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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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Suite 590
Atlanta, Georgia 30329

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EXECUTIVE SUMMARY

The Department of Defense (DOD) has developed a program to identify and evaluate past hazardous material disposal sites on DOD property, to control the migration of hazardous contaminants, and to control hazards to health or welfare that may result from these past disposal operations. This program is called the Installation Restoration Program (IRP). The IRP has four phases consisting of Phase I, Installation Assessment/Records Search; Phase II, Confirmation/Quantification; Phase III, Technology Base Development; and Phase IV, 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.

2. 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.

3. 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.

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

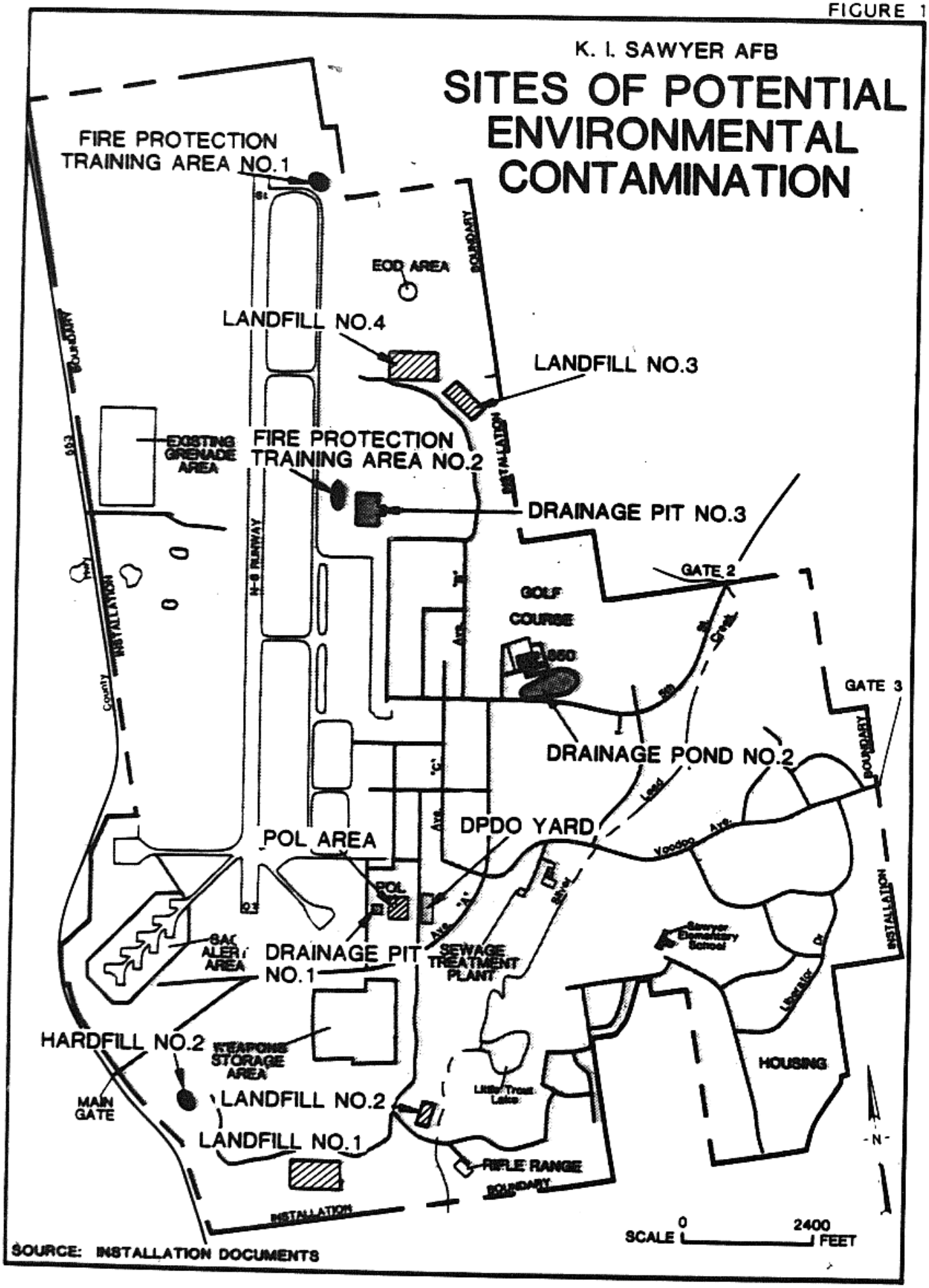
METHODOLOGY

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



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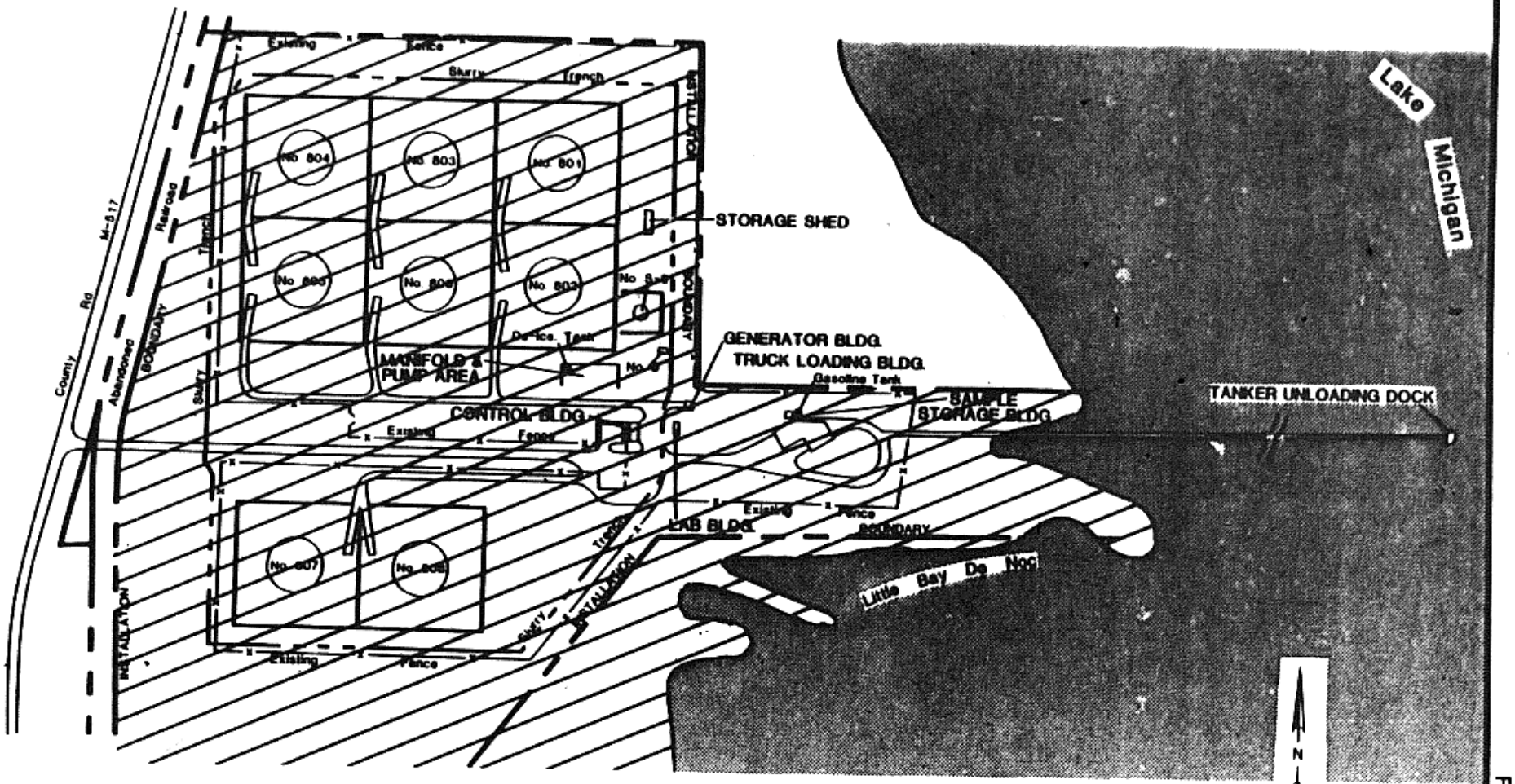
SITE OF POTENTIAL ENVIRONMENTAL CONTAMINATION
WELLS TERMINAL ANNEX



SOURCE: INSTALLATION DOCUMENTS

FIGURE 2

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:

- 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.

- 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.

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

- 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.

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

- 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.

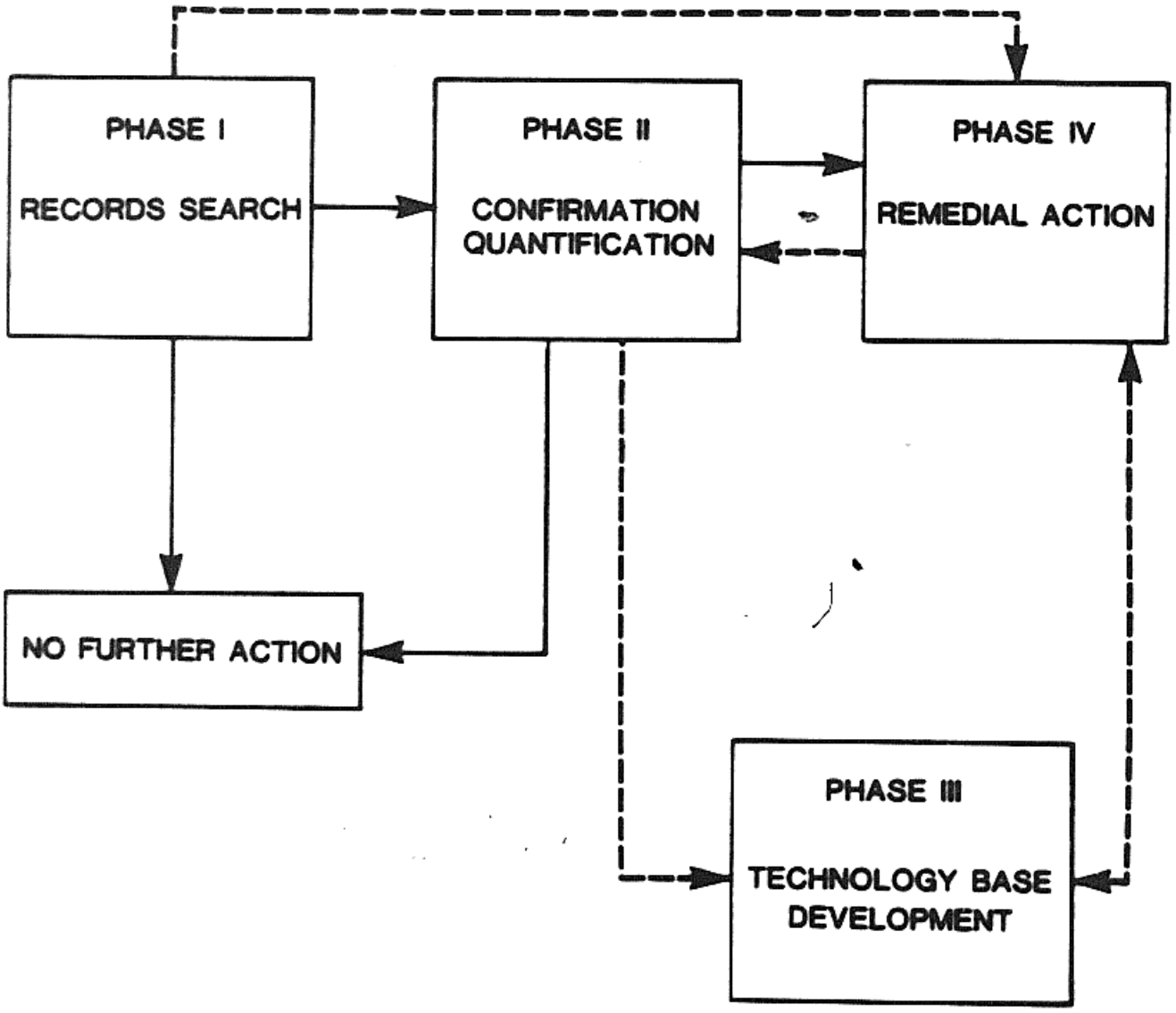
PURPOSE AND SCOPE

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.

FIGURE 1.1

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 ma'ntenance, 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.

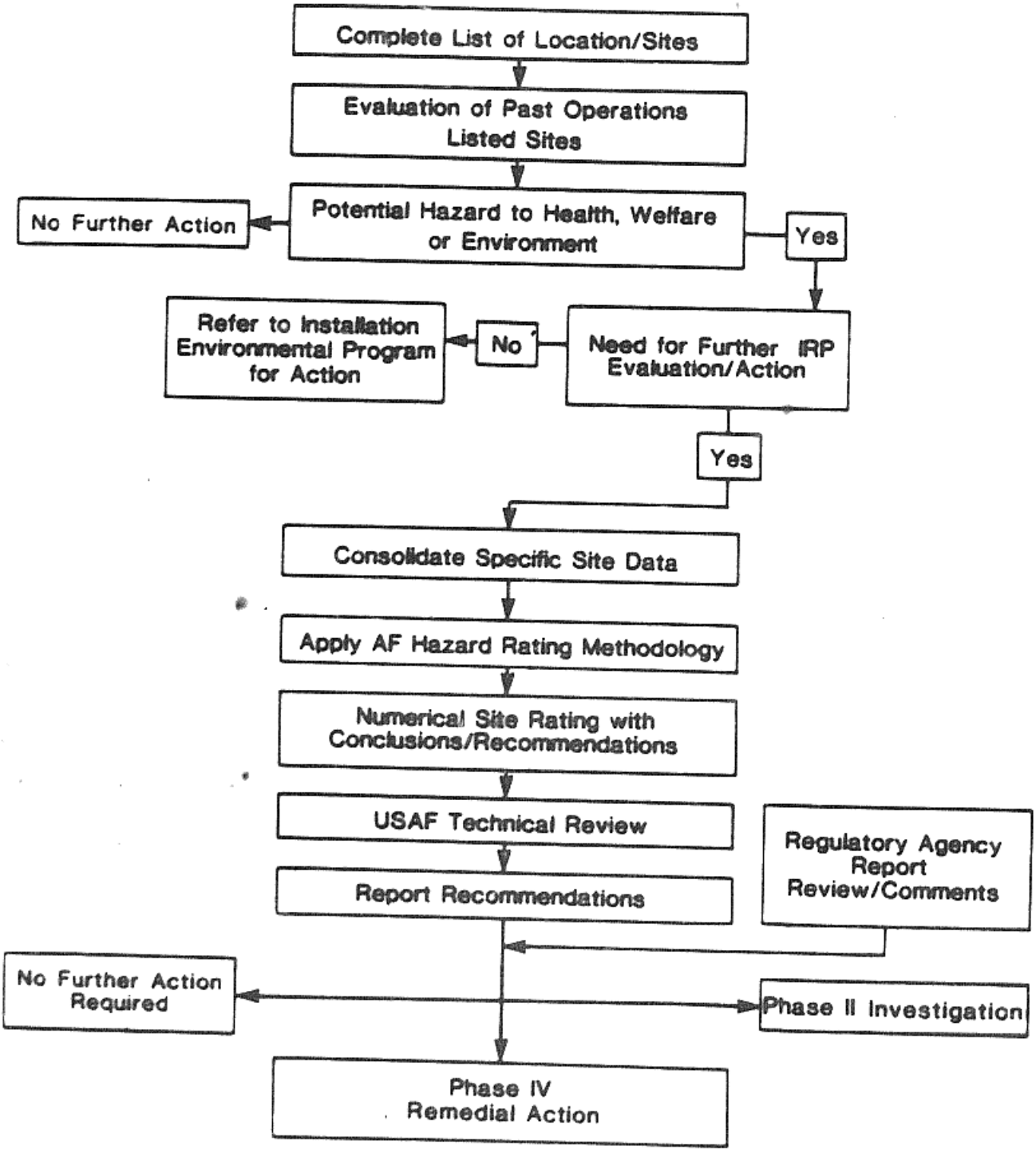
A ground tour of the identified sites was made by the Engineering-Science Project Team to gather site-specific information including: (1) general observations of existing site conditions; (2) visual evidence of environmental stress; (3) presence of nearby drainage ditches or surface waters; and (4) visual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

FIGURE 1.2

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:

- Calumet Air Force Station — 104 acres
- 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.

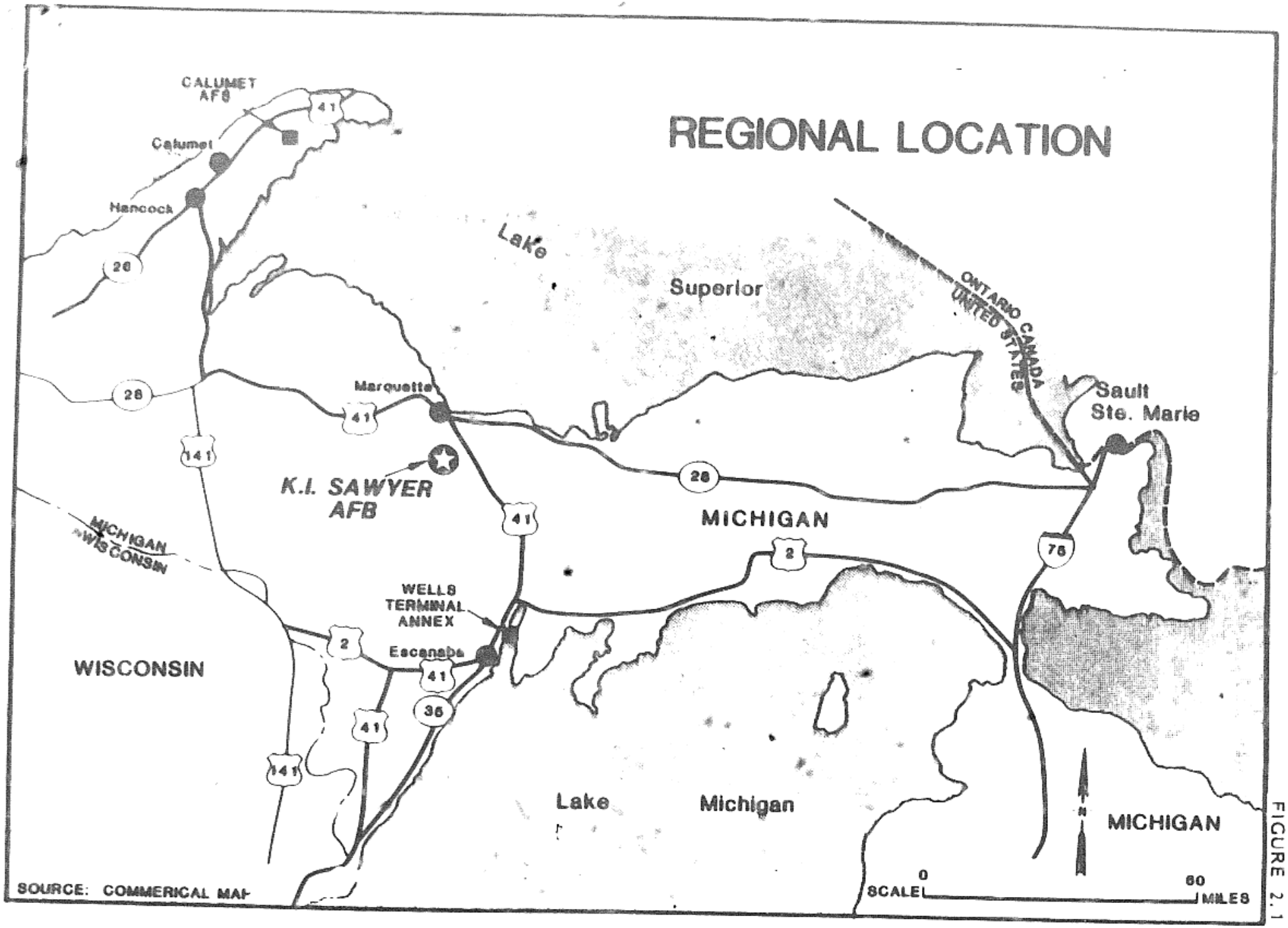
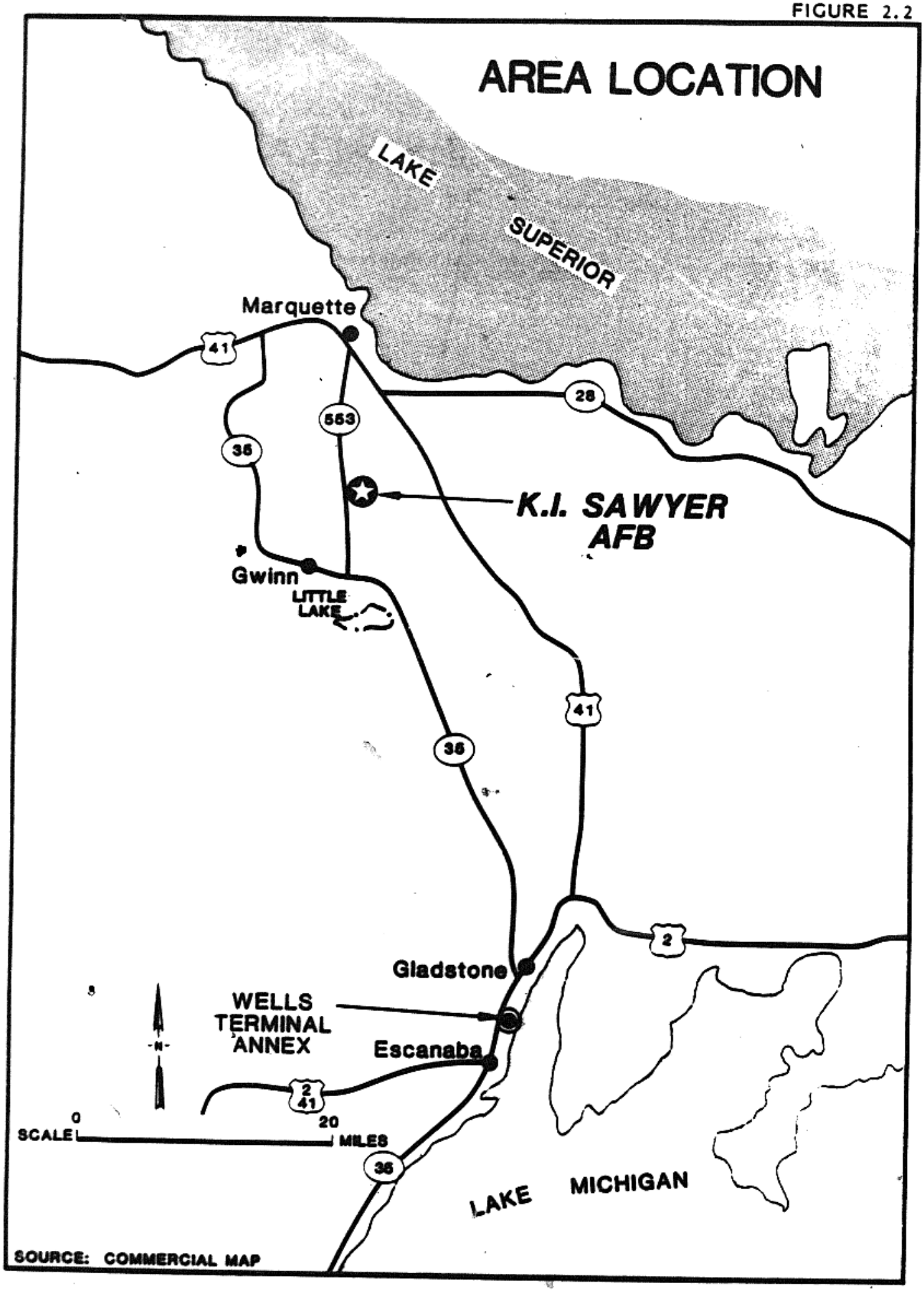

REGIONAL LOCATION
CALUMET AFB
Calumet
Hancock
41
26
Lake
Superior
ONTARIO CANADA
UNITED STATES
Sault Ste. Marie
Marquette
41
28
141
K.I. SAWYER AFB
28
MICHIGAN
41
MICHIGAN
WISCONSIN
2
76
WELLS TERMINAL ANNEX
Escanaba
2
WISCONSIN
41
35
41
141
Lake
Michigan
MICHIGAN
N
SOURCE: COMMERICAL MAP
0
60
SCALE
MILES

FIGURE 2.1

FIGURE 2.2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AFB
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2
Gladstone
WELLS
TERMINAL
ANNEX
Escanaba
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20
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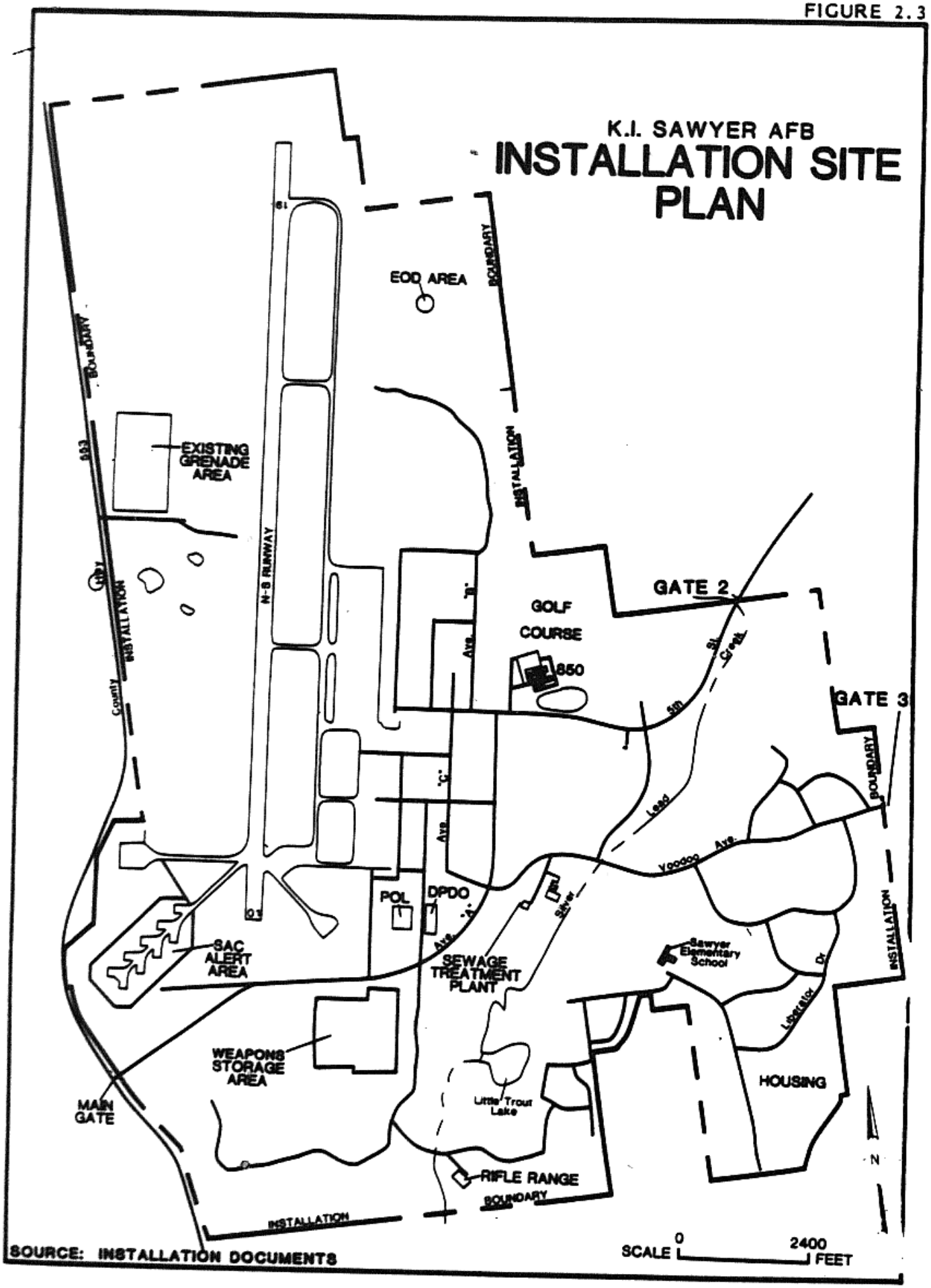
LAKE
MICHIGAN
SOURCE: COMMERCIAL MAP

FIGURE 2.3



SOURCE: INSTALLATION DOCUMENTS

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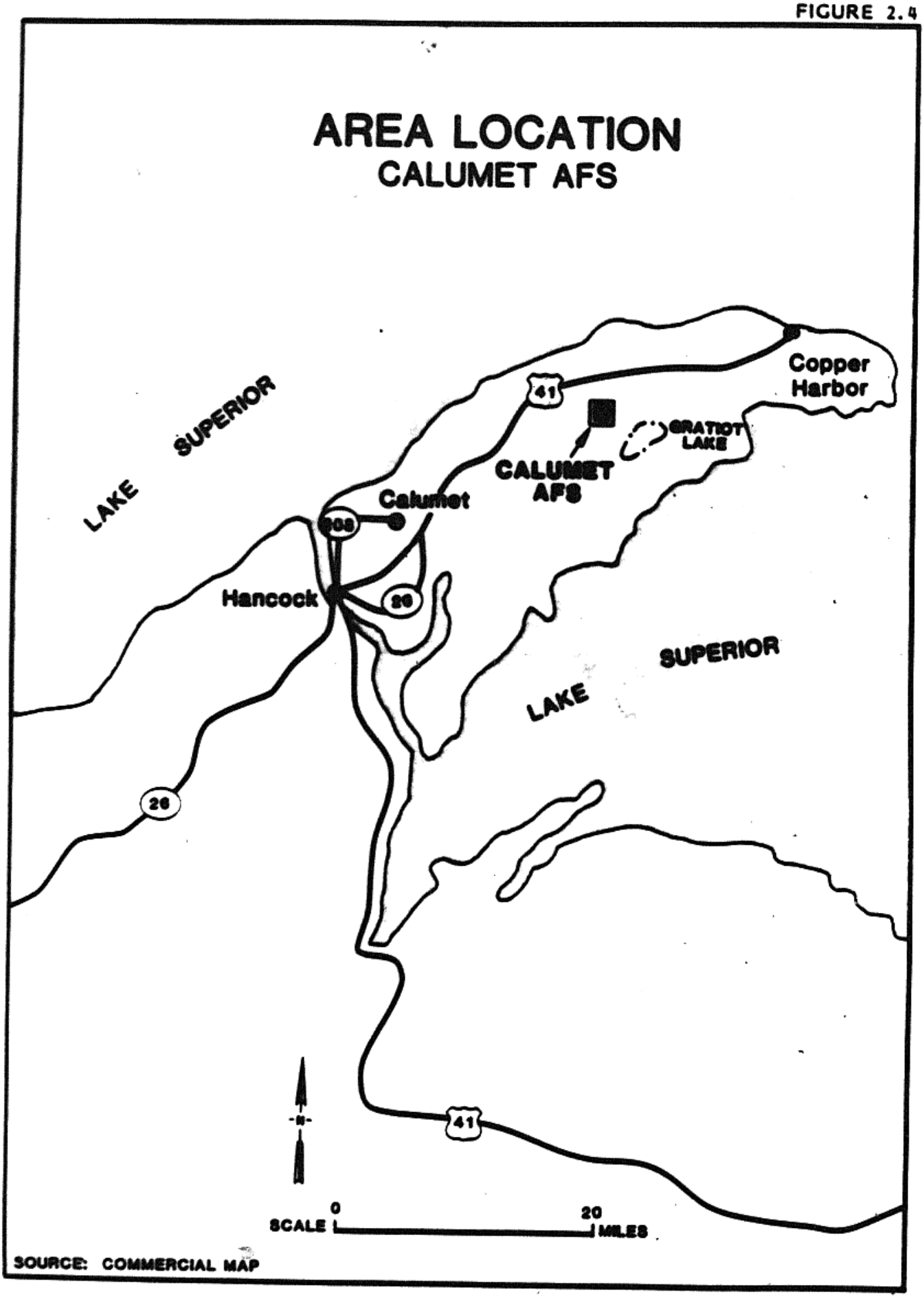


SOURCE: COMMERCIAL MAP

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 (Penneman 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

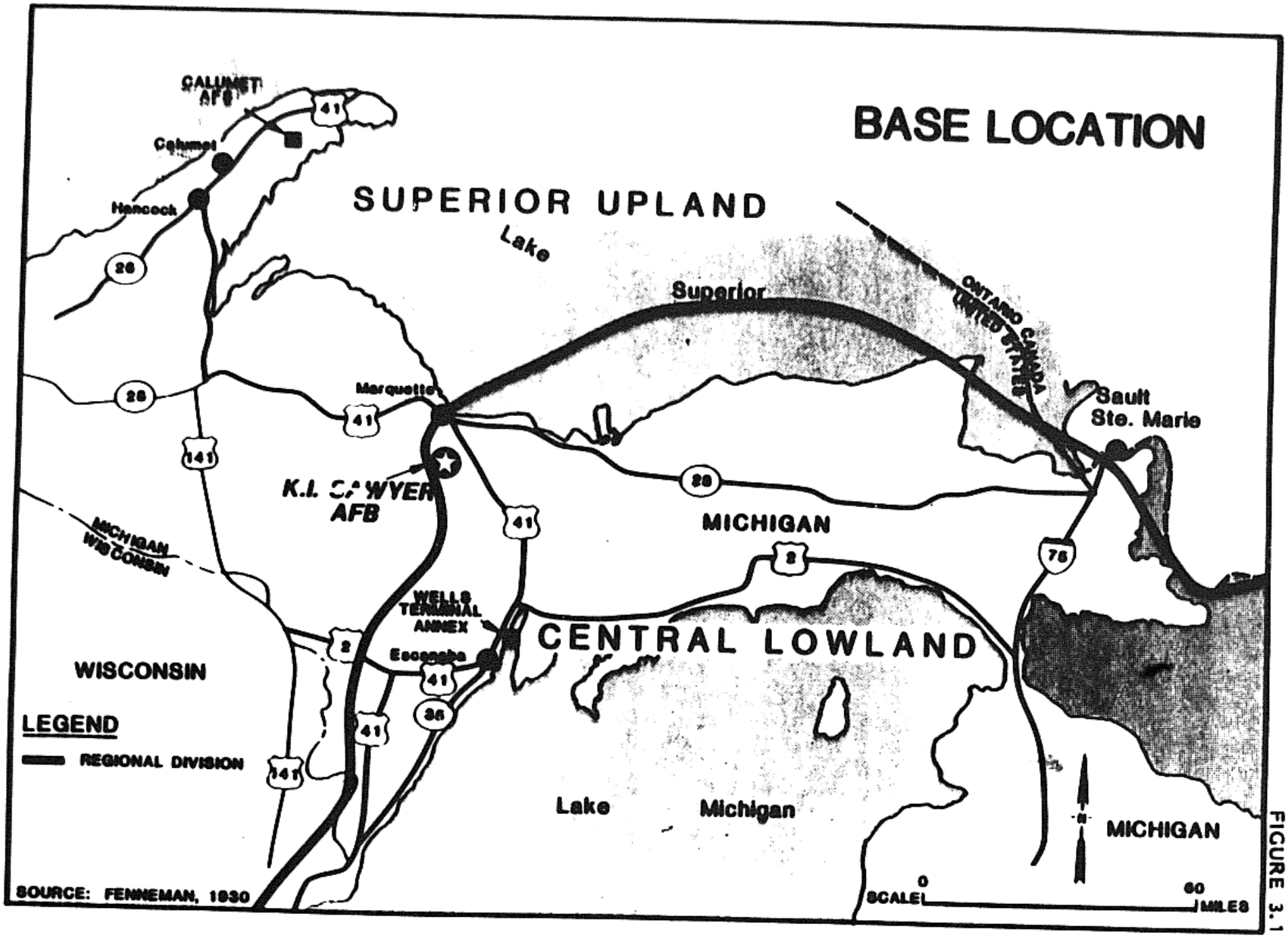
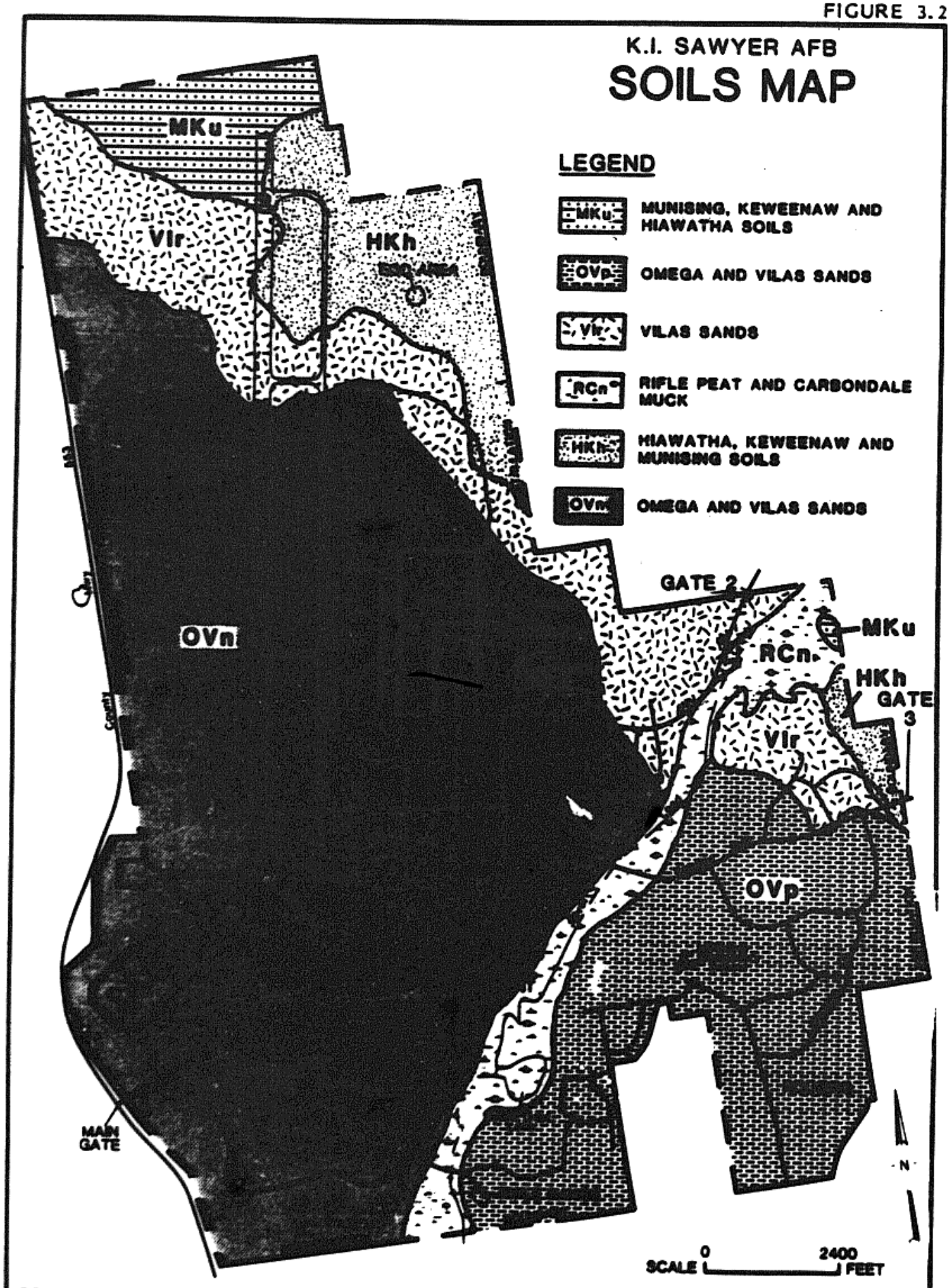

BASE LOCATION
SUPERIOR UPLAND
CENTRAL LOWLAND
Lake Superior
Lake Michigan
CALUMET AFB
Calumet
Hancock
Marquette
K.I. SAWYER AFB
WELLS TERMINAL ANNEX
Escanaba
Sault Ste. Marie
MICHIGAN
WISCONSIN
MICHIGAN WISCONSIN
ONTARIO CANADA UNITED STATES
LEGEND
REGIONAL DIVISION
SOURCE: FENNEMAN, 1930
SCALE 0 60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

FIGURE 3.1

FIGURE 3.2



SOURCE: SCHNEIDER, 1951

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.

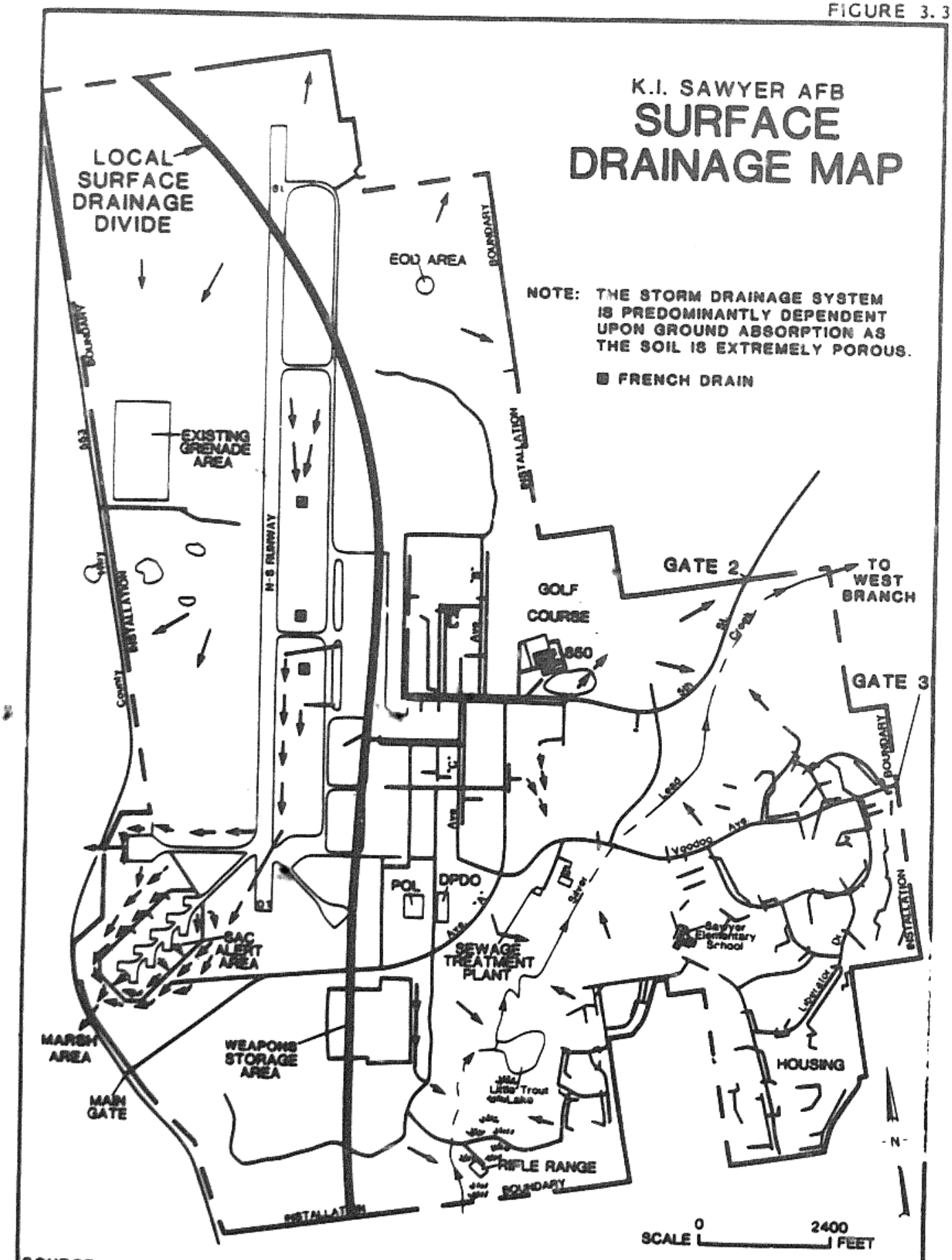
Soils present at the Wells Terminal Annex have been mapped in detail by the USDA, Soil Conservation Service. Modern soils found within the annex boundary include alluvium deposited by the Escanaba River and hardfill material used to build up the surrounding area. The alluvium tends to be material ranging 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

ENGINEERING-SCIENCE

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.

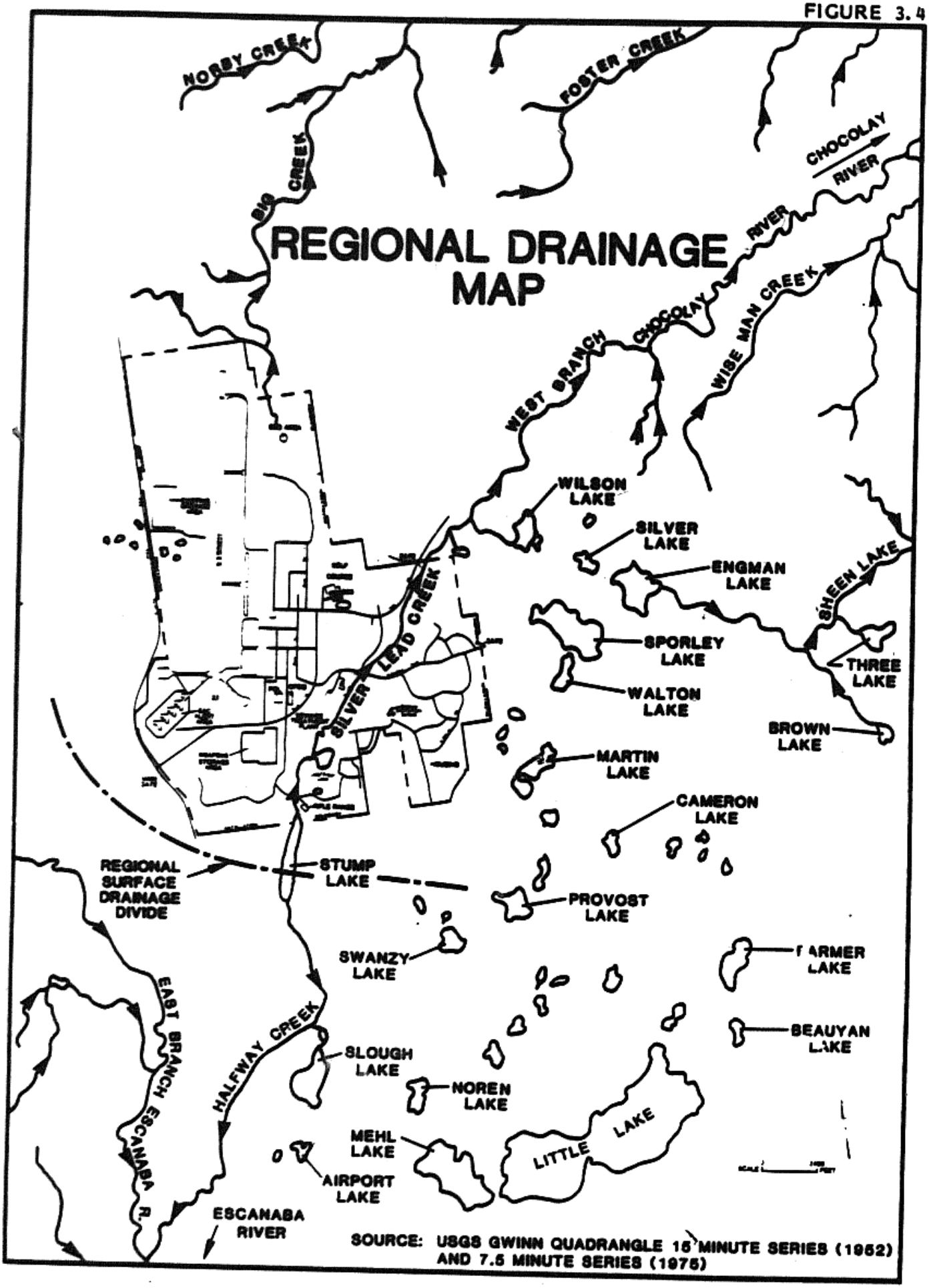
Additional surface water resources on or in the vicinity of the base include four ponds located west of the runway, Little Trout Lake north of the rifle range, Stump Lake south of the rifle range and wetland areas south of the base boundary (USGS, 1975). A surface water divide cuts across Stump Lake, 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

FIGURE 3.4



ES ENGINEERING-SCIENCE

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.

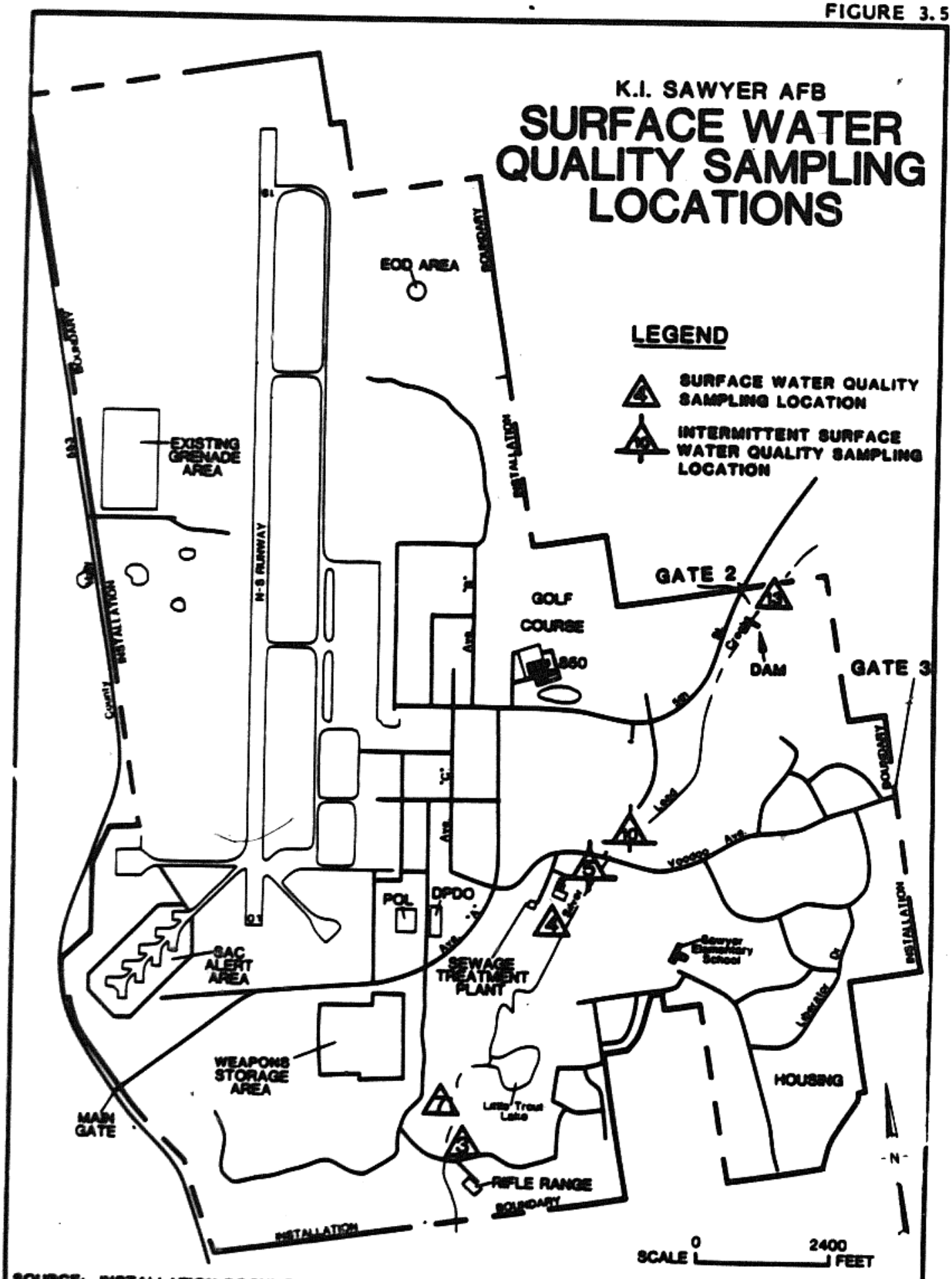
Surface water sampling on the base is presently conducted at six stations along Silver Lead Creek. Two are south of Little Trout Lake, the third is south of the sewage treatment plant, the fourth one is just north of the confluence of the sewage treatment plant effluent and Silver Lead Creek, the fifth 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

ES ENGINEERING-SCIENCE

TABLE 3.3
SELECTED SURFACE WATER QUALITY DATA
FOR G.I. SOUTER 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 R.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 1) 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	208	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	--	--	--	--	--	--	--	--	--	6.4

Site 10 Silver Lead Creek at Voodoo Hill*	Trichloroethylene (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

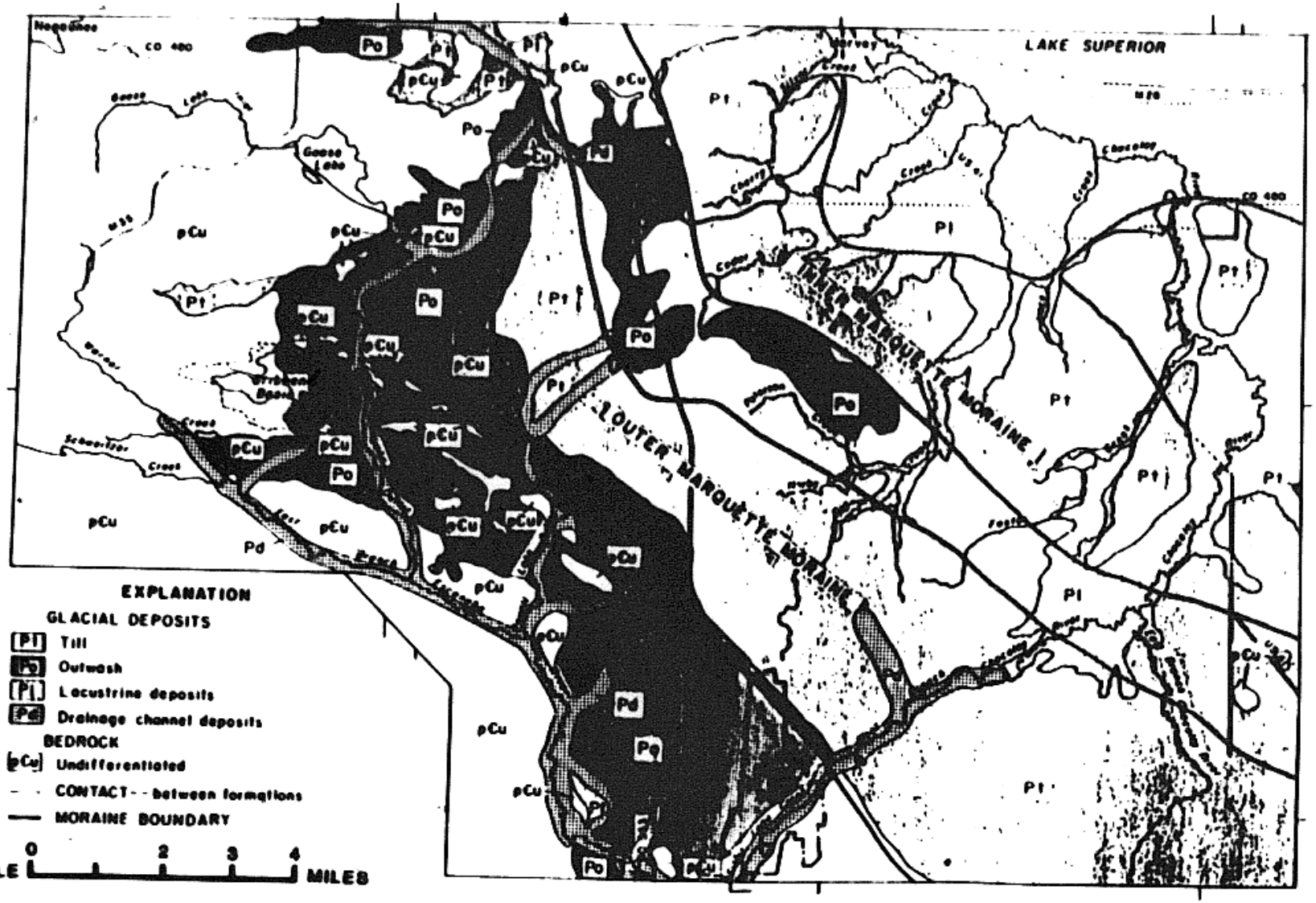
K. I. Sawyer AFB is located within the Sands Plain ground-water resource area of the Upper Peninsula. The ground-water resources in the immediate vicinity of the base are abundant due to the presence of several hundred feet of stratified sand and gravel that comprise the glacial outwash aquifer underlying 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 deposit-

[redacted]

REGIONAL DISTRIBUTION OF GLACIAL DEPOSITS

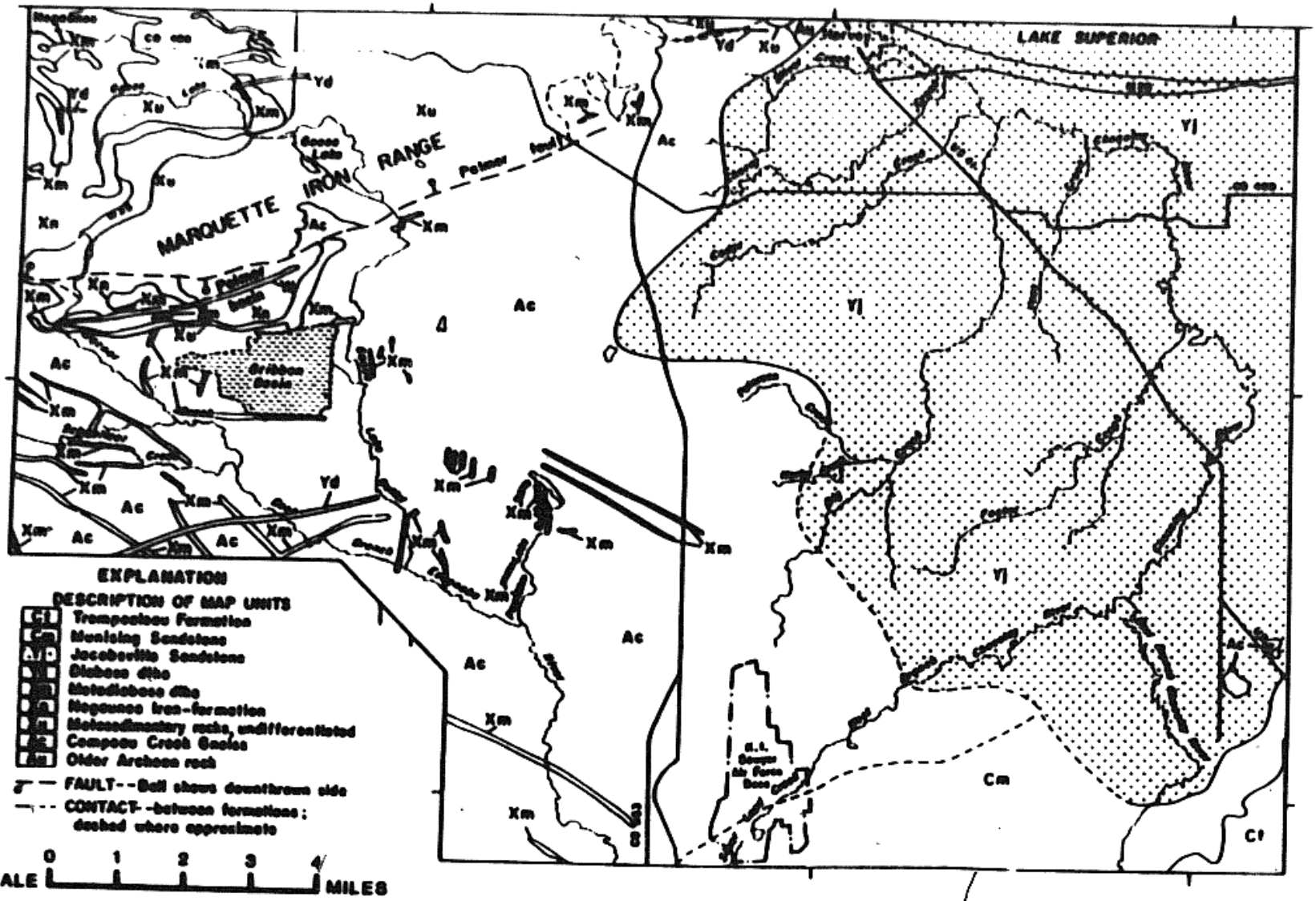


SOURCE: MODIFIED FROM GRANNEMANN, 1984

NOTE: SEE TABLE 3.4 FOR EXPLANATION

FIGURE 3.6

REGIONAL BEDROCK GEOLOGIC MAP



SOURCE: MODIFIED FROM GRANNEMANN, 1984

NOTE: SEE TABLE 3.4 FOR EXPLANATION

FIGURE 3.7

TABLE 3.4

HYDROGEOLOGIC UNITS AND THEIR WATER-BEARING CHARACTERISTICS IN THE VICINITY OF EL DORADO AFB

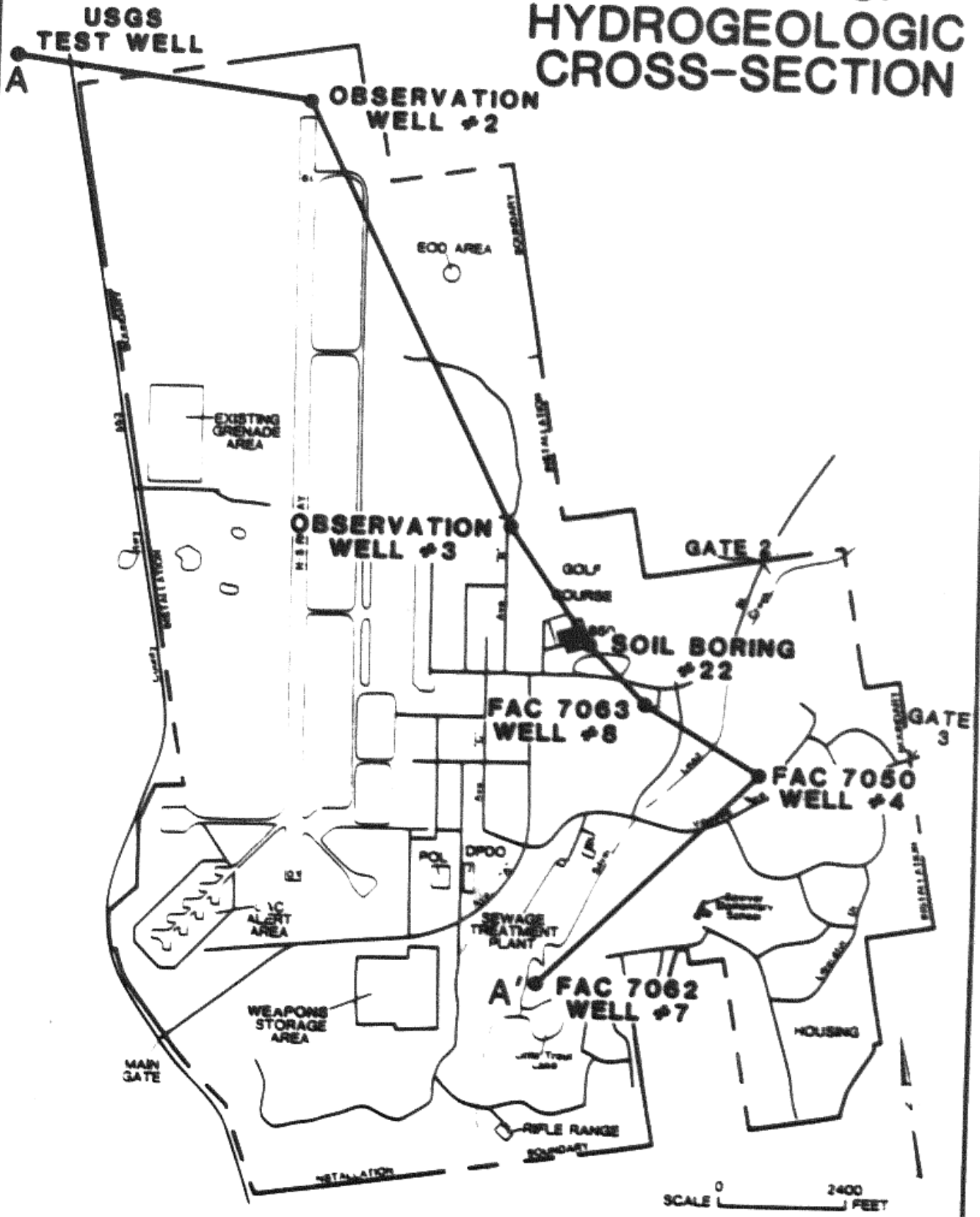
Age	Hydrogeologic Unit	Hydrogeologic Classification	Approximate Thickness	Dominant Lithology	Water-Bearing Characteristics
Pleistocene	Glacial Outwash	Chief Aquifer	Up to 300 ft.	Stratified sand and gravel.	Readily transmits water. Wells yield up to 1000 gpm.
	Glacial Moraines	Localized Aquifer	Up to 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	Wanakah 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: H. G. Grannemann, 1984, F. R. Twenter, 1981.

FIGURE 3.8

K.I. SAWYER AFB

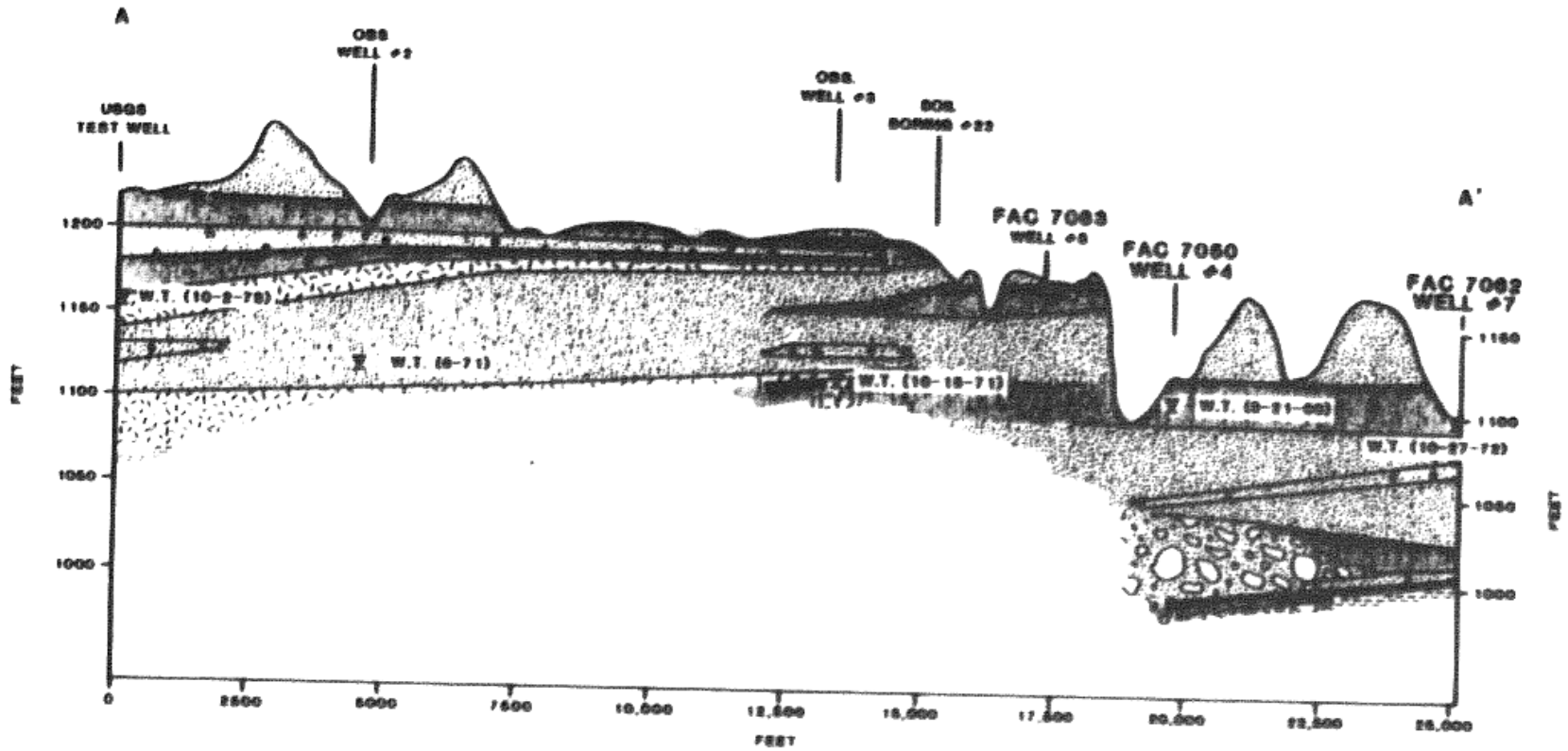
LOCATION OF HYDROGEOLOGIC CROSS-SECTION



SOURCE: INSTALLATION DOCUMENTS

K.I. SAWYER AFB

HYDROGEOLOGIC CROSS-SECTION



LEGEND

- PACKED SAND, CLAY
- SAND
- SAND & GRAVEL
- SAND, GRAVEL & CLAY
- GRAVEL, BOULDERS
- BEDROCK
- WATER TABLE LEVEL

SOURCE: INSTALLATION DOCUMENTS

FIGURE 3.9

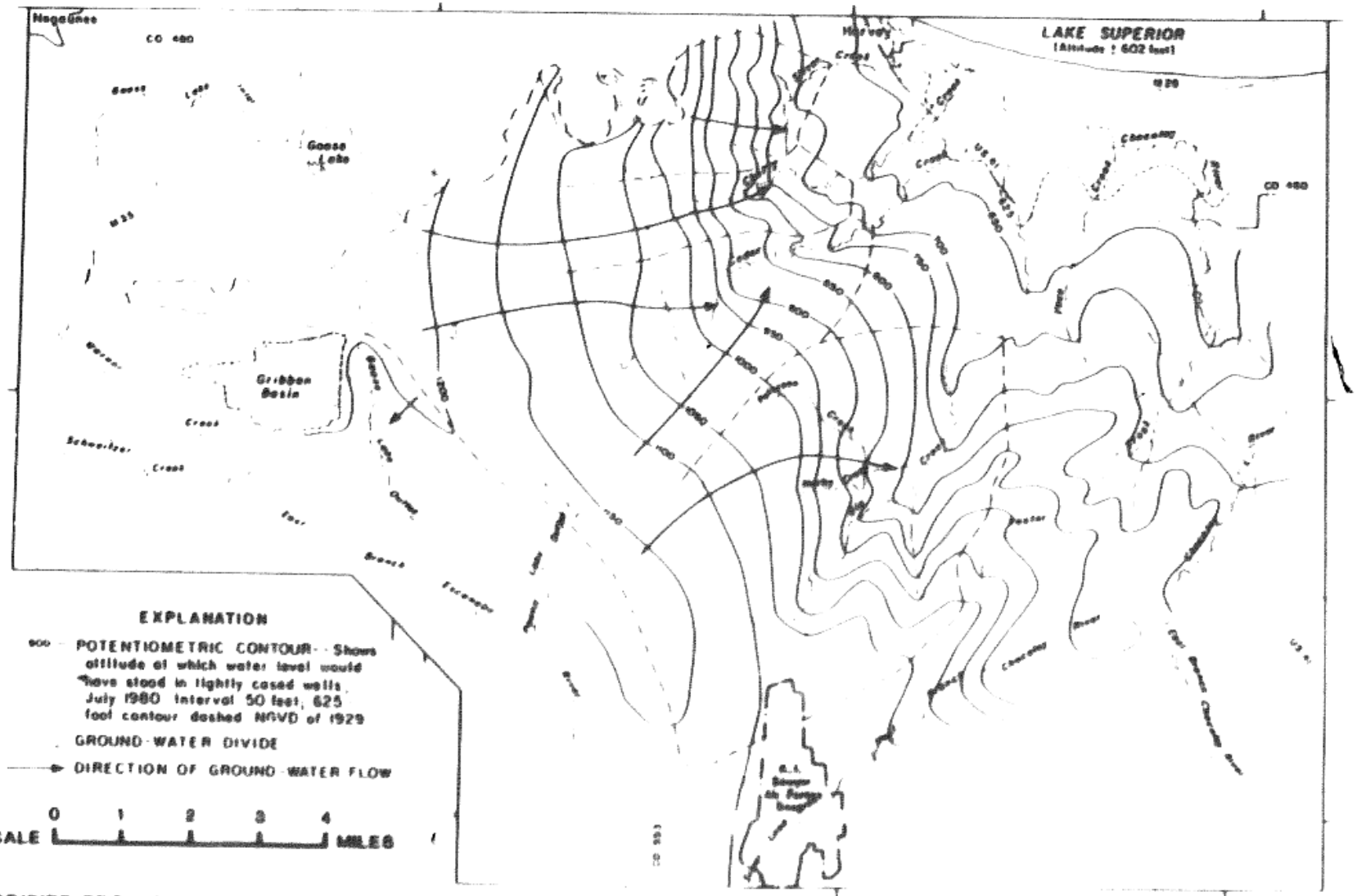
cross section across portions of the base. Figure 3.9 illustrates cross section A-A' showing boring locations advanced into the unconsolidated glacial outwash deposits. The water table was reached by each well. Records suggest that ground-water levels at these locations have remained relatively stable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

REGIONAL POTENTIOMETRIC SURFACE CONTOUR OF THE GLACIAL AQUIFER



SOURCE: MODIFIED FROM GRANNEMANN, 1984

FIGURE 3.10

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]	--	3.5	--	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. Grannemann, 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

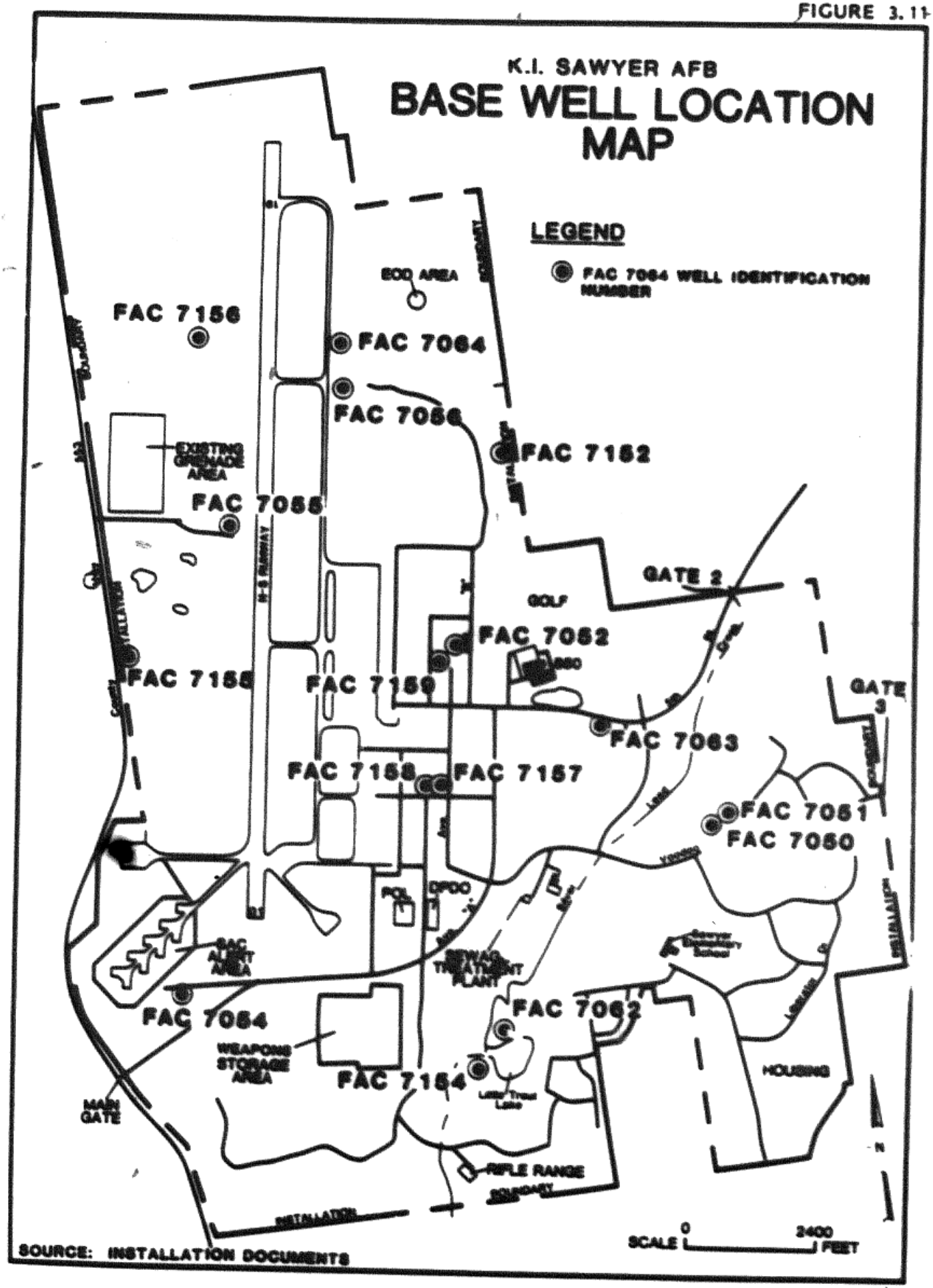
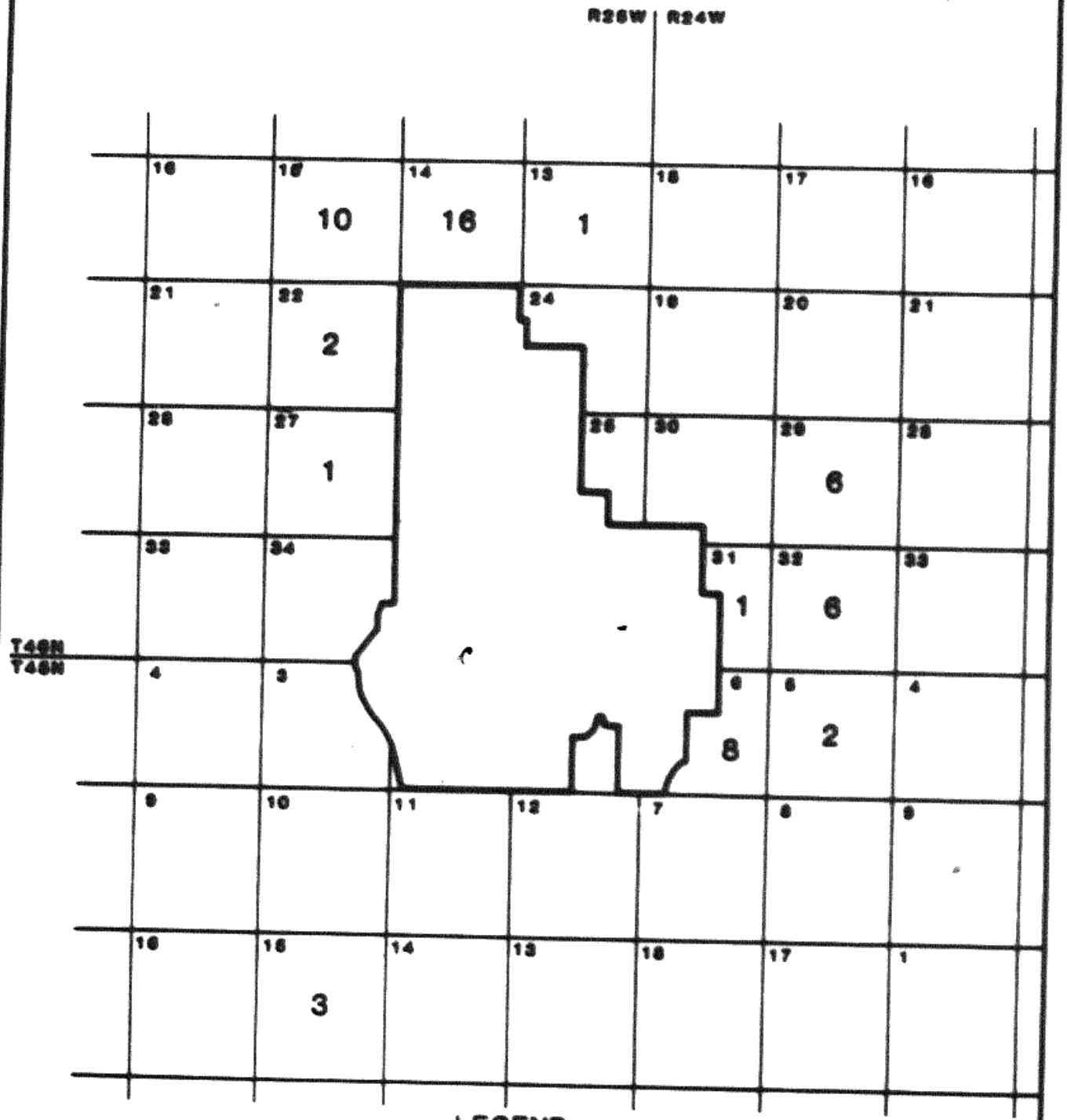

K.I. SAWYER AFB
BASE WELL LOCATION MAP
LEGEND
FAC 7064 WELL IDENTIFICATION NUMBER
EOD AREA
FAC 7156
FAC 7064
FAC 7066
FAC 7152
EXISTING GRENADE AREA
FAC 7065
GATE 2
GOLF
FAC 7062
FAC 7155
FAC 7159
GATE 3
FAC 7063
FAC 7158
FAC 7157
FAC 7061
FAC 7060
POL
DPDO
BAC ALERT AREA
SEWAGE TREATMENT PLANT
FAC 7064
FAC 7062
WEAPONS STORAGE AREA
FAC 7154
HOUSING
MAIN GATE
RIFLE RANGE
INSTALLATION
SCALE 0 2400 FEET
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 songbirds, 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 alignments 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:

- Industrial Operations (Shops)
- Waste Accumulation and Storage Areas
- Fuels Management
- Spills and Leaks
- Pesticide Utilization
- 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 poly-

chlorinated 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 1981
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	1965 TRIPLE RINSE & DISPOSED IN LANDFILL/DPDO
PAINT SHOP	531	PAINT THINNER	200 GALS/YR	1981 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	880 GALS./YR.	LANDFILL/OBC → OBC
REFRIGERATION	709 (530 prior to 1977)	COMPRESSOR OIL	60 GALS./YR.	1954 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)	385 GALS./YR.	LANDFILL/ STORM SEWER → OBC
AGE	618	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
		C[illegible]ON REMOVER	12 GALS./YR.	STORM SEWER → OWS/INDUSTRIAL SEWER
		A[illegible] ALKALINE SOAP	1320 GALS./YR.	STORM SEWER → OWS/INDUSTRIAL SEWER
		SULFURIC ACID ELECTROLYTE	300 GALS./YR.	NEUTRALIZED & DILUTED TO SEWER
CORROSION CONTROL	673	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 (748 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	600 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	18 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 (1958 / 1968 / 1978 / 1988)
410 ORGANIZATIONAL MAINTENANCE SQUADRON (cont'd)				
TANKER BRANCH	619	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	250 GALS./YR	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 CONTRACT

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 (1958 – 1968 – 1978 – 1988)
410 TRANSPORTATION SQUADRON (cont'd)				
VEHICLE MAINTENANCE (cont'd)	608	SULFURIC ACID ELECTROLYTE	500 GALS /YR	NEUTRALIZED TO STORM SEWER (1961) → NEUTRALIZED TO INDUSTRIAL SEWER
		PAINTS & THINNERS	165 GALS /YR	LANDFILL/OBC → DPDO
HEAVY EQUIPMENT MAINTENANCE	530	ANTIFREEZE & SOME HYDRAULIC FLUID	1200 GALS /YR	(1956) STORM SEWER → OBC
		AIRCRAFT SOAP	2800 GALS /YR	STORM SEWER → OWS/INDUSTRIAL SEWER
		PD 680	300 GALS /YR	STORM SEWER → OBC
REFUELING TRUCK MAINTENANCE	609	JP 4, MOGAS DIESEL MOTOR OIL AND ANTIFREEZE	1200 GALS /YR	(1958) FPTA/OBC → OBC
410 MUNITIONS MAINTENANCE SQUADRON				
SRAM	323	SOLVENTS (NAPHTHA ALCOHOL MEK TOLUENE ETC.)	55 GALS /YR	(1972) DPDO
EQUIPMENT MAINTENANCE BRANCH	740	AIRCRAFT SOAP	220 GALS /YR	(1961) FLOOR DRAIN DISCHARGING TO GROUND
		AIR SHOW GEL (DEGREASER)	110 GALS /YR	FLOOR DRAIN DISCHARGING TO GROUND
		HYDRAULIC FLUID	660 GALS /YR	FPTA/OBC → 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

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 (1958 – 1968 – 1978 – 1988)
410 MUNITIONS MAINTENANCE SQUADRON (cont'd)				
EQUIPMENT MAINTENANCE BRANCH (cont'd)	740	BRAKE FLUID	90 GALS./YR.	1963 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	622	FIXER	180 GALS./YR.	1971 SILVER RECOVERY TO STORM SEWER → SILVER RECOVERY TO INDUSTRIAL SEWER
		DEVELOPER	730 GALS./YR.	STORM SEWER → INDUSTRIAL SEWER
		FLATTENER	50 GALS./YR.	STORM SEWER → INDUSTRIAL SEWER
		DEVELOPER CLEANER	26 LB./YR.	STORM SEWER → INDUSTRIAL SEWER
AGE	631	PD 680	520 GALS./YR.	1988 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 1958 1968 1978 1988
87 FIGHTER INTERCEPTOR SQUADRON (cont'd)				
CORROSION CONTROL	622	PAINT & PAINT THINNER	110 GALS /YR.	1971 DPDO
		AIRCRAFT ALKALINE SOAP	780 GALS. /YR.	INDUSTRIAL SEWER
		PAINT STRIPPER	175 GALS. /YR.	OBC
		CORROSION REMOVER	2 GALS. /YR.	DPDO
MISSILE MAINTENANCE	603	FIXER	6 GALS. /YR.	SILVER RECOVERY TO SEWER
ARMAMENT SYSTEMS	620	PD 680	1200 GALS. /YR.	OBC
HUSH HOUSE	636 (in 614 prior to 1982)	JET ENGINE OIL	100 GALS. /YR.	1982 OBC
		JP 4	100 GALS. /YR.	1982 OBC/OBC
		PD 680	100 GALS. /YR.	1982 OBC/OBC
TEST CELL (OPERATED BY 62nd SQUADRON 1958 1971)	614	JET ENGINE OIL	100 GALS. /YR.	DISPOSAL TO GROUND 1958 OBC 1982
		JP 4	100 GALS. /YR.	STORM SEWER OBC 1982
		PD 680	100 GALS. /YR.	STORM SEWER OBC 1982
F 106 FLIGHT	621	JET ENGINE OIL	50 GALS /YR	1971 OBC

KEY

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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 1968 | 1968 | 1978 | 1988
87 FIGHTER INTERCEPTOR SQUADRON (cont'd)				
JET ENGINE SHOP (OPERATED BY 63rd SQUADRON PRIOR TO 1971)	662	JET ENGINE OIL	500 GALS./YR.	FPTA/OBC → OBC
		PD 680, CARBON REMOVER AND AND JP 4 (80% PD 680)	55 GALS./YR.	LANDFILL/STORM SEWER → DPDO
INSPECTION SECTION	621	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	986	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 1958 1968 1978 1988
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.	1986 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 → 1989
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 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 1958 1968 1978 1988
USAF HOSPITAL K.I. SAWYER				
DENTAL X RAY	850	FIXER	48 GALS /YR	1968 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	1958 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

DPDO - DEFENSE PROPERTY DISPOSAL OFFICE

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.

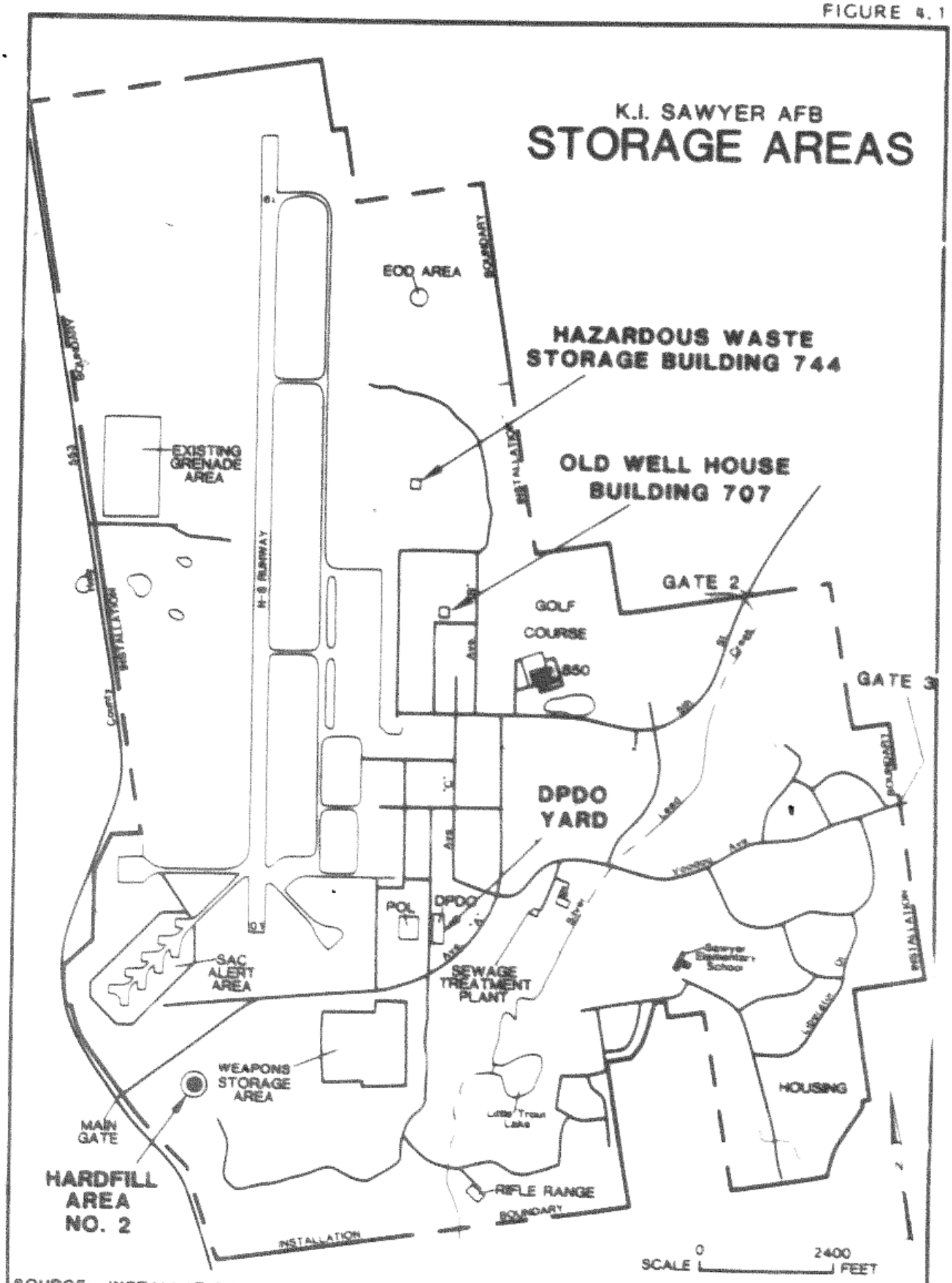
The Defense Property Disposal Office (DPDO), has always been located in Building 417, across from the POL storage area. The DPDO has been responsible for hazardous waste disposal since 1980. Prior to this time DPDO was used as a storage yard for wastes that could be reclaimed. Waste oil was stored on 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.

FIGURE 4.1



SOURCE: INSTALLATION DOCUMENTS

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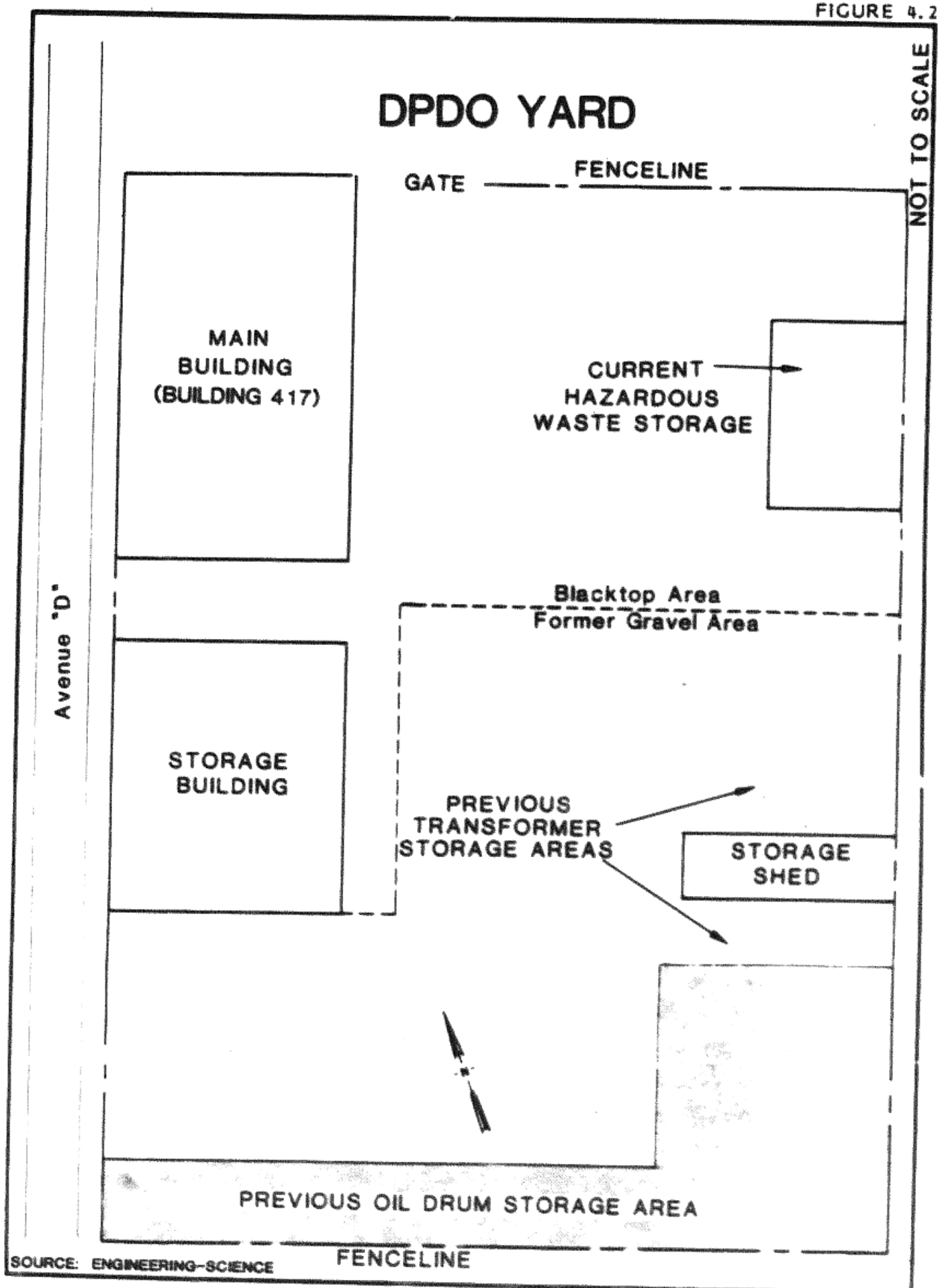
FIGURE 4.2


DPDO YARD
NOT TO SCALE
GATE
FENCELINE
MAIN BUILDING (BUILDING 417)
CURRENT HAZARDOUS WASTE STORAGE
Avenue "D"
Blacktop Area
Former Gravel Area
STORAGE BUILDING
PREVIOUS TRANSFORMER STORAGE AREAS
STORAGE SHED
PREVIOUS OIL DRUM STORAGE AREA
FENCELINE
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 as a 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.

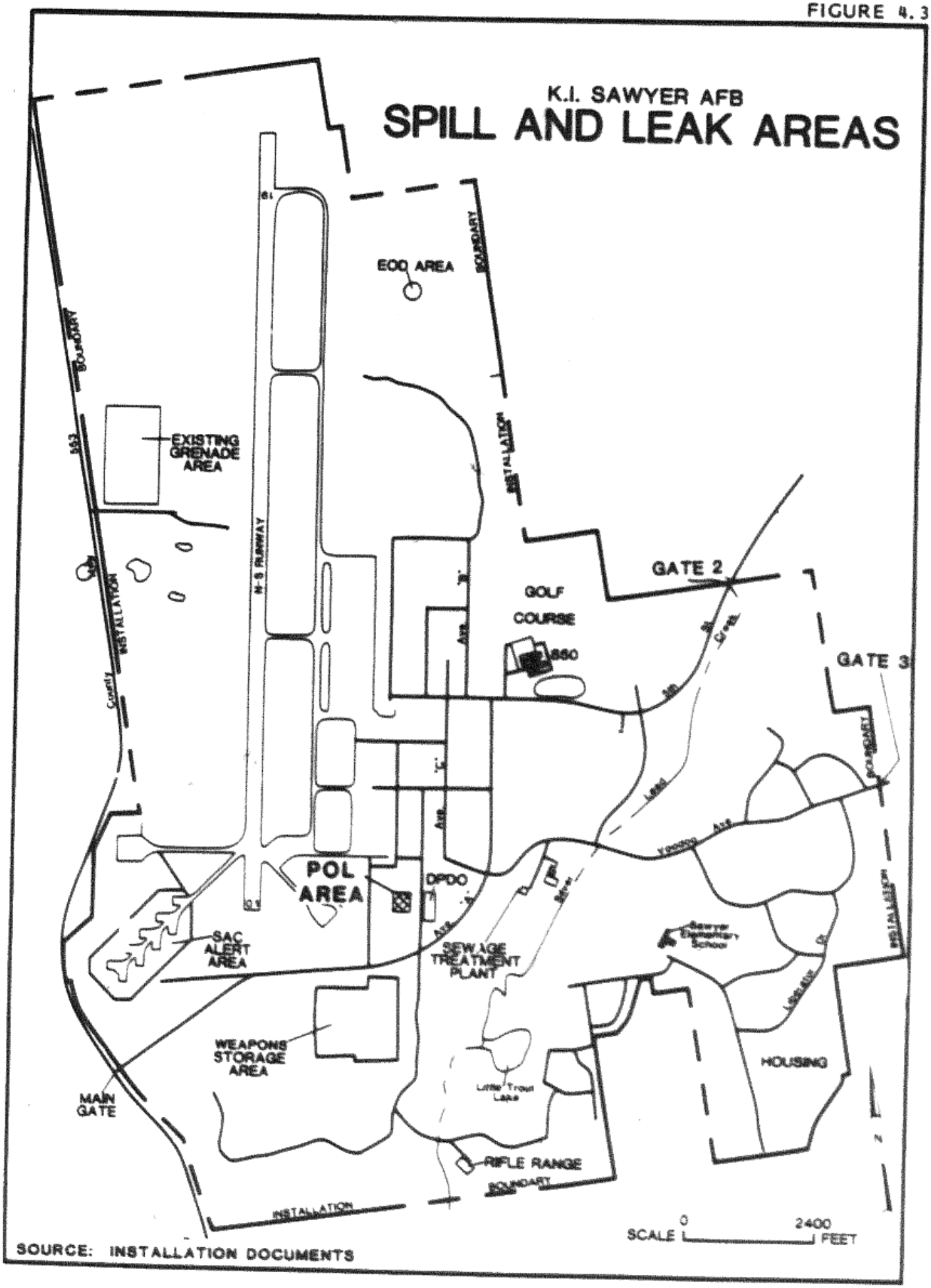
Fuel storage tanks are inspected annually. An interval of three to five years is typical for cleaning of tanks. A small amount of sludge is generated in these tanks and is placed in the oil holding tank of the oil/water separator in the POL area (Facility No. 411) for removal off-base by contract.

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.

FIGURE 4.3



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

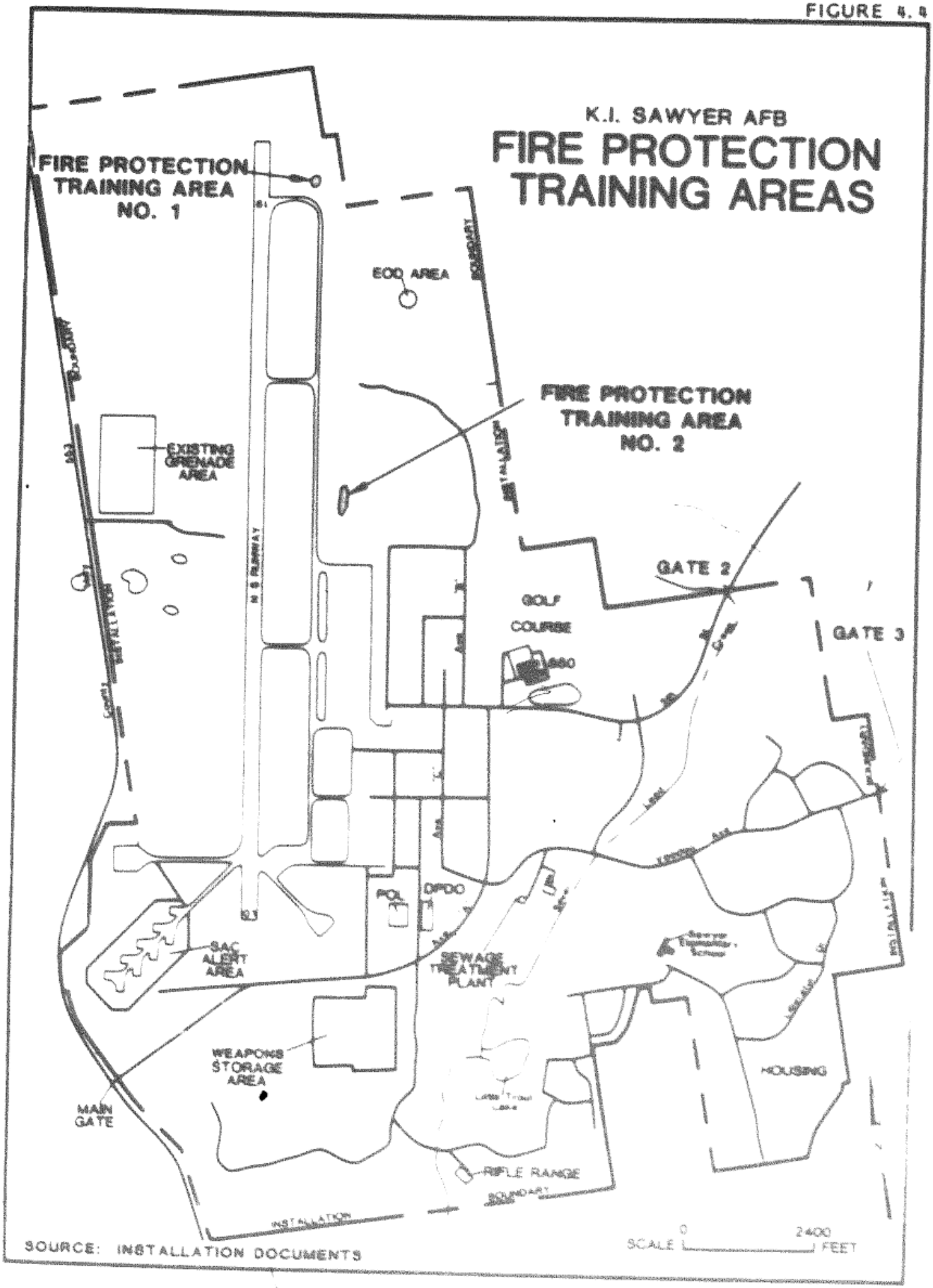
Fire Protection Training Area No. 1 was located at the northern end of the base, north of the primary taxiway. This site was activated in approximately 1958 and was used until the early 1970's. At this site fuel was stored in 55-gallon drums adjacent to (east of) the site; drums were emptied onto a soil-covered 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

FIGURE 4.4



SOURCE: INSTALLATION DOCUMENTS

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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:

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

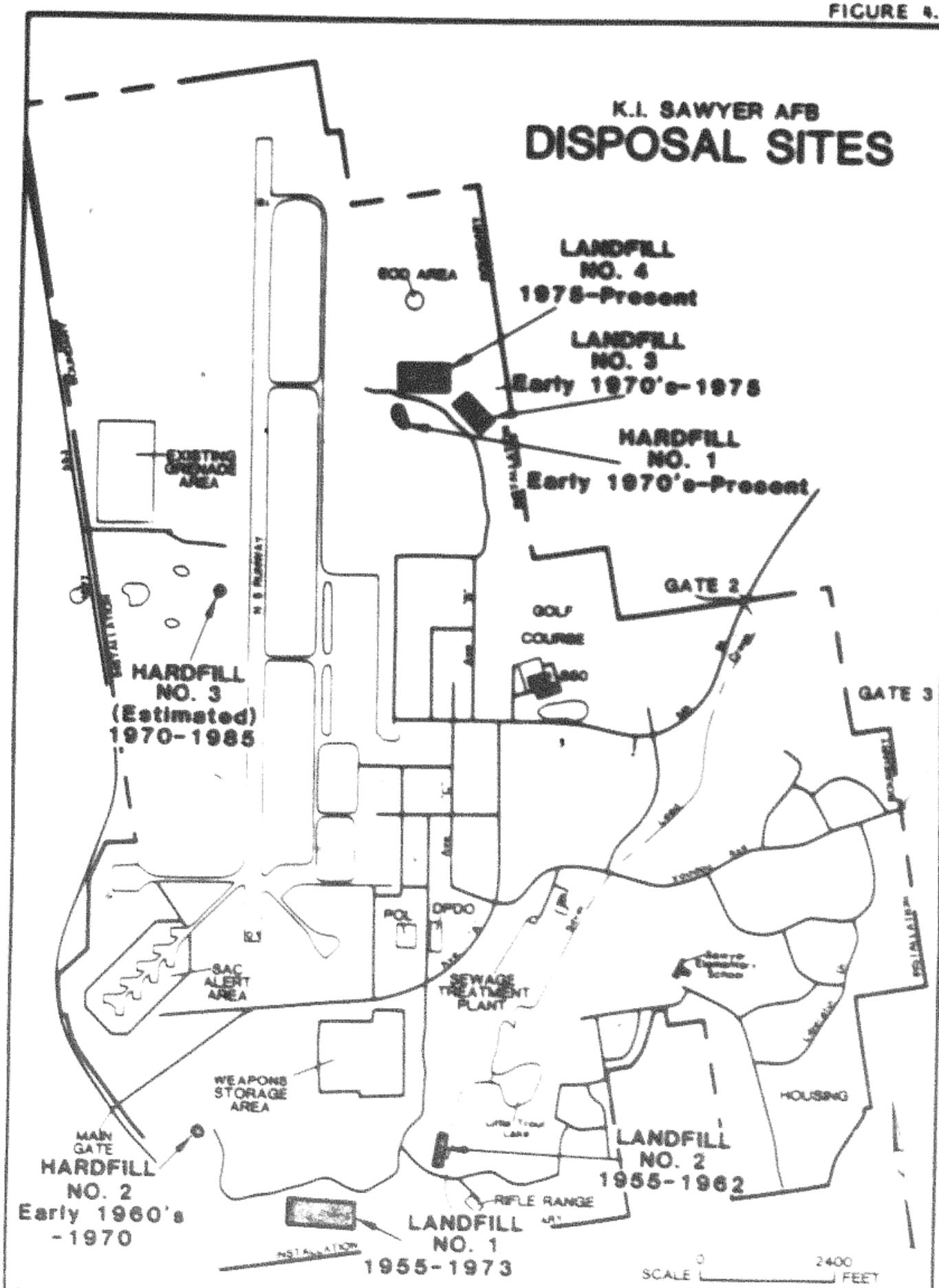
Landfill No. 1 is located just south of the Weapons Storage Area (WSA), to the south of the dirt access road. This site was first used from approximately 1955 to 1957. During this time period only one trench was used. Burning was performed weekly. As the base became more developed and the flightline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

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

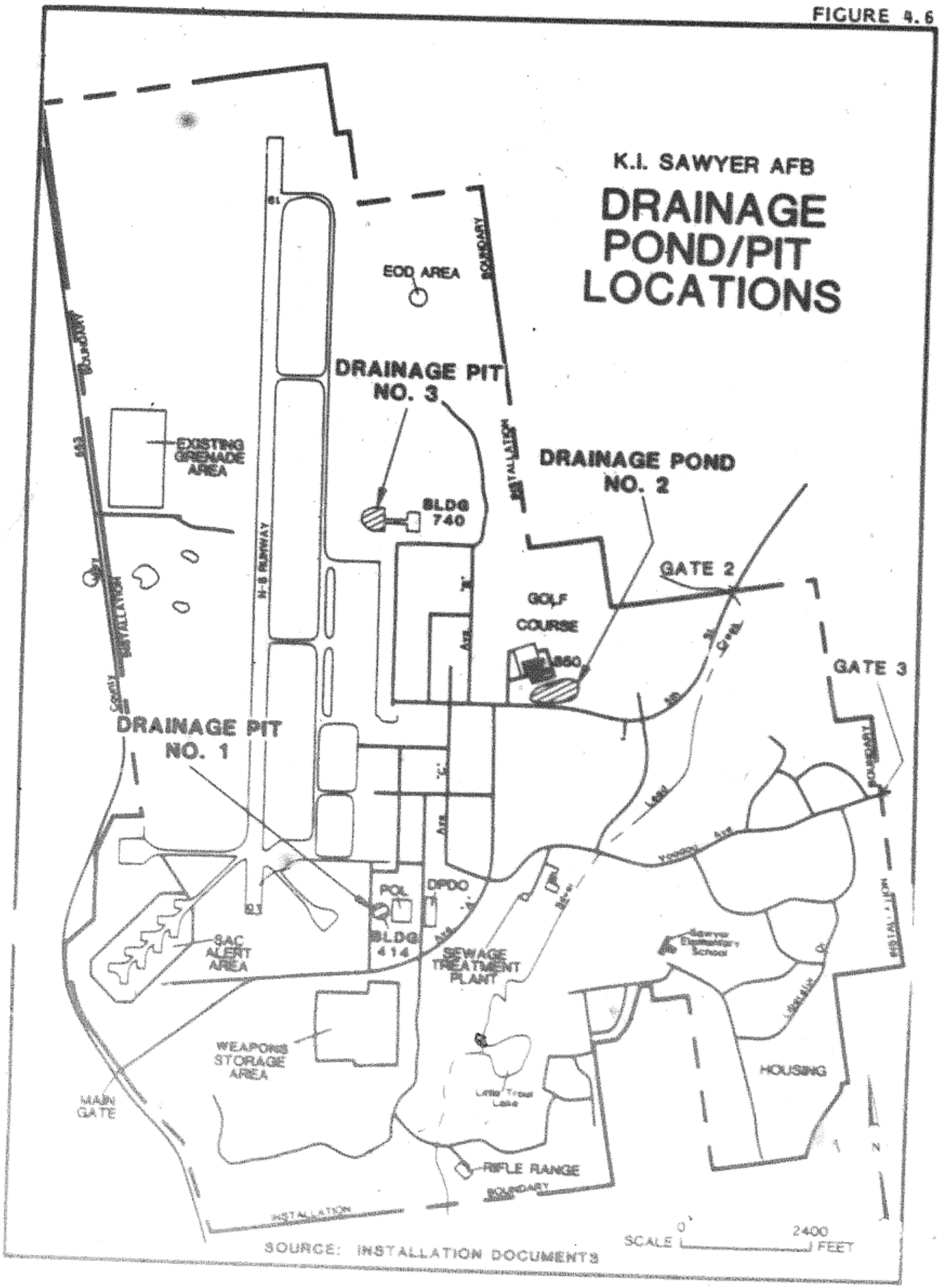
This pit is located behind Building 414 and was used as a test cell by the 87th FIS until the Hush House was completed in 1981. The pit is approximately 4 feet by 15 feet and is approximately 2 feet deep. The pit appeared to be stained with oil. No vegetation was observed growing within the pit. The 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



SOURCE: INSTALLATION DOCUMENTS

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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 600,000 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.

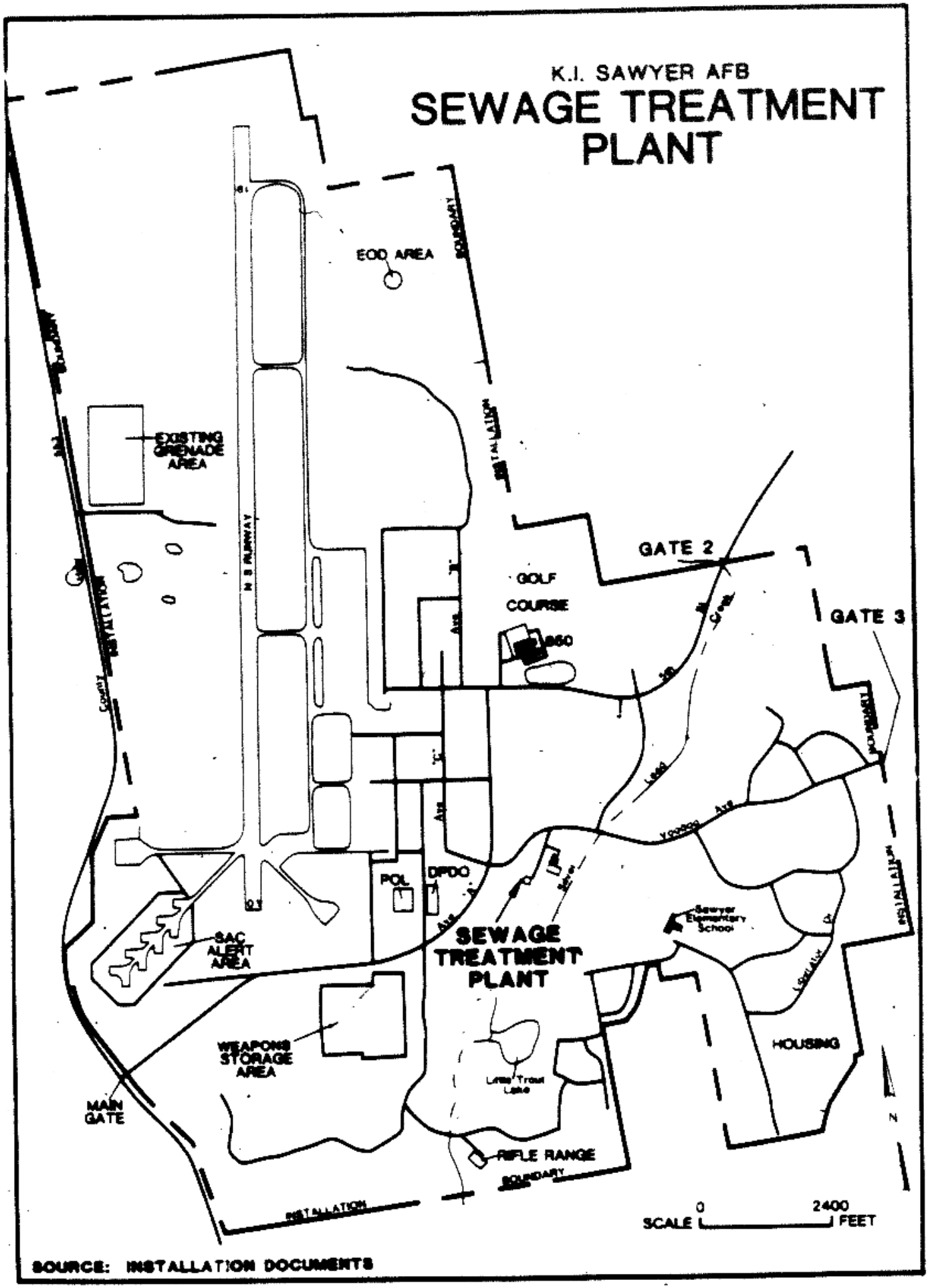
Surface Drainage System

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.

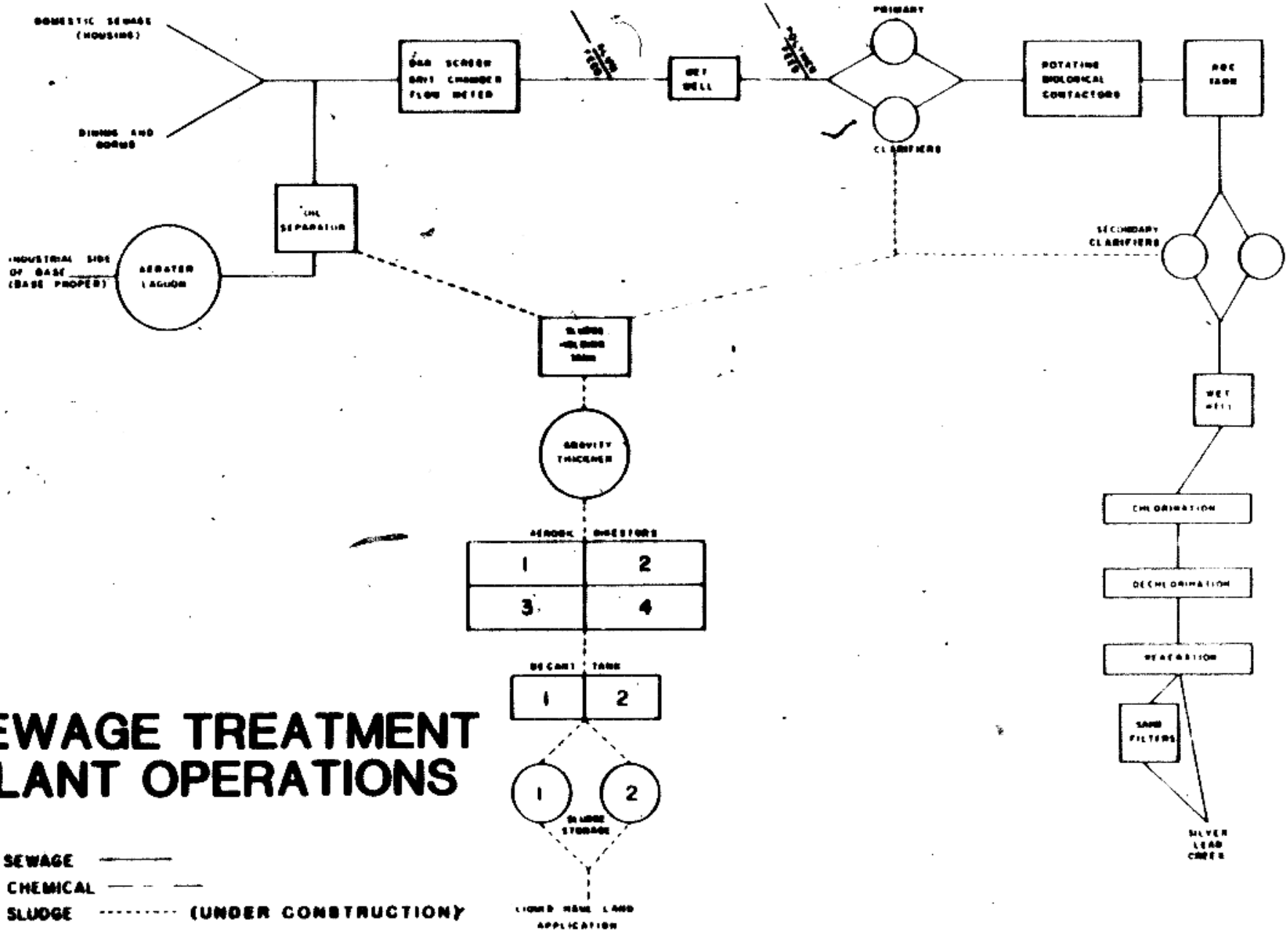
The north end of the industrial area, flightline area and the hospital area are drained by a network of pipes, varying in size from 12 to 36 inches. Drain water flows east in these pipes to a ground surface outfall located near the hospital and golf course area. This area has been discussed further in 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.



SOURCE: INSTALLATION DOCUMENTS



SEWAGE TREATMENT PLANT OPERATIONS

FIGURE 4.8

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.

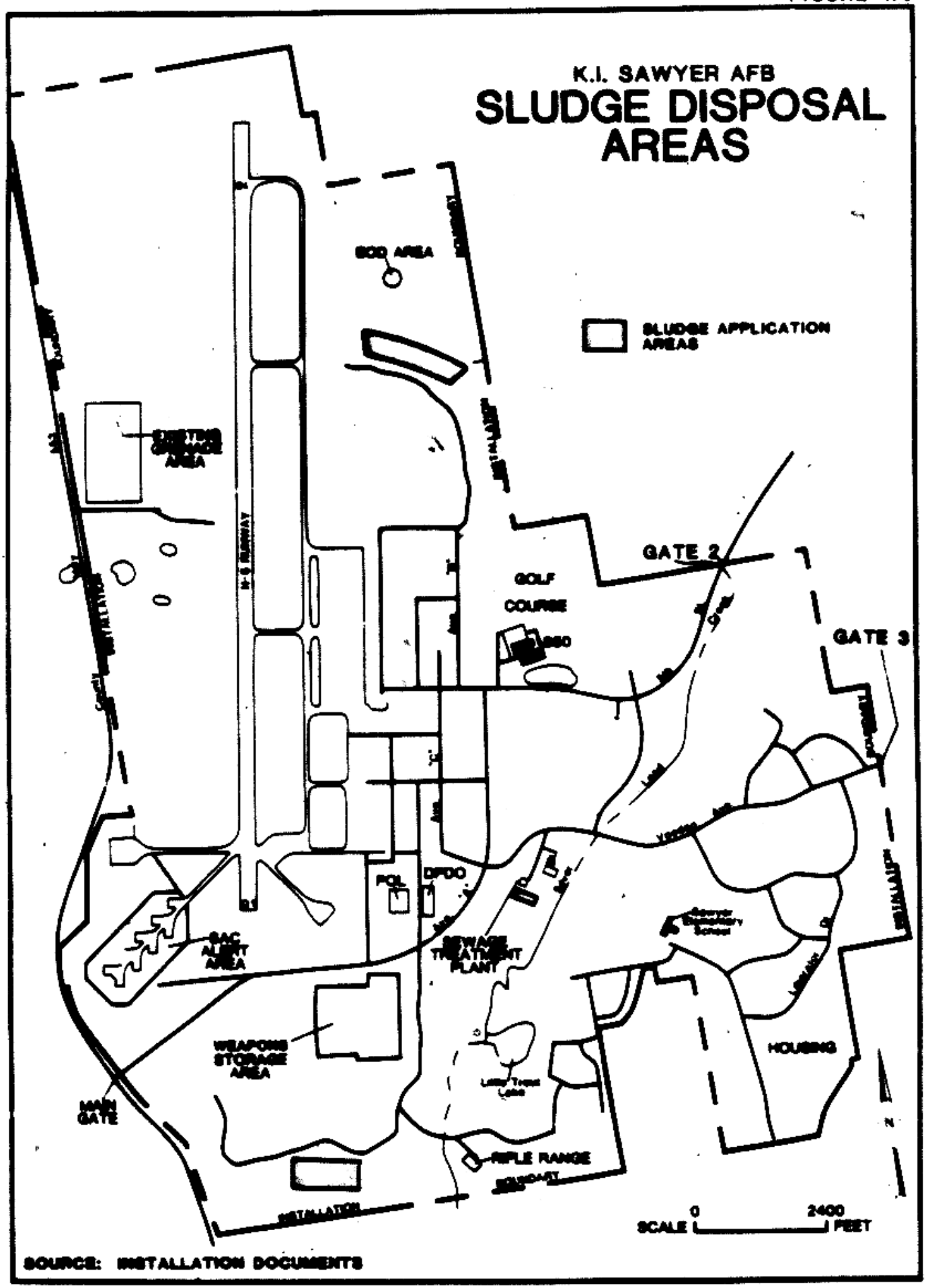
SATELLITE FACILITIES REVIEW

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

FIGURE 4.9



SOURCE: INSTALLATION DOCUMENTS

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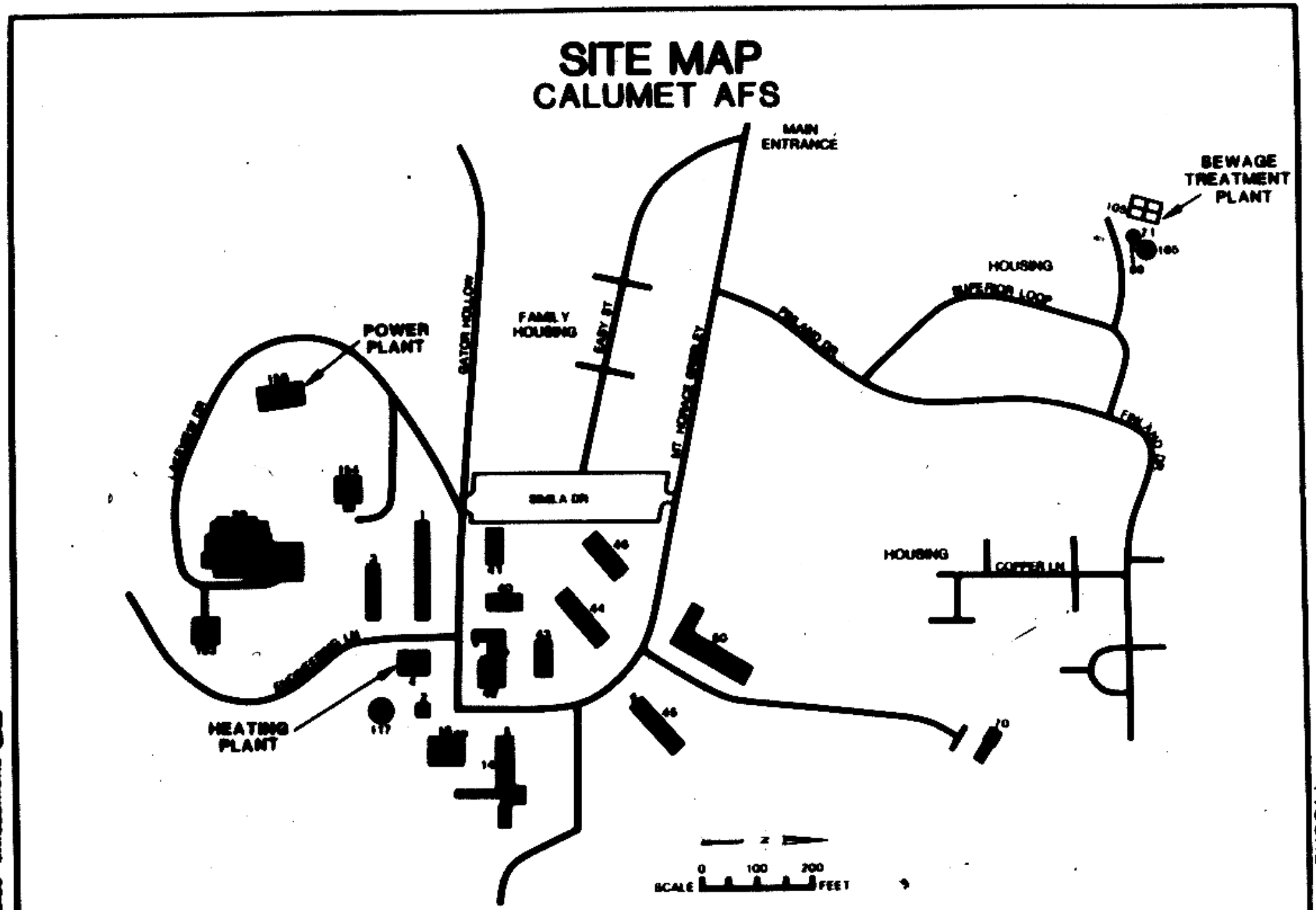


SOURCE: INSTALLATION DOCUMENTS

FIGURE 4.10

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 1980'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.

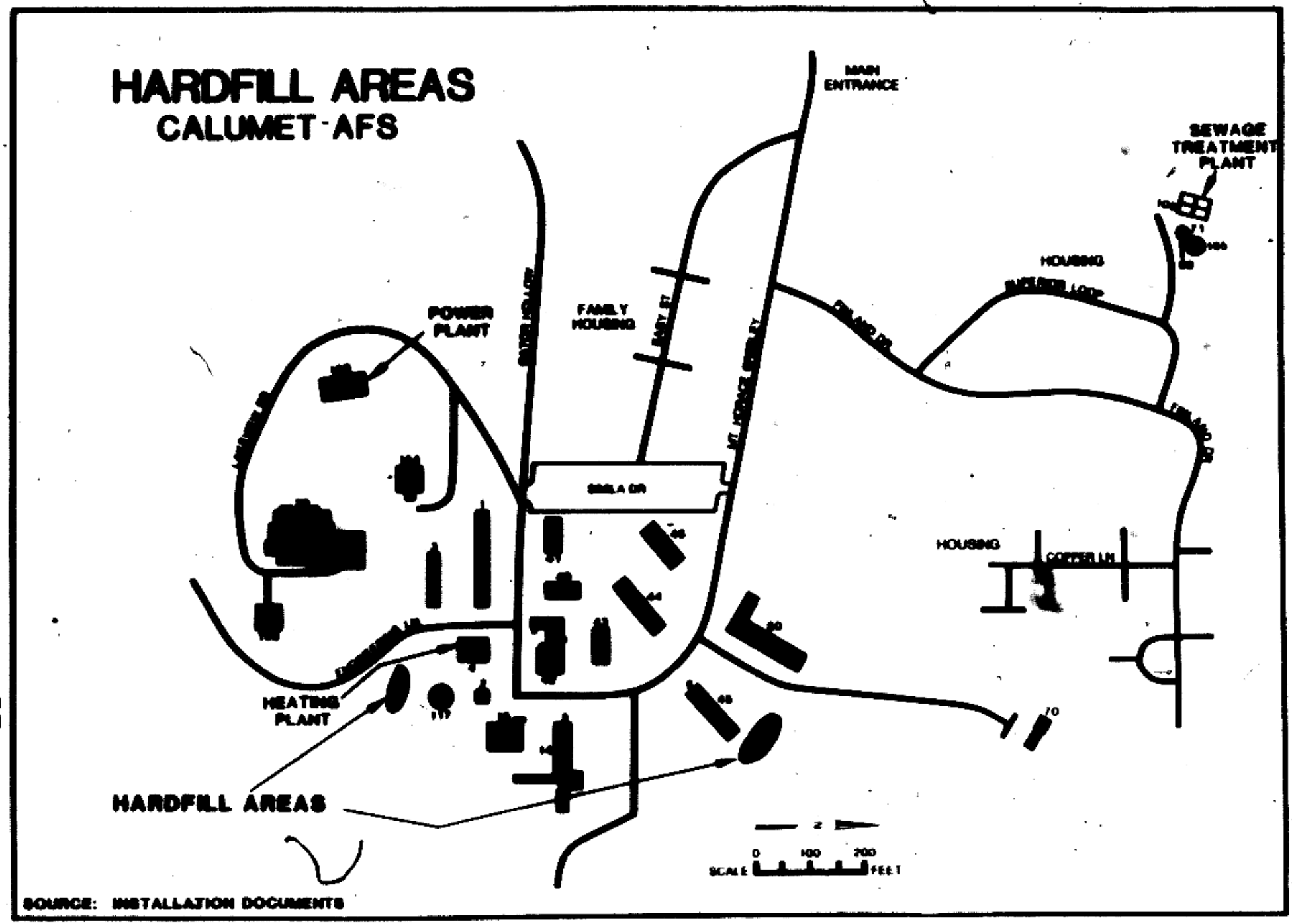
No evidence was found to indicate that a landfill has ever been operated at the station. The hard bedrock base the station is located on has made it virtually impossible to dig to a depth that would be suitable for operation of a landfill. Refuse routinely has been taken to the Calumet Township Landfill. 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.



SOURCE: INSTALLATION DOCUMENTS

FIGURE 4.11

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.

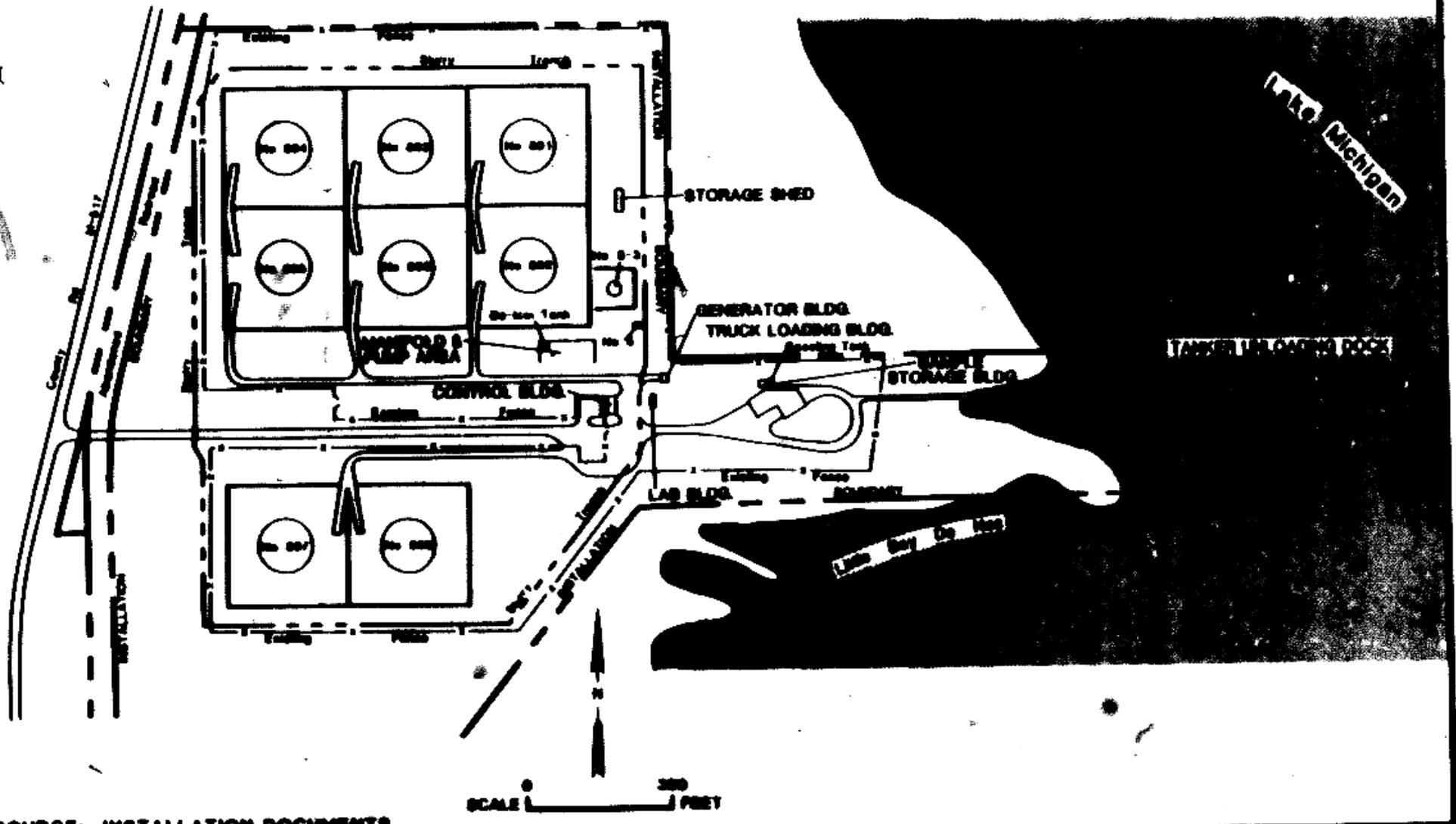
Each holding tank is diked by an earthen berm. A drainage system is currently being put into place. A holding pond for discharge of water from this system has been built and is currently filled with water due to rainfall. The diked area had no visible contamination. An underground collection system for 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

FIGURE 4-12

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.

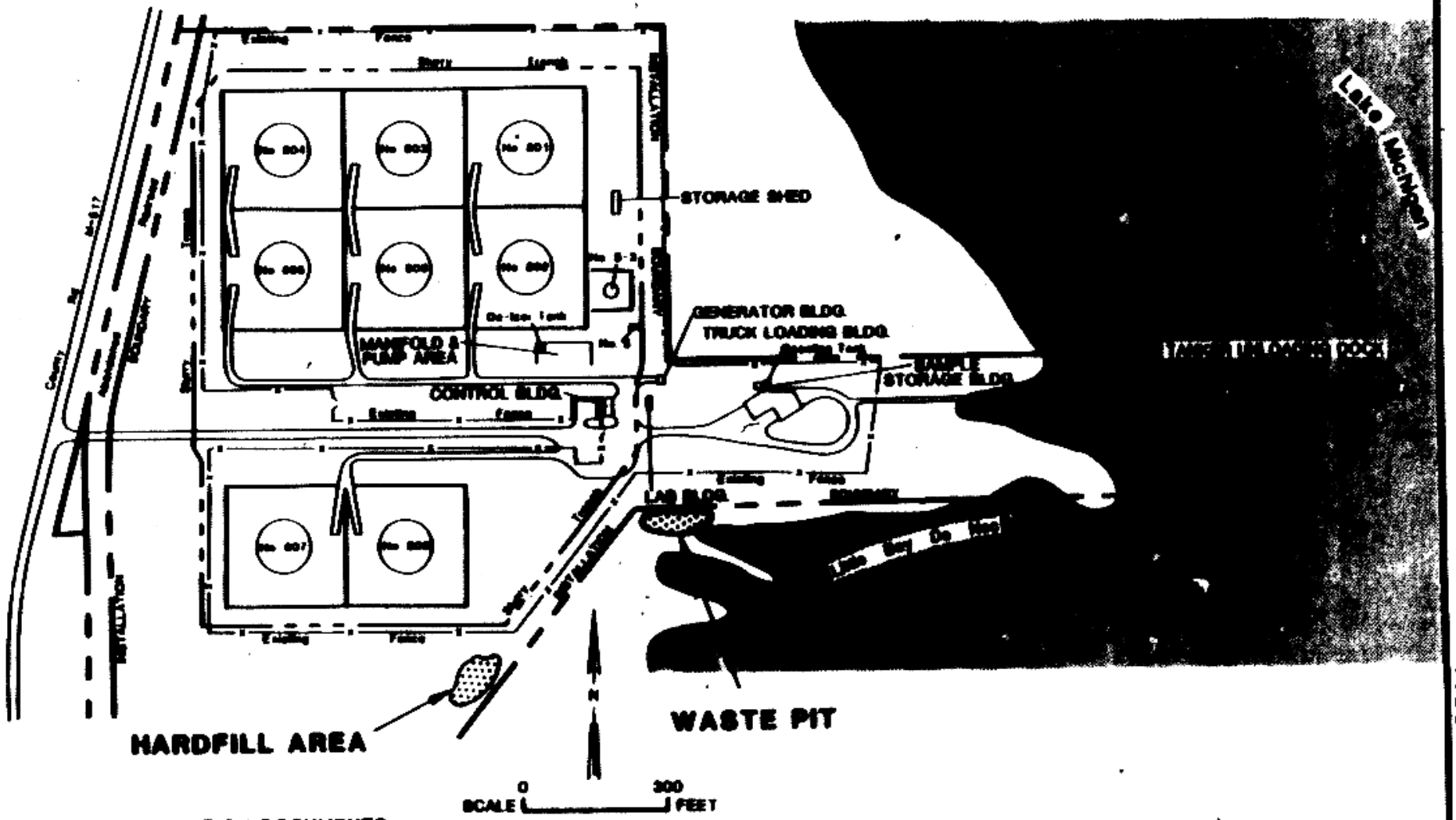
Two wells are currently located at the annex. Well number 1 is sixty feet deep. The water was recently tested and found to contain animal feces. A new well, 300 feet deep was installed. Water quality from this well has been good. Homes in the surrounding area have individual wells for their personal 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

WASTE PIT LOCATION
WELLS TERMINAL ANNEX



SOURCE: INSTALLATION DOCUMENTS

FIGURE 4.13

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