horizontally north toward tributaries of Big Creek. The quantities of fuel burned in this area, along with the permeable nature of the soils, makes the potential for environmental contamination significant. Follow-on investigation is warranted. This site received a HARM rating of 60.

FIRE PROTECTION TRAINING AREA NO. 2

This site is the current site for fire training excercises and is located in the northeast portion of the base, east of the primary taxiway. This site has been used since the early 1970's. Originally the site was a soil covered area with no fuel recovery and collection system. Limited pre-wetting occurred. Burn frequencies averaged three to four times per month, with 300 to 500 gallons of JP-4 used. The site was modified in 1982 by construction of a concrete pad and a fuel-water drain system.

The soils at this site are typically medium to coarse grained highly permeable sands and because of the nature and duration of activities at the site, a potential for contaminant migration exists and follow-on investigation is warranted. The site received a HARM rating of 55.

HARDFILL AREA NO. 2

This hardfill area is located approximately 1500 feet southeast of the main gatehouse. The site was used for disposal of base hardfill materials from the early 1960's until approximately 1970. The site was also used as a storage area for transformers. Transformers were kept on racks in the area and many were noted to have leaks. Some were cleaned and/or drained to the ground surrounding the racks. Many of these transformers were known to have contained PCB's. The site is underlain by glacial outwash deposits which are typically medium to coarse grained highly permeable sands. Due to the potential for PCB contamination and the permeable nature of the soils at this site, a follow-on investigation is warranted. The site received a HARM rating of 55.

LANDFILL NO. 4

Landfill No. 4 has been in use at the base since 1975 for disposal of refuse from base dumpsters in shop and housing areas. There are also several pits located in this area for disposal of STP sludge. Small quantities of hazardous wastes were disposed in this area prior to 1980, the year DPDO took over this responsibility.

The soils at this site are characteristically moderate to highly permeable sand and sandy loam. Due to the uncertainty of the types and quantities of waste disposed in this landfill, this site is recommended for follow-on investigation. The site received a HARM score of 54.

DRAINAGE PIT NO. 1

A large pit, visibly stained with a black residue, was noted behind the old 87th FIS test cell in Building 414. Shop personnel indicated that this staining was probably due to workers dumping wastes, such as oil and fuel, to the pit and surrounding area. The precise quantity of waste disposed in this manner was not determined. This site is underlain by glacial outwash deposits consisting of highly permeable medium to coarse grained sand. Surface drainage is assumed to flow east toward Silver Lead Creek. Due to the permeable nature of soils in this area, and the close proximity of surface waters, this site has the potential for environmental contamination and follow-on investigation is warranted. The site received a HARM rating of 53.

DPDO YARD

The DPDO Yard at K. I. Sawyer AFB has been used periodically for storage of transformers and some evidence indicates that oil leaked or was dumped to the surrounding soil. Some of these transformers most likely contained PCB contaminated oil. Additionally, oil storage drums from various shops were held in an area of the yard prior to disposal. Both the transformer storage and oil drum storage areas were on unlined portions of the yard with sandy soils forming the base.

This site is located in an area where the soils are highly permeable medium to coarse grained sand. Surface drainage is anticipated to flow east to Silver Lead Creek and a potential for environmental contamination exists due to the possibility of oil leaks and spills. Follow-on investigation is thus warranted. The site received a HARM rating of 50.

SECTION 6
RECOMMENDATIONS

Thirteen sites were identified at K. I. Sawyer AFB as having the potential for environmental contamination. These sites have been evaluated and rated using the HARM system which assesses their relative potential for contamination and provides the basis for determining the need for Phase II IRP investigations. All of the thirteen sites have sufficient potential to create environmental contamination and warrant Phase II investigations.

PHASE II MONITORING RECOMMENDATIONS

The recommendations in this section are made to further assess the potential for environmental contamination from waste disposal areas at K. I. Sawyer AFB. The recommended actions are generally one time sampling programs to determine if contamination does exist at the site. If contamination is identified, the sampling program may need to be expanded to further define the extent of contamination. The thirteen sites recommended for further actions include the Wells Terminal Annex, two fire protection training areas, four former landfill areas, one former hardfill area, the DPDO storage yard, three waste discharge areas and the POL Area.

The hydrogeologic conditions present at each waste disposal facility are entirely site-specific due to variations in geology, topography, land use modifications, etc. These natural conditions or man-made changes in the local environmental setting must be clearly understood in order to design an effective ground-water quality monitoring system. At present, the site-specific conditions existing at the K. I. Sawyer AFB sites are unknown. Soil test borings and temporary observation wells may be employed to obtain site-specific information. A systematic, more efficient and cost-effective approach would be to utilize geophysical techniques to obtain local subsurface information. Electrical resistivity (ER) and electromagnetic conductivity (EM) are geophysical instruments that employ indirect measurement technologies to collect data describing subsurface material electrical properties. They respond to changes or contrasts in either the horizontal or vertical planes which may be correlated to direct sampling methods, such as test borings. Both methods may be utilized in shallow situations to determine stratigraphic changes, depth to ground water, aquifer thickness and contaminated zones if sufficient contrast in the local geology exists. ER may be employed in more complicated terrains or in situations where deep contamination is suspected. Wells may then be installed systematically, in zones selected by the geophysical technique. This approach to monitoring program design significantly reduces both costs and schedules.

The use of geophysical techniques at waste disposal facilities has been well documented in the technical literature. A USEPA guidance manual describes the capabilities and limitations of electrical resistivity at waste disposal facilities and is applicable to the probable conditions that may be encountered at K. I. Sawyer AFB (USEPA, 1978). Other geophysical methodologies can be utilized for specialized purposes - for example, a metal detector may be used in shallow settings to locate buried ferrous materials and the magnetometer may be utilized to locate either buried objects or disturbed zones (backfilled trenches or pits) in shallow and deep settings.

Ground-water quality monitoring systems must be designed for the site-specific conditions existing at a waste disposal facility. Guidelines for well system design have been published in several USEPA reports. One report indicates that a few guidelines are applicable to conditions such as those noted at K. I. Sawyer AFB. For large areas/landfills, or for areas with multiple ground-water flow directions, it is recommended that more than the usual four wells (one upgradient and three downgradient, from RCRA, Subpart F, Section 265.91, "Ground-water Monitoring System") may be required. Where multiple flow directions may exist beneath a site, geophysical methods should be utilized to guide well placement, both the physical location and the screened interval.

In situations where the site is physically large or has an unusual geometry and therefore has a long downgradient dimension (the site border, which when sketched on a topographic map, appears to be drawn at a right angle to the principal direction of ground-water flow), the general rule is to install one monitoring well for each 250 feet of downgradient frontage (USEPA, 1980, page 41). This well spacing is considered to be a maximum allowable interval between wells, assuming that local hydrogeologic conditions are reasonably uniform. Wells must be installed at closer intervals if the site subsurface conditions are determined to be complex. While well installation and soil borings are being performed, readings with an organic vapor analyzer (OVA) or similar equipment should be made. Such equipment can be used as a screening device to determine those soil samples to be put aside for chemical analyses and can also be used as a health and safety device for the protection of the field crew from potentially harmful vapors.

Following geophysical surveys, the proper placement of additional soil borings and/or ground-water quality monitoring wells can be determined. Those sites with a potential for ground-water contamination will be monitored with 4-inch diameter wells consisting of Schedule 40 PVC with solid casing and machine slotted screen. Well screens should be installed to permit sampling of the uppermost aquifer's complete saturated thickness. Well depth should be determined by site geophysics. If the initial ground-water samples indicate contamination, additional wells may be required. The number of wells may be reduced if the geophysical techniques are successful in identifying subsurface plumes. The recommended monitoring program is summarized in Table 6.1 and discussed below for each site. Table 6.2 lists the recommended analyses. Figures 6.1 and 6.2 illustrate several proposed Phase II monitoring locations.

Wells Terminal Annex

The Wells Terminal Annex has significant potential for environmental contamination and monitoring is recommended. This site is unique in that the natural geology has been altered by placement of a slurry wall completely around the site. A complete geophysical study is thus recommended to fully characterize the study area. This should include, but need not be limited to, geophysics, soil sampling, and placement of

TABLE 6.1
RECOMMENDED MONITORING PROGRAM FOR PHASE II IRP
AT K. I. SAWYER AFB

Site Name	Rating Score	Recommended Monitoring	Sample Analyses List	Comments
Wells Terminal Annex	78	Geophysical study to characterize the study area to include soil sampling, geophysics and placement of observation wells. Monitoring wells should be subquently added along the perimeter of the site, one background well should be placed upgradient to the site. Perform soil sampling up to at least 15 feet below grade and at 3 foot intervals. Sample sediments in local surface water near the mouth of the Escanaba River and at one upstream location. Sample drinking water well and analyze for priority pollutants. One boring taken from the creosote pit, outside the fenceline to a depth of five feet. Samples should be analyzed at one foot intervals.	Ground Water, Surface Water, Soil Samples List A Drinking Water Well List B	If sampling indicates contamination, continue monitoring. Additional wells and soil borings may be necessary to assess extent of contamination. The southern boundary of the annex should be resurveyed to determine the exact location of the creosote pit with respect to AF property.

TABLE 6.1 (Continued)
RECOMMENDED MONITORING PROGRAM FOR PHASE II IRP
AT K. I. SAWYER AFB

Site Name	Rating Score	Recommended Monitoring	Sample Analyses List	Comments
Drainage Pond No. 2	75	Sample pond water using a grid pattern to assure a composite sample. Sample water near outfall. Sediment sampling taken at four locations in the pond. One soil boring in golf course area to be performed up to 15 feet below grade and samples taken at 3 foot intervals. Placement of four monitoring wells around the site. Sample sediments and surface water from Silver Lead Creek at one upgradient and two downgradient locations.	Surface Water and Ground Water List C Sediments & Soils List D	No background well should be necessary since recharge is to surrounding soils. This should be verified by use of observation wells. Additional sampling may be necessary to assess the extent of contamination.
POL Area	75	Geophysical study to determine the areal limits of the contaminants and the optimum sampling locations and depths; install and sample monitoring wells.	List E	If sampling indicates contamination, continue monitoring. Additional wells and soil borings may be necessary to assess extent of contamination. Care must be taken to ensure that wells are installed so that the normal water table intersects the well screen.

TABLE 6.1 (Continued)
RECOMMENDED MONITORING PROGRAM FOR PHASE II IRP
AT K. I. SAWYER AFB

Site Name	Rating Score	Recommended Monitoring	Sample Analyses List	Comments
Landfill No. 1	71	Geophysical study to determine extent of contamination and to aid in placement of wells; install and sample one background well and one downgradient well for each 250 feet of downgradient frontage; sample surface water and sediments upgradient and downgradient from the site.	Ground Water and Surface Water List C and G Sediment Samples List D and G	If sampling indicates contamination, continue monitoring. Additional wells and soil borings may be necessary to assess extent of contamination.
Landfill No. 2	67	Geophysical study to determine extent of contamination and to aid in placement of wells; install and sample one background well and one downgradient well for each 250 feet of downgradient frontage; sample surface water and sediments upgradient and downgradient from the site.	Ground Water and Surface Water List C Sediment Samples List D	If sampling indicates contamination, continue monitoring. Additional wells and soil borings may be necessary to assess extent of contamination.

TABLE 6.1 (Continued)
RECOMMENDED MONITORING PROGRAM FOR PHASE II IRP
AT K. I. SAWYER AFB

Site Name	Rating Score	Recommended Monitoring	Sample Analyses List	Comments
Drainage Pit No. 3	64	Geophysics to aid in determining the extent of contamination and to aid in the placement of ground-water monitoring wells. Three downgradient wells and one upgradient well are recommmended.	List C	If sampling indicates contamination, continue monitoring. Additional wells and soil borings may be necessary to assess extent of contamination.
Landfill No. 3	62	Geophysical study to determine extent of contamination and to aid in placement of wells; install and sample one background well and one downgradient well for each 250 feet of downgradient frontage; sample surface water and sediments upgradient and downgradient from the site.	Ground Water and Surface Water List C Sediment Samples List D	If sampling indicates contamination, continue monitoring. Additional wells and soil borings may be necessary to assess extent of contamination.
Fire Protection Training Area No. 1	60	At least three test borings should be taken within site limits; perform sampling up to 15 ft below grade and at three foot vertical intervals; conduct geophysical survey; install and sample one up-gradient and three down-gradient wells.	Soil Samples List D Ground Water List C	If sampling indicates contamination, continue monitoring. Additional wells and soil borings may be necessay to assess extent of contamination.

TABLE 6.1 (Continued)
RECOMMENDED MONITORING PROGRAM FOR PHASE II IRP
AT K. I. SAWYER AFB

Site Name	Rating Score	Recommended Monitoring	Sample Analyses List	Comments
Fire Protection Training Area No. 2	55	At least three test borings should be taken within site limits; perform sampling up to 15 ft below grade and at three ft vertical intervals; conduct geophysical survey; install and sample one upgradient and three downgradient wells.	Soil Samples List D Ground Water List C	If sampling indicates contamination, continue monitoring. Additional wells and soil borings may be necessay to assess extent of contamination.
Hardfill Area No. 2	55	Three borings at the site to a depth of at least 20 ft below grade. Samples should be taken at three foot intervals.	List F	If sampling indicates contamination, continue monitoring. Wells and additional soil borings may be necessary to assess extent of contamination.
Landfill No. 4	54	Geophysical study to determine extent of contamination and to aid in placement of wells; install and sample one background well and one downgradient well for each 250 feet of downgradient frontage; sample surface water and sediments upgradient and downgradient from the site.	Ground Water and Surface Water List C Sediment Samples List D	If sampling indicates contamination, continue monitoring. Additional wells and soil borings may be necessary to assess extent of contamination.

TABLE 6.1 (Continued)
RECOMMENDED MONITORING PROGRAM FOR PHASE II IRP
AT K. I. SAWYER AFB

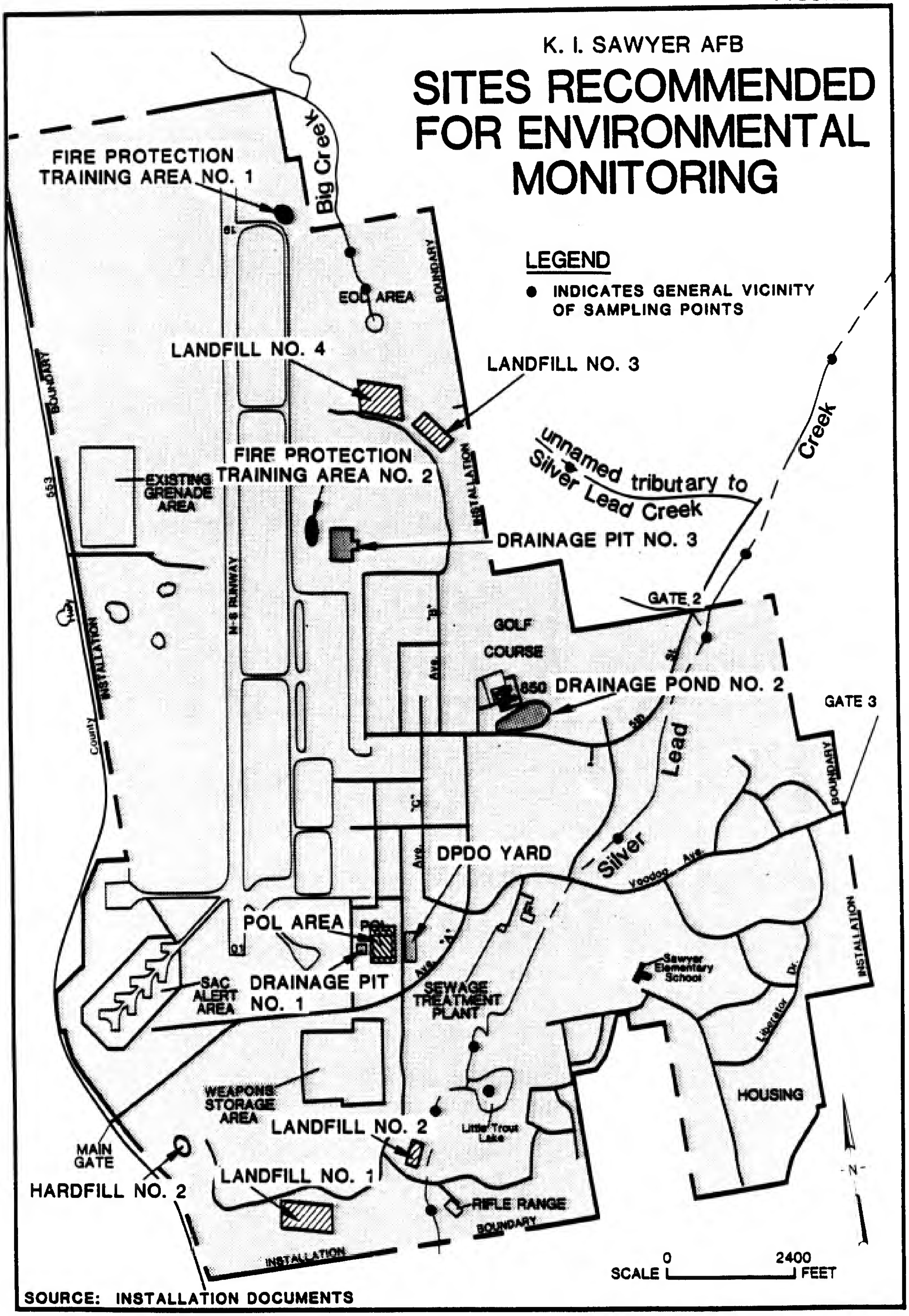
Site Name	Rating Score	Recommended Monitoring	Sample Analyses List	Comments
Drainage Pit No. 1	53	Two soil borings, one at each end of the pit should be performed up to 15 ft below grade and samples should be taken at three foot intervals.	List D	If sampling indicates contamination, geophysics should be used to guide the placement of a ground-water monitoring system.
DPDO Yard	50	Three soil borings, should be performed up to 15 ft below grade and samples should be taken at three foot intervals.	List F	If sampling indicates contamination, geophysics should be used to guide the placement of a ground-water monitoring system.

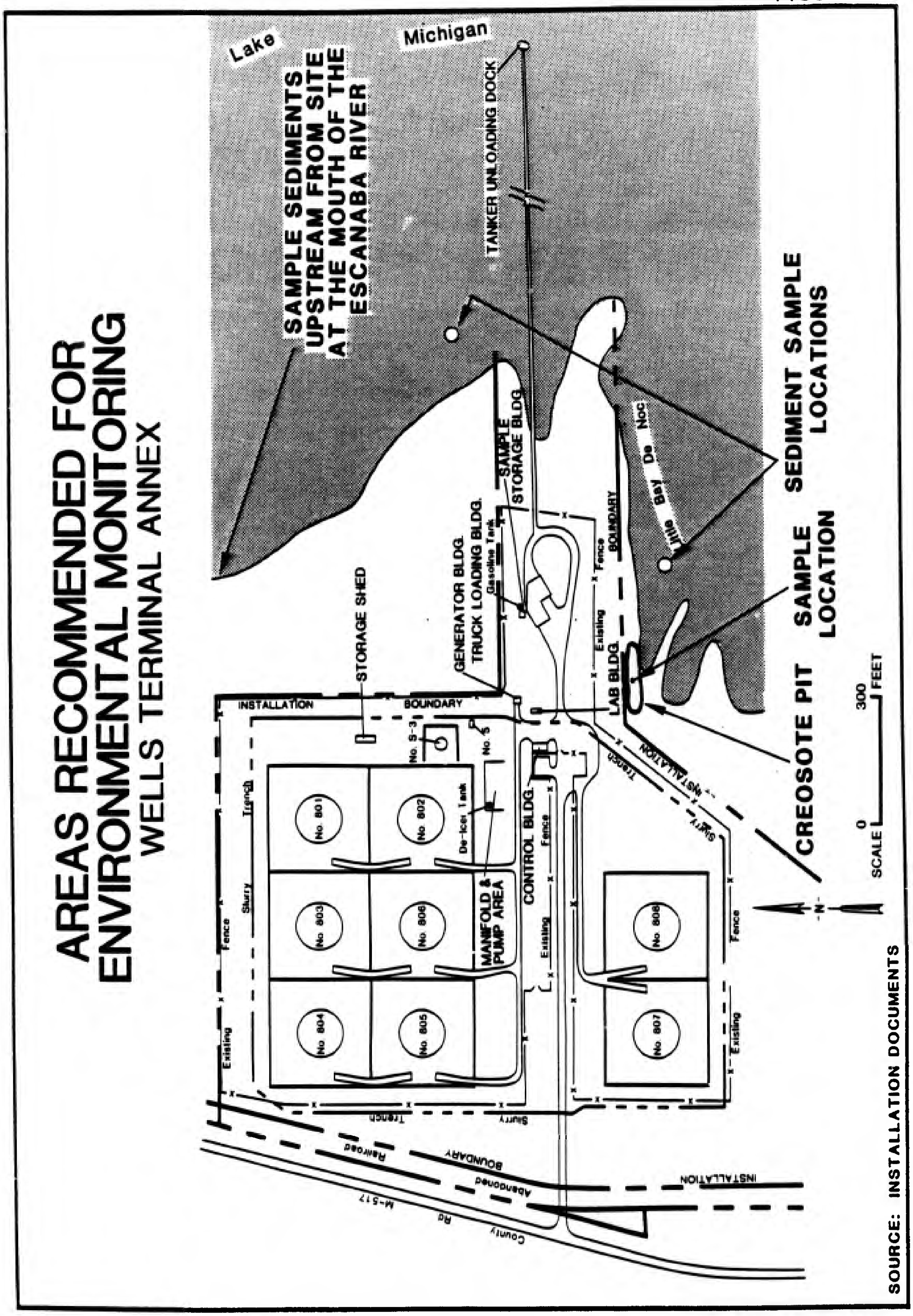
TABLE 6.2
RECOMMENDED LIST OF ANALYTICAL PARAMETERS FOR PHASE II IRP
AT K. I. SAWYER AFB

	EPA Method Number
List A	
Purgeable Organics (VOA)	624 (waters) 8240 (soils/sediments)
Semivolatile Organics (to include cresol compounds and derivatives)	625 (waters) 8270 (soils/sediments)
List B	
GC/MS Priority Pollutant Scan	624/625/608
List C	
Purgeable Halocarbons	601
Purgeable Aromatics	602
Phenol	420.1
Oil & Grease	413.1
pH	150.1
List D	
Halogenated & Aromatic Volatile Organics	8010/8020
Oil & Grease	413.1
Phenols	420.1
EP Toxicity	40 CFR 261.24
List E	
Total Organic Carbon	415.1
Oil & Grease	413.1
List F	
Pesticides/PCB's	8080
Oil & Grease	413.1
List G	
Pesticides/PCB's	608 (waters) 8080 (soils/sediments)

Source: Engineering-Science

FIGURE 6.1


K. I. SAWYER AFB
SITES RECOMMENDED FOR ENVIRONMENTAL MONITORING
LEGEND
● INDICATES GENERAL VICINITY OF SAMPLING POINTS
FIRE PROTECTION TRAINING AREA NO. 1
Big Creek
EOD AREA
LANDFILL NO. 4
LANDFILL NO. 3
FIRE PROTECTION TRAINING AREA NO. 2
EXISTING GRENADE AREA
DRAINAGE PIT NO. 3
Unnamed tributary to Silver Lead Creek
Creek
GATE 2
GOLF COURSE
DRAINAGE POND NO. 2
GATE 3
N-S RUNWAY
INSTALLATION BOUNDARY
County 553
Silver Lead
DPDO YARD
Voodoo Ave.
POL AREA
DRAINAGE PIT NO. 1
SAC ALERT AREA
SEWAGE TREATMENT PLANT
Sawyer Elementary School
Liberator Dr.
WEAPONS STORAGE AREA
LANDFILL NO. 2
Little Trout Lake
HOUSING
MAIN GATE
HARDFILL NO. 2
LANDFILL NO. 1
RIFLE RANGE
N
SCALE 0 2400 FEET
SOURCE: INSTALLATION DOCUMENTS


AREAS RECOMMENDED FOR
ENVIRONMENTAL MONITORING
WELLS TERMINAL ANNEX
Lake
Michigan
SAMPLE SEDIMENTS UPSTREAM FROM SITE AT THE MOUTH OF THE ESCANABA RIVER
TANKER UNLOADING DOCK
SAMPLE STORAGE BLDG
Little Bay De Noc
SEDIMENT SAMPLE LOCATIONS
SAMPLE LOCATION
CREOSOTE PIT
LAB BLDG
BOUNDARY
Fence
Existing
GENERATOR BLDG.
TRUCK LOADING BLDG.
Gasoline Tank
STORAGE SHED
INSTALLATION
BOUNDARY
No. S-3
No. 5
De-icer Tank
MANIFOLD & PUMP AREA
CONTROL BLDG.
No 801
No 802
No 803
No 806
No 804
No 805
No 808
No 807
Trench
Slurry
Railroad
Abandoned
INSTALLATION
M-517
County Rd
SCALE
0
300
FEET
-N-
SOURCE: INSTALLATION DOCUMENTS

observation wells. Once the study area has been more fully characterized, monitoring wells should be established along the perimeter of the site, at each wall. Both shallow and deep wells should be used. Background wells should be placed upgradient to the site. Ground-water well samples should be analyzed for the parameters given in Table 6.2, list A.

Specific locations for soil borings should be determined based on the results of the geophysical study. Sampling should be performed to a depth of at least 15 feet below grade with samples taken at three foot intervals or in areas of obvious visual contamination. If soil borings indicate visual contamination at 15 feet, deeper borings should be taken until no visual contamination is evident. Soil borings should be analyzed for the parameters given in Table 6.2, list A.

In addition to the above, sediments from surface waters in the area should be tested. The annex is located near the point where the Escanaba River enters into Little Bay de Noc. One sample should be taken at the mouth of the river, one off the eastern edge of the site and another sample should be taken at an upstream location. These samples should be analyzed for the parameters listed in Table 6.2, list A.

The existing drinking water well should be analyzed for priority pollutants to ensure that no contaminants have reached this aquifer (list B).

An area just outside the fenceline south of the lab building was suspected to be an old creosote dump pit. The area poses a potential for environmental contamination and a sample of this material should also be taken and analyzed. One boring should be taken in the center of the area. Sampling should be performed to a depth of five feet and samples should be analyzed at one foot intervals or in areas of obvious contamination. These samples should be analyzed for the parameters given in Table 6.2, list A. The southern boundary of the annex should be resurveyed to determine the exact location of the creosote pit with respect to AF property.

Drainage Pond No. 2

The drainage pond near the base hospital has been used as a storm sewer outfall since the base first began operations. Many of the industrial shops discharged portions of their waste to this system and this area thus has a potential for environmental contamination. This practice has since been stopped.

The pond was noted to originally extend eastward into the golf course area but was diked to help contain the water. Follow-on recommendations include sediment sampling, surface water sampling, sampling of the soil at the golf course in the vicinity of the overflow area, and installation of a ground-water quality monitoring system.

Sampling of the surface water should be performed using a grid pattern to assure composite samples. If the pond is shallow no vertical composite need be done. However, if the pond rises above 1 foot, vertical samples should be taken and composited at selected increments. A sample of the outfall from the oil/water separator should also be taken.

Silver Lead Creek should be sampled at one upstream location and two downstream locations. Both surface waters and sediments should be sampled.

Water samples should be analyzed for the parameters given in Table 6.2, list C.

Sediment samples should be taken at four locations in the pond. One sample should be taken near the outfall from the oil/water separator. The additional three samples should be taken from the far end of the pond and from each side of the pond. One soil sample should be taken from the golf course area immediately adjacent to the pond. This boring should be taken up to 15 feet below grade and samples should be taken at three foot intervals or in areas of obvious visual contamination. All soil and sediment samples should be analyzed for the parameters given in Table 6.2, list D.

Using geophysics as a guide, four wells should be placed surrounding the site. No background well can be used since the site appears to recharge the local aquifer in all directions. This should be confirmed with the use of observation wells. The wells should be placed on each side of the site and samples should be analyzed for the parameters given in Table 6.2, list C.

POL Area

The POL Area has been the site of several major fuel spills with little or no fuel recovery or cleanup. This site also contains a malfunctioning oil/water separator that allows fuel to pass through it and into a gravel lined pit designed to collect the water phase from the separator.

A geophysical study, including both electromagnetic conductivity and electrical resistivity is recommended for this site. The two survey results should then be compared and the probable contamination migration areal limits and optimum sampling depths determined.

Monitoring wells should be installed at the locations and depths indicated by the geophysical study. Wells installed into zones where floating contaminants are present must be constructed so that the normal water table intersects the well screen. The water level must not be present above the well screen because light-weight contaminants will float past the monitoring point undetected.

Wells should be sampled for the parameters listed in Table 6.2, list E.

Landfill No. 1

Landfill No. 1 is located just south of the WSA and was used for disposal of various waste materials including fuel, solvents, paints, DDT, housing refuse, and fertilizer. Environmental contamination is of concern in this general area. An investigation of the site specific hydrogeologic conditions is recommended with subsequent placement of a ground-water quality monitoring system consistent with local subsurface conditions. The ground-water quality monitoring system should consist of one background well and one downgradient monitoring well for each 250 feet of "downgradient" frontage. These wells should be constructed as previously discussed.

In addition to the above, surface water, in the direction of flow from the site, should be sampled to determine if any significant water quality degradation has occurred. Drainage from this area is toward Silver Lead Creek. An upgradient sample should be taken from Stump Lake and at least two downgradient samples should be taken from Silver Lead Creek. Both ground-water and surface water samples should be tested for the parameters listed in Table 6.2, lists C, and G.

Sediment samples should be taken at equivalent locations in the creek as well as in Stump Lake. These samples should be analyzed for the parameters listed in Table 6.2, lists D, and G.

Landfill No. 2

Landfill No. 2 is located west of Silver Lead Creek and southeast of the WSA. The site has been used for hardfill, household refuse and various shop wastes. An investigation of the site specific hydrogeologic conditions is recommended with subsequent placement of a ground-water quality monitoring system consistent with local subsurface conditions. The ground-water quality monitoring system should consist of one background well and one downgradient monitoring well for each 250 feet of "downgradient" frontage. These wells should be constructed as previously discussed.

In addition to the above, surface water, in the direction of flow from the site, should be sampled to determine if any significant water quality degradation has occurred. Drainage from this area is toward Silver Lead Creek. An upgradient sample should be taken from Stump Lake. One downgradient sample should be taken from Silver Lead Creek and one from Little Trout Lake. Care should be taken to ensure that these samples are representative. Sediment samples should also be taken at these locations.

Both ground-water and surface water samples should be analyzed for the parameters listed in Table 6.2, list C. Sediment samples should be analyzed as per list D, Table 6.2.

Drainage Pit No. 3

Building 740 currently discharges shop wastes to a drainage outfall to the west of Avenue G. This practice has been ongoing, although since the DPDO has been established the quantity of waste disposed in this fashion has decreased. Recommendations for this site include a determination of site specific hydrogeology, including geophysics, to determine the extent of contamination and to aid in the placement of ground-water quality monitoring wells. Following this study, three downgradient wells and one upgradient well are recommended for installation. Ground-water samples should be analyzed for the parameters listed in Table 6.2, list C.

Landfill No. 3

Landfill No. 3 contains general base refuse, sewage sludge, household refuse, and some industrial wastes. An investigation of the site specific hydrogeologic conditions is recommended with subsequent placement of a ground-water quality monitoring system consistent with local subsurface conditions. The ground-water quality monitoring system should consist of one background well and one downgradient monitoring well for each 250 feet of "downgradient" frontage. These wells should be constructed as previously discussed.

In addition to the above, surface water, in the direction of flow from the site, should be sampled to determine if any significant water quality degradation has occurred. Drainage from this area is toward Silver Lead Creek and an intermittent unnamed stream. An upgradient sample should be taken from Silver Lead Creek and at least two downgradient samples should be taken from the creek. If the unnamed stream has flow, a sample should also be taken from this stream. Both ground water and surface water samples should be tested for the parameters listed in Table 6.2, list C.

Sediment samples should be taken at corresponding locations in the creek as well as in the unnamed stream. These samples should be analyzed for the parameters listed in Table 6.2, list D.

Fire Protection Training Area No. 1

FPTA No. 1 was actively used for approximately 12 years with large quantities of fuel and other wastes being burned. The area has a significant potential for environmental contamination and monitoring is recommended. Test borings should be taken at three or more locations within the site limits. Soil sampling should be performed up to 15 feet below grade and samples should be taken at three foot vertical intervals or in areas of obvious visual contamination. Samples should be analyzed for the parameters listed in Table 6.2, list D. Additionally, using geophysics as a guide, one upgradient and three downgradient wells should be installed within the uppermost aquifer. Ground-water well samples should be analyzed for the parameters listed in Table 6.2, list C.

Fire Protection Training Area No. 2

FPTA No. 2 is the current site for fire training exercises and has been used since the early 1970's. The area has a significant potential for environmental contamination and monitoring is recommended. Test borings should be taken at three or more locations within the site limits. Soil sampling should be performed up to 15 feet below grade and samples should be taken at three foot vertical intervals or in areas of obvious visual contamination. Samples should be analyzed for the parameters listed in Table 6.2, list D. Additionally, using geophysics as a guide, one upgradient and three downgradient wells should be installed within the uppermost aquifer. Ground-water well samples should be analyzed for the parameters listed in Table 6.2, list C.

Hardfill Area No. 2

The hardfill area located near the main gate rated a relatively high HARM score due to the potential for PCB oil spills and leaks from transformers stored in this area. Due to the persistent nature of PCB's and their high affinity for soil, soil borings should be taken in this area and analyzed. Three borings should be taken and should extend to a depth of at least twenty feet below grade. Samples should be taken at three foot intervals. Samples should be analyzed as specified in Table 6.2, list F.

Landfill No. 4

Landfill No. 4 has been used at the base since approximately 1975 and is currently used for disposal of base refuse and sewage sludge. An investigation of the site specific hydrogeologic conditions is recommended with subsequent placement of a ground-water quality monitoring system consistent with local subsurface conditions. The ground-water quality monitoring system should consist of one background well and one downgradient monitoring well for each 250 feet of "downgradient" frontage. These wells should be constructed as previously discussed.

In addition to the above, surface water, in the direction of flow from the site, should be sampled to determine if any significant water quality degradation has occurred. Drainage from this area may be toward Silver Lead Creek and its unnamed tributary and/or to Big Creek. An upgradient sample should be taken from Silver Lead Creek and at least two downgradient samples should be taken from the creek. If the unnamed tributary has flow, a sample should also be taken from this stream. Two samples should be taken from Big Creek. Both ground-water and surface water samples should be tested for the parameters listed in Table 6.2, list C.

Sediment samples should be taken at locations in the two creeks as well as in the unnamed stream. These samples should be analyzed for the parameters listed in Table 6.2, list D.

Drainage Pit No. 1

A large pit, visibly stained with a black residue, was noted behind the old 87th FIS Test Cell in building 414. Two soil borings, one at each end of the pit, should be performed up to 15 feet below grade and samples should be taken at three foot vertical intervals or in areas of obvious visual contamination. Samples should be analyzed for the parameters listed in Table 6.2, list D. If analysis shows contamination to be present, geophysics should be used to guide the placement of a ground-water quality monitoring system.

DPDO Yard

The DPDO yard was formerly used for storage of waste oil drums and transformers. Leaks and spills occurred in this area and follow-on action is warranted. Three soil borings should be performed up to 15 feet below grade and samples should be taken at three foot vertical intervals or in areas of obvious visual contamination. These samples should be taken in the old oil storage areas (previously indicated). Samples should be analyzed for the parameters listed in Table 6.2, list F. If analysis shows contamination to be present, geophysics should be used to guide the placement of a ground-water quality monitoring system.

TABLE OF CONTENTS
APPENDICES

		Page No.
APPENDIX A	BIOGRAPHICAL DATA	
	E. H. Snider	A-1
	S. K. Minicucci	A-3
	S. J. Tiffany	A-5
	J. N. Baker	A-7
APPENDIX B	LIST OF INTERVIEWEES AND OUTSIDE AGENCY CONTACTS	
	List of Interviewees	B-1
	Outside Agency Contacts	B-7
APPENDIX C	TENANT ORGANIZATIONS AND MISSIONS	C-1
APPENDIX D	SUPPLEMENTAL BASE FINDINGS INFORMATION	D-1
APPENDIX E	MASTER LIST OF SHOPS	
	410 Avionics Maintenance Squadron	E-1
	410 Civil Engineering Squadron	E-1
	410 Field Maintenance Squadron	E-3
	410 Organizational Maintenance Squadron	E-5
	410 Transportation Squadron	E-5
	410 Munitions Maintenance Squadron	E-6
	87 Fighter Interceptor Squadron	E-7
	410 Supply Squadron	E-9
	410 Combat Support Group	E-9
	USAF Hospital, K. I. Sawyer	E-10
	2001 Information Systems Squadron	E-10
	410 Security Police Squadron	E-11
APPENDIX F	PHOTOGRAPHS	F-1
APPENDIX G	USAF INSTALLATION RESTORATION PROGRAM HAZARD ASSESSMENT RATING METHODOLOGY	G-1
APPENDIX H	SITE HAZARD ASSESSMENT RATING FORMS	
	Wells Terminal Annex	H-1
	Drainage Pond No. 2	H-3
	POL Area	H-5
	Landfill No. 1	H-7
	Landfill No. 2	H-9
	Drainage Pit No. 3	H-11
	Landfill No. 3	H-13
	Fire Protection Training Area No. 1	H-15
	Fire Protection Training Area No. 2	H-17
	Hardfill Area No. 2	H-19
	Landfill No. 4	H-21
	Drainage Pit No. 1	H-23
	DPDO Yard	H-25

TABLE OF CONTENTS
APPENDICES
(Continued)

APPENDIX I	GLOSSARY OF TERMINOLOGY AND ABBREVIATIONS	I-1
APPENDIX J	REFERENCES	J-1
APPENDIX K	INDEX OF REFERENCES TO POTENTIAL CONTAMINATION SITES AT K. I. SAWYER AFB	K-1

APPENDIX A

BIOGRAPHICAL DATA

APPENDIX A

BIOGRAPHICAL DATA

Page No.

- E. H. Snider, Ph.D., P.E. - Project Manager A-1
- S. K. Minicucci, Chemical/Environmental Engineer A-3
- S. J. Tiffany, Civil Engineer A-5
- J. N. Baker, Geologist A-7

BIOGRAPHICAL DATA

Eric Heinman Snider

Manager, Industrial Waste Department

Personal Information

Date of Birth: 14 April 1951

Education

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

Professional Affiliations

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

Honorary Affiliations

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

Experience Record

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

Eric H. Snider (Continued)

1976-1977 Clemson University, Clemson, S.C., Chief Analyst on airborne fluoride monitoring project in Chemical Engineering Department, performed for Owen-Corning Fiberglas Corp., Toledo, Ohio.

1978-1982 The University of Tulsa, Tulsa, OK., Assistant Professor of Chemical Engineering and Associate Director, University of Tulsa Environmental Protection Projects (UTEPP) Program. Normal teaching duties; research centered on specialized petroleum refinery problems of water and solid wastes and oil-water emulsions. Supervised an industry-sponsored research program in the area of oil-water emulsion breaking technologies.

1982-1983 The University of Tulsa, Tulsa, OK., Associate Professor of Chemical Engineering and Director of UTEPP Program. Normal teaching duties; researched and wrote five monographs on environmental areas; including, incineration, flotation, gravity separation, screening/sedimentation, and equalization.

1983-1984 Engineering-Science, Senior Engineer. Responsible for a wide variety of waste treatment, chemical process, resource recovery, energy, incineration and air pollution control activities for industrial and governmental clients.

1984-Date Engineering-Science, Manager of Industrial Waste Department. Responsible for managing a department consisting of chemical, civil, and environmental engineers and scientists performing a variety of projects for industrial and municipal clients.

Publications

32 technical publications, including five technical monographs.

Biographical Data

SUSAN K. MINICUCCI

Chemical/Environmental Engineer

Personal Information

Date of Birth: 30 September 1957

Education

B.S.E. Chemical Engineering, Michigan State University, E. Lansing, Michigan, 1980
M.S.E. Environmental Engineering, University of Michigan, Ann Arbor, Michigan, 1984

Professional Affiliations/Honors

Water Pollution Control Federation
American Institute of Chemical Engineers
American Society of Civil Engineers
Society of Women Engineers
U.S.P.H.S. Scholarship
Public Health Service Achievement Medal
Public Health Service Unit Commendation Medal

Experience Record

1978 — National Institute for Occupational Safety and Health. Rockville, Maryland. Research work to provide background toxicological information from which recommended standards for occupational exposure may be derived. Responsibilities included assessment of health hazards, environmental fate, and toxic and hazardous properties of various chemicals.

1979 — E. I. du Pont de Nemours. Troy, Michigan. Designed and implemented a laboratory research project to improve process time for in-plant procedures.

1980-1983 — U.S. Public Health Service, Food & Drug Administration, Office of Radiological Health, Rockville, Maryland. Regulatory Engineer. Evaluation of quality control programs used in the manufacture of diagnostic x-ray equipment, conducted facility inspections to evaluate test programs to assure compliance with federal regulations, procurement and analysis of computer data pertaining to equipment failure and system design, development of a computerized/compliance status monitoring system which incorporated risk analyses for health and safety for radiological equipment. Involved in assessing risk to populations exposed to various types of ionizing radiation devices. Member of the task force for promulgation of new regulations for computed tomography x-ray systems for publication in the Federal Register. Completed several courses in Basic Radiological Health and Safety.

1983-1984 University of Michigan - Research Assistant. Research involving parameter evaluation for predictive modeling and design of multicomponent adsorption systems.

1984-Present Engineering-Science, Atlanta, Georgia. Project Engineer responsible for various activities within the hazardous waste group. Lead responsibility in preparation of remedial investigation and feasibility study reports for several consenting defendents under a Partial Consent Decree. Included a detailed analysis of remedial action programs. Hazardous waste group activities include landfill evaluations, waste disposal alternative evaluations, permit and regulatory assistance, transportation evaluation, and waste management program development. Design of mobil onsite wastewater treatment facilities.

Biographical Data

SUSAN J. TIFFANY

Engineer

Personal Information

Date of Birth: 25 February 1958

Education

B.S. in Civil Engineering, 1980, Massachusetts Institute of Technology
M.S. in Civil Engineering, 1981, Stanford University

Professional Affiliations

American Society of Civil Engineers
American Chemical Society
EIT - State of California No. 52332, July 15, 1981

Experience Record

1979-1980 Meta Systems, Inc., Cambridge, MA. Staff Researcher. Researched and wrote description statements for potentially toxic chemicals. Major categories of concern were precursors, production processes, producers, uses and side effects.

Massachusetts Institute of Technology. Research Assistant. Designed and performed toxicity experiments on *Daphnia magna*.

1980-1981 Massachusetts Institute of Technology, Cambridge, MA. Editing Assistant. Aided in preparation of aquatic chemistry textbook.

1982-1984 Clement Associates, Arlington, VA. Staff Engineer. Defined extent of contamination at Superfund sites as part of Remedial Action Master Plans (RAMPs) prepared for EPA. Prepared sections of a RCRA Part B permit application for a proposed hazardous waste treatment and disposal facility. Performed on-site inspections and prepared multimedia risk assessments of chemical manufacturing, electronics, and waste disposal facilities applying for Environmental Impairment Liability (EIL) insurance. Final assessment included analysis of facility operations, waste treatment and disposal practices, regulatory compliance and other areas of potential environmental impact. Scored selected metals and organic compounds on the basis of their persistence in air, surface, water, and groundwater for EPA's Office of Solid Waste. Results of the scoring exercise were to be included in an assessment of low-risk waste treatment strategies that integrated wastes, environments, and technologies (W-E-T), in an attempt to provide a framework for the regulation of hazardous waste facilities.

1984-Present — Engineering-Science, Inc. Staff Engineer. Responsible for gathering existing data on the removal of priority pollutants by GAC. Data will be used to assess the feasibility of meeting BATEA standards proposed for the affected industry. Involved in preparation of post-closure plans for three hazardous waste surface impoundments and a hazardous waste landfill at a military installation. Currently participating in Phase I investigations of 32 superfund sites for the State of New York.

Biographical Data

JAMES N. BAKER
Geologist

Personal Information

Date of Birth: 26 May 1953

Education

Geology and Chemistry, 1973-1976, Indiana University, Bloomington
Advanced Wastewater and Water Treatment Operations, 1978, Rutgers University, New Brunswick, New Jersey
B.S., Geology, 1983, Georgia State University, Atlanta, Georgia

Experience Record

1977-1979 Engineering-Science, Inc. Field Technician responsible for performance of in-plant survey and operation and monitoring of bench and pilot-scale treatability equipment which includes multi-media filters, carbon columns, sludge conditioning and dewatering equipment, and biological reactors. Services performed for Monsanto Company, FMC Corporation, Eli Lilly Industries, American Cyanamid Company, General Electric Company, Proctor and Gamble, American Textile Manufacturers, Northern Petrochemical Company, Penn Dye and Finishing Company, Exxon Petroleum, Weyerhaeuser, Mobay Dyestuff, and C & D Battery. Among the projects participated in are the following:

Herbicide waste treatment evaluations. Responsibilities included conducting of bench-scale biological treatability studies, biological inhibition/degradation assays on specific chemicals, review of plant's wastewater analysis procedures, hydraulic characterization of treatment units, clay and powdered activated carbon adsorption isotherms, in-plant carbon column testing, operations and monitoring of dual media filtration and granular activated carbon adsorption pilot plant.

1980-1983 Technical specialist responsible for planning and conducting field engineering activities on a large number of varied industrial waste studies. Specific responsibilities include experimental planning, lab and pilot-scale treatment process operation, data collection, data evaluation, troubleshooting, data quality assurance and report preparation. Also experienced in planning and conducting operations evaluations or assistance programs at industrial and municipal wastewater treatment plants ranging in size from 0.1 to

James N. Baker (Continued)
Page 2

70 MGD. Services performed for Monsanto Company, Weyerhaeuser, General Electric Company, Mobay Dyestuff and the City of Columbus, Mississippi.

Environmental Scientist responsible for planning and conducting activities on a large number of varied industrial and groundwater waste studies. Specific responsibilities include experimental planning, laboratory and pilot-scale treatment process operation, data collection, evaluation via computer microprocessing, data quality assurance, groundwater monitoring, background literature research and report preparation. Services performed for Burlington Industries, Monsanto Company, IBM Corporation, O.M. Scott and Sons, Dayco Corporation, PPG Industrie-s and The Coca-Cola Company.

1983-Date Geologist responsible for a variety of industrial and hazardous waste studies including hydrogeologic field investigations at a hazardous waste site in Illinois involving surficial soil sampling, surface water and sediment sampling, stream flow measurements, observation and monitoring well installation, geophysical surveys using electrical resistivity, direct measurement of ground-water flow direction and velocity, monitoring well sampling, and mapping surface water, sediment, surface soil and ground-water contamination including development of a ground-water contour map. Performed hydrogeologic investigation at an Army landfill facility including direct measurement of ground-water flow direction and velocity, ground-water sampling and mapping of surface drainage patterns. Performed a gas migration investigation at an abandoned municipal landfill, responsible for conducting geophysical survey using a magnetometer and gas monitoring well installation.

APPENDIX B

LIST OF INTERVIEWEES AND OUTSIDE AGENCY CONTACTS

TABLE B.1

LIST OF INTERVIEWEES

	Position	Years of Service at this Installation
1.	Civilian, Chief, Defense Property Disposal Office	2
2.	Civilian, Retired Chief, Defense Property Disposal Office	26
3.	Civilian, Electrical Superintendent	20
4.	Civilian, Real Property Officer	2
5.	Civilian, Environmental Coordinator	19
6.	Chief, Bioenvironmental Engineering	2
7.	Civilian, Retired Landfill Equipment Operator	28
8.	Civilian, Chief, Contract Management	14
9.	Civilian, Landfill Equipment Operator	19
10.	Civilian, Mechanical Superintendent	23
11.	NCOIC, Bioenvironmental Engineering Section	2
12.	Civilian, Material Storehouser and Classifier	25
13.	Civilian, Deputy Chief, Operations and Maintenance	29
14.	Civilian, Chief, Environmental and Contract Planning Section	8
15.	Civilian, Foreman, Heavy Equipment	27
16.	Civilian, Foreman, Water and Waste	19
17.	Civilian, Terminal Manager, Wells Terminal Annex	24
18.	Civilian, Watchman, Wells Terminal Annex	26
19.	Civilian, Terminal Superintendent, Wells Terminal Annex	13
20.	Civilian, Assistant Superintendent, Wells Terminal Annex	10

TABLE B.1
LIST OF INTERVIEWEES
(Continued)

Position	Years of Service at this Installation
21. Civilian, General Foreman, Operations and Maintenance, Calumet AFS	2
22. Civilian, Foreman, Power Plant, Calumet AFS	15
23. Medical Technician, Calumet AFS	1
24. Civilian, Retired Foreman, Power Production, Calumet AFS	28
25. Civilian, Foreman, Heating Plant, Calumet AFS	20
26. Chief, Base Medical Services, Calumet AFS	1
27. NCOIC, Logistics Support, Calumet AFS	3
28. Assistant NCOIC, Logistics Support, Calumet AFS	1
29. Chief, Supply, Calumet AFS	1
30. Fire Chief, Calumet AFS	1
31. NCOIC, Auto Hobby Shop, Calumet AFS	2
32. NCOIC, Vehicle Maintenance Shop, Calumet AFS	1
33. NCOIC, Pavement and Grounds Section	3
34. Civilian, Fire Chief	21
35. Civilian, Assistant Fire Chief for Training	11
36. Civilian, Assistant Chief of Supply	27
37. Civilian, Chief, MS&D Branch	25
38. NCOIC, Wing Historian	1
39. Civilian, Community Planner	12
40. NCO, Fuels Management	1
41. Civilian, Liquid Fuels Maintenance Supervisor	21

TABLE B.1
LIST OF INTERVIEWEES
(Continued)

Position	Years of Service at this Installation
42. Civilian, Entomology Foreman	17
43. Acting NCOIC, Munitions Maintenance Squadron, 410 MMS	9
44. NCOIC, Maintenance Bay Chief, SRAM, 410 MMS	8
45. NCOIC, Missile Maintenance, 87 FIS	5
46. NCOIC, Armament Systems, 87 FIS	2
47. NCOIC, Photo Lab, 87 FIS	6
48. Shop Chief, AGE, 87 FIS	2
49. Assistant Shop Chief, AGE, 87 FIS	13
50. Civilian, Heating Plant Foreman, 410 CES	21
51. NCOIC, Electrical Power, Power Production, 410 CES	4
52. Civilian, Mechanic, Heavy Equipment Maintenance, 410 TRANS	12
53. Civilian, Mechanic, Heavy Equipment Maintenance, 410 TRANS	1
54. Civilian, Mechanic, Vehicle Maintenance, 410 TRANS	15
55. Civilian, Supervisor, Refueling Truck Maintenance, 410 TRANS	28
56. Assistant NCOIC, Repair and Inspection, AGE, 410 FMS	3
57. NCOIC, Servicing, AGE, 410 FMS	10
58. NCOIC, Corrosion Control, 410 FMS	6
59. Assistant Chief, Tanker Branch, 410 OMS	1
60. NCOIC, Repair and Reclamation, 410 FMS	1

TABLE B.1
LIST OF INTERVIEWEES
(Continued)

Position	Years of Service at this Installation
61. Maintenance Superintendent, Bomber Branch, 410 OMS	3
62. Support Equipment Technician, Support Branch AGE, 410 OMS	3
63. Lab Chief, PMEL, 410 AMS	11
64. Shift Supervisor, Environmental Systems, 410 FMS	4
65. Assistant Branch Chief, Electronic Counter Measure, 410 AMS	3
66. Technician, Defense Fire Control, 410 AMS	1
67. NCOIC, NDI Laboratory	4
68. Technician, Propulsion Branch, 410 FMS	3
69. Shop Chief, Propulsion Branch, 410 FMS	13
70. Shift Supervisor, Battery and Electric, 410 FMS	4
71. Branch Chief, Equipment Maintenance, 410 MMS	1
72. First Sgt., 410 MMS	3
73. Former Branch Chief, Equipment Maintenance	6
74. Jet Engine Mechanic, Test Cell, 410 FMS	3
75. Civilian, Mechanic, Auto Hobby Shop, 410 CSG	9
76. Foreman, Service Station	6
77. NCOIC, Dental Lab, USAF HOSP	2
78. Dental Assistant, Dental X-Ray, USAF HOSP	2
79. NCOIC, Medical X-Ray, USAF HOSP	3
80. Mechanic, Jet Engine Shop, 87 FIS	14

TABLE B.1
LIST OF INTERVIEWEES
(Continued)

Position	Years of Service at this Installation
81. NCOIC, Bioenvironmental Engineering, USAF HOSP	1
82. Foreman, Exterior Electric, 410 CES	1
83. Mechanic, Jet Engine Shop, 87 FIS	14
84. Aircraft Flight Chief, F-106 Flight, 87 FIS	2
85. NCOIC, Corrosion Control, 87 FIS	1
86. EOD Technician, 410 MMS	2
87. NCOIC, Base Fuels Operations	1
88. NCOIC, T-33 Flight	3
89. Flight Simulator Specialist, Simulator, 87 FIS	11
90. Superintendent, Pavements & Grounds Section, 410 CES	3
91. Superintendent, Heating Maintenance, 410 CES	3
92. Superintendent, Audio-Visual, 410 CSG	4
93. Assistant Quality Control Inspector, Base Fuels Lab	6
94. NCOIC, Armaments & Equipment, 410 SPS	2
95. Director, Arts & Crafts Shop, 410 CSG	2
96. Assistant Dock Chief, Night Shift, Inspection Section, 87 FIS	5
97. NCOIC, Pneudraulics, 410 FMS	2
98. NCOIC, Servicing Branch, 410 FMS	4
99. NCOIC, Equipment Support Section, 410 TRANS	7
100. Structural Superintendent, 410 CES	20

TABLE B.1
LIST OF INTERVIEWEES
(Continued)

Position	Years of Service at this Installation
101. NCOIC, Combat Arms Training & Explosive Safety, 410 CSG	3
102. Assistant Chief, Fire Protection Bureau, 410 CES	30
103. NCOIC, Air Conditioning/Refrigeration, 410 CES	6

TABLE B.2
OUTSIDE AGENCY CONTACTS

Agency	Point of Contact
USDA-Soil Conservation Service Marquette County Soil and Water Conservation District 104 Coles Drive Marquette, Michigan 49855 (906) 226-8871	Howard Wilson, Engineer
USDA-Soil Conservation Service Marquette County Soil and Water Conservation District 104 Coles Drive Marquette, Michigan 49855 (906) 226-9460	David Ottoson, Soil Scientist
USDA-Soil Conservation Service Soil Survey Office 1500 Birch Street Hancock, Michigan 49930 (906) 482-0360	Chuck Schwenner, Soil Scientist
Michigan Department of Natural Resource Regional Geological Survey Division 1990 U.S. 41 South Marquette, Michigan 49855 (906) 228-6561	Jack Van Alstine, Senior Geologist
Michigan Department of Natural Resources Regional Geological Survey Division 1990 U.S. 41 South Marquette, Michigan 49855 (906) 228-6561	Bill Swenor, Environmental Technician
Michigan Department of Natural Resources Regional Geological Survey Field Office 201 State Office Building Escanaba, Michigan 49829 (906) 786-0333	Frank Chenir, Geologist
Michigan Department of Natural Resources Regional Geological Survey Field Office 201 State Office Building Escanaba, Michigan 49829 (906) 786-0333	Jennifer B. Huffman, Geologist

TABLE B.2
OUTSIDE AGENCY CONTACTS
(CONTINUED)

Agency	Point of Contact
Michigan Department of Natural Resources Regional Ground Water Quality Division 1990 U.S. 41 South Marquette, Michigan 49855 (906) 228-6561	Earl Olsen
Michigan Department of Natural Resources Regional Ground Water Quality Division 1990 U.S. 41 South Marquette, Michigan 49855 (906) 228-6561	Mark Petry, Geologist
Michigan Department of Natural Resources Geological Survey Division Stevens T. Mason Building P.O. Box 30028 Lansing, Michigan 48909 (517) 373-8790	William A. Walden, Geologist
Michigan Department of Natural Resources Regional Wildlife Division 1990 U.S. 41 South Marquette, Michigan 49855 (906) 228-6561	Robert Strong
Modern Military Field Branch Washington National Record Center 4025 Suitland Road Suitland, Maryland (301) 763-1710	Mr. W. Lewis
Cartographic and Architectural Branch National Archives 841 S. Pickett Street Alexandria, Virginia 22304 (703) 756-6700	Mr. J. Dwyer
Modern Military Branch National Archives 8th and Pennsylvania Avenue Washington, DC (202) 523-3340	Mr. E. Reese

TABLE B.2
OUTSIDE AGENCY CONTACTS
(CONTINUED)

Agency	Point of Contact
Office of Air Force History Bolling AFB Washington, DC (202) 767-5090	Sgt. Jernigan
United States Department of the Interior United States Geological Survey 6520 Mercantile Way, Suite 5 Lansing, Michigan 48910 (517) 377-1608	Norman G. Grannemann, Hydrologist

APPENDIX C

TENANT ORGANIZATIONS AND MISSIONS

K. I. SAWYER AFB

APPENDIX C

TENANT ORGANIZATIONS AND MISSIONS

K. I. SAWYER AFB

87TH FIGHTER INTERCEPTOR SQUADRON

The 87th Fighter Interceptor Squadron (FIS) is an air defense unit of Tactical Air Command (TAC). The mission of the 87th is to maintain proficiency in fighter-versus-fighter tactics and aerial refueling, as well as flying intercept training missions. The 87th, which moved to K. I. Sawyer in mid-1971, is currently in the process of being deactivated.

71ST FLYING TRAINING WING

The mission of the 71st Flying Training Wing is to provide T-37 aircraft, maintenance support and instructor pilots to the 410th Bombardment Wing Accelerated Co-pilot Enrichment (ACE) Program.

2001ST INFORMATION SYSTEMS SQUADRON

The 2001st Information Systems Squadron (ISS) operates and maintains the base navigational aids, radar, radios, and weather equipment supporting military and civilian flying communities. Additionally, the 2001st ISS maintains the base telecommunications center and data processing systems.

225TH FIELD TRAINING DETACHMENT

The mission of the 225th Field Training Detachment (FTD) is to provide technical instruction to assist the 410th Bombardment Wing meet the training requirements needed to accomplish its missions. In addition to courses of instruction on the B-52H and KC-135A aircraft and associated support equipment, the 225th FTD is also available to give assistance in shops and on the flightline.

AIR FORCE AUDIT AGENCY

The mission of the Air Force Audit Agency is to provide all levels of Air Force management with independent, objective and constructive evaluations of the economy, effectiveness and efficiency with which managerial responsibilities (including financial, operational and support activities) are carried out.

DETACHMENT 24, 26TH WEATHER SQUADRON

The mission of Detachment 24, 26th Weather Squadron is to provide 24-hour weather service to all base organizations. The Detachment also provides forecasting and observing services in support of the Air Weather Service Global Weather concept, and completes special projects as directed by higher weather authorities.

DETACHMENT 512, AIR FORCE OFFICE OF SPECIAL INVESTIGATIONS

The mission of Detachment 512 of the Air Force Office of Special Investigations is to provide counterintelligence, criminal and special investigative services for all Air Force activities and to collect, analyze and disseminate counterintelligence data.

DETACHMENT 29, 3904TH MANAGEMENT ENGINEERING SQUADRON (SACMET)

This tenant unit assists commanders in the determination, allocation, and effective utilization of manpower, through analysis of conditions and by accomplishment of management advisory studies.

DEFENSE PROPERTY DISPOSAL OFFICE (DPDO)

This tenant's mission is to achieve maximum reutilization of DOD-owned material and equipment. Maintains and operates facilities to provide disposal services for the Department of Defense.

DEFENSE INVESTIGATIVE AGENCY, DOD

This unit conducts all background investigations for security clearances for all DOD activities.

APPENDIX D

SUPPLEMENTAL BASE FINDINGS INFORMATION

TABLE D.1
WASTEWATER TREATMENT PLANT
PERFORMANCE DATA SUMMARY

	Date	BOD-5 (mg/1) AVG	BOD-5 (mg/1) MAX	Solids-Suspended (mg/1) AVG	Solids-Suspended (mg/1) MAX	Phosphorus-Total (mg/1) AVG	Phosphorus-Total (mg/1) MAX	Ammonia-Nitrogen (mg/1) AVG	Ammonia-Nitrogen (mg/1) MAX	pH (SU) AVG	pH (SU) MAX	DO (mg/1)	Coliform-Fecal (#/100 ml) AVG	Coliform-Fecal (#/100 ml) MAX	Chlorine (mg/1)	VSS (mg/1) AVG	VSS (mg/1) MAX
Plant Influent	6-84	187	250	158	231	4.8	6.5	18.3	20.0	7.2	7.5	--	--	--	--	123	201
	9-84	165	353	157	294	5.4	13.2	17.4	20.3	7.0	7.4	--	--	--	--	136	274
	10-84	159	204	163	360	5.3	7.1	--	--	7.0	7.2	--	--	--	--	142	336
	11-84	151	237	151	318	5.1	8.3	--	--	6.9	7.2	--	--	--	--	130	236
	12-84	154	189	145	206	4.9	5.9	--	--	7.25	7.6	--	--	--	--	126	177
Primary Effluent	6-84	75	105	34	49	--	--	--	--	--	--	--	--	--	--	26	39
	9-84	43	55	24	38	--	--	--	--	--	--	--	--	--	--	20	32
	10-84	51	78	28	49	--	--	--	--	--	--	--	--	--	--	23	37
	11-84	46	105	26	51	--	--	--	--	--	--	--	--	--	--	20	38
	12-84	54	87	29	58	--	--	--	--	--	--	--	--	--	--	22	46
Final Effluent	6-84	10	19	2.6	5	0.17	0.3	--	--	6.6	6.8	8.18	156	630	--	2.5	5
	9-84	5	9	2.8	6	0.14	0.6	9.52	12.10	6.6	7.2	8.97	13	63	--	2.6	4
	10-84	8	12	3.7	8	0.16	0.3	--	--	6.5	6.8	7.38	37	220	--	3.3	6
	11-84	6	15	2.6	5	0.17	0.4	--	--	6.5	6.7	8.65	--	--	--	2.4	5
	12-84	10	19	6.4	12	0.25	0.5	--	--	6.7	6.9	9.28	--	--	--	5.4	11

TABLE D.2
SELECTED GROUND WATER DATA FOR K.I. SAWYER AFB

(milligrams per liter)

Well Number		4	5	7	4	5	7	4	5	6	4	5	7
Date of Collection		7-17-69	7-17-69	7-17-69	7-9-70	7-9-70	7-9-70	7-10-72	7-10-72	7-10-72	4-1-82	4-1-82	4-1-82
Silica	(SiO_2)	9.0	8.0	5.0	14	12	11	9.0	8.6	7.4	11.2	9.6	8.4
Iron	(Fe)	.02	.02	.07	.02	.02	.03	.03	.02	.06	<.1	<.1	<.1
Manganese	(Mn)	.02	.02	.01	--	--	--	--	--	--	<.05	<.05	<.05
Calcium	(Ca)	18	25	26	18	26	27	31	30	12	15.8	26.5	20.4
Magnesium	(Mg)	4.4	5.2	6.8	3.7	5.1	5.8	4.1	6.8	2.0	4.0	6.6	6.2
Sodium	(Na)	1.3	1.8	1.2							2.7	7.2	4.7
Potassium	(K)	.9	1.4	.7	5.8*	6.2*	1.6*	0*	0*	2.1*	--	--	--
Bicarbonate	(HCO_3)	75	83	89	69	78	82	80	82	44	--	--	--
Carbonate	(CO_3)	2	2	0	5	4	2	0	0	0	--	--	--
Sulfate	(SO_4)	3.2	10	13	2.8	10	15	11	12	3.4	8	12	10
Chloride	(Cl)	0	5.0	4.0	3.0	8.0	3.7	12	13	2.0	4	16	4
Fluoride	(Fl)	.0	.2	0	.2	.1	.2	.2	.2	.2	<.1	<.1	<.1
Nitrate	(NO_3)	.0	4.1	4.1	.1	8.7	4.6	5.2	5.1	.1	.3	1.6	1.6
Dissolved Solids													
calculated		76	104	105	87	118	111	112	116	50	--	--	--
residue on evaporation at 180°C		80	100	110	83	115	99	114	116	46	93**	162**	117**
Hardness as $CaCO_3$		63	84	93	60	86	92	94	100	38	56	93	76
Alkalinity as $CaCO_3$		64	70	73	65	70	67	66	67	36	72	86	86
Specific Conductance (micromhos at 25°C)		128	182	188	128	191	182	189	190	78	160	260	205
pH (std unit)		8.3	8.4	8.1	8.5	8.4	8.3	7.6	7.4	7.2	8.2	8.1	8.1
Carbon Dioxide (CO_2)		1.3	.5	1.2	NR	NR	NR	NR	NR	NR	6	6.8	8
Temperature (°C)		9	8	8	9.0	9.0	9.0	8.5	8.5	10.0	10	9	10

TABLE D.2
(CONTINUED)
SELECTED GROUND WATER DATA FOR K.I. SAWYER AFB

(milligrams per liter)

Well Number		4	5	7	8	4	5	7
Date of Collection		6-14-84	6-14-84	6-14-84	6-26-84	3-85	3-85	3-85
Silica	(SiO_2)	9.7	8.1	7.7	8.0	10.0	10.0	8.0
Iron	(Fe)	ND	ND	ND	<0.1	0.1	0.1	0.1
Manganese	(Mn)	0.03	ND	0.02	<0.05	0.02	0.05	0.05
Calcium	(Ca)	20.2	31.5	23.3	28.8	15.5	27.7	21.2
Magnesium	(Mg)	4.0	6.3	5.5	9.1	3.7	6.7	6.2
Sodium	(Na)	2.0	8.0	4.0	5.7	1.4	7.2	3.2
Nitrate	(NO_3)	ND	-	0.9	1.6	-	-	-
Residue	(TDS)	-	-	-	203	91	164	128
Alkalinity		-	-	-	110	64	88	82
Specific Conductance		171	257	193	250	120	250	185

* (Na+K) as Na (Calculated)
** (Residue, Filtrable (TDS)

NR = not recorded
ND = not detected
\- = not analyzed

Sources: Water Resources Division, USGS (1969 - 1972), installation documents (1982, 1984 and 1985)

TABLE D.3
SELECTED WATER WELL DATA FOR
K. I. SAWYER AFB AND VICINITY

Well ID. (Marquette Co.)	Owner	Well Depth (ft.)	Depth of Water Producing Zone Below Ground Surface (ft.)	Yield (GPM)	Lithologic Unit Tapped By Well	Water Level Below Ground Surface (ft.)	Well Use
45/24-5	Julie Oxford	67	63	15	Sand	40	D
45/24-5	USGS	62	58	NR	Sand	41	O
45/24-6	John Schaefer	86	83	10	Sand	16	D
45/24-6	Joseph Gendron	75	71	15	Sand	40	D
45/24-6	Al Winfield	102	99	15	Sand	55	D
45/24-6	Gerald Sullivan	110	107	20	Sand	55	D
45/24-6	Hiraim Davis	84	81	10	Sand	47	D
45/24-6	Donald Mulder	85	81	15	Sand	NR	D
45/24-6	Charles Hohman	74	70	5.5	Sand	51	D
45/24-6	Charles Hohman, Jr.	85	81	15	Sand	55	D
45/25-1-T7	KI Sawyer AFB	85	61	244	SS	Surface	T
45/25-1-1	KI Sawyer AFB	110	80	NR	SS	1.55	O
45/25-1-2	KI Sawyer AFB	70	68	NR	SS	Surface	O
45/25-1-3	KI Sawyer AFB	37	28	NR	GR	1.01	O
45/25-1-4	KI Sawyer AFB	50	26	NR	GR	1.36	O
45/25-11	USGS	90	88	NR	Sand	51.3	O
45/25-15	Clarence Landrum, Jr.	35	31	7	Sand	18	D
45/25-15	Bill Johnson	42	39	10	S&G	16	D
45/25-15	Kenneth R. Jankas	35	32	NR	NR	9	D
46/24-29-1SW	Michigan State Hwy. Dept.	20	NR	NR	Sand	NR	NR
46/24-29-2SW	Michigan State Hwy. Dept.	19	NR	NR	Loam	NR	NR

TABLE D.3
(Continued)
SELECTED WATER WELL DATA FOR
K. I. SAWYER AFB AND VICINITY

Well ID. (Marquette Co.)	Owner	Well Depth (ft.)	Depth of Water Producing Zone Below Ground Surface (ft.)	Yield (GPM)	Lithologic Unit Tapped By Well	Water Level Below Ground Surface (ft.)	Well Use
46/24-29-1NE	Michigan State Hwy. Dept.	30	NR	NR	Sand	NR	NR
46/24-29-1NW	Michigan State Hwy. Dept.	40	NR	NR	Sand	17	NR
46/24-29-2NW	Michigan State Hwy. Dept.	40	NR	NR	Sand	12	NR
46/24-29-3NW	Michigan State Hwy. Dept.	35	NR	NR	Sand	6	NR
46/24-31	Jones & Laughlin	145	122	NR	G-S	2	OE
46/24-32	Dan Miller	60	56	10	Sand	30	D
46-24-32	Patrick O'Conner	141	138	3+	Sand	32	D
46/24-32	James Soetaert	82	78	12	Sand	41	D
46/24-32	Brian O'Conner	29	Not reached	None	Sand & Rocks	Not reached	D
46/24-32	Roe E. Maki	92	89	12	Sand	28	D
46/24-32	Stephen Rechner	54	51	5-6	S&G	24	D
46/25-13	Tom Hakes	179	175	10	Sand	140	D
46/25-14	William Branchi	224	219	6	Sand	142	D
46/25-14	Ken Contois	139	135	12	Sand	110	D
46/25-14	William Deguise	131	NR	4	GR	70	D
46/5-14	Larry Eveland	150	147	10	S&G	130	D
46/25-14	Larry Eveland	150	148	10	Sand	110	D
46/25-14	Mark Hosford	129	124	10	Sand	98	D
46/25-14	Dan MacDonald	200	196	12	Sand	140	D
46/25-14	William P. Madzia	178	175	5	Sand	149	D
46/25-14	Howard Shram	366	NR	1	GR-GR	122	D
46/25-14	Howard Shram	140	139	11	Sand	105	D
46/25-14	Joe Sirois	189	185	10	Sand	140	D

TABLE D.3
(Continued)
SELECTED WATER WELL DATA FOR
K. I. SAWYER AFB AND VICINITY

Well ID. (Marquette Co.)	Owner	Well Depth (ft.)	Depth of Water Producing Zone Below Ground Surface (ft.)	Yield (GPM)	Lithologic Unit Tapped By Well	Water Level Below Ground Surface (ft.)	Well Use
46/25-14	Ronald Skutley	160	156	10	Sand	130	D
46/25-14	Jerry Sullivan	135	131	15	Sand	97	D
46/25-14	Tri-City Mobile Homes	261	Not reached	None	GR	Not reached	NR
46/25-14	Tri-City Mobile Homes	170	160	40	Sand	132	T
46/25-14	Henry Wolfe	160	156	NR	Sand	120	D
46/25-15	Leonard Blondeau	160	156	10	Sand	134	D
46/25-15	USGS	187	78	9	BR	72	T
46/25-15	USGS	159	72	5	BR	67	T
46/25-15	David Wright	60	56	10	Sand	41	D
46/25-15	James Powell	71	68	10	Sand	38	D
46/25-15	Gary Carr	62	58	10	Sand	41	D
46/25-15	Gary Carr	63	58	15	Sand	35	D
46/25-15	Wayne Grace	62	58	15	Sand	40	D
46/25-15	John Church	63	59	15	Sand	32	D
46/25-15	Elvie Wilson	55	NR	15	S&G	35	D
46/25-22	Juanita Magnasson	78	74	15	Sand	40	D
46/25-22-3	KI Sawyer AFB	62	59	NR	Gravel	51.5	O
46/25-22	USGS	51	42	11	BR	29.7	T
46/25-23-2	KI Sawyer AFB	100	97	NR	S&G	88	O
46/25-25	KI Sawyer AFB	50	Not reached	None	Sand	Not reached	SI
46/25-25	KI Sawyer AFB	101	98	12	Gravel	85	O
46/25-26	KI Sawyer AFB	71	68	NR	S&G	31	O
46/25-27	USGS	82.5	55	0.1	Gravel	41	T
46/25-27	KI Sawyer AFB	59	56	NR	Sand	24	O
46/25-36	USGS	21.5	NR	NR	NR	Surface	O
46/25-36	USGS	136	121	150	S&G	77	PS

TABLE D.3
(Continued)
SELECTED WATER WELL DATA FOR
K. I. SAWYER AFB AND VICINITY

Well ID. (Marquette Co.)	Owner	Well Depth (ft.)	Depth of Water Producing Zone Below Ground Surface (ft.)	Yield (GPM)	Lithologic Unit Tapped By Well	Water Level Below Ground Surface (ft.)	Well Use
46/25-36	KI Sawyer AFB	96	NR	140	S&G	75	PS
46/25-36	KI Sawyer AFB	110	NR	150	NR	77	PS
46/25-36	USGS	NR	NR	NR	S&G	18	O
(Delta Co.)							
40/24-12	John Anderson	55	NR	30	White rock	Flowing	D
40/24-12	G. Anderson	75	NR	6	Blue rock	25	D
40/24-12	Glenn A. Hentz	60	NR	20	White rock	12	D
40/24-12	William Slagstad	154	NR	8	LS	40	D
40/24-13	Jack Harrison	100	NR	10	LS	30	D
40/24-13	Millard Carson & Fred Calouette	30	NR	8	Blue rock	12	D
40/24-19	George Dubord	165	NR	NR	SH	75	D
40/24-19	Victor Peacock	90	NR	20	Gray rock	38	D
40/24-25	Robert Chenier	238	NR	50	LS	25	D
40/24-25	Robert Beauchamp	135	NR	10	Blue rock	45	D
40/24-25	Eugene James	35	NR	16	BR	10	D
(Keweenaw Co.)							
57/31-1	Joseph Lizzardo	230	NR	3.5	Rock	8	D
58/31-36A	US Corps of Engineers	66.3	NR	NR	BR	1	T
58/31-36B	US Corps of Engineers	51.4	NR	NR	BR	Surface	T

NR - Not recorded
SS - Sandstone
GR - Granite
GR-GR - Greenstone & granite
S&G - Sand and gravel
LS - Limestone
SH - Shale
BR - Bedrock

D - Domestic
O - Observation
T - Test well
OE - Ore exploration
SI - Soil information
PS - Public supply

45/25-5 Township 45N/Range 25W - Section 5

GPM - gallons per minute

Sources: Michigan Department of Public Health, Michigan Department of Conservation

TABLE D.4
WASTE ACCUMULATION POINTS
K.I. SAWYER AFB

Building No.	Shop
Above Ground (Bowsers and/or Drums)	
311	Munitions Maintenance, 410 MMS
323	SRAM, 410 MMS
402	Jet Engine Shop, 87 FIS
406	Base Fuels Laboratory, 410 Supply
411	Bulk Storage, 410 Supply
420	Armament Systems, 87 FIS
421	F-106 Flight, 87 FIS
422	Corrosion Control, 87 FIS
431	AGE, 87 FIS
436	Hush House, 87 FIS
530	Heavy Equipment Maintenance, 410 Trans
533	Pavements & Grounds Section, 410 CES
608	Vehicle Maintenance, 410 Trans (also has underground storage)
610	AGE, 410 FMS
613	Corrosion Control, 410 FMS
615	Repair and Reclamation, 410 FMS
627	Non-Powered AGE, 410 OMS
725	Propulsion Branch, 410 FMS
740	Equipment Maintenance Branch, 410 MMS
741	Test Cell, 410 FMS
Underground Tanks	
608	Vehicle Maintenance, 410 Trans (also has above ground storage)
609	Refueling Truck Maintenance, 410 Trans
709	Refrigeration, 410 CES
824	Auto Hobby Shop, 410 CSG
826	Service Station

TABLE D.5
LIST OF POL STORAGE TANKS

Location/Function	Tank No.	A=Aboveground U=Underground	Product	Capacity (Gallons)
POL Yard	1	A	Pickled	215,973
	2	A	DeIcer	215,973
	3	A	JP-4	418,386
	4	A	FS-2	1,560,530
	5	A	JP-4	834,161
Base Service Stations	1	U	Mogas	4,966
	2	U	MUR	3,999
	3	U	Diesel	3,999
	4	U	Diesel	5,024
	5	U	Mogas	10,020
	6	U	Mogas	15,112
Pump House 1	Tk 1	U	JP-4	50,000
(Building 720)	Tk 2	U	JP-4	50,000
	Tk 3	U	JP-4	50,000
	Tk 4	U	JP-4	50,000
Pump House 2	Tk 1	U	JP-4	50,000
(Building 721)	Tk 2	U	JP-4	50,000
	Tk 3	U	JP-4	50,000
	Tk 4	U	JP-4	50,000
Pump House 3	Tk 1	U	JP-4	50,000
(Building 723)	Tk 2	U	JP-4	50,000
	Tk 3	U	JP-4	50,000
	Tk 4	U	JP-4	50,000
	Tk 5	U	JP-4	50,000
	Tk 6	U	JP-4	50,000
Pump House 4	Tk 1	U	JP-4	50,000
(Building 724)	Tk 2	U	JP-4	50,000
	Tk 3	U	JP-4	50,000
	Tk 4	U	JP-4	50,000
	Tk 5	U	JP-4	50,000
	Tk 6	U	JP-4	50,000
Waste Fuel	Bldg 411	U	JP-4	1,000
"Sump Tanks"	Bldg 413	U	JP-4	275
	Bldg 720	U	JP-4	1,000
	Bldg 721	U	JP-4	1,000
	Bldg 723	U	JP-4	1,000
	Bldg 724	U	JP-4	1,000
	Bldg 609	U	JP-4	2,000

TABLE D.6
PESTICIDE INVENTORY AS OF MARCH 1984
K. I. SAWYER AFB

<u>Insecticides</u>

Baygon
Carbaryl
Diazinon - 48.2%
Diazinon Powder - 2%
Dichloruos
Dursban
Ficam - W
Malathion - 57%
Malathion - 91%
Phenothrim
Pyrethrum
Sevin

Source: Installation Documents

TABLE D.7
K.I. SAYWER AFB PRETREATMENT DEVICES
(OIL/WATER SEPARATORS)

Facility No.	Service	Disposition of Water Phase
609	410 Transportation-Refueling Maintenance	Sanitary Sewer
610	410 Field Maintenance-AGE	Sanitary Sewer
746	410 CE-Fire Training Area	Percolation
869	410 CE-Wastewater Treatment Plant	Sanitary Sewer
5065	410 CE-Water Treatment Plant-Storm Sewer	Surface Discharge to Hospital Pond
411	410 Supply-POL Bulk Storage Yard	Percolation

TABLE D.8
PETROLEUM STORAGE FACILITIES
CALUMET AIR FORCE STATION

Facility Number	Facility	Type of POL	Capacity (gallons)	Storage Description
Housing Units	Housing	#2 Fuel Oil	275 gallons each	45 Underground Tanks
4	Heating Plant	#2 Fuel oil	50,000 gallons each	4 Underground Tanks
158	Power Plant	Diesel Fuel	42,500 gallons	1 Underground Tank
158	Power Plant	Pickled	42,500 gallons	1 Underground Tank
158	Power Plant	Waste Oil	300 gallons	1 Underground Tank
158	Power Plant	Empty	8,000 gallons each	3 Aboveground Tanks
49	Housing	#2 Fuel Oil	500 gallons	1 Aboveground Tank
70	Youth Center	#2 Fuel Oil	250 gallons	2 Aboveground Tanks
30	GATR Site	#2 Fuel Oil	500 gallons	1 Aboveground Tank
50	Motor pool	Waste Oil	8,000 gallons	1 Underground Tank
1	Administration	MOGAS	500 gallons	1 Underground Tank
16	BX	MOGAS	1,000 gallons	2 Underground Tanks

APPENDIX E

MASTER LIST OF INDUSTRIAL SHOPS

APPENDIX E
MASTER LIST OF INDUSTRIAL SHOPS
K.I. SAWYER AFB

Name	Present Location (Bldg. No.)	Handles Hazardous Materials	Generates Hazardous Wastes	Waste Management Practices
410 Avionics Maintenance Squadron				
PMEL	708	Yes	Yes	DPDO
Auto Pilot/Instruments	725	Yes	No	--
Bomb Navigation	725	Yes	No	--
Communications/Radar	725	Yes	No	--
ATD Systems	730	Yes	No	--
Doppler	725	Yes	No	--
Electronic Counter Measure	725	Yes	Yes	DPDO
Defense Fire Control	725	Yes	Yes	Contract disposal off-base
410 Civil Engineering Squadron				
Carpenter Shop	531	Yes	No	--
Plumbing	531	Yes	No	--
Entomology	531	Yes	Yes	Empty cans triple-rinsed and disposed to base landfill or DPDO
Sheet Metal/Welding	531	Yes	No	--
Paint Shop	531	Yes	Yes	DPDO

APPENDIX E
MASTER LIST OF INDUSTRIAL SHOPS
K.I. SAWYER AFB
(Continued)

Name	Present Location (Bldg. No.)	Handles Hazardous Materials	Generates Hazardous Wastes	Waste Management Practices
410 Civil Engineering Squadron (Continued)				
Central Heating Plant	521	Yes	Yes	Burn with coal
Power Production	530	Yes	Yes	5000-gal TRANS tank, then contract disposal off-base
Pavements & Grounds Section	533	Yes	Yes	Industrial sewer; contract disposal off-base
Golf Course Maintenance	786	Yes	No	--
Fire Extinguisher Maintenance	600	Yes	No	--
Liquid Fuel Maintenance	405	Yes	No	--
Heating Maintenance	531	Yes	No	--
Interior Electric	408	No	No	--
Housing Maintenance	1246	Yes	No	--
Refrigeration	709	Yes	Yes	Contract disposal off-base
Sewage Treatment Plant	869	Yes	No	--
Water Treatment Plant	712	Yes	No	--

APPENDIX E
MASTER LIST OF INDUSTRIAL SHOPS
K.I. SAWYER AFB
(Continued)

Name	Present Location (Bldg. No.)	Handles Hazardous Materials	Generates Hazardous Wastes	Waste Management Practices
410 Civil Engineering Squadron (Continued)				
Exterior Electric	530	Yes	Yes	DPDO; contract disposal off-base
Drafting	531	Yes	No	--
Energy Monitor & Control Systems	414, 850	No	No	--
410 Field Maintenance Squadron				
Pneudraulics	725	Yes	Yes	Contract disposal off-base
Battery & Electric	725	Yes	No	--
Fuels Systems	612	Yes	No	--
Repair/Reclamation	615	Yes	Yes	DPDO; contract disposal off-base
Aerospace Ground Equipment (AGE)	610	Yes	Yes	Contract disposal off-base; FPTA; O/W separator to industrial sewer; neutralization to sewer at AGE battery shop

APPENDIX E
MASTER LIST OF INDUSTRIAL SHOPS
K.I. SAWYER AFB
(Continued)

Name	Present Location (Bldg. No.)	Handles Hazardous Materials	Generates Hazardous Wastes	Waste Management Practices
410 Field Maintenance Squadron (Continued)				
Corrosion Control	613	Yes	Yes	Industrial sewer; DPDO
NDI Lab	725	Yes	Yes	Contract disposal off-base
Machine Shop	725	Yes	No	--
Structural Repair	725	Yes	No	--
Welding	725	Yes	No	--
Test Cell	741	Yes	Yes	Contract disposal off-base
Bearing Room (Propulsion Branch)	725	Yes	Yes	DPDO; contract disposal off-base
Filter Lab (Propulsion Branch)	725	Yes	Yes	DPDO; contract disposal off-base
Engine Conditioning (Propulsion Branch)	725	Yes	Yes	Contract disposal off-base
Environmental Systems	725	Yes	Yes	Contract disposal off-base
Survival Equipment	725	Yes	No	--

APPENDIX E
MASTER LIST OF INDUSTRIAL SHOPS
K.I. SAWYER AFB
(Continued)

Name	Present Location (Bldg. No.)	Handles Hazardous Materials	Generates Hazardous Wastes	Waste Management Practices
410 Organizational Maintenance Squadron				
Support Branch	627	Yes	Yes	Contract disposal off-base
Bomber Branch	616	No	No	--
Flightline Section	615	Yes	No	--
Phase Inspection	615	Yes	Yes	DPDO
Tanker Branch	614	Yes	Yes	Reclamation; contract disposal off-base
410 Transportation Squadron				
Warm Barn	604	Yes	Yes	Oil/water separator to industrial sewer
Air Freight	522	No	No	--
Packing & Crating	522	Yes	No	--
Vehicle Maintenance	608	Yes	Yes	Contract disposal off-base; 5000-gal TRANS tank, then contract disposal off-base; neutralization at TRANS battery shop; DPDO

APPENDIX E
MASTER LIST OF INDUSTRIAL SHOPS
K.I. SAWYER AFB
(Continued)

Name	Present Location (Bldg. No.)	Handles Hazardous Materials	Generates Hazardous Wastes	Waste Management Practices
410 Transportation Squadron (Continued)				
Allied Trades	608	Yes	Yes	See Vehicle Maintenance
Diagnostics, Quality & Assurance (DQ&A)	608	Yes	Yes	See Vehicle Maintenance
Heavy Equipment Maintenance	530	Yes	Yes	O/W separator to industrial sewer; 5000-gal TRANS tank, then contract disposal off-base
Refueling Truck Maintenance	609	Yes	Yes	5000-gal TRANS tank, then contract disposal off-base
410 Munitions Maintenance Squadron				
Weapons Maintenance	321	Yes	No	--
Explosive Ordnance Disposal (EOD)	740	Yes	No	--
Short Range Attack Missile (SRAM)	323	Yes	Yes	DPDO
Equipment Maintenance Branch	740	Yes	Yes	Drain to ground; contract disposal off-base

APPENDIX E
MASTER LIST OF INDUSTRIAL SHOPS
K.I. SAWYER AFB
(Continued)

Name	Present Location (Bldg. No.)	Handles Hazardous Materials	Generates Hazardous Wastes	Waste Management Practices
410 Munitions Maintenance Squadron (continued)				
Munitions Services	740	Yes	No	--
Munitions Maintenance	311	Yes	Yes	DPDO
87 Fighter Interceptor Squadron				
Photo Lab	422	Yes	Yes	Industrial sewer; silver recovery, then to industrial sewer
Aerospace Ground Equipment (AGE)	431	Yes	Yes	Contract disposal off-base; neutralization to sewer at AGE battery shop; FPTA
Corrosion Control	422	Yes	Yes	Industrial sewer; contract disposal off-base
Metal Fabrication	421	Yes	No	--
Survival Equipment	430	Yes	No	--
Egress	421	Yes	No	--
MA-1 Mockup	404	Yes	No	--

APPENDIX E
MASTER LIST OF INDUSTRIAL SHOPS
K.I. SAWYER AFB
(Continued)

Name	Present Location (Bldg. No.)	Handles Hazardous Materials	Generates Hazardous Wastes	Waste Management Practices
87 Fighter Interceptor Squadron (Continued)				
Munitions Maintenance	304	Yes	No	--
Missile Maintenance	403	Yes	Yes	Silver recovery, then to sewer
Armament Systems	420	Yes	Yes	Contract disposal off-base
Hush House	436	Yes	Yes	O/W separator; contract disposal off-base
F-106 Flight	421	Yes	Yes	Contract disposal off-base
Life Support	426	No	No	--
T-33 Flight	422	Yes	No	--
Simulator	428	Yes	No	--
Jet Engine Shop	402	Yes	Yes	Contract disposal off-base; DPDO
MA-1 Periodic Inspection	422	Yes	No	--
Inspection Section	421	Yes	Yes	Contract disposal off-base

APPENDIX E
MASTER LIST OF INDUSTRIAL SHOPS
K.I. SAWYER AFB
(Continued)

Name	Present Location (Bldg. No.)	Handles Hazardous Materials	Generates Hazardous Wastes	Waste Management Practices
410 Supply Squadron				
Base Fuels Lab	406	Yes	Yes	Contract disposal off-base; FPTA; 5000-gal TRANS tank, then contract disposal off-base; DPDO
Bulk Storage	411/413	Yes	No	--
Base Fuels Operation	406	Yes	No	--
410 Combat Support Group				
Arts & Crafts Center (includes Wood Hobby Shop & Photo Hobby Shop)	825	Yes	Yes	Industrial sewer
Auto Hobby Shop	824	Yes	Yes	Contract disposal off base; industrial sewer
Audio Visual	601	Yes	Yes	Silver recovery to industrial sewer; industrial sewer
Small Arms Range	866	Yes	Yes	DPDO
Life Support	725	Yes	No	--

APPENDIX E
MASTER LIST OF INDUSTRIAL SHOPS
K.I. SAWYER AFB
(Continued)

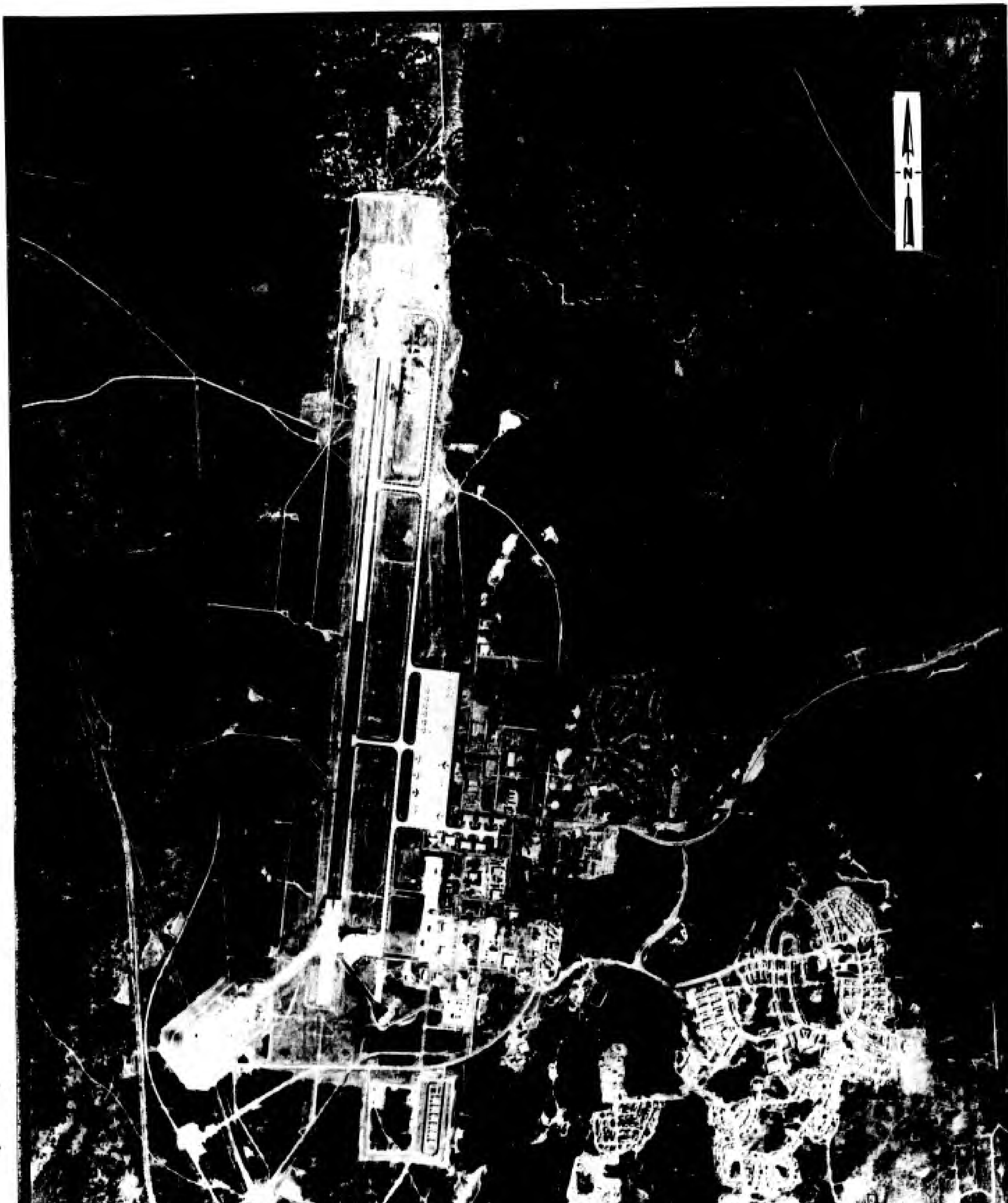
Name	Present Location (Bldg. No.)	Handles Hazardous Materials	Generates Hazardous Wastes	Waste Management Practices
410 Combat Support Group (continued)				
Reproduction	708	Yes	No	--
USAF Hospital, K. I. Sawyer				
Dental Laboratory	850	Yes	No	--
Medical Laboratory	850	Yes	No	--
Dental X-Ray	850	Yes	Yes	Silver recovery, then to industrial sewer
Medical X-Ray	850	Yes	Yes	Silver recovery, then to industrial sewer; industrial sewer
Surgery/OB/CSS	850	No	No	--
Dental Clinic	850	Yes	No	--
Central Sterile Supply	850	Yes	No	--
2001 Information Systems Squadron				
Radar	708	Yes	No	--
Navigational Aids	708	Yes	No	--
Weather Maintenance	708	Yes	No	--

APPENDIX E
MASTER LIST OF INDUSTRIAL SHOPS
K.I. SAWYER AFB
(Continued)

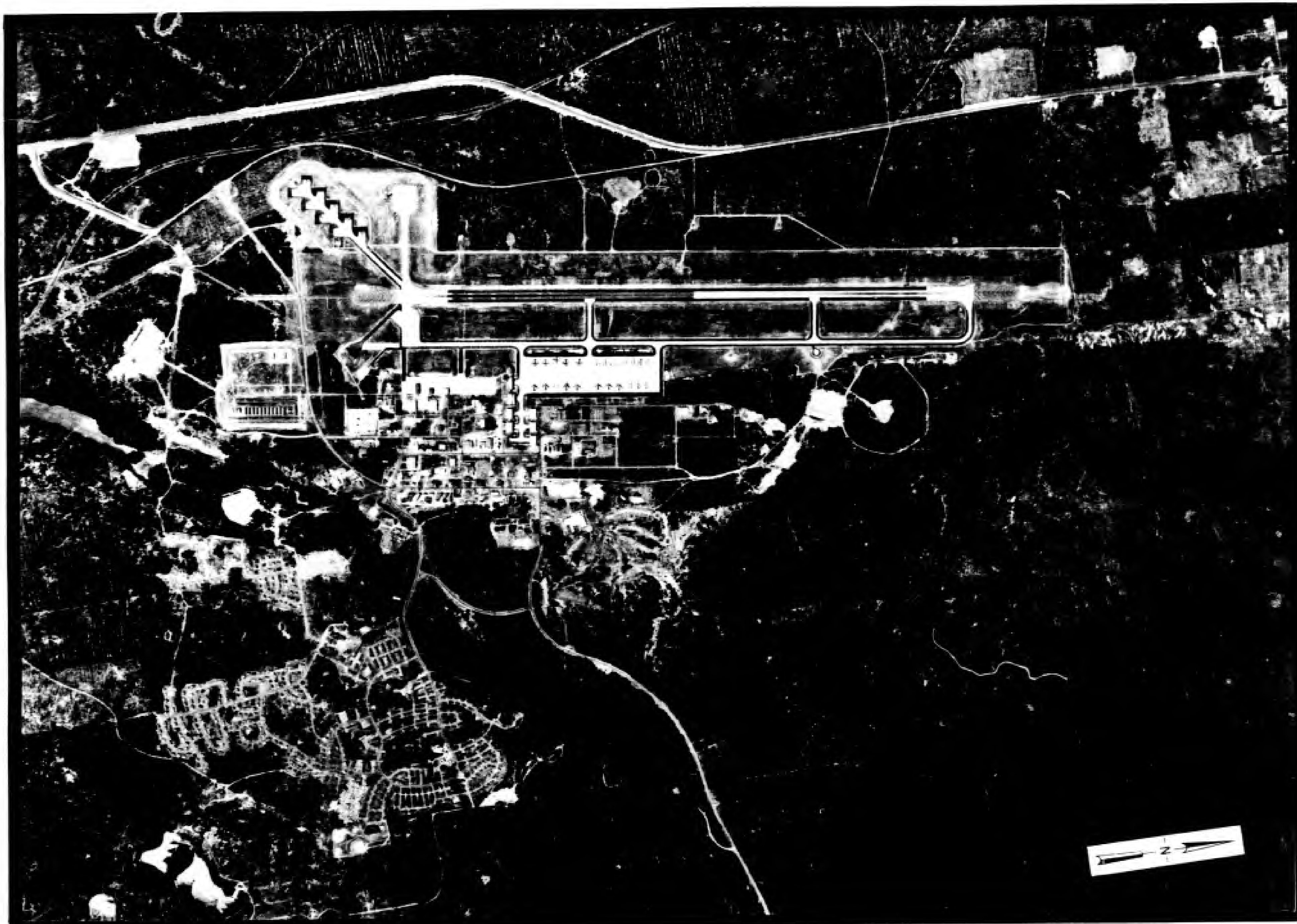
Name	Present Location (Bldg. No.)	Handles Hazardous Materials	Generates Hazardous Wastes	Waste Management Practices
2001 Information Systems Squadron (Continued)				
Radio	708	Yes	No	--
Base Interservice Surveillance Sets (BISS)	708	Yes	No	--
Crypto/Teletype	708	Yes	No	--
Communications/Message Center	708	Yes	No	--
410 Security Police Squadron				
Armory	611	Yes	Yes	DPDO

APPENDIX F

PHOTOGRAPHS



K.I. SAWYER AFB, MICHIGAN CIRCA 1969



K.I. SAWYER AFB, MICHIGAN 1978

K.I. SAWYER AFB

Wells Terminal Annex

Wells Terminal Annex - Chemical Discharge

ES ENGINEERING-SCIENCE

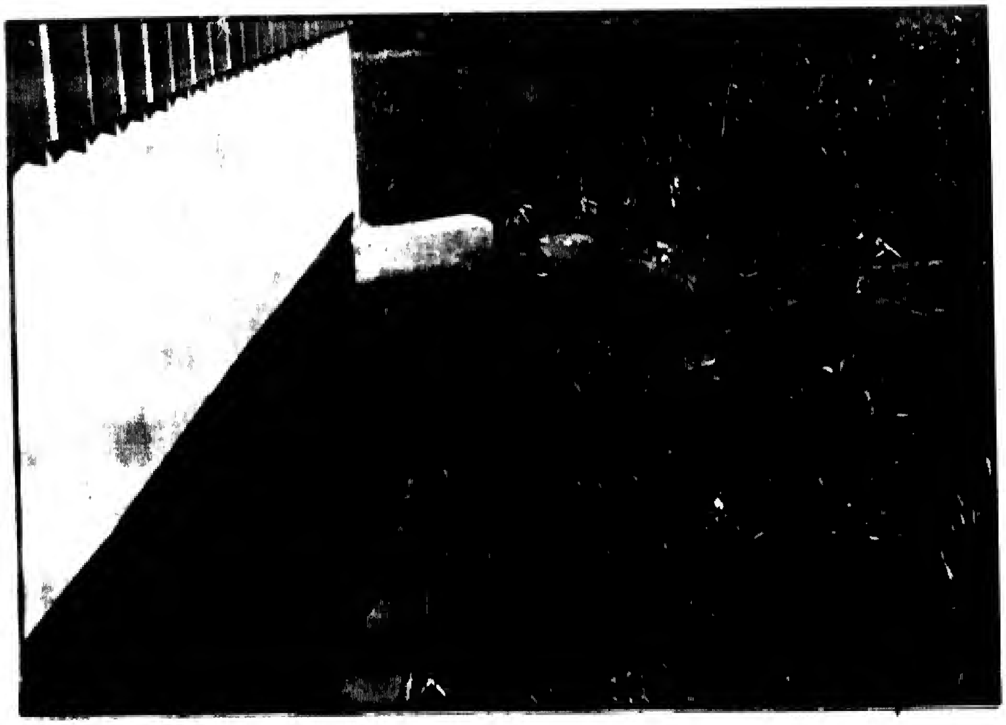
K.I. SAWYER AFB

Wells Terminal Annex – Creosote Pit

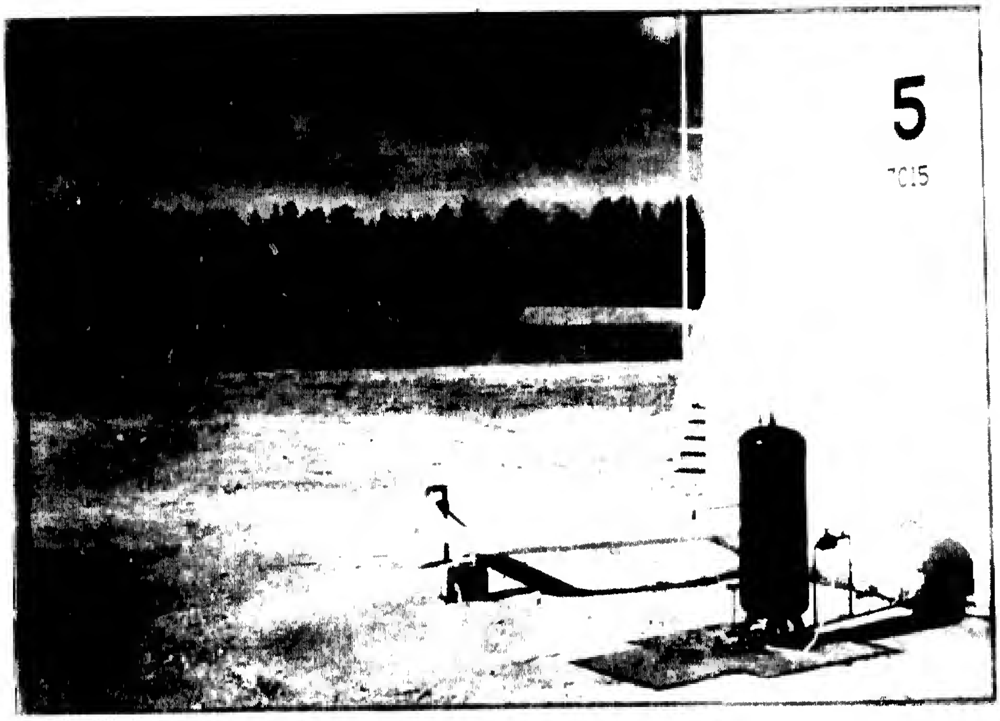
Drainage Pond–No. 2

ES ENGINEERING-SCIENCE

K.I. SAWYER AFB



Drainage Pond No. 2

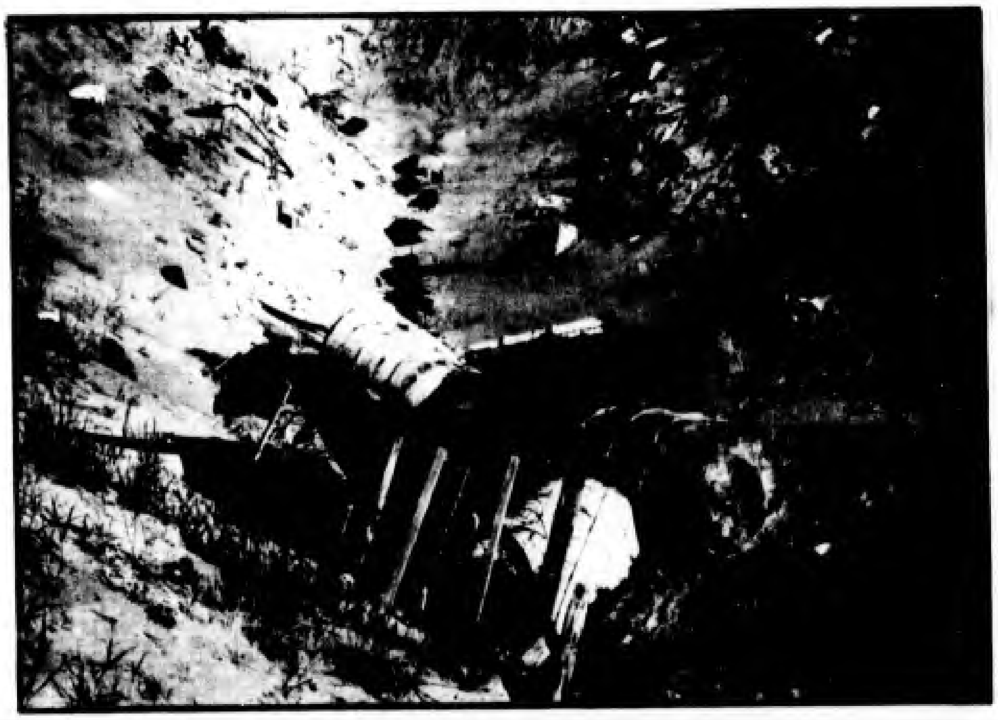


POL Area

POL Area

Oil/Water Separator Pit (POL Area)

Landfill No. 1



Landfill No. 1

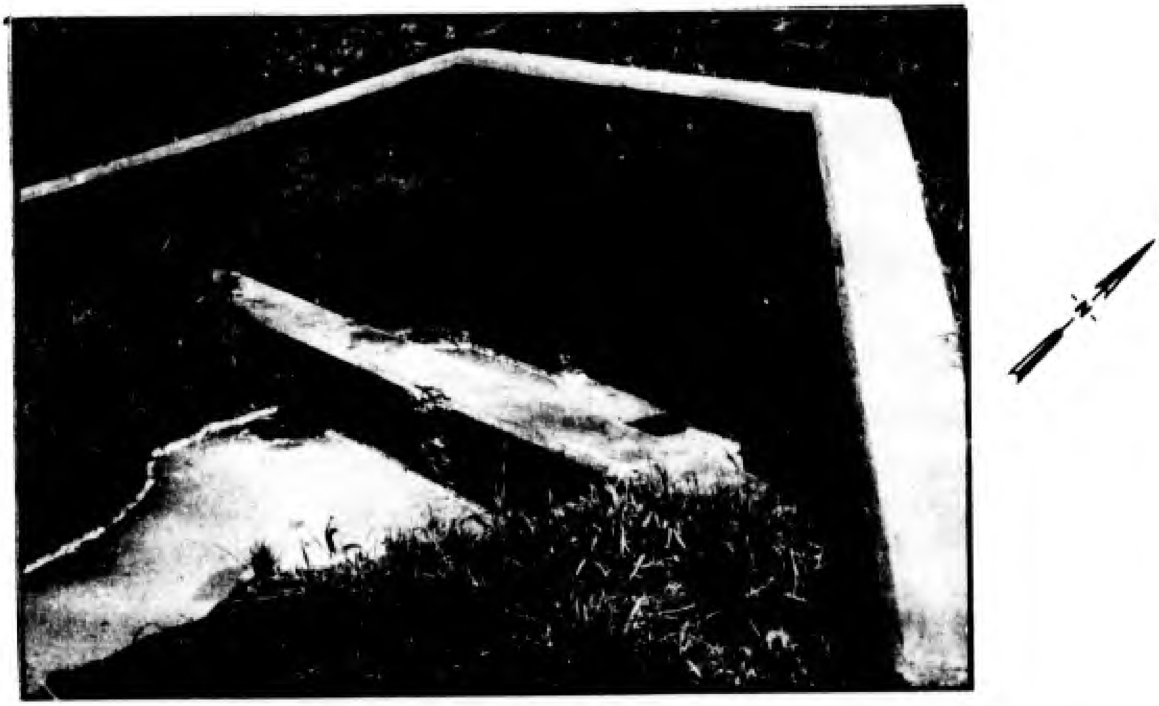
K.I. SAWYER AFB

Landfill No. 1

Landfill No. 2

K.I. SAWYER AFB

Drainage Pit No. 3



Drainage Pit No. 3

Landfill No. 3

Fire Protection Training Area No. 2

Fire Protection Training Area No. 2

Hardfill Area No. 2

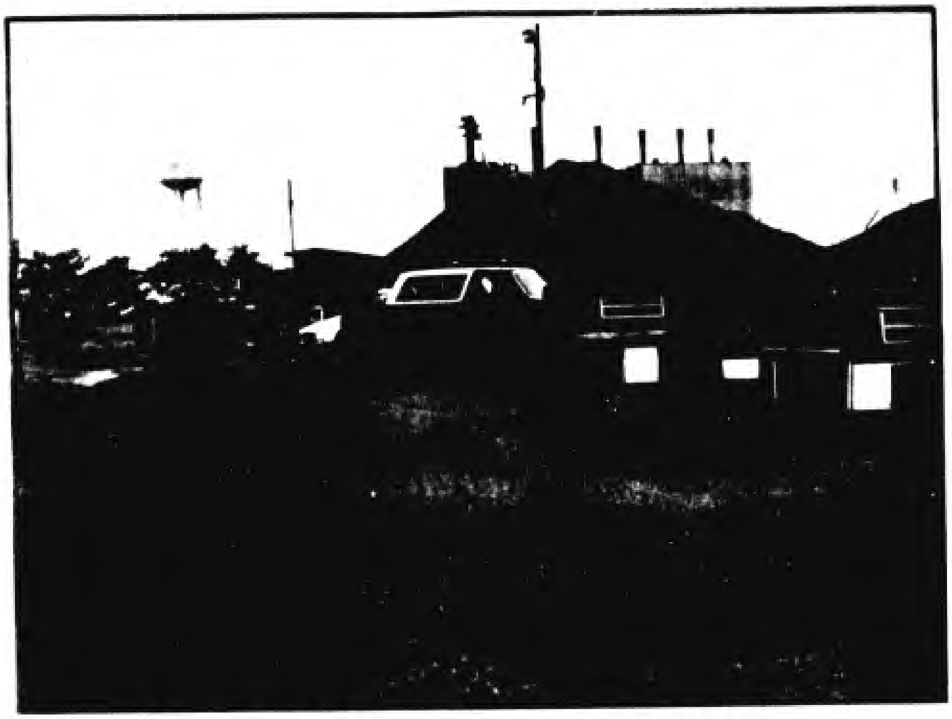
K.I. SAWYER AFB

Landfill No. 4

Landfill No. 4 - Sludge Disposal Pit

K.I. SAWYER AFB

Drainage Pit No.1



DPDO Past Storage Area

APPENDIX G

USAF INSTALLATION RESTORATION PROGRAM

HAZARD ASSESSMENT RATING METHODOLOGY

APPENDIX G

USAF INSTALLATION RESTORATION PROGRAM
HAZARD ASSESSMENT RATING METHODOLOGY

BACKGROUND

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

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

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

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

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

PURPOSE

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

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

DESCRIPTION OF MODEL

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

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

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

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

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

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

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

FIGURE 1

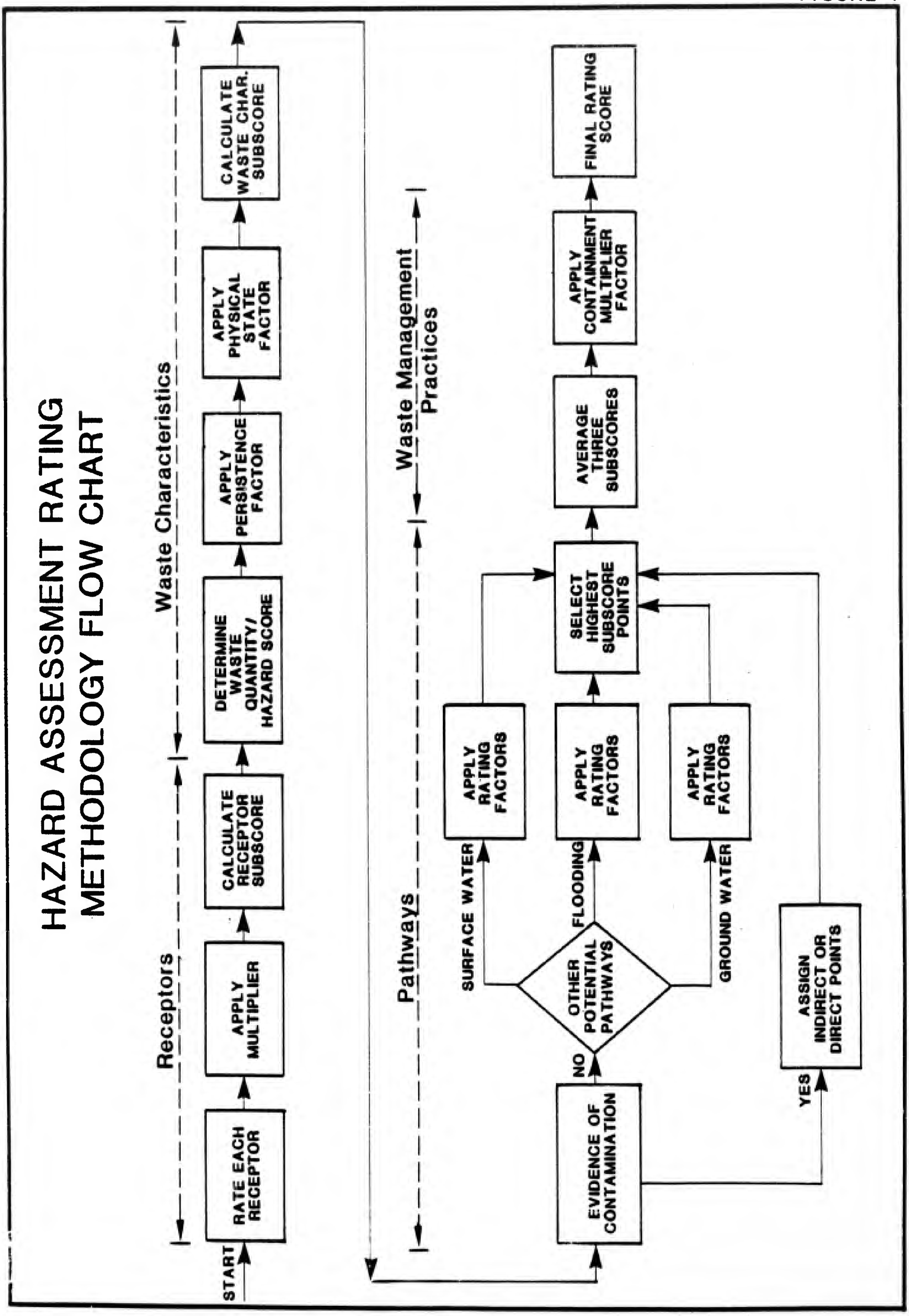

HAZARD ASSESSMENT RATING
METHODOLOGY FLOW CHART
Receptors
Waste Characteristics
Pathways
Waste Management Practices
START
RATE EACH RECEPTOR
APPLY MULTIPLIER
CALCULATE RECEPTOR SUBSCORE
DETERMINE WASTE QUANTITY/ HAZARD SCORE
APPLY PERSISTENCE FACTOR
APPLY PHYSICAL STATE FACTOR
CALCULATE WASTE CHAR. SUBSCORE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

FIGURE 2

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		3		
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					
Floodplain	Beyond 100-year floodplain	In 25-year floodplain	In 10-year floodplain	Floods annually	1

B-3 POTENTIAL FOR GROUND-WATER CONTAMINATION

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

TABLE 1 (Continued)

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

IV. WASTE MANAGEMENT PRACTICES CATEGORY

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

B. WASTE MANAGEMENT PRACTICES FACTOR

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

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

Guidelines for fully contained:

Landfills:

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

Spills:

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

Surface Impoundments:

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

Fire Proection Training Areas:

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

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

APPENDIX H

INDEX FOR HAZARD ASSESSMENT

METHODOLOGY FORM

APPENDIX H

TABLE OF CONTENTS

TITLE	PAGE
Wells Terminal Annex	H-1
Drainage Pond No. 2	H-3
POL Area	H-5
Landfill No. 1	H-7
Landfill No. 2	H-9
Drainage Pit No. 3	H-11
Landfill No. 3	H-13
Fire Protection Training Area No. 1	H-15
Fire Protection Training Area No. 2	H-17
Hardfill Area No. 2	H-19
Landfill No. 4	H-21
Drainage Pit No. 1	H-23
DPDO Yard	H-25

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of site: Wells Terminal Annex
Location: Township of Wells
Date of Operation: 1957 - Present
Owner/Operator: USAF Owned
Comments/Description: Area owned by AF, run by Defense Fuels Support Group

Site Rated by: E.H.Snider, S.K. Minicucci, S.J. Tiffany, J. N. Baker

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to installation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	3	6	18	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	3	6	18	18
I. Population served by ground-water supply within 3 miles of site	2	6	12	18
Subtotals			146	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 81

II. WASTE CHARACTERISTICS

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

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

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

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

80 x 0.90 = 72

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

72 x 1.00 = 72

III. PATHWAYS

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

Subscore 80

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

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	3	8	24	24
Net precipitation	2	6	12	18
Surface erosion	1	8	8	24
Surface permeability	0	6	0	18
Rainfall intensity	3	8	24	24
Subtotals			68	108
Subscore (100 x factor score subtotal/maximum score subtotal)				63
2. Flooding	1	1	1	3
Subscore (100 x factor score/3)				33
3. Ground-water migration				
Depth to ground water	2	8	16	24
Net precipitation	2	6	12	18
Soil permeability	3	8	24	24
Subsurface flows	1	8	8	24
Direct access to ground water	0	8	0	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 80

IV. WASTE MANAGEMENT PRACTICES

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

Receptors		81
Waste Characteristics		72
Pathways		80
Total	233	divided by 3 = 78 Gross total score

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

Gross total score x waste management practices factor = final score

78 x 1.00 = \ 78 \

FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of site: Drainage Pond No. 2 (Hospital Area)
Location: South of Building 850
Date of Operation: 1956-PRESENT
Owner/Operator:K.I. Sawyer
Comments/Description: Drainage Area for Shop sewer lines.

Site Rated by: E.H.Snider, S.K. Minicucci, S.J. Tiffany, J. N. Baker

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	3	4	12	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to installation boundary	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	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			124	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 69

II. WASTE CHARACTERISTICS

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

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

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

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

100 x 1.00 = 100

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

100 x 1.00 = 100

III. PATHWAYS

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

Subscore 0

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

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	3	8	24	24
Net precipitation	2	6	12	18
Surface erosion	2	8	16	24
Surface permeability	0	6	0	18
Rainfall intensity	1	8	8	24
Subtotals			60	108
Subscore (100 x factor score subtotal/maximum score subtotal)				56
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	1	8	8	24
Net precipitation	2	6	12	18
Soil permeability	3	8	24	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			44	114
Subscore (100 x factor score subtotal/maximum score subtotal)				39

C. Highest pathway subscore.

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

Pathways Subscore 56

IV. WASTE MANAGEMENT PRACTICES

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

Receptors		69		
Waste Characteristics		100		
Pathways		56		
Total	224	divided by 3 =	75	Gross total score

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

Gross total score x waste management practices factor = final score

75 x 1.00 = \ 75 \

FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of site: POL Area
Location: POL Yard
Date of Operation: 1970-1985
Owner/Operator:K.I. Sawyer
Comments/Description: Includes two spill areas and discharge pit

Site Rated by: E.H.Snider, S.K. Minicucci, S.J. Tiffany, J. N. Baker

I. RECEPTORS

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

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

II. WASTE CHARACTERISTICS

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

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

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

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

100 x 0.80 = 80

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

80 x 1.00 = 80

III. PATHWAYS

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

Subscore 80

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

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	2	8	16	24
Net precipitation	2	6	12	18
Surface erosion	1	8	8	24
Surface permeability	0	6	0	18
Rainfall intensity	1	8	8	24
Subtotals			44	108
Subscore (100 x factor score subtotal/maximum score subtotal)				41
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	1	8	8	24
Net precipitation	2	6	12	18
Soil permeability	3	8	24	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			44	114
Subscore (100 x factor score subtotal/maximum score subtotal)				39

C. Highest pathway subscore.

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

Pathways Subscore 80

IV. WASTE MANAGEMENT PRACTICES

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

Receptors		64
Waste Characteristics		80
Pathways		80
Total	224	divided by 3 = 75 Gross total score

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

Gross total score x waste management practices factor = final score

75 x 1.00 = 75

FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of site: Landfill No.1
Location: South of Ammunitions Storage Area
Date of Operation: 1955-1973
Owner/Operator:K.I. Sawyer
Comments/Description: Landfill used for disposal of housing & industrial wastes.

Site Rated by: E.H.Snider, S.K. Minicucci, S.J. Tiffany, J. N. Baker

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	3	10	30	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to installation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			118	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 66

II. WASTE CHARACTERISTICS

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

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

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

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

100 x 1.00 = 100

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

100 x 1.00 = 100

III. PATHWAYS

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

Subscore 0

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

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	2	8	16	24
Net precipitation	2	6	12	18
Surface erosion	2	8	16	24
Surface permeability	0	6	0	18
Rainfall intensity	1	8	8	24
Subtotals			52	108
Subscore (100 x factor score subtotal/maximum score subtotal)				48
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	1	8	8	24
Net precipitation	2	6	12	18
Soil permeability	3	8	24	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			44	114
Subscore (100 x factor score subtotal/maximum score subtotal)				39

C. Highest pathway subscore.

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

Pathways Subscore 48

IV. WASTE MANAGEMENT PRACTICES

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

Receptors	66		
Waste Characteristics	100		
Pathways	48		
Total 214	divided by 3 =	71	Gross total score

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

Gross total score x waste management practices factor = final score

71 x 1.00 = 71

FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of site: Landfill No.2
Location: SE of Ammunitions Storage, West of Silver Lead Creek
Date of Operation: 1955-1962
Owner/Operator:K.I. Sawyer
Comments/Description: Small landfill near Silver Lead Creek

Site Rated by: E.H.Snider, S.K. Minicucci, S.J. Tiffany, J. N. Baker

I. RECEPTORS

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

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

II. WASTE CHARACTERISTICS

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

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

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

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

80 x 1.00 = 80

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

80 x 1.00 = 80

III. PATHWAYS

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

Subscore 0

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

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

IV. WASTE MANAGEMENT PRACTICES

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

Receptors		64	
Waste Characteristics		80	
Pathways		56	
Total	200	divided by 3 =	67 Gross total score

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

Gross total score x waste management practices factor = final score

67 x 1.00 = \ 67 \

FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of site: Drainage Pit No. 3
Location: West of Building 740
Date of Operation: 1956-1985
Owner/Operator: K. I. Sawyer
Comments/Description: Drainage area for shop waste.

Site Rated by: E.H.Snider, S.K. Minicucci, S.J. Tiffany, J. N. Baker

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to installation boundary	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	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			113	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 63

II. WASTE CHARACTERISTICS

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

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

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

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

80 x 1.00 = 80

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

80 x 1.00 = 80

III. PATHWAYS

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

Subscore 0

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

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	3	8	24	24
Net precipitation	2	6	12	18
Surface erosion	1	8	8	24
Surface permeability	0	6	0	18
Rainfall intensity	1	8	8	24
Subtotals			52	108
Subscore (100 x factor score subtotal/maximum score subtotal)				48
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	1	8	8	24
Net precipitation	2	6	12	18
Soil permeability	3	8	24	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			44	114
Subscore (100 x factor score subtotal/maximum score subtotal)				39

C. Highest pathway subscore.

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

Pathways Subscore 48

IV. WASTE MANAGEMENT PRACTICES

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

Receptors		63
Waste Characteristics		80
Pathways		48
Total	191 divided by 3 =	64 Gross total score

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

Gross total score x waste management practices factor = final score

64 x 1.00 = 64

FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of site: Landfill No.3
Location: South of EOD Area, East of Taxiway F
Date of Operation: Early 1970's to 1975
Owner/Operator:K.I. Sawyer
Comments/Description: East of current landfill area

Site Rated by: E.H.Snider, S.K. Minicucci, S.J. Tiffany, J. N. Baker

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	3	10	30	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to installation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			115	180

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

II. WASTE CHARACTERISTICS

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

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

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

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

80 x 1.00 = 80

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

80 x 1.00 = 80

Name of site: Landfill No.3

III. PATHWAYS

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

Subscore 0

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

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	2	8	16	24
Net precipitation	2	6	12	18
Surface erosion	1	8	8	24
Surface permeability	0	6	0	18
Rainfall intensity	1	8	8	24
Subtotals			44	108
Subscore (100 x factor score subtotal/maximum score subtotal)				41
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	1	8	8	24
Net precipitation	2	6	12	18
Soil permeability	3	8	24	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			44	114
Subscore (100 x factor score subtotal/maximum score subtotal)				39

C. Highest pathway subscore.

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

Pathways Subscore 41

IV. WASTE MANAGEMENT PRACTICES

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

Receptors	64
Waste Characteristics	80
Pathways	41
Total 185	divided by 3 = 62 Gross total score

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

Gross total score x waste management practices factor = final score

62 x 1.00 = 62 FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of site: FPTA-1
Location: North end of base
Date of Operation: 1958-1970
Owner/Operator:K.I. Sawyer
Comments/Description: First FPTA used

Site Rated by: E.H.Snider, S.K. Minicucci, S.J. Tiffany, J. N. Baker

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	3	10	30	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to installation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			109	180

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

II. WASTE CHARACTERISTICS

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

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

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

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

100 x 0.80 = 80

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

80 x 1.00 = 80

III. PATHWAYS

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

Subscore 0

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

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	1	8	8	24
Net precipitation	2	6	12	18
Surface erosion	2	8	16	24
Surface permeability	0	6	0	18
Rainfall intensity	1	8	8	24
Subtotals			44	108
Subscore (100 x factor score subtotal/maximum score subtotal)				41
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	1	8	8	24
Net precipitation	2	6	12	18
Soil permeability	3	8	24	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			44	114
Subscore (100 x factor score subtotal/maximum score subtotal)				39

C. Highest pathway subscore.

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

Pathways Subscore 41

IV. WASTE MANAGEMENT PRACTICES

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

Receptors 61
Waste Characteristics 80
Pathways 41
Total 181 divided by 3 = 60 Gross total score

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

Gross total score x waste management practices factor = final score

60 x 1.00 = 60

FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of site: FPTA-2
Location: Northeast protion of base, East of primary taxiway
Date of Operation: Early 1970's to Present
Owner/Operator:K.I. Sawyer
Comments/Description: Current FPTA

Site Rated by: E.H.Snider, S.K. Minicucci, S.J. Tiffany, J. N. Baker

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	3	10	30	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to installation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			109	180

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

II. WASTE CHARACTERISTICS

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

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

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

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

80 x 0.80 = 64

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

64 x 1.00 = 64

III. PATHWAYS

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

Subscore 0

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

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	1	8	8	24
Net precipitation	2	6	12	18
Surface erosion	2	8	16	24
Surface permeability	0	6	0	18
Rainfall intensity	1	8	8	24
Subtotals			44	108
Subscore (100 x factor score subtotal/maximum score subtotal)				41
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	1	8	8	24
Net precipitation	2	6	12	18
Soil permeability	3	8	24	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			44	114
Subscore (100 x factor score subtotal/maximum score subtotal)				39

C. Highest pathway subscore.

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

Pathways Subscore 41

IV. WASTE MANAGEMENT PRACTICES

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

Receptors		61
Waste Characteristics		64
Pathways		41
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 1.00 = 55

FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of site: Hardfill Area No.2
Location: 1500 feet SE of main gatehouse
Date of Operation: Early 1960's until approx. 1970
Owner/Operator:K.I. Sawyer
Comments/Description: Used for storage of PCB transformers

Site Rated by: E.H.Snider, S.K. Minicucci, S.J. Tiffany, J. N. Baker

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	3	10	30	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to installation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			115	180

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

II. WASTE CHARACTERISTICS

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

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

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

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

60 x 1.00 = 60

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

60 x 1.00 = 60

III. PATHWAYS

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

Subscore 0

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

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	2	8	16	24
Net precipitation	2	6	12	18
Surface erosion	1	8	8	24
Surface permeability	0	6	0	18
Rainfall intensity	1	8	8	24
Subtotals			44	108
Subscore (100 x factor score subtotal/maximum score subtotal)				41
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	1	8	8	24
Net precipitation	2	6	12	18
Soil permeability	3	8	24	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			44	114
Subscore (100 x factor score subtotal/maximum score subtotal)				39

C. Highest pathway subscore.

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

Pathways Subscore 41

IV. WASTE MANAGEMENT PRACTICES

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

Receptors	64		
Waste Characteristics	60		
Pathways	41		
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 1.00 = 55 FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of site: Landfill No.4
Location: East of Taxiway F
Date of Operation: 1975 to Present
Owner/Operator:K.I. Sawyer
Comments/Description: Currently used for base disposal & sludge disposal

Site Rated by: E.H.Snider, S.K. Minicucci, S.J. Tiffany, J. N. Baker

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	3	10	30	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to installation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			109	180

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

II. WASTE CHARACTERISTICS

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

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

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

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

60 x 1.00 = 60

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

60 x 1.00 = 60

III. PATHWAYS

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

Subscore 0

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

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	2	8	16	24
Net precipitation	2	6	12	18
Surface erosion	1	8	8	24
Surface permeability	0	6	0	18
Rainfall intensity	1	8	8	24
Subtotals			44	108
Subscore (100 x factor score subtotal/maximum score subtotal)				41
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	1	8	8	24
Net precipitation	2	6	12	18
Soil permeability	3	8	24	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			44	114
Subscore (100 x factor score subtotal/maximum score subtotal)				39

C. Highest pathway subscore.

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

Pathways Subscore 41

IV. WASTE MANAGEMENT PRACTICES

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

Receptors		61
Waste Characteristics		60
Pathways		41
Total	161	divided by 3 = 54 Gross total score

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

Gross total score x waste management practices factor = final score

54 x 1.00 = 54 FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of site: Drainage Pit No.1 (Test Cell)
Location: Behind Building 414
Date of Operation: 1957- Present
Owner/Operator: K.I. Sawyer
Comments/Description: Drainage pit used by occupants of building.

Site Rated by: E.H.Snider, S.K. Minicucci, S.J. Tiffany, J. N. Baker

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	2	4	8	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to installation boundary	1	6	6	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	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			114	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 63

II. WASTE CHARACTERISTICS

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

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

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

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

50 x 1.00 = 50

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

50 x 1.00 = 50

III. PATHWAYS

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

Subscore 0

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

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	2	8	16	24
Net precipitation	2	6	12	18
Surface erosion	1	8	8	24
Surface permeability	0	6	0	18
Rainfall intensity	1	8	8	24
Subtotals			44	108
Subscore (100 x factor score subtotal/maximum score subtotal)				41
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	2	8	16	24
Net precipitation	2	6	12	18
Soil permeability	3	8	24	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	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		63	
Waste Characteristics		50	
Pathways		46	
Total	159 divided by 3 =		53 Gross total score

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

Gross total score x waste management practices factor = final score

53 x 1.00 = \ 53 \

FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of site: DPDO Yard
Location: East of POL, West of coal plant.
Date of Operation: 1960-1980
Owner/Operator:K.I. Sawyer
Comments/Description: Storage of PCB Transformers, Waste Oil Drums

Site Rated by: E.H.Snider, S.K. Minicucci, S.J. Tiffany, J. N. Baker

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	2	4	8	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to installation boundary	1	6	6	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	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			114	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 63

II. WASTE CHARACTERISTICS

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

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

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

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

40 x 1.00 = 40

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

40 x 1.00 = 40

III. PATHWAYS

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

Subscore 0

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

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	2	8	16	24
Net precipitation	2	6	12	18
Surface erosion	1	8	8	24
Surface permeability	0	6	0	18
Rainfall intensity	1	8	8	24
Subtotals			44	108
Subscore (100 x factor score subtotal/maximum score subtotal)				41
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	2	8	16	24
Net precipitation	2	6	12	18
Soil permeability	3	8	24	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	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		63	
Waste Characteristics		40	
Pathways		46	
Total	149	divided by 3 =	50 Gross total score

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

50 x 1.00 = 50

FINAL SCORE

APPENDIX I

GLOSSARY OF TERMINOLOGY AND ABBREVIATIONS

APPENDIX I

GLOSSARY OF TERMINOLOGY AND ABBREVIATIONS

ABG: Air Base Group.

ACFT MAINT: Aircraft Maintenance.

ADC: Aerospace Defense Command.

ADTAC: Air Defense Tactical Air Command

AEC: Atomic Energy Commission.

AF: Air Force.

AFB: Air Force Base.

AFCS: Air Force Communications Service.

AFESC: Air Force Engineering and Services Center.

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

AFR: Air Force Regulation.

AFS: Air Force Station.

AFCC: Air Force Communications Command.

Ag: Chemical symbol for silver.

AGE: Aerospace Ground Equipment.

ALC: Air Logistics Center.

ALLUVIUM: Materials eroded, transported and deposited by streams.

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

AMS: Avionics Maintenance Squadron.

ANG: Air National Guard.

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

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

APS: Aerial Port Squadron.

ARTESIAN: Ground water contained under hydrostatic pressure.

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

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

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

AREFG: Air Refueling Group.

ASC: Audiovisual Service Center.

ATC: Air Training Command.

ATD: Air Training Detachment

AVGAS: Aviation Gasoline.

Ba: Chemical symbol for barium.

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

BEE: Bioenvironmental Engineer.

BES: Bioenvironmental Engineering Section.

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

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

BISS: Base Interservice Surveillence Sets.

BMW: Bombardment Wing.

BOD: Biochemical Oxygen Demand

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

BX: Base Exchange.

CAMS: Consolidated Aircraft Maintenance Squadron.

CAP: Civilian Air Patrol.

Cd: Chemical symbol for cadmium.

CE: Civil Engineering.

CERCLA: Comprehensive Environmental Response, Compensation and Liability Act.

CES: Civil Engineering Squadron.

CIRCA: About; used to indicate an approximate date.

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

CMS: Component Maintenance Squadron.

CN: Chemical symbol for cyanide.

COASTAL PLAINS: Physiographic province of the Eastern United States characterized by a gently seaward sloping surface formed over exposed, unconsolidated, stratified marine fluvial sediments. Typical coastal plain features include low hills and ridges, organic deposits, floodplains and high water tables.

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

COE: Corps of Engineers.

COLLUVIUM: Sediments that have moved down slope primarily under the influence of gravity or as periodic, unchannelized flow. It frequently includes large boulders or other fragments which contrast this material to alluvium, material deposited by channelized flow which results in some degree of sorting according to particle size.

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

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

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

CONUS: Continental United States.

CPM: Counts per minute (alpha radiation measurement).

Cr: Chemical symbol for chromium.

CRS: Component Repair Squadron.

CSG: Combat Support Group.

Cu: Chemical symbol for copper.

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

DEQPPM: Defense Environmental Quality Program Policy Memorandum

DET: Detachment.

DIP: The angle measured from the horizontal that a structural feature makes. Structural features may include bedding, folds, faults, etc. Dip is measured in degrees of the vertical plane, normal to strike.

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

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

DOD: Department of Defense.

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

DP: Discharge Pit.

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

DQ & A: Diagnostics, Quality and Assurance.

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

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

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

ELECTROMAGNETIC CONDUCTIVITY: EM

EMCS: Energy Monitor and Counter Systems

EOD: Explosive Ordnance Disposal.

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

EPA: U.S. Environmental Protection Agency.

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

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

ES: Engineering-Science, Inc.

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

F-106: Type of fighter aircraft.

FAA: Federal Aviation Administration.

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

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

Fe: Chemical symbol for iron.

FIS: Fighter Interceptor Squadron.

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

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

FMS: Field Maintenance Squadron.

FPTA: Fire Protection Training Area.

FTD: Field Training Detachment.

FTW: Fighter Training Wing.

GATR: Ground to Air Transmitter Receiver Site.

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

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

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

GLAUCOMITIC SAND AND GRAVEL: A mixture of sand, gravel and glaucomite, an iron-potassium silicate mineral which imparts a green color to the mixture. Glaucomite is geologically significant because it indicates slow sedimentation.

GLIDE-BLOCK: A large section of a geologic unit that has separated from the main portion of the unit due to earthquake/landslide-induced lateral movement.

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

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

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

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

HARM: Hazard Assessment Rating Methodology.

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

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

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

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

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

5. Additional substances designated under Paragraph 102 of CERCLA.

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

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

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

Hg: Chemical symbol for mercury.

HQ: Headquarters.

HWAP: Hazardous Waste Accumulation Point.

HWMF: Hazardous Waste Management Facility.

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

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

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

IRP: Installation Restoration Program.

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

ISOTOPE: Two or more species of atoms of the same chemical element, with the same atomic number and place in the periodic table, and nearly identical chemical properties, but with different atomic mass numbers and different physical properties; an example may be the radioactive isotope - Carbon (12) and Carbon-14.

ISS: Information Systems Squadron.

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

JP-5: Jet Propulsion Fuel Number Five; consists of high boiling kerosene fractions.

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

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

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

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

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

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

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

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

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

MA-1: Type of aircraft component.

MAC: Military Airlift Command.

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

MAINT: Recording System Maintenance.

MATS: Military Air Transport Service.

MAW: Military Airlift Wing.

MEK: Methyl Ethyl Ketone.

METALS: See "Heavy Metals".

mgd: Million Gallons per Day.

MIBK: Methyl Isobutyl Ketone.

MICRO: u (10^{-6})

ug/l: Micrograms per liter.

umhos: A unit of electrical conductivity (the reciprocal of ohm). One mho conductance per centimeter cubed with a potential of one volt allows the passage of one ampere current per square centimeter of area.

mg/l: Milligrams per liter.

MMS: Munitions Maintenance Squadron.

MOA: Military Operating Area.

MOGAS: Motor gasoline.

Mn: Chemical symbol for manganese.

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

MORAINE: An accumulation of glacial drift deposited chiefly by direct glacial action and possessing initial constructional form independent of the floor beneath it.

MSL: Mean Sea Level.

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

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

MWR: Morale Welfare and Recreation.

NCO: Noncommissioned Officer.

NCOIC: Noncommissioned Officer In-Charge.

NDI: Non-destructive Inspection.

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

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

Ni: Chemical symbol for nickel.

NOAA: National Oceanic and Atmospheric Administration.

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

NPDES: National Pollutant Discharge Elimination System.

OBC: Off-Base Contract

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

OEHL: USAF Occupational and Environmental Health Laboratory.

OIC: Officer-In-Charge.

OMS: Organizational Maintenance Squadron.

OPNS: Operations.

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

OSI: Office of Special Investigations.

O&G: Symbols for oil and grease.

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

OUTWASH: Well-sorted sand and gravel strata deposited in the melt water streams of a retreating glacier.

OXIDIZER: Material necessary to support combustion of fuel.

Pb: Chemical symbol for lead.

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

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

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

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

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

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

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

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

pH: Negative logarithm of hydrogen ion concentration.

PIEDMONT: An upland subdivision of the Appalachian Highlands Physiographic Province, extending from Alabama to New York. The zone is characterized by rolling hills and residual ridges formed by dissection of peneplained irgneous and metamorphic terrain.

pico: 10^{-12}

PL: Public Law.

PMEL: Precision Measurement Equipment Lab.

POL: Petroleum, Oils and Lubricants.

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

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

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

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

ppb: Parts per billion by weight.

ppm: Parts per million by weight.

PRECIPITATION: Rainfall.

PROPELLANT: fuels, oxiders and monopropellants.

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

QAE: Quality Assurance Evaluator.

QUICKTRANS: Automated Terminal Service.

RBC: Rotating Biological Contactors.

RCRA: Resource Conservation and Recovery Act.

RD: Low-level radioactive waste disposal site.

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

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

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

RECON: Reconnaissance.

RESISTIVITY: See Electrical Resistivity

RM: Resource Management.

RWDS: Radioactive Waste Disposal Site.

SAC: Strategic Air Command.

SACMET: Strategic Air Command Management Engineering Team.

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

SAPROLITE: A residual soil retaining the physical appearance or former structure of the parent rock.

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

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

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

SEISMICITY: Pertaining to earthquakes or earth vibrations.

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

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

SMART: Structural Maintenance and Repair Team.

SOLID WASTE: Any garbage, refuse, or sludge from a waste treatment plant, water supply treatment, or air pollution control facility and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, commercial, mining, or agricultural operations and from community activities, but does not include solid or dissolved materials in domestic sewage; solid or dissolved materials in irrigation return flows; industrial discharges which are point source subject to permits under Section 402 of the Federal Water Pollution Control Act, as amended (86 USC 880); or source, special nuclear, or by-product material as defined by the Atomic Energy Act of 1954 (68 USC 923).

SP: Spill area.

SPS: Security Police Squadron

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

SRAM: Short Range Attack Missile

SS: Supply Squadron.

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

STP: Sewage Treatment Plant.

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

SUPS: Supply Squadron.

T: Treatment site method.

T-33: Type of Trainer aircraft

TAC: Tactical Air Command.

TACC: Tactical Air Control Center.

TASS: Tactical Air Support Squadron.

TCA: 1,1,1,-Tetrichloroethane.

TCE: Trichloroethylene, a solvent and suspected carcinogen.

TDS: Total Dissolved Solids.

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

TFTS: Tactical Fighter Training Squadron.

TFW: Tactical Fighter Wing.

TIDAL STRIP: Physiographic subdivision commonly associated with (ocean) wave activity. Usually includes berms, beach ridges, tidal flats and related landforms typically produced by coastal erosional and depositional processes.

TILL: Unstratified glacial drift consisting of clay, sand, gravel and boulders intermingled.

TMDE: Test Measurement and Diagnostic Equipment.

TOC: Total Organic Carbon.

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

TRANS: Transportation Squadron.

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

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

TS: Transportation Squadron.

TSD: Treatment, storage or disposal sites/methods.

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

US: United States.

USAF: United States Air Force.

USAFSS: United States Air Force Security Service.

USDA: United States Department of Agriculture.

USFWS: United States Fish and Wildlife Service.

USGS: United States Geological Survey.

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

WWTP: Wastewater Treatment Plant.

Zn: Chemical symbol for zinc.

Table I-1

GEOLOGICAL TIME SCALE

Era	*Period*	*Epoch*	*Tentative Absolute Age*
Cenozoic	Quaternary	Holocene	11,000 yrs.
		Pleistocene	2 million yrs.
	Tertiary	Pliocene	8
		Miocene	26
		Oligocene	37
		Eocene	53
		Paleocene	70 m.yrs.
Mesozoic	Cretaceous		135
	Jurassic		190
	Triassic		230 m.yrs.
Paleozoic	Permian		280
	Pennsylvanian		
	Mississippian		350
	Devonian		400
	Silurian		430
	Ordovician		500
	Cambrian		600 m. yrs.
Precambrian			600-3600 m.yrs.
---------- Lost Interval ----------			
Origin of Earth			4600 m.yrs.

APPENDIX J

REFERENCES

APPENDIX J
REFERENCES

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APPENDIX K

INDEX OF REFERENCES TO POTENTIAL CONTAMINATION SITES

AT K. I. SAWYER AFB

APPENDIX K

INDEX OF REFERENCES TO POTENTIAL CONTAMINATION SITES AT K. I. SAWYER AFB

Wells Terminal Annex	6, 7, 8, 4-41, 4-44, 4-46, 4-48, 4-49, 5-1, 5-2, 6-3, 6-4, 6-12, F-3, H-1
Drainage Pond No. 2	5, 7, 8, 4-31, 4-32, 4-48, 4-49, 5-2, 5-3, 6-5, 6-11, 6-13, F-4, H-3
POL Area	5, 7, 8, 4-20, 4-21, 4-37, 4-48, 4-49, 5-2, 5-3, 6-5, 6-11, 6-14, F-5, H-5
Landfill No. 1	5, 7, 8, 4-25, 4-26, 4-27, 4-48, 4-49, 5-2, 5-4, 6-6, 6-11, 6-15, F-7, H-7
Landfill No. 2	5, 7, 8, 4-26, 4-27, 4-28, 4-48, 4-29, 5-2, 5-4, 6-6, 6-11, 6-16, F-8, H-9
Drainage Pit No. 3	5, 7, 8, 4-32, 4-33, 4-48, 4-49, 5-2, 5-5, 6-7, 6-11, 6-16, F-9, H-11
Landfill No. 3	5, 7, 8, 4-26, 4-27, 4-29, 4-48, 4-49, 5-2, 5-5, 6-7, 6-11, 6-16, F-10, H-13
Fire Protection Training Area No. 1	5, 7, 8, 4-23, 4-24, 4-48, 4-49, 5-2, 5-6, 6-7, 6-11, 6-17, H-15
Fire Protection Training Area No. 2	5, 7, 8, 4-23, 4-24, 4-48, 4-49, 5-2, 5-6, 6-8, 6-11, 6-17, F-10, H-17
Hardfill Area No. 2	5, 7, 9, 4-17, 4-18, 4-27, 4-30, 4-48. 4-49, 5-2, 5-6, 6-8, 6-11, 6-18, F-11, H-19
Landfill No. 4	5, 7, 8, 4-26, 4-27, 4-29, 4-48, 4,49, 5-2, 5-7, 6-8, 6-11, 6-18, F-12, H-21
Drainage Pit No. 1	5, 7, 9, 4-31, 4-32, 4-48, 4-49, 5-2, 5-7, 6-9, 6-11, 6-19, F-13, H-23
DPDO Yard	5, 7 , 9, 4-17, 4-18, 4-19, 4-48, 4-49, 5-2, 5-7, 6-9, 6-11, 6-19, F-13, H-25