AD-A133 469

INSTALLATION RESTORATION PROGRAM

PHASE I - RECORDS SEARCH

LOWRY AFB, COLORADO

PREPARED FOR

Final rept.

UNITED STATES AIR FORCE
AFESC/DEV
Tyndall AFB, Florida

DTIC FILE COPY

DTIC ELECTE OCT 1 3 1983 A

AUGUST 1983

This document has been approved for public release and sale; its distribution is unlimited.

ENGINEERING-SCIENCE

PII Redacted

NOTICE

This report has been prepared for the United States Air Force by Engineering-Science for the purpose of aiding in the Air Force Installation Restoration Program. It is not an endorsement of any product. The views expressed herein are those of the contractor and do not necessarily reflect the official views of the publishing agency, the United States Air Force, nor the Department of Defense.

Copies of the report may be purchased from:

National Technical Information Service
5285 Port Royal Road
Springfield, Virginia 22161

Federal Government agencies and their contractors registered with Defense Technical Information Center should direct requests for copies of this report to:

Defense Technical Information Center
Cameron Station
Alexandria, Virginia 22314

INSTALLATION RESTORATION PROGRAM
PHASE I - RECORDS SEARCH
LOWRY AFB, COLORADO

Prepared For

United States Air Force
AFESC/DEV
Tyndall AFB, Florida

August 1983

Accession For
NTIS GRA&I
DTIC TAB
Unannounced
Justification
By
Distribution/
Availability Codes
and/or
Dist Special
A

DTIC COPY INSPECTED

By

ENGINEERING-SCIENCE
57 Executive Park South, N.E.
Suite 590
Atlanta, Georgia 30329

This document has been approved

NOTICE

This report has been prepared for the United States Air Force by Engineering-Science for the purpose of aiding in the Air Force Installation Restoration Program. It is not an endorsement of any product. The views expressed herein are those of the contractor and do not necessarily reflect the official views of the publishing agency, the United States Air Force, nor the Department of Defense.

Copies of the report may be purchased from:

National Technical Information Service
5285 Port Royal Road
Springfield, Virginia 22161

Federal Government agencies and their contractors registered with Defense Technical Information Center should direct requests for copies of this report to:

Defense Technical Information Center
Cameron Station
Alexandria, Virginia 22314

TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

LIST OF FIGURES

LIST OF TABLES

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, Initial Assessment/Records Search; Phase II, Confirmation/Quantification; Phase III, Technology Base Development/Evaluation of Alternative Remedial Actions; and Phase IV, Operations/Remedial Actions. Engineering-Science (ES) was retained by the Air Force Engineering and Services Center to conduct the Phase I, Initial Assessment/Records Search at Lowry AFB under Contract No. F08637-80-G0009-5005, using funding provided by the Air Training Command.

INSTALLATION DESCRIPTION

Lowry Air Force Base is located in the northeast quadrant of Colorado in Arapahoe County. The City of Denver borders Lowry AFB in the south, west and most of the northern part of the base. The remainder of the base is bordered by the City of Aurora, Colorado. All of the property around the base is zoned and used for residential and/or commercial purposes. The base was established in August 1937 and has been used primarily as a training base throughout its history. The main installation comprises 1860 acres of land. In addition two annexes under the jurisdiction of Lowry AFB were also included in the study: Lowry Training Annex and Dillon Recreational Area. Lowry Training Annex which is located 16 miles southeast of Lowry is comprised of 3311 acres of land used for field training exercises to support the training mission of Lowry AFB. Dillon Recreational Area is comprised of 68 acres of land 80 miles west of Lowry AFB used for recreational purposes by base personnel.

ENVIRONMENTAL SETTING

The environmental setting data reviewed for this investigation identified the following major points that are relevant to Lowry Air Force Base.

- The normal annual precipation at the base is 15.5 inches and yearly net precipitation is -30 inches. The negative value of yearly net precipitation indicates that yearly evaporation is greater than yearly rainfall and that water will evaporate from the land surface at a greater rate than it can be replenished.
- The base is located in a moderately active seismic area. Earthquakes of Modified Mercalli Intensity VII have occurred in the area in the recent past. An earthquake of this magnitude will probably have little or no impact on existing subsurface waste disposal facilities and will not significantly alter ground-water flow paths and contaminant transport.
- Ground-water flow in the Denver aquifer at the base is to the north. Water entering the base is derived from recharge to the aquifer south of the base. Water leaving the base discharges to wells in the Commerce City area or to alluvial aquifers in the South Platte River basin. Contamination of the ground water may potentially occur at subsurface waste disposal sites on the base because of the close proximity of the water table to the land surface. Ground water periodically comes into contact with the buried wastes.
- The surficial unconsolidated deposits at the base are generally permeable and allow rapid infiltration of water.
- Contamination of ground water may potentially occur at subsurface waste disposal sites on the base because of the close proximity of the water table to the land surface. Ground water periodically comes into contact with the buried wastes.
- Lateral movement of contaminants in the subsurface environment at the base will follow the general ground-water flow direction and will be relatively slow. Ground water in the unconsolidated deposits probably moves at an average velocity of less than 135 feet per year.

- The base has been subjected to an increased flooding potential because of urbanization of the Westerly Creek drainage basin.
- The water quality of Westerly Creek, which drains most of the base, varies areally. The total dissolved solids content of the water that drains the southeast area of the base was 1,100 to 1,500 mg/l in 1982. The total dissolved solids content of the water that drains the south and southwest portions of the base generally ranged between 200 and 600 mg/l. Sulfate accounts for approximately one-half of the dissolved solids content of the water draining from the southeast. The origin of the sulfates is unknown. They could be occurring off-base.

METHODOLOGY

During the course of this project, interviews were conducted with base 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 inspections were conducted at past hazardous waste activity sites. Nine sites located on the Lowry AFB property were identified as potentially containing hazardous materials resulting from past activities (Figure 1). These sites have been assessed using a Hazard Assessment Rating Methodology (HARM) which takes into account factors such as site characteristics, waste characteristics, potential for contaminant migration and waste management practices. The details of the rating procedure are presented in Appendix H and the results of the assessment are given in Table 1. The rating system is designed to indicate the relative need for follow-on action.

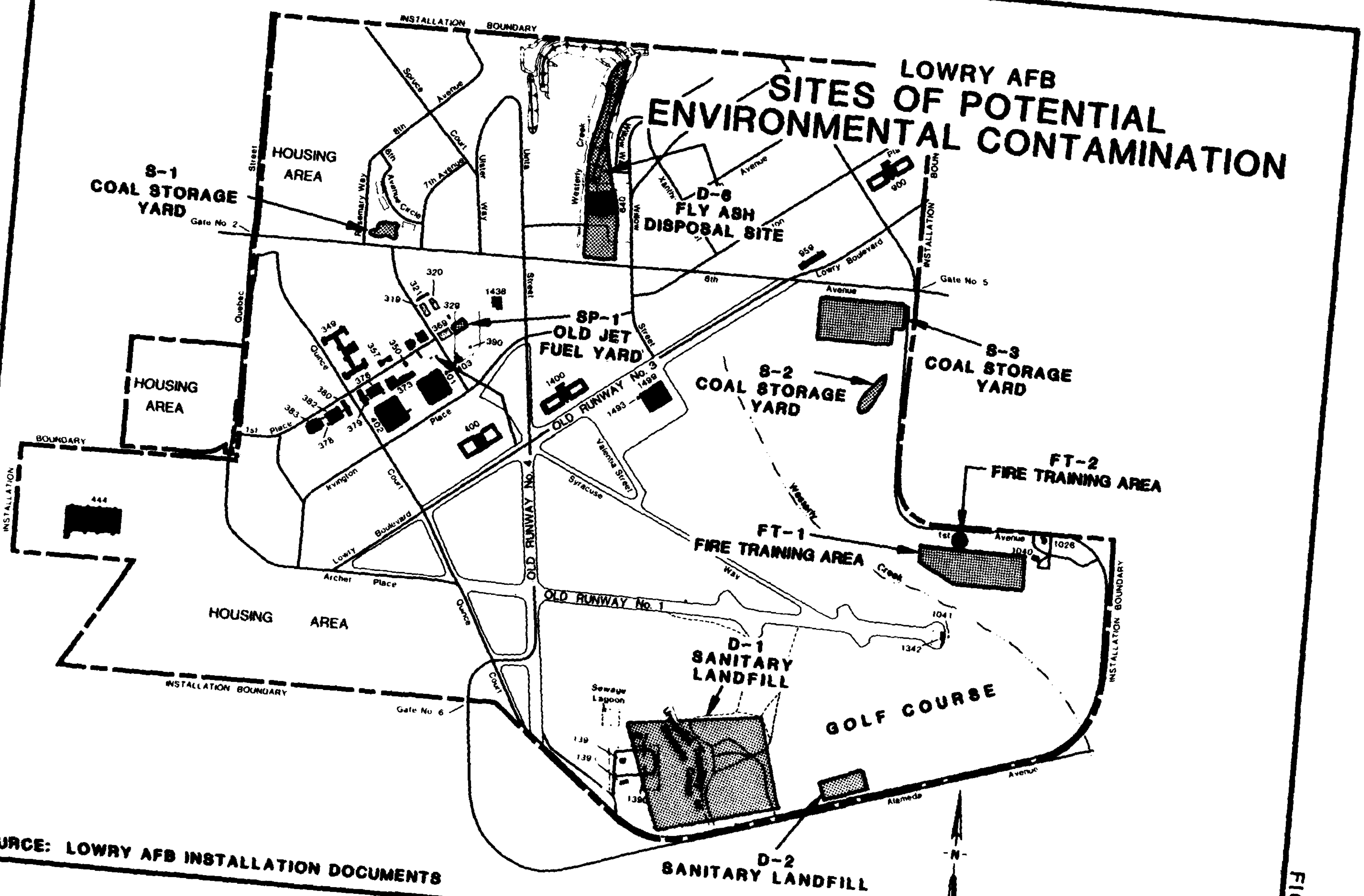
FINDINGS AND CONCLUSIONS

The following conclusions have been developed based on the results of the project team's field inspection, review of base records and files and interviews with installation personnel.

The areas determined to have a moderate potential for environmental contamination are as follows:

- Site FT-1, Fire Training Area No. 1
- Site D-1, Sanitary Landfill

FIGURE 1



SOURCE: LOWRY AFB INSTALLATION DOCUMENTS

TABLE 1
PRIORITY RANKING OF POTENTIAL CONTAMINATION SOURCES

Rank	Site No.	Site Name	Date of Operation or Occurrence	Overall Total Score
1	FT-1	Fire Training Area No. 1	1946-1965	64
2	D-1	Sanitary Landfill	1948-1983	58
3	FT-2	Fire Training Area No. 2	1965-1980	47
4	SP-1	Old Jet Fuel Yard Area	1950's-1966	47
5	D-2	Sanitary Landfill	Early 1960's	38
6	D-6	Fly Ash Disposal Site	1940-1948	32
7	S-1	Coal Storage Yard	Unknown	32
8	S-2	Coal Storage Yard	Unknown	32
9	S-3	Coal Storage Yard	Unknown	32

The areas determined to have a low potential for environmental contamination are as follows:

- o Site FT-2, Fire Training Area No. 2
- o Site SP-1, Old Jet Fuel Yard Area
- o Site D-2, Sanitary Landfill
- o Site D-6, Fly Ash Disposal Site
- o Site S-1, Coal Storage Yard
- o Site S-2, Coal Storage Yard
- o Site S-3, Coal Storage Yard

RECOMMENDATIONS

The detailed recommendations developed for further assessment of potential environmental contamination are presented in Section 6. The recommended actions are one-time sampling programs to determine if contamination does exist at the site. If contamination is identified, the sampling program may need to be expanded to further define the extent of contamination. The recommendations are summarized in Table 2.

TABLE 2
RECOMMENDED MONITORING PROGRAM FOR PHASE II
LOWRY AFB

Site	Rating Score	Recommended Monitoring	Comments
1. D-1 Sanitary Landfill	58	a) Conduct a geophysical survey using both electromagnetic conductivity and electrical resistivity methods to delineate the extent of any contaminated plume at the site and aid in determining proper locations for monitoring wells. b) One set of upgradient monitoring wells and three sets of downgradient monitoring wells should be installed at the landfill. The upgradient well will have to be installed east of the landfill and adjacent to the fence service road. Each of the wells will be sampled and analyzed for the parameters listed in Table 6.2. c) Three surface water and sediment samples should be collected in the unnamed tributary of Westerly Creek in the vicinity of the landfill. Each sample should be analyzed for the parameters listed in Table 6.2.	

TABLE 2
RECOMMENDED MONITORING PROGRAM FOR PHASE II
LOWRY AFB
(continued)

Site	Rating Score	Recommended Monitoring	Comments
2. FT-1 Fire Training Area No. 1	64	a) Install a monitoring well set at the center of the site completed to bedrock. Utilize an OVA during the drilling. b) Five surface water samples should be collected in the storm drainage network on the southeast end of the base. One sampling location should be in golf course area as far southwest in the drainage network as practical. A second sample should be located just southeast of Building 1499. The remaining sample locations should be equidistantly distributed between the first two locations. The samples should be analyzed for the parameters listed in Table 6.2.	If contamination is detected during the drilling process then three well sets should be installed at the edge of the contaminant plume. Each of the wells the should be sampled and analyzed for sulfates the parameters listed in Table 6.2.

SECTION 1
INTRODUCTION

BACKGROUND

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

PURPOSE AND SCOPE OF THE ASSESSMENT

The Installation Restoration Program has been developed as a four-phased program as follows:

Phase I - Initial Assessment/Records Search

Phase II - Confirmation/Quantification

Phase III - Technology Base Development/Evaluation of Alternative Remedial Actions

Phase IV - Operations/Remedial Actions

Engineering-Science (ES) was retained by the United States Air Force to conduct the Phase I Records Search at Lowry Air Force Base under Contract No. F08637-80-60009-5005. This report contains a summary and an evaluation of the information collected during Phase I of the IRP. The land areas included as part of the Lowry AFB study are as follows:

Main Base Site	1860 acres (owned)
Dillon Recreational Site	68 acres (leased)
Lowry Training Annex	3311 acres (owned)

The goal of the first phase of the program was to identify the potential for environmental contamination from past waste disposal practices at Lowry AFB, and to assess the potential for contaminant migration. The activities that were performed in the Phase I study included the following:

- Reviewed site records
- Interviewed personnel familiar with past generation and disposal activities
- Inventoried wastes
- Determined quantities and locations of current and past hazardous waste storage, treatment and disposal
- Defined the environmental setting at the base
- Reviewed past disposal practices and methods
- Conducted field and aerial inspection
- Gathered pertinent information from Federal, state and local agencies
- Assessed potential for contaminant migration.

ES performed the on-site portion of the records search during May 1983. The following core team of professionals were involved:

- W. G. Christopher, Environmental Engineer and Project Manager, ME, Environmental Engineering, 8 years of professional experience
- R. S. Mcleod, Hydrologist, MS Civil Engineering, 21 years professional experience
- R. J. Reimer, Chemical Engineer, MS Chemical Engineering, 4 years of professional experience

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

METHODOLOGY

The methodology utilized in the Lowry AFB Records Search began with a review of past and present industrial operations conducted at the base. Information was obtained from available records such as shop files and real property files, as well as interviews with 45 past and present base employees from the various operating areas. Those interviewed included current and past personnel associated with the Civil Engineering Squadron, Bioenvironmental Engineering Services, Consolidated Maintenance Squadron, Air Base Group, Transportation Division, and the Technical Training Wing. Experienced personnel from past tenant organizations were also interviewed. A listing of Air Force interviewees by position and approximate period of service is presented in Appendix B.

Concurrent with the base interviews, the applicable Federal, state and local agencies were contacted for pertinent base-related environmental data. The seven organizations contacted and interviewed are listed below as well as in Appendix B.

- o U.S. Department of Agriculture, Soil Conservation Service
- o U.S. Geological Survey, Water Resources Division
- o U.S. Environmental Protection Agency, Region VIII

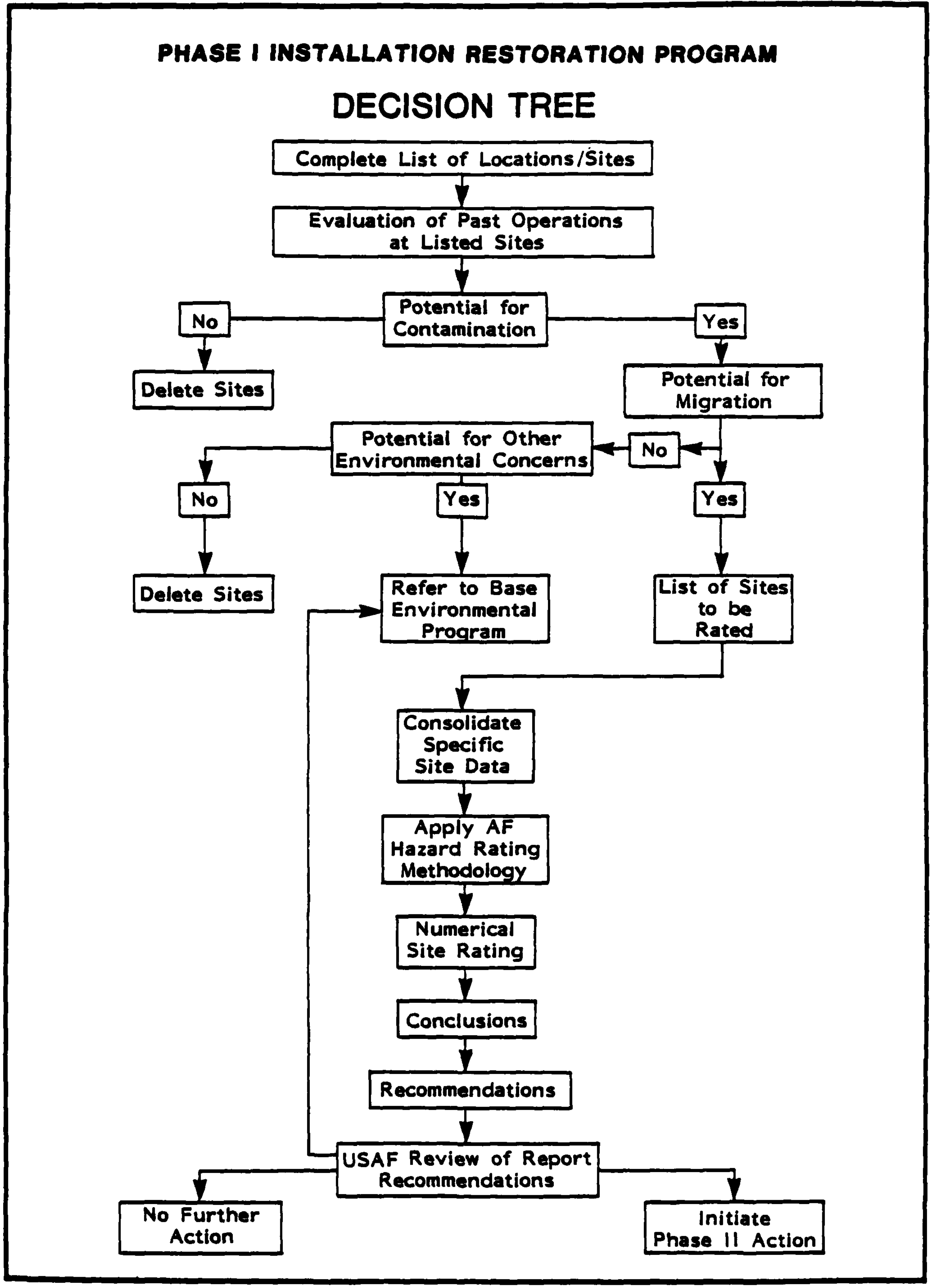
- Colorado Department of Natural Resources, Division of Water Resources
- Colorado Department of Natural Resources, Geological Survey
- Colorado Department of Health, Water Pollution Control Division
- Colorado Department of Health, Waste Management Division

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

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

A decision was then made, based on all of the above information, whether a potential exists for hazardous material contamination at any of the identified sites using the Decision Tree shown in Figure 1.1. If no potential existed, the site was deleted from further consideration. For those sites where a potential for contamination was identified, a determination of the potential for migration of the contamination was made by considering site-specific conditions. If there were no further environmental concerns, then the site was deleted. If the potential for contaminant migration was considered significant, then the site was evaluated and prioritized using the Hazard Assessment Rating Methodology (HARM). A discussion of the HARM system is presented in Appendix G. The sites that were evaluated using the HARM procedures were also reviewed with regard to future land use restrictions.

FIGURE 1.1


PHASE I INSTALLATION RESTORATION PROGRAM
DECISION TREE
Complete List of Locations/Sites
Evaluation of Past Operations at Listed Sites
Potential for Contamination
No
Yes
Delete Sites
Potential for Migration
Potential for Other Environmental Concerns
No
No
Yes
Yes
Delete Sites
Refer to Base Environmental Program
List of Sites to be Rated
Consolidate Specific Site Data
Apply AF Hazard Rating Methodology
Numerical Site Rating
Conclusions
Recommendations
USAF Review of Report Recommendations
No Further Action
Initiate Phase II Action

SECTION 2

INSTALLATION DESCRIPTION

LOCATION, SIZE AND BOUNDARIES

Lowry Air Force Base (AFB) is located in the northeast quadrant of Colorado and lies within two municipalities, (Figures 2.1 and 2.2). The western and central portions of the base are within the city and county of Denver, while the northeastern and southeastern parts are within the city of Aurora and Arapahoe County. All of the property around the base is urbanized and used for residential and/or commercial purposes. No future changes in the land use of the areas surrounding the base are expected. Figure 2.3 depicts the configuration of the 1860 acres comprising Lowry AFB. Two annexes under the jurisdiction of Lowry AFB were also included in this study. These areas are described below and depicted in Figures 2.4 and 2.5.

Lowry Training Annex: 3311 acres located 16 miles southeast of Lowry AFB. The site provides land for field training exercises to support the training mission of Lowry AFB.

Dillon Recreational Area: 68 acres located 80 miles west of Lowry AFB. The site is used for recreational purposes by base personnel. Facilities include 33 campsites, two comfort stations and a well.

BASE HISTORY

Lowry AFB was established in August 1937. The original site was the former Agnes Phipps Memorial Sanitarium, which was donated to the Federal Government by the City and County of Denver. By 1940, two hangers had been constructed. Nine hundred and sixty adjoining acres were donated by the City and County of Denver in 1941. Lowry's program during World War II focused on photography, armament and B-29 crew training.

FIGURE 2.1

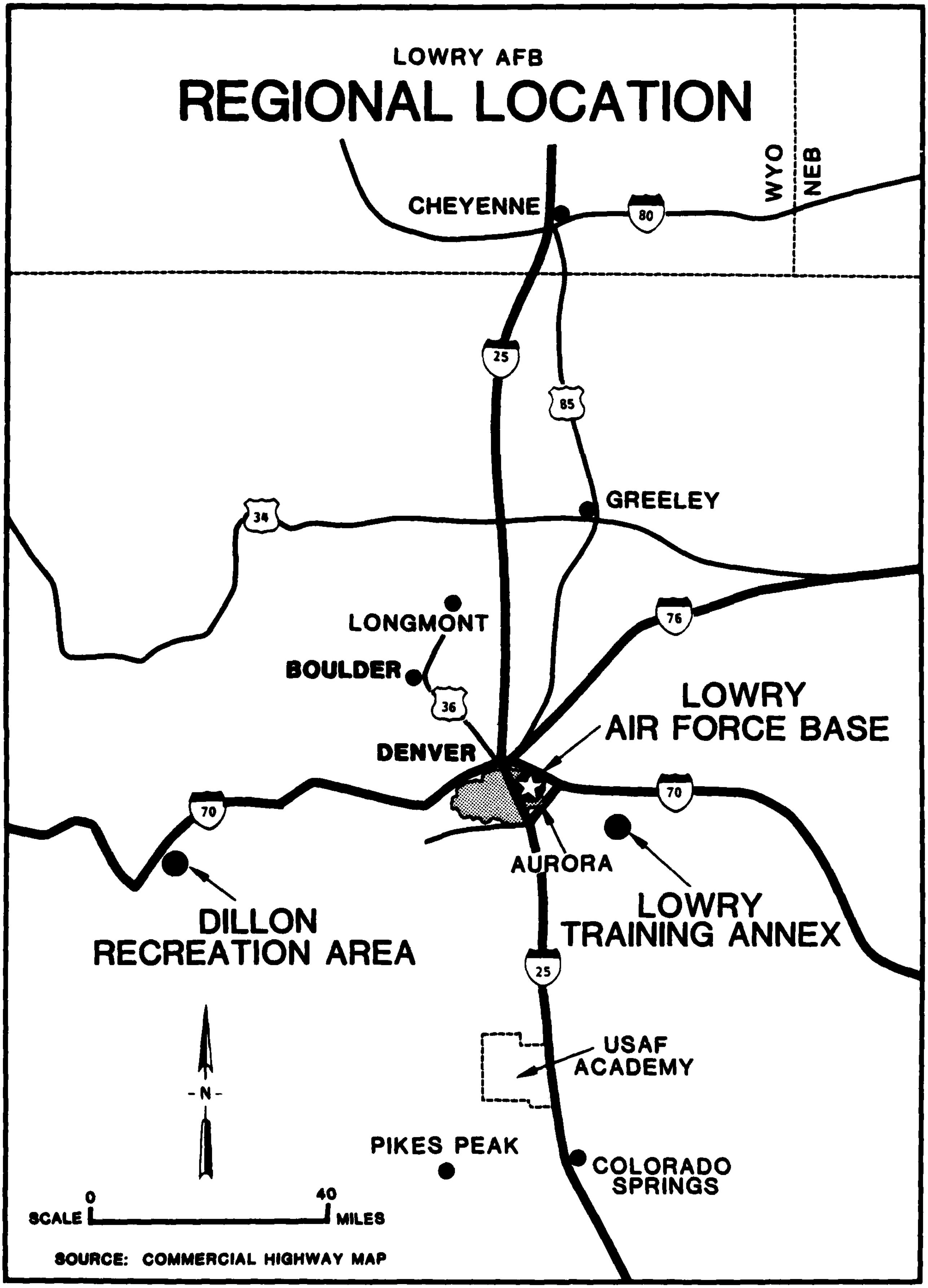
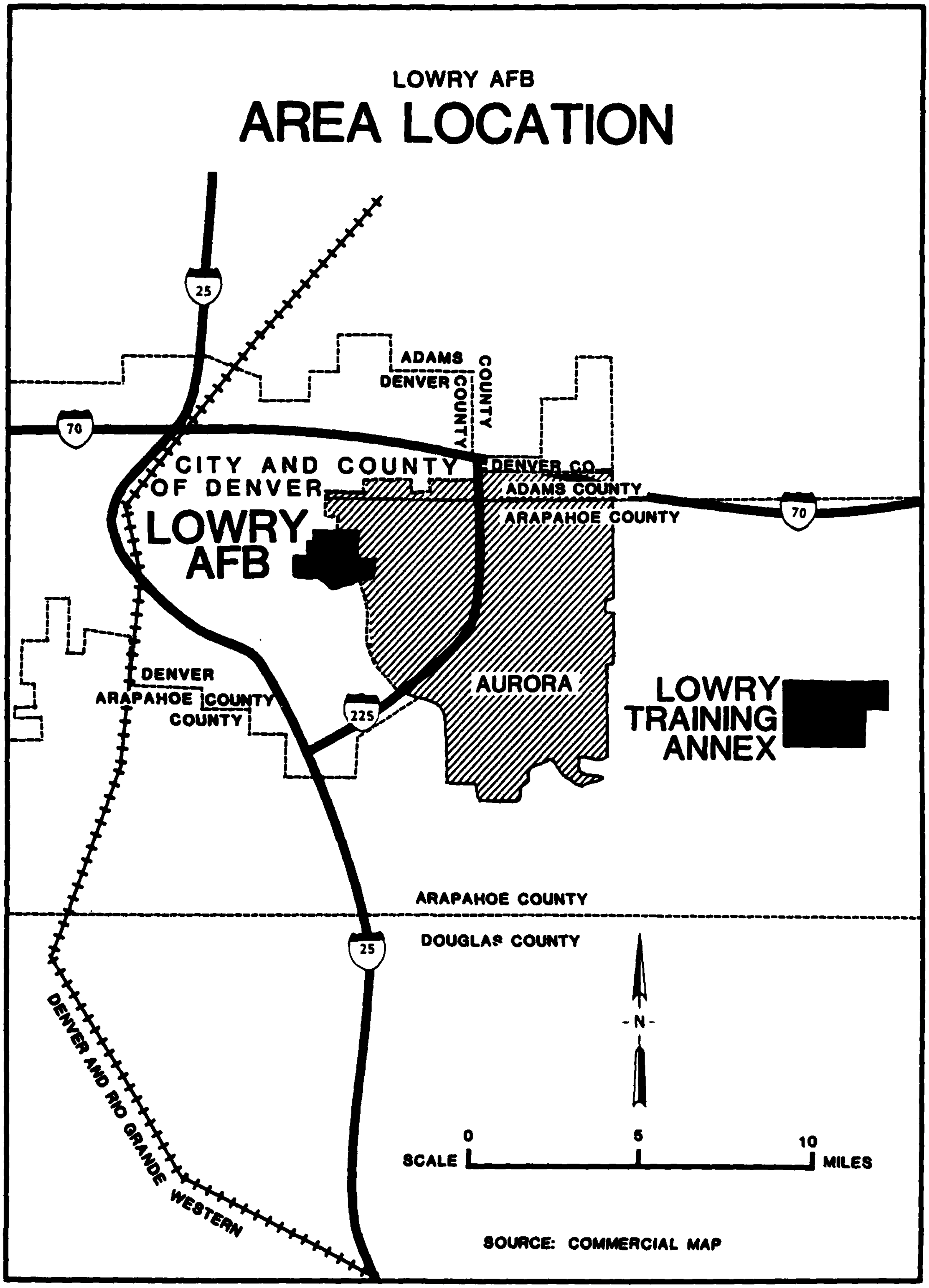
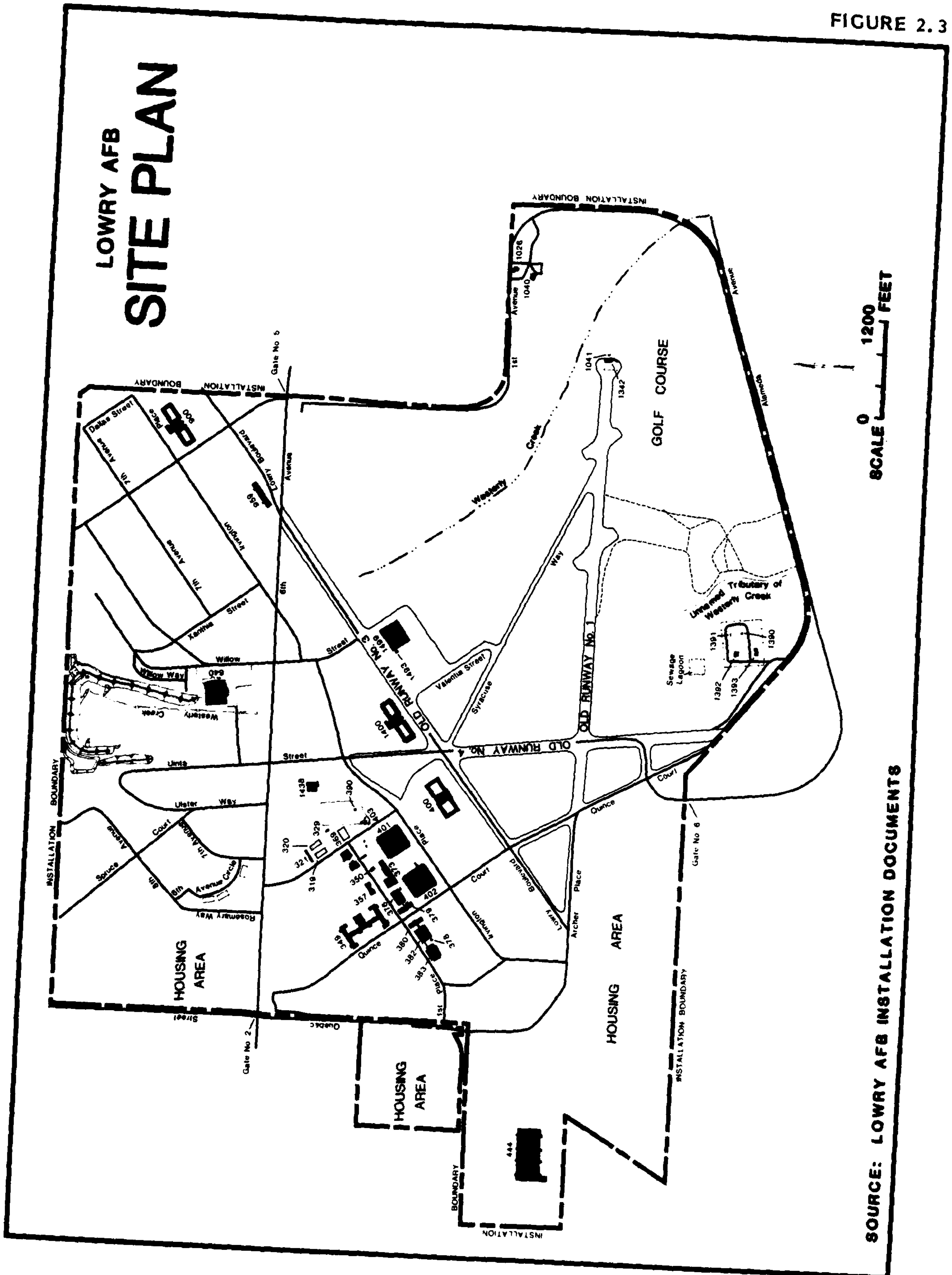

LOWRY AFB
REGIONAL LOCATION
WYO
NEB
CHEYENNE
80
25
85
GREELEY
34
LONGMONT
76
BOULDER
36
LOWRY
AIR FORCE BASE
DENVER
70
70
AURORA
LOWRY
TRAINING ANNEX
DILLON
RECREATION AREA
25
- N -
USAF
ACADEMY
PIKES PEAK
COLORADO
SPRINGS
SCALE 0 40 MILES
SOURCE: COMMERCIAL HIGHWAY MAP

FIGURE 2.2

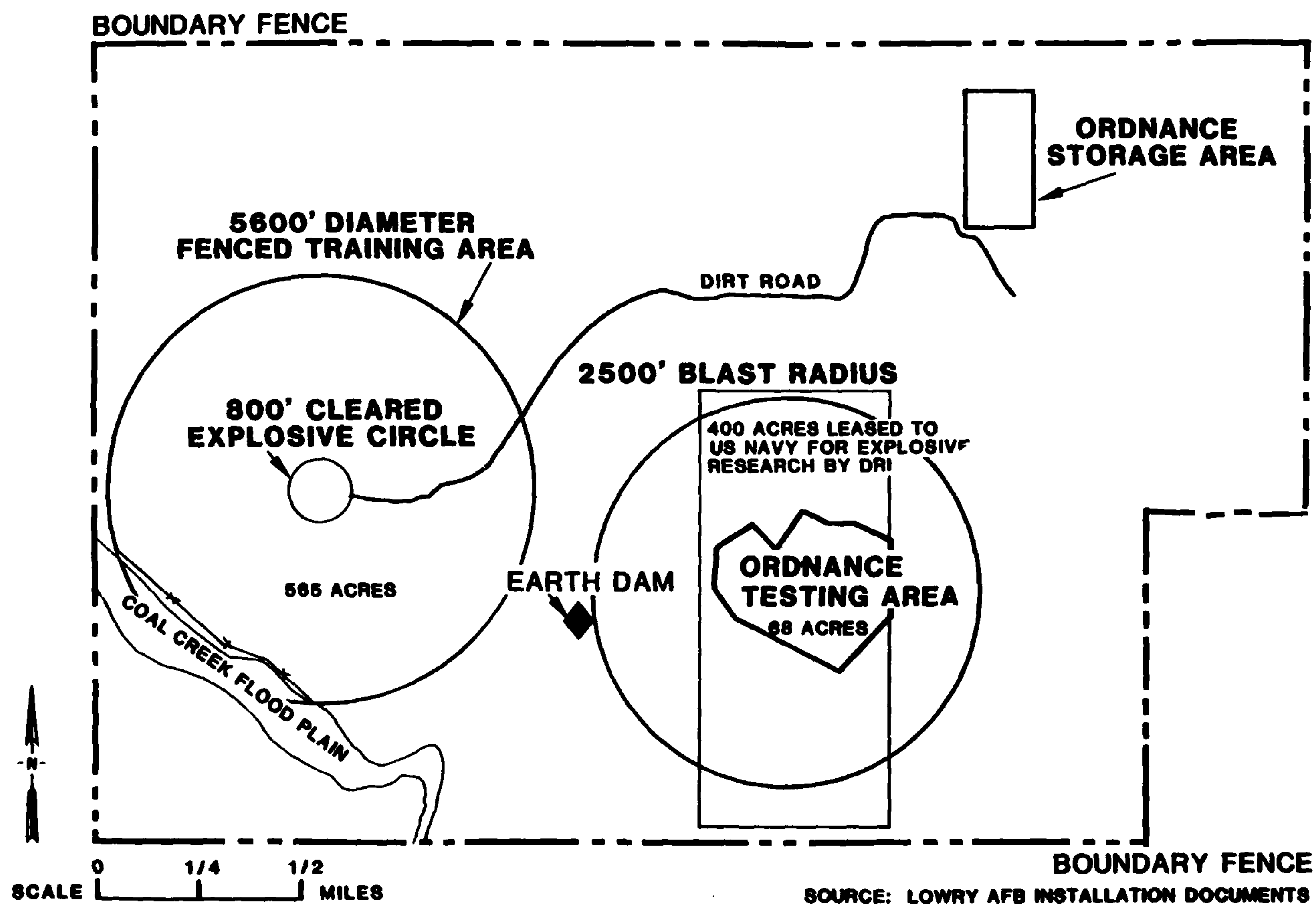


ES ENGINEERING-SCIENCE



ES ENGINEERING-SCIENCE

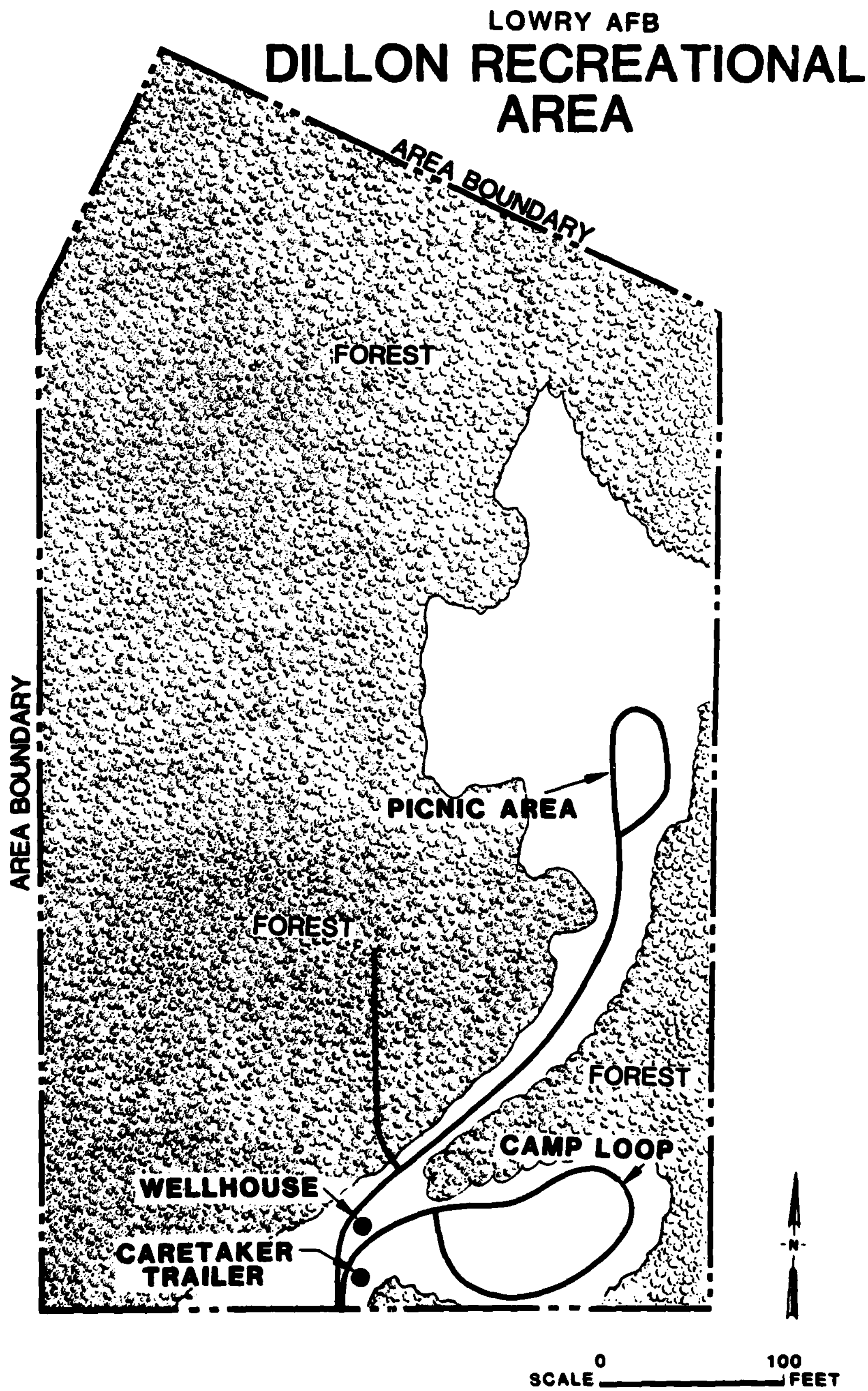
LOWRY AFB
TRAINING ANNEX SITE PLAN



SOURCE: LOWRY AFB INSTALLATION DOCUMENTS

FIGURE 2.4

FIGURE 2.5



SOURCE: LOWRY AFB INSTALLATION DOCUMENTS

Following the conclusion of the war, Lowry Field was renamed Lowry Air Force Base and continued its work as a training base. With the development of the Korean Conflict in 1950, Lowry initiated new courses dealing with rocket propulsion and missile guidance systems. Lowry AFB also hosted the Air Force Academy from 1954 through 1958, while the permanent Colorado Springs facility was under construccion.

In 1958, preparation for the Titan I Missile began with the activation of the 703rd Strategic Missile Wing at Lowry AFB. The missile silos were located on property which has since been excessed. In 1961 the 703rd was redesignated the 451st Strategic Missile Wing and the first missiles arrived. By March 1962, all eighteen missiles were in place. SAC phased out the Titan missiles at Lowry in 1965 and in June 1966 the last T-29 departed from Lowry AFB, ending Lowry's years as an active flying base.

Since 1966 significant construction of dormatories and offices has occurred but there has been only minimal change in terms of the base industrial shop operations.

ORGANIZATION AND MISSION

The present host organization at Lowry AFB is the 3400th Technical Training Wing whose mission is to provide individual military and technical training for officers and airmen of the Air Force, the Air Force Reserve, the Air National Guard and other DOD agencies and for allied students; and to provide technical training for Air Force Civilian Employees. The wing is also responsible for operating Lowry AFB and providing adequate support to tenant units.

Tenant organizations at Lowry AFB are listed below. Descriptions of the major base tenant organizations and their missions are presented in Appendix C.

USAF Clinic
1987th Communications Squadron (AFSC)
USAF Postal and Courier Service (HQ, Comd, USAF)
USAF-CAP Colorado Wing/Rocky Mtn. Region (HQ, Comd, USAF)
Air Force Human Resources Lab (AFSC)
Air Force Human Intelligence Squadron/RE DTS4 (HQ, WAF)

Det 4, 3314th Management Engineering Squadron (ATC)

AFOSI, District 14 (HQ,AFOSI)

3506th USAF Recruiting Group, Det G07 (ATC)

Denver Labor Relations Office (HQ,COMD, WAF)

Det 57, 1035th Technical Operations Group (HQ, COMD, USAF)

Air Force Audit Agency

Colorado National Bank

Lowry Federal Credit Union

USAF Judiciary Area Defense Counsel, Dets QD4A and QT4A

U.S. Army, Omaha District, Corps of Engineers

2nd Communications Squadron (ADS)

American National Red Cross

U.S. Postal Service

Air Force Accounting and Finance Center

- Air Reserve Personnel Center

Air Force Systems Electronics Systems Division

SECTION 3

ENVIRONMENTAL SETTING

The geological and hydrological setting at Lowry Air Force Base is described in this section. An understanding of the geology and hydrology is needed to aid in identifying hydrologic conditions which could contribute to migration of contaminants which may have been introduced into the environment at the base.

METEOROLOGY

The climate at Lowry Air Force Base is semi-arid (USDC, 1980). The average annual temperature is approximately fifty degrees Fahrenheit (50° F). The normal daily minimum temperature ranges from a low of about 16°F in January to a high of about 59°F in July. The normal daily maximum temperature ranges from a low of about 43°F in January to a high of about 86°F in July.

The normal annual precipitation is approximately 15.5 inches. Precipitation is generally greatest during the month of May and least during December. The highest recorded monthly and daily precipitation totals have occurred in May. Minimum monthly precipitation totals of 0.10 inches or less have occurred in all months except March and July. Snowfall has been recorded in all months except July and August.

Meteorological data, taken from the National Weather Service Station located at Stapleton International Airport approximately two miles north of Lowry Air Force Base, are summarized in Table 3.1.

Yearly net precipitation at the base is approximately -30 inches. Negative values of yearly net precipitation indicate that yearly evaporation is greater than yearly rainfall, and that water will evaporate from the land surface at a greater rate than it can be replenished.

TABLE 3.1

SUMMARY OF METEOROLOGICAL DATA(1)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Temperature (°F)													
Normal	29.9	32.8	37.0	47.5	57.0	66.0	73.0	71.6	62.8	52.0	39.7	32.6	50.1
Daily Maximum	43.5	46.2	50.1	61.0	70.3	80.1	87.4	85.8	77.7	66.8	53.3	46.2	64.0
Daily Minimum	16.2	19.4	23.8	33.9	43.6	51.9	58.6	57.4	47.8	37.2	25.4	18.9	36.2
Precipitation (inches)													
Normal	0.61	0.67	1.21	1.93	2.64	1.93	1.78	1.29	1.13	1.13	0.76	0.43	15.51
Maximum Monthly	1.44	1.66	2.89	4.17	7.31	4.69	6.41	5.85	4.67	4.17	2.97	2.84	7.31
Minimum Monthly	0.01	0.01	0.13	0.03	0.06	0.09	0.17	0.06	T(2)	0.05	0.01	0.03	T(2)
Maximum in 24 hrs.	1.02	1.01	1.48	3.25	3.55	3.16	2.42	3.43	2.44	1.71	1.29	1.38	3.55
Maximum Monthly Snowfall (inches)	23.7	18.3	29.2	28.3	13.6	0.3	0.0	0.0	21.3	31.2	39.1	30.8	39.1

(1) Temperature based on the period 1872 to 1980; snowfall based on the period 1935 to 1980; normals based on the period 1941 to 1970.

(2) Trace

GEOGRAPHY

Lowry Air Force Base is located along the western edge of the Great Plains physiographic province (Figure 3.1). This province slopes eastward from the Rocky Mountain Front Range. The base is in an area of grass-covered tablelands that are generally covered by alluvium and loess, and separated from each other by broad, flat-bottomed valleys. The area around the base is urbanized.

The base is in the South Platte River drainage basin which is the major drainage basin in the area (Figure 3.1). The South Platte River, which originates in the mountains southwest of the base, flows generally northeastward along the front range in the vicinity of the base.

Two tributaries to the South Platte River drain Lowry Air Force Base; Cherry Creek drains a small portion of the west side of the base and Westerly Creek drains the remainder of the base.

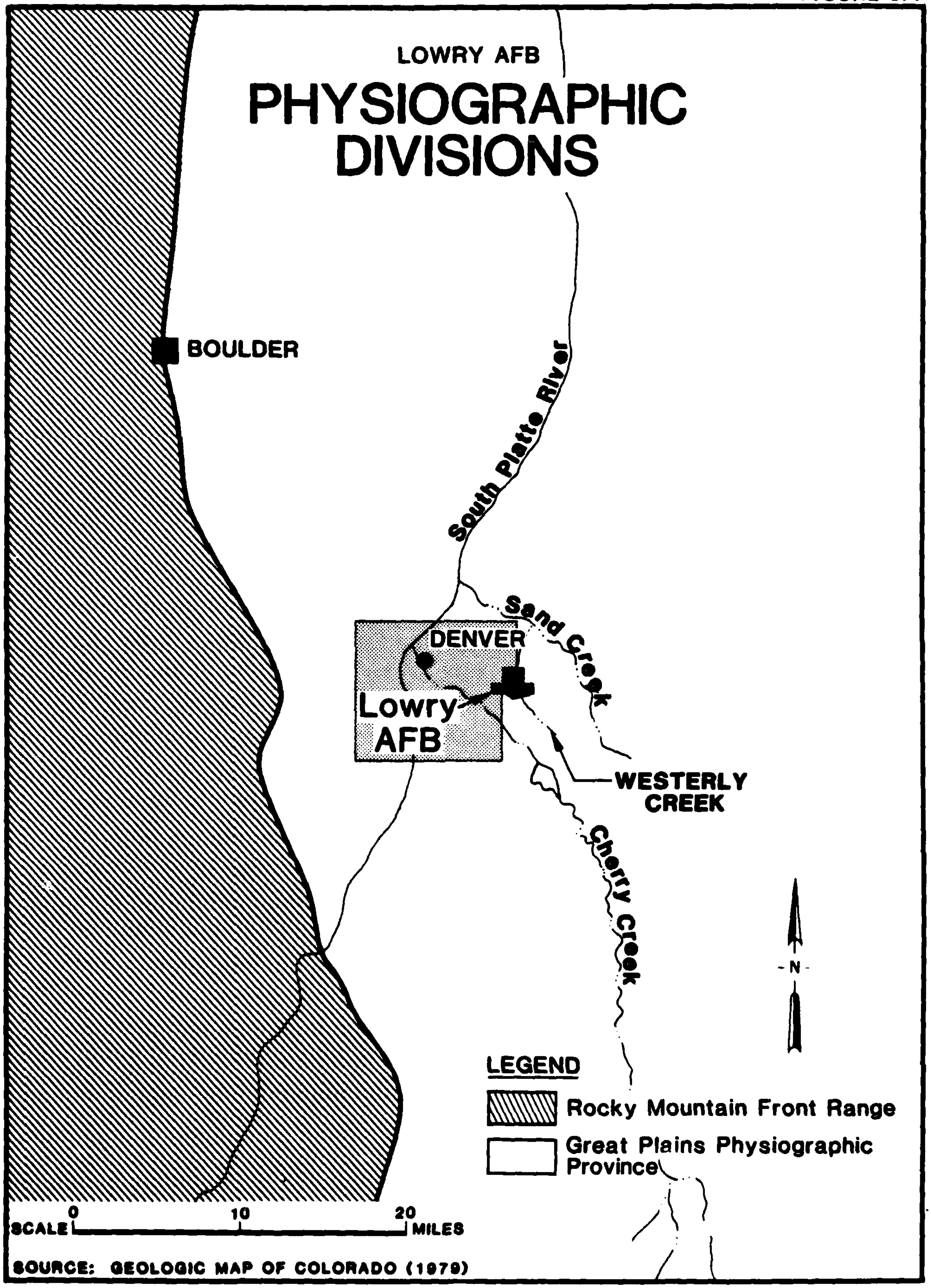
Topography and Drainage

The topography at Lowry Air Force Base is gently rolling to flat as illustrated in Figure 3.2. The highest point on the base is approximately 5,450 feet mean sea level (MSL). This point occurs along the east edge of the base in the vicinity of the golf course. The lowest point is approximately 5,350 feet and occurs along the north boundary of the base. There is a ridge on the base that parallels the west border of the base.

Most of the storm drainage for the base is directed to Westerly Creek. Westerly Creek, which enters the south side of the base at Alameda Avenue and Havana Street, drains in a northerly direction through the base and exits the north side of the base at Kelly Road Dam.

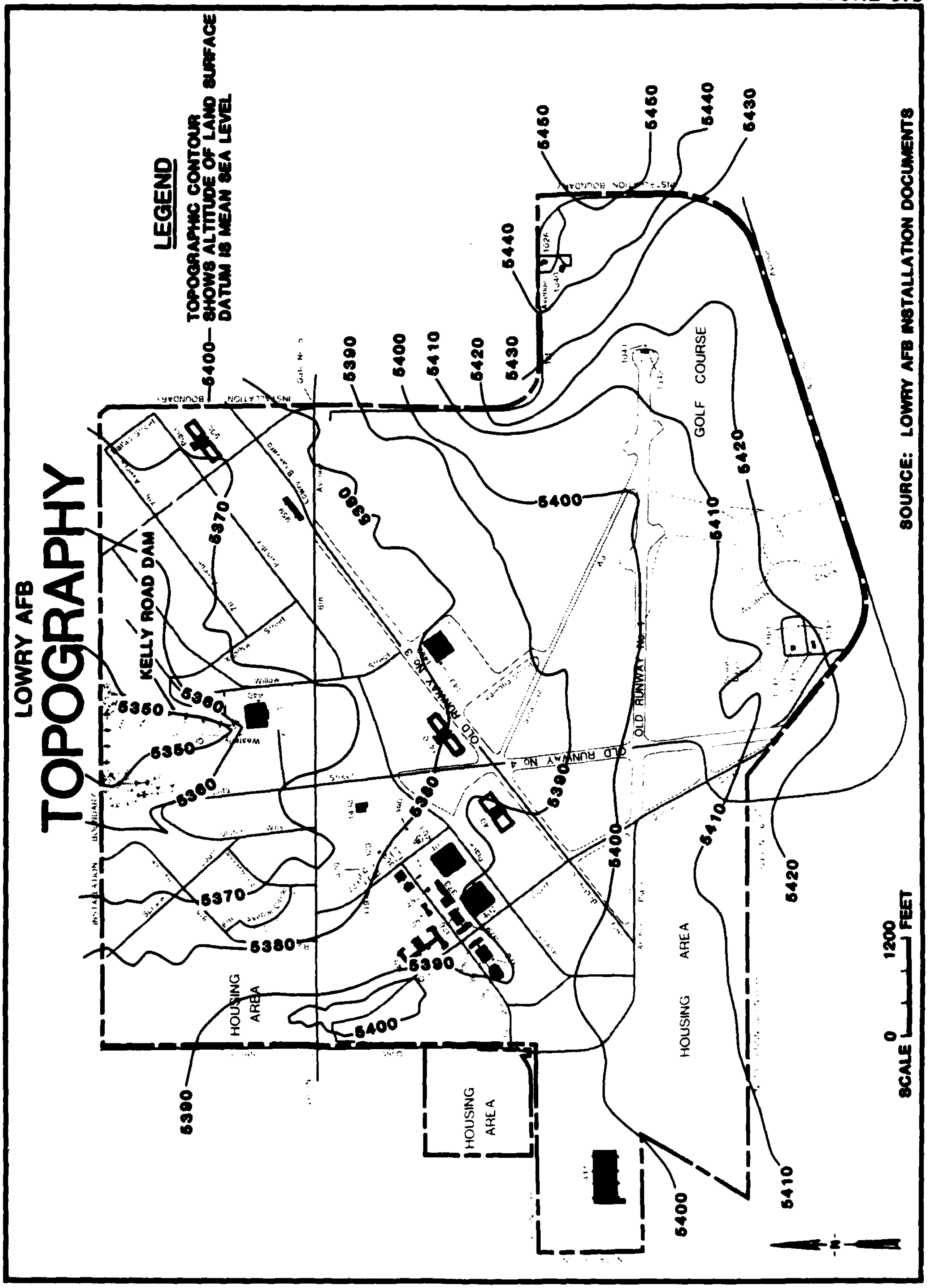
Drainage at Lowry Air Force Base is comprised of a combination of open channels and drainage structures. The areas of open channel flow are limited to two small areas on the south side of the base in the vicinity of the golf course and an area on the north side of the base near Kelly Road Dam. The creek is diverted through storm drains in the intervening area. The relationship between Westerly Creek and base drainage structures is shown on Figure 3.3.

FIGURE 3.1



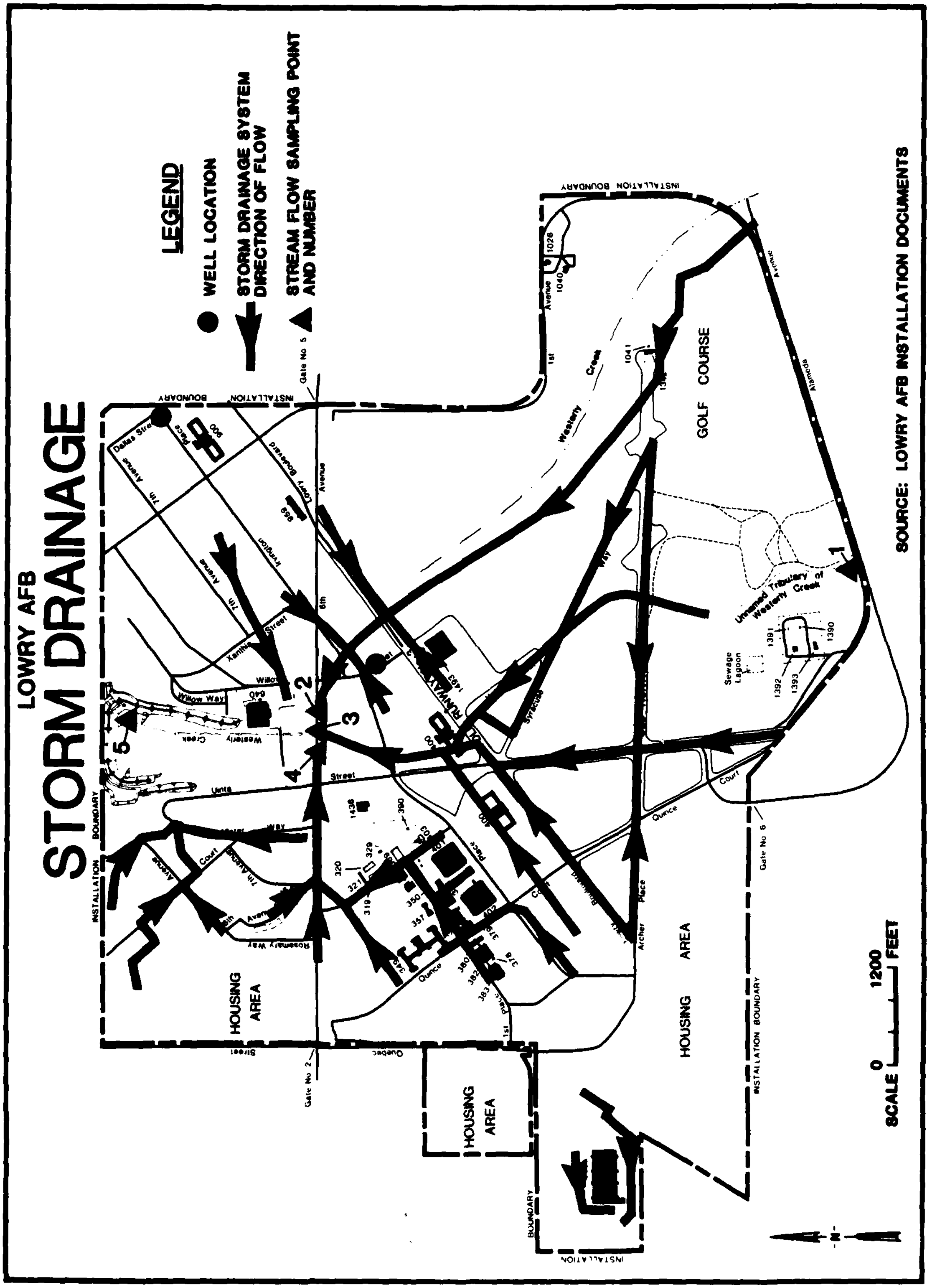
ES ENGINEERING-SCIENCE

FIGURE 3.2



ES ENGINEERING-SCIENCE

FIGURE 3.3



LOWRY AFB
STORM DRAINAGE
LEGEND
WELL LOCATION
STORM DRAINAGE SYSTEM DIRECTION OF FLOW
STREAM FLOW SAMPLING POINT AND NUMBER
SOURCE: LOWRY AFB INSTALLATION DOCUMENTS
SCALE 0 1200 FEET
GOLF COURSE
HOUSING AREA
HOUSING AREA
HOUSING AREA
INSTALLATION BOUNDARY
Gate No 2
Gate No 5
Gate No 6
Westerly Creek
Unnamed Tributary of Westerly Creek
Sewage Lagoon
RUNWAY
Lowry Boulevard
Alameda Avenue
Quince Court
Uinta Street
Syracuse Way
Archer Place
Rosemary Way
Willow Way
Xanthia Street
Dallas Street
6th Avenue
7th Avenue
1st Avenue
Quebec Street

GEOLOGY

The rocks and soils in the area include rocks of Precambrian age and younger and unconsolidated alluvium and loess of Quaternary age. The mountains west of Lowry Air Force Base are composed of Precambrian bedrock. The bedrock formations underlying the base are Tertiary age and older (Table 3.2).

Stratigraphy and Distribution

The Dawson Arkose plus Denver and Arapahoe formations of Upper Cretaceous to Tertiary ages comprise the uppermost rock units in the vicinity of Lowry Air Force Base. These units are composed of sand, clay, shale and sandstone with some coal seams. The combined thickness of these units underlying the base is 1,000 to 1,200 feet.

The Laramie Formation of Upper Cretaceous age underlies the Arapahoe Formation. The Laramie Formation is composed of sand, clay, and shale. Coal seams are common within the formation. The thickness of the Laramie Formation in the vicinity of the base is 600 to 650 feet.

Underlying the Laramie Formation is the Fox Hills Sandstone, also of Upper Cretaceous age. This formation has a thickness of about 200 feet and is composed of shale, shaley sandstone and sandstone. (Robson and others, 1981)

The Pierre Shale of Upper Cretaceous age underlies the Fox Hills Sandstone. The Pierre Shale is composed of shale with thin layers of siltstone and sandstone. The reported thickness of this formation in the Denver area is 5,000 to 8,000 feet (Robson and others, 1981).

Bedrock of Middle-to-Lower Cretaceous age and older underlies the Pierre Shale.

The combined thickness of the undifferentiated Dawson Arkose, Denver Formation and Arapahoe Formation, as well as the thickness of the Laramie Formation at the base were derived from drilling logs for wells that had been drilled on the base. The wells were drilled in 1955 and 1956, and used for watering grass until they were taken out of service in 1976. The location of the wells is shown on Figure 3.3.

The surficial deposits at the base are largely Quaternary age sand and loess that has been deposited by the wind (Shroba, 1980; Trimble and Machette, 1979). The sand is very fine to course and yellowish-brown in

TABLE 3.2
GENERALIZED STRATIGRAPHY

System	Formation	Thickness (feet)	Lithology
Quaternary	Loess and alluvium	7-80	Unconsolidated sand, silt and clay.
Tertiary	Dawson Arkose Denver Formation Arapahoe Formation	1000-1200	Sand, clay, shale and sandstone with some coal seams.
Upper Cretaceous	Laramie Formation	600-650	Sand, clay and shale. Coal seams are common.
	Fox Hills Sandstone	200	Shale, shaley sandstone and sandstone.
	Pierre Shale	5000-8000	Shale
Middle Cretaceous age rocks and older	Not Studied.		

Source: Modified From Pearl (1980).

color. The loess is a yellowish-brown clayey sandy silt. These deposits are relatively permeable and generally allow rapid infiltration of water.

Artificial fill and alluvium comprise the remaining surficial deposits on Lowry Air Force Base. These deposits are located predominately along the Westerly Creek drainageway. The large area of fill on the south side of the base was at one time the base waste disposal area (Site D-1). Figure 3.4 shows the approximate areal distribution of the surficial deposits.

All areas of fill deposits on the base are not mapped. A detailed surficial geology map (Shroba, 1980) was used to identify the distribution of surficial deposits for the western two-thirds of the base. Thin discontinuous fills were not included on the detailed surficial geology map. A generalized surficial geology map (Trimble and Machette, 1979) was used to aid in mapping the surficial deposits for the eastern one-third of the base. This generalized surficial geology map did not include artificial fill areas.

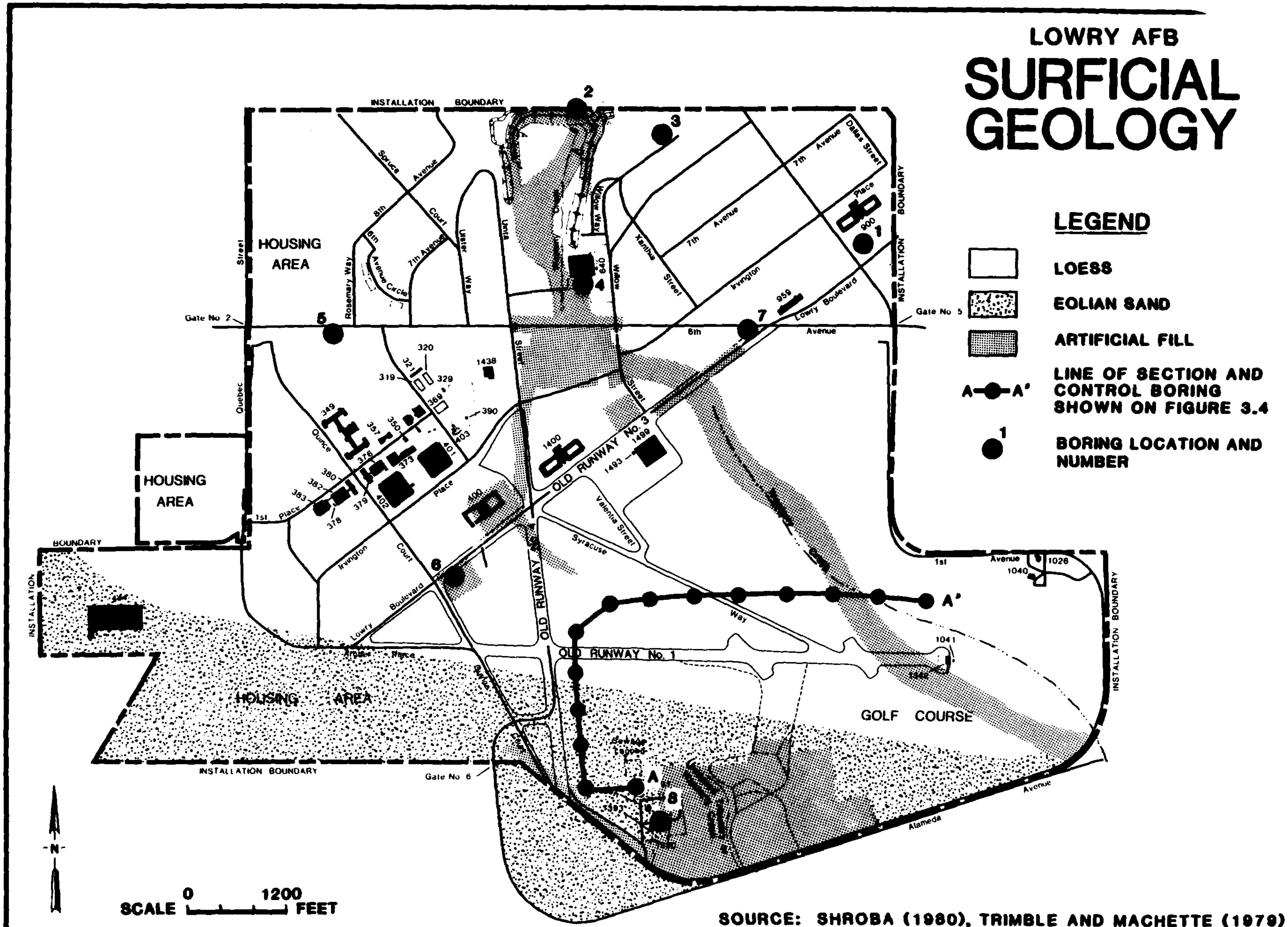
The unconsolidated deposits below the surface are generally sands and clays, and vary in thickness from about 7 feet to more than 51 feet (Table 3.3). The thickest deposits that have been identified by borings are located in the area of the topographic high near the west boundary of the base. Hamilton and Owens (1972) indicate that unconsolidated deposit thicknesses greater than 80 feet exist in the west end of the base. A cross-section through the south area of the base (Figure 3.5) shows the lithology and thickness of the unconsolidated deposits in that area. These deposits are generally sandy clays and clayey sa.. with some sand and clay lenses.

The bedrock surface encountered by shallow borings was generally a weathered shale.

Structure

Lowry Air Force Base is located within the Denver Basin, a major structural feature in the area (Figure 3.6). The basin, which is oval in shape, is the result of rocks dipping inward from all sides. The western edge of the basin is located along the frontal edge of the Rocky Mountains. The basin extends as far north as Greeley and as far south as

FIGURE 3.4



SOURCE: SHROBA (1980), TRIMBLE AND MACHETTE (1979)

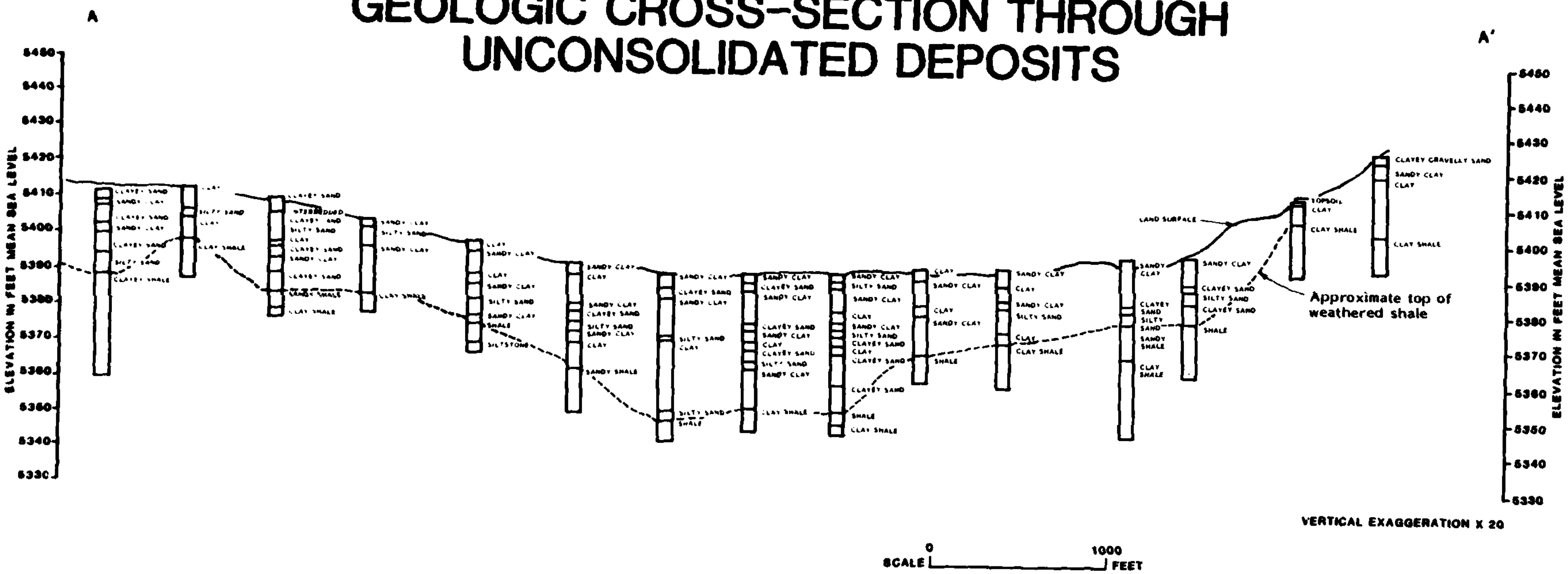
TABLE 3.3
SUMMARY OF SELECTED SOIL BORINGS

Boring Number	Boring Depth (Feet)	Lithology
1	0-16.0	Sandy Clay
	16.0	Claystone and Siltstone (bedrock)
2	0-15.1	Clay
	15.1-20.0	Silt
	20.0	Claystone and Siltstone (bedrock)
3	0-4.9	Sandy Clay
	4.9-8.9	Silty Sand
	8.9-12.8	Sandy Clay
	12.8	Claystone and Siltstone (bedrock)
4	0-1.0	Loess
	1.0-11.2	Sandy Clay
	11.2-16.1	Clayey Sand
	16.1-22.0	Gravely Sand
	22.0	Claystone and Siltstone (bedrock)
5	0-20.0	Sandy Silt
	20.0-39.0	Clayey Gravel
	39.0-51.1	Sandy Silt
6	0-1.0	Silty Sand
	1.0-17.1	Sandy Clay
	17.1-19.0	Silty Sand
	19.0-23.0	Sandy Clay
	23.0-27.9	Sand
	27.9-31.8	Sandy Clay
	31.8-37.7	Clayey Sand
	37.7	Claystone and Siltstone (bedrock)
7	0-6.9	Sandy Clay
	6.9	Claystone, Siltstone and sandstone (bedrock)
8	0-1.0	Clayey Sand
	1.0-6.9	Silty Sand
	6.9-17.1	Sandy Clay
	17.1	Claystone and Siltstone (bedrock)

Modified from Shroba (1980).
Boring locations shown on Figure 3.4.

FIGURE 3.5

LOWRY AFB
GEOLOGIC CROSS-SECTION THROUGH UNCONSOLIDATED DEPOSITS



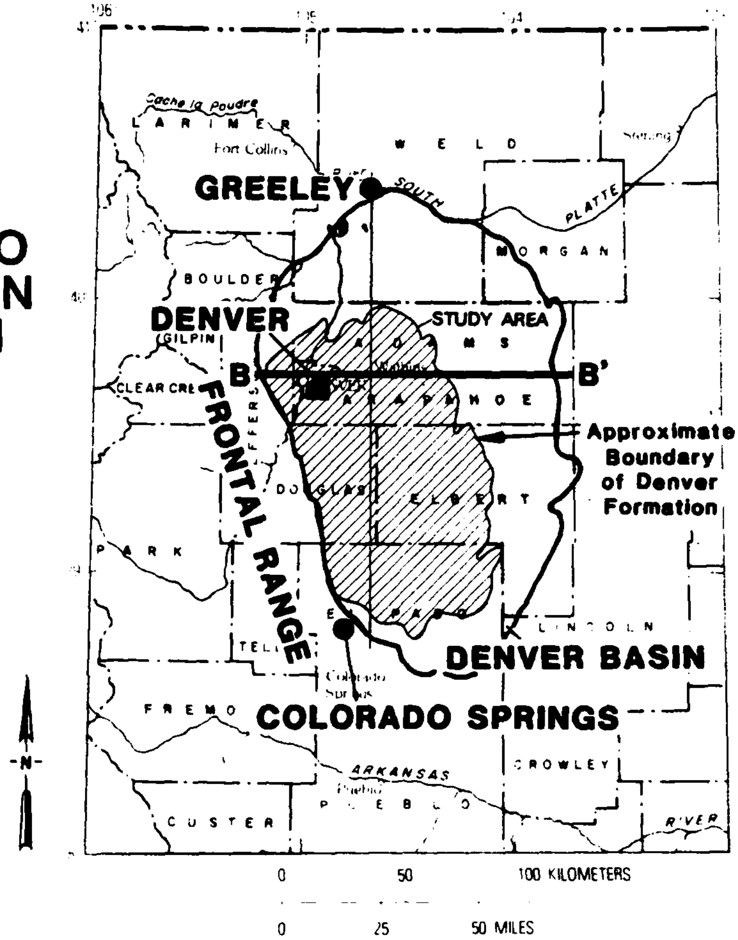
SOURCE: GEOLOGY MODIFIED FROM CORPS OF ENGINEERS, 1980
LINE OF SECTION SHOWN ON FIGURE 3.4

FIGURE 3.6

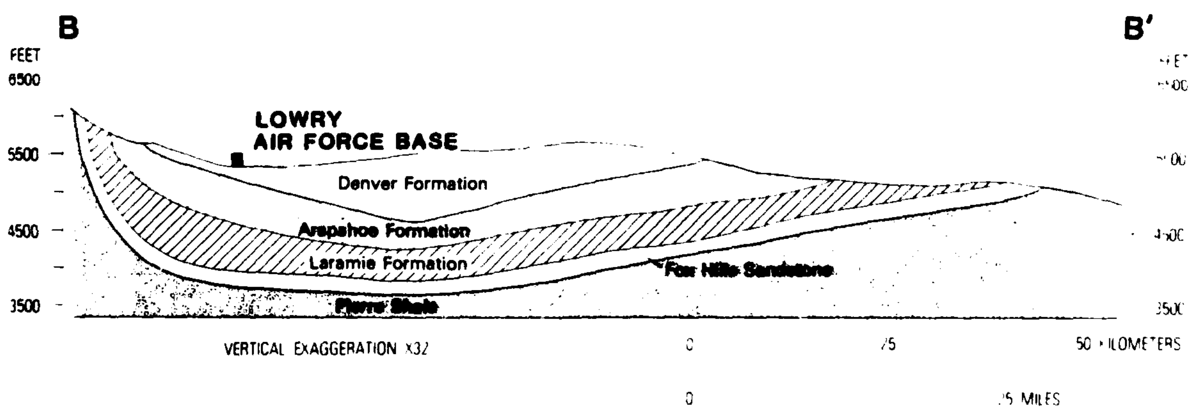
LOWRY AFB

RELATION BETWEEN GEOLOGIC STRUCTURE AND STRATIGRAPHY

A MAP OF COLORADO SHOWING LOCATION OF DENVER BASIN



B GEOLOGIC CROSS-SECTION THROUGH DENVER BASIN



SOURCE: ROBSON AND OTHERS, 1981

ES ENGINEERING-SCIENCE

Colorado Springs. The eastern boundary of the basin is located approximately 80 miles east of the frontal range. The dip of the rocks on the western edge of the basin is relatively steep, while along the eastern edge of the basin the dip of the rocks is relatively gentle. The rocks, which are upturned and outcropped along the western edge of the basin, are two to three thousand feet below the surface in the vicinity of Lowry Air Force Base.

Potentially active faults exist in and around the Denver area (Kirkham and Rogers, 1981). The location of potentially active faults nearest the base are shown on Figure 3.7.

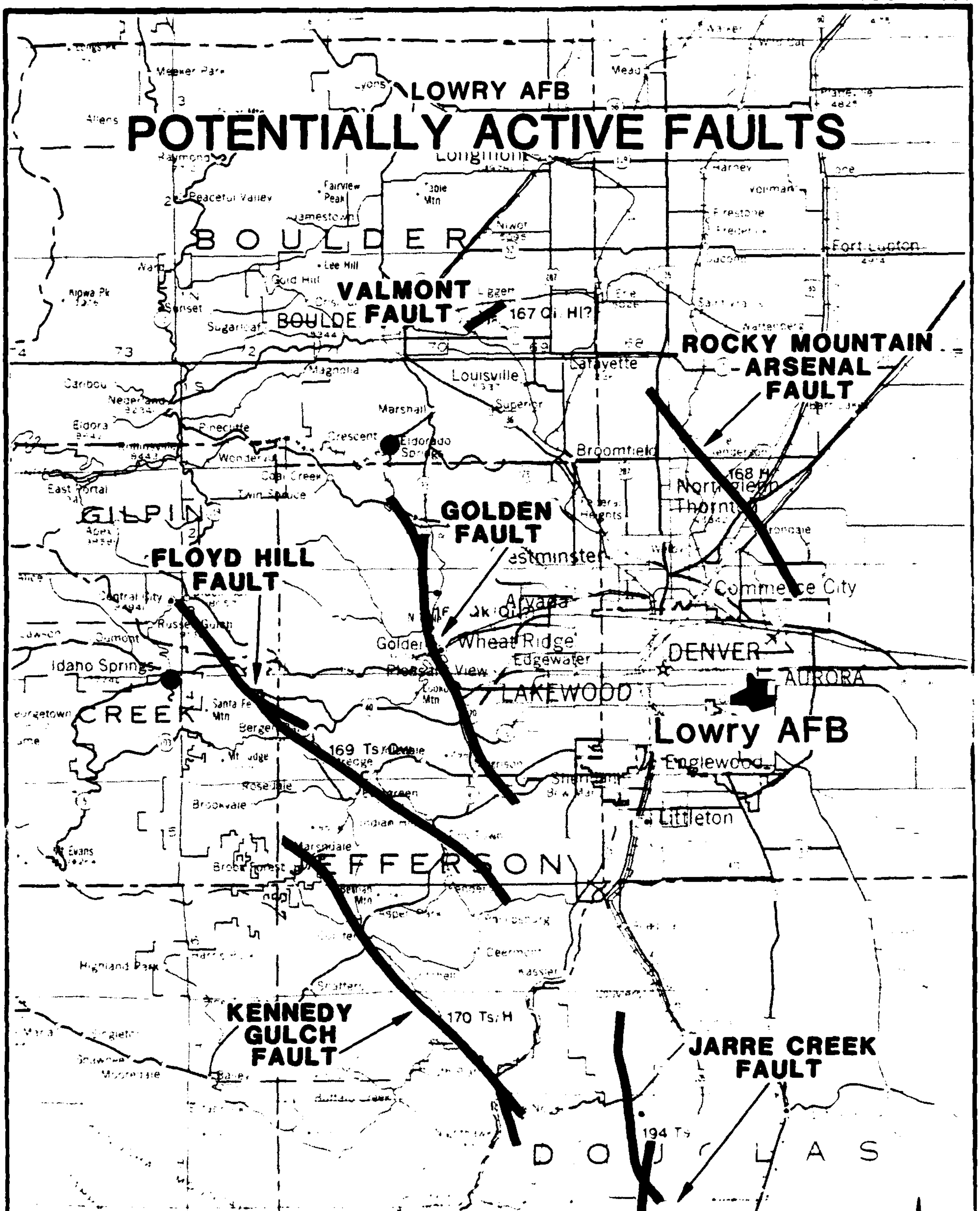
A potentially active fault zone whose origin is in Precambrian age rocks exists approximately five (5) miles north of Lowry Air Force Base. A series of earthquakes that began in 1962 in northeast Denver defined a northwest-southeast trending fault zone that is called the Rocky Mountain Arsenal Fault.

Other potentially active fault zones include the Golden Fault, Floyd Hill Fault, Kennedy Gulch Fault, Jarre Creek Fault and Valmont Fault. The nearest of these faults to Lowry Air Force Base is the Golden Fault located about 18 miles west of the base (Figure 3.7). The Golden and Valmont Faults show evidence of movement within the last 75,000 to 500,000 years. The Floyd Hill, Kennedy Gulch and Jarre Creek Faults show signs of considerable movement within the last 25 million years. Considering the geologic time frame, 25 million years is relatively recent.

Seismicity

Seismic activity has occurred in the Denver area in the past. In November, 1882, an earthquake was felt over much of Colorado and southern Wyoming. This earthquake was centered in the north Denver area, where Modified Mercalli intensities of VII (see Appendix J) were felt. An event of Modified Mercalli Intensity III occurred in the north Denver area in 1916. Earthquakes whose center is in northeast Denver have been observed from 1962 to the present. These earthquakes range in intensity between about II and VII on the Modified Mercalli Intensity Scale. The cause for these earthquakes has been attributed to a deep injection well at the Rocky Mountain Arsenal about five miles north of Lowry Air Force Base. Liquid wastes were injected into the well between 1962 and 1966.

FIGURE 3.7



ES ENGINEERING-SCIENCE

Based on results of recent investigations, Kirkham and Rogers (1981) concluded that the Denver area should be considered as Zone II in the Uniform Building Code scheme of seismic zonation. Denver is currently classified as Zone I in which earthquakes of intensity VI and smaller are likely to occur. Earthquakes of intensity VII have been recorded historically in the Denver area.

An earthquake of intensity VII may be expected to occur once every 100 to 200 years at Lowry Air Force Base (Rogers, oral comm., 1983). An earthquake of this intensity has been observed in the Denver area within the last 100 years.

An earthquake of intensity VII would probably have little or no impact on existing subsurface waste disposal facilities at the base and would not significantly alter ground-water flow paths and contaminant transport in the vicinity of the base. On-base waste disposal facilities are unlined and thus present no potential for failure during an earthquake.

HYDROLOGY

Subsurface Hydrology

Major aquifers in the vicinity of Lowry Air Force Base include alluvial deposits found along the course of Cherry Creek, the Dawson aquifer located generally south of the base and the Denver, Arapahoe and Laramie-Fox Hills aquifers located under the base. The Dawson aquifer is composed of the saturated part of the Dawson Arkose and the Arapahoe aquifer is composed of the saturated part of the Arapahoe Formation. The Laramie-Fox Hills aquifer includes the basal sandstone units of the Laramie Formation and the upper sandstone and siltstone units of the underlying Fox Hills Sandstone.

The Denver aquifer is of greatest interest for this study. It is the uppermost aquifer at the base. The Denver aquifer includes the saturated thickness of the Denver Formation.

The saturated thickness of unconsolidated deposits at the base are probably hydraulically connected to the Denver aquifer and are considered part of the aquifer for this study. Water levels in the unconsolidated deposits are approximately equal to those observed in the Denver aquifer in the vicinity of the base.

The water table is the upper limit of the ground-water reservoir at the base. The water table during 1977, was between 5,381 and 5,413 feet MSL near the south end of the base and between 5,338 and 5,343 feet MSL at the north end of the base (Figure 3.8). Water in these areas varied between about 5 and 15 feet below land surface and occurred in unconsolidated deposits. The water-table configuration was constructed from data collected by the Corps of Engineers as part of a flood control plan study (Corps of Engineers, 1980).

Ground-water flow in the Denver aquifer at Lowry Air Force Base is generally from south to north. Regionally, ground water entering the base is derived from recharge to the aquifer that occurs south of the base. Water leaving the base to the north either discharges to wells in the Commerce City area or to alluvial aquifers in the South Platte River Basin. Regional ground-water flow in the Denver aquifer in the vicinity of the base was estimated based on the work done by Robson and Romero (1981).

There is a potential for contamination of ground water to occur at subsurface waste disposal sites as a result of the ground water coming into direct contact with the disposed wastes. The water table is close to land surface over most of the base.

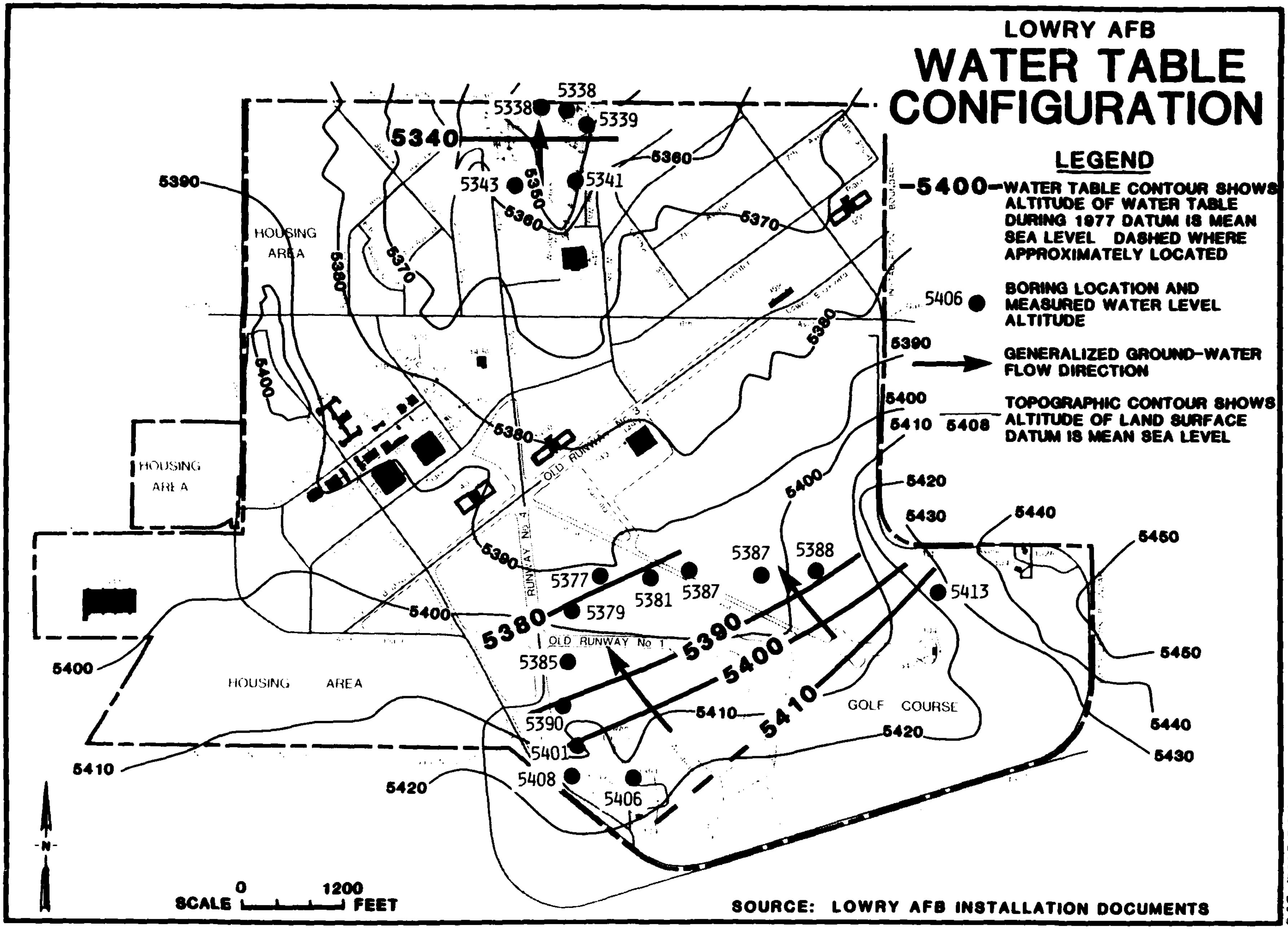
Lateral movement of contaminants in the subsurface would follow the general ground-water flow direction and would be relatively slow. Ground water in the unconsolidated deposits probably moves at an average velocity of less than 135 feet per year. This estimate is based on the slope of the water table, an estimated range in hydraulic conductivity for the unconsolidated deposits and an estimated effective porosity for these deposits.

The movement of contaminants in the ground water would be limited by the attenuating capabilities of the subsurface deposits. Contaminants would be attenuated by the processes of sorption and dilution. The attenuating capabilities of the subsurface at the base are unknown.

Surface Hydrology

Westerly Creek drains most of Lowry Air Force Base (See Figure 3.3). The creek is a combination of open channels and drainage structures that drains in a northerly direction and approximately bisects the

FIGURE 3.8



SOURCE: LOWRY AFB INSTALLATION DOCUMENTS

base. The creek has been observed to flow continuously for at least three years (Oral comm., SSgt. J. Freitas, 1983).

Kelly Road Dam, a Corps of Engineers Flood Control Dam, was constructed on Westerly Creek in 1953. This dam is located on the north end of the base where the creek exits the base. The purpose of this dam is to provide flood protection to residents downstream from the dam.

Periodic flooding of buildings in the Westerly Creek flood plain can be expected at Lowry Air Force Base under current conditions. These floodwaters originate as runoff from the base and from the basin upstream. The approximate limits of flooding for the Corps of Engineers Standard Project Flood (SPF) is shown on Figure 3.9. The recurrence interval for the SPF lies between once every 100 years and once every 500 years.

WATER USE

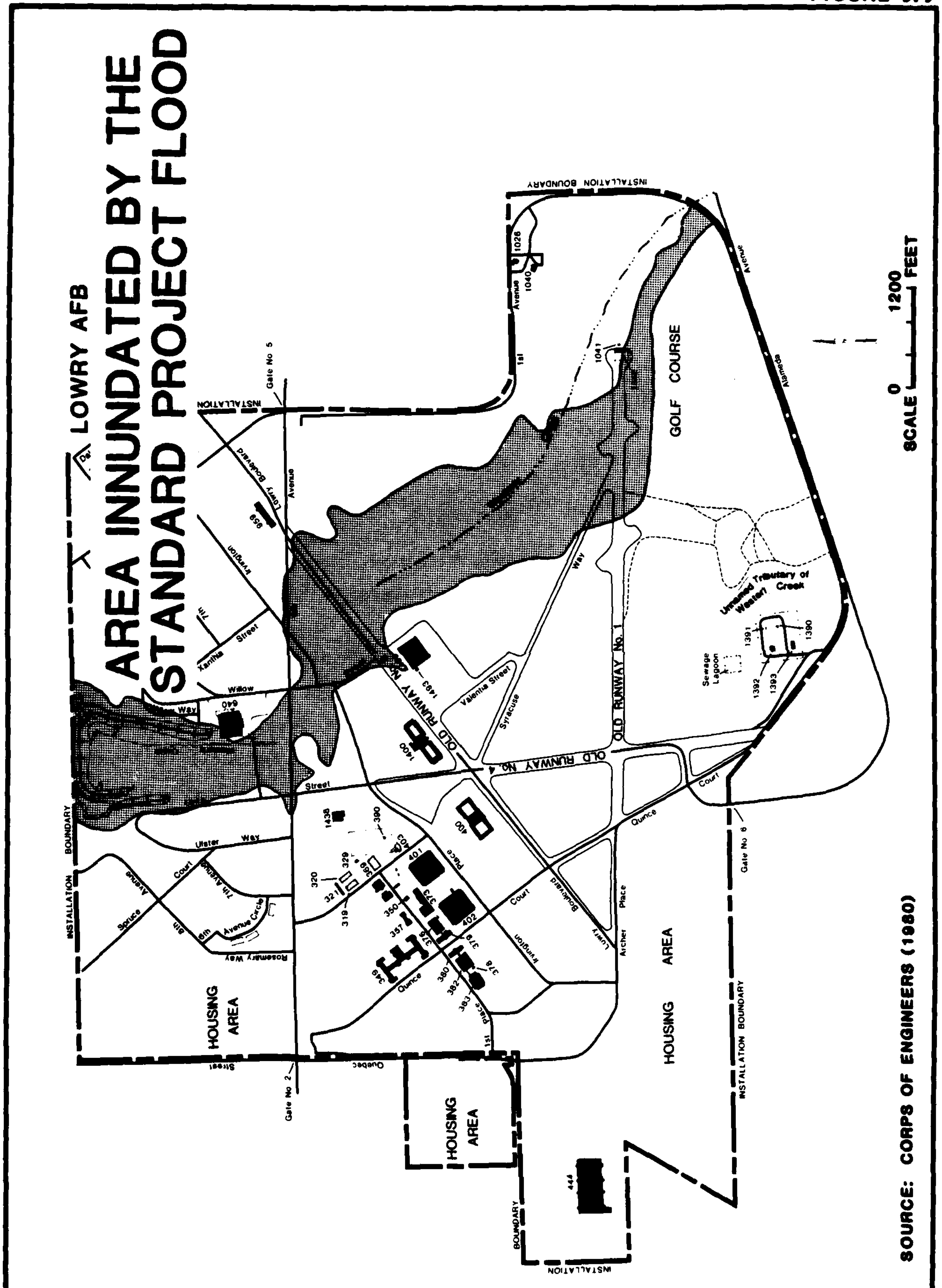
Lowry Air Force Base receives its water supply from the City and County of Denver. Surface and ground waters at the base are not used for supply.

Two deep wells were drilled on the base in the middle 1950's and used for irrigation until their use was discontinued in 1976. These wells withdraw water from the Laramie-Fox Hills aquifer. One well is located in the northeast corner of the base. The other well is located near the center of the base. The well locations are shown on Figure 3.3.

Numerous domestic, commercial, industrial, and municipal supply wells are located within one mile of the base boundaries. Most wells are 25 to 50 feet deep and are probably used as a water source for lawn sprinkling. Some wells are 1,000 to 2,000 feet deep and are probably a source of drinking water. The Glendale Water and Sanitation District has high-capacity shallow wells one to two miles west of the base.

WATER QUALITY

Surface water samples are collected quarterly from Westerly Creek by base personnel at five sampling points (Figure 3.3). Sampling Point 1 is near the nose cone facility on an unnamed tributary to Westerly Creek where the creek enters the base. Points 2, 3 and 4 are on Sixth


LOWRY AFB
AREA INNUNDATED BY THE STANDARD PROJECT FLOOD
GOLF COURSE
HOUSING AREA
HOUSING AREA
HOUSING AREA
OLD RUNWAY No. 1
OLD RUNWAY No. 4
INSTALLATION BOUNDARY
Gate No 5
Gate No 2
Gate No 6
Sewage Lagoon
Unnamed Tributary of Westerly Creek
Lowry Boulevard
Alameda Avenue
SCALE 0 1200 FEET
SOURCE: CORPS OF ENGINEERS (1980)

Avenue where drainage from the southwest, south, and southeast, respectively, discharges to the creek. Sampling Point 5 is on Westerly Creek where the creek exits the base. The discharges at Point 2 and Point 3 include water that enters the base.

The water quality of Westerly Creek varies areally (Table 3.4). The total dissolved solids content of the water at Point 2, which includes water that drains the southeast area of the base, was 1,100 to 1,500 mg/l. The total dissolved solids content of the water at Points 3 and 4 that drain the south and southwest portions of the base generally ranged between 200 and 600 mg/l. The high sulfate content of water samples taken from Point 2 accounts for about one-half of the dissolved solids content observed at the site. The origin of the sulfates is unknown. They could be occurring off-base.

Two anomalies in heavy metals content of the sampled waters were apparent during 1982. First, the zinc content of the water at Point 4 is consistently higher than that for waters at the other sampling locations. Second, the lead content was very high in August for all of the sampled waters. The reason for the increased zinc content in the water draining the southwest part of the base is unknown. The reason for the high lead concentrations in the water for the August sampling is also unknown. However, the fact that the lead content of the water at each sampling site was about 0.4 mg/l suggests the possibility that the samples may have inadvertently become contaminated with lead.

Westerly Creek is classified for recreational use (Colorado Dept. of Health, 1981). Physical and biological standards include dissolved oxygen for the water equal to 5.0 milligrams per liter, pH for the water of 6.5 to 9.0 standard units and fecal coliforms equal to 2000 per 100 milliliters. No inorganic or metals standards have been established for water in the creek.

Water from the two wells on the base is a sodium-bicarbonate type water. This description is based on the results of samples taken for chemical analyses in 1971 by the U.S. Geological Survey (Table 3.5). The water is slightly above recommended limits for dissolved iron and total dissolved solids in public water supplies (USEPA, 1975).

TABLE 3.4
SUMMARY OF SELECTED CHEMICAL ANALYSES FOR WESTERLY CREEK DURING 1982
(Analyses in Milligrams Per Liter)

Date	Sampling Point	Sulfate	Chloride	Nitrate	Phosphate	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Silver	Zinc	Mercury	Total Organic Carbon	Phenols	Total Dissolved Solids
Feb.	1	60	88	0.7	0.28	<0.01	<0.05	<0.02	0.214	<0.05	0.800	<0.01	<0.05	<5	2	<0.01	509
	2	750	72	3.2	0.18	<0.01	<0.05	<0.02	0.180	<0.05	0.241	<0.01	<0.05	<5	1	<0.01	1500
	3	354	88	1.6	0.34	<0.01	<0.05	<0.02	0.280	<0.05	0.106	<0.01	0.051	<5	2	<0.01	1120
	4	54	32	0.2	3.40	<0.01	<0.05	0.037	0.476	<0.05	<0.05	<0.01	0.219	<5	15	<0.01	272
	5	375	56	0.2	0.41	<0.01	<0.05	<0.02	0.374	<0.05	.148	<0.01	<0.05	<5	2	<0.01	1090
May	1	36	40	<0.10	0.24	<0.01	<0.05	<0.02	0.190	<0.05	0.304	<0.01	<0.05	<5	12	<0.01	357
	2	86	15	2.5	0.16	<0.01	<0.05	<0.02	0.467	<0.05	0.113	<0.01	<0.05	<5	13	<0.01	1490
	3	84	16	1.1	0.16	<0.01	<0.05	<0.02	0.983	<0.05	<0.05	<0.01	<0.05	<5	5	<0.01	520
	4	-	-	0.4	2.60	<0.01	<0.05	0.020	0.369	<0.05	<0.05	<0.01	0.212	<5	10	<0.01	-
	5	96	148	1.8	0.23	<0.01	<0.05	<0.02	0.424	<0.05	.090	<0.01	0.05	<5	8	<0.01	1280
Aug.	1	66	44	<0.10	0.31	<0.01	<0.05	0.077	<0.100	0.411	0.186	<0.01	<0.05	<5	7	<0.01	360
	2	790	84	2.1	0.13	<0.01	<0.05	<0.02	0.103	0.413	0.095	<0.01	<0.05	<5	5	<0.01	1580
	3	74	52	1.2	0.22	<0.01	<0.05	<0.02	0.110	0.394	<0.05	<0.01	<0.05	<5	6	<0.01	463
	4	31	20	0.2	0.87	<0.01	<0.05	0.072	0.359	0.400	<0.05	<0.01	0.63	<5	9	<0.01	153
	5	620	84	1.6	0.21	<0.01	<0.05	0.060	0.166	0.400	<0.05	<0.01	<0.05	<5	11	<0.01	1280
Nov.	1	48	56	<0.20	<0.10	<0.01	<0.05	<0.02	0.484	<0.05	1.091	<0.01	<0.05	<2	5	<0.01	493
	2	670	72	1.3	0.2	<0.01	<0.05	<0.02	0.102	<0.05	0.153	<0.01	<0.05	3	6	<0.01	1450
	3	57	56	1.1	0.34	<0.01	<0.05	<0.02	<0.100	<0.05	<0.05	<0.01	<0.05	<2	6	<0.01	585
	4	41	8	0.1	1.41	<0.01	<0.05	0.035	0.203	<0.05	<0.05	<0.01	0.92	<2	6	<0.01	192
	5	700	84	1.9	0.39	<0.01	<0.05	<0.02	0.652	<0.05	.167	<0.01	<0.05	3	6	0.02	1450

TABLE 3.5

SUMMARY OF SELECTED CHEMICAL ANALYSES FOR WATER FROM WELLS

(Analyses in milligrams per liter except as noted)

Well Location Limitations (1)	Well Depth (Ft)	Water Sampling Date	Calcium Ca NA	Magnesium Mg NA	Sodium Na NA	Potassium K NA	Bicarbonate HCO_3 NA	Carbonate CO_3 NA	Sulfate SO4 250	Chloride Cl 250	Silica Si NA	Iron Fe 0.3	Total Dissolved Solids 500	pH (Standard Units) NA
Lowry Air Force Base, Bldg. 950	2023	11/16/71	3.0	0.4	220	2.2	521	0	0	58	15	0.36	588	7.8
Lowry Air Force Base, Bldg. 1432	2000	11/16/71	3.2	0.6	230	2.1	518	0	0.0	57	15	0.48	592	7.9
Lowry Training Annex, Demonstration Range	1384	11/16/71	7.3	0.8	70	6.7	200	0	15	3.7	14	0.20	234	8.2
		07/27/72	7.9	0.6	71	13	152	23	21	3.9	12	0.19	250	8.6
		07/16/73	10	0.9	110	4.8	185	17	18	55	12	0.25	309	8.9
		06/13/74	9.0	0.9	71	3.3	185	1	20	7.2	13	0.15	215	8.5
		12/01/75	11	0.6	71	4.7	173	7	21	7.4	11	0.15	210	9.0
		07/29/76	13	1.2	71	7.0	184	0	30	9.4	11	0.11	240	-
Lowry Training Annex, Ammunition Storage Area	1500	11/22/71	12	1.7	79	6.3	157	0	87	7.4	11	0.38	268	8.5
		07/27/72	14	3.4	100	8.3	132	0	150	11	9.6	3.2	392	8.2
		07/16/73	37	4.5	92	7.9	154	3	180	12	10	0.24	418	8.4
		06/13/74	23	2.8	79	4.2	161	1	86	8.9	11	0.04	313	8.5
		12/01/75	13	1.3	69	4.2	147	6	50	4.9	8.8	0.17	226	8.6
		07/29/76	15	2.0	76	4.7	149	0	75	6.9	9.2	0.24	264	-
Lowry Training Annex-Stock Well No. 1	11	10/11/74	-	-	-	-	-	-	-	21	-	-	667	-
Lowry Training Annex-Stock Well No. 2	24	10/11/74	-	-	-	-	-	-	-	26	-	-	905	-
Dillon Recreation Area	108	07/26/72	7.9	0.9	1.3	0.8	43	0	4.7	2.1	6.9	2.9	66	6.2
		07/11/73	6.7	0.9	3.9	1.3	41	0	3.8	3.3	6.7	5.9	49	7.0
		06/12/74	5.5	0.9	2.1	1.0	30	0	4.4	2.0	7.2	3.8	66	6.7
		07/28/76	7.3	1.2	2.1	0.8	44	0	5.2	2.6	6.3	6.1	56	-

1. Recommended limit for public water supply, in mg/l (USEPA, 1975).
2. NA: Not Applicable.

SATELLITE FACILITIES

Lowry Air Force Base operates two Satellite Facilities. One, the Lowry Training Annex, is located approximately 16 miles east of the base. The other, the Dillon Recreation Area, is located about 80 miles west of the base. The environmental setting at each of these locations is discussed below.

Lowry Training Annex

The Lowry Training Annex is located in a physiographic setting similar to the base. The Training Annex is an area of grass-covered tablelands that are generally covered by alluvium and loess. Precipitation received at the Training Annex is about the same as that received at the base. Coal Creek, a minor tributary to the South Platte River, traverses the southwest corner of the Training Annex and drains most of the Annex (Figure 3.10).

The geology at the Training Annex is similar to that at the base. The undifferentiated Dawson and Denver Formations comprise the bedrock unit. Cretaceous age and older rock formations underlie these formations. The surficial deposits are Quaternary age alluvium and loess. The alluvium is confined to the valley of Coal Creek and has a maximum thickness of about 25 feet (USGS, 1976). Approximately four feet of unconsolidated material was encountered above bedrock when a water supply well was drilled at the Demonstration Range. Bedrock was reported at the surface when the Ammunition Storage Area water supply well was drilled.

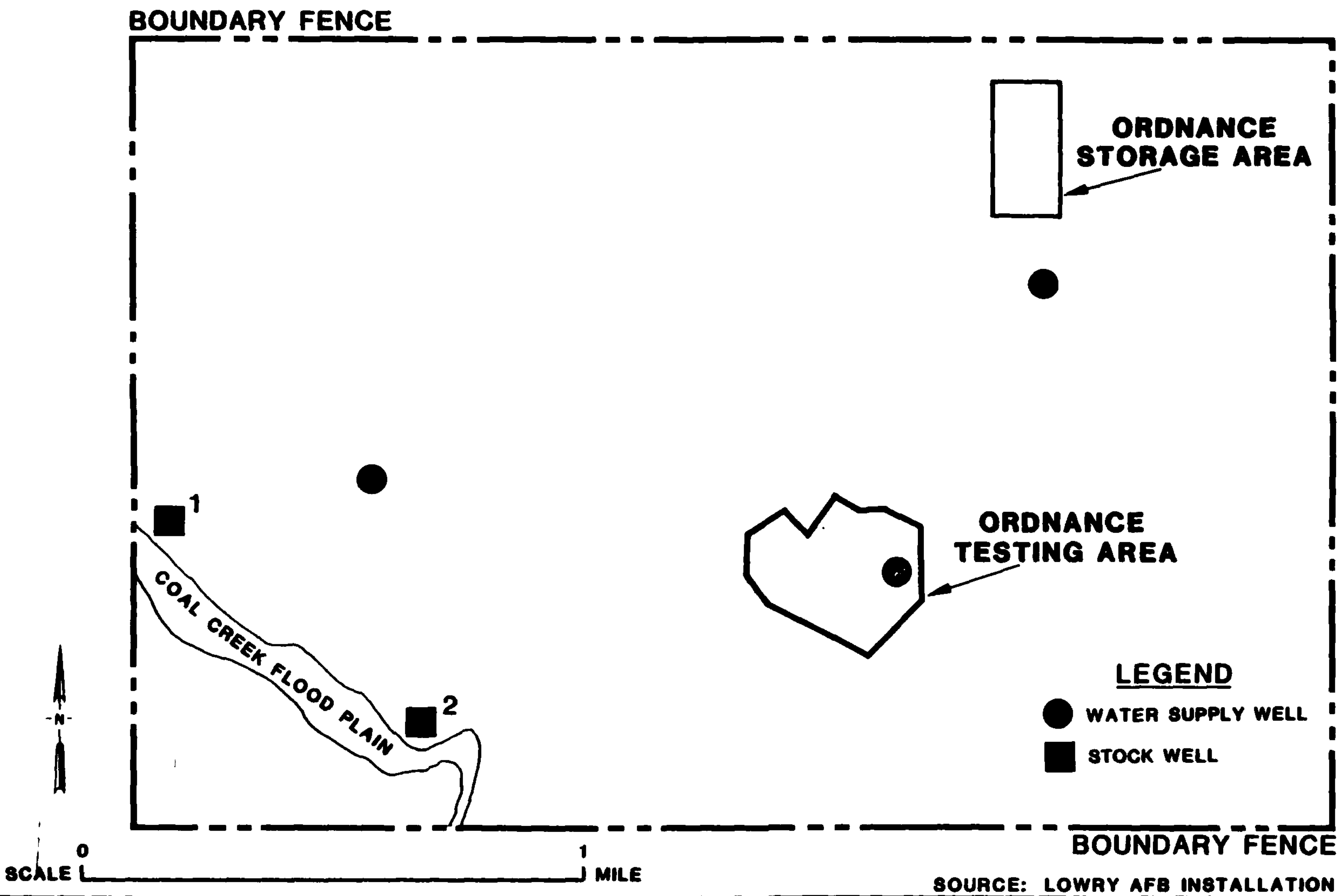
Three wells supply the drinking water for facilities on the Training Annex. One well is located at the Demonstration Area and supplies water to the facilities there. A second well is located at the Ammunition Storage Area and supplies water to those facilities. A third well is located at the Ordnance Testing Area. The Demonstration Area and Ammunition Storage Area wells are deep wells with depths reported on drilling logs of 1,384 and 1,500 feet, respectively. The Ordnance Testing Area is a shallow bedrock well with a reported depth of 110 feet (R. Bjarnason, oral comm., 1983).

Ground water occurs in the valley alluvium and in the rock units. Water levels in shallow wells completed in the alluvium are 10 to 15 feet below land surface and ground-water movement in the alluvium is

FIGURE 3.10

LOWRY AFB

LOCATION OF WELLS AT LOWRY TRAINING ANNEX



SOURCE: LOWRY AFB INSTALLATION DOCUMENTS

generally down the valley in a north to northwest direction (Robson, 1976). The ground-water altitude in the alluvium is about 5,700 feet mean sea level where Coal Creek traverses the annex.

Water levels in deep wells are lower than water levels in the shallow alluvium. The water levels observed in wells drilled at the Demonstration Range and Ammunition Storage Area in 1969 were 100 to 150 feet lower than the general water level in the alluvium. The depth to water at the Demonstration Range well is about 280 feet. The depth to water at the Ammunition Storage Area is approximately 400 feet.

Numerous domestic, stock and irrigation wells are located within one mile of the Training Annex boundaries and two stock wells are located on the annex near Coal Creek.

Water from the two deep wells on the Training Annex is a sodium-sulfate-bicarbonate water. This description is based on the results of samples taken for chemical analyses between 1971 and 1976 by the U.S. Geological Survey (Table 3.5). The water generally meets recommended limits for dissolved constituents in public water supplies (USEPA, 1975). Water samples are taken twice monthly by personnel from Lowry Air Force Base and tested to assure that the water is bacteriologically safe.

Dillion Recreation Area

The Dillon Recreation Area is located in the Rocky Mountains near the western edge of the Frontal Range. Precambrian age rocks occur at or very near the surface throughout most of the area. Rainfall at the Recreation Area averages between 30 and 40 inches per year.

One well supplies drinking water for facilities in the Recreation Area. This well is completed at a depth of 108 feet.

Water from the well is a calcium-bicarbonate type water and is high in iron (Table 3.5) Except for the high iron content, the water meets recommended limits for dissolved constituents in public water supplies (USEPA, 1975). The recommended upper limit for iron is 0.3 mg/l. The iron content of the water at the Recreation Area varies between three and six mg/l.

Water samples are taken twice monthly by personnel from Lowry Air Force Base during the recreation season. The samples are tested to assure that the water is bacteriologically safe.

SUMMARY OF ENVIRONMENTAL SETTING

The environmental setting data reviewed for this investigation identified the following major points that are relevant to Lowry Air Force Base.

- o The normal annual precipation at the base is 15.5 inches and yearly net precipitation is -30 inches. The negative value of yearly net precipitation indicates that yearly evaporation is greater than yearly rainfall and that water will evaporate from the land surface at a greater rate than it can be replenished. Hence, the low net precipitation at this installation reduces the potential for contaminant migration.
- o The base is located in a moderately active seismic area. Earthquakes of Modified Mercalli Intensity VII have occurred in the area in the recent past. An earthquake of this magnitude will probably have little or no impact on existing subsurface waste disposal facilities and will not significantly alter ground-water flow paths and contaminant transport.
- o Ground-water flow in the Denver aquifer at the base is generally to the north. Water entering the base is derived from recharge to the aquifer south of the base. Water leaving the base discharges to wells in the Commerce City area or to alluvial aquifers in the South Platte River basin.
- o The surficial unconsolidated deposits at the base are generally permeable and allow rapid infiltration of water.
- o Contamination of ground water may potentially occur at subsurface waste disposal sites on the base because of the close proximity of the water table to the land surface. Ground water periodically comes into contact with the buried wastes.
- o Lateral movement of contaminants in the subsurface environment at the base will follow the general ground-water flow direction and will be relatively slow. Ground water in the unconsolidated deposits probably moves at an average velocity of less than 135 feet per year.
- o The water quality of Westerly Creek, which drains most of the base, varies areally. The total dissolved solids content of the water that drains the southeast area of the base was 1,100 to

1,500 mg/l in 1982. The total dissolved solids content of the water that drains the south and southwest portions of the base generally ranged between 200 and 600 mg/l. Sulfate accounts for approximately one-half of the dissolved solids content of the water draining from the southeast. The origin of the sulfates is unknown. They could be occurring off-base.

- The base has been subjected to an increased flooding potential because of urbanization of the Westerly Creek drainage basin.

SECTION 4

FINDINGS

To assess hazardous waste management at Lowry Air Force Base, Lowry Training Annex and Dillon Recreational Area, past activities of waste generation and disposal methods were reviewed. This section summarizes the hazardous waste generated by activity; describes waste disposal methods; identifies the disposal sites located on the base; and evaluates the potential for environmental contamination.

PAST SHOP AND BASE ACTIVITY REVIEW

To identify past base activities that resulted in generation and disposal of hazardous waste, a review was conducted of current and past waste generation and disposal methods. This activity consisted of a review of files and records, interviews with base employees, and site inspections.

The source of most hazardous wastes on Lowry AFB can be associated with one of the following activities:

- Industrial operations (shops)
- Pesticide utilization
- Fuels management
- Fire training
- EOD (Lowry Training Annex)

The following discussion addresses only those wastes generated on Lowry AFB which are either hazardous or potentially hazardous. In this discussion a hazardous waste is defined as hazardous by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) or by Colorado regulations concerning hazardous waste. A potentially hazardous waste is one which is suspected of being hazardous, although insufficient data are available to fully characterize the waste material.

Industrial Operations (Shops)

Since early 1940 through 1966, industrial operations (shops) at Lowry AFB have included maintenance activities to support aircraft flying missions. These shops maintained, fabricated and repaired components and parts of aircraft and ground equipment. Since 1966, shops have been operated at Lowry to support its training mission. A list of past and present industrial shops was obtained from the Bioenvironmental Engineering Services (BES) files. Information contained in the files indicated those shops which generate hazardous waste and/or handle hazardous materials. A summary review of the shop files is shown in Appendix D, Master List of Industrial Shops.

For those shops that generated hazardous waste, key personnel within the base maintenance support functions were interviewed. A timeline of disposal methods was established for major wastes generated. The information from interviews with base personnel and base records has been summarized in Table 4.1. This table presents a list of building locations as well as the waste material names, waste quantities, and disposal method timeline. Many of the disposal methods were identified from information obtained from personnel currently at the base. The waste quantities shown in Table 4.1 are based on verbal estimates given by shop personnel at the time of the interviews. The shops that have generated insignificant quantities or no hazardous waste are not listed in Table 4.1.

From the time operations began at the base (1940) until 1966, most highly-combustible wastes generated at the various facilities throughout the base were drummed and delivered to the Fire Training Area and burned by the fire department during routine training exercises. Chemical wastes may also have entered the sanitary sewer during this period. From the early 1970's until the late 1970's reusable chemical wastes (i.e., some solvents and cleaning solutions) and waste petroleum products were typically stored at the generators site until a USAF organization could be found to re-use the material. Since 1980, most hazardous wastes have been accumulated on-base at one of four storage locations (Sites S-4, S-5, S-6 and S-7) before being delivered to DPDO at the Rocky Mountain Arsenal for disposal (Figure 4.1). Used oil is

TABLE 4.1

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.) PRESENT	LOCATION (BLDG. NO.) PAST	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL 1940 1950 1960 1970 1980
3415th CONSOLIDATED MAINTENANCE SQUADRON					
CORROSION CONTROL	363		TOLUENE	3 GALS./MO.	1940 FLOOR PIT TO STORM DRAIN DPDO
			LAQUER THINNER & PAINTS	12 GALS./MO.	FLOOR PIT TO STORM DRAIN DPDO
BATTERY SHOP	401		BATTERY ACID	15 GALS./MO.	NEUTRALIZED TO SANITARY SEWER
AVIONICS AGE	404	869	TRICHLOROETHANE	<1 GAL./MO.	DPDO
			WASTE OILS	75 GALS./MO.	DPDO
PNEUDRAULICS SHOP	903		PD-680	6 GALS./MO.	DPDO
MISSILE COURSE	903	901	TRICHLOROETHANE	<1 GAL./MO.	1961 DPDO
			THINNER	<1 GAL./MO.	DPDO
SPECIAL WEAPONS MAINTENANCE	1497	842, 844, 1033	TRICHLOROETHANE	<1 GAL./MO.	DPDO
			ACETONE	<1 GAL./MO.	DPDO
			METHYL ETHYL KETONE	<1 GAL./MO.	DPDO
			DENATURED ALCOHOL	<1 GAL./MO.	DPDO
			THINNER, DOPE & LAQUER	<1 GAL./MO.	DPDO

KEY

——— CONFIRMED TIME FRAME DATA BY SHOP PERSONNEL

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

NOTE: WASTES DESIGNATED FOR DPDO HANDLING ARE STORED ON BASE AT VARIOUS LOCATIONS PRIOR TO DELIVERY TO OR SALE BY THE OFF BASE DPDO OFFICE AT ROCKY MOUNTAIN ARSENAL.

TABLE 4.1 (cont'd)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.) PRESENT	PAST	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL 1940 1950 1960 1970 1980
3415th CONSOLIDATED MAINTENANCE (cont'd)					
TRAINING AIDS FABRICATION/ SHEET METAL	1475	1704	ACETONE	4 GALS./MO.	1940 - - - DPDO →
			PAINTS & THINNERS	2 GALS./MO.	1940 - - - DPDO →
TRAINING AIDS, PAINT	1475	1704	PAINTS & THINNERS	<5 GALS./MO.	1940 - - - DPDO →
F-15, ELECTRICAL	859	869	ETHYL ALCOHOL	<1 GAL./MO.	1975 - - - DPDO →
F-16, MAINTENANCE	859	869	GLACIAL ACETIC ACID	<1 GAL./MO.	1975 - - - DPDO →
F-111, MAINTENANCE	859	869	GLACIAL ACETIC ACID	<1 GAL./MO.	1966 - - - DPDO →
			METHYL ETHYL KETONE	<1 GAL./MO.	1966 - - - DPDO →
			ACETONE	<1 GAL./MO.	1966 - - - DPDO →
3415th CIVIL ENGINEERING SQUADRON					
ENTOMOLOGY	329	265	EXCESS PESTICIDE AND CANISTER RINSATE	<20 GALS./MO.	1937 SANITARY SEWER OR REUSED - - - 1975 REUSED →
			EMPTY PESTICIDE CONTAINERS	35/MO.	1937 - - - DUMPSTER - - - →

KEY

——— CONFIRMED TIME FRAME DATA BY SHOP PERSONNEL

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

NOTE: WASTES DESIGNATED FOR DPDO HANDLING ARE STORED ON BASE AT VARIOUS LOCATIONS PRIOR TO DELIVERY TO OR SALE BY THE OFF-BASE DPDO OFFICE AT ROCKY MOUNTAIN ARSENAL.

TABLE 4.1 (cont'd)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.) PRESENT	LOCATION (BLDG. NO.) PAST	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1940–1980)
3415th CIVIL ENGINEERING SQUADRON (cont'd)					
LOCKSMITH SHOP	364	265	EMPTY GRAPHITE CONTAINERS	<2/MO.	1937 DUMPSTER
			EMPTY SPRAY CANS	2 CANS/MO.	DUMPSTER
HEATING SHOP	366	265	PD-680	<1 GAL./MO.	DPDO
EXTERIOR ELECTRIC	366	265	PCB (CONTAMINATED) TRANS-FORMERS	<1/MO.	DPDO
HEATING PLANT	361		CAUSTIC POTASH	<1 GAL./MO.	DRAIN TO GROUND 1976
			STANNOUS CHLORIDE	30 ml./MO.	SANITARY SEWER
LAWN MOWER REPAIR	403		PD-680	<5 GALS./MO.	DPDO
PACKING AND CRATING	597		EMPTY SPRAY PAINT CANS	50 CANS/MO.	DUMPSTER
PAINT SHOP	363	265	THINNER	3 GALS./MO.	DPDO
3415th AIR BASE GROUP					
BASE HOBBY CRAFT SHOP	629	935	PHOTOCHEMICALS	15 GALS./MO.	1940 SANITARY SEWER
			STONE CUTTING OIL	<1 GAL./MO.	DRAIN TO GROUND

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

NOTE: WASTES DESIGNATED FOR DPDO HANDLING ARE STORED ON BASE AT VAROUS LOCATIONS PRIOR TO DELIVERY TO OR SALE BY THE OFF-BASE DPDO OFFICE AT ROCKY MOUNTAIN ARSENAL.

TABLE 4.1 (cont'd)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.) PRESENT	LOCATION (BLDG. NO.) PAST	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1940 1950 1960 1970 1980)
3415th AIR BASE GROUP (cont'd)					
AUTO HOBBY SHOP	1430	381	SODIUM HYDROXIDE CONTAINERS	3/MO.	1940 DUMPSTER
			WASTE OIL	400 GALS./MO.	OIL/WATER SEPERATOR; DPDO
			PD-680	10 GALS./MO.	SANITARY SEWER; DPDO
			SODIUM HYDROXIDE WASH	10 POUNDS/MO.	DILUTE TO SANITARY SEWER
BX SERVICE STATION	606	862	UNDERCOATING	4 POUNDS/MO.	1937 SANITARY SEWER
TRANSPORTATION DIVISION					
HEAVY EQUIPMENT MAINTENANCE	369		MURATIC ACID	<1 GAL./MO.	SANITARY SEWER
			OAKITE CLEANER	40 POUNDS/MO.	SANITARY SEWER
			PD-680	55 GALS./MO.	FIRE TRAINING; DPDO
			WASTE OILS	200 GALS./MO.	DPDO
VEHICLE MAINTENANCE	1438	362	PAINT RESIDUES	55 GALS./MO.	FIRE TRAINING; DPDO
			WASHRACK RUNOFF	ESTIMATE NOT AVAILABLE	DRAIN TO GROUND
			WASTE OILS	120 GALS./MO.	DPDO

KEY

——— CONFIRMED TIME FRAME DATA BY SHOP PERSONNEL

- - - - ESTIMATED TIME FRAME DATA BY SHOP PERSONNEL

NOTE: WASTES DESIGNATED FOR DPDO HANDLING ARE STORED ON BASE AT VAROUS LOCATIONS PRIOR TO DELIVERY TO OR SALE BY THE OFF BASE DPDO OFFICE AT ROCKY MOUNTAIN ARSENAL.

TABLE 4.1 (cont'd)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.) PRESENT	LOCATION (BLDG. NO.) PAST	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1940–1980)
3400th TECHNICAL TRAINING WING					
LASER TRAINING	373		PHOTOCHEMICALS	10 GALS./MO.	1970 SANITARY SEWER
SOLDERING COURSE	903		SOLDERING FLUX	2 POUNDS/MO.	1940 DUMPSTER
PHOTO TRAINING	382/383		PHOTOCHEMICALS	10,500 GALS./MO.	SANITARY SEWER
			VARIOUS IGNITABLES ON RAGS	20 POUNDS/MO.	DUMPSTER
USAF CLINIC					
DENTAL CLINIC	753	753, 898	PHOTOCHEMICALS	12 GALS./MO.	1937 SANITARY SEWER
			ELECTROPLATING SOLUTION	1 GAL./MO.	SANITARY SEWER

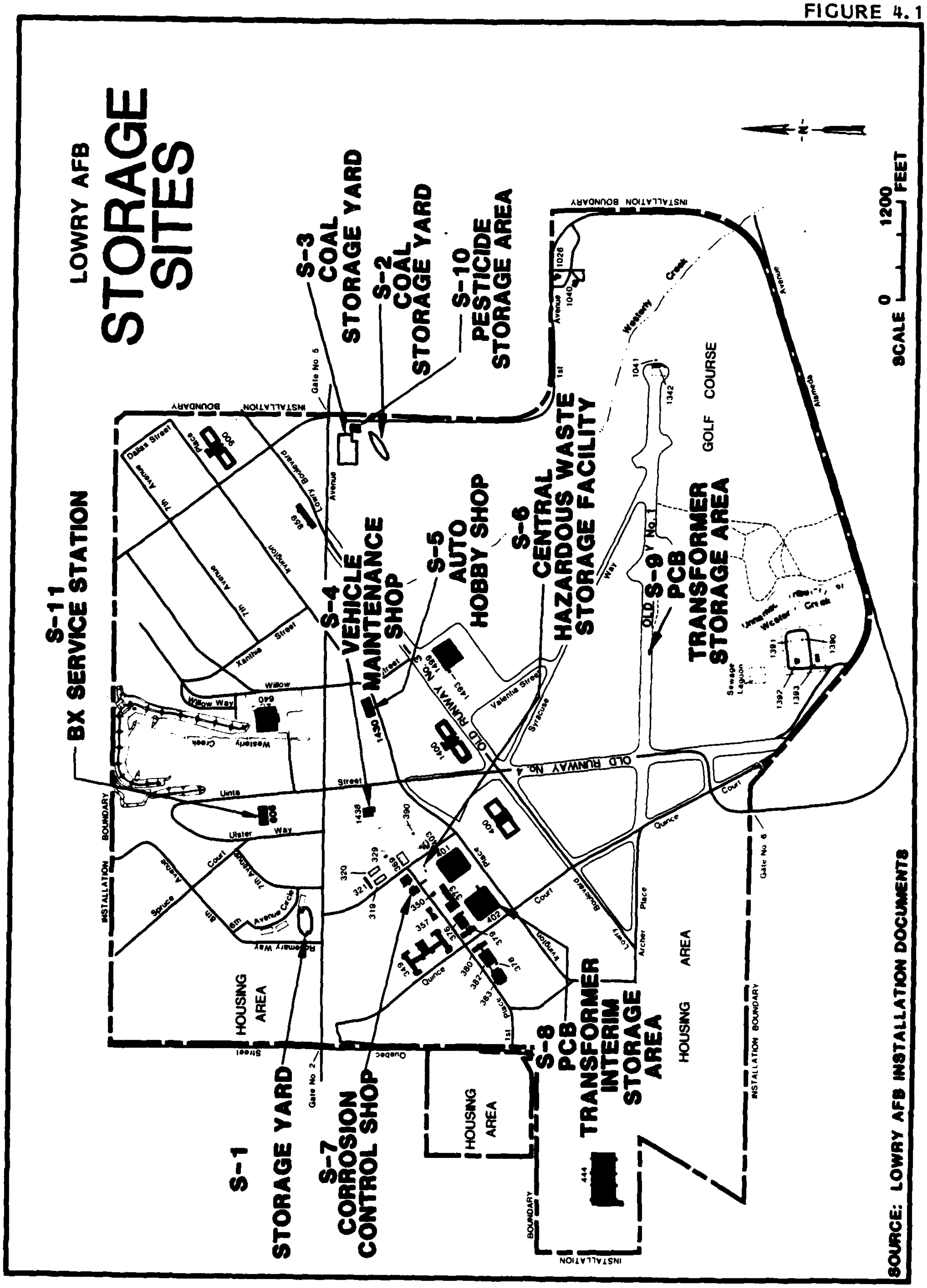
KEY

——— CONFIRMED TIME FRAME DATA BY SHOP PERSONNEL

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

NOTE: WASTES DESIGNATED FOR DPDO HANDLING ARE STORED ON BASE AT VARIOUS LOCATIONS PRIOR TO DELIVERY TO OR SALE BY THE OFF-BASE DPDO OFFICE AT ROCKY MOUNTAIN ARSENAL.

FIGURE 4.1


LOWRY AFB
STORAGE SITES
S-1 STORAGE YARD
S-2 COAL STORAGE YARD
S-3 COAL STORAGE YARD
S-4 VEHICLE MAINTENANCE SHOP
S-5 AUTO HOBBY SHOP
S-6 CENTRAL HAZARDOUS WASTE STORAGE FACILITY
S-7 CORROSION CONTROL SHOP
S-8 PCB TRANSFORMER INTERIM STORAGE AREA
S-9 PCB TRANSFORMER STORAGE AREA
S-10 PESTICIDE STORAGE AREA
S-11 BX SERVICE STATION
GOLF COURSE
HOUSING AREA
HOUSING AREA
HOUSING AREA
INSTALLATION BOUNDARY
OLD RUNWAY No. 4
OLD RUNWAY No. 3
Gate No 2
Gate No 5
Gate No 6
SCALE 0 1200 FEET
N
SOURCE: LOWRY AFB INSTALLATION DOCUMENTS

still stored in various storage tanks throughout the base prior to removal by off-base contractors.

Pesticide Utilization

Pest management has been conducted at Lowry AFB by the Civil Engineering Squadron since the base was constructed. Herbicide applications were performed by the Roads and Grounds Shop until 1982 at which time these responsibilities were transferred to the Entomology Shop. The pest management program entails routine and specific-job-order chemical application and spraying. No aerial spraying has been conducted at Lowry AFB. Pesticides are presently stored at the Entomology Shop (Building 329). Prior to the mid-1970's the Entomology Shop was located in the one-thousand block of buildings (Site S-10) near the firing range office. During the winter season, many herbicides were temporarily stored in Building 320 since it was heated and Building 1000 (Roads and Grounds Shop) was not. Pesticides and herbicides on-hand at the time of this study are listed in Appendix E, Table E.1.

Rinsate from cans is saved in labeled drums along with excess leftover pesticides and re-used later to mix new cheimcals. Old cans are typically rinsed and punctured prior to disposal as regular rubbish.

Pesticides regularly used at Lowry AFB are Malathion, Diazion, Durban and Orthene. These have a one-month life and are not normally used again until this period of time has passed. The only persistant-type pesticide used since 1978 at Lowry is Chlordane. It has been used twice for termite control, and then only in the wood of the structure, not on the soil.

Fuels Management

The Lowry AFB Fuels Management system includes a number of above ground and underground storage tanks located throughout the base. A summary of the major fuel and oil storage capacities is illustrated in Table 4.2. The two fuels present in greatest total quantities are No. 2 heating oil (310,000 gal.) and diesel fuel (114,850 gal.). There is a 65,000 gallon storage capacity for MOGAS (leaded and unleaded). All other petroleum products are stored on base in total quantities under 5,000 gallons. There is no jet fuel presently stored on base. Tanks are routinely cleaned out in a five to seven year cycle by an off-base contractor. Tanks were last cleaned in 1977.

TABLE 4.2
SUMMARY OF MAJOR PETROLEUM PRODUCT STORAGE CAPACITIES

Item	No. of Tanks	Maximum Tank Volume (gals)	Minimum Tank Volume (gals)	Total Storage Volume (gals)
No. 2 Heating Oil	3	210,000	50,000	310,000
Diesel Fuel	22	20,000	250	114,850
MOGAS	9	17,200	500	65,000
Calibrating Fluid	2	2,500	2,500	5,000
Solvents	4	1,000	500	3,300
Waste Oil	3	1,000	500	2,500

Source: Lowry AFB Installation Documents

In the early 1950's when the base maintained a flying mission a simple but sizeable aircraft fuel distribution network was constructed. Fuels (AVGAS and jet fuel) were delivered to the base by tank car or tank trucks and off-loaded by means of a hydrant system. There was one 136,000 gallon bulk storage tank for AVGAS and one 69,000 gallon bulk storage tank for jet fuel. (A drawing dated 1957 identified the bulk jet fuel storage tank as having a 126,000 gallon capacity.) Both tanks were underground. Also located in the bulk storage area was a 50,000 gallon underground tank for contaminated fuel storage. Nearer to the flight apron, there was a collection of tanks (total capacity 50,000 gal.) which served as immediate use jet fuel storage. Planes were fueled by tank truck although in 1957 a hydrant system was installed to deliver fuel for tank trucks loading in an area to the east of the flight apron, across Runway No. 4.

The area identified as Site SP-1 (Figure 4.2) Old Jet Fuel Storage Yard was the site of small spills of jet fuel during the 1950's and early 1960's. No major spills were reported at this site; however, numerous small spills occurred during loading and unloading of the aircraft. Due to the nature of soils at the site and high ground-water table a potential for contamination exists.

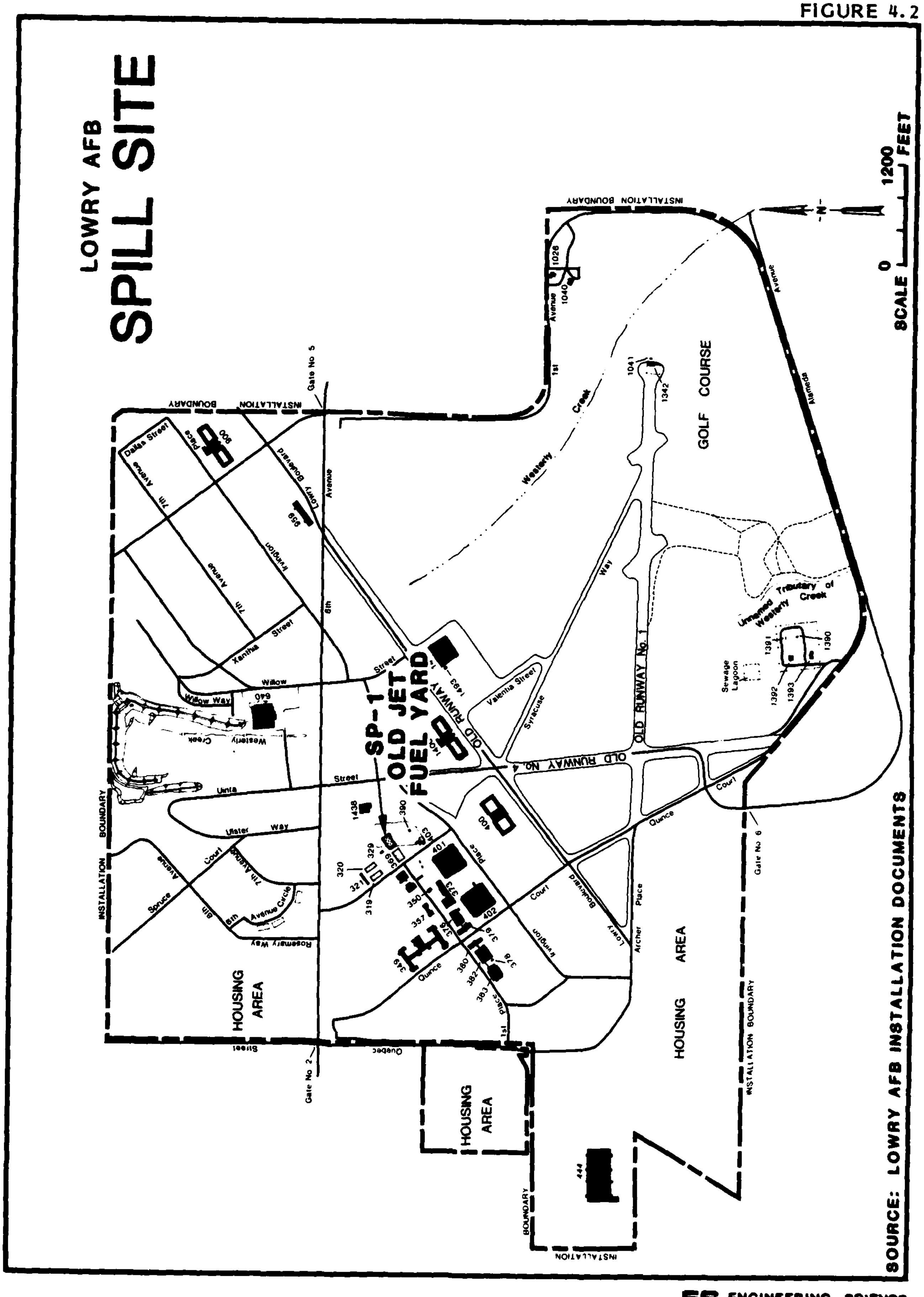
<u>Fire Training</u>

The Fire Department at Lowry AFB has operated two fire training sites at which fires were ignited and then extinguished. Each of these sites is illustrated in Figure 4.3.

<u>FT-1 Fire Training Area No. 1</u>

Site FT-1 was utilized from 1946 to 1965 as a fire training area. Appendix F contains several aerial photos of the fire training area during the 1950's which explicitly depict the use and development of the fire training area. The site consisted of a drum storage area, a bermed burning area and several old aircraft. The drum storage area was utilized to store 50-150 55-gallon drums of contaminated oils, fuels and waste solvents from aircraft maintenance and industrial shop activities. During the period 1946-1960 fire training exercises were conducted four to five times per day, five days per week. During each exercise, 500 to 1,000 gallons of contaminated waste materials and JP4 fuel were either placed in the aircraft or spread on the bermed burn area and ignited.

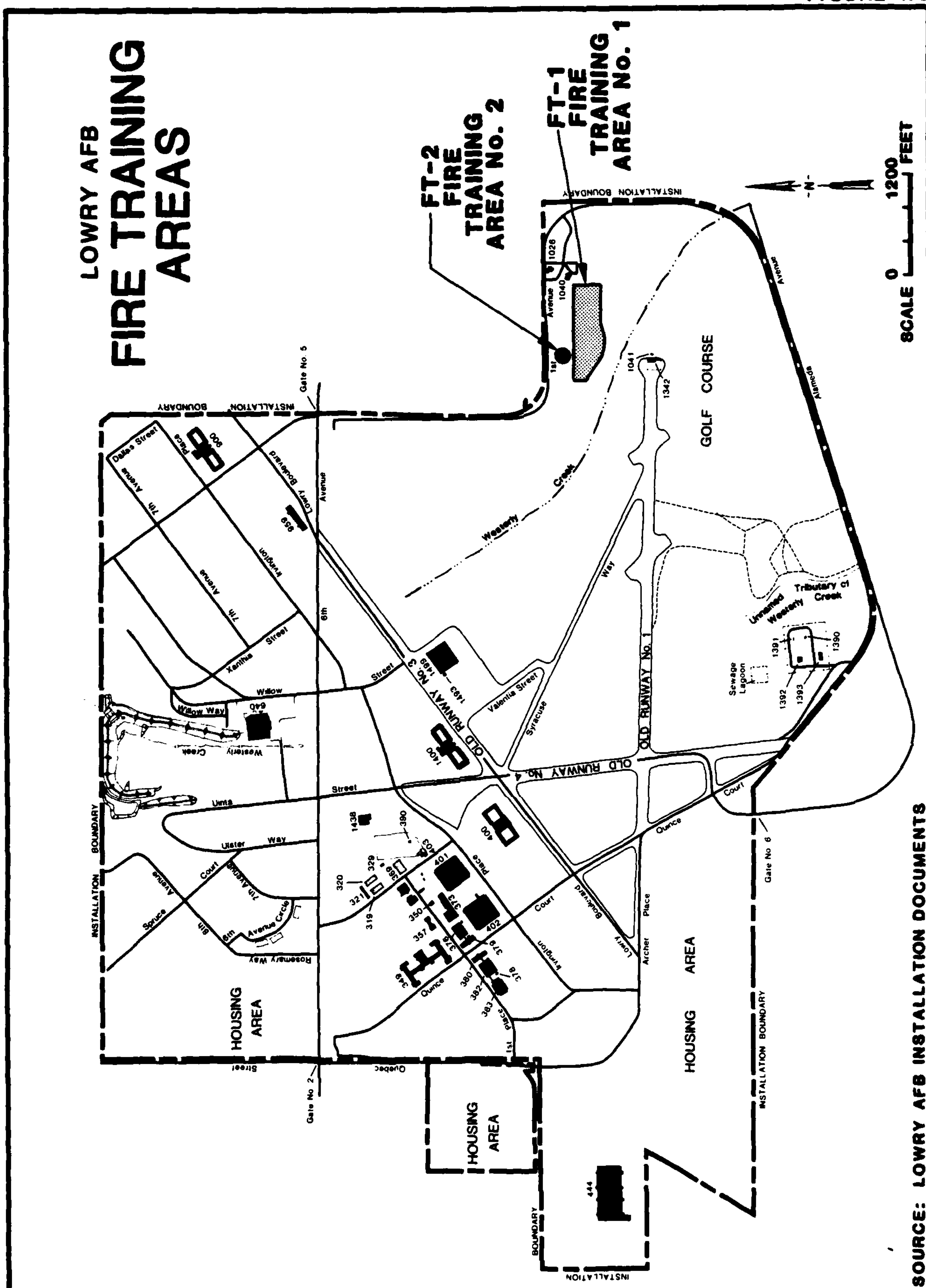
FIGURE 4.2



LOWRY AFB
SPILL SITE

SOURCE: LOWRY AFB INSTALLATION DOCUMENTS

FIGURE 4.3



LOWRY AFB
FIRE TRAINING AREAS
FT-2 FIRE TRAINING AREA No. 2
FT-1 FIRE TRAINING AREA No. 1
GOLF COURSE
HOUSING AREA
HOUSING AREA
HOUSING AREA
INSTALLATION BOUNDARY
OLD RUNWAY No. 1
OLD RUNWAY No. 3
OLD RUNWAY No. 4
Gate No. 5
Gate No 2
Gate No 6
SCALE 0 1200 FEET
SOURCE: LOWRY AFB INSTALLATION DOCUMENTS

During 1961-1965, 500 gallons were ignited once per week. Protein foams were then used to extinguish the fire. According to personnel interviews, unconsumed waste fuel remained within the burn area following each fire training exercise.

Visual examination of the area during the site visit indicated no obvious remnants of fuel residues on-site, nor evidence of surficial contamination. However, the main burn area, which is just north of a golf course fairway, does not support abundant vegetative or grass cover. Due to the permeable soils and unconsolidated deposits in the vicinity of the site and the relatively shallow depth to ground water a potential for contaminant migration exists since much of the spent material may have seeped into the ground.

FT-2 Fire Training Area No. 2

Site FT-2 was used as a fire training site from 1965 to 1980. As illustrated in Figure 4.3, a small pit was used to burn five gallons of clean JP4 fuel once every three months for familiarization blazes. Protein foam and AFFF were used to extinguish the fires. Visual examination of the site revealed no evidence of residual fuels. However, the site presents a potential for contamination due to the permeable nature of the site soils and unconsolidated deposits as well as the proximity of the site to the ground-water table.

EOD Training

The Lowry Training Annex has contained a demonstration range used for practice bombs, MI-27 parachute flares, blasting caps and M-18 smoke grenades. Training has been conducted approximately twice per week, with a limit of five pounds of high explosives per day. According to Lowry AFB documents the demonstration range has received certified clearances from Hill AFB for unexploded ordnance. Due to the nature of the materials and location of the site, no potential for contamination exists regarding Lowry Training Annex activities.

DESCRIPTION OF PAST ON-BASE DISPOSAL METHODS

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

- o Waste storage sites
- o Disposal sites

- Low level radioactive waste disposal sites
- Refuse incineration
- Sanitary sewer system
- Oil water separators
- Storm drainage system.

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

Waste Storage Sites

Several hazardous material and waste storage sites have been located on Lowry AFB. These sites are areas of interest due to their potential for environmental contamination and were reviewed during the on-site survey. These sites are illustrated in Figure 4.1 and discussed below.

Sites S-1, S-2 and S-3 / Coal Storage Yards

Coal-fired boilers had been used for heating on Lowry AFB until 1975 when the conversion to natural gas was mandated. One coal-fired boiler remains in operable condition today, to be used as emergency back-up to the natural gas supply. This boiler was test-fired at least once each year since 1975 until Lowry AFB's emissions variance with the State of Colorado expired in 1982. Sites S-1 and S-2 are former coal storage areas no longer in use. Site S-3 still holds a stockpile of coal for the emergency boiler. Runoff from coal piles may generally be characterized by low pH, high concentrations of chromium, copper, iron, magnesium, nickel, or zinc. The specific coal pile runoff characteristics are dependent on the source of coal. Due to the open-air nature of these sites, all three sites are considered to have a potential for environmental contamination of both surface water and ground water.

Sites S-4, S-5, and S-11/Vehicle Maintenance Shop, Auto Hobby Shop and BX Service Station

Waste oil storage tanks are located at Sites S-4, S-5, and S-11, the vehicle maintenance facility, Auto Hobby Shop and BX Service Station. The tanks are underground but have shown no indications of leakage. The tanks are regularly pumped out by an off-base contractor. For these reasons, the three sites do not present a potential for environmental contamination.

Site S-6/Central Hazardous Waste Storage Facility

Site S-6 (Building 384) is a masonry struture with a slab floor, containing a deluge shower, emergency eyewash and fire extinguishers. The building is located in the POL storage area, which is surrounded by a 7-foot chain-link fence. The materials are stored in a variety of containers (usually drums) and present no potential for contamination, since no spills have occurred.

Site S-7/Corrosion Control Shop Pit

There is one below-ground concrete pit located at Site S-7 (Building 363) which collects floor washings from the corrosion control/paint shop. This pit is emptied four times per year. When not in use the liquid level in the pit does not appear to change, indicating that it does not leak. This site is not considered to present potential for environmental contamination.

Sites S-8 and S-9/PCB Transfomer Storage Areas

A number of PCB or PCB-contaminated transformers have been in use at Lowry AFB in the past. When one is taken out of service, it is turned over to Base Supply (Site S-8) which in turn stores the transformer in Building 1375 (Site S-9). At the time of the site visit, six transformers were being held at S-9 and none at S-8. Both facilities have concrete floors with no outlets. No PCB leakage has been observed. The sites therefore do not present a potential for environmental contamination.

Site S-10/Pesticide Storage Area

Prior to the mid-1970's, pesticides were stored in Building 1000. During the winter seasons, the inventory was temporarily moved to Building 320, which was a heated facility. No significant pesticide spills or leakages have been reported in the facility. The site therefore does not present a potential for environmental contamination.

Disposal Sites

The majority of general refuse generated at Lowry AFB has been disposed of off-site at the City of Denver Municipal Landfill. From the 1940's through 1983 (except 1969 to 1971) eight to ten 1 1/2 ton truck loads per week (uncompacted) of garbage was hauled to an offsite landfill. During 1969 to 1971 the base's general refuse was hauled to Buckley Field.

Minimal records exist regarding the disposal sites at Lowry AFB. The majority of information regarding these sites was collected through personnel interviews with current and retired employees. A description and evaluation of each site is presented herein. Table 4.3 summarizes pertinent information for each of the disposal sites listed in Figure 4.4.

Site D-1/Sanitary Landfill

Site D-1, located on the south side of the base near Building 1390 was used as a disposal area for general refuse generated from base operations from 1948-1979. Since 1979, only construction rubble has been buried at the site. The western half of the site, in the vicinity of Westerly Creek, was operated using the trench and fill method. Typically trenches were excavated to 12-15 foot depth using a dragline. Based on interviews with personnel familiar with the landfill operation the trenches were normally excavated below ground water. Solid wastes from base operations were then disposed in the trench and covered daily with local soil. Although the majority of waste filled at the site consisted of general refuse, other materials such as waste solvents, empty pesticide containers, paint thinners, cutting oils, and spent acids were disposed of in drums at the site during the 1950's and 1960's. The majority of the site is closed with several feet of local soil cover and grass. However, the northeastern edge of the site is still used to dispose of construction rubble. Based on visual examination of the area, including Westerly Creek which traverses the fill, no evidence of leachate, contaminated surface water, or vegetative stress exists at the site. However, due to the presence of small quantities of hazardous waste at the site, the porous nature of the unconsolidated deposits in the area and the relatively high ground-water table, a potential for contamination exists at Site D-1.

Site D-2/Sanitary Landfill

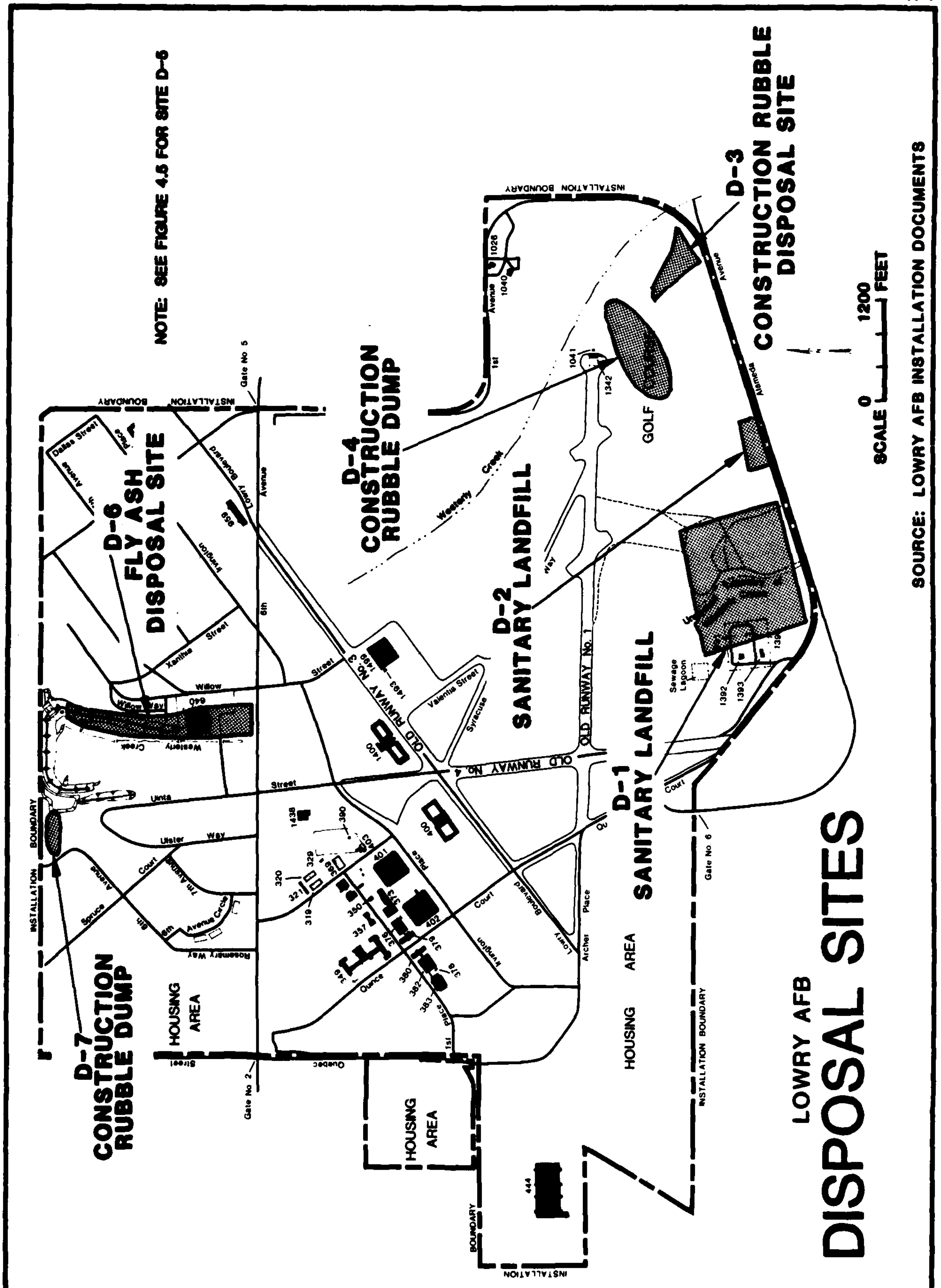
During the early 1960's small quantities of base general refuse and construction rubble were used to fill a 100 foot by 500 foot depression in the southeast corner of the base in an area now occupied by the golf course. The depth of fill is estimated as 6-8 feet. The bottom of the fill is several feet above the ground-water table. Based on interviews with base personnel familiar with the site, no hazardous wastes were

TABLE 4.3

DISPOSAL SITE INFORMATION SUMMARY

Site	Figure Number	Operation Period	Approximate Size	Type of Wastes	Method of Operation	Closure Status	Surface Drainage	Site Visit Comments
D-1	4.4	1948-83	45 acres	General refuse, waste construction rubble, waste solvents, spent acid	Trench and fill depth: 12'-15'	Closed with local soil and cover except small area used for construction rubble disposal.	To Westerly Creek	No surficial evidence of contamination.
D-2	4.4	Early 1960's	100' x 500'	General refuse, construction rubble	Trench and fill depth: 6'-8'	Closed with local soil and cover.	To Westerly Creek	No evidence of contamination.
D-3	4.4	Unknown - 1958	< 0.5 acre	Construction rubble, hardfill	Area Fill Depth: 6'-8'	Closed with local soil and cover.	To Westerly Creek	No evidence of contamination.
D-4	4.4	Unknown	1 acre	Construction rubble, hardfill	Area Fill Depth: 6'-8'	Closed with local soil and cover.	To Westerly Creek	No evidence of contamination.
D-5	4.5	1970's - 1983	< 0.5 acre	Construction rubble, hardfill	Area Fill Depth: 6'-8'	Open dump	To Coal Creek Creek	No evidence of contamination.
D-6	4.4	1940-1948	10 acres	General refuse, fly ash	Area Fill Depth: 8'-10'	Closed with local soil and cover. Commissary built on part of site.	To Westerly Creek	No evidence of contamination.
D-7	4.4	Unknown	< 0.5 acre	Construction rubble, hardfill	Area Fill depth: 6'-8'	Closed with local soil and cover	To Westerly Creek	No evidence of contamination.

FIGURE 4.4



ES ENGINEERING-SCIENCE

disposed at Site D-1 although minor quantities of hazardous substances resulting from industrial shop operations may have been disposed of. The site is presently closed with several feet of local soil and is revegetated. No visual evidence of contamination exists at the site although the site presents a potential for contamination due to:

1) The site's close proximity to the installation boundary (less than 100 feet).
2) High ground-water table in the vicinity of the site.
3) Porous nature of the unconsolidated deposits at the site.

Site Nos. D-3, D-4, D-5 and D-7/Construction Rubble Disposal Sites

Several inactive disposal sites at Lowry AFB or Lowry Training Annex (Site D-3, Site D-4, Site D-5, and Site D-7) were used to dispose of construction rubble generated due to the change in base operations and renovation of various areas on the base. Each site (except D-5) is presently covered with several feet of local soil and contains a cover growth of grass. Site D-5 is located on the Lowry Training Annex (Figure 4.5) and is not closed. No visual evidence of contamination exists at any of these locations. Due to the inert nature of the wastes deposited at these locations, a potential for contamination does not exist.

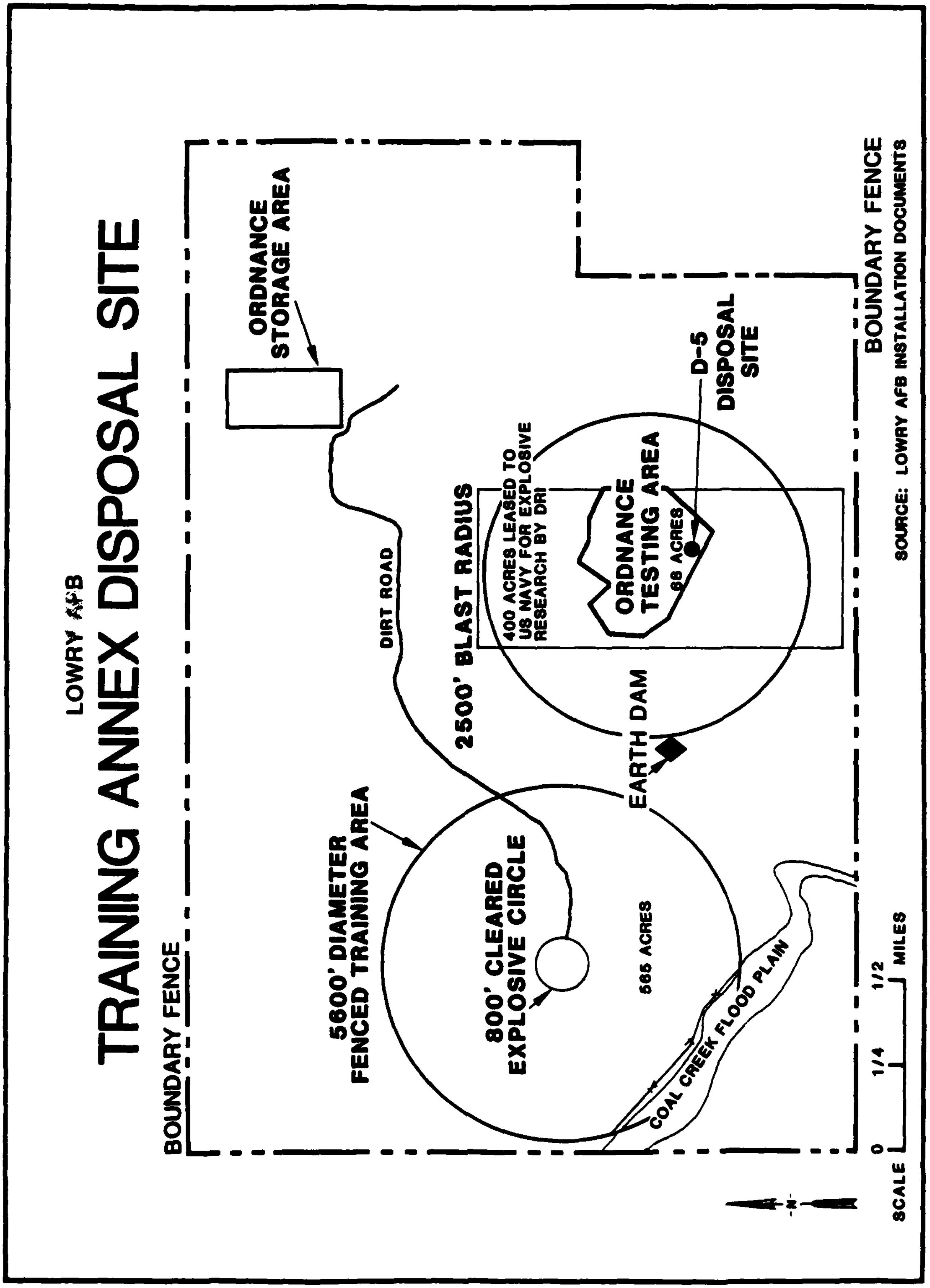
Site D-6/Fly Ash Disposal Site

From 1940 to 1948 Site D-6 was used for disposal of fly ash from the base's coal-fired heat generation facilities and for disposal of general refuse. The area used for disposal is located on the east side of Westerly Creek in the vicinity of the commissary. In recent years, excavation near the site has unearthed some trash and fly ash. At present, the site is covered with local soil and grass. No visual evidence of contamination exists at the site although a minor potential for contamination exists due to the nature of the wastes disposed of and the proximity of the site to Westerly Creek.

Low-Level Radioactive Waste Disposal Site

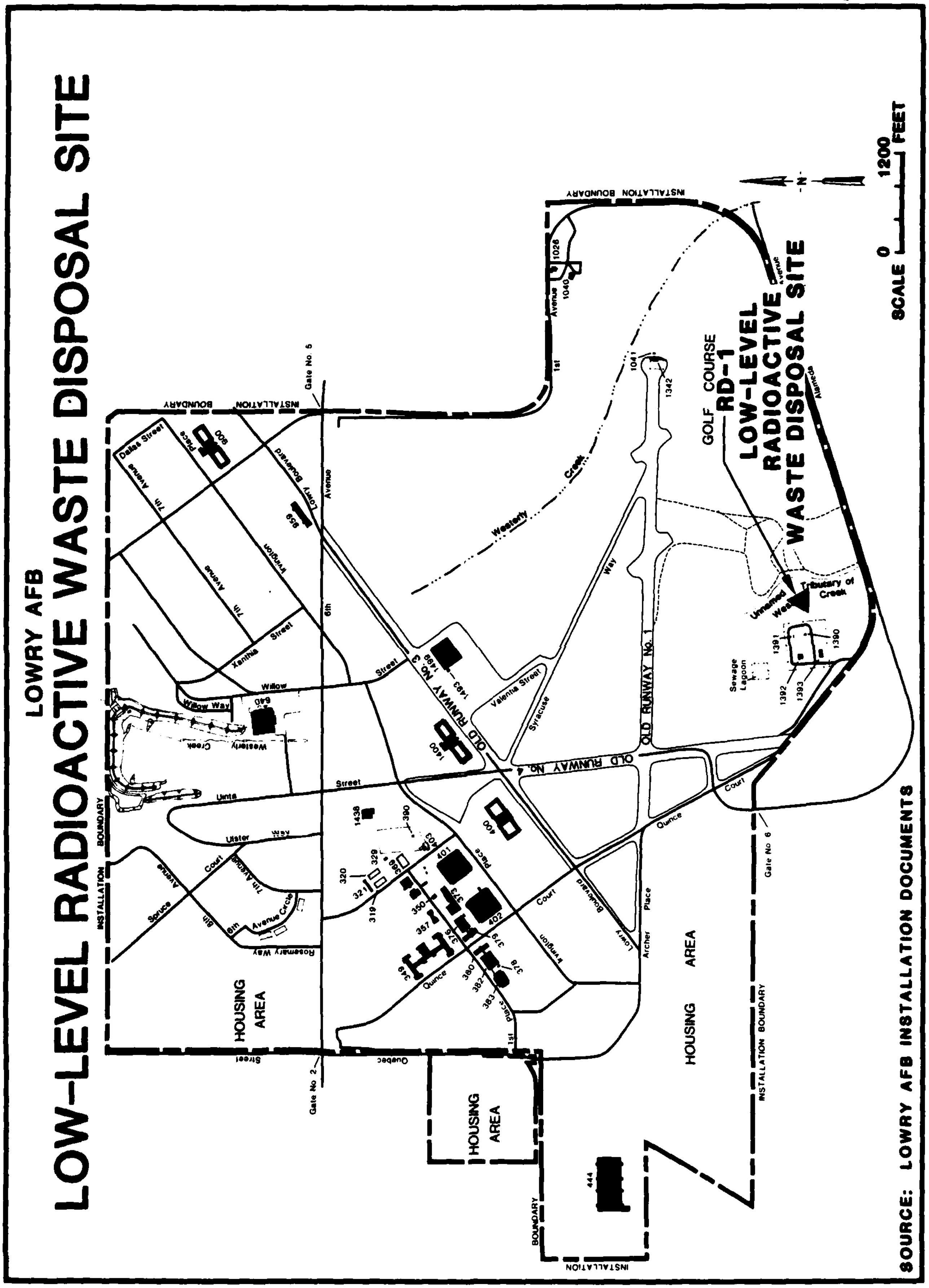
A suspected low-level radioactive waste disposal site exists at Lowry AFB (Site RD-1). The site, illustrated in Figure 4.6, is located within Site D-1 (Sanitary Landfill). Electron tubes were deposited in a concrete vault made from portions of a storm drain. In the 1950's the 30'x30' site was fenced. At present, the depository is located under 12

FIGURE 4.5



ES ENGINEERING-SCIENCE

FIGURE 4.6


LOWRY AFB
LOW-LEVEL RADIOACTIVE WASTE DISPOSAL SITE
GOLF COURSE
RD-1
LOW-LEVEL RADIOACTIVE WASTE DISPOSAL SITE
HOUSING AREA
HOUSING AREA
HOUSING AREA
OLD RUNWAY No. 3
OLD RUNWAY No. 4
OLD RUNWAY No. 1
INSTALLATION BOUNDARY
Gate No 5
Gate No 2
Gate No 6
Westerly Creek
Unnamed Tributary of Westerly Creek
Sewage Lagoon
SCALE
0
1200
FEET
N
SOURCE: LOWRY AFB INSTALLATION DOCUMENTS

to 15 feet of fill material. However, the precise location is not known. Based on the types of materials present at the site and its location, it is unlikely that this site presents a potential for contamination. However, the characteristics of the waste will be included in the HARM rating of Site D-1.

Refuse Incineration

According to personnel interviews conducted at Lowry AFB, a refuse incinerator existed at Site T-2 (Figure 4.7) during the 1950's. No documentation exists regarding this incinerator, however, it was believed to be a brick and concrete incinerator which burned small quantities of general refuse. Due to the nature of the material stored at the site and the removal of the incineration from the site in the 1950's, no potential exists for contamination at Site T-2.

Sanitary Sewer System

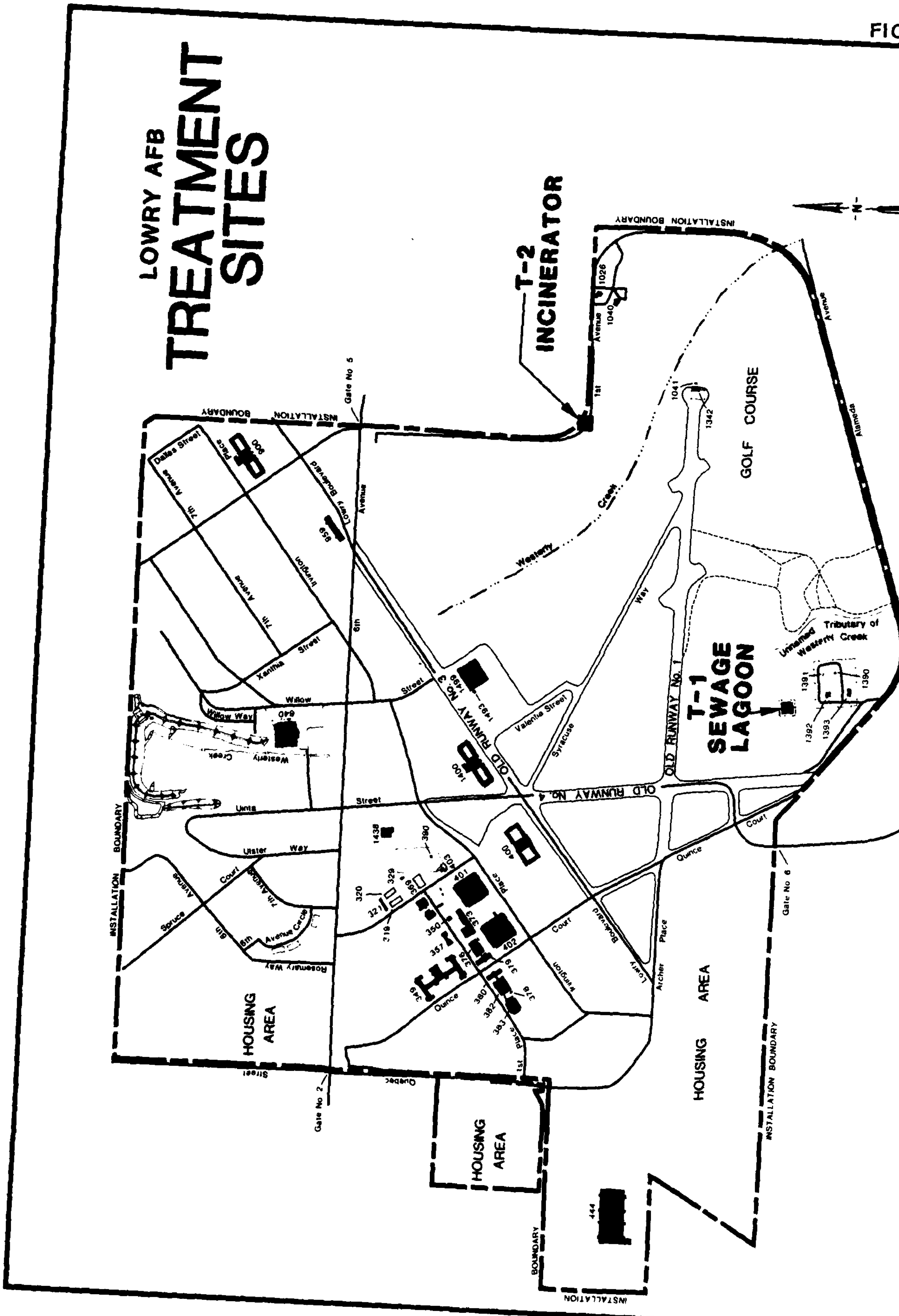
Domestic sewage at Lowry AFB has been disposed of through the public sewage system of the City of Denver. There is a small non-discharging (evaporative type) sewage stabilization pond (Site T-1) located in the southern portion of the base near the Alameda Street gate (Figure 4.7). The pond serves a single classroom building and is scheduled to be replaced by a septic tank system within a few years. Since the pond does not discharge to surface waters, there is no NPDES permit. Due to the generally non-hazardous nature of the wastes disposed in the sanitary sewer system and the stabilization pond, these areas pose no potential for environmental contamination.

Oil/Water Separators

There are six oil/water separators located at Lowry AFB. The separators are located near the following buildings:

Location	Building Use
Bldg 366	Civil Engineering Maintenance Shops
Bldg 369	Heavy Equipment Maintenance Shop
Bldg 667	Base Exchange Service Station
Bldg 1040	Golf Course Maintenance
Bldg 1430	Auto Hobby Shop
Bldg 1438	Vehicle Maintenance Shop

FIGURE 4.7



SOURCE: LOWRY AFB INSTALLATION DOCUMENTS

The recovered oil from each separator is disposed of by a contractor and the majority of the wastewater enters the sanitary sewer system. There has been at least one instance where a separator leaked into the ground (Auto Hobby Shop). Currently all separators on the base are structually sound. Based on the on-site survey, these units should not pose a potential ground-water contamination hazard due to overflow or past operational problems.

Storm Drainage System

Surface run-on from Westerly Creek enters the base on the south perimeter near Building 1393. Westerly Creek then enters an extensive storm drainage system and re-appears at the main surface run-off collection point by the north perimeter. This collected runoff exits the base as Westerly Creek again. Three minor peripheral storm drainage networks empty directly to the City of Denver Main. A detailed discussion of the base storm drainage system is included in Section 3 of this report. The majority of the storm drainage system consists of reinforced concrete pipe in the 18" to 42" range. No known problems exist.

EVALUATION OF PAST DISPOSAL ACTIVITIES AND FACILITIES

The review of past operation and maintenance functions and past waste management practices at Lowry AFB has resulted in the identification of sites initially considered as areas of concern with regard to their potential for contamination and migration of contaminants. These sites were evaluated using the Decision Tree Methodology illustrated in Figure 1.1. Those sites which were not considered to have the potential for contamination were deleted from further consideration. Those sites which were considered as having a potential for contamination, as well as a potential for the migration of contaminants, were further evaluated using the Hazard Assessment Rating Methodology (HARM). Table 4.4 identifies the Decision Tree logic questions used for each of the areas of initial concern.

Based on the decision tree logic, fourteen of the sites originally reviewed were not considered to warrant further evaluation using the Hazard Assessment Rating Methodology. The rationale for omitting these sites from HARM evaluation is described below.

- Sites D-3, D-4, D-5 and D-7, Construction Rubble Disposal Sites - Inert nature of wastes deposited at the sites.
- Site T-1, Sewage Lagoon - Non-hazardous nature of wastes deposited at the sites.
- Site T-2, Refuse incinerator - No known hazardous materials stored or incinerated at this site.
- Site S-4, S-5, and S-11 Vehicle Maintenance Shop, Auto Hobby Shop and BX Service Station Waste Oil Storage Tanks - No known spills or leakage.
- Site S-6, Central Hazardous Waste Storage Facility - The storage site contains drums contained within a building and no known spills have occurred.
- Site S-7, Corrosion Control Shop Pit - No known leakage has occurred.
- Site S-8 and S-9, PCB Transformer Facilities - No spills have occurred.
- Site S-10, Pesticide Storage Area - No known leakage or spills have occurred.

The remaining nine sites identified in Table 4.4 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. The details of the rating procedures are presented in Appendix G. Results of the assessment for the sites are summarized in Table 4.5. The HARM system is designed to indicate the relative need for follow-on action. The information presented in Table 4.5 is intended to determine priorities for further evaluation of the Lowry AFB potentially contaminated areas (Section 5, Conclusions and Section 6, Recommendations). The rating forms for the affected sites at Lowry AFB are presented in Appendix H. Photographs of two key sites are included in Appendix F.

TABLE 4.4
SUMMARY OF DECISION TREE LOGIC FOR AREAS OF INITIAL ENVIRONMENTAL CONCERN AT LOWRY AFB

Site No.	Site Description	Potential For Contamination	Potential For Contaminant Migration	Potential For Other Environmental Concern	Refer to Base Environmental Programs	HARM Rating
D-1	Sanitary Landfill	Yes	Yes	N/A	N/A	Yes
D-2	Sanitary Landfill	Yes	Yes	N/A	N/A	Yes
D-3	Construction Rubble Dump	No	No	No	No	No
D-4	Construction Rubble Dump	No	No	No	No	No
D-5	Construction Rubble Dump	No	No	No	No	No
D-6	Fly Ash Disposal Site	Yes	Yes	N/A	N/A	Yes
D-7	Construction Rubble Dump	No	No	No	No	No
FT-1	Fire Training Area No. 1	Yes	Yes	N/A	N/A	Yes
FT-2	Fire Training Area No. 2	Yes	Yes	N/A	N/A	Yes
T-1	Sewage Lagoon	No	No	No	No	No
T-2	Refuse Incinerator	No	No	No	No	No
SP-1	Old Jet Fuel Yard Area	Yes	Yes	N/A	N/A	Yes
S-1	Coal Storage Yard	Yes	Yes	N/A	N/A	Yes
S-2	Coal Storage Yard	Yes	Yes	N/A	N/A	Yes
S-3	Coal Storage Yard	Yes	Yes	N/A	N/A	Yes
S-4	Vehicle Maintenance Waste Oil Storage Tank	No	No	No	No	No
S-5	Auto Hobby Shop Waste Oil Storage Tank Tank	No	No	No	No	No
S-6	Central Hazardous Waste Storage Facility	No	No	No	No	No
S-7	Corrosion Control Shop Pit	No	No	No	No	No
S-8	PCB Transformer Storage Area	No	No	No	No	No
S-9	PCB Transformer Storage Area	No	No	No	No	No
S-10	Pesticide Storage Area	No	No	No	No	No
S-11	BX Service Station Waste Oil Storage Tank	No	No	No	No	No

TABLE 4.5
SUMMARY OF HARM SCORES FOR POTENTIAL CONTAMINATION SOURCES

Rank	Site Names	Receptor Subscore	Waste Characterization Subscore	Pathways Subscore	Waste Management Factor	Overall Total Score
1	FT-1 Fire Training Area No. 1	57	100	35	1.0	64
2	D-1 Sanitary Landfill	57	70	56	0.95	58
3	FT-2 Fire Training Area No. 2	57	48	35	1.0	47
4	SP-1 Old Jet Fuel Yard Area	53	32	56	1.0	47
5	D-2 Sanitary Landfill	57	8	56	0.95	38
6	D-6 Fly Ash Disposal Site	57	4	42	0.95	32
7	S-1 Coal Storage Yard	57	4	35	1.0	32
8	S-2 Coal Storage Yard	57	4	35	1.0	32
9	S-3 Coal Storage Yard	57	4	35	1.0	32

SECTION 5

CONCLUSIONS

The goal of the IRP Phase I study is to identify sites where there is the potential for environmental contamination resulting from past waste disposal practices and to assess the probability of contaminant migration from these sites. The conclusions given below are based on the assessment of the information collected from the project team's field inspection, review of records and files, review of the environmental setting, and interviews with base personnel, past employees and state and local government employees. Table 5.1 contains a list of the potential contamination sources identified at Lowry AFB and a summary of HARM scores for those sites.

1. Site FT-1, Fire Training Area No. 1 (1946-1965), has a moderate potential for environmental contamination. Leaking drums of contaminated waste oils, waste solvents, paint thinners and sludge were stored on this site prior to burning them during training exercises within the fire burn area. The depth to ground water is estimated to be less than fifteen feet. Regional geology indicates the unconsolidated deposits at the site are comprised of permeable materials. The site received a HARM score of 64.
2. The old sanitary landfill, Site D-1 , (which includes Site RD-1), also has a moderate potential for environmental contamination. General refuse and other waste materials including waste acids, paint thinners, and waste solvents from the industrial shop operations were disposed in trenches at this site from 1948 to 1979. Trenches at the landfill were excavated to a depth of twelve feet which was into the ground water table at this location. The soils in the area are permeable. The site is in close proximity to the south installation boundary. The landfill received a HARM score of 58.

TABLE 5.1
PRIORITY RANKING OF POTENTIAL CONTAMINATION SOURCES

Rank	Site No.	Site Name	Date of Operation or Occurrence	Overall Total Score
1	FT-1	Fire Training Area No. 1	1946-1965	64
2	D-1	Sanitary Landfill	1948-1983	58
3	FT-2	Fire Training Area No. 2	1965-1980	47
4	SP-1	Old Jet Fuel Yard Area	1950's-1966	47
5	D-2	Sanitary Landfill	Early 1960's	38
6	D-6	Fly Ash Disposal Site	1940-1948	32
7	S-1	Coal Storage Yard	Unknown	32
8	S-2	Coal Storage Yard	Unknown	32
9	S-3	Coal Storage Yard	Unknown	32

SECTION 6

RECOMMENDATIONS

To aid in the comparison of the nine sites identified in this study with those sites identified in the IRP at other Air Force Installations, a Hazard Assessment Rating Methodology (HARM) was used for prioritizing IRP Phase II studies. Of primary concern at Lowry AFB are those sites with a moderate potential for environmental contamination which are listed in Table 6.1. These sites require further investigation in Phase II. Sites of secondary concern are those with low potential for contaminant migration. No further monitoring is recommended for the other sites with low potential for migration of contaminants unless other data collected indicate a potential problem could exist.

The following recommendations are made to further assess the potential for environmental contamination from past activities at Lowry AFB. The recommended actions are one time sampling and analysis programs to determine if contamination does exist at the site. If contamination is identified the program may need to be expanded to further define the extent of contamination. The recommended monitoring program for Phase II is summarized in Table 6.1.

PHASE II MONITORING RECOMMENDATIONS

1. The old sanitary landfill (Site D-1) is considered to have a moderate potential for environmental contamination. A geophysical survey should be conducted in the vicinity of the site using both electromagnetic conductivity and electrical resistivity methods. The results of these surveys will be used to delineate the extent of any contaminant plume and aid in determining the proper locations for monitoring wells. One set of upgradient monitoring wells and three sets of down-gradient monitoring wells should be installed at the landfill. A set of wells should consist of one well completed in the unconsolidated deposits and one well completed in the top of bedrock. The well completed in the unconsolidated deposits should be drilled

TABLE 6.1
RECOMMENDED MONITORING PROGRAM FOR PHASE II
LOWRY AFB

Site	Rating Score	Recommended Monitoring	Comments
1. D-1 Sanitary Landfill	58	a) Conduct a geophysical survey using both electromagnetic conductivity and electrical resistivity methods to delineate the extent of any contaminated plume at the site and aid in determining proper locations for monitoring wells. b) One set of upgradient monitoring wells and three sets of downgradient monitoring wells should be installed at the landfill. The upgradient well will have to be installed east of the landfill and adjacent to the fence service road. Each of the wells will be sampled and analyzed for the parameters listed in Table 6.2. c) Three surface water and sediment samples should be collected in the unnamed tributary of Westerly Creek in the vicinity of the landfill. Each sample should be analyzed for the parameters listed in Table 6.2.	

TABLE 6.1
RECOMMENDED MONITORING PROGRAM FOR PHASE II
LOWRY AFB
(continued)

Site	Rating Score	Recommended Monitoring	Comments
2. FT-1 Fire Training Area No. 1	64	a) Install a monitoring well set at the center of the site completed to bedrock. Utilize an OVA during the drilling. b) Five surface water samples should be collected in the storm drainage network on the southeast end of the base. One sampling location should be in golf course area as far southwest in the drainage network as practical. A second sample should be located just southeast of Building 1499. The remaining sample locations should be equidistantly distributed between the first two locations. The samples should be analyzed for the parameters listed in Table 6.2.	If contamination is detected during the drilling process then three well sets should be installed at the edge of the contaminant plume. Each of the wells the should be sampled and analyzed for sulfates the parameters listed in Table 6.2.

to the top of bedrock and screened the length of the saturated zone in the unconsolidated deposits. The well completed into bedrock should be drilled 25 to 50 feet into the rock and cased to the rock surface to seal off water from the overlying unconsolidated deposits. The upgradient well set will have to be installed east of the landfill and adjacent to the fence service road. Each well will be sampled and analyzed for the parameters listed in Table 6.2. In addition three surface water and sediment samples will be collected at sites in Westerly Creek in the vicinity of the landfill. One sampling site should be located at the entrance of the creek to the base. The second sample location should be near the entrance of the creek to the culvert that transmits the water under the base. The third sample location should be approximately one half way between the first two sites. Each surface water and sediment sample will be analyzed for the parameters listed in Table 6.2.

2. The Fire Training Areas (Sites FT-1 and FT-2) are considered to have a moderate potential for environmental contamination. One ground-water monitoring well set should be located approximately in the center of fire training area FT-1. One continuous core sample should be taken of the unconsolidated deposits during drilling operations. During the drilling process, an organic vapor analyzer (OVA) should be employed to detect the presence of potential organic contamination. If observations made during the soil boring collection survey indicates that contamination is present, then a ground-water monitoring system consisting of three additional well sets should be placed within the downgradient boundries of the contaminant plume. The well sets should be drilled in an identical manner to Site D-1. Samples should be collected and analyzed for the parameters listed in Table 6.2. In addition five surface water samples should be collected in the storm drainage network on the southeast end of

TABLE 6.2
RECOMMENDED LIST OF ANALYTICAL PARAMETERS[(1)]

Total organic carbon
pH[(2)]
Copper
Zinc
Oil and Grease
Nickel
TCE
Total dissolved solids[(2)]
Total Organic Halogen[(2)]

Arsenic	Lead
Barium	Mercury
Cadmium	Selenium
Chromium	Silver

(1) All analyses will be conducted in accordance with: "Methods for Analyses of Water and Wastes - Environmental Monitoring and Support Laboratory. Office of Research and Development. USEPA. EPA 600/4-78-020. March, 1979.

(2) These analyses will not be performed on soil or sediment analyses.

the base to aid in identifying the source of high sulfates in this area. One sampling location should be in the golf course area as far southeast in the drainage network as practical. A second sample should be located just southeast of Building 1499. The remaining locations should be equidistantly distributed between the first two locations. The samples should be analyzed for sulfates and the parameters listed in Table 6.2.

RECOMMENDED GUIDELINES FOR LAND-USE RESTRICTIONS

It is recommended that land use restrictions at the identified disposal and spill sites at Lowry AFB be considered. The purpose of such land use restrictions would be: (1) to provide the continued protection of human health, welfare, and the environment; (2) to insure that the migration of potential contaminants is not promoted through improper land uses; (3) to facilitate the compatible development of future USAF facilities; and (4) to allow for identification of property which may be proposed for excess or outlease.

The recommended guidelines for land use restrictions at each of the identified disposal and spill sites at Lowry AFB are presented in Table 6.3. A description of the land use restriction guidelines is presented in Table 6.4. Land use restrictions at sites recommended for Phase II monitoring should be reevaluated upon the completion of Phase II monitoring program and changes made where appropriate. In particular, plans for flood control structures in the area of Site D-1 should be reviewed following the Phase II effort.

TABLE 6.3

RECOMMENDED GUIDELINES FOR FUTURE LAND USE RESTRICTIONS AT POTENTIAL CONTAMINATION SITES

Site Name	Recommended Guidelines for Future Land Use Restrictions											
	Construction on the Site	Excavation	Well Construction on or near the Site	Agricultural Use	Silvicultural Use	Water Infiltration (run-on, ponding, irrigation)	Recreational Use	Burning or Ignition Source	Disposal Operations	Vehicular Traffic	Material Storage	Housing on or Near the Site
FT-1, Fire Training Area No. 1	X	X	X	X		X	X		X		X	X
D-1, Sanitary Landfill	X	X	X	X		X	X		X		X	X
FT-2, Fire Training Area No. 2	X	X	X	X		X	X		X			X
SP-1, Old Jet Fuel Yard Area			X	X		X	X	X	X			
D-2, Sanitary Landfill	X	X	X	X		X	X		X		X	X
D-6, Fly Ash Disposal Site			X									
S-1, Coal Storage Yard			X									
S-2, Coal Storage Yard			X									
S-3, Coal Storage Yard			X									

Note: See Table 6.4 for discussion of Guidelines

TABLE 6.4
DESCRIPTION OF GUIDELINES FOR LAND-USE RESTRICTIONS

Guideline	Description
Construction on the site	Restrict the construction of structures which make permanent (or semi-permanent) and exclusive use of a portion of the site's surface.
Excavation	Restrict the disturbance of the cover or subsurface materials.
Well construction on or near the site	Restrict the placement of any wells (except for monitoring purposes) on or within a reasonably safe distance of the site. This distance will vary from site to site, based on prevailing soil conditions and ground-water flow.
Agricultural use	Restrict the use of the site for agricultural purposes to prevent food chain contamination.
Silvicultural use	Restrict the use of the site for silvicultural uses (root structures could disturb cover or subsurface materials).
Water infiltration	Restrict water run-on, ponding and/or irrigation of the site. Water infiltration could produce contaminated leachate.
Recreational use	Restrict the use of the site for recreational purposes.
Burning or ignition sources	Restrict any and all unnecessary sources of ignition, due to the possible presence of flammable compounds.
Disposal operations	Restrict the use of the site for waste disposal operations, whether above or below ground.
Vehicular traffic	Restrict the passage of unnecessary vehicular traffic on the site due to the presence of explosive material(s) and/or of an unstable surface.
Material storage	Restrict the storage of any and all liquid or solid materials on the site.
Housing on or near the site	Restrict the use of housing structures on or within a reasonably safe distance of the site.

APPENDIX A

PROJECT TEAM QUALIFICATIONS

- W. G. Christopher
- R. J. Reimer
- R. S. McLeod

Biographical Data

WILLIAM GARY CHRISTOPHER

Manager, Industrial Wastes

PII Redacted

[redacted]

Education

B.S.C.E. in Civil Engineering, (Magna Cum Laude), 1974
West Virginia University, Morgantown, W.Va.
M.E. in Environmental Engineering, 1975, University of Florida, Gainesville, Florida

Professional Affiliations

Registered Professional Engineer (Georgia No. 11886)
American Society of Civil Engineers (Associate Member)
West Virginia Water Pollution Control Federation

Honorary Affilitations

Chi Epsilon
Tau Beta Pi
EPA Traineeship for Master's Degree

Experience Record

1972-1974 West Virginia Department of Highways. Morgantown, West Virginia. Highway Co-op Technician. Handled inspection of drainage, concrete structures, earthwork and compaction testing for interstate highway construction within Monongalia County and Preston County. Performed field office assignments to finalize estimates and quantities for a completed section of highway construction.

1975-1977 Union Carbide Corporation, Chemicals and Plastics Division, Environomental Engineering Department. As a process/project engineer performed environmental protection engineering for Union Carbide's Taft and Texas City Plants. Projects included process design of a rapid mix-flocculation basin for the Gulf Coast Waste

2/82

William Gary Christopher (Continued)

Disposal Authority (GCWDA) 40-Acre Facility Treatment Plant. Performed bench-scale studies of coagulant use to improve settling of aeration basin effluent biosolids at the 40-acre facility. Predicted 40-acre facility effluent BOD and effluent TSS quality following operation changes to the existing facility including addition of a limited aeration basin to the front end of the treatment plant. Performed process feasibility and conceptual design of an aeration treatment facility for Union Carbide's Texas City plant concentrated waste stream. Performed preliminary process scope and cost appraisals for sludge disposal alternatives at Texas City including: landfarming, pressure filtration-landfill and pressure filtration-incineration. Performed settling column studies for solvent vinyl resin and suspension vinyl resin waste streams and sized settling basins from the studies. Proposed bench-scale study of the effect of ethyleneamines waste stream on anaerobic treatment of Texas City concentrated wastes. Provided review assistance for a 200-acre regional industrial landfill, in-place stabilization processes for 18-acre lagoons of primary sludge and pyrolysis fuel oil mixtures at Texas City, and source reduction projects. Evaluated at UNOX compressor piping modification for the Taft Plant to reduce power consumption by 50%. Wrote preliminary operational considerations for a proposed GCWDA regional landfarm.

1977-Date — Engineering-Science, Inc. Project Engineer on study for the American Textile Manufacturers Institute and EPA. Responsible for field pilot plant study and evaluation of coagulation/clarification/multi-media filtration, carbon adsorption, ozonation, coagulation/multi-media filtration and dissolved air flotation technologies for treatment of textile industry "BPT" effluents to meet future BATEA guidelines. An ancillary portion of this project included review of existing activated sludge facilities and operational practices to meet current "BPT" limits at 5 textile mill sites.

Project engineer on study for Lederle Laboratories, Pearl River, New York plant. Responsible for wastewater treatment plant evaluation and optimization study with particular emphasis on operational changes to improve performance. Treatment processes included coagulation, flocculation, primary sedimentation, oxygen activiated sludge and final sedimentation.

William Gary Christopher (Continued)

Project manager of waste treatment operations evaluation at a pharmaceutical plant. Responsibilities included operational optimization of the full-scale activated sludge process with full-scale coagulation testing, bench-scale bioreactor studies and equalization mixing and capacity studies.

Project engineer on study to determine the impact of RCRA regulations on the coal-fired utility industry. Assisted in development of design criteria and cost methodology and estimates to compare the cost impact of RCRA 3004 and 4004 regulations on fly ash, bottom ash and FGD sludge disposal on a regional and nationwide basis.

Project Manager for review of a Permit Application and design for a proposed Hazardous Waste Disposal Facility in North Carolina.

Project Manager for preparation of a "white paper" for the Department of Energy to assess major impacts of proposed RCRA 3001, 3004 and 3006 regulations on industrial coal use for power generation.

Project Manager on study to determine biotreatability of new process wastes for a pharmaceutical chemical plant and to evaluate and define options for liquid waste incineration.

Project Manager on odor control study of process wastes for a major organic chemicals company. Responsible for laboratory bench-scale and field pilot plant study involving evaluation of liquid waste, air and steam stripping, chemical oxidation, ozonation, and activated carbon adsorption. Design criteria for a biological treatment system for the odor pretreatment effluent was also developed from bench-scale bioreactor studies.

Project Manager on a study to provide a preliminary evaluation of advanced waste treatment technologies required for upgrading an existing activated sludge facility treating organic chemical and pharmaceutical wastes with high COD and nitrogenous concentrations.

Project Manager on a biological treatability study to provide expanded waste treatment facilities for a major organic chemicals firm. Responsibilities included laboratory bench-scale and pilot scale treatability and sludge handling studies involving waste characterization, activated sludge treatability, aerobic digestion, gravity thickening, dissolved air flotation, belt filter press sludge dewatering, plate and frame pressure

William Gary Christopher (Continued)

filter, vacuum filter (rotary precoat), and centrifugation for nine different raw waste streams.

Project Manager for a project involving process selection and preliminary engineering design for a pulp and paper mill waste treatment facility.

Project Manager on Solid and Hazardous Waste study for a diverse chemicals and plastics production facility. Responsibilities included RCRA Interim Status Compliance, RCRA Manifest Implementation and plant training, RCRA Notification and Permit Part A applications. Detailed Solid Waste inventories by production unit and classification of wastes according to RCRA were developed. Segregation of wastes, recycle/recovery and ultimate disposal options including incineration and secure landfills were evaluated for the short-term. Long-term evaluations will be considered in Phase II of the Study.

Project Manager on Solid and Hazardous Waste study for a diverse organic chemicals manufacturing facility. Long-term alternatives for storage, handling, treatment and disposal of a variety of types of hazardous wastes were evaluated based on technical performance and economic comparisons. Alternatives evaluated included solid and liquid incineration, landfill, landfarm, solidification/fixation, and physical volume reduction (shredding,compaction). Developed a detailed Spill Control and Best Management Practices Manual.

Project Manager for a waste treatment plant capacity evaluation for a silicon wafer manufacturing facility. Bench-scale and pilot scale coagulation and settling column studies were performed in addition to field scale oxygen transfer tests to predict maximum design organic and hydraulic loadings for an existing activated sludge waste treatment facility.

Project manager for a biological treatability study to determine the optimum conditions (temperature and hydraulic residence time) for removal of a specific organic currently produced at a chemical production facility.

Project manager for five Installation Restoration Programs (IRP) Phase I projects for the U.S. Air Force (Kelly AFB, Eglin AFB, Duluth AFB, Hancock AFB, DESC). Each of these projects utilized a project team of various disciplines (geology, chemical engineering, biology, environmental engineering) to assess the potential for environmental contamination migration

William Gary Christopher (Continued)

resulting from past hazardous waste handling, storage, treatment and disposal practices. The project tasks included environmental audits, development of waste inventories and waste classification, assessment of site environmental setting, assessment of past waste handling practices (surface impoundments, landfills, storage areas, fire training areas) and finally priority ranking of sites and recommendations for Phase II groundwater monitoring programs.

Project manager for a preliminary design for upgrading an existing activated sludge facility (175,000 gpd) to accommodate expanded pharmaceutical and chemical production facilities. The modifications included provisions for additional submerged aeration capacity, solids contact clarification and mixed equalization.

Other recent projects include development of the work plan and experimental program for an American Cyanamid Company organic chemical plant primary treatment study, development of design specifications for a pharmaceutical production facility waste treatment plant and mixed liquor coagulation operations assistance for a plastics production waste treatment facility.

<u>Technical Publications</u>

"Magnesium Recovery from a Neutral Sulfite Semi-chemical Pulp and Paper Mill Sludge," Master of Engineering Research Project, University of Florida, Gainesville, Florida 1975.

"Siting Considerations for Hazardous Waste Disposal Facilities," presented at the Georgia Environmental Health Association Conference, Jekyll Island, Georgia, July, 1981. (Co-author T.N. Sargent)

"Hazardous Waste Management," Seminar presented to Capitol Associated Industries, Inc., Raleigh, North Carolina, August 21, 1981

"A Solid and Hazardous Waste Management Program for Industrial Facilities," Industrial Wastes Magazine (publication pending), 1982.

"Ground-Water Monitoring" Seminar and Workshop presented to the State of Mississippi, Bureau of Pollution Control, Jackson, Mississippi, February 16-17, 1982. (Co-presentors - J. R. Absalon, E.J. Schroeder).

William Gary Christopher (Continued)

"Ground-Water Monitoring and Sampling" Seminar and Workshop presented to the State of Alabama, Huntsville, Alabama, July 20-21, 1982. (Co-presentors - J. R. Absalon, R. E. McLeod).

"Ground-Water Monitoring and Sampling" Seminar and Workshop presented to the State of Kentucky. Bowling Green, Kentucky, July 27-28, 1982. (Co-presentors - J. R. Absalon, R. E. McLeod).

"Preliminary Assessment of Past Hazardous Waste Storage, Treatment and Disposal Sites" presented to the Association of Engineering Geologists, Atlanta, Georgia, September 17, 1982.

#67

Biographical Data

ROBERT J. REIMER

PII Redacted

Chemical Engineer

[redacted]

Education

B.S. in Chemical Engineering, 1979, University of Notre Dame
B.A. in Art, 1979, University of Notre Dame
M.S. in Chemical Engineering, 1980, University of Notre Dame

Honors

Amoco Company Fellowship for Graduate Studies in Chemical Engineering, University of Notre Dame (1979-1980)

Professional Affiliations

American Institute of Chemical Engineers

Experience Record

1978-1979 PEDCo Environmental, Cincinnati. Engineer's Assistant. Responsible for compilation of data base report reviewing solid waste disposal in the nonferrous smelting industry. Participated in SO_2 scrubber emissions testing program, Columbus, Ohio. Worked on team establishing a computerized reference file on the overall smelting industry. Performed technical editing and report review.

1979-1980 Camargo Associates, Ltd., Cincinnati. Design Engineer and Draftsman. Responsible for HVAC design on numerous projects. Designed fire protection system for an industrial plastics press. Designer on various general plumbing jobs. Prepared EPA air pollution permit applications.

1980-Date Engineering-Science. Chemical Engineer. Responsible for the preparation of environmental reports and permit documents as well as providing general environmental assistance to clients to assure compliance with state and federal regulations.

3/83

Robert J. Reimer (Continued)

1980-Date Developed cost estimates for several hazardous waste management facility closures. Prepared several Interim Status Standards Manuals, including Manifest Plans, Waste Analysis Plans, Closure Plans and Contingency/Emergency Plans. Provided technical assistance in the design of a one-million gallon per year fuel alcohol production facility.

Provided assistance for a water reuse/reduction plan at a major petroleum refinery. Conducted an extensive review of emerging energy technologies for the Department of Energy. Participated in several Installation Restoration Programs for the U. S. Air Force. Assisted in the design of a contaminated ground water air stripping column based on a lab model to be developed. Prepared several delisting petitions for the removal of industrial wastestreams from EPA's hazardous waste list. Assisted in a study of waste oil reuse for the U.S. Army CERL.

Biographical Data

ROBERT S. McLEOD

Hydrologist

PII Redacted

[redacted]

Education

B.S. in Civil Engineering, 1962, University of Illinois
M.S. in Civil Engineering, 1965, University of Wisconsin

Professional Affiliations

Registered Professional Engineer (Georgia No. CE12684)
American Society of Civil Engineers
American Water Resources Association
National Water Well Association

Experience Record

1962-1964 U.S. Army Corps of Engineers. Staff Engineer. Involved in a low-head dam rehabilitation project. Monitored dredging operations for turning basins in small harbors.

1964-1980 U.S. Geological Survey. Project Chief. Supervised a study on the effects of using groundwater to maintain lake levels which involved evaluation of various hydrologic factors in relation to water-level fluctuations and description of the hydrologic system response from pumping groundwater into the lake. Conducted a study on probable future effects of groundwater pumping on an aquifer system using three-dimensional digital-modeling techniques to predict head declines in the water table and underlying deep aquifer and reductions in flow of nearby streams. Supervised a study to evaluate groundwater and surface water hydrology and hydrological changes caused by construction of a reservoir and a floodwater retention structure in a small basin. Developed a digital-computer program which when applied to two-dimensional, confined groundwater flow problems can predict changes in flow caused by pumping. Developed automated data files and support programs for storing and displaying various types of hydrologic records.

Robert S. McLeod (Continued)

Project Hydrologist. Investigated surface and groundwater supplies in an area of near-surface crystalline rock to determine availability of groundwater as a source of industrial and municipal supplies. Refined flood-frequency relationships for streams to determine 50-year flood levels. Conducted a study on the relationship between low-flow characteristics and basin characteristics to determine magnitude and frequency of low flows from streams. Involved in basic records collection of surface water and groundwater data. Surface water data were collected to aid in defining the statistical properties of and trends in the occurrence of water in streams and lakes. Groundwater data were collected on water-level fluctuations in principal aquifers to monitor natural and man-induced changes and to estimate the severity of climatic cycles on the availability of groundwater.

1980-1982 Law Engineering Testing Company, Atlanta, Georgia. Project Manager. Responsible for coal hydrology studies in Alabama involving geologic and hydrologic analyses of mining sites, descriptions of site geology, and estimates on probable hydrologic consequences of mining as part of the Office of Surface Mining Small Operator Assistance Program.

Director of Analysis and Reporting/Hydrogeologist. Evaluated the feasibility of using salt domes in the Gulf Coast area to store high-level nuclear wastes. Defined site geology, hydrology, and groundwater flow, direction, and rates for contaminant transport.

1982-Date Engineering-Science. Hydrologist. Responsible for groundwater monitoring studies, aquifer testing, contaminant migration studies, and modeling of groundwater systems.

Publications

"Groundwater Occurrence and Movement Related to Aquifer System Models," Workshop Proceedings, Indiana Water Resources - Future Problems and Needs, Purdue University, May 10-11, 1973.

"A Digital Computer Model for Estimating Drawdowns in the Sandstone Aquifer System in Dane County, Wisconsin," Wisconsin Geological and Natural History Survey Information Circular 28, and presented at the National Water Well Association Midwest Conference, September 1973.

Robert S. McLeod (Continued)

"A Digital Computer Model for Estimating Hydrologic Changes in the Aquifer System in Dane County, Wisconsin," Wisconsin Geological and Natural History Information Circular 30, and presented at the American Water Resources Association Tenth National Convention, August 1974.

Papers and Presentations

"Relation Between Groundwater Pumping and Streamflow in the Yahara River Watershed, Wisconsin," presented at the Madison Hydrology Club, November 1978.

"Groundwater Modeling Techniques for Managing Aquifer Systems," presented at the University of Wisconsin Continuing Education Sanitary Engineering Institute, March 1979.

"Water Use Data Collection Program in Wisconsin," presented at the Midwest Groundwater Conference, November 1979.

"Groundwater Flow in the Vicinity of Richton and Cypress Creek Salt Domes, Perry County, Mississippi," presented at the Fifth Southeastern Groundwater Conference, November 1981.

APPENDIX B
LIST OF INTERVIEWEES

TABLE B.1
LIST OF INTERVIEWEES

Position	Period
1. Civilian Supervisor, Corrosion Control, 3415 CMS	1982-present
2. Civilian Supervisor, AGE, 345 CMS	1973-1982
3. Civilian Supervisor, Heavy Equipment Maint., Trans.	1977-present
4. Civilian Supervisor, Electric Shop, 3415 CES	1978-present
5. Civilian Supervisor, Auto Hobby Shop, 3415 ABG	1982-present
6. Civilian supervisor, Vehicle Maint., Trans	1975-present
7. NCO, Washrack, Bldg. 1439	1982-present
8. NCOIC, Photo Services, 3400 TTW	1982-present
9. Civilian Supervisor, Entomology, 3415 CES	1978-present
10. Civilian Supervisor, Base Maint., 3415 CES	1960-1982
11. Bioenvironmental Engineer, BES	1968-1972
12. Civilian Supervisor, Real Property Office, 3415 ABG	1959-1970
13. NCOIC,BES	1964-present
14. NCO, BES	1980-present
15. Base Environmental Engineer, BES	1982-present
16. Base Historian, 3415 ABG	1981-present
17. Civilian Employee, Real Property Office, 3415 ABG	1975-present
18. NCOIC, Munitions Training, 3400 TTW	1981-present
19. C.E. Environmental Planner, 3415 CES	1980-present
20. Civilian Employee Pavement and Grounds, 3415 CES	1947-1948, 1961-1966
21. Civilian Heavy Equipment Operator, 3415 CES	1954-1980
22. Fire Chief, Fire Department, 3415 CES	1947, 1959-1971, 1975-present
23. Civilian Employee, Fire Department, 3415 CES	1962-present

TABLE B.1
LIST OF INTERVIEWEES

Position	Period
24. Deputy Base Civil Engineer, 3415 CES	1956-1973
25. Deputy Base Civil Engineer, 3415 CES	1965-1968, 1973-1979
26. Officer, Bombing Range	1948-present
27. Branch Chief, Engineering and Environmenal Planning, 3415 CES	1973-1982
28. Civilian Employee, Real Property, 3415 ABG	1981-82
29. Civilian Employee, Real Property, 3415 ABG	1968-1982
30. Civilian Employee, Grounds Maintenance, 3415 CES	1960-present
31. Officer, Fuels Management, 3415 Supply	1981-present
32. Civilian Employee, Grounds Section, Fuels Section, 3415 CES	1951-present
33. a. Heavy Equipment Operator, 3415 CES	1940-1950
b. Superintendent of Roads and Grounds, 3415 CES	1950-1963
c. Housing Manager, 3415 CES	1963-1973
34. Civilian Supervisor, Interior and Exterior Electric, 3415 CES	1970's-present
35. Civilian Employee, Vehicle Maint. Facility, 3415 Trans.	1978-present
36. Civilian Supervisor, Maint., 3415 CES	1960-1982
37. a. Heavy Equipment Operator, 3415 CES	1951-1965
b. Shop Foreman, 3415 CMS	1965-1967
c. Civilian Supervisor, Sanitation, 3415 CES	1967-present
38. Natural Resources Planner, 3415 CES	1971-present
39. Engineering Technical Supervisor, 3415 CES	1963-present
40. Airman	1943-1944
41. Denver Research Institute	1963-present
42. a. Civilian Employee, Warehouse, 3415 Supply	1950-1960
b. Civilian Employee, Grounds Section, 3415 CES	1960-present
43. NCOIC, Demonstration Range	1981-present

TABLE B.2

OUTSIDE AGENCY CONTACTS

1. S.G. Robson, US Geological Survey, Water Resources Division, Denver, Hydrologist, May 2, 1983. (303/234-3487)

2. R. Borman, US Geological Survey, Water Resources Division, Denver, Hydrologist, May 2, 1983. (303/234-3487)

3. D. Holden, Soil Conservation Service, Denver, Soil Scientist, May 2, 1983. (303/837-5791)

4. J.C. Romero, Colorado Department of Natural Resources, Division of Water Resources, Ground Water Analysis Branch, Denver, Chief Water Resource Engineer, May 2, 1983. (303/866-3581)

5. R.H. Pearl, Colorado Department of Natural Resources, Colorado Geological Survey, Ground Water Investigation Section, Denver, Chief of Section, May 2, 1983. (303/866-2611)

6. W.P. Rogers, Colorado Department of Natural Resources, Colorado Geological Survey, Engineering and Environmental Section, Denver, Chief of Section, May 2, 1983. (303/866-2611)

7. R.D. Anderson, Colorado Department of Health, Water Pollution Control Division, Denver, Public Health Officer, May 3, 1983. (303/320-8333)

8. C. Sutton, Colorado Department of Health, Waste Management Division, Denver, Industrial Hygenist, May 3, 1983. (303/320-8333)

APPENDIX C
TENANT MISSIONS

APPENDIX C

TENANT MISSIONS

USAF CLINIC

The USAF Clinic at Lowry provides patient care to active duty military personnel and emergency care to military members and their families, as well as to civilian employees. Complete dental services for individuals on active duty are provided at Lowry's modern Dental Clinic. In addition, dental prophylaxis and instruction on dental hygiene are offered annually to dependent children.

1987TH COMMUNICATIONS SQUADRON (AFSC)

The 1987th Communications Squadron operates and maintains communication facilities as approved by the Chief of Staff and as directed by the Commander, AFCS, and other competent authority. It also provides CE staff mission coverage for the Commander, LTCC, by programming new CE facilities to meet mission requirements and monitoring the operations/management of CE facilities to off-base areas supported by Lowry Air Force Base.

USAF POSTAL AND COURIER SERVICE (HQ, COMD USAF)

The USAF Postal and Courier Service provides delivery of personal mail to all military personnel who reside on Lowry proper except family quarters occupants, and provides mail directory service for all military personnel assigned/attached to and/or supported by Lowry. The OL Chief serves as the Base Postal Officer and represents the Lowry Air Force Base Commander on all postal matters.

USAF-CAP COLO WG/ROCKY MTN REGION (HQ, COMD, USAF)

The Colorado Wing of USAF-CAP provides liaison and assists in promoting harmonious relations between CAP and USAF, Civil Defense agencies, state and local agencies, and other military services. The

Rocky Mountain Region Group provides necessary liaison between CAP and USAF. The mission of the CAP includes cadet training, search and rescue, civil defense, communications, and the fostering of aerospace education in schools.

AIR FORCE HUMAN RESOURCES LAB (AFSC)

The mission of the Air Force Human Resources Lab is to execute exploratory research and advanced development programs as a means of improving the technical training of officers, NCOs, and airmen in the Air Force. This involves development, demonstration, and evaluation of improved methods, media, and systems for technical training.

AIR FORCE INTELLIGENCE SQUADRON/RE DTS4 (HQ, USAF)

The mission of the AFIS/RE is to conduct world-wide human intelligence (HUMINT) collection activities and to coordinate and provide staff and special support for HUMINT activities of other USAF collection elements. The AFIS/RE provides direct operational support to various activities within the intelligence community.

DET 4, 3314 MANAGEMENT ENGINEERING SQUADRON (ATC)

The 3314st Management Engineering Squadron provides all manpower and management engineering service to ATC units assigned to attached to Lowry Air Force Base.

AFOSI, DISTRICT 14 (HQ AFOSI)

The AFOSI provides criminal, counterintelligence, and special investigative service to all Air Force installations in Colorado, Wyoming, and Utah and investigates matters pertaining to fraud in procurement or disposal of Air Force property. They also effect coordination for Air Force commanders with the FBI and other federal agencies and civil authorities in the vicinity of Air Force installations.

3506TH RECRUITING GROUP, DET 607 (ATC)

The mission of the 3506th Recruiting Group, Det. 607 is to conduct recruiting activities in Colorado, Wyoming, New Mexico and metropolitan El Paso, Texas.

DENVER LABOR RELATIONS OFFICE (HQ, COMD USAF)

The mission of the Denver Labor Relations offices is to prevent labor disputes, work stoppages and picket actions on any government contract, primarily construction contracts. States covered are Colorado, Wyoming, and Utah.

DET 57, 1035TH TECHNICAL OPERATIONS GROUP (HQ, COMD USAF)

The mission of the 1035th Technical Operations Group is to serve as liaison between HQ USAF Air Force Technical Applications Center (AFTAC) and the 3420th School Squadron.

AIR FORCE AUDIT AGENCY (HQ, COMD USAF)

The mission of the Air force Audit Agency is to provide all levels of Air Force management with an independent, objective, and constructive evaluation of the effectiveness and efficiency with which managerial responsibilities, (including financial, operational, and support activities) are carried out. All organizational components and levels of operations are subject to internal audit review and appraisal as they impact on the consumption and use of Air Force resurces.

COLORADO NATIONAL BANK

The Colorado National Bank provides banking services to all military and civilian personnel at Lowry Air Force Base.

LOWRY FEDERAL CREDIT UNION

The Lowry Federal Credit Union provides savings, loans and financial counseling to Lowry military and civilian personnel.

USAF JUDICIARY AREA DEFENSE COUNSEL (HQ USAF) DETS QD4A AND QT4A

The mission of the USAF Judiciary Area Defense Counsel is to provide defense counsel for General and Special Court-Martials, Article 15, Article 32, and Administrative Discharges within the 4th Judicial Circuit.

U.S. ARMY, OMAHA DISTRICT, CORPS OF ENGINEERS

The Resident Engineer of the CoE monitors Air Force military construction program projects.

2ND COMMUNICATIONS SQUADRON (ADC)

The mission of the 2nd Communications Squadron is to operate and maintain classified high frequency terminal and computer systems to provide vital defense information to NORAD.

AMERICAN RED CROSS

The American Red Cross provides services to families residing in military-controlled housing and to unmarried service personnel assigned to installations under the jurisdiction of the Red Cross Field Director. Services offered include assistance in obtaining emergency leave, emergency financial aid, and communication between servicemen and their families. Counseling and referral service regarding personal and family problems is also provided.

U.S. POST OFFICE

The mission of the U.S. Post Office on Lowry AFB is to provide services normal to branch post offices.

AIR FORCE ACCOUNTING AND FINANCE CENTER

The mission of the Air Force Accounting and Finance Center is to provide centralized accounting for all Air force appropriated funds. It handles pay for all active, active reserve and retired Air Force personnel and operates the world-wide Air Force Accounting and Finance Network. Tenants of AFAFC include the Air Force Audit Agency, Air Force Audit Staff, General Accounting Office, the Federal Legal Information Through Electronics (FLITE) and the Air Reserve Personnel Center (ARPC).

AIR FORCE SYSTEMS ELECTRONICS SYSTEMS DIVISION

The mission of the AFS Electronics Systems Division is to aid in the design and construction of a link in the GWEN transmitter system to be located at the Lowry Training Annex.

APPENDIX D
MASTER LIST OF INDUSTRIAL SHOPS

APPENDIX D

MASTER LIST OF INDUSTRIAL SHOPS

Name	Present Location (Bldg. No.)	Handles Hazardous Materials	Generates Hazardous Wastes	Typical T.S.D. Methods
3415th Consolidated Maintenance Squadron				
PMEL	354	No	No	----
Corrosion Control	363	Yes	Yes	DPDO
Battery Shop	401	Yes	Yes	Neutral. to Sanitary Sewer
Avionics AGE	404	Yes	Yes	DPDO
F-16 Maintenance	859	Yes	Yes	DPDO
F-111 Maintenance	859	Yes	Yes	DPDO
F-15 Electrical	859	Yes	Yes	DPDO
Pneudraulic Shop	903	Yes	Yes	DPDO
Missile Course	903	Yes	Yes	DPDO
Special Weapons	1497	Yes	Yes	DPDO
Woodworking Shop	1475	Yes	No	----
Training Aids Welding	1475	Yes	No	----
Training Aids Paint	1475	Yes	Yes	DPDO/Storage
Training Aids Fabrication and Sheet Metal	1475	Yes	Yes	DPDO
3415th Civil Engineering				
Entomology	329	Yes	Yes	Reused
Paint Shop	363	Yes	Yes	DPDO
Locksmith Shop	364	Yes	Yes	Dumpster
Carpenter Shop	364	Yes	No	----
Heating Shop	366	Yes	Yes	DPDO
Refrigeration Shop	366	Yes	No	----
Exterior-Electric	366	Yes	Yes	DPDO
Interior-Electric	366	No	No	----

APPENDIX D

MASTER LIST OF INDUSTRIAL SHOPS
(Continued)

Name	Present Location (Bldg. No.)	Handles Hazardous Materials	Generates Hazardous Wastes	Typical T.S.D. Methods
3415th Civil Engineering (cont.)				
Heating Plant	361	Yes	Yes	Drains to Ground
Lawn Mower Repair	403	Yes	Yes	DPDO
Pavement & Ground	403	Yes	No	----
Golf Course Maintenance	1041	Yes	No	----
3415 Air Base Group				
Indoor Firing Range	364	Yes	No	----
Duplication Center	577	Yes	No	----
Base Exchange Service Station	606	Yes	Yes	DPDO
Base Hobby & Craft Shop	627	Yes	Yes	Sanitary Sewer
Auto Hobby Shop	1430	Yes	Yes	DPDO/Sanitary Sewer
Transportation Division				
Heavy Equipment Maintenance	369	Yes	Yes	DPDO/Fire-Training/Sanitary Sewer
Packing & Crating	597	Yes	Yes	Dumpster
Vehicle Maintenance	1438	Yes	Yes	DPDO

APPENDIX D

MASTER LIST OF INDUSTRIAL SHOPS
(Continued)

Name	Present Location (Bldg. No.)	Handles Hazardous Materials	Generates Hazardous Wastes	Typical T.S.D. Methods
3400th Technical Training Wing				
Laser Training	373	Yes	Yes	Sanitary Sewer
Soldering Course	903	Yes	Yes	Dumpster
Meteorology Training	1433	Yes	No	----
Photo Training	382/383	Yes	Yes	Sanitary Sewer
USAF Clinic				
Hospital Clinic	752	Yes	No	----
Dental Clinic	753	Yes	Yes	Sanitary Sewer
Dental ADL	777	No	No	----

NOTE: Wastes designated for DPDO handling are stored on base at various locations prior to delivery to, or sale by, the off-base DPDO office at Rocky Mountain Arsenal.

APPENDIX E

SUPPLEMENTAL BASE ENVIRONMENTAL DATA

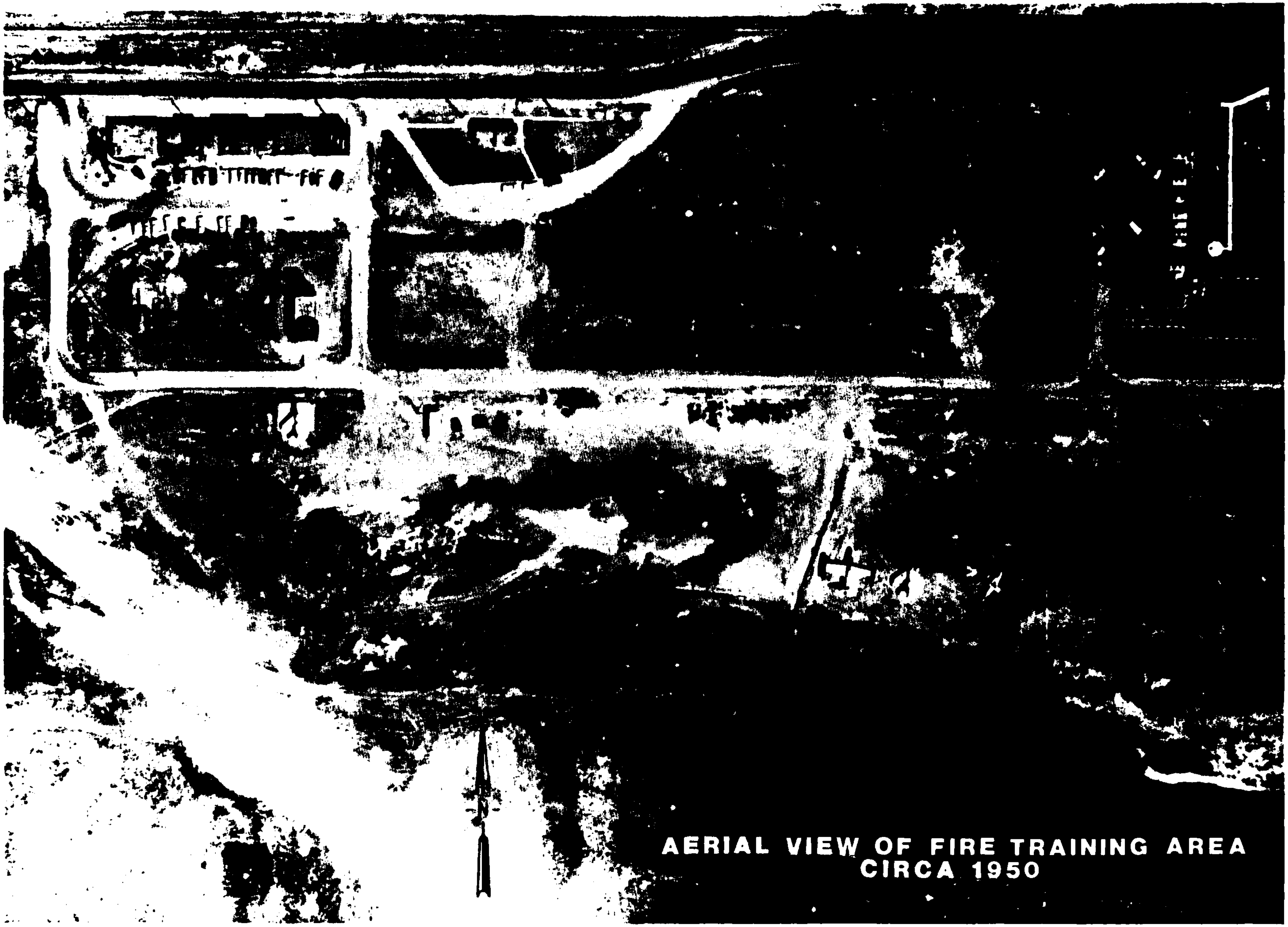
TABLE E.1
PESTICIDES USED BY THE ENTOMOLOGY SHOP
Lowry AFB
September, 1982

Pesticide	Monthly Use
Calcium Cyanide	Emergency Only
Chlordane	Emergency Only
Chlorpyrifos (Dursban)	1 Gal./Mo.
Diazinon	2 Gal./Mo.
Dichlorvos (Vapona)	1 Qt./Mo.
Malathion	100 Gals./Mo., Summer Only
Methoxychlor	INA
Propoxur (Baygon)	Emergency Only
Pyrethrum	6 pounds/Mo.
Orthene	66 pounds/Mo.
Dacamine 360D	INA
Hyvar X-L	INA
Roundup	INA
Resmethrin	9 pounds/Mo.
Paradichlorobenzene	Emergency Only
Zinc Phosphide Powder	Emergency Only
Warfarin	5 pounds/Mo.
Pival	Emergency Only
Prostoxin Tablets	Emergency Only

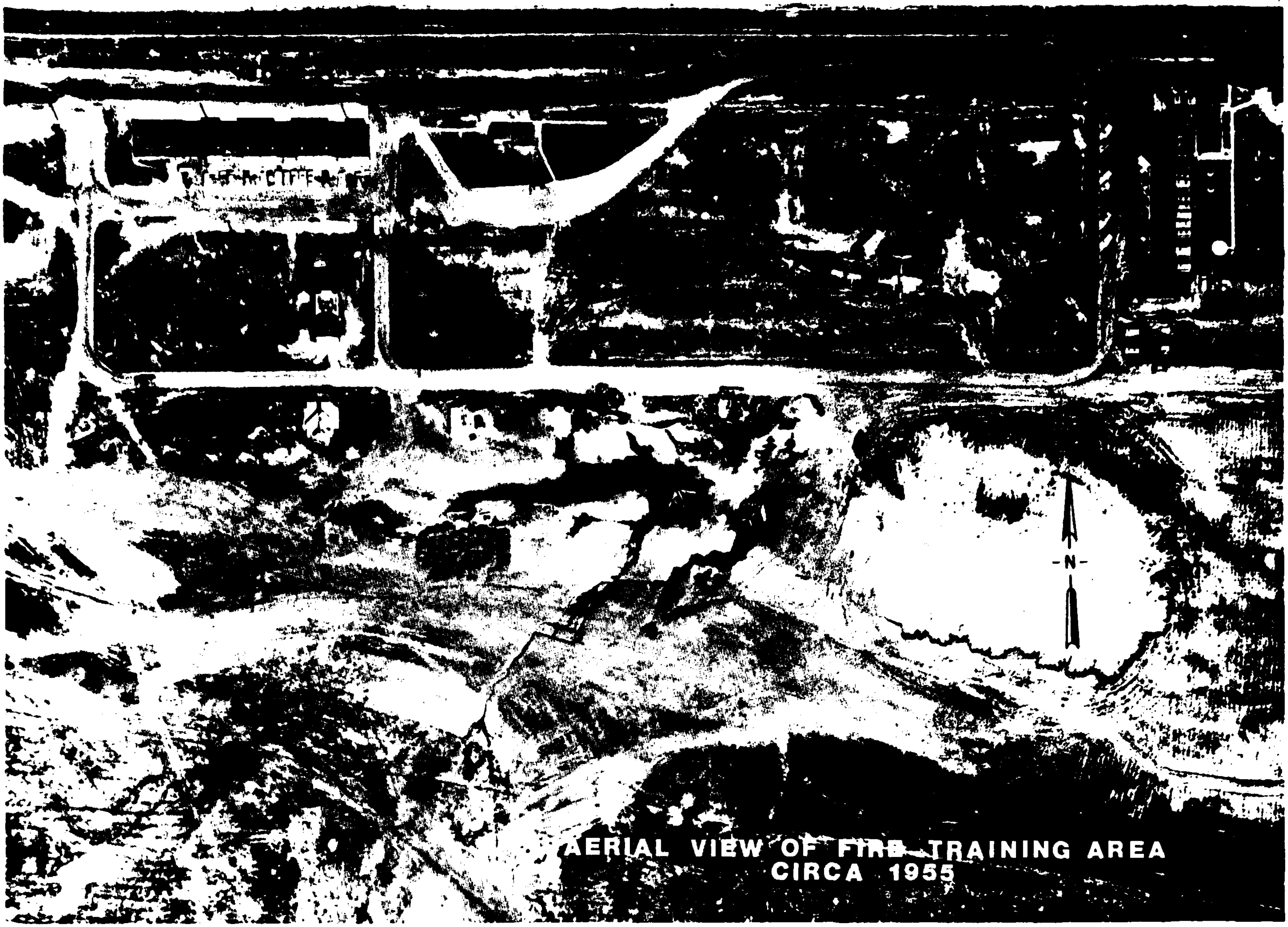
INA - Information Not Available

APPENDIX F
SITE PHOTOGRAPHS

TABLE OF CONTENTS

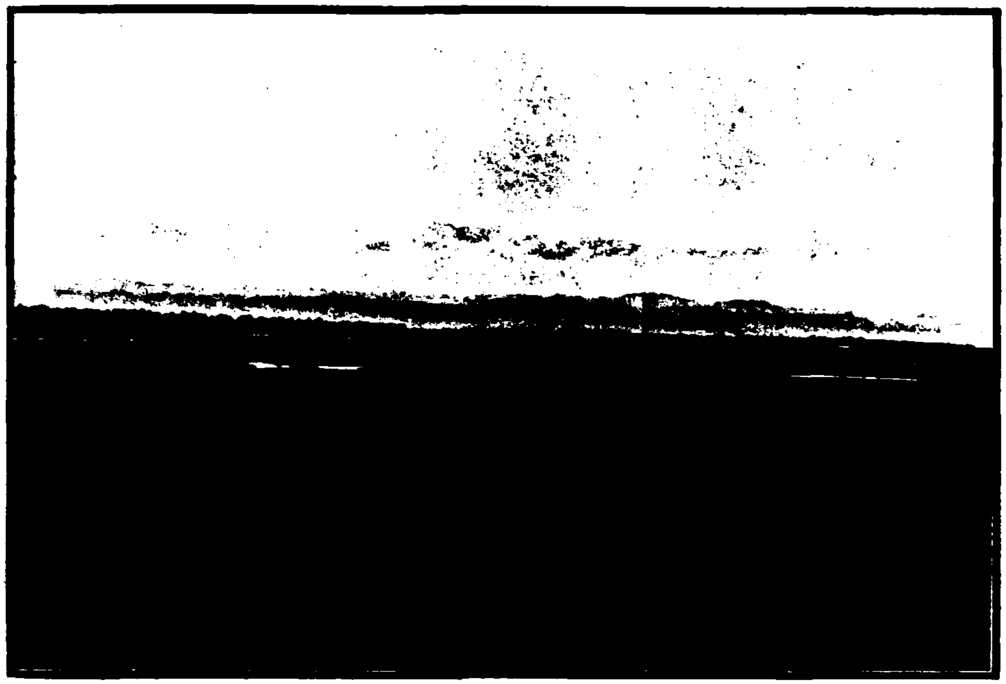


AERIAL VIEW OF FIRE TRAINING AREA
CIRCA 1950



AERIAL VIEW OF FIRE TRAINING AREA
CIRCA 1955

LOWRY AFB



Site FT-1
Fire Protection Training Area
(Looking Southeast)

Site FT-1
Fire Protection Training Area
(Looking East)

Site D-1
Sanitary Landfill
(Looking East)

Site D-1
Sanitary Landfill
(Looking Southeast)

APPENDIX G

HAZARD ASSESSMENT RATING METHODOLOGY

APPENDIX G

USAF INSTALLATION RESTORATION PROGRAM
HAZARD ASSESSMENT RATING METHODOLOGY

BACKGROUND

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

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

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

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

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

PURPOSE

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

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

DESCRIPTION OF MODEL

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

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

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

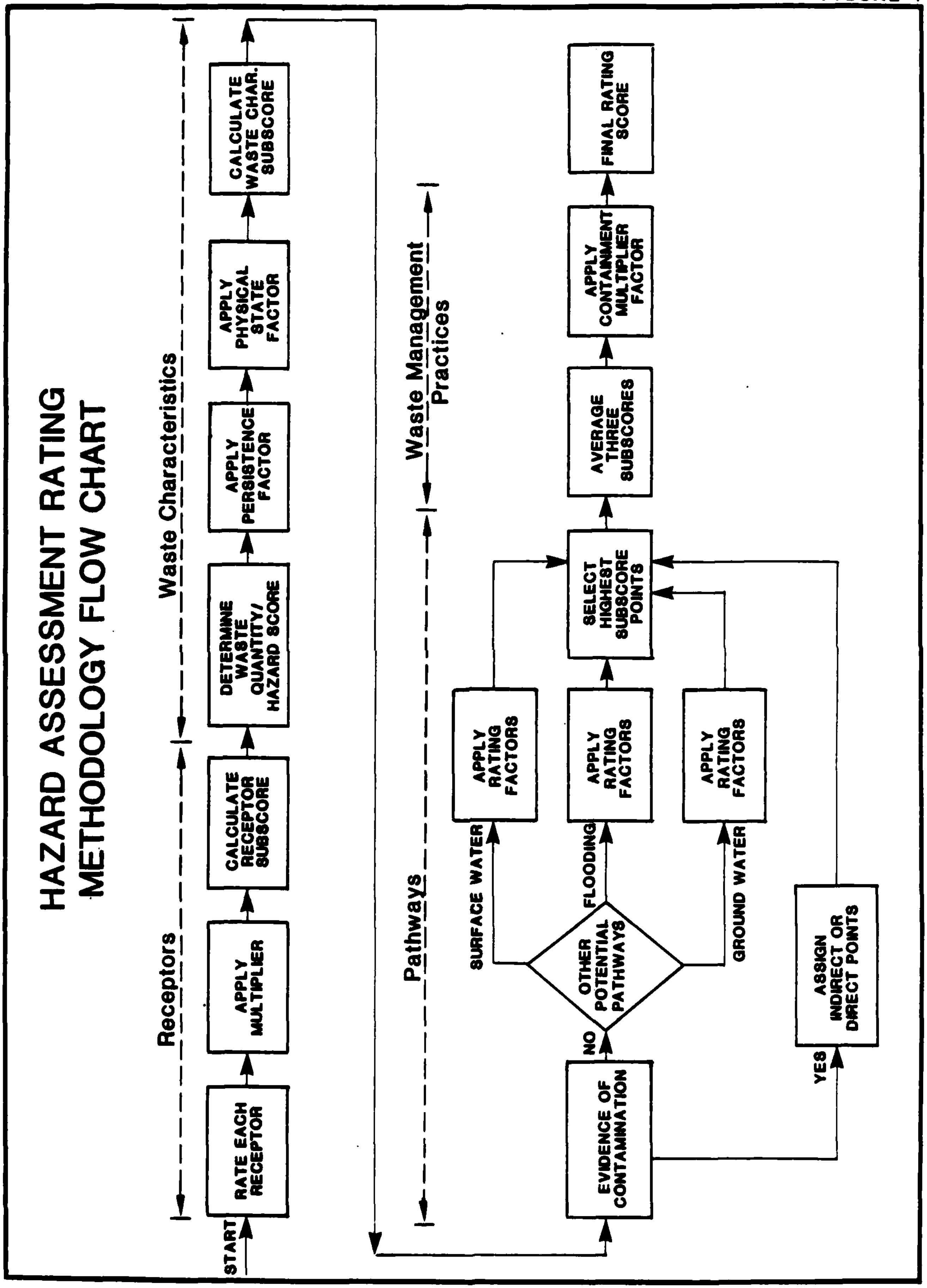
The receptors category rating is calculated by scoring each factor, multiplying by a factor weighting constant and adding the weighted scores to obtain a total category score.

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

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

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

FIGURE 1



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

FIGURE 2

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE ____________________

LOCATION ____________________

DATE OF OPERATION OR OCCURRENCE ____________________

OWNER/OPERATOR ____________________

COMMENTS/DESCRIPTION ____________________

SITE RATED BY ____________________

I. RECEPTORS

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

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

II. WASTE CHARACTERISTICS

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

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

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

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

______ X ______ = ______

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

______ X ______ = ______

FIGURE 2 (Continued)

III. PATHWAYS

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

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

Subscore ______

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

1. Surface water migration

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

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

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

Subscore (100 x factor score/3) ______

3. Ground-water migration

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

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

C. Highest pathway subscore.

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

Pathways Subscore ______

IV. WASTE MANAGEMENT PRACTICES

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

Receptors ______
Waste Characteristics ______
Pathways ______

Total ______ divided by 3 = ______
Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

______ X ______ = ______

TABLE 1

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

I. RECEPTORS CATEGORY

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

TABLE 1 (Continued)

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

II. WASTE CHARACTERISTICS

A-1 Hazardous Waste Quantity

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

A-2 Confidence Level of Information

C = Confirmed confidence level (minimum criteria below)

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

S = Suspected confidence level

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

A-3 Hazard Rating

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

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

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

TABLE 1 (Continued)

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

II. WASTE CHARACTERISTICS (Continued)

Waste Characteristics Matrix

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

Notes:
For a site with more than one hazardous waste, the waste quantities may be added using the following rules:

Confidence Level
- o Confirmed confidence levels (C) can be added
- o Suspected confidence levels (S) can be added
- o Confirmed confidence levels cannot be added with suspected confidence levels

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

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

B. Persistence Multiplier for Point Rating

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

C. Physical State Multiplier

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

TABLE 1 (Continued)

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

III. PATHWAYS CATEGORY

A. Evidence of Contamination

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

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

Rating Factor	Rating Scale Levels 0	1	2	3	Multiplier
B-1 POTENTIAL FOR SURFACE WATER CONTAMINATION					
Distance to nearest surface water (includes drainage ditches and storm sewers)	Greater than 1 mile	2,001 feet to 1 mile	501 feet to 2,000 feet	0 to 500 feet	8
Net precipitation	Less than -10 in.	-10 to + 5 in.	+5 to +20 in.	Greater than +20 in.	6
Surface erosion	None	Slight	Moderate	Severe	8
Surface permeability	0% to 15% clay ($>10^{-2}$ cm/sec)	15% to 30% clay (10^{-2} to 10^{-4} cm/sec)	30% to 50% clay (10^{-4} to 10^{-6} cm/sec)	Greater than 50% clay ($<10^{-6}$ cm/sec)	6
Rainfall intensity based on 1 year 24-hr rainfall	<1.0 inch	1.0-2.0 inches	2.1-3.0 inches	>3.0 inches	8
B-2 POTENTIAL FOR FLOODING					
Floodplain	Beyond 100-year floodplain	In 25-year floodplain	In 10-year floodplain	Floods annually	1
B-3 POTENTIAL FOR GROUND-WATER CONTAMINATION					
Depth to ground water	Greater than 500 ft	50 to 500 feet	11 to 50 feet	0 to 10 feet	8
Net precipitation	Less than -10 in.	-10 to +5 in.	+5 to +20 in.	Greater than +20 in.	6
Soil permeability	Greater than 50% clay ($>10^{-6}$ cm/sec)	30% to 50% clay (10^{-4} to 10^{-6} cm/sec)	15% to 30% clay (10^{-2} to 10^{-4} cm/sec)	0% to 15% clay ($<10^{-2}$ cm/sec)	8
Subsurface flows	Bottom of site greater than 5 feet above high ground-water level	Bottom of site occasionally submerged	Bottom of site frequently submerged	Bottom of site located below mean ground-water level	8
Direct access to ground water (through faults, fractures, faulty well casings, subsidence fissures, etc.)	No evidence of risk	Low risk	Moderate risk	High risk	8

TABLE 1 (Continued)

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

IV. WASTE MANAGEMENT PRACTICES CATEGORY

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

B. WASTE MANAGEMENT PRACTICES FACTOR

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

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

Guidelines for fully contained:

Landfills:

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

Spills:

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

Surface Impoundments:

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

Fire Proection Training Areas:

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

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

APPENDIX H
SITE ASSESSMENT RATING FORMS

TABLE OF CONTENTS
SITE ASSESSMENT RATING FORMS

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE FT-1 FIRE TRAINING AREA NO. 1

LOCATION SOUTH OF FIRST AVE, NORTH OF ALAMEDA AVE, WEST OF HAVANA ST

DATE OF OPERATION OR OCCURRENCE 1946 - 1965

OWNER/OPERATOR LOWRY AFB

COMMENTS/DESCRIPTION

SITE RATED BY U. G. Christopher

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	3	4	12	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			102	180

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

II. WASTE CHARACTERISTICS

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

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

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

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

100 x 1.0 = 100

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

100 x 1.0 = 100

III. PATHWAYS

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

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

Subscore NA

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

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	2	8	16	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
Subtotals			30	108

Subscore (100 X factor score subtotal/maximum score subtotal) 28

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

Subscore (100 x factor score/3) 0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			40	114

Subscore (100 x factor score subtotal/maximum score subtotal) 35

C. Highest pathway subscore.

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

Pathways Subscore 35

IV. WASTE MANAGEMENT PRACTICES

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

Receptors	57
Waste Characteristics	100
Pathways	35
Total 192 divided by 3 =	64 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

64 x 1.0 = 64

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE D-1 SANITARY LANDFILL
LOCATION SOUTH OF RV STORAGE AREA, NORTH OF ALAMEDA AVENUE
DATE OF OPERATION OR OCCURRENCE 1948 - 1983
OWNER/OPERATOR LOWRY AFB
COMMENTS/DESCRIPTION
SITE RATED BY W. B. Christopher

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	3	4	12	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			102	180

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

II. WASTE CHARACTERISTICS

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

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

Factor Subscore A (from 20 to 100 based on factor score matrix) 70

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

70 x 1.0 = 70

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

70 x 1.0 = 70

III. PATHWAYS

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

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

Subscore ______

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

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
Subtotals			38	108

Subscore (100 X factor score subtotal/maximum score subtotal) 35

2. Flooding

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

Subscore (100 x factor score/3) 0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	3	8	24	24
Direct access to ground water	0	8	0	24
Subtotals			64	114

Subscore (100 x factor score subtotal/maximum score subtotal) 56

C. Highest pathway subscore.

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

Pathways Subscore 56

IV. WASTE MANAGEMENT PRACTICES

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

Receptors	57
Waste Characteristics	70
Pathways	56
Total 183 divided by 3 =	61 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

61 x 0.95 = 58

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE FT-2 FIRE TRAINING AREA NO. 2

LOCATION NORTH OF FT-1, SOUTH OF FIRST AVE, EAST OF HAVANA ST.

DATE OF OPERATION OR OCCURRENCE 1965 - 1980

OWNER/OPERATOR LOWRY AFB

COMMENTS/DESCRIPTION ---

SITE RATED BY W. G. Christopher

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	3	4	12	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			102	180

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

II. WASTE CHARACTERISTICS

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

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

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

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

60 x 0.8 = 48

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

48 x 1.0 = 48

III. PATHWAYS

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

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

Subscore NA

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

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	1	8	8	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
		Subtotals	22	108

Subscore (100 X factor score subtotal/maximum score subtotal) 20

2. Flooding

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

Subscore (100 x factor score/3) 0

3. *Ground-water migration*

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
		Subtotals	40	114

Subscore (100 x factor score subtotal/maximum score subtotal) 35

C. Highest pathway subscore.

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

Pathways Subscore 35

IV. WASTE MANAGEMENT PRACTICES

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

Receptors	57
Waste Characteristics	48
Pathways	35
Total 140 divided by 3 =	47
	Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

47 x 1.0 = 47

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE SP-1 OLD JET FUEL YARD AREA

LOCATION NORTH OF IRVINGTON PLACE, SOUTH OF 6th AVENUE, WEST OF VINTA S

DATE OF OPERATION OR OCCURRENCE 1950's - 1966

OWNER/OPERATOR LOWRY AFB

COMMENTS/DESCRIPTION

SITE RATED BY W. G. Christopher

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	3	4	12	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
		Subtotals	96	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 53

II. WASTE CHARACTERISTICS

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

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

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

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

40 x 0.8 = 32

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

32 x 1.0 = 32

III. PATHWAYS

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

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

Subscore N.A.

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

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	2	8	16	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
		Subtotals	30	108

Subscore (100 X factor score subtotal/maximum score subtotal) 28

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

Subscore (100 x factor score/3) 0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	3	8	24	24
Direct access to ground water	0	8	0	24
		Subtotals	64	114

Subscore (100 x factor score subtotal/maximum score subtotal) 56

C. Highest pathway subscore.

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

Pathways Subscore 56

IV. WASTE MANAGEMENT PRACTICES

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

Receptors	53
Waste Characteristics	32
Pathways	56
Total 141 divided by 3 =	47 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

47 x 1.0 = 47

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE D-2 SANITARY LANDFILL

LOCATION EAST OF SITE D-1, NORTH OF ALAMEDA AVENUE

DATE OF OPERATION OR OCCURRENCE EARLY 1960's

OWNER/OPERATOR LOWRY AFB

COMMENTS/DESCRIPTION

SITE RATED BY W. G. Christopher

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	3	4	12	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			102	180

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

II. WASTE CHARACTERISTICS

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

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

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

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

20 x 0.8 = 16

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

16 x 0.5 = 8.0

III. PATHWAYS

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

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

Subscore NA

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

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	2	8	16	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
Subtotals			30	108

Subscore (100 X factor score subtotal/maximum score subtotal) 28

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

Subscore (100 x factor score/3) 0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	3	8	24	24
Direct access to ground water	0	8	0	24
Subtotals			64	114

Subscore (100 x factor score subtotal/maximum score subtotal) 56

C. Highest pathway subscore.

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

Pathways Subscore 56

IV. WASTE MANAGEMENT PRACTICES

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

Receptors	57
Waste Characteristics	8
Pathways	56
Total 121 divided by 3 =	40 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

40 x 0.95 = 38

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE D-6 FLY ASH DISPOSAL SITE

LOCATION BETWEEN WESTERLY CREEK AND WILLOW STREET

DATE OF OPERATION OR OCCURRENCE 1940 - 1948

OWNER/OPERATOR LOWRY AFB

COMMENTS/DESCRIPTION

SITE RATED BY W G Christopher

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	3	4	12	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			102	180

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

II. WASTE CHARACTERISTICS

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

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

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

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

20 x 0.4 = 8.0

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

8.0 x 0.5 = 4.0

III. PATHWAYS

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

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

Subscore N.A

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

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
Subtotals			38	108

Subscore (100 X factor score subtotal/maximum score subtotal) 35

2. Flooding

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

Subscore (100 x factor score/3) 0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	1	8	8	24
Direct access to ground water	0	8	0	24
Subtotals			48	114

Subscore (100 x factor score subtotal/maximum score subtotal) 42

C. Highest pathway subscore.

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

Pathways Subscore 42

IV. WASTE MANAGEMENT PRACTICES

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

Receptors 57
Waste Characteristics 4
Pathways 42
Total 108 divided by 3 = 34 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

34 x 0.95 = 32

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE S-1 COAL STORAGE YARD

LOCATION SOUTH OF 6th AVENUE CIRCLE, EAST OF ROSEMARY WAY, NORTH OF 6th AVE

DATE OF OPERATION OR OCCURRENCE

OWNER/OPERATOR LOWRY AFB

COMMENTS/DESCRIPTION

SITE RATED BY W G Christopher

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	3	4	12	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
		Subtotals	102	180

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

II. WASTE CHARACTERISTICS

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

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

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

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

20 x 0.4 = 8

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

8 x 0.5 = 4

III. PATHWAYS

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

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

Subscore N A

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

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	1	8	8	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
Subtotals			22	108

Subscore (100 X factor score subtotal/maximum score subtotal) 20

2. Flooding

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

Subscore (100 x factor score/3) 0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			40	114

Subscore (100 x factor score subtotal/maximum score subtotal) 35

C. Highest pathway subscore.

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

Pathways Subscore 35

IV. WASTE MANAGEMENT PRACTICES

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

Receptors	57
Waste Characteristics	4
Pathways	35
Total 96 divided by 3 =	32 (Gross Total Score)

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

32 x 1.0 = 32

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE S-2 COAL STORAGE YARD

LOCATION NORTH OF 5th AVENUE, SOUTH OF 6th AVENUE, WEST OF DAYTON STREET

DATE OF OPERATION OR OCCURRENCE

OWNER/OPERATOR LOWRY AFB

COMMENTS/DESCRIPTION

SITE RATED BY W. G. Christopher

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	3	4	12	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
		Subtotals	102	180

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

II. WASTE CHARACTERISTICS

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

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

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

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

20 x 0.4 = 8.0

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

8.0 x 0.5 = 4.0

III. PATHWAYS

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

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

Subscore N.A.

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

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	1	8	8	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
Subtotals			22	108

Subscore (100 X factor score subtotal/maximum score subtotal) 20

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

Subscore (100 x factor score/3) 0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			40	114

Subscore (100 x factor score subtotal/maximum score subtotal) 35

C. Highest pathway subscore.

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

Pathways Subscore 35

IV. WASTE MANAGEMENT PRACTICES

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

Receptors	57
Waste Characteristics	4
Pathways	35
Total 96 divided by 3 =	32
	Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

32 x 1.0 = 32

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE S-3 COAL STORAGE YARD

LOCATION SOUTH OF 6th AVENUE, NORTH OF 5th AVENUE, WEST OF DAYTON STREET

DATE OF OPERATION OR OCCURRENCE

OWNER/OPERATOR LOWRY AFB

COMMENTS/DESCRIPTION

SITE RATED BY W. G. Christopher

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	3	4	12	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
		Subtotals	102	180

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

II. WASTE CHARACTERISTICS

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

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

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

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

20 x 0.4 = 8.0

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

8.0 x 0.5 = 4.0

III. PATHWAYS

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

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

Subscore NA

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

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	1	8	8	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
Subtotals			22	108

Subscore (100 X factor score subtotal/maximum score subtotal) 20

2. Flooding

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

Subscore (100 x factor score/3) 0

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			40	114

Subscore (100 x factor score subtotal/maximum score subtotal) 35

C. Highest pathway subscore.

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

Pathways Subscore 35

IV. WASTE MANAGEMENT PRACTICES

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

Receptors	57
Waste Characteristics	4
Pathways	35
Total 96 divided by 3 =	32 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

32 x 1.0 = 32

APPENDIX I

REFERENCES

APPENDIX I
REFERENCES

1. Bjarnason, R, Denver Research Institute, Denver, CO, 1983, Oral comm.

2. Colorado Department of Health, Water Quality Control Comm., 1981, Classifications and Numeric Standards, South Platte River Basin, Laramie River Basin, Smoky Hill River Basin.

3. Freitas, SSgt. J., U.S. Air Force, Lowry Air Force Base, Denver, CO, 1983, Oral Comm.

4. Hamilton, J.H., and Owens, W.G., 1972, Geologic Aspects, Soils and Related Foundation Problems, Denver metropolitan area, Colorado: Department of Natural Resources, Colorado Geological Survey.

5. Kirkham, R.M. and Rogers, W.P., 1981, Earthquake Potential in Colorado: Dept. of Natural Resources, Colorado Geological Survey.

6. Lowry AFB, A Forty Year Look at Lowry Air Force Base, 1937-1977, January 1978.

7. Lowry AFB, Land Management Plan, January 1981.

8. Lowry AFB, Tab A-1, Environmental Information.

9. Lowry Technical Training Center, Hazardous Waste Management Plan, February 15, 1982.

10. Lowry Technical Training Center, Oil and Hazardous Substances Contingency Plan, June 1, 1983.

11. Pearl, Richard Howard, 1974, Geology of Ground Water Resources in Colorado, An Introduction: Colorado Geological Survey Special Pub. 4.

12. Robson, S.G., 1976, Ground-water quality near a sewage-sludge recycling site and a landfill near Denver, Colorado: U.S. Geol. Survey Water Resources Inv. 76-132.

13. Robson, S.G., and others, 1981, Geologic structure, hydrology, and water quality of the Laramie-Fox Hills aquifer in the Denver Basin, Colorado: U.S. Geol. Survey Hydrologic Investigations Atlas HA-650.

14. Robson, S.G., and Romero, J.C., 1981, Geologic structure, hydrology, and water quality of the Denver aquifer in the Denver Basis, Colorado: U.S. Geol. Survey Hydrologic Investigations Atlas HA-646.

15. Rogers, W.P., Department of Natural Resources, Colorado Geological Survey, Denver, CO, 1983, Oral comm.

16. Shroba, R.R., 1980, Geologic map and physical properties of the surficial and bedrock units of the Englewood quadrangle, Denver, Arapahoe and Adams Counties, Colorado: U.S. Geol. Survey Geologic Quadrangle Map GQ-1524.

17. Trimble, D.E., and Machette, M.N., 1979, Geologic map of the greater Denver area, front range urban corridor, Colorado: Misc. Inv. Series I-856-H.

18. Tweto, Ogden, 1979, Geologic Map of Colorado: Colorado Geological Survey, 1:500:000.

19. U.S. Army Corps of Engineers, 1980, Water and related land resources management study, Metropolitan Denver and South Platte River and tributaries Colorado, Wyoming, and Nebraska, Vol. III C, Flood Control Plan Formulation, Appendix A-Supplement for Westerly Creek, Colorado: U.S. Army Corps of Engineers, Omaha Dist.

20. U.S. Department of Commerce, 1980, Local Climatological Data, 1980, Denver, Colorado: U.S. Dept. Comm., National Oceanic and Atmos. Admin., Env. Data and Info. Ser., Nat. Climatic Ctr., Ashville, N.C.

21. U.S. EPA Region VIII, Oil and Hazardous Substances Pollution Contingency Plan, Draft, February 22, 1983.

APPENDIX J

GLOSSARY OF TERMINOLOGY AND ABBREVIATIONS

APPENDIX J

GLOSSARY OF TERMINOLOGY AND ABBREVIATIONS

ABG: AIR BASE GROUP

ACFT MAINT: Aircraft Maintenance

ADC: Air Defense Command

AF: Air Force

AFFF: Aqueous Film Forming Foam

AFB: Air Force Base

AFCS: Air Force Communications Service

AFESC: Air Force Engineering and Services Center

AFR: Air Force Regulation

AFSC: Air Force Systems Command

Ag: Chemical symbol for silver

AGE: Aerospace Ground Equipment

Al: Chemical symbol for aluminum

ALLUVIUM: Unconsolidated sediments deposited in relatively recent geologic time by the action of water

ARTESIAN: Ground water contained under hydrostatic pressure

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

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

AQUITARD: A soils formation which impedes ground-water flow

ATC: Air Training Command

AVGAS: Aviation Gasoline

Ba: Chemical symbol for barium

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

BES: Bioenvironmental Engineering Services

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

CAP: Civilian Air Patrol

Cd: Chemical symbol for cadmium

CE: Civil Engineering

CERCLA: Comprehensive Environmental Response, Compensation and Liability Act

CES: Civil Engineering Squadron

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

CMS: Component Maintenance Squadron

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

COE: Corps of Engineers

COMD: Command

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

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

Cr: Chemical symbol for chromium

Cu: Chemical symbol for copper

D: Disposal Site

DET: Detachment

DIP: The angle at which a stratum is inclined from the horizontal

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

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

DOD: Department of Defense

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

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

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

EOD: Explosive Ordnance Disposal

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

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

EPA: U.S. Environmental Protection Agency

EROSION: The wearing away of land surface by wind or water

FAA: Federal Aviation Administration

FACILITY: Any land and appurtenances used for the treatment, storage and/or disposal of hazardous wastes

Fe: Chemical symbol for iron

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

FLOW PATH: The direction or movement of ground water and any contaminants that may be contained therein, as governed principally by the hydraulic gradient

FT: Fire Training

FTA: Fire Training Area

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

GROUND WATER: Water beneath the land surface that is under atmospheric or artesian pressure

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

HALF-LIFE: The time required for half the atoms present in radioactive substance to decay

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

HARM: Hazard Assessment Rating Methodology

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

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

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

Hg: Chemical symbol for mercury

HQ: Headquarters

HWMF: Hazardous Waste Management Facility

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

INFILTRATION: The gradual passing of liquid through matter.

IRP: Installation Restoration Program

JP-4: Jet Fuel

LAFB: Lowry Air Force Base

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

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

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

LOESS: A sediment composed dominantly of silt-size particles that has been deposited primarily by the wind

LOX: Liquid Oxygen

LTTC: Lowry Technical Training Center

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

MEK: Methyl Ethyl Ketone

MGD: million gallons per day

MOA: Military Operating Area

MOGAS: Motor gasoline

Mn: Chemical symbol for manganese

MODIFIED MERCALLI INTENSITY: A number describing the effects of an earthquake on man, structures and the earth's surface. A Modified Mercalli Intensity of I is not felt. An intensity of II may be felt indoors. Intensities of III and IV are felt indoors with increasing strength. An intensity of V is felt both indoors and outdoors. Objects begin falling off shelves at intensity VI. For an intensity of VII it becomes difficult for a man to remain standing. Intensities of IX to XII involve increasing levels of destruction with destruction being nearly total at an intensity of XII.

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

MSL: Mean Sea Level

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

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

NCO: Non-commissioned Officer

NCOIC: Non-commissioned Officer In-Charge

NDI: Non-destructive Inspection

NET PRECIPITATION: The amount of annual precipitation minus annual evaporation

NGVD: National Geodetic Vertical Datum

Ni: Chemical symbol for nickel

NPDES: National Pollutant Discharge Elimination System

OEHL: Occupational and Environmental Health Laboratory

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

O&G: Symbols for oil and grease

OSI: Office of Special Investigations

OVA: Organic Vapor Analyzer

Pb: Chemical symbol for lead

PCB: Polychlorinated Biphenyls; highly toxic to aquatic life; they persist in the environment for long period and are biologically accumulative

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

PERMEABILITY: The rate at which fluids may move through a solid, porous medium

PD-680: Cleaning solvent, safety solvent, Stoddard solvent, petroleum distillate

pH: Negative logarithm of hydrogen ion concentration; measurement of acids and bases

PL: Public Law

POL: Petroleum, Oils and Lubricants

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

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

PPM: Parts per million by weight

PRECIPITATION: Rainfall

RCRA: Resource Conservation and Recovery Act

RD: Low-level radioactive waste disposal site

RECHARGE AREA: An area in which water is absorbed that eventually reaches the zone of saturation in one or more aquifers

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

RECON: Reconnaissance

RWDS: Radioactive Waste Disposal Site

S: Storage Site

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

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

SEISMICITY: Pertaining to earthquakes or earth vibrations

SLUDGE: The solid residue resulting from a manufacturing or wastewater treatment process which also produces a liquid stream

SOLID WASTE: Any garbage, refuse, or sludge from a waste treatment plant, water supply treatment, or air pollution control facility and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, commercial, mining, or agricultural operations and from community activities, but does not include solid or dissolved materials in domestic sewage; solid or dissolved materials in irrigation return flows; industrial discharges which are point source subject to permits under Section 402 of the Federal Water Pollution Control Act, as amended (86 USC 880); or source, special nuclear, or by-product material as defined by the Atomic Energy Act of 1954 (68 USC 923)

SP: Spill Area

SPILL: Any unplanned release or discharge of a hazardous waste onto or into the air, land, or water

STORAGE OF HAZARDOUS WASTE: Containment, either on a temporary basis or for a longer period, in such a manner as not to constitute disposal of such hazardous waste

TAC: Tactical Air Command

TCE: Tetrachloroethylene

TCA: 1,1,1-Tetrachloroethane

TOC: Total Organic Carbon

TOXICITY: The ability of a material to produce injury or disease upon exposure, ingestion, inhalation, or assimilation by a living organism

TRANSMISSIVITY: The rate at which water is transmitted through a unit width under a unit hydraulic gradient

TREATMENT OF HAZARDOUS WASTE: Any method, technique, or process including neutralization designed to change the physical, chemical, or biological character or composition of any hazardous waste so as to neutralize the waste or so as to render the waste nonhazardous

TTW: Technical Training Wing

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

USAF: United States Air Force

USGS: United States Geological Survey

WATER TABLE: Surface of a body of unconfined ground water at which the pressure is equal to that of the atmosphere

Zn: Chemical symbol for zinc

APPENDIX K

INDEX OF REFERENCES TO INITIAL SOURCES OF ENVIRONMENTAL CONCERN

APPENDIX K

INDEX TO AREAS OF INITIAL ENVIRONMENTAL CONCERN AT LOWRY

APPENDIX K
INDEX TO AREAS OF INITIAL ENVIRONMENTAL CONCERN AT LOWRY
(Continued)

Site No.	Site Description	Pages
S-4	Maintenance Waste Oil Storage Tank	4-2, 4-5, 4-8, 4-15, 4-24, 4-25, 4-28, D-2
S-5	Heavy Equipment Maintenance Waste Oil Storage Tank	4-2, 4-5, 4-8, 4-15, 4-24, 4-25, 4-28, D-2
S-6	Central Hazardous Waste Storage Facility	4-2, 4-8, 4-15, 4-25, 4-28
S-7	Corrosion Control Shop Pit	4-2, 4-4, 4-8, 4-25, 4-28, D-1
S-8	PCB Transformer Interim Storage Area	4-8, 4-16, 4-25, 4-28
S-9	PCB Transformer Storage Area	4-8, 4-16, 4-25, 4-28
S-10	Pesticide Storage Area	4-8, 4-9, 4-16
S-11	BX Service Station	4-8, 4-15