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AD-A226 992

Installation Restoration Program

PHASE I - RECORDS SEARCH

United States Air Force Academy
Colorado Springs, Colorado

December 1984

Prepared for:

United States Air Force Academy
Colorado Springs, Colorado

WESTON

DESIGNERS CONSULTANTS

PROPRIETARY NOTICE

This report has been prepared for the U.S. Air Force by Roy F. Weston, Inc. for the purpose of aiding in the implementation of 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 or the Department of Defense.

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INSTALLATION RESTORATION PROGRAM

PHASE I: RECORDS SEARCH

U.S. AIR FORCE ACADEMY

COLORADO SPRINGS, COLORADO

Prepared for:

U.S. AIR FORCE ACADEMY

COLORADO SPRINGS, COLORADO

DECEMBER 1984

By:
Roy F. Weston, Inc.
Weston Way
West Chester, Pennsylvania 19380

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EXECUTIVE SUMMARY

The Department of Defense (DOD) has developed a program to identify and evaluate past hazardous waste disposal sites on DOD facilities. This program has also been designed to provide for control of migration of hazardous contaminants and control of hazards to health or welfare that may result from past practices. The program, called the Installation Restoration Program (IRP) has four phases:

Phase I - Initial Assessment (Records Search)
Phase II - Confirmation/Quantification
Phase III - Technology Base Development
Phase IV - Operations/Remedial Actions.

Roy F. Weston, Inc. (WESTON) has been retained by the United States Air Force to conduct the Phase I Initial Assessment (Record Search) at the United States Air Force Academy. This report presents the results of the Phase I effort.

INSTALLATION DESCRIPTION

The U.S. Air Force Academy is located 10 miles north of Colorado Springs, Colorado, and is wholly contained within El Paso County. The Academy proper contains 18,325 acres and occupies most of the T12S and R67W, R66W area. Farrish Memorial Recreation Annex consists of 655 additional acres and is located six miles west of the Academy's western boundary which is in the mountainous Rampart Range. Elevations at the Academy range from 6,325 feet to 8,000 feet and average 7,000 feet above sea level.

The climate of the area is a continental type with large temperature variations, periodic high winds and variable rainfall. The average annual precipitation is 17.5 inches; potential evapotranspiration is 25.09 inches.

The primary mission of the Academy has not changed since the founding of the Academy in 1954--to provide instruction and experience to each cadet so that he/she graduates with the knowledge and character essential to leadership and the motivation to become a career officer in the U.S. Air Force. Because of this mission the operations of the Academy are more similar to those of any other college than to those of a military facility.

ENVIRONMENTAL CONSIDERATIONS

The environmental conditions at the U.S. Air Force Academy indicate that the following data are important to the evaluation of past hazardous waste handling practices:

1. Precipitation at the Academy is seasonal and normally occurs as intense storms with high runoff and relatively low infiltration. Due to the relatively low precipitation rate and high solar radiation annual evapotranspiration exceeds precipitation by 7.5 inches which could decrease the rate of leachate generation and vertical transfer of contaminants to ground water.

2. Depth to ground water on the Academy property is variable because of variation in the type and distribution of unconsolidated materials and variations in topography. Overall, however, depths to the saturated zone averages less than 20 feet. The shallow depth to ground water increases the probability that contamination will reach the water table.

3. In the area around the Academy ground water is used extensively for water supply. Most of the water is obtained from the Dawson Arkose which is at or near the surface on the Air Force Academy. This indicates the potential for migration of contaminants to a water supply source.

METHODOLOGY

During this Phase I effort data were collected from interviews with present and past personnel at the Academy. File searches were conducted for information related to past practices. Field inspections were also conducted at sites that were potential contaminant sources. Fourteen sites were initially identified as areas of concern. Four sites were determined to have little or no potential for contaminant release and migration. Ten sites were identified as having a potential for environmental contamination. These sites were rated using the Hazard Assessment Rating Methodology (HARM) which considers site environment, waste characteristics, potential contaminant receptors and waste management practices.

CONCLUSIONS

As a result of the rating recommendations were developed for follow-on investigations to determine if contamination has, in fact, occurred. These recommendations are summarized on Table ES-1; site locations are shown on Figure ES-1. The sites are briefly described below.

- JP-4 Spill: In 1983 an unknown quantity of JP-4 was spilled from a partially buried tank located behind a retaining wall. The quantity of fuel lost has been estimated at between 5,000 and 6,000 gallons. The recommendations have been developed to determine the extent of migration in the soil and whether the ground water has been impacted.

- Farish Sites: A landfill and a dredged material disposal site have been identified at the Farish Memorial Recreation Area. Both sites are of concern because of their proximity to surface water. Recommendations have been developed to determine if surface water, sediments and ground water have been impacted.

- Fire Training Area: The Fire Protection Training Area has been identified as a site for additional investigation because the site is in close proximity to a stream and to ground water. The recommendations developed are to sample ground water and the soil between the site and the stream.

- Dredged Material Disposal Site: This site was used for disposal of sediment from non-potable reservoir 1. There have been reports of a mercury spill in that sediment. It is recommended that the material be sampled to determine the presence or absence of mercury.

- Landfills: Landfills 1 and 2 have been identified as sites because of the wide variety of wastes that may have been disposed, proximity to both surface water and ground water. The recommended follow-on investigation calls for sampling of ground water between the landfills and Monument Creek.

- Digester Sludge Disposal Site: This site has been used for disposal of digester sludge from

TABLE ES-1

SUMMARY OF RECOMMENDATIONS
U.S. AIR FORCE ACADEMY

Rank	Site Name	HARM Score	Recommended Monitoring	Comments
1	JP4 Spill	62	Soil sampling at 6 locations.	
			Install and sample two downgradient wells. Two rounds of sampling are recommended.	If oil is found on the water table, additional wells may be needed to determine the extent.
2	Dredged Material Disposal Site - Farish	56	Soil sampling at 9 locations. Sediment sampling in lake.	If groundwater is found to be be contaminated, additional monitoring is recommended to determine migration.
			Install and sample groundwater monitor wells at four downgradient locations, and one upgradient location.	
2	Landfill - Farish	56	Install and sample two groundwater monitor wells. Sample Surface water in two lakes.	The upgradient well installed for the other dredged material site can be used to provide background data for this site.
3	Fire Training Area	53	Install and sample one upgradient and 2 downgradient wells.	If confirmation is found in soil, sampling of West Monument Creek sediment is recommended. If groundwater is found to be contaminated, additional sampling may be required.
			Soil sampling at 3 downslope locations and one upslope location.	
4	Dredged Material Disposal Site	46	Soil sampling at 10 locations.	If soil samples show contamination, then groundwater sampling and sediment sampling in Monument Creek are recommended.

Table ES-1 (cont.)

Rank	Site Name	HARM Score	Recommended Monitoring	Comments
5	Landfill #1	42	Install and sample groundwater monitor wells at one upgradient and four downgradient locations	If groundwater samples indicate contamination, additional sampling is recommended to determine extent.
5	Landfill #2	42	Same as Above	Same as Above.
6	Digester Sludge Disposal Site	39	Soil sampling at 12 locations.	If contamination is found, then groundwater sampling is recommended.
7	Firing Range	38	Install and sample groundwater monitor wells at one upgradient and two downgradient locations.	
8	Visitors Center	37	Geophysical investigation, followed by installation and sampling of three groundwater wells.	

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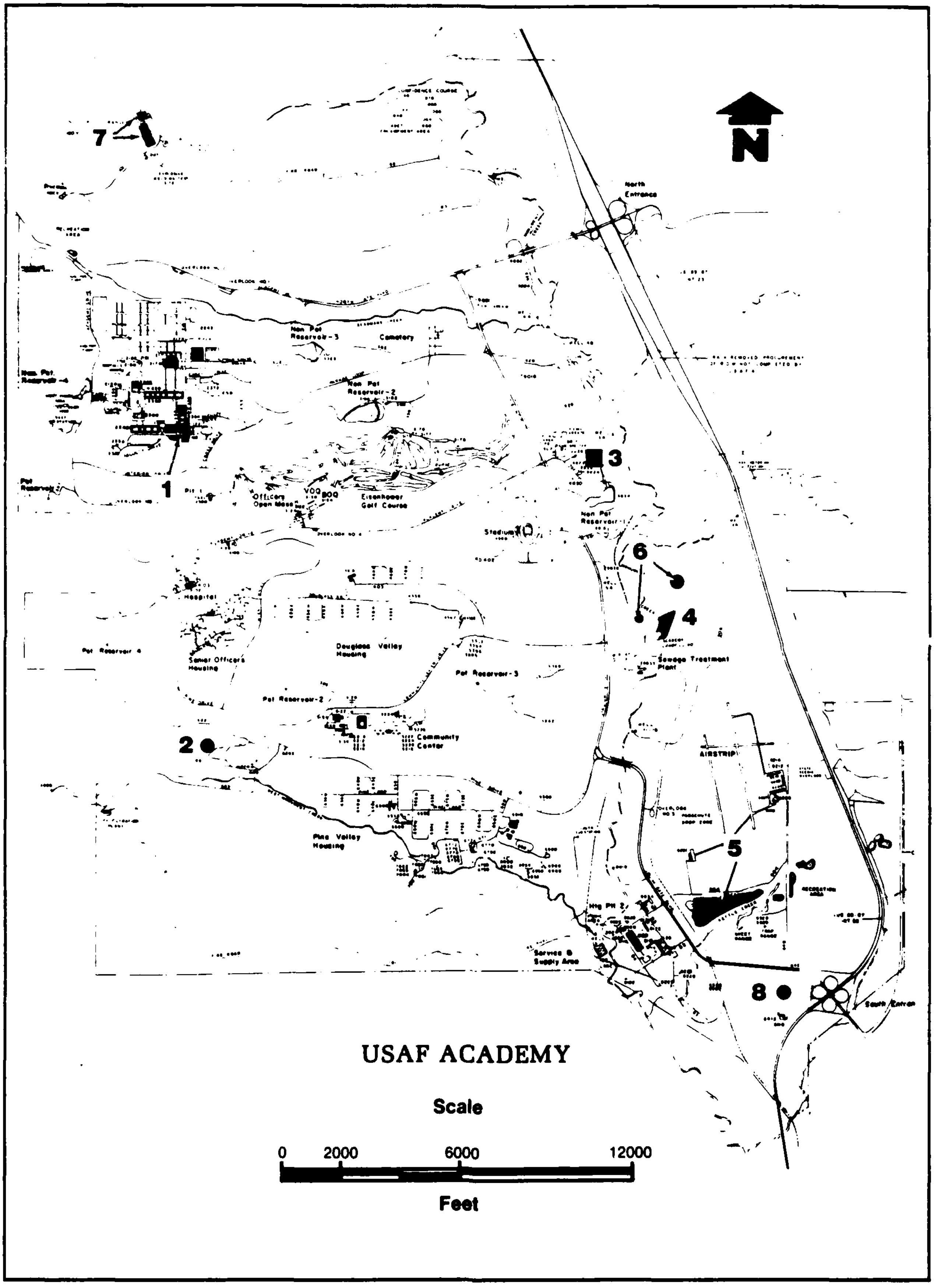

FIGURE ES-1 SITES RATED BY HAZARD ASSESSMENT RATING METHODOLOGY

the Academy Sanitary Sewage Treatment Plant. This plant has received waste from Academy facilities including laboratory wastes. The recommendation is sampling of the sludge to determine if laboratory constituents have been concentrated in the sludge and pose a threat to the environment.

- Firing Range: The firing range is identified as a site because of the potential for migration of lead. Since the range is still in use, soil sampling at the site is not recommended. However, ground water sampling downgradient of the site is recommended to determine if lead has reach ground water.

- Visitors Center Site: This site has been identified because of reports that it was used for disposal prior to Academy acquisition of the property. Geophysical investigation and ground water sampling are recommended.

SECTION 1

INTRODUCTION

1.1 BACKGROUND AND AUTHORITY

The United States Air Force, due to the nature of its primary mission, has long been engaged in a wide variety of operations dealing with toxic and hazardous materials. This circumstance, coupled with the enactment of environmental legislation at the Federal, state, and local levels of government, has required action to be taken to identify and eliminate hazards related to past disposal sites in an environmentally responsible manner.

The primary Federal legislation governing the disposal of hazardous waste is the Resource Conservation and Recovery Act (RCRA), as amended. Under Section 6002 of the Act, Federal agencies are directed to assist EPA and make available information on past disposal practices. Section 3012 of RCRA requires each state to inventory disposal sites and make information available to requesting agencies. To assure compliance with these hazardous waste regulations, DOD issued Defense Environmental Quality Program Policy Memoranda (DEQPPM), which mandated a comprehensive Installation Restoration Program (IRP).

The current DOD IRP policy is contained in DEQPPM 81-5, dated 11 December 1981 and implemented by Air Force message dated 21 January 1982. DEQPPM 81-5 reissues, consolidates, and amplifies all previous directives and memoranda on the Installation Restoration Program. DOD policy is to identify and fully evaluate suspected problems associated with past hazardous material disposal sites, to control migration of hazardous contamination from Air Force facilities, and to control hazards to health or welfare that resulted from past operations. The IRP will be the basis for U.S. Air Force response actions under the provisions of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, directed by Executive Order 12316 and 40 CFR 300, Subpart F, National Contingency Plan (NCP). CERCLA is the primary legislation governing remedial action at past hazardous waste disposal sites.

1.2 Purpose and Scope of the Assessment

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

- Phase I - Initial Assessment (Records Search)
- Phase II - Confirmation/Quantification
- Phase III - Technology Base Development
- Phase IV - Operations/Remedial Actions.

WESTON was retained by the United States Air Force to conduct the Phase I Records Search at United States Air Force Academy under Contract No. F0863783 G00095000. This report contains a summary and an evaluation of the information collected during Phase I of the IRP.

The objective of the first phase of the program is to identify the potential for environmental contamination from past waste disposal practices at the Air Force Academy and to assess the probability for contaminant migration. The Phase I program included a pre-performance meeting, an on-site base visit, a review and analysis of the information collected and preparation of this report.

The pre-performance meeting was held at the Air Force Academy on 23 May 1984. The purpose of this meeting was to define responsibilities of the project participants, establish a program schedule, transfer information to the project contractor, and to tour the base facilities.

WESTON's team conducted the on-site Academy visit on June 25 to 29, 1984. Activities performed during the on-site visit included a detailed search of installation records, tours of the installation, and interviews with past and present Academy personnel. At the conclusion of the on-site visit, an outbriefing was held to discuss preliminary findings.

The following individuals comprised WESTON's record search team:

1. Katherine A. Sheedy — Project Manager
M.S., Geology, 1975

2. David Russell — Environmental Engineer,
B.S., Environmental Engineering, 1980

3. John A Gilbert — Chemical Engineer
B.A., Chemistry,
Civil Engineering, 1980

Resumes of these key team members are provided in Appendix A.

1.3 METHODOLOGY

The Air Force Academy records search began with a review of past and present operations and was conducted at the Academy. Information was obtained from available records, such as shop files and real property files, and from interviews with past and present Academy employees from the various operating areas. A list of Air Force interviewees by position and approximate years 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 agencies contacted are listed in Appendix C.

The next step in the activity review process was to identify all hazardous waste generators and to determine the past management practices regarding the use, storage, treatment, and disposal of hazardous materials from the various Air Force 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 was then made by the WESTON record search team to gather site-specific information, including general site conditions, visual evidence of environmental stress, and the presence of nearby drainage ditches or surface water bodies. These water bodies are inspected 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 Flow Chart shown in Figure 1-1. If no potential existed, the site was deleted from further consideration. If minor operations and maintenance deficiencies are noted during the investigation, the conditions are reported to the Base Environmental Coordinator for remedial action.

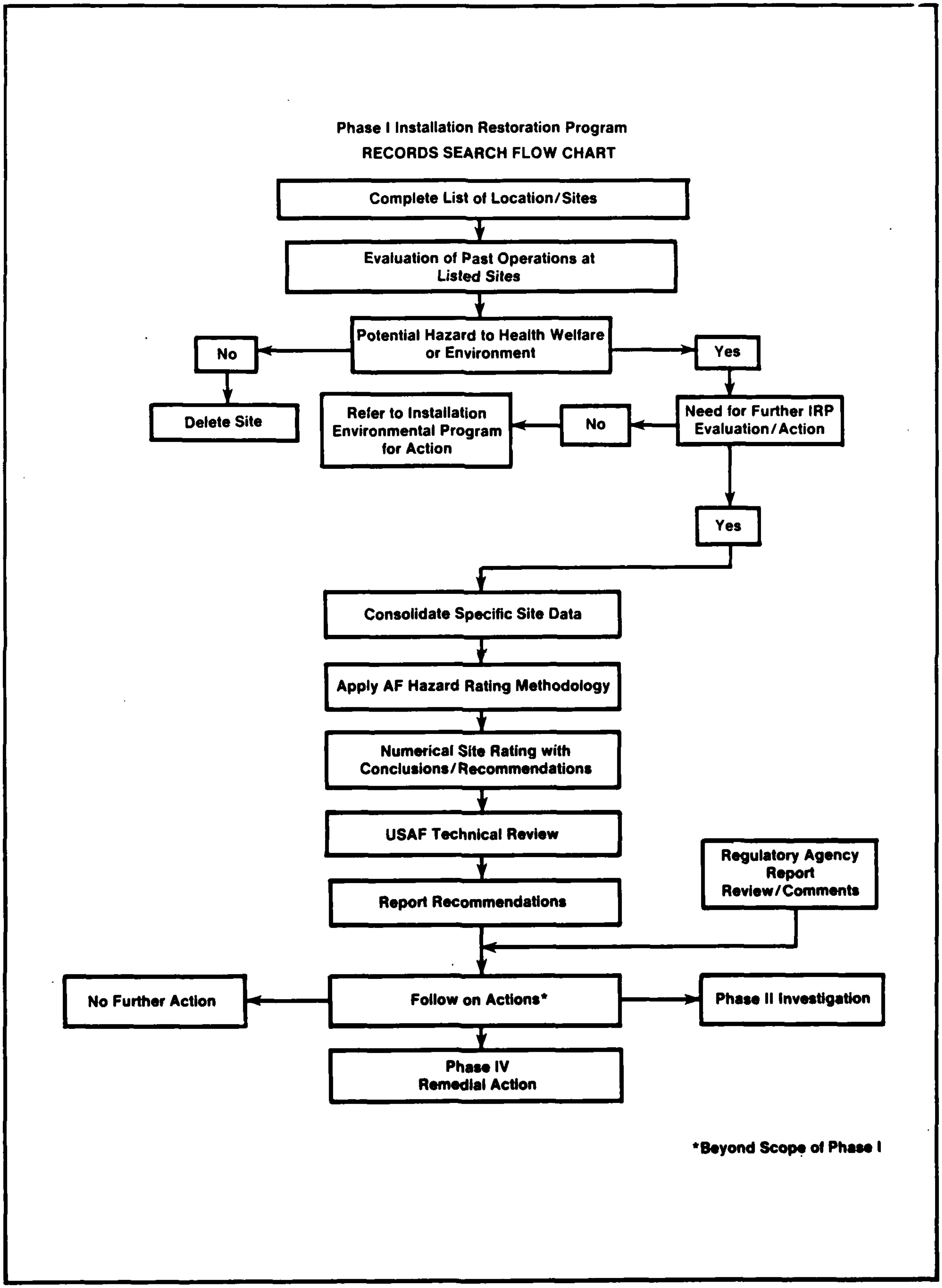

FIGURE 1-1 PHASE I INSTALLATION RESTORATION PROGRAM

For those sites where a potential for contamination was identified, the potential for migration of the contamination across installation boundaries was evaluated by considering site-specific ground and surface water conditions. If there is potential for on-base contamination or other environmental concerns, the site is referred to the Base Environmental Coordinator for further action. If there is a potential for contaminant migration, the site was evaluated and prioritized using the Hazard Assessment Rating Methodology (HARM) and recommendations are developed.

Recommendations may vary from no action to a complete monitoring and sampling program for the sites receiving a high HARM score. A limited Phase II program may be recommended for sites receiving a low to moderate HARM rating to confirm that hazardous materials are not migrating from the site. The site rating methodology is described in Appendix D.

SECTION 2

INSTALLATION DESCRIPTION

2.1 LOCATION, SIZE AND BOUNDARIES

The United States Air Force Academy is located 10 miles north of the center of Colorado Springs, Colorado, and is contained wholly within El Paso County, Colorado. The Academy proper comprises 18,325 acres and occupies most of the T12S and R67W and R66W area. The Farish Memorial Recreation Annex, consisting of an additional 655 acres, is located approximately six miles west of the Academy. The facility location is depicted in Figure 2-1. Land use is summarized in Table 2-1.

Population centers in the vicinity of the Academy include: Colorado Springs, Palmer Lake, Monument and Woodmore to the north, Chapel Hill and Black Forest to the east; and Thunderbird Estates, Woodman Valley, and Falcon Estates to the south. The western boundary is dominated by the Rampart Range of the mountains, and Pike National Forest.

The combined population of El Paso County and Colorado Springs was estimated to be 296,000 in 1975--an increase of 25.4 percent from the 1970 census. Excluding Colorado Springs, the land use of El Paso County is dominated by agriculture, grazing and woodlands. There are also military installations in the area--the Air Force Academy, Fort Carson, and the North American Air Defense Command Cheyenne Mountain Complex. Federally-owned National Forest Lands dominate the western portion of the County. The trend in El Paso County is toward residential expansion to the north, east and northeast of Colorado Springs. Some commercial and industrial expansion is expected to follow the course of residential growth, but the area will remain primarily residential in character.

2.2 BASE HISTORY

2.2.1 Academy History

The concept of establishing a separate Air Force Academy dates back to the early 1920's, but no real progress was made toward the actual establishment of the Academy until after World War II. President Dwight D. Eisenhower signed

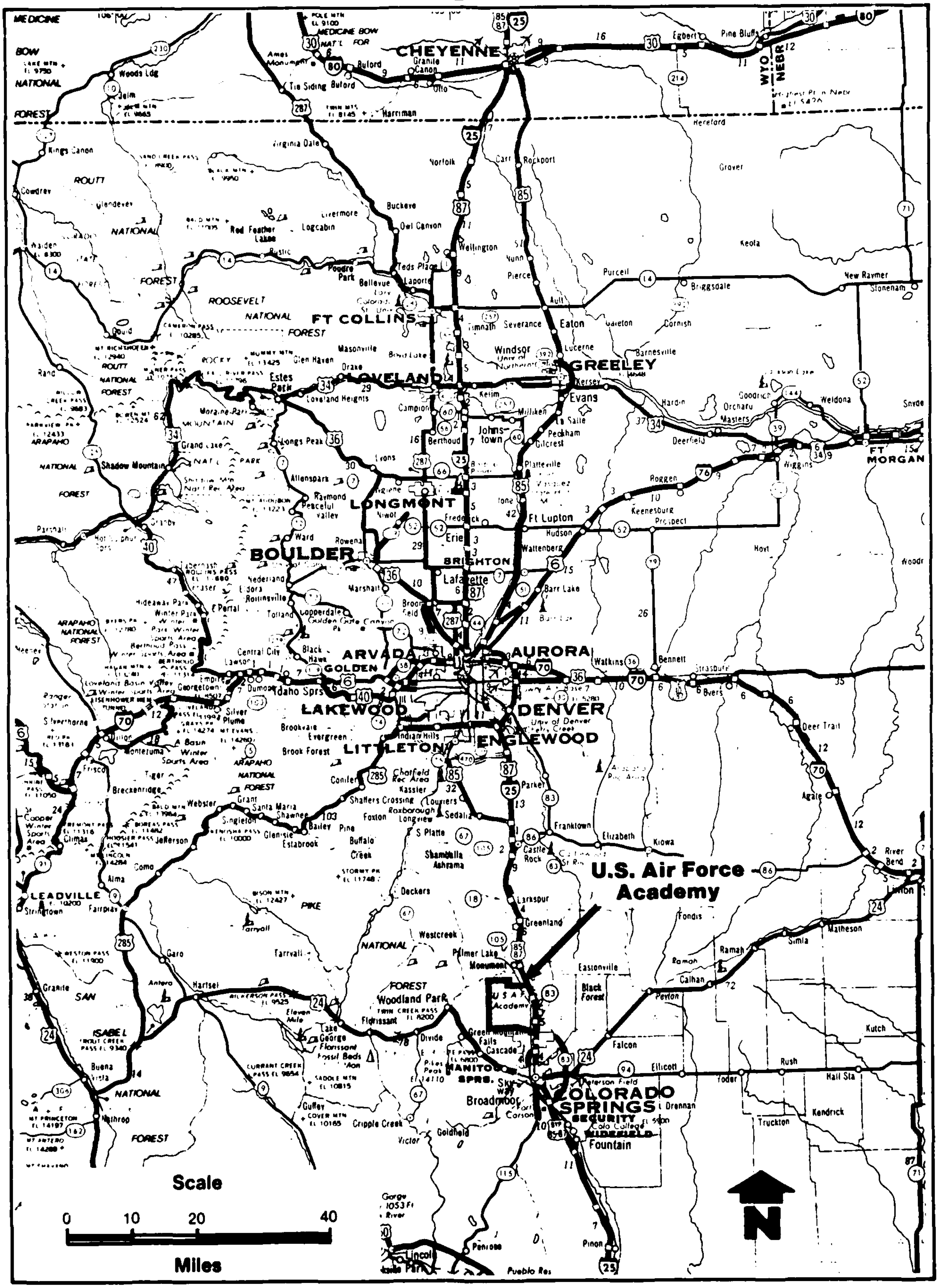

FIGURE 2-1 LOCATION OF THE U.S. AIR FORCE ACADEMY

Table 2-1

LAND USE AT AIR FORCE ACADEMY
(as of September 1971)

Improved Grounds	752.61
Unimproved Grounds*	1,175.55
Timberland Management	9,000.00
Semi-Improved Grounds	6,540.84
Other	856.00
Total Acreage	18,325.00

*Farish Annex represents an additional 655 acres of unimproved grounds

Source: USAF Academy, Land Management Plan, 15 March 1984, p. 9

the law authorizing the Academy in 1954. Temporary facilities were established at Lowry Air Force Base in Denver in 1954. Construction of the Academy began in 1955 and was completed in late 1958. A $40 million expansion program was completed between 1965 to 1968 to accommodate an increase in cadet strength from 2,529 to 4,417. Since 1968, major improvements have included construction of a permanent airfield for cadet flight training, and construction of an NCO Club. The site plan is shown in Figure 2-2. A second airfield is currently under construction on the northern portion of the Academy. This airfield is an auxilliary field for powered glides.

2.2.2 Site History

The Colorado Springs site for the Air Force Academy was selected in 1954, after consideration of over 500 potential sites in 45 states. Selection criteria had included acreage, topography, climate, water supply, utilities, flight training potential and construction costs.

Prior to construction of the Academy, the site was thinly settled. Figure 2-3 shows the site conditions prior to development by the Air Force. There were several towns on the site; the largest town was Husted which was located near the present north entrance to the Academy. Approximately 50 homes were located along Monument Creek. The greatest concentration of homes was at the southeastern corner of the Academy property. Commercial development consisted of three service stations (locations unknown), several motels and a tavern. There was also a small factory or foundry on the property; the foundry building was converted to Academy use and is now the Air Force Academy Visitors Center. Most recent previous owners of the foundry were American Machine and Foundry Company (1951 to 1956) and Welch Industries, Inc. (1945 to 1951). During the period of American Machine and Foundry (AMF) ownership there were references to AMF working on a Navy contract for manufacture of specialty tools.

Most of the other buildings that were on the property prior to Air Force purchase were inventoried, photographed and demolished.

Originally the site was served by a blacktop road from U.S. Highway 85-87 into Pine Valley, a gravel road west of Monument Creek and dirt roads into the valleys. Tracks of the Denver and Rio Grande Western Railroad Company and Atchison, Topeka and Santa Fe Railroad Company ran north-south along Monument Creek. The Atchison, Topeka and Santa Fe tracks were removed although the track bed remains as a broken, linear topographic feature. The Denver and Rio

R67W

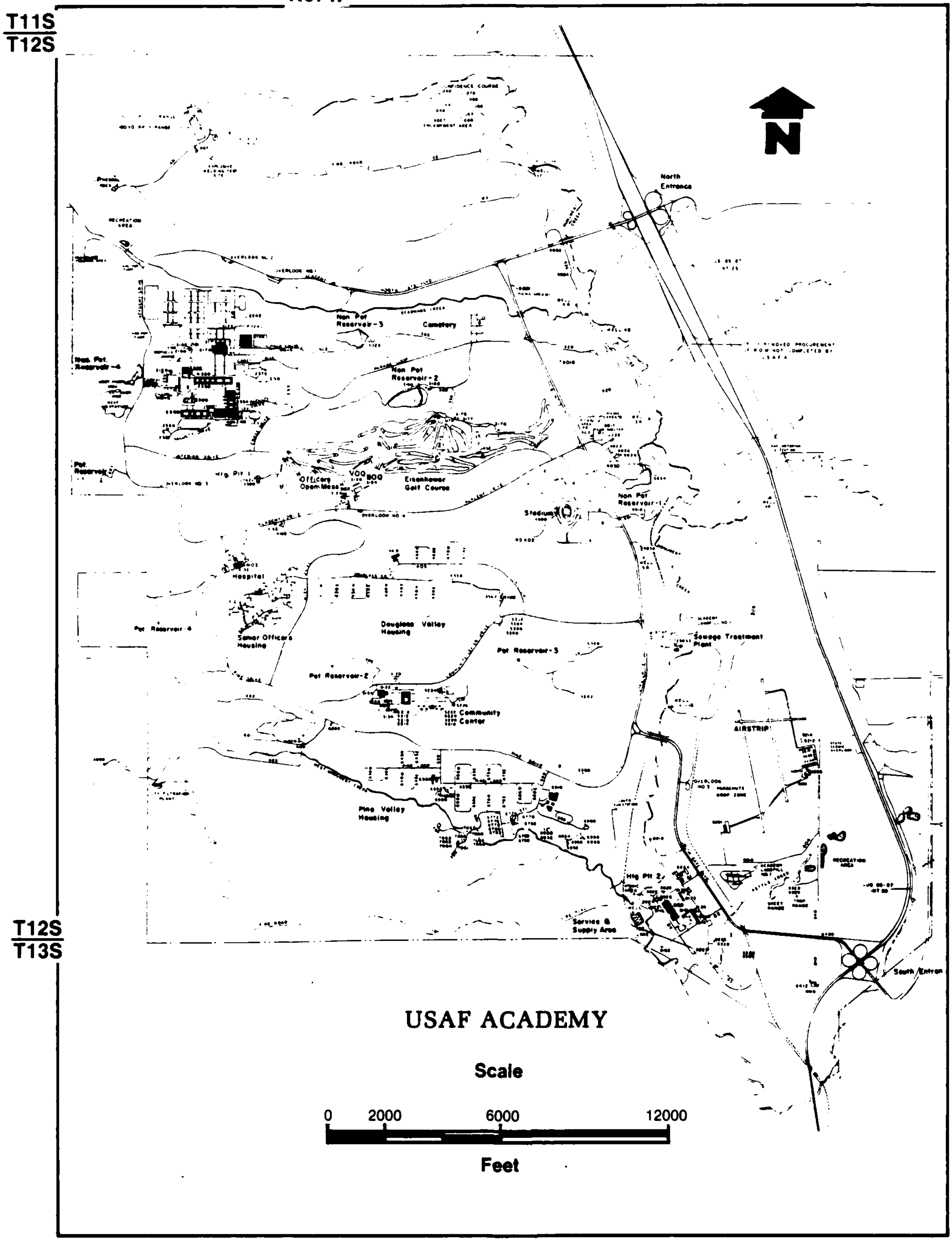

FIGURE 2-2 FACILITY LAYOUT - U.S. AIR FORCE ACADEMY

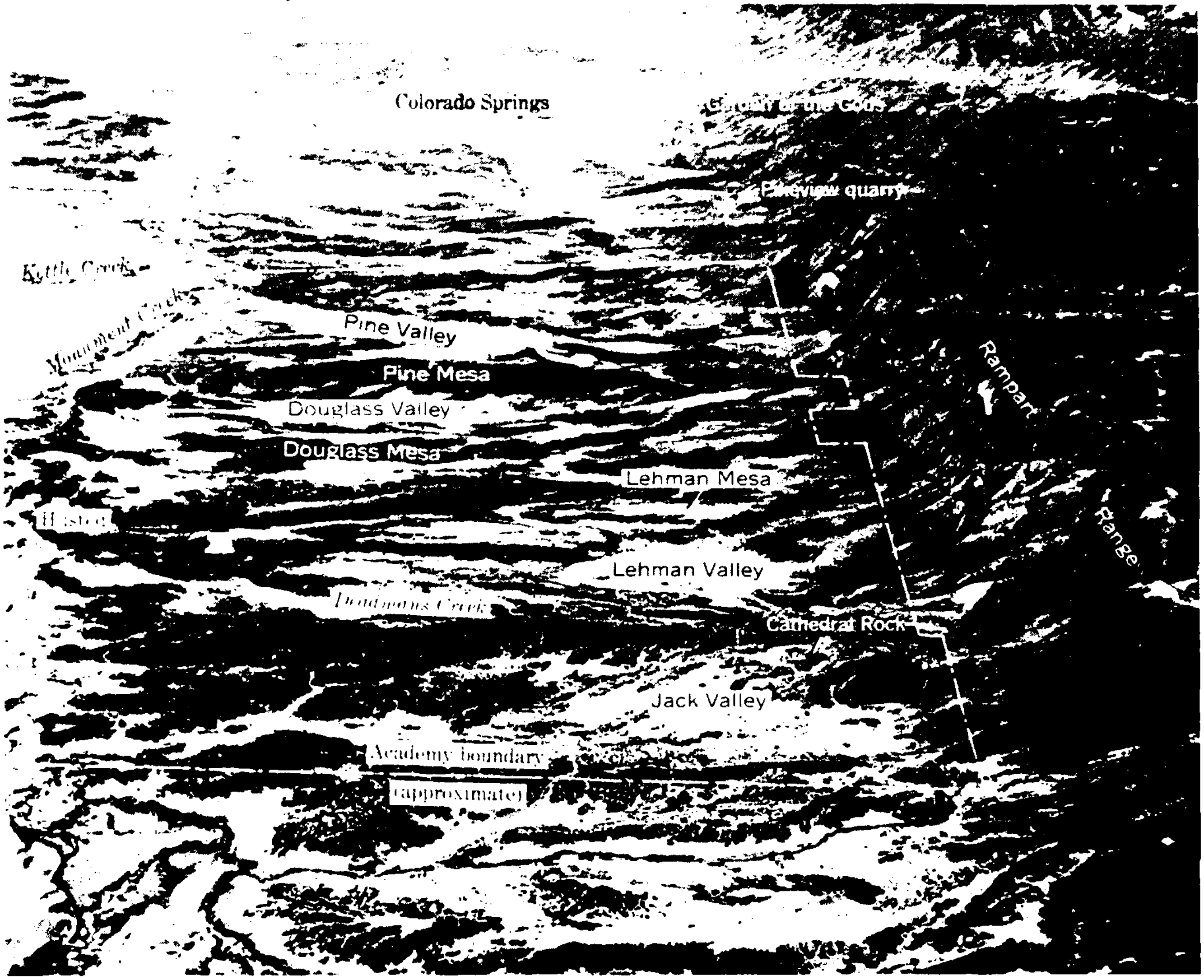

FIGURE 2-3 U.S. AIR FORCE ACADEMY SITE PRIOR TO CONSTRUCTION (VIEW IS FROM NORTH TO SOUTH)

SOURCE: Varnes and Scott (1967)

Grande Western tracks remain and are in current use; both railroad maintain right-of-way strips through the Academy property.

2.3 ORGANIZATION AND MISSION

The primary mission of the United States Academy is to provide instruction and experience to each cadet so that he/she graduates with the knowledge and character essential to leadership and the motivation to become a career officer in the U. S. Air Force. This mission has not changed since the Academy was founded. Organizations responsible for carrying out the primary mission are listed in Table 2-2. Descriptions of these organizations are included in Appendix E.

Tenant units located at the Air Force Academy are listed below. Descriptions of the tenant units and their missions are provided in Appendix E.

- The Frank J. Seiler Research Laboratory
- 1876th Communications Squadron
- Medical Review Board
- 557th Flying Training Squadron
- Audit Agency.

The USAF Academy Airstrip was constructed as a day, VFR, light aircraft only operation which supports Cadet Airmenship program.

The following aircraft are based on the Air Force Academy:

Type	Number
U-4B	2
T-41C	45
Aero-Club, Various Types	9
Super Cub Towships	3
	59

Table 2-2

U.S. AIR FORCE ACADEMY DEPARTMENTS

- Superintendent
- Director of Protocol
- Inspector General
- Chief of Staff
- Director of Athletics
- Commandant of Cadets
- Dean of the Facility
- Directorate of Admissions and Registrar
- USAF Academy Preparatory School
- Social Actions Office
- Director of Information
- Director of Historical Studies
- Director of Administration
- Chief of Safety
- Staff Judge Advocate
- Command Chaplain
- U.S. Air Force Academy Hospital (Surgeon)
- Director of Security Police - 7625th Security Police Squadron
- DCS/Civil Engineering -7625th Civil Engineering Squadron
- DCS/Logistics - 7625th Material Squadron
- DCS/Comptroller
- DCS/Operations
- DCS/Personnel
- USAF Academy Band
- Headquarters Squadron Section.

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SECTION 3

ENVIRONMENTAL SETTING

3.1 INTRODUCTION

In this section, the environmental setting of the Air Force Academy is described. Natural features which relate to the movement of hazardous waste contamination and are particularly sensitive are the focus of the discussion. The environmental conditions pertinent to this study are summarized at the conclusion of this section.

3.2 METEOROLOGY

The USAF Academy is located along the eastern slope of the Rocky Mountains, and, as a result, experiences large temperature variations from summer to winter, high winds and rapid changes of weather due to storm travelling from west to east through the region. A continental type climate prevails in the area. Extremes of temperature can take place over a 24-hour period. Topographic relationships at the Academy influence local climatological conditions. For example, because the Academic area lies so close to the Rampart Range, the sun goes down 20 minutes earlier there than it does at the airstrip. North facing slopes are more susceptible to frost and remain snow covered longer than south-facing slopes. Spring snow melt frequently results in the formation of seeps and wet areas or bogs.

The monthly average temperature varies from 27°F in January to 65°F in July. Average annual precipitation is 17.5 inches. Most precipitation falls during the spring and summer months, when frequent movement of air from the south and more solar radiation produce convective showers. The most precipitation falls in the month of July (average 2.9 inches) while the least precipitation falls during January (average of 0.4 inches). The areal distribution of rainfall can be highly variable, since a large portion of rainfall result from summertime convective storms. Climatic data are summarized in Table 3-1.

Because of the relatively low precipitation and high solar radiation in the area, potential evapotranspiration (25.09

Table 3-1

CLIMATOLOGICAL DATA
U.S. AIR FORCE ACADEMY

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
Temperature													
Highest	68	70	74	78	87	97	97	95	91	86	75	71	97
Mean Daily Max.	42	43	47	56	65	75	80	79	73	62	51	43	60
Mean Daily Min.	12	15	20	28	37	44	50	49	41	30	20	13	30
Lowest	-26	-27	-13	-8	16	24	33	46	17	-9	-16	-25	-27
Mean No. of Days													
Max. Temp. $90^{o}F$	0	0	0	0	0	4	8	5	2	0	0	0	19
Min. Temp. $32^{o}F$	30	27	27	15	5	0	0	0	1	8	25	31	169
Precipitation													
Mean (inches)*	0.40	0.60	1.10	2.20	2.50	1.80	2.90	2.70	1.10	1.00	0.60	0.60	17.50
Snowfall													
Mean (inches)	4	8	13	17	4	0	0	0	1	.5	6	8	66

Source: USAF, Tab A-1 Environmental Narrative, USAF Academy, Colorado Springs, CO, p. 62

*Actual precipitation during most years will be less than average, since the few years above normal will skew the average upward inches) exceeds mean annual precipitation by 7.5 inches. These data are for Colorado Springs.

Rainfall intensity is an indicator of the potential for excessive runoff and erosion, and is of interest in determining the potential for movement of contaminants. The one-year, 24-hour rainfall event is used to gauge the potential for runoff and erosion. The one-year, 24-hour rainfall in the vicinity of the USAF Academy is approximately 1.35 inches, (NOAA, 1962).

3.3 GEOGRAPHY

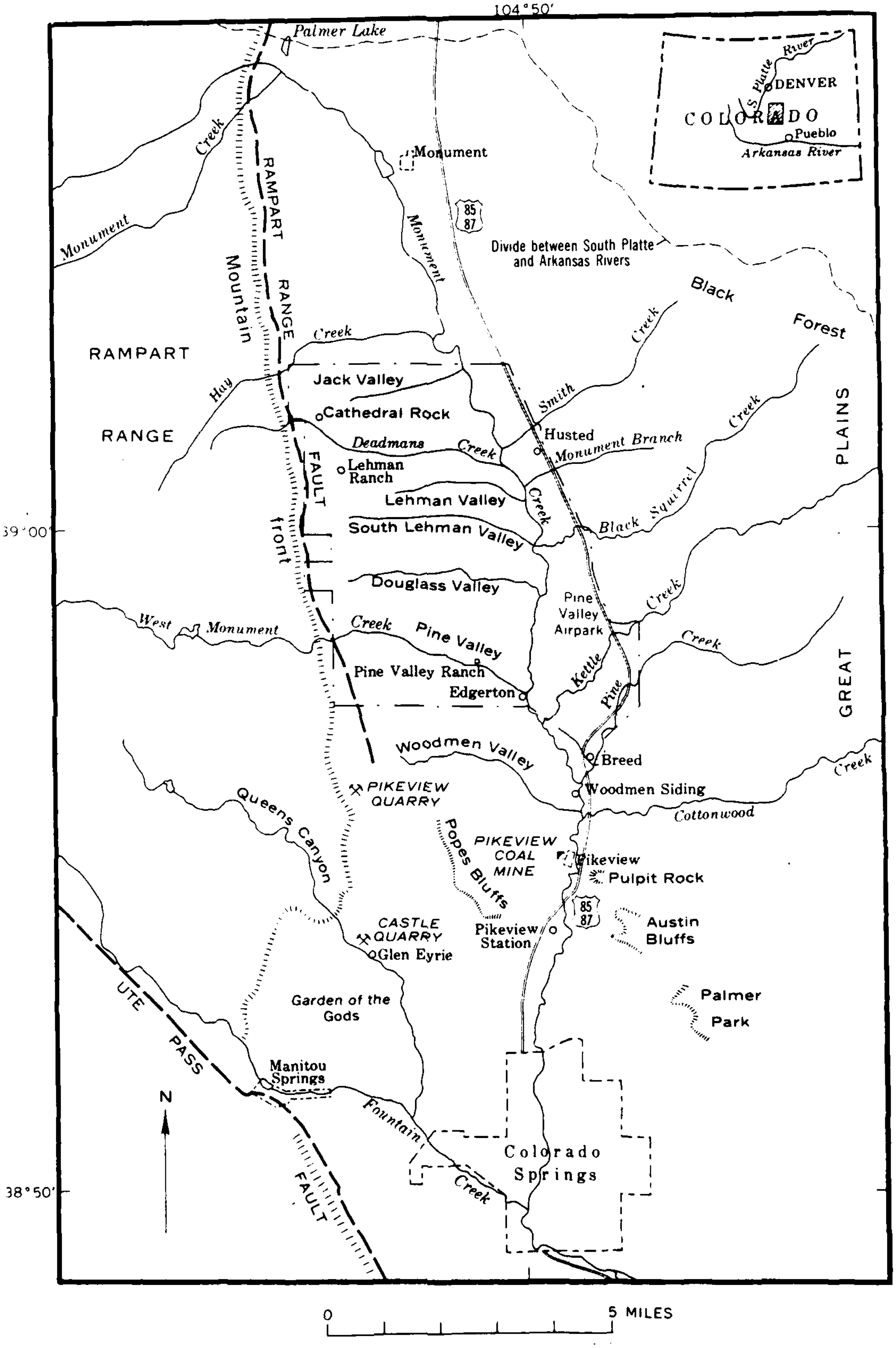
3.3.1 Topography

The Academy site is located in the foothills at the eastern base of the Rampart Range of the Rocky Mountains. The site altitude averages 7,000 above sea level. The lowest elevation of 6,325 feet occurs at the southeastern corner of the site near Monument Circle. The highest elevation of 8,000 feet occurs on the western boundary of the slopes of the Rampart Range.

The Air Force Academy site is divided by Monument Creek, which flows from north to south across the Academy grounds. Roughly one-third of the site lies east of Monument Creek and has broad, flat areas. The air strip is located on the eastern edge of the site in this flat area.

The two-thirds of the site located west of Monument Creek has rugged topography divided into five main valleys, as shown in Figure 3-1. The valleys are defined by ridges extending east at varying distances from the Rampart Range toward Monument Creek, and are the major building sites for the Academy.

The broad valley to the extreme north, Jack's Valley, is used as a maneuver and firing range. The elevation at the upper end of Jack's Valley is 7,200 feet, elevation at the lower end is 6,700 feet. Lehman Valley, the next valley to the south, is a broad valley where the cadet athletic facilities are located; the range in elevation is Lehman Valley is similar to that in Jack's Valley. South Lehman Valley is short and narrow and is occupied by two 18 hole-golf courses; there is very little level land in this valley. Douglass Valley is a broad, sloping valley occupied by the hospital, an elementary school and a large housing area. The range in elevation



SOURCE: VARNES AND SCOTT, 1967

FIGURE 3-1 MAJOR TOPOGRAPHIC FEATURES AT THE U.S. AIR FORCE ACADEMY

in Douglass Valley is from approximately 7,000 feet at the upper end to 6,500 feet at the lower (eastern) end. Pine Valley is the flattest valley, and furnishes sites for elementary and senior high schools, as well as a large housing area. The range in elevation is similar to that in Douglass Valley. Pine Valley is deeply pocketed. The north valley wall is a steep, well-defined hillside rising approximately 250 feet above the floor of the Valley. The south wall is more irregular. West Monument Creek, which flows through Pine Valley is one of the main branches of Monument Creek even though it only has intermittent flow.

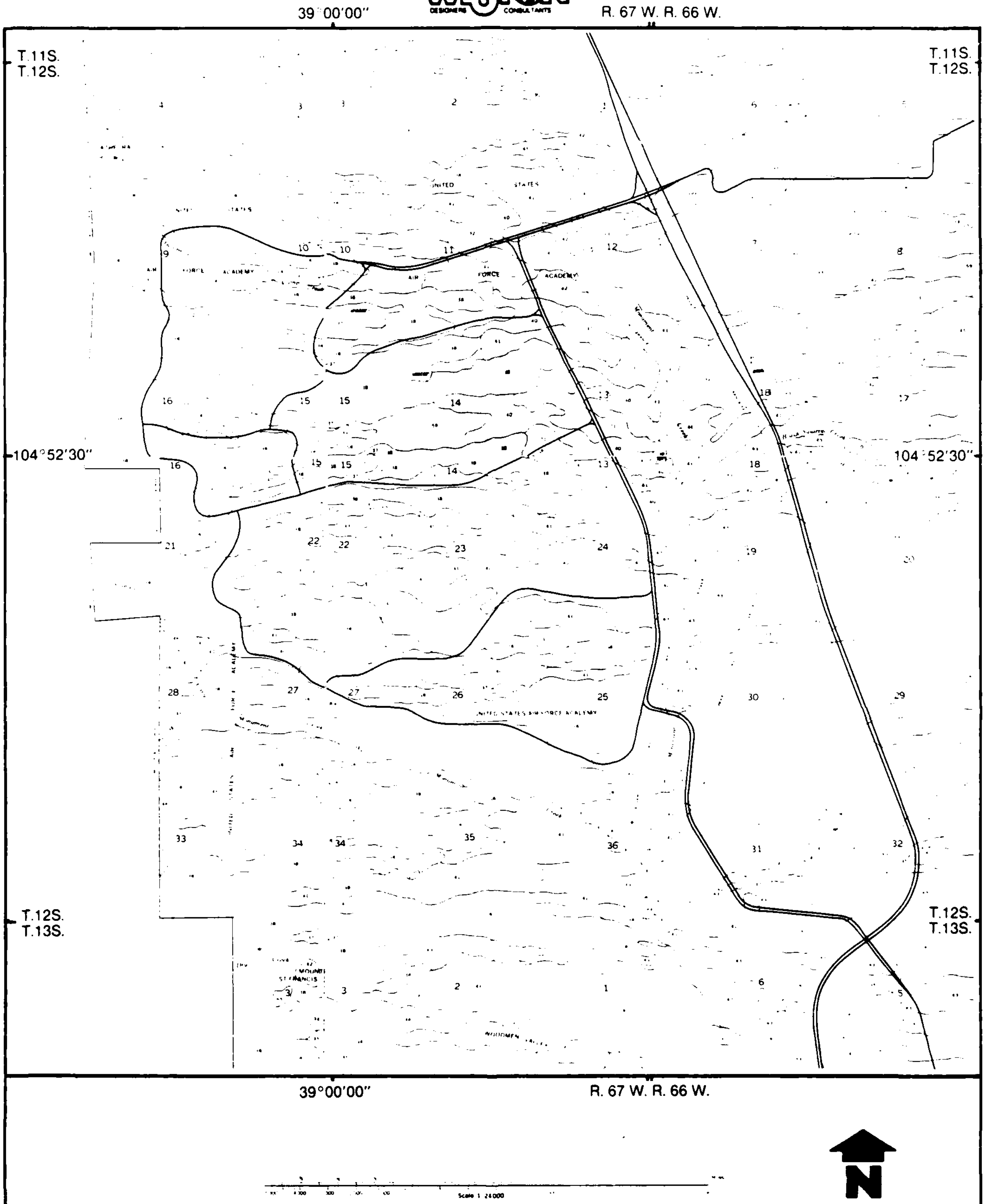
The broad-tapped mesa directly south of Lehman Valley is used for the Cadet Area. The mesa between Douglass and Pine Valleys extends farthest toward Monument Creek and provides good building sites. It was chosen for the development of the Community Center. Elevations along Monument Creek vary from 6,590 feet where the creek enters the site on the north to 6,340 feet at the southern boundary of the Academy.

3.3.2 Soils

The soils in the vicinity of the Air Force Academy are formed in material weathered from arkosic sedimentary rock. Most of the soil on the site is sandy or gravelly and contains varying amounts of rocks and boulders. The soils generally exhibit a high rate of permeability, though clay content makes the soil rather impermeable in scattered areas. A map showing the distribution of soils is provided in Figure 3-2. A legend to the map, and a summary of soil characteristics, are included in Table 3-2.

The soil property of primary concern in assessing the potential for surface water infiltration and the movement of contaminants is vertical permeability. As shown in Table 3-2, most soils exhibit moderate to rapid permeability. An exception is the Kutch clay loam which has slow permeability and is found in an undeveloped area in the southwestern portion of the site (USDA, 1974).

At localized areas on the Academy the soils are known to be corrosive; these areas are apparently restricted to drainage channels. Soil in these areas tend to act as an electrolyte. This condition lead to corrosion of high temperature hot water lines during the early 1960's.



SOURCE: DEPARTMENT OF AGRICULTURE, 1981

FIGURE 3-2 SITE SOILS

Table 3-2

U.S. AIR FORCE ACADEMY SOILS*

Number on Figure 3-2	Soil Name	Unit Description	Soil (inches)	Permeability (in/hr)	Use Limitations: Septic Tank Absorption Fields	Use Limitations: Trench Sanitary Landfill
3	Ascalon Sandy Loam 3% to 9% slopes	Deep, well-drained soil	0 - 60	0.6 - 6.0	Slight	Severe: seepage
19	Combine gravelly, sandy loam, 0 to 3% slopes	Deep well-drained to excessively drained soiil on alluvial terraces and fans and on flood plains	0 - 60	6.0 - >20	Slight	Severe seepage, too sandy
23	Cushman Loam 5 to 15% slopes	Moderately deep, well drained soil on uplands	0 - 30	0.6 - 2.0	Severe: depth to rock	Severe: depth to rock
28	Ellicott Loamy Coarse Sand 0 to 5% slopes	Deep, excessively drained soil on terraces and flood plains	0 - 60	6.0 - 20	Severe: floods	Severe: floods, seepage
34	Holderness Loam 1 to 5% slopes	Deep, well-drained soil on uplands	0 - 60	0.6 - 20	Severe: percs slowly	Moderate: too clayey
37	Jarre Gravely Sandy Loam 1 to 8% slopes	Deep, well drained soil on alluvial fans or old upland terraces	0 - 60	0.6 - 6.0	Slight: slope	Severe: seepage
38	Jarre-Tecolote Complex 8 to 65% slopes	Jarre prt deep, well drained soil Telecote prt deep, well-drained soil	0 - 60	0.6 - 6.0	Severe: slope	Severe: small stones, seepage, slope
40	Kettle Gravelly Loam Sand 3 to 8% slopes	Deep well-drained soil on uplands	0 - 60	6.0 - 20	Slight	Severe: seepage
41	Kettle Gravelly Loamy Sand, 8 to 40% slopes	Deep well-drained soil on uplands	0 - 60	6.0 - 20	Slight: severe slope	Sevee: seepage
42	Kettle-Rock Outcrop Complex 8 to 40% slopes	Kettle soil part, deep well-drained soil deposits, mostly on the lower slopes of the complex	0 - 60	6.0 - 20	Severe: slope	Severe: seepage
		Rock Outcrop			Severe	Severe
45	Kutch Clay Loam 5 to 20% slopes	Moderately deep, well-drained soil on uplands	0 - 36	0.06- 0.6	Severe: depth to rock percks slow	Severe: depth to rock too clayey

*Adapted from: U.S. Department of Agriculture, Soil Conservation Service, 1981

Table 3-2 (cont.)

Number on Figure 3-2	Soil Name	Unit Description	Soil (inches)	Permeability (in/hr)	Use Limitations: Septic Tank Absorption Fields	Use Limitations: Trench Sanitary Landfill
46	Kutler-Broadmoor - Rock outcrop complex 25 to 90%	Kutler part-moderately deep and somewhat extensively drained	0 - 23	2.0 - 20	Severe: slope depth to rock	Severe: seepage, slope, depth to rock
		Broadmoor part-moderately deep excessively drained soil	0 - 28	6.0 - 20	Severed: depth to rock, slope	Severe: depth to rock slope, seepage
66	Peyton Sandy Loam 1 to 5% slopes	Deep, noncalcareous, well-drained soil on uplands	0 - 60	0.6 - 6.0	Moderate: percs slowly	Slight
67	Peyton Sandy Loam 5 to 9% slopes	Peyton part-Deep, well-drained soil on upland	0 - 60	0.6 - 60	Moderate: percs slowly	Slight
68	Peyton-Pring Complex 3 to 8% slopes	Peyton part-deep, well-drained soil on uplands	0 - 60	0.6 - 6.0	Moderate: percs slowly	Slight
		Pring part-deep, well-drained soil	0 - 60	2.0 - 20	Slight	Severe: seepage
71	Pring Coarse Sandy Loam 3 - 8%	Deep, well-drained soil on valley side slopes and on uplands	0 - 60	2.0 - 20	Slight	Severe: seepage
72	Pring Coarse Sandy Loam 8 to 15%	Deep, noncalcareous, well-drained soil on valley side slopes and uplands	0 - 60	2.0 - 20	Moderate: slope	Severe: seepage
77	Rock Outcrop -Coldcreek Tolman Complex, 9 to 90% slopes	Coldcreek Part - Deep and well-drained	0 - 43	0.6 - 2.0	Severe: slope	Severe: slope, depth to rock
		Tolman Part - Shallow and well-drained	0 - 13	0.6 - 2.0	Severe: slope, depth to rock	Severe: slope, depth to rock
83	Stapleton Sandy Loam 3 to 8% slopes	Deep, well-drained soil on uplands	0 - 60	6.0 -20	Slight	Severe: seepage
92	Tomah-Crowfoot Loamy Sands 3 to 8% slopes	Tomah Part - Deep., well-drained soils or residuum derived from Arkose beds	0 -60	2.0 - 20	Moderate: percs slowly	Severe: seepage
		Crowfoot Part - Deep, well-drained soils	0 - 60	0.6 - 2.0	Slight	Severe: seepage
93	Tomah-Crowfoot Loamy Sands 8 to 15%	Deep, well-drained soils-Tomah Part	0 -60	2.0 - 20	Moderate: slope, percs slowly	Severe: seepage
		Crowfoot Pt.	0 - 60	0.6 - 20	Moderate: slope	Severe: seepage
94	Travesilla - Rock Outcrop Complex, 8 - 90% slope	Shallow, well-drained soils	0 - 11	2.0 - 6.0	Severe: depth to rock, slope	Severe: depth to rock, slope
96	Truckton Sandy Loam 0 - 3% slope	Deep, well-drained soil on upland	0 - 60	2.0 - 6.0	Slight	Severe: seepage

3.4 GEOLOGY

3.4.1 Structural Geology

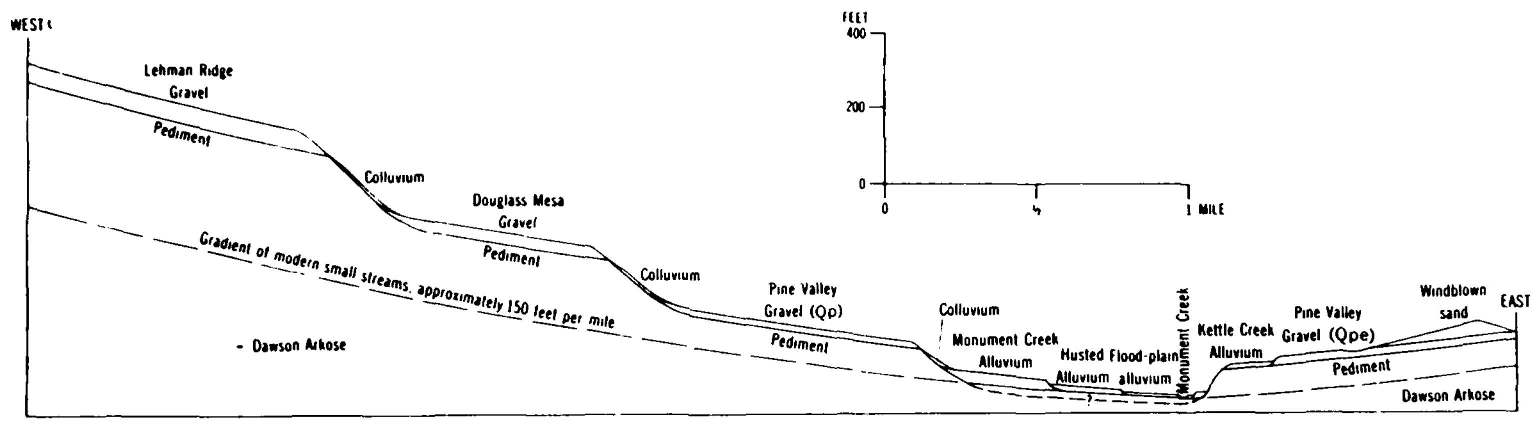
The geology of the Academy area has been critical to the development of physical and cultural features. Topography of the Academy property is largely the result of geologic structures. The most significant structures are the Rampart Range fault and the monoclinal fold on the west side of the site. During the emergence of the Rampart Range the sedimentary rocks on the flanks of the Range were pushed into a monoclinal fold which eventually ruptured forming a long high-angle reverse fault or zone of closely spaced faults. The Pikes Peak granite was forced up and over the sedimentary rocks along the fault. The fault zone is along the western boundary of the Academy and is thought to dip to the west. Maximum stratigraphic displacement along the fault is west of Douglass Valley where Pikes Peak Granite is in contact with the Dawson Arkose. The location of the fault is shown on Figure 3-1.

The mountainous topography and granitic rock types found at the extreme western edge of the Academy form the Rampart Range west of the fault. The less extreme topography and sedimentary rock types characteristic of most of the Academy are east of the fault and are part of the monoclinal fold.

The mesas and pediments of the portion of the Academy east of the fault are the result of down cutting and stream capture that apparently occurred during Tertiary time.

3.4.2 Surficial Geology

Unconsolidated surficial deposits of sand, silt and gravel of Pleistocene and Recent age cover three-fourths of the Academy grounds. The topographic relationships of the surficial deposits are shown in Figure 3-3. The stratigraphic names used in the discussion are those that were used informally in the original mapping of the Academy area. This nomenclature was not intended to be a formal nomenclature, but has been informally adapted in the literature since the original mapping. For clarification where a formal stratigraphic formation or unit name exists it is shown on the correlation chart on Table 3-3. A geologic map of the Academy site and the areal distribution of the various lithologic types is presented in Appendix F.



SOURCE: USGS, GENERAL AND ENGINEERING GEOLOGY OF THE U.S. AIR FORCE ACADEMY SITE, COLORADO, 1967

FIGURE 3-3 DIAGRAMMATIC SECTION SHOWING TOPOGRAPHIC RELATIONS OF THE SURFICIAL DEPOSITS AT THE AIR FORCE ACADEMY

Table 3-3

CORRELATION OF STRATIGRAPHIC NOMENCLATURE
SURFICIAL DEPOSITS

Air Force Academy	Formal Stratigraphic Nomenclature
Lehman Ridge Gravel	Rocky Flats Alluvium
Douglass Mesa Gravel	Verdos Alluvium
Pine Valley Gravel	Slocum Alluvium
Kettle Creek Alluvium	Louviers Alluvium
Monument Creek Alluvium	Broadway Alluvium
Husted Alluvium	Piney Creek Alluvium

Four main groups of surficial deposits are found at the Air Force Academy:

- Pediment Gravels, consisting of stream deposited sediments; the oldest unconsolidated deposits on the site.
- Colluvium, material eroded off the hills which underlies intermediate slopes and grades into sediment gravels.
- Windblown Sand, blown out of the stream bottoms and hills and deposit in long low dunes on the east side of Monument Creek.
- Alluvium/Flood Plain Alluvium, which lies in stream bottoms and along streams in the area.

Pediment gravels of three ages outcrop at the Academy: Lehman Ridge Gravel, Douglass Mesa Gravel and Pine Valley Gravel.

The Lehman Ridge Gravel is composed of reddish brown fragments of Pikes Peak Granite ranging in size from silt to boulders 20 feet in diameter. Pebbles of quartz and feldspar one-quarter inch to one inch in diameter make up the bulk of the gravel. Boulders are both more numerous and larger nearer the mountains. The Lehman Ridge Gravel is generally more than 25 feet thick and in several places exceeds 50 feet.

The Douglass Mesa Gravel is composed of reddish brown fragments of Pikes Peak Granite ranging in size from sand to boulders six feet in diameter, and of varying amounts of silt and clay. One quarter inch pebbles of quartz and feldspar form the bulk of the gravel. The Douglass Mesa Gravel ranges from five to more than 50 feet in thickness and probably averages about 30 feet.

The Pine Valley Gravel is found on the lowest pediment in the Academy area. The Pine Valley Gravel west of Monument Creek consists primarily of reddish brown fragments of Pikes Peak Granite, which generally contain a greater admixture of sand, silt, and clay than do the older pediment gravels. The soil in the upper few feet of the alluvium contains both humic and clayey layers. The Pine Valley Gravel east of

Monument Creek is derived largely from Dawson Arkose. It contains no material larger than one and one-half inch pebbles and has a thickness than ranges from 5 to about 30 feet.

Colluvium is detritus that moves or was deposited mainly by the action of gravity or rill wash rather than streams. It is confined mostly to the area west of Monument Creek. Colluvium generally covers steeply sloping areas and forms fan-shaped deposits. Most of colluvium is reddish-brown and consists of fragments of Pikes Peak Granite and Dawson Arkose. Humic material from adjacent soils is abundant in the colluvium. The colluvium deposits are very poorly bedded and sorted. Boulders 12 inches in diameter are common in colluvium along Monument Creek. Boulders 12 feet in diameter are common in colluvium along the mountain front.

Windblown sand deposits form a few low northeast trending ridges east of Monument Creek and in South Lehman Valley and Pine Valley west of Monument Creek. The windblown sand lies in low dune like ridges and in irregular patches and is stabilized by a foot or two of humic soil and grass cover. The windblown sand seldom exceeds 30 feet in thickness and is generally less than 10 feet thick.It consists of stratified light-yellowish-brown sand in individual layers one-sixteenth to eight inches thick. The sand is mostly coarse, but contains minor amounts of find sand and silt.

Alluvium is found in three terraces of different elevations along streams. From the oldest to youngest, (and highest to lowest terrace level), these deposits are named: Kettle Creek Alluvium, Monument Creek Alluvium and Husted Alluvium.

Kettle Creek Alluvium crops out only along Monument Creek, Black Squirrel Creek and Kettle Creek. The top of the alluvium forms a terrace 35 to 40 feet above stream level. Kettle Creek Alluvium consists of unconsolidated olive-gray and yellowish-brown medium to coarse sand. The alluvium is poorly stratified. Individual beds are generally less than a foot thick, however, the thickness of Kettle Creek Alluvium ranges from three to 15 feet.

Monument Creek Alluvium consists of stream deposits of pebbly sand along most of the streams flowing into Monument Creek from he east, but principally within the valleys of Monument Creek and Kettle Creek. Monument Creek Alluvium forms the second major terrace above the modern flood plain.

The top of the terrace is 20 to 25 feet above the stream. The thickness of the alluvium ranges from five to 25 feet. Monument Creek Alluvium is usually iron-stained orange or brownish red and the maximum dimension of the pebbles is generally about one inch.

Husted Alluvium is a silty deposit present in nearly all stream valleys within the Academy area. Husted Alluvium consists in large part of material derived from a humic soil developed in the past on all of the unconsolidated materials of the region. The thickness of the unit ranges from 5 to about 12 feet. It is made up of poorly consolidated compact dark-yellowish brown sandy and silty material containing variable amounts of organic matter, interbedded with thin beds and lenses of sand, gravel and cobbles.

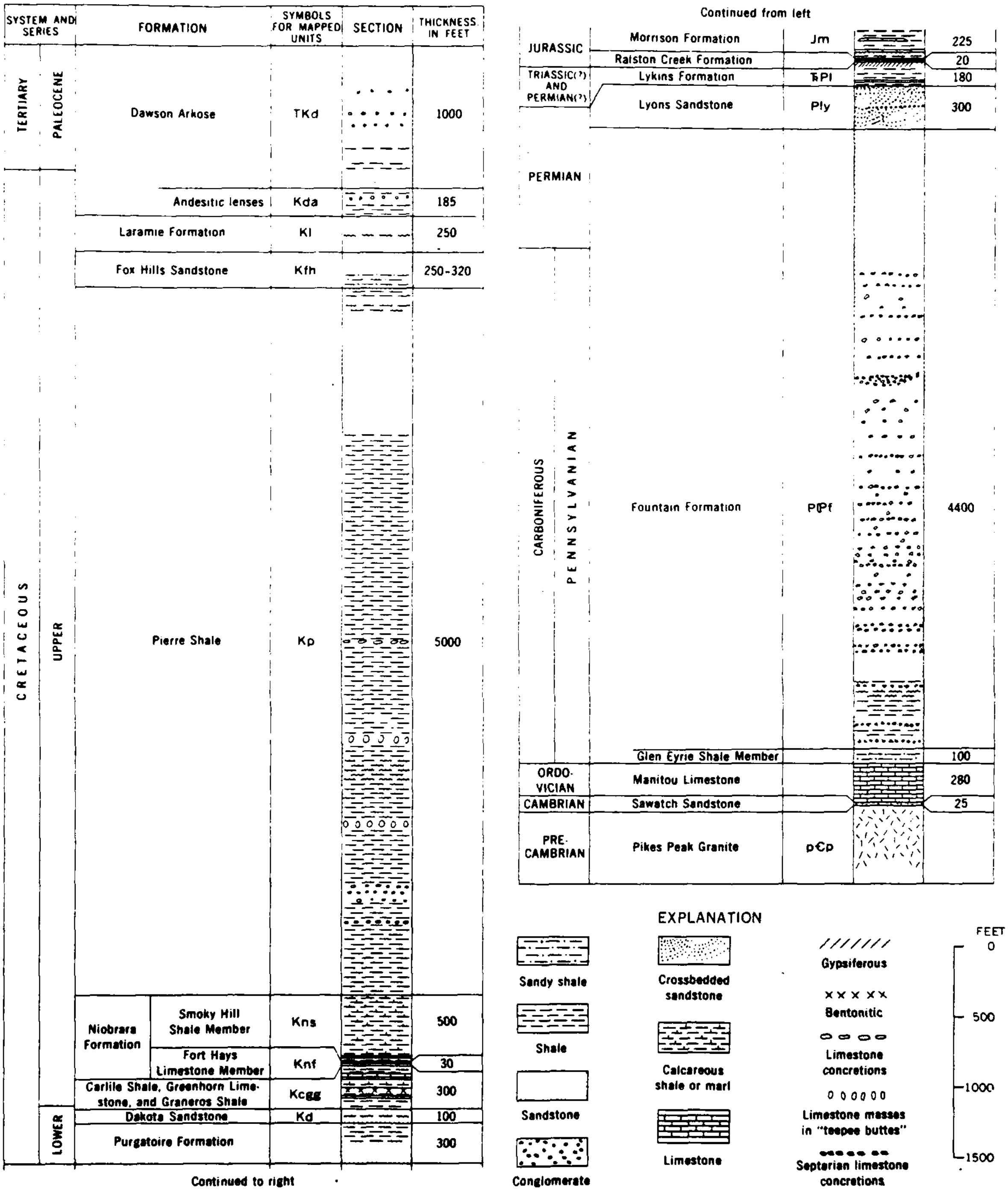
Floodplain Alluvium lies in stream bottoms in almost every valley in the area. Most of the flood plain alluvium is at stream level and forms thin, irregular, willow-covered mounds of sand on the inside of meanders. The flood plain alluvium, generally less than 10 feet thick, consists of interbedded, unconsolidated sand, pebbly sand, silty and clayey sand layers. The sandy and pebbly beds are light yellowish-brown, and the clayey, silty, and humus rich beds are darker brown. Generally, the individual beds are less than a foot thick. Most of the flood plain alluvium is saturated and unstable.

3.4.3 Bedrock Geology

Bedrock geology at the Air Force Academy includes rocks that range in age from Precambrian to Teritary; Figure 3-4 is a stratrigraphic column for the Academy and shows the lithology, thickness and stratigraphic relationships of the various rock types. The major rock types are described briefly here, from oldest to youngest. Distribution of bedrock types is shown on in Appendix F.

Pikes Peak Granite outcrops in two small areas on the western margin of the Academy. Joints are prominent and display consistent trends and inclination over many miles of outcrop. The granite weathers primarily by mechanical disintegration resulting in the release of individual grains or grain aggregates.

Fountain Formation outcrops in the northwestern and southwestern portions of the Academy. It contains coarse



Bedrock exposed in and near the Air Force Academy grounds, Colorado Springs, Colo.

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FIGURE 3-4 BEDROCK STRATIGRAPHY (VARNES AND SCOTT, 1967)

alluvium eroded from a pre-Rampart range of mountains. The formation has been greatly thinned by faulting. The formation forms some of the monuments in the Garden of Gods south of the Academy.

Lyons Sandstone occurs as outcrop in a belt several hundred feet wide at the head of Jack's Valley in the southwest corner of the Academy. The outcrops are of the following types: thin bedded, well laminated, friable sandstone and massive fine-grained sandstone. The friable sandstone is more typical of the upper part of the formation. The lower part is cemented by iron oxide and forms the huge vertical sheets (hogback) at the Garden of the Gods.

Cretaceous Marine Sediments consist of early and late Cretaceous shales and limestones that are exposed in small outcrops on the Academy. Fossils are common in the limestone layers.

Pierre Shale is seen in outcrop at the head of Pine Valley; north of this location it has been cut out by the Rampart Range Fault. The outcrop area widens to the south; at Colorado Springs the outcrop area is 4.5 miles wide.

Dawson Arkose is the predominant bedrock immediately underlying the surficial material at the Academy and outcrops over approximately 25 percent of the Academy. According to Varnes and Scott (1967) an accurate picture of distribution of the Dawson can be obtained from the location of indigeneous pine trees which appear to grow only where the Dawson is within 15 feet of the surface. This is attributed to the water holding capacity of the arkosic rocks. Lithologies typical of the formation include: interbedded sandstone, siltstone and silty claystone and andesitic shale. It is notable that some of the claystone lenses swell upon exposure.

3.5 SURFACE WATER RESOURCES

3.5.1 Surface Water Drainage

El Paso County is drained by tributaries of both the South Platte and the Arkansas River. Approximately 95 percent of the County, including the Academy, is in the Arkansas River Basin.

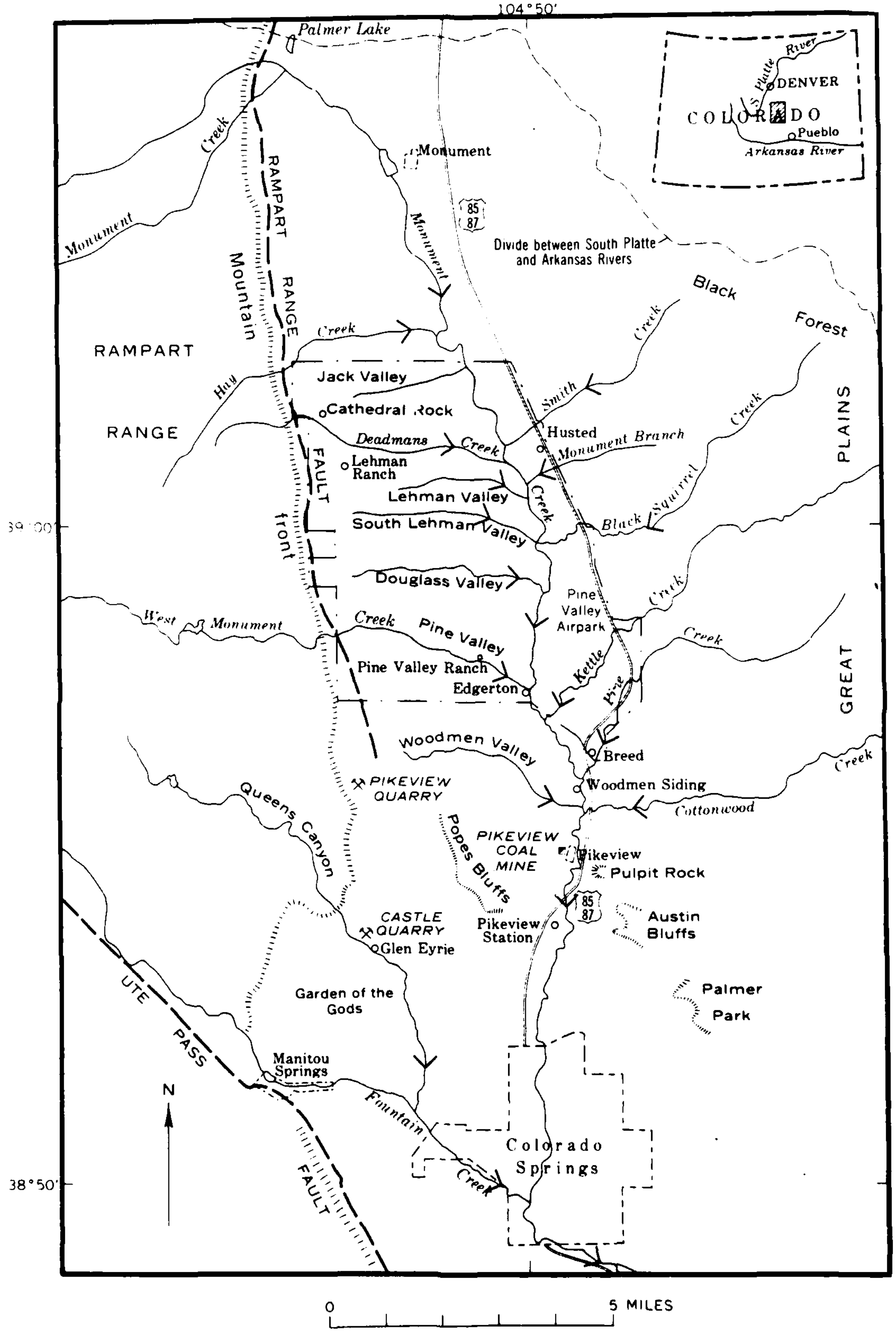
There are approximately 14 miles of streams on the Academy property. Monument Creek is the major stream; it flows from north to south along the eastern edge of the Academy. The creek bed is generally confined by precipitous outbanks which are 40 to 60 feet high. Eastern tributaries to Monument Creek are Smith Creek, Black Squirrel Creek and Kettle Creek. Tributaries which enter from the west are Deadman's Creek and West Monument Creek. Locations of these streams are shown on Figure 3-5. With the exception of Monument Creek all streams on the Academy property have only intermittent flow.

Monument Creek flows into Fountain Creek approximately 11 miles south of the Academy. Fountain Creek is the major stream in El Paso County and is a tributary of the Arkansas River.

Because precipitation in the area frequently occurs in the form of cloudbursts, runoff can be rapid resulting in high stream flow for short periods. Reportedly the most severe flood that has occurred was on 30 May 1935 when 18 inches of rain fell in 12 hours on a small area in the headwaters of Monument Creek. Runoff from that storm resulted in water 22 feet deep in both Kettle and Pine Creeks. Railroad tracks along Monument Creek were undercut. It has been noted that severe storms can result in substantial scour of stream beds although rise in stream level is minimal (Varnes and Scott, 1967). The range of stream flow in the Academy area is shown on Table 3-4.

Preliminary mapping has been completed by FEMA (Federal Emergency Management Agency) for flood insurance purposes for most of northwestern El Paso County. Federal facilities, including the Academy, were not included in this report. Other flood related mapping has been conducted on Monument Creek by the U.S. Army Corps of Engineers. This effort, however, did not include the portion of Monument Creek on the Academy.

In order to control runoff from melting snow there are water storage facilities which retain runoff in early summer for later use during dry periods. The total design water storage capacity for northwestern El Paso County exceeds 79,000 acre/feet. Rampart Reservoir No. 5, located on West Monument Creek four miles west of the Academy's west boundary, is the largest reservoir with a capacity of 40,865 acre-feet.



SOURCE VARNES AND SCOTT, 1967

FIGURE 3-5 MAJOR INTERMITTANT AND PERENIAL STREAMS

Table 3-4

STREAM FLOW - AIR FORCE ACADEMY AND VICINITY

Stream-Gaging Stations No. (U.S. Geological Survey)	Location			Drainage Area (mi^2)	Period of Record[1]	Mean Annual Discharge[2]		Maximum Discharge		Maximum Daily Discharge		Minimum Daily Discharge	
	Sec.	Township	Range			ft^3/s	mgal/d	ft^3/s	Date	ft^3/s	Date	ft^3/s	Date
West Monument Creek at U. S. Air Force Academy (07103800)	28	12 S.	67 W.	14.9	1971-72	7.96	5.14	41	6/29/71	---	---	.11	8/18/72
West Monument Creek near Pikeview (07103900)	28	12 S.	67 W.	15.4	1957-63	.74	.48	400	6/17/65	---	---	0	Many Years
Monument Creek at Pikeview (07104000)	18	13 S.	66 W.	203.0	1938-49	26.50	17.10	1,190	5/11/47	---	---	0	7/24/39

[1] Refers to available record for which flow characteristics were determined; records may exist for other periods.

[2] Based on water year, October 1 to September 30, except as indicated.

Adapted from Livingston, et al, 1975

Stormwater at the Academy is handled by a storm water system in the developed areas of the site. Because of the size and the site there are numerous discharge points from the storm water system. There are discharges to natural drainage swales (some of the swales are lined with concrete), to the intermittent creek beds and to Monument Creek. Non-potable reservoir No. 4 is primarily used for collection of runoff.

3.5.2 Surface Water Quality

Water quality analysis of samples collected at Colorado Springs, shown on Table 3-5, indicate that water from Monument Creek is a calcium bicarbonate sulfate type. During periods of low flow, the percentage of sulfate exceeds the percentage of bicarbonates. According to Livingston et al (1975) this suggests that base flow may be sustained by ground water that is high in sulfate. Livingston also indicate that there is an inverse relationship between specific conductance and stream discharge. This is typical of the region, indicating that during periods of high runoff the concentrations of dissolved solids are lowered by dilution.

Water quality analysis from the Academy are shown on Table 3-6. These analysis, for fecal coliform, are for samples collected at Monument Creek at the north (upstream) and south (downstream) boundaries of the Academy, at each of the non-potable reservoirs and at the sewage treatment plant effluent.

The Academy holds a National Pollution Discharge Elimination (NPDES) permit for the treatment plant to discharge to Monument Creek. During normal operation, however, the plant does not discharge to the Creek, the discharge path is shown schematically on Figure 3-6. As seen on that diagram, under normal conditions there is no discharge of effluent to Monument Creek.

3.5.3 Surface Water Use

The primary source of water supply in El Paso County is surface water. The City of Colorado Springs is the major population center in the County and is the major supplier of public water in the County. Available data for 1969 to 1974 show that at that time sources of water supply to Colorado Springs were as follows:

TABLE 3-5

CHEMICAL QUALITY OF SURFACE WATER FROM MONUMENT CREEK AT MOUTH, AT COLORADO SPRINGS

Date	Discharge (FT^3/s)	Dissolved Silica (SiO_2)(mg/1)	Dissolved Iron (FE) (ug/1)	Dissolved Manganese (MN) (ug/1)	Dissolved Calcium (CA) (mg/1)	Dissolved Magnesium (MG) (mg/1)	Dissolved Sodium (NA) (mg/1)	Dissolved Potassium (K) (mg/1)	Bicarbonate (HCO_3) (mg/1)	Alkalinity as $CaCO_3$ (mg/1)	Dissolved Sulfate (SO_4) (mg/1)	Dissolved Chloride (CL) (mg/1)	Dissolved Fluoride (F) (mg/1)	Dissolved Phosphorus (P) (mg/1)	Dissolved Solids (Sum of Constituents) (mg/1)	Hardness (CA, MG) (mg/1)	Non-Carbonate Hardness (mg/1)	Specific Conductance (micromhos)	pH (units)	Temperature (°C)	Carbon Dioxide (CO_2) (mg/1)
1972																					
10/20	32	17	600	30	62	13	36	5.0	158	130	120	16	2.0	.26	359	210	79	564	7.8	8.0	4.0
11/20	28	17	20	30	56	13	35	4.8	145	119	110	16	1.9	.62	338	190	74	537	8.3	1.0	1.2
12/18	25	18	20	40	65	15	48	5.0	161	132	150	33	1.6	.30	427	220	92	667	7.7	1.0	5.1
1973																					
1/29	30	17	30	10	65	15	36	4.8	158	130	140	20	1.6	.37	388	220	94	615	7.8	1.0	4.0
2/20	10	19	30	30	61	14	38	5.4	156	128	140	21	1.8	.57	390	210	82	577	7.6	.0	6.3
3/19	30	18	50	20	51	9.6	26	5.0	127	104	94	14	1.4	.54	291	170	63	459	7.3	4.0	10.
4/17	70	17	70	20	30	5.2	13	4.2	84	69	47	7.8	1.5	.19	172	96	27	176	7.1	15.0	11.
5/18	260	16	140	20	15	2.2	5.7	2.8	41	34	22	3.1	1.4	.02	90	47	13	135	7.4	--	2.6

Adapted from Livingston et al, 1975

Table 3-6

WATER SAMPLING RESULTS - FECAL COLIFORM

Date	North Boundary	South Boundary	Non-Potable Reservoir #1	Non-Potable Reservoir #2	Non-Potable Reservoir #3	Non-Potable Reservoir #4	Effluent
11/82	10.9	10.9	17,773	801.9	14.7	1.14	85,533
12/82	4.30	9.93	8,893	303.6	3.47	--	11,319
1/83	--	--	3,078	216	6.21	1	10,545
2/83	--	--	1,231	80.9	1.68.	--	27,720
3/83	5	4	65	10	1	1	280
4/83	--	--	3	2	0	0	1,254
5/83	--	--	333	8	0	0	9,678
6/83	--	--	50	10	2	2	30,686

Source: Air Force Academy Records

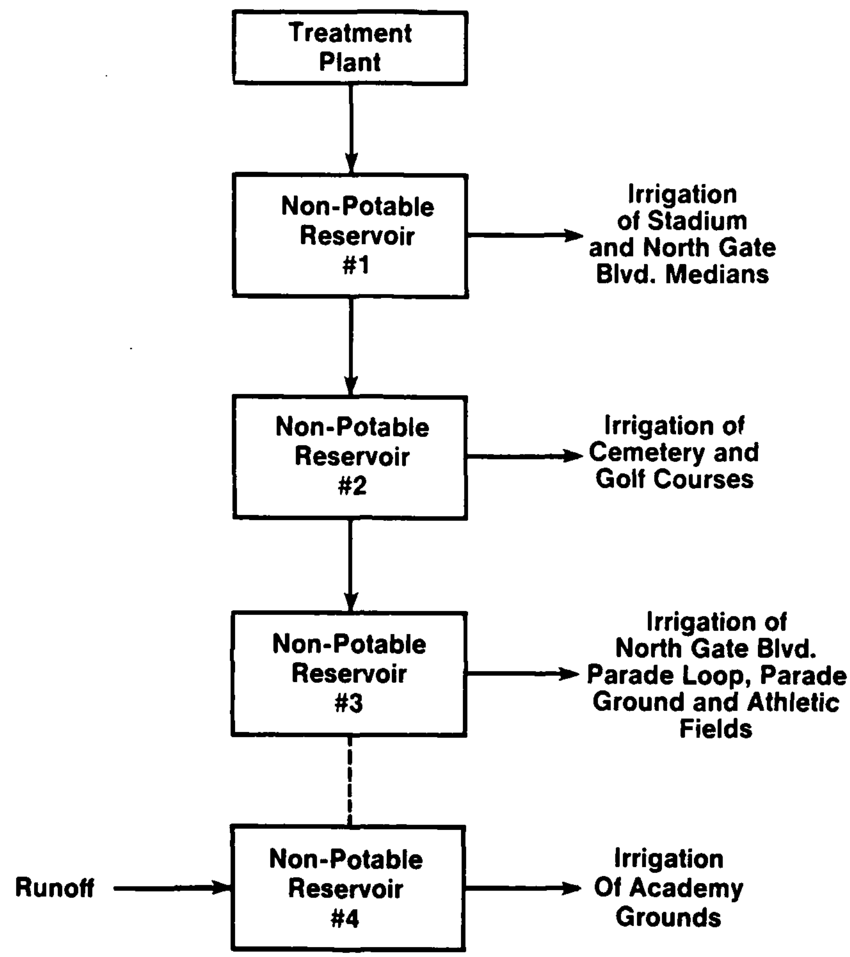


FIGURE 3-6 SCHEMATIC DIAGRAM OF THE PATH OF DISCHARGE FROM THE SANITARY SEWER TREATMENT PLANT

	Avg. Use Per Year	% of Total
Imported Surface Water	7,536 million gal.	53
Pikes Peak	3,777	27
Other Surface Water	1,597	11
Imported Ground Water	846	6
Local Ground Water	441	3
Total	14,200	100

The Air Force Academy obtains all potable water from the City of Colorado Springs. The source of the water is reported to be impounded runoff from Pikes Peak although the other sources used by the City may also be included in the Academy supply.

3.6 GROUND WATER

3.6.1 Regional and Site Hydrogeology

The principal aquifer in northwestern El Paso County is the Dawson Arkose. As previously described the Dawson Arkose is the uppermost bedrock formation at the Academy. The elevation of the top of the water-bearing zone in the formation ranges from approximately 6,600 feet at the northern end of the Academy to 6,350 feet at the southern end. Elevation of the bottom of the water bearing zone is approximately 5,750 feet at the northern end of the Academy and 6,290 feet at the southern end of the Academy.

Increasing thickness northward is attributed to less erosion and possible stratigraphic thickening to the northeast. The lower 125 feet of the formation is predominantly fine grained rock with limited secondary permeability and is, therefore, not a water bearing zone. Permeable beds in the formation are fine to very coarse-grained arkosic sandstone; these beds are lenticular with variable thickness and areal extent. Permeable zones are separated by less permeable siltstone and shale. The effect of alternating beds of varying permeability is that the formation is a multi-aquifer system. Wells penetrating the Dawson commonly are screened throughout the thickness of formation in order to intercept the maximum number of permeable zones.

On the Academy grounds water in the Dawson occurs under both confined and unconfined conditions. The potentiometric surface elevation ranges from 6,610 feet on the north end to 6,400 feet on the south. Reported yields of Dawson wells in northwestern El Paso County range from five to 400 gallons per minute.

The Dawson receives recharge from streams that intercept the formation and from direct infiltration of precipitation in outcrops . As shown on Table 3-7 for most of the portion of Monument Creek that flows through the Academy grounds the stream gains water. Only the station at Deadmans' Creek showed a net loss of stream flow indicating that the stream was recharging the aquifer. It must be noted, however, that data were collected during early spring. It is probable that there is some seasonal variability in the pattern of ground-water/surface water interactions.

Since the Dawson formation does outcrop on the Academy property, the Academy can be considered as a local recharge area for the formation. The major regional recharge area for the formation is the Black Forest, approximatley eight miles east of Monument Creek. The recharge rate for the Black Forest area has been modeled and reported by Livingston et al (1976) as 2.0 to 2.2 inches per year. The same model estimated the recharge rate at the Academy to range from less than 0.05 inches per year along Monument Creek to 0.5 to 1.0 inch per year along the Rampart Range Fault.

Regional flow directions in the aquifer are east and west from the Black Forest area. Local flow directions at the Academy is east-southwest toward Monument Creek.

The other aquifer in the Academy area consists of the Fox Hills and Laramie Formations which occur below the Dawson Formation. The two formations are normally combined and referred to as the L-F aquifer. Depths to the L-F aquifer ranges from 400 to 1,165 feet and increase northward as a result of the northwest dip of the formation and a rise in surface elevation. The aquifer has not been used extensively because of its depth. Reported yields of wells are less than 100 gallons per minute.

Water occurs in the L-F aquifer under confined conditions. The approximate elevation of the potentiometric surface at the Academy is 6,000 feet.

Surficial unconsolidated alluvial deposits do contain water bearing zones. Yields of wells in these materials, however, are generally les than 10 gallons per minute with the result

TABLE 3-7

SUMMARY OF GAIN AND LOSS INVESTIGATION OF MONUMENT CREEK,

18-19 APRIL 1973

Site Name	Downstream Distance in River Miles	Main stem discharge in ft^3/s	Water Temperature in ^oC	Specific Conductance in micromhos/cm	Dissolved load, in tons/d	Net Gain or Loss: Discharge in ft^3/s	Net Gain or Loss: Dissolved solids load, in tons/d
Monument Creek above Smith Creek, at U.S. Air Force Academy	5.7	48.7	11.0	160	13.3	+4.0	+2.0
Monument Creek below Deadmans Creek, at U.S. Air Force Academy	8.2	48.2	10.5	200	16.4	-1.4	+2.7
Monument Creek near Pine Valley Airport, at U.S. Air Force Academy	11.1	51.5	6.0	250	22.0	+2.0	+5.3

Adapted from Livingston et al, 1975

that the surficial deposits are not used extensively for water supply.

3.6.2 Ground-Water Quality

Water in the Dawson aquifer is variable in quality. In the extreme northern part of El Paso County the water is soft and of the calcium bicarbonate type. Elsewhere in northwestern El Paso County water in the Dawson is more mineralized due to dissolution of minerals in the rock. Concentrations of dissolved solids in the Dawson range from 76 to 1,150 mg/liter. Water in the Woodman Valley area is particularly high in dissolved solids. This has been attributed to the rapid dissolution of rock minerals by acidic waters; the acidic condition may be related to thin coal beds in the Dawson. The regionally high dissolved solids concentration haws also been attributed to evapotranspiration of ground water.

Table 3-8 shows the results of analysis of samples collected from wells at the Academy in 1955 and 1957.

3.6.3 Ground-Water Use

Since the early 1970's there has been a marked increase in development in El Paso County and a consequent increase in ground-water use. Table 3-9 summarizes the known wells in the vicinity of the Academy as of 2 July 1984. Most of these wells are completed in the Dawson formation; some of the deeper wells are completed in the L-F aquifer.

Livingston et al (1976) present prediction of water level decline in the Dawson due to pumping of the aquifer. The predicted decline, by the Year 2000, in the area of the Academy is zero to 25 feet.

The Academy has 10 wells which are used for irrigation. The locations of these wells are shown on Figure 3-7. These wells were completed in the 1950's. Dates of completion, depth and geologic source are shown on Table 3-8. It has been reported that during the 1970's several of the wells became non-functional due to incrustation and corrosion of the casing. U.S. Geological Survey personnel examined that wells and provided remedial recommendations, but there was no report written and the record does not indicate what corrective actions had been taken. The wells are functioning now. There is no evidence that there was any

TABLE 3-8

Chemical Analyses of Water from Wells

(Results in parts per million except as indicated)

Well	Depth (ft.)	Geologic Source	Date of Collection	Temperature (^{o}F)	pH	Specific Conductance in micromhos at 25^{o}C	Percent sodium	Sodium Adsorption Ratio (SAR)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Silica (SiO_2)	Dissolved Solids	Hardness (calculated as $CaCO_3$) Total	Hardness Noncarbonate
1	1,065	Fox Hills and Laramie Formations	10/28/55	61	7.6	769	7	0.27	---	107	23.0	12		130	263	4.0	0.8	0	--	474	362	255
1A	358	Dawson Arkose.	11/11/55	52	6.9	254	12	.29	---	32	5.4	6.7		65	55	2.0	1.0	.02	--	134	102	48
2	1,493	Fox Hills and Laramie Formations	3/5/56	57	7.6	229	19	.46	---	27	4.9	9.8	5.0	106	21	2.0	2.0	.3	--	124	88	0
2A	826	Dawson Arkose.	2/7/56	51	7.0	316	10	.26	---	42	6.8	7.0	3.0	66	90	2.5	0.5	.2	24	184	133	79
4A	672	----do------	8/30/56	55	7.3	136	13	.24	0	19	2.4	4.2	2.2	65	9.4	2.2	1.0	.4	23	73	58	4
5A	575	----do------	8/25/56	53	8.0	163	12	.24	---	21	3.6	4.7	3.0	62	22	2.5	1.2	.7	--	89	68	16
(1)	600	----do------	5/29/57	55	6.5	439	23	.79	.04	55	5.8	23.0	3.0	120	98	6.0	0.9	2.4	--	253	161	62

(1) Location SE¼SE¼NE¼ sec. 21, T. 11 S., R. 67 W, U.S. Forest Service well

Adapted from Cardwell and Jenkins in Varnes and Scott (1967)

Table 3-9

WELL INVENTORY
U.S. AIR FORCE ACADEMY VICINITY
Data as of 2 July 1984

Location	No. Wells	Comments
T11S, R66W	255	Most are domestic use: 200 to 300 feet deep; 6 municipal wells: 1 - <50' 1 - 200 - 300' 4 - 1000 - 1300'
T11S, R67W	192	Most are domestic use: 200 to 300 feet deep; 20 municipal wells: 1 - <50' 2 - 100 - 200' 1 - 300 - 400' 2 - 400 - 500' 10 - 700 - 1200' 1 - 1400 - 1500' 1 - 1800 - 1900' 1 - *Unknown* 17 wells for commercial and industrial use - most less than 200 feet
T12S, R66W	362	Most are domestic wells 200 to 300' deep; 8 municipal wells: 3 - 400' 5 - 800 - 1300'
T12S, R67W	13	Includes wells owned by the Academy
T13S, R66W	640	155 - <50' 74 - 50 and 75' Majority of remaining wells between 200 and 300 feet; 12 municipal wells: 1 - 50' Remainder btween 200 to 1200' deep
T13S, R67W	137	One well is a municipal well. Most are <300'

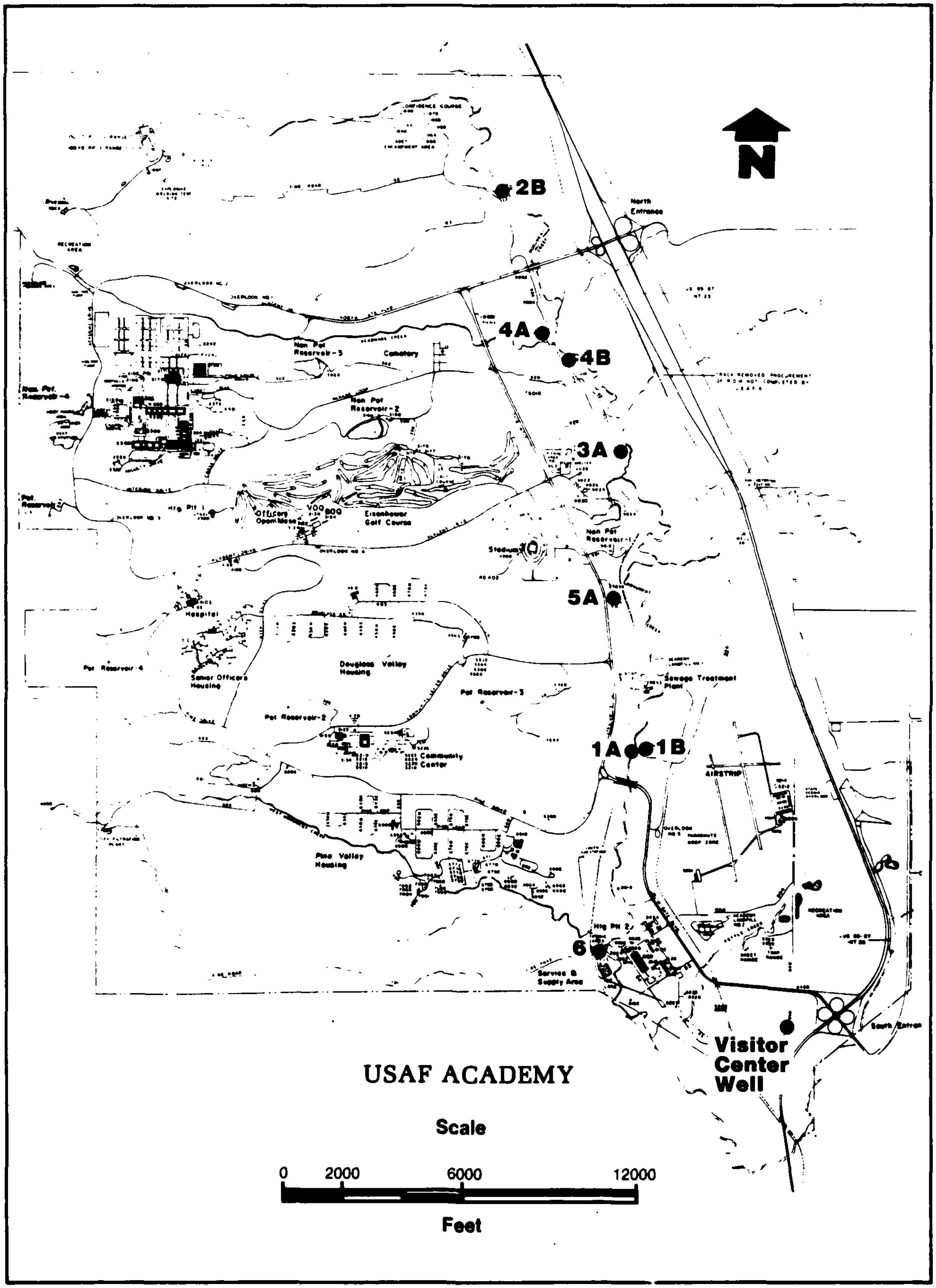


FIGURE 3-7 LOCATION OF ACADEMY WELLS

contamination associated with the encrustation and corrosion.

3.7 BIOTIC ENVIRONMENT

3.7.1 Plants

Vegetation at the U.S. Air Force Academy is directly related to land use. The types of vegetation various land use categories as summarized in Table 3-10. Native plants are well adapted to sandy soils with low fertility and low water-holding capacity. Representative species include ponderosa pine, Douglas fir, scrub oak, mountain mahogany and blue gamma grass. A complete list is provided in Appendix F. Because these native plants generally do not provide desired growth characteristics for landscaping, plant species have been introduced into improved areas. These introduced species usually require supplemental irrigation.

3.7.2 Wildlife

Large animals (over 30 pounds) may be found at the Air Force Academy include mule deer, white-tailed deer, antelope, coyotes, black bears, and big horn sheep. Occasional migrating elk are present. Antelope and coyote population are declining as they seek less populated areas. Mule, deer, and white-tailed deer populations are on the rise. In 1984, the estimated deer population on the base was 1500.

Predatory birds found on the Academy property include prairie falcons, hawks and horned owls. The prairie falcon population is apparently stable. Hawk and owl populations are stable, and may be increasing due to ideal food conditions.

Small animals at the Academy include racoons, beavers, porcupines, cottontail rabbits, abert squirrels, weasels, fox squirrels and skunks. Raccoons and abert squirrel populations are stable, and beaver populations are declining. Black-tailed prairie dogs and jack rabbits once frequented the area, but are no longer common.

Birds include the scaled quail, dove, blue grouse, turkeys, and a variety of song birds. Scaled quail, dove and blue grouse populations are stable while turkeys are on the increase. Song birds are trending upward.

WESTON

Table 3-10

VEGETATION AT THE U.S. AIR FORCE ACADEMY
BY LAND USE CATEGORY

Vegetation Type	Land Use	Acreage
Natural Vegetation	Unimproved Areas	1,367.70
Timberlands	Forest Management Areas	9,000.00
Mixed	Semi-Improved Areas (mowed and fetilized once per yer)	6,377.98
Bluegrass/Shrub Plantings	Improved Areas, etc.	723.42
None	Buildings, Paved Areas	856.00
	Total	18,325.10

*Does not include 655 acres of natural vegetation in the Farrish Annex

Source: USAF, Environmental Narrative, Tab A-1, p. 71

Fish were first stocked at the Academy in 1967, and are found in creeks, beaver ponds, lakes and reservoirs on the base. Species introduced included rainbow, cutthroat and brook trout and channel catfish.

3.5.3 Threatened and Endangered Species

There are not known threatened or endangered plant species at the Air Force Academy.

The black footed ferret is an endangered species dependent on prairie dog towns, which are not found on the Academy site today. Prairie falcons are rare on the base. Two eyries with four to six birds are found on adjacent U.S. Forest Service lands. An eyrie on the Base at Cathedral Rock was abandoned by the falcons with the advent of the gunning range. Golden eagles have been known to pass through the Academy and there may be a nesting area in the mountains west of the Academy.

3.8 SUMMARY OF ENVIRONMENTAL SETTING

The environmental conditions at the U.S. Air Force Academy indicate that the following data are important to the evaluation of past hazardous waste handling practices:

1. Precipitation at the Academy is seasonal and normally occurs as intense storms with high runoff and relatively low infiltration. Due to the relatively low precipitation rate and high solar radiation annual evapotranspiration exceeds precipitation by 7.5 inches which could decreased the rate of leachate generation and vertical transfer of contaminants to ground water.

2. Depth to ground water on the Academy property is variable because of variation in the type and distribution of unconsolidated materials and variations in topography. Overall, however, depths to the saturated zone averages less than 20 feet. The shallow depth to ground water increases the probability that contamination will reach the water table.

3. In the area around the Academy ground water is used extensively for water supply. Most of the water is obtained from the Dawson Arkose which is at or near the surface on the

Air Force Academy. This indicates the potential for migration of contaminants to a water supply source.

SECTION 4

FINDINGS

4.1 INTRODUCTION

To assess hazardous waste management at the Air Force Academy, 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 Academy, and discusses the potential for environmental contamination.

4.2 PAST ACADEMY ACTIVITY REVIEW

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

4.2.1 Waste Generation

The Academy is unique in the Air Force that it is primarily an academic institution. The activities at the Academy are similar to those at a college rather than to those at other Air Force installations. There are no large scale industrial activities nor are there major aircraft facilities that would generate significant amounts of hazardous waste. In general, hazardous wastes are generated in small quantities by support activities (i.e. maintenance, fuels management) and by the academic laboratories.

The sources of the most hazardous waste on the Air Force Academy can be associated with one of the following activities:

- o Maintenance Operations
- o Fire Protection Training
- o Pesticide Utilization
- o Fuels Management
- o Laboratory Operations.

The Bioenvironmental Engineering (BEE) Office provided a listing of hazardous waste generation from many of the Academy activities. From this information and interviews with Academy personnel, a master list of generator locations was prepared showing building locations, identification of hazardous wastes, waste quantities, and past and present disposal methods. This listing is provided as Table 4-1. the operation and waste management practices for each activities are discussed below. Locations of the activities areas are shown on Figure 4-1. Treatment and disposal areas are shown on Figure 4-2.

4.2.1.1 Maintenance Operations

Maintenance operations consist primarily of vehicle maintenance and repair activities. Vehicles are primarily used for on-Base transportation and maintenance of Base buildings and grounds. The primary location for vehicle maintenance and repair is the yard in the Service and Supply Area (near Buildings 8112, 8113 and 8114). A general review of the waste disposal practices is discussed below.

1960's to Early 1970's. During the early period of Academy operations (1960's through early 1970's), waste oils and solvents were removed by an outside contractor or rinsed through the drainage systems. In the early 1960's, combustible refuse was burned in an incinerator located at Building 9040. Non-combustible refuse and incinerator ash were disposed in a landfill (Landfill No. 2) located south of the airstrip.In the mid 1960's, all refuse was disposed in this landfill. During the late 1960's and early 1970's, all waste solvents and oils were disposed in waste oil holding tanks and then removed by an outside contractor.

Mid 1970's to Present In the mid-1970's, a second landfill was used for refuse disposal. This landfill (Landfill No. 1) is located adjacent to the sewage treatment plant. All refuse, including grease, empty paint and thinner cans and dead animals were disposed in this landfill until 1978. At that time, an outside contractor began removing all refuse from the Academy. Landfill No. 1 is presently designated for use for rubble fill only. Recently, waste solvents have been disposed of by the contract supplier of the solvents. Waste oils continue to be removed by the contractor from the various holding tanks located on the Academy. Hazardous wastes generated are presently stored at the point of

TABLE 4-1

WASTE MANAGEMENT
AIR FORCE ACADEMY

Shop Name	Location (Building Number	Waste Material	Waste Quantity	Waste Management Practices 1950 – 1960 – 1970 – 1980
Auto Hobby	4562	Lubrication Oils Antifreeze	Combined value 2,733 gals/yr	--------------Waste Oil Tank to Contractor----------
BX Garage	5120	Lubrication Oils Gasoline	Combined value 1,000 gals/yr	--------------Waste Oil Tank to Contractor-----------
Heavy Equipment Shop	8114	Lubrication Oils Antifreeze Hydraulic Fluid Petro Inhibited	Combined value 928 gals/yr	--------------Waste Oil Tank to Contractor-----------
		Solvents	225 gals/yr	---Waste Oil Tank or Fire Dept.-----/Recycled by Supply Contr.
AERO Club	9206	Lubrication Oils	400 gals/yr	---Waste Oil Tank or Fire Dept.-----/Waste oil tank to Contr.
DOSS Aviation	9208	Lubrication Oils Gasoline	Combined value 878 gals/yr	---Waste Oil Tank or Fire Dept.-----/55 gal. drum to Contractor
		Solvent	Approx. 75 gal/yr	---Waste Oil Tank or Fire Dept.-----/Recycled by Supply Contr.
Print Shop	2354		Combined value 75 gals/yr	---Diluted to sanitary sewer thru----/5 gal containers to DPDO waste holding tanks
Laboratories	2354	Carbon Tetrachloride Tetrachloroethylene Trichloroethylene	Combined value 9 gals/yr	---Diluted to sanitary sewer thru----/Diluted to sanitary sewer waste holding tanks
		Methylene Chloride 1,1,1-Trichloroethane Nitrobenzene Toluene Methyl Ethyl Ketone Carbon Disulfie Pyridine 1,2,2-Tetrachloroethane 1,1,2-Trichloroethane P-Dichlorobenzene Trichlorofluoromethane	Combined value 5 gals/yr	---Diluted to sanitary sewer thru----/Diluted to sanitary sewer waste holding tanks
		Misc. Chemicals and Reagents (over 1200 Separate Compounds)	Combined value 288 kilograms/yr	--------Sanitary Sewer-------------- ---Sanitary Sewer

TABLE 4-1 (Cont.)

WASTE MANAGEMENT
AIR FORCE ACADEMY

Shop Name	Location (Building Number)	Waste Material	Waste Quantity	WASTE MANAGEMENT PRACTICES 1950 – 1960 – 1970 – 1980
Motor Pool	8122	Lubrication Oils Hydraulic Fluid	Combined value 1,452 gals/yr	-------------Waste Oil Tank to Contractor------------------
		Solvent	225 gals/yr	-------------Waste Oil Tank to Contractor------------------
		Battery Acid	Unknown Quantity	----------Neutralized, then to sanitary sewer--------------
Radiology	4102	Photographic Fixer	7,500 gals/yr	--------------Directly to Sanitary Sewer------------------
		Photographic Developer	3,800 gals/yr	--------------Directly to Sanitory Sewer------------------
Hospital	4102	Xylene	60 gals/yr	----------Sanitary Sewer---------------/Containers to DPDO
		Sodium Azide	Less than 50 gals/yr	----------Sanitary Sewer---------------/Not in use

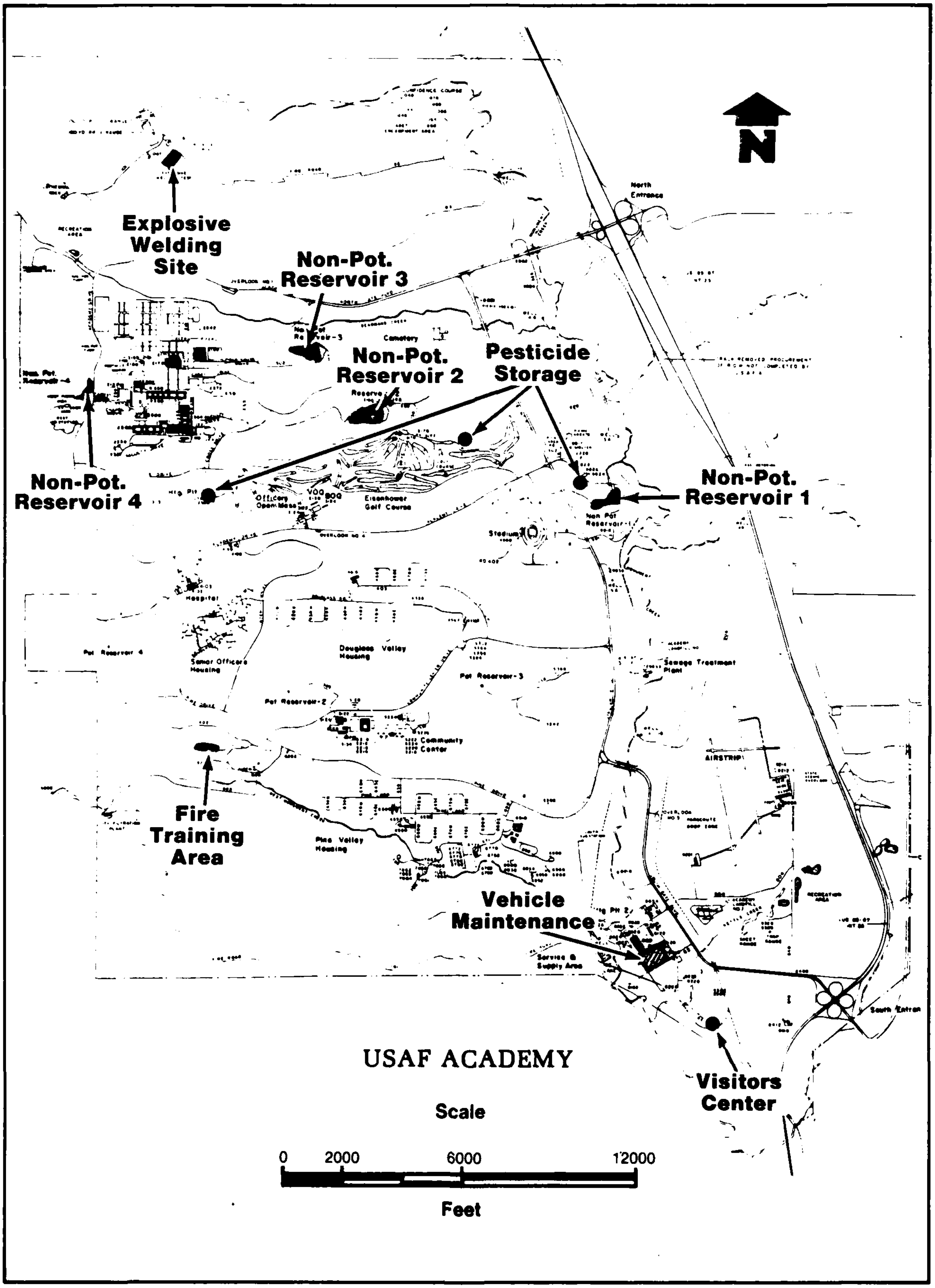


FIGURE 4-1 ACTIVITY AREAS

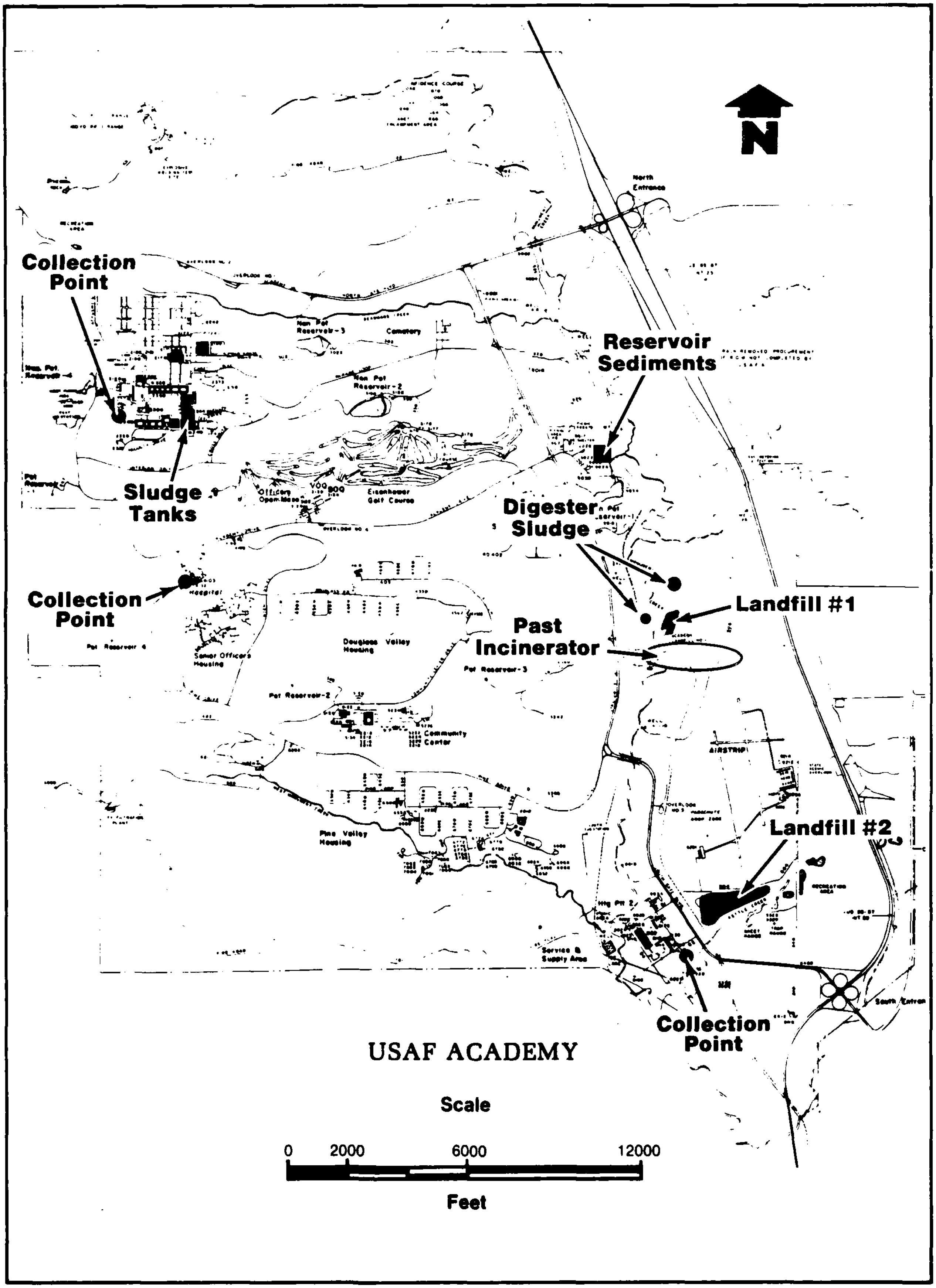


FIGURE 4-2 TREATMENT, DISPOSAL, AND COLLECTION AREAS

generation until sufficient quantity is produced for transfer to a central collection point. When volumes are sufficient at these locations the wastes are removed to Ft. Carson for DPDO disposal.

4.2.1.2 Fire Protection Training

The Academy fire Department has operated a fire protection training area since 1975. The area is located in a secluded section in the southwest area of the Academy. Solvents and JP-4 fuel have been used for burning. The pit has an eight-inch clay liner to prevent infiltration of fuels used. The pit is flooded and fuel pumped onto the surface of the water during exercises. In the 1970's waste solvents were used along with JP-4. Now only JP-4 is used for fire pit burns. The training area is used several times a year, burning approximately 1,200 gallons of fuel.

4.2.1.3 Pesticide Utilization

Pesticide management has been the responsibility of Academy personnel. Pesticides and herbicides have been stored at various locations throughout the Academy. Buildings 2562, 3178 and 9018 have been used as storage areas. Currently only Building 9018 is used for herbicide and pesticide storage. All chemicals are mixed in the storage buildings and transferred to 200 to 300-gallon trailers. Chemicals are used completely and empty containers rinsed at a regular pesticide application point to dispose of all residue. Empty containers are then disposed with normal refuse. There have been several reports of pesticide spills in the past years. All spills were reported to have been small in quantity and cleanup procedures completed.

4.2.1.4 Fuels Management

The fuels management system at the Academy consists of many underground gasoline, diesel, and fuel oil tanks. Several above-ground tanks also exist containing JP-4 fuel. Table 4-2 provides listings and descriptions of existing tanks.

Corrosion of underground pipelines has been a persistent problem throughout the history of the Academy. Although reports vary for the causes of corrosion, there have been numerous incidences of pipeline leakage. Most underground tanks on the Academy have cathodic protection. Although cathodic protection is present, the effectiveness is not known.

Table 4-2

U.S. AIR FORCE ACADEMY
STORAGE TANKS

Location	Contents	Capacity (gallons)	Above or Below Ground	Cathodic Protection	Tank Material
Grounds					
Building 2180	Regular Gasoline	1,000	Below	No	Steel
Building 2180	Diesel	500	Above	No	Steel
Building 2180	Diesel	500	Above	No	Steel
Building 2180	Diesel	500	Above	No	Steel
Fairchild Hall					
Laboratory 2354	Empty (no longer in use) (Prior use for waste laboratory)	3 tanks	Above	Yes	Steel
Aeronautics Lab					
Building 2410	JP-4	10,000	Below	Yes	Steel
Building 2410	JP-4	10,000	Below	Yes	Steel
Heating Plant No. 1					
Building 2560	No. 5 Fuel Oil	636,000	Above	No	Concrete
Buidling 2560	No. 5 Fuel Oil	50,000	Below	Yes	Steel
Building 2560	No. 5 Fuel Oil	50,000	Below	Yes	Steel
Hospital					
Building 4102	Diesel	3,000	Below	Yes	Steel
Building 4102	Waste		Above	Unknown	
Golf Course					
Buidling 3178	Diesel	500	Above	No	Steel
Building 3178	Regular Gasoline	500	Below	No	Steel
Auto Hobby Shop					
Building 4562	Waste Oil	300	Below	No	Steel
BX Service Station					
Building 5120	Regular Gasoline	10,000	Below	Yes	Steel
Building 5120	Regular Gasoline	10,000	Below	Yes	Steel
Building 5120	Premium Gasoline	10,000	Below	Yes	Steel
Building 5120	Unleaded Gasoline	10,000	Below	No	Fiberglas
Building 5120	Unleaded Gasoline	10,000	Below	No	Fiberglas
Building 5120	Waste Oil	500	Below	No	Steel
Security Police					
Building 8024	Diesel Fuel	130	Above	No	Steel
Heating Plant No. 2					
Buidling 8026	No. 5 Fuel Oil	50,000	Below	Yes	Steel
Building 8026	No. 5 Fuel Oil	50,000	Below	Yes	Steel
Heavy Equipment					
Building 8114	Waste Oil	1,000	Below	No	Steel
Motor Pool					
Building 8122	Diesel	6,000	Below	Yes	Steel
Buidling 8122	Unleaded Gasoline	6,000	Below	Yes	Steel
Building 8122	Regular Gasoline	12,000	Below	Yes	Steel
Building 8122	Waste Oil	1,000	Below	No	Steel
Building 8122*	Regular Gasoline	600	Above	No	Steel
Building 8122*	Regular Gasoline	600	Above	No	Steel

*Mobile Tank

Source: Air Force Academy Real Property Listing and Academy Records

Table 4-2 (cont.)

Location	Contents	Capacity (gallons)	Above or Below Ground	Cathodic Protection	Tank Material
Sewage Lift Stations					
Building 9005	Diesel	285	Below	Yes	Steel
Buidling 9013	Diesel	285	Below	Yes	Steel
Forestry					
Building 9030	Regular Gasoline	500	Above	No	Steel
Grounds					
Building 9040	Regular Gasoline	500	Above	No	Steel
Building 9040	Diesel	300	Above	No	Steel
Buidling 9040	Diesel	500	Above	No	Steel
Building 9040	Diesel	500	Above	No	Steel
Air Strip					
Building 9206	AVGAS	8,000	Above	No	Steel
Building 9206	AVGAS	8,000	Above	No	Steel
Building 9206	AVGAS	10,000	Above	No	Steel
Buidling 9206	AVGAS	6,000	Above	No	Steel
Buidling 9212	Diesel	560	Above	No	Steel
Farish Memorial					
	Diesel	300	Above	No	Steel
	Regular Gasoline	300	Above	No	Steel
School District					
Building 6910	Regular Gasoline	1,000	Below	No	Steel

Fuel Spills

Several fuel spills have occured in various areas throughout the Academy. In 1976, a diesel locomotive overturned on the railroad right-of-way on the Academy. This accident resulted in less than 1,000 gallons of diesl fuel spilled on the surrounding ground. This spill was not contained nor cleanup action taken.

In 1977, a gasoline spill of approximately 2,500 gallons occurred. The fire department responded and contained the spill by diking the surrounding area, igniting the spilled gasoline and allowing the fuel to burn off. Due to the containment and effective cleanup procedures, no significant environmental contamination is attributed to this spill.

During 1977 to 1978 two spills of fuel occurred on the clover leaf near the south gate. The spills occurred when tank trucks overturned; the combined discharge was approximately 200 gallons. The spills were reported to have been cleaned up rapidly.

A major spill was reported near the aeronautics lab (Building 2410) in 1983. The above ground JP-4 pipeline cracked from the weight of heavy snows. The crack was not immediately recognized due to the snow. Approximately 5,000 to 6,000 gallons of JP-4 spilled onto the ground under the snow. The fire department responded when the spill was noticed and attempted to contain and cleanup the surrounding area. The fuel salvaged from the spill area was used for fire training exercises. Due to the undetected leak, the effects of this spill cause concern for environmental harm.

A few small fuel spills were reported to have occurred in the area of the South Gate. All spills were small in quantity and contained. No environmental harm is attributed to these spills. Locations of the major spills are shown on Figure 4-3.

4.2.1.5 Laboratory operations

Due to the academic facilities present at the Academy, laboratory wastes are a significant source of hazardous wastes. Fairchild Hall, which contains the A~ademy laboratory facilities, had a special chemical waste treatment system installed when the building was constructed. The system,

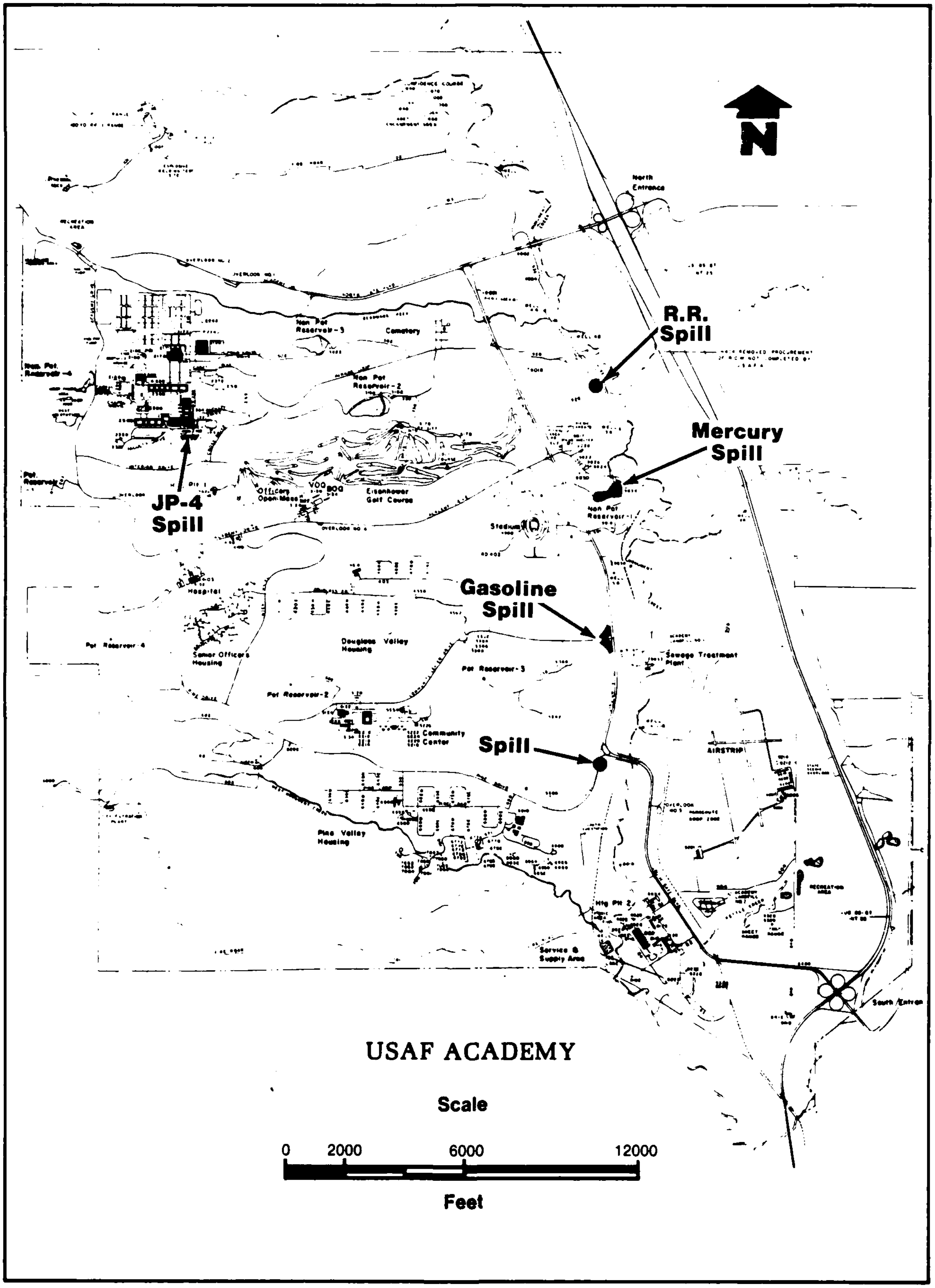


FIGURE 4-3 MAJOR SPILL AREAS

located in the basement of Fairchild Hall, consisted of two pH control dosing tanks. Before 1968, the system was connected to the waste lines of the laboratories and discharged to the sanitary sewer. The system was abandoned in 1968 due to the difficulties encountered with the pH dosing system. The tanks were disconnected and the waste lines repiped into the sanitary system.

In 1983, the existing sludges contained in the dosing tanks was sampled, analyzed and removed by an outside contractor. The results of the sludge samples are contained in Table 4-3. Due to high levels of mercury and lead, the sludge was treated as a hazardous waste. The remaining sludge was shovelled into 55-gallon drums and removed.

The Academy has completed an Architect Engineering Study to install a new pH control waste system. This is due to the possible disrupting effects the laboratory wastes may have on the sanitary sewage treatment process. The Academy's removal of the sludge contained in the dosing tanks minimizes possible environmental harm caused by their presence.

4.3 HAZARDOUS WASTE STORAGE

The Academy has an expedient hazardous waste disposal process. This process results in minimal volumes of hazardous waste being present on the A~ademy. There is currently no hazardous waste storage areas on Academy property. The waste are stored at the point of generation until sufficient volume is present for disposal. The waste is then moved to a collection point. There are four collection points located at Buildings 4010, 2304 and 8116. Figure 4-2 gives the location of these areas. The wastes are collected at three points and delivered to DPDO at Fort Carson. The volume of hazardous wastes present at one time at the Academy is small.

4.4 PCB HANDLING

The Academy is currently in the process of removing and replacing any transformers that may contain concentrations of PCB oil. No PCB oil spills or leaks have been reported at the Academy. There are two substations at the Academy that may have contained transformers with PCBs. Although no spills or leaks have been reported there is some ground staining within the substations indicating the possibility of spills in the past.

WESTON

Table 4-3

AIR FORCE ACADEMY
FAIRCHILD HALL WASTE SLUDGE ANALYTICAL RESULTS
COMPOSITE SAMPLE

Parameter	Result (mg/L Unless Other-Wise Noted)	Parameter	Result (ug/L)
pH	8.44 (pHU)	Methylene Chloride	549
Cadmium	0.5	1,1 Dichloroethane	<10
Lead	67.0	1,2 Dichloroethane	<10
Mercury	37.0	1,1 Trichloroethane	38,800
Barium	23.6	Trichloroethylene	30,600
Silver	0.6	1,1,2 Trichloroethane	<10
Chromium	1.2	Benzene	1056
Aresenic	<0.0100	1,1,2,2 Tetrachloroethane	<10
Selenium	0.1276	Tetrachloroethylene	324
		Toluene	144

4.5 OTHER ACTIVITY AREAS

4.5.1 Pre-Academy Activities

Hazardous wastes also may be present on the Academy property due to pre-Academy occupation operations. Prior to the Air Force's presence at tnis site (1950's) a foundry existed in the area of the Visitor's Center. Specialty machine tools were manufactured at the foundry. Wastes generated during foundry operations could still be present.Also, in 1945 this area was reportedly used for munitions work during World War II. Munitions disposal areas may be present in the vicinity of the Visitor's Center.

4.5.2 Farish Memorial Resort

The Air Force maintains a recreational area for Air Force personnel called Farish Memorial. This 655 acre resort has a septic system for sanitary waste and a landfill that has been used for refuse in the past. The original septic system reportedly operated poorly. There were several incidences of tank overflow into the surrounding drainage creek. In 1982 to 1983 the septic system was rebuilt and a new title field constructed. The system is effectively working presently. The landfill at Farish was the destination of all general refuse. In the early 1970's, the landfill was closed to refuse and only clean rubble was permitted to be dumped in the landfill.

The use of vegetation and pest control chemicals (copper sulfate and sodium arsenic) have been present at Farish. There was a report of a full 55-gallon drum of sodium arsenic being dumped into the landfill years ago. Drainage for the landfill will enter either the Farish lake or the neighboring property lake. Also, a lake has recently been dredged and the sediments dumped at several locations at Farish. The use of copper sulfate for aquatic vegetation control causes concern of possible contamination in the dredged sediments.

4.5.3 Explosive Welding Area

An area in the northwest corner of the Academy property was used for an experimental explosive welding project. This area was used approximately 15 years ago. Information concerning this activity is sketchy and there is no evidence of any disturbance in this area. Information obtained during interviews indicate that the activity was conducted in an enclosed trailer that was removed some time after the project ended.

4.5.4 Mercury Spills

The fire department has reported small elemental mercury spills in facilities at the Academy. Spills have been reported in Buildings 2410, 6000, 5136, 2348 and 2354. All spills were cleaned up by vacuuming and using soda ash as an absorbent. The areas were checked with a mercury detector to determine possible safety hazards.

A mercury spill has been reported at non-potable Reservoir No. 1. The spill occurred in the early 1970's and may have released between one and three pounds of mercury. The source of the spill has been reported as a break in an instrument at the reservoir. Occurrence of the leak was prior to dredging the reservoir sediment.

4.5.5 Non-Potable Reservoir No. 4

Several incidences of fish stress have been noticed in non-potable Reservoir No. 4. Interviews revealed possible silver and lead concentrations found in the fish. A thesis study was worked on by a faculty member to determine possible causes for stress. The study was not completed and information is not clear concerning the results.

4.6 PAST ON-BASE TREATMENT AND DISPOSAL METHODS

The Academy facilities which have been used for treatment and disposal of wastes can be categorized as follows:

1. Landfills
2. Sewage Treatment Plant
3. Incinerator.

4.6.1 Landfills

Two landfills, used for the disposal of refuse, were identified at the Academy. Landfill locations have been identified on Figure 4-2.

4.6.1.1 Landfill No. 1

Landfill No. 1 is located just north of the main air strip. This landfill received all Academy refuse from 1972 to 1978. Over 200,000 yds^3 of refuse were excavated and used for refuse burial. During this period, incoming wastes were monitored by the environmental coordinator. Monthly reports of disposed wastes were completed. Incoming wastes would include empty paint cans, some hospital wastes, and used pesticide and herbicide containers. Since 1978, the landfill has been authorized for disposing of clean rubble only. During the site inspection by the Record Search Team, paint cans, oil cans and several empty drums were seen at the landfill. Also some localized staining was noted on the surface in the landfill area.

4.6.1.2 Landfill No. 2

Landfill No. 2 is located near the south gate entrance. This landfill was in use from 1960 to 1972. During the early 1960's, only non-combustible trash and ash from the incinerator (Building 9040), were disposed in Landfill No. 2. In the late 1960's and early 1970's, all academy refuse was brought to this landfill. Approximately 200,000 yds^3 of refuse have been disposed in this landfill. Landfill No. 2 is currently closed to dumping of wastes.

4.6.2 Sewage Treatment Plant

The Air Force Academy operates a sewage treatment plant for all sanitary wastes. The plant is located along the railroad tracks north of the air strip. The secondary treatment plant consists of primary classifiers, trickling filters, a chlorine contact-basin and anaerobic digesters. The plant does not discharge directly to a stream. The effluent is discharged to the non-potable reservoir system. Prior to 1978 grease collected from the incoming sanitary waste was disposed in the landfill. Currently a contractor disposes of the collected grease. Digested sludge is composted and used as fertilizer throughout the Base. There have been several overflow spills due to pump station breakdowns. When these spills occur the effluent discharges into M-nument Creek. An overflow spill basin has been installed to prevent overflow spillage incidences.

The anaerobic digesters have been emptied for cleaning maintenance twice. The sludge has been spread out across Academy land and mixed into the surface soils. Figure 4-1 indicates the location of the sewage treatment plant and the two known areas where digester sludge has been spread. Over 10 years ago, sediments were dredged from the bottom of the Non-Potable Reservoir No. 1. These dredgings were dumped near the picnic areas along Stadium Boulevard.

Regular sampling and analyses are performed on the effluent and reser oirs. The National Pollution Discharge Elimination System (NPDES) permit for the plant effluent has set units for Biochemical Oxygen Demand (BOD_5), total suspended solids (TSS), pH and chlorine residual (Cl_2R). Review of past data has shown fecal coliform counts in the effluent. All other results have been consistently within the NPDES limitations. The 30 day average fecal coliform results for the past year are provided in Table 4-4.

Prior to the sewage treatment plant, there were 18 septic tanks in use at the A~ademy. All tanks have been closed and are currently not in use.

4.6.3 Incinerator

During the early 1960's an incinerator was used to burn combustible refuse. This incinerator was located in Building 9040. In 1963, the incinerator was determined to be uneconomical to be modified for improved effectiveness and increased capacity. The incinerator was abandoned and all refuse went to the landfill.

There is a small incinerator at the hospital that has been in use since the early 1960's. The incinerator is reported to only used for burnable solid waste from the hospital.

4.7 EVALUATION OF PAST ACTIVITIES

Review of past operations and waste management practices at the U.S. Air Force Academy has resulted in identification of 13 sites of initial environmental concern. Two of these sites are at the Farish Recreation Area; the remaining eleven sites are at the Academy. All sites were evaluated according to the Decision Tree Methodology shown on Figure 1-1. Results of application of the methodology are shown on Table 4-5. Figure 4-4 shows the locations of the sites on the Academy property; sites at Farish are shown on Figure 4-5.

Three fuel spill sites were determined to have little to no potential for contamination and for contaminant migration. This conclusion was based on review of the reported cleanup procedures. Interviews with Academy personnel indicated that cleanup of spills was rapid and effective.

The non-potable reservoirs were considered on the list of areas of initial concern because of the potential buildup of hazardous materials in the sediment. The sewer system discharges to the reservoirs; the water is then pumped from the reservoirs to irrigate developed areas of the Academy.

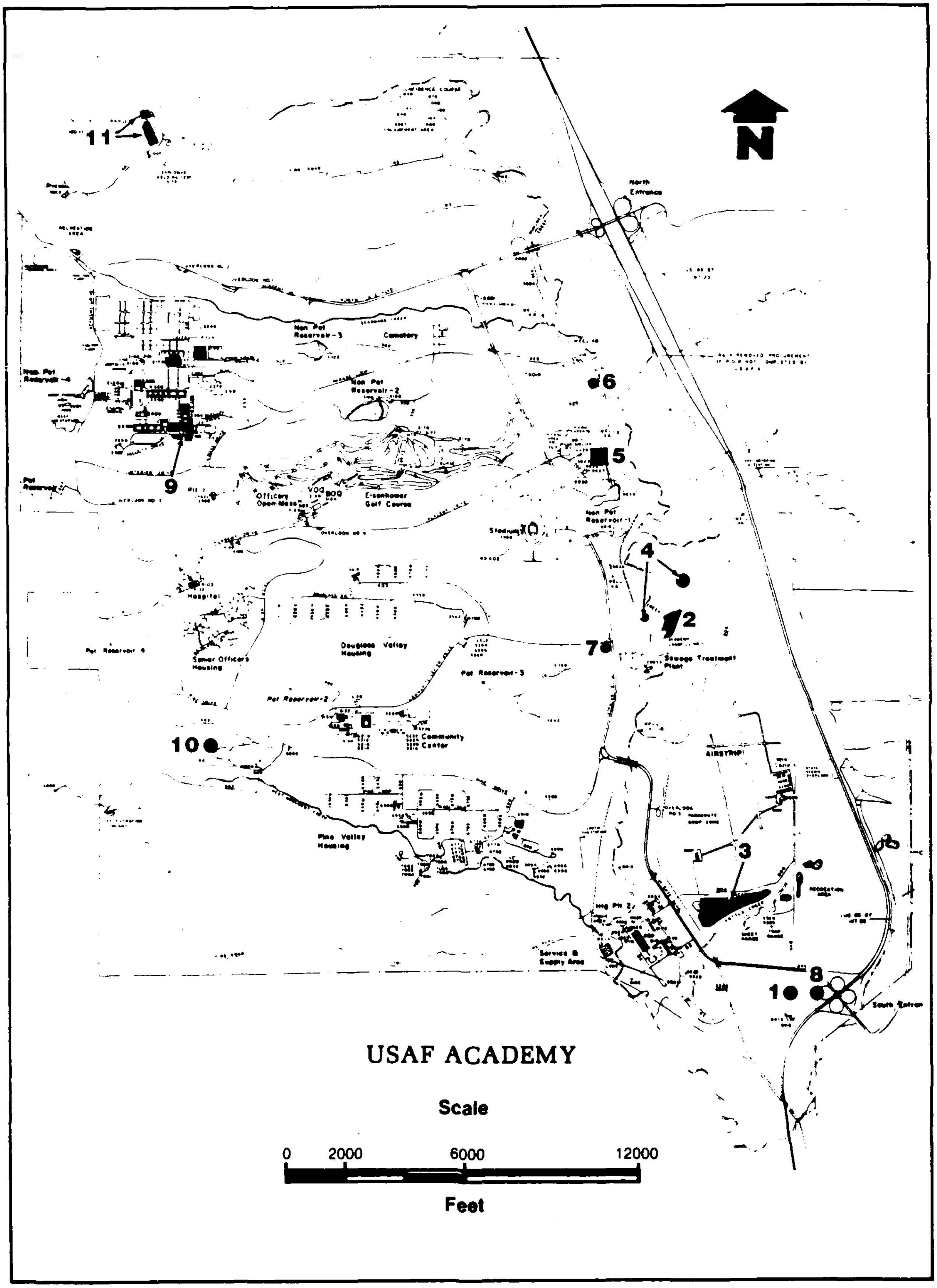


FIGURE 4-4 AREAS OF INITIAL ENVIRONMENTAL CONCERN (SEE TABLE 4-5 FOR SITE NAMES)

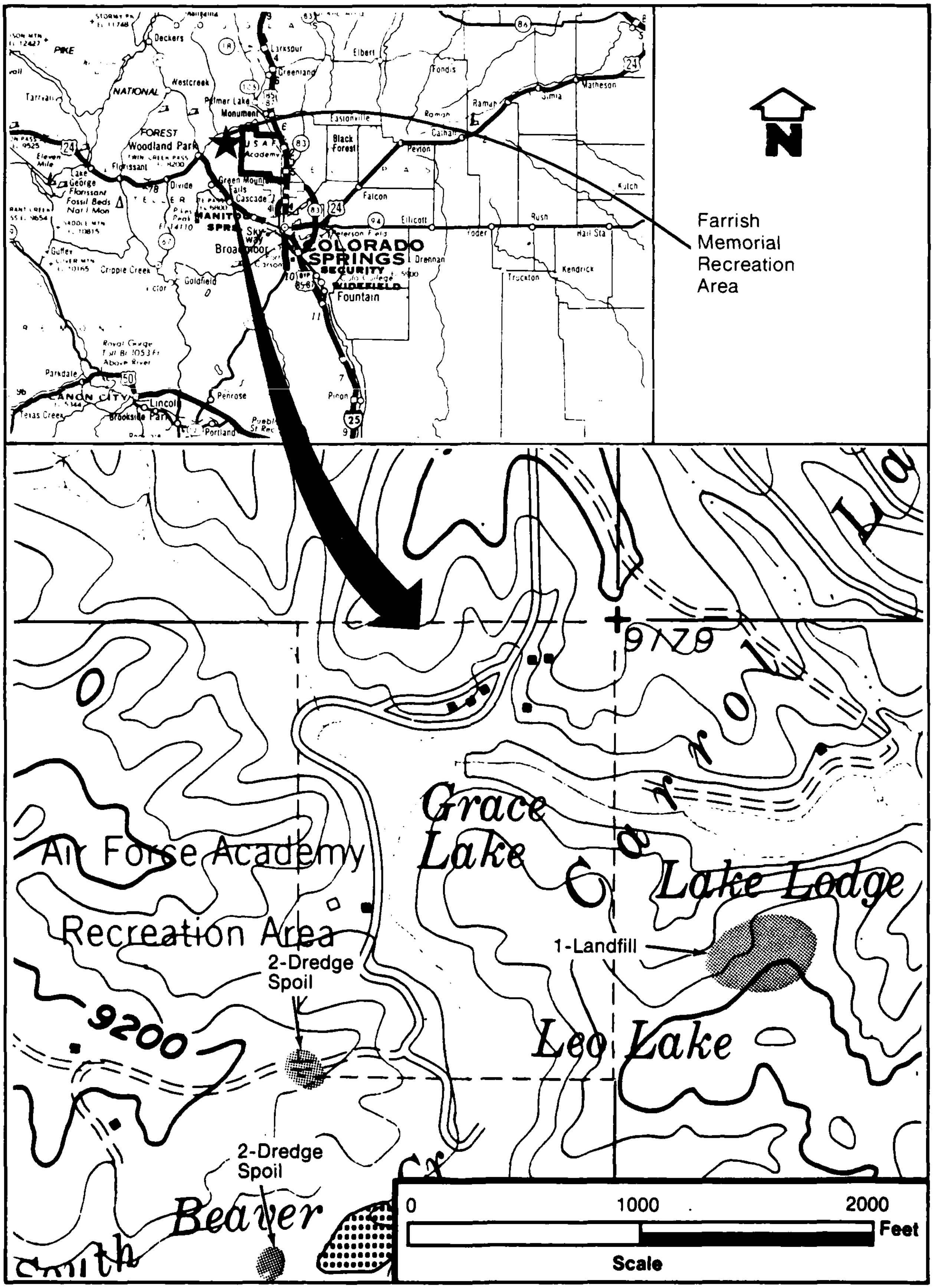


FIGURE 4-5 AREAS OF INITIAL ENVIRONMENTAL CONCERN - FARRISH MEMORIAL RECREATIONAL AREA

Table 4-4

AIR FORCE ACADEMY TREATMENT PLANT EFFLUENT
SUMMARY OF FECAL COLIFORM RESULTS
MONTHLY AVERAGES (JULY 1983 - JUNE 1984)

Month	Fecal Coliform Counts/100 mL
July 1983	2,600
August 1983	12,640
September 1983	16,833
October 1983	12,050
November 1983	33,900
December 1983	32,183
January 1984	69,925
February 1984	16,750
March 1984	17,656
April 1984	19,577
May 1984	17,125
June 1984	7,035

Source: Air Force Academy Records

WESTON

TABLE 4-5

SUMMARY OF FLOW CHART ANALYSIS FOR AREAS OF INITIAL ENVIRONMENTAL CONCERN

Site Description	Map I.D. No.	Potential for Contamination	Potential for Contaminant Migration	Potential for Other Environmental concern	HARM Scores
DISPOSAL SITES					
World War II Waste Disposal Site (Visitors Center)	1	Yes	Yes	Yes	Yes
Landfill #1	2	Yes	Yes	No	Yes
Landfill #2	3	Yes	Yes	No	Yes
Digester Sludge Sites	4	Yes	Yes	Yes	Yes
Dredge Spoil Disposal Site	5	Yes	Yes	No	Yes
SPILLS					
Diesel Spill	6	No	No	No	No
Gasoline Spill	7	No	No	No	No
South Gate Spill Site	8	No	No	No	No
JP-4 Spill	9	Yes	Yes	No	Yes
OTHER					
Fire Training Area	10	Yes	Yes	No	Yes
Firing Range	11	Yes	Yes	No	Yes
Non-Potable Reservoirs	12	Yes	No	Yes	No
FARISH RECREATION AREA					
Dredge Spoil Site	1	Yes	Yes	Yes	Yes
Landfill	2	Yes	Yes	No	Yes

Throughout the history of the Academy waste and very small spills from numerous areas of the Academy have, the academic laboratories in particular, gone into the sewer system. Although the quantities at any one time have not been large, over more than 20 years it is possible that a considerable quantity of hazardous material has accumulated in the ponds. There is no immediate potential for contamination since the reservoirs have concrete and bituminous liners. Because there is no potential for contaminant release the reservoirs were not subjected to HARM score calculation. In Section 6 of this document recommendations are presented for sampling prior to any future dredging of the reservoirs.

The remaining sites identified were determined to have a potential for environmental contamination and migration and were, therefore, evaluated using the Hazard Assessment Rating Methodology (HARM). The HARM process considered the potential contamination receptors, waste characteristics, migration pathways, and waste management practices in use at the site. The details of the system and rating sheets for the individual are presented in Appendix D. The HARM system is designed to indicate the relative need for follow-on action and the resulting ratings are intended for assigning priorities for further investigation in order to more fully evaluate the sites identified. Table 4-6 is a summary of the HARM scores for the site.

TABLE 4-6

SUMMARY OF HARM SCORES

Site	Rank	Site	Map I.D.No.	Receptors Subscore	Waste Characteristics Subscore	Pathways Subscore	Waste Management Factor	Score
1	1	JP-4 Spill Site	9	52	80	54	1	62
2	2	Dredge Spoil Site - Farish	1	75	30	63	1	56
3	3	Landfill - Farish	2	75	30	63	1	56
4	3	Fire Training Area	10	43	54	61	1	53
D-5	4	Dredge Spoil Disposal Site	5	51	40	48	1	46
D-6	5	Landfill No. 1	2	54	24	47	1	42
D-7	5	Landfill No. 2	3	54	24	47	1	42
D-8	6	Digester Sludge Disposal Site	4	54	15	48	1	39
D-9	7	Firing Range	11	43	39	40	1	38
D-10	8	World War II Disposal Site (Visitors Center)	1	62	8	40	1	37

SECTION 5

CONCLUSIONS

5.1 INTRODUCTION

The objective of this Installation Restoration Program (IRP) Phase I study is to identify sites which have the potential for environmental contamination resulting from past waste disposal practices and to determine the potential for contaminant migration from these sites. The conclusions presented in this section are based on review of records and files; interviews with retired and present employees; interviews with federal, state and local agency personnel; field inspections; and consideration of the environmental setting of the U.S. Air Force Academy. Table 5-1 is a list of potential contamination sources identified at the Academy. Site locations are shown on Figures 5-1 and 5-2. Descriptions of each site are presented in the following subsections. Recommendations for follow-on actions are presented in Section 6.

5.2 SITES AT THE U.S. AIR FORCE ACADEMY

5.2.1 JP-4 Spill Site

There is sufficient evidence that the site of the JP-4 spill has the potential for environmental contamination and a follow-on investigation is warranted. The spill occurred on the south side of Building 2140 in 1983. JP-4 is stored in two tanks that are in an open pit in back of the building. The area around the pit is a parking lot. there has been cut and fill in the area since there is a retaining wall south of the pit and parking lot. Figure 5-3 shows the retaining wall and the downgradient area.

The spill occurred during the winter when a pipe broke under the weight of snow and ice. The spill was not noticed until fuel was seen to be staining the snow.

Because the spill was not identified immediately the quantity of fuel that was discharged is not known exactly, but has been estimated to be between 5,000 gallons and 6,000 gallons. Although a cleanup was performed it is probable that a significant amount of fuel infiltrated into the pit bed

TABLE 5-1

SITES EVALUATED USING THE
HAZARD ASSESSMENT RATING METHODOLOGY

Rank	I.D. No.	Site	Operating Period	Score
1	1	JP-4 Spill	1983	62
2*	2	Dredge Disposal Site, Farish	1983	56
2		Landfill - Farish	1975-1983	56
3	2	Fire Training Area	1975-present	53
4	3	Dredged Material Disposal Site	1974	46
5	4	Landfill No. 1	1971-1977 (8)	42
5	4	Landfill No. 2	1960-1972	42
6	6	Digester Sludge Disposal Site	1974	39
7	7	Firing Range	To present	38
8	8	Visitors Center	1940's	37

* Locations Shown on Figure 5-2

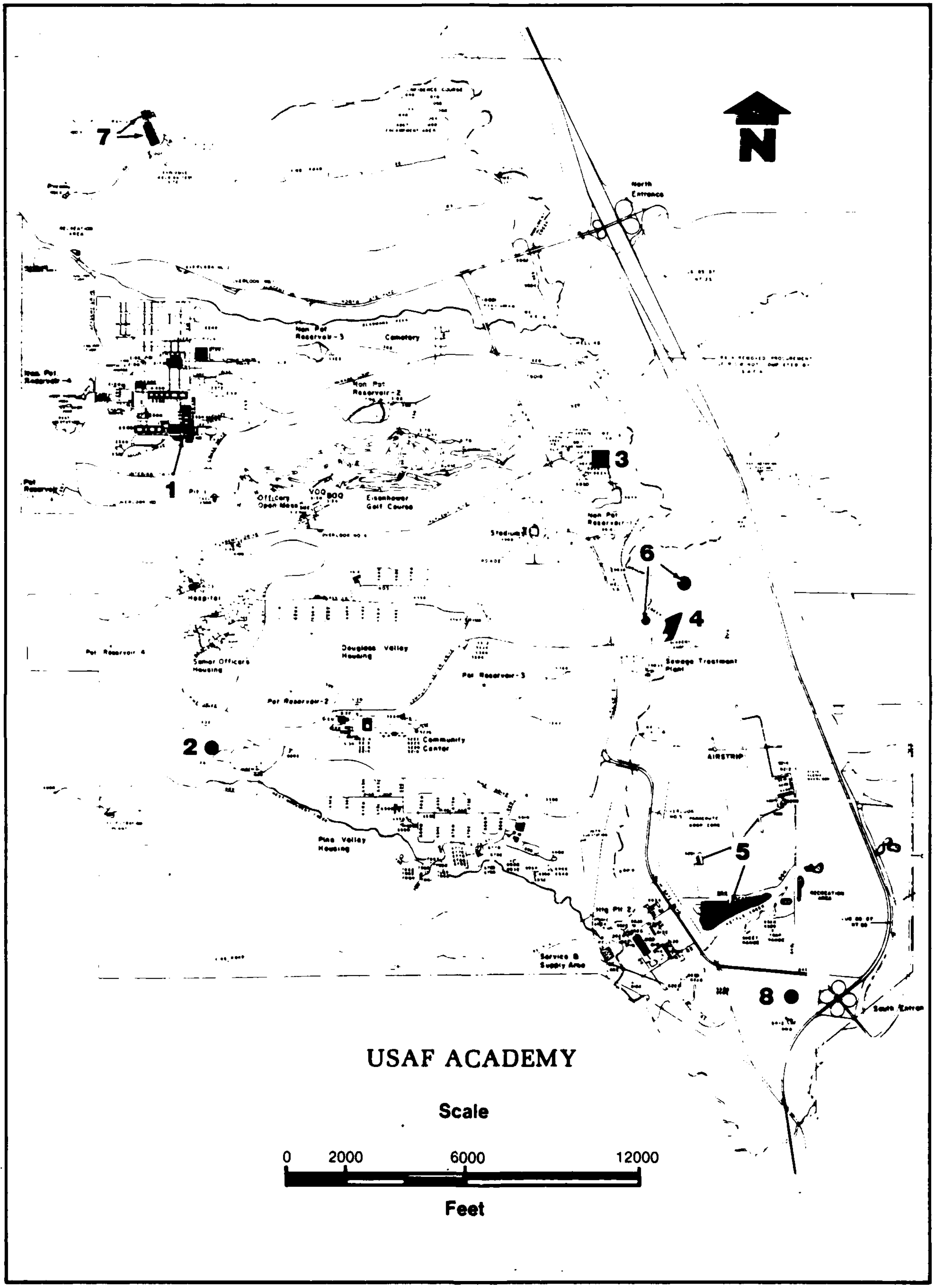


FIGURE 5-1 SITES RATED BY HAZARD ASSESSMENT RATING METHODOLOGY (SEE TABLE 5-1 FOR SITE NAMES)

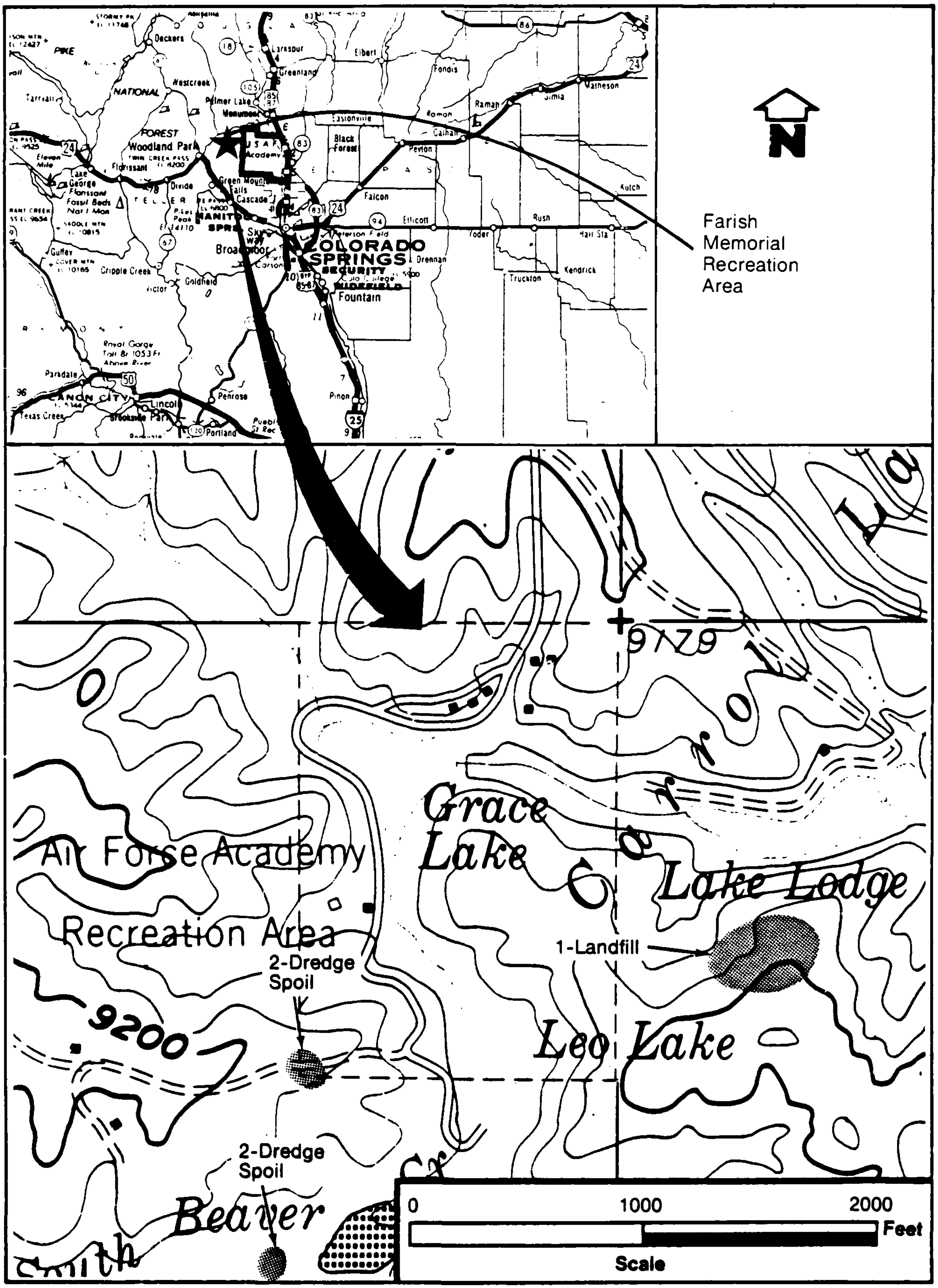


FIGURE 5-2 SITES RATED BY HARM

BUILDING 2140 WITH RETAINING WALL
(VIEW IS TO THE EAST FROM FACULTY DRIVE)

VIEW ALONG RETAINING WALL-SPILL
IS INDICATED BY ARROW

FIGURE 5-3 JP-4 SPILL

prior to discovery of the spill. It has been estimated that 4,000 to 5,000 gallons may remain in the ground in the are of the spill. Because the area has an excess evapotranspiration rate and the spill is relatively recent there is a low probability that the fuel has migrated vertically very far. Lateral migration has been at least temporarily retarded by the retaining wall. However, if residual fuel is allowed to remain in the ground migration will occur

The site received a HARM score of 62.

5.2.2 Fire Protection Training Area

Based on evaluation of data obtained from interviews with Academy personnel there is sufficient evidence to indicate that the Fire Training Area has a potential for environmental contamination. The area, shown on Figure 5-4, has been used since 1975 for fire training. Each year approximately 1,000 gallons of fuel are used, the fuel is primarily JP-4, but solvents of various types have also been used. The training operation consists of flooding the area, pouring the fuel on top of the water, lighting the fuel and extinguishing the fire. The training area has a six-inch clay liner; however, site conditions are such that the integrity of the liner is questionable. Alternating saturation and drying of clay normally creates desiccation cracks in the clay; such cracks would allow water and unbermed fuel and solvent to move through the liner. The soils in the area are deep and well drained with moderate permeability. This condition would facilitate the migration of contaminants, introduced at the surface, through the unsaturated zone to ground water.

As seen on the upper right of Figure 5-4, the land surface south of the training area slopes toward West Monument Creek, which along with ground water, is a potential receptor of contaminants.

The site received a HARM score of 53.

5.2.3 Dredge Spoil Disposal Site

Based on evaluation of Academy records and interviews with Academy personnel, there is sufficient evidence to indicate that this site has the potential for environmental contamination. The site was used once for the disposal of sediment that had been dredged from non-potable reservoir No. 1. As discussed in Section 4, there had been reports of a spill of one to three pounds of mercury into the reservoir prior to dredging of the sediment. The mercury would have been

FIGURE 5-4 FIRE TRAINING AREA (VIEW IS FROM A HELICOPTER)

retained in the sediment and been removed with the sediment in the dredging operation.

In addition to the mercury spill, there is the potential for other hazardous materials in the sediment. Non-potable reservoir No. 1 receives discharge directly from the sanitary sewage treatment plant and, as described previously, small quantities of laboratory wastes are disposed of into the sewer system. Through the years of operation hazardous constituents that have not been removed in the treatment plant would tend to have been concentrated in the sediments in the reservoir.

The site is approximately 750 feet from Monument Creek which would be the receptor for contaminants transported in runoff from the disposal site. Mercury is insoluble, therefore, the path for transport of mercury is would be through erosion and subsequent redeposition in Monument Creek. This would also be expected to be the pathway for migration of other contaminants since it is assumed that only insoluble hazardous constituents would have been concentrated in the sediment in the reservoir.

The site received a HARM score of 46, based on consideration of the suspected laboratory wastes in the dredged material.

5.2.4 Landfill No. 1

Examination of the site and interviews with Academy personnel have provided evidence that the site is a potential source of contamination. The site is located north of the sanitary sewage treatment plant and has been operated since 1972. From 1972 to 1978 the landfill was the only disposal site for solid waste that was generated on the Academy. Since 1978 the site has been used for disposal of rubble and other material. The method of disposal is in trenches approximately 40 feet wide by 30 feet deep by 500 feet. Trenches are excavated by the U.S. Army Corps of Engineers. Reportedly excavation was always stopped prior to reaching the water table. During the site visit, however, an open cell (seen in Figure 5-5) did contain water. It was not possible to determine if the water was impounded runoff or ground water. The rate of waste disposal has been reported at approximately 40,000 cubic yards per year from 1972 to 1978.

The landfill currently has a gate and access for rubble disposal is controlled. However, during the site visit the gate was found to be open and cans of paints and motor oil were observed in the area, as was stained soil.

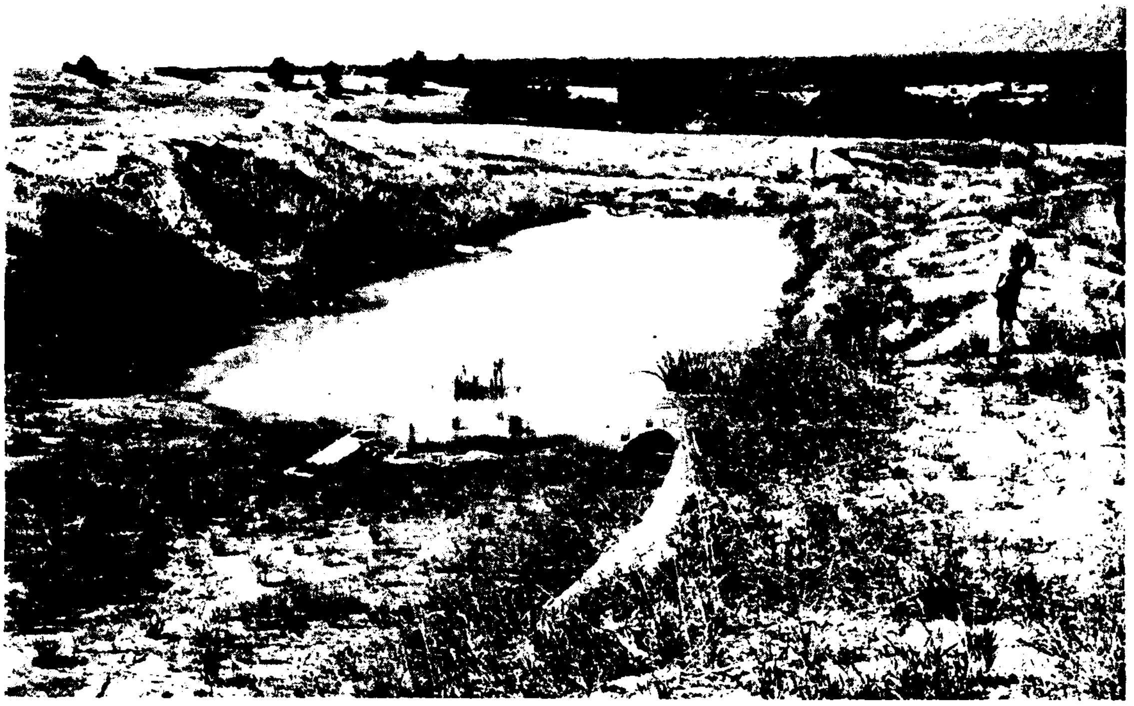


FIGURE 5-5 LANDFILL NO. 1 - OPEN TRENCH

The potential receptors of contamination are ground water and Monument Creek. The site received a HARM score of 42.

5.2.5 Landfill No. 2

Review of information obtained from Academy records and personnel interviews and inspection of the site has indicated the potential for environmental contamination resulting from the site. The site operated from 1960 to 1972. From 1960 to 1965 the primary wastes disposed at the site were nonburnable trash and ash from the incinerator that was located at Building 9040 where all burnable trash was taken. From 1965 to 1972 all trash from the Academy, including saturated adsorbant material and paint, were taken to the landfill. It has also been reported that some digest sludge from the sanitary sewage treatment plant and ash from the hospital incinerator was placed in the landfill. During the period 1965 to 1972 the estimated waste disposal rate was 40,000 cubic yards per year.

The potential contaminant receptors are ground water and Monument Creek. This site received a HARM score of 42.

5.2.6 Digester Sludge Disposal Site

Based on review of liquid waste generation records and operation of the sanitary sewage treatment plant, there is evidence that this site has the potential for environmental contamination. The site is in two parts. The smaller western portion was used approximately 10 years or more ago, the larger eastern site was recently used. These two areas are of concern because of the possibility that hazardous materials placed into the sewer system have been concentrated in the digester sludge. Analysis of the sludge reportedly had been performed; however, the results could not be confirmed.

The potential contaminant receptors from this site are ground water and Monument Creek. This site received a HARM score of 39.

5.2.7 Firing Range

The site includes the impact areas for both the pistol and rifle ranges which contain large amounts of bullets and shells. Based on the use of the sites the potential for environmental contamination by lead does exist. As far as is known, spent ammunition has never been removed from the impact areas. The concern is primarily for lead contamination of soil. There is also a concern for ground-water contamination because ground water at the north end of the Academy has been reported to be acidic.

The site received a HARM score of 38.

5.2.8 Visitors Center Site

This site has been determined to be a potential contaminant source based on interviews with Academy personnel. The potential contaminant predated purchase of the property by the U.S. Air Force. According to the information obtained from interviews the Visitors Center at the Academy was used for munitions related activities during World War II. The interviewees further stated that a small area in a clump of trees north of the Center (Figure 5-6) contained munitions or munitions waste from that operation. Records could not be found prior to 1945 so that the statements could not be verified.

The primary potential receptor for contamination form this site is ground water. The site received a HARM score of 37.

5.3 Sites at Farish Memorial Recreational Area

5.3.1 Landfill

Based on interviews with Academy personnel and consideration of the environmental setting this site has been determined to have a potential for causing environmental contamination. The landfill was operated from 1959 to 1960 and from 1968 to 1971. Material disposed was all trash generated at F-rish including paint and paint thinner. It was reported that approximately 10 years ago a full drum of sodium arsenate was placed in the landfill because the drum was corroded. The location of the site, topographically above Grace Lake and Leo Lake, indicates the potential for transport of contaminants to the lakes.

The site received a HARM Score of 56.

5.3.2 Dredged Material Disposal Site

The primary concern for potential environmental contamination from this two-part site results from the practice of using sodium arsenate and potential for concentration of arsenic in the lake sediments to control algae in the lakes at Farish. The dredged material was removed from the lakes

FIGURE 5-6 WORLD WAR II DISPOSAL SITE -
LOOKING NORTH FROM VISITORS CENTER

on the recreational area. Under low pH conditions arsenic could be mobilized and transported to ground water. The more likely method of contaminants transfer is through erosion of the dredged sediment and transport to surface water bodies.

This site received a HARM score of 56.

SECTION 6

RECOMMENDATIONS

6.1 INTRODUCTION

Ten sites have been identified at the U.S. Air Force Academy as having the potential for causing environmental contamination and warranting follow-on investigations. Two of the sites are located at the Farish Memorial Recreational Area which is located west of the Academy. Recommendations are made for the types of follow-on investigations appropriate to each site. Site locations are shown on Figure 6-1.

The confirmation (Phase II) investigation has been designed to determine if contamination does exist at each site in order to provide data to assess the extent of the hazard associated with each site. The recommended actions are generally limited sampling events with recommendations for additional sampling if the contamination is identified. Table 6-1 summarizes the recommended investigations at each site. At those sites which require installation and sampling of ground-water wells WESTON suggests that the minimum well construction requirements shown on Table 6-2 be used. The recommended analysis parameters for soil/sediment samples and shown on Table 6-3. Recommended analysis parameters for ground water are provided in Table 6-4. It is recommended that the existing wells at the Academy be sampled and analyzed as shown on Table 6-4.

Unless specified in the text the ground-water monitoring wells that are recommended are intended to intercept the water table aquifer. In most cases this will be unconsolidated material. At all sites where analytical results show contamination of this zone, WESTON recommends that additional wells be installed in the Dawson Formation in order to determine the extent of vertical migration of contaminants. Monitor wells in the Dawson should be screened across the full thickness of the uppermost water-bearing zone.

In addition to recommended investigations, WESTON has provided recommendations concerning future land use restrictions at sites where appropriate. These recommendations are applicable to the sites in their present condition and present level of data. Current land use has also been taken into ac-

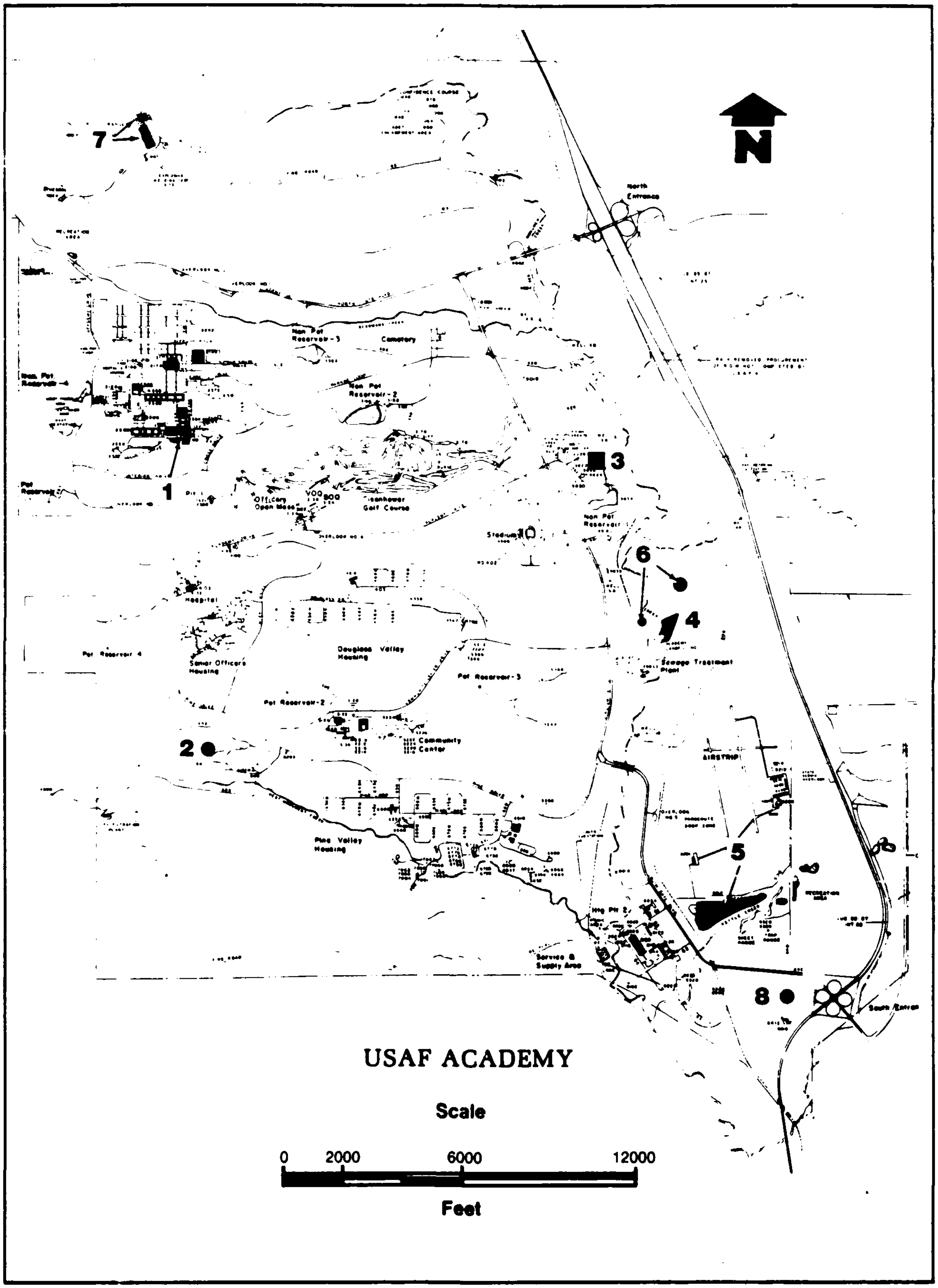


FIGURE 6-1 SITES RATED BY HAZARD ASSESSMENT RATING METHODOLOGY

TABLE 6-1

SUMMARY OF RECOMMENDATIONS
U.S. AIR FORCE ACADEMY

Rank	Site Name	HARM Score	Recommended Monitoring	Analysis List	Comments
1	JP4 Spill	62	Soil sampling at 6 locations.	Table 6-3	
			Install and sample two down-gradient wells. Two rounds of sampling are recommended.	Table 6-4	If oil is found on the water table, additional wells may be needed to determine the extent.
2	Dredged Material Disposal Site -	56	Soil sampling at 9 locations. Sediment sampling in lake.	Table 6.3	If groundwater is found to be be contaminated, additional monitoring is recommended to determine migration.
			Install and sample groundwater monitor wells at four down-gradient locations, and one upgradient location.	Table 6-4	
2	Landfill - Farish	56	Install and sample two ground-water monitor wells. Sample Surface water in two lakes.	Table 6-4	The upgradient well installed for the other dredged material site can be used to provide background data for this site.
3	Fire Training Area	53	Install and sample one upgradi-ent and 2 downgradient wells.	Table 6-4	If confirmation is found in soil, sampling of West Monument Creek sediment is recommended.
			Soil sampling at 3 downslope locations and one upslope lo-cation.	Table 6-3	If groundwater is found to be contaminated, additional sampling may be required.
4	Dredged Material Disppsal Site	46	Soil sampling at 10 locations.	Table 6-3	If soil samples show contamina-tion, then groundwater sampling and sediment sampling in Monument Creek are recommended.

Table 6-1 (cont.)

Rank	Site Name	HARM Score	Recommended Monitoring	Analysis List	Comments
5	Landfill #1	42	Install and sample groundwater monitor wells at one upgradient and four downgradient locations	Table 6-4	If groundwater samples indicate contamination, additional sampling is recommended to determine extent.
5	Landfill #2	42	Same as Above	Table 6-4	Same as Above.
6	Digester Sludge Disposal Site	39	Soil sampling at 12 locations.	Table 6-3	If contamination is found, then groundwater sampling is recommended.
7	Firing Range	38	Install and sample groundwater monitor wells at one upgradient and two downgradient locations.	Table 6-4	
8	Visitors Center	37	Geophysical investigation, followed by installation and sampling of three groundwater wells.	Table 6-4	

Table 6-2

Recommended Minimum Well Construction Requirements

Item	Description
Casing	PVC with nonglue fittings.
Minimum Casing Diameter	Four inches.
Screen	PVC wound with nonglue connectors and bottom cap.
Top of Screen	5 feet above the water table.
Gravel Pack	2 feet above top of the screen.
Bentonite Seal	A 2-foot bentonite seal should be placed above the gravel pack.
Grout	Six to one bentonite/cement mix to 2 feet below surface. Grout emplaced with a grout pipe. Grout pumped through pipe to the bottom of the open annulus (above the seal).
Protective Cover	5-foot length of black iron pipe extending 3 feet above the ground surface and set in cement grout. Pipe diameter must be at least 2 inches greater than casing diameter.
Cap	A secure locking cap should be provided.
Survey	Locations and elevations of all wells should be surveyed.

TABLE 6-3

SOIL/SEDIMENT ANALYSIS PARAMETERS

Site Name / Analysis Parameter	Oil & Grease	Priority Pollutant Metals	Volatile Organic Compounds	Base Neutral Compounds	PCB's
JP4 Spill	X			X	
Dredged Material Disposal Site - Farrish	X	X			X
Fire Training Area	X		X	X	X
Dredged Material Disposal Site	X	X	X	X	X
Digester Sludge Disposal Site	X	X	X	X	X

TABLE 6-4

GROUNDWATER ANALYSIS PARAMETERS

Site Name / Analysis Parameters	Total Dissolved Solids	Volatile Organic Compounds	Total Organic Halogens	Oil and Grease	pH	Base Neutral Compounds	Priority Pollutant Metals	Total Organic Carbon	PCB	TNT Nitroglycerine Nitrocellulose
JP4 Spill	x	x		x	x	x		x		
Dredged Material Disposal Site (Farrish)	x	x		x	x		x	x	x	
Landfill (Farrish)	x	x	x	x	x	x		x		
Fire Training Area	x		x	x	x	x		x	x	
Landfill #1		x	x	x	x	x		x	x	
Landfill #2	x	x	x	x	x	x		x	x	
Firing Range	x				x		x			
Existing Academy Wells	x	x	x	x	x	x	x	x	x	
World War II Disposal Site										x

count in determining available land use options. Additional investigation and/or remedial actions could cause land use restrictions to be removed or increased. Recommended restrictions are discussed in the text and summarized on Table 6-5.

Recommended follow-on investigations are described in the following section. Section 6-3 describes recommended actions for other areas of environmental concern at the Academy.

6.2 RECOMMENDED INVESTIGATIONS

6.2.1 JP-4 Spill

This site has the potential for environmental contamination and monitoring is recommended. Recommended actions include sampling both soil and ground water. Soil samples shall be collected from six locations: three locations within the retaining wall and three locations immediately downslope of the retaining wall. The samples shall be collected from soil borings completed to the water table (a depth of 15 feet is assumed outside the retaining wall and 25 feet inside the retaining wall). Composite samples shall be collected from each five-foot interval and analyzed shown on Table 6-3. The total number of anticipated samples is 24. During drilling of the borings special note should be made of visible fuel or any odors encountered.

Ground-water sampling shall be accomplished by installation of two monitor wells. An upgradient well is not recommended at this time because there are no known sources of JP-4 contamination upgradient of the site and because of the developed condition of the upgradient area. The recommended locations of the two downgradient wells is immediately outside the retaining wall. Soil borings can be extended and used for the completion of the monitor wells. The recommended analysis parameters are shown on Table 6-4. Parameters in addition to oil and grease are included to determine if soluble fractions of the fuel are affecting ground-water quality. Because the water table elevation can be expected to be variable due to the climate at the Academy two ground water sampling rounds are recommended in order to account for the situation of fuel remaining entrained in the soil during periods of low ground water levels. At least one set of samples shall be collected in late spring/early summer when ground-water elevations would be expected to be the highest of the year.

TABLE 6-5

RECOMMENDED LAND USE RESTRICTIONS

Site Name	Restricted Activities
JP4 Spill	Excavation and construction within the area enclosed by retaining wall. Installation of water supply wells. Burning or use of open flame within area enclosed by retaining wall.
Dredged Material Disposal Site - Farrish	Excavation within area; construction on top of material. Installation of water supply wells. Agriculture on material and in vicinity. Use of off-road vehicles.
Landfill - Farrish	Excavating within area; construction on top of material. Installation of water supply wells. Agriculture on material and in vicinity. Use of off-road vehicles. Silviculture on landfill. Burning in vicinity.
Fire Training Area	Excavation in site. Construction on site. Installation of water supply wells. Silviculture on site. Agriculture on site.
Dredged Material Disposal Site	Excavation in site. Construction on site. Installation of water supply wells. Silviculture on site. Agriculture on site. Application of liquids such as for groundwater recharge or storm water retention.
Landfill #1	Excavation in site. Construction on site. Installation of water supply wells. Silviculture on site. Agriculture on site. Application of liquids such as for groundwater recharge or storm water retention.

TABLE 6-5 (cont.)

Site Name	Restricted Activities
Landfill #2	Excavation in site. Construction on site. Installation of water supply wells. Silviculture on site. Agriculture on site. Application of liquids such as for groundwater recharge or storm water retention.
Digester Sludge Disposal Site	Excavation in site. Construction on site. Installation of water supply wells. Silviculture on site. Agriculture on site. Application of liquids such as for groundwater recharge or storm water retention.
World War II Disposal Site	Excavation in site. Construction on site. Burning and use of open flame. Installation of water supply wells.
Firing Range	Excavation in site. Construction on site. Installation of water supply wells.

Neither construction nor excavation should be carried out within the retaining wall area until the extent of fuel in the ground water is determined. Such activities would increase the difficulty of cleanup should it be necessary. Other restrictions shown on Table 6-5 are recommended to insure health land safety and to prevent further contaminant migration.

6.2.2 Dredged Material Disposal Site - Farish

This site, consisting of two proximous areas, has the potential for environmental contamination. Both soil and groundwater sampling are recommended. Each of the nine soil sampling locations consists of a soil boring completed to the water table or bedrock, whichever is encountered first. Sampling procedures are as described in Section 6.^.1. The assumed depth of each boring is 15 feet resulting in 27 samples collected. Three borings shall be in each of the two parts of the site and two borings shall be located downslope from each part of the site. One boring is recommended as a background sampling point; it shall be located out of the runoff path from the dredge material disposal area and the landfill, but shall be in the same soil type as found at the disposal area. Analytical parameters are shown on Table 6-3.

Ground-water monitor wells shall be installed at five locations. One well shall be at a background location. Four wells are recommended downgradient of the site; two downgradient of each part of the site. It is expected that the water table will be encountered in bedrock and a perched water table may exist seasonally at the soil/bedrock interface. It is, therefore, recommended that the wells be screened to allow monitoring of the perched water table and the permanent water table. Installation of two wells within the same borehole is <u>not</u> recommended. Installation of properly sealed multiple screened intervals in the same well is recommended. Analytical parameters for ground-water samples are shown in Table 6-4.

In order to determine if dredged material has been transported back to the lakes and if there is a current build-up of metals in the lake sediments, it is also recommended that three sediment samples be collected from each lake and analyzed for the parameters shown on Table 6.3.

In order to minimize difficulty in accomplishing remedial actions, if necessary, excavation and construction are not recommended at this site. Agriculture is not recommended because of the potential for heavy metal uptake by plants and increased erosion. Similar use of off-road vehicles on the area is not recommended because such use increases erosion. Installation of water supply wells is not recommended due to the potential for increasing contaminant migration.

6.2.3 Landfill - Farish

The site has the potential to cause environmental contamination and, therefore, additional investigation is recommended. Installation of two downgradient monitor wells is recommended to determine if ground-water contamination has occurred. The background well recommended in Section 6.2.2 can be used as a background location for this site. The well construction recommendations are also as described on Table 6-2. It is also recommended that three water samples be collected from each lake to determine if the landfill is impacting surface water quality. Recommended analysis parameters are shown on Table 6-4.

In addition to the land use restrictions recommended for dredged material disposal site, a restriction on silviculture is recommended at the landfill in order to minimize disturbance of the filled material and penetration of the underlying soil by roots.

6.2.4 Fire Training Area

The Fire Training Area has the potential to be a contaminant source; additional investigation is, therefore, recommended. Soil sampling and ground-water sampling are recommended. Four soil sampling locations are recommended. Soil samples shall be taken as composites within five-foot intervals from soil borings to the water table surface as described in Section 6.2.1. Each boring is estimated to be 15 feet for a total of 12 sample locations. Three downslope soil samples are suggested to determine if contaminants have been transported via runoff. One background location is recommended in the same soil type. Analysis parameters are shown on Table 6-3.

Ground-water sampling is recommended at two downgradient locations and one upgradient location. These locations can be coincident with soil boring locations. Well construction is recommended as described in Section 6.2.1. The analysis parameters are shown on Table 6-4. Once again two sampling rounds are suggested in order to account for the effect of seasonal water table fluctuations on migration of petroleum.

The land use restrictions shown on Table 6-5 are primarily to avoid increased transport of contaminants and to minimize difficulty in remedial actions if they are required.

6.2.5 Dredged Material Disposal Site

Evaluation of the available data indicates that this site has the potential for causing environmental contamination, therefore, additional investigation is recommended. Because it is not confirmed that the materials are contaminated a limited investigation is recommended at this time. If contamination is found in soil sampling then installation of one upgradient and two downgradient monitoring wells and sampling of sediment and water in Monument Creek are suggested. These samples should be analyzed for those constituents identified in the soil sample analyses.

Soil sampling is recommended at nine locations within the dredged material and at one background location. Samples shall be collected from soil borings drilled 10 feet below the surface. As described in Section 6.2.1 composite samples are recommended at five-foot intervals; the total number of samples is 20.

The primary objectives in land use restriction recommendations are to avoid later problems in cleanup if necessary and to prevent contaminant migration.

6.2.6 Landfill No. 1

Landfill No. 1 has the potential to be a source of ground-water contamination; additional investigation is, therefore, warranted. Installation of one upgradient and four down-gradient wells is recommended. Well construction guidelines are shown on Table 6-2. Analysis parameters for ground-water samples are shown on Table 6-4.

As previously stated, if ground-water contamination is identified, additional monitor wells should be installed in the Dawson Formation to determine the extent of vertical migration and the potential threat to off-Base water supply sources.

Land use restrictions indicated on Table 6-5 are intended to minimize migration from the site. It is particularly critical to avoid application of water to the site surface, including irrigation. Because of the climate of the Academy area there is minimal driving force for leachate generation and migration. Application of liquid to the site would provide such a driving force.

6.2.7 Landfill No. 2

This landfill also has the potential for causing ground-water contamination. The recommendations for sampling and analysis at this site are identical to those for L-ndfill No. 1. The recommendations for land use restrictions are also identical to those identified for Landfill No. 1.

6.2.8 Digester Sludge Disposal Site

Evaluation of data relating to use and operation of the sanitary sewage treatment plant indicates that this site has the potential to be a contaminant source, therefore, additional investigation is warranted. The digester sludge has not, however, been confirmed as contaminated; therefore a limited investigation is recommended to make this determination. Should the contaminants be identified then installation of an upgradient and three downgradient monitor wells is recommended. These wells should be sampled for contaminants identified in the soil sampling effort.

Collection of soil samples is recommended at one background location, five locations in the smaller portion of the site and six locations in the larger portion. Each soil boring shall be completed to 10 feet below land surface and will provide two samples composited from two five-foot intervals. Recommended analytical parameters are shown on Table 6-3.

Land use restrictions are recommended to minimize contaminant transport.

6.2.9 Firing Range

This site has the potential to be a source of ground-water contamination and further investigation is recommended.

Installation of a background monitoring well and two downgradient wells is recommended. Well construction guidelines are shown on Table 6-2 and sampling parameters are shown on Table 6-4.

Soil sampling is not recommended at this location, because the firing range is still in use and therefore spent ammunition is still accumulating. It is recommended that soil sampling be conducted as part of closure of the firing range should the range be taken out of service.

L-nd use restrictions are recommended to prevent further migration of contaminants.

6.2.10 Visitors Center Site

Evidence from personnel interviews suggests that this site may be a potential hazard and source of contamination and follow-on investigation is recommended. Since the type of munitions related waste that may be present is not known it is recommended that geophysical surveys be conducted to determine if there are shells or ordnance in the area. A combination of electromagnetic conductivity, magnetometer and metal detector is recommended. It is recommended that three ground water wells be constructed outside the boundary of the site, and that these wells be sampled for the parameters shown on Table 6-4.

Land use restrictions are recommended to prevent disturbance of the area until it is determined if the site is a potential hazard.

6.3 RECOMMENDATIONS

Based on WESTON's review of the Academy activities there are three areas of environmental concern for which recommendations have been developed. There are described in the following subsections.

6.3.1 Tanks

There are a number of storage tanks on the Academy grounds. Some tanks have been taken out of service, the majority remain in service. The most reliable data available are from undated inventory forms which indicate whether or not specific tanks have corrosion protection. As far as is known, none of the tanks have been leak tested. In addition, soils for portions of the A~ademy are known to be corrosive. It is, therefore, recommended that all underground and in-ground tanks be leak tested as soon as possible and that a regular testing and inspection program be initiated and maintained. I~ any tank should fail the testing procedure the area around the tank should be examined and sampled to determine if a discharge has occurred.

6.3.2 Non-Potable Reservoirs

As described in Section 5 Reservoirs 1, 2, 3 and 4 receive discharge from the treatment plant creating the potential for concentration of hazardous constituents in the sediment in these reservoirs. WESTON, therefore, recommends that prior to removal of sediment from Reservoirs 1, 2, 3 and 4 sediment samples be collected on 50-foot centers. The suggested analysis parameters are the Priority Pollutants. The whole list is recommended because of the variety of materials that have been discharged to the sewer system.

6.3.3 Irrigated Areas

As described on Figure 3-7 water from the non-potable water reservoirs is used to irrigate the Academy grounds. There is potential for some constituents, in small quantities, to have passed through the treatment system. Irrigation, combined with the high evapotranspiration rate at the Academy could result in buildup of metals in the soil. It is, therefore, recommended that existing soil sampling programs conducted to determine land management needs be expanded. The suggested expansion is inclusion of analysis for priority pollutant metals in all irrigated areas.

APPENDIX A

RESUMES OF WESTON PROJECT TEAM

KATHERINE A. SHEEDY
PROJECT MANAGER

Fields of Competence

Geologic investigation and site evaluation; environmental impact assessment, quantitative and qualitative groundwater analysis; design of groundwater monitoring systems.

Experience Summary

Nine years experience in geological investigations including environmental impact analysis in geology, groundwater, and soils; hydrogeologic investigations of hazardous waste sites, preparation and delivery of expert testimony; assessment and mitigation of low-level radioactive contamination of groundwater and soils; migration of radionuclides in groundwater; site stability in limestone terrains; development of evaluation criteria for site search and selection projects; pre-mine opening hydrologic investigations for surface and underground coal mines; development of clean-up strategies for hazardous and radioactive waste disposal sites; Environmental Impact Statement preparation and review; site suitability investigations of waste disposal facilities for industrial and residential developments.

Credentials

B.A., — Queens College, CUNY (1969)

M.S., Geology — University of Delaware (1975)

American Geophysical Union

Geological Society of America

National Water Well Association - Technical Division

Employment History

1974-Present	WESTON
1972-1974	University of Delaware

Key Projects

Preparation of RCRA Part B permit application for facilities in the Midwest and on the West coast.

Project Manager for NACIP Confirmation Study at Alleghany Ballistics Laboratory.

Principal Investigator and team leader for initial assessment studies at NAS Brunswick and the Portsmouth Naval Shipyard, Maine.

Project Manager for Phase I, IRP studies at four Air Force Reserve facilities and the Air Force Academy.

Professional Profile

Groundwater consultant for a state-of-the-art assessment of TCE removal from groundwater for the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA).

Principal Geologist on an R&D project for USATHAMA to develop lagoon closure guidelines for lagoons comtaminated with explosives residue.

Project Manager and Principal Investigator for: locating, investigating, assessing, and cleanup of a site contaminated by pharmaceutical wastes; supervisory of a leachate collection system and groundwater monitoring program for an industrial landfill.

Assessment of groundwater contamination from a municipal landfill in the Atlantic Coastal Plain including aquifer simulation to determine migration 10, 20, and 30 years in the future.

Hydrogeologic assessment of a multi-source military installation. the project includes groundwater modeling for the installation and for areas outside the installation in conjunction with State and Federal agencies.

Design of monitoring systems for a large industrial complex in Montana.

Assessment of regulatory requirements for hazardous waste lagoon closure in over forty states.

Assessment and analysis of emerging trends in groundwater research as applied to the utility industry.

Preparation of EPA Remedial Action Master Plans for five uncontrolled hazardous waste sites.

Principal investigator for geology, soils and groundwater portion of an Environmental Impact Statement for the decontamination of a radioactive waste disposal site in Canonsburg, Pennsylvania.

Project manager and principal investigator on clean-up of a site contaminated by pharmaceutical wastes in New Jersey.

Project manager and principal investigator for assistance in EIS preparation for five synthetic fuel plants in east-central United States.

Evaluation of environmntal impact and operation of 23 municipal landfills in the Atlantic Coastal Plain.

Hydrogeologic investigations at mine sites prior to, during, and after mining operations in Illinois.

Hydrogeologic investigations to determine site suitability for landfills, sewage sludge disposal, spray irrigation and industrial waste disposal.

Principal investigator on a dredge material disposal site feasibility study for Interstate Division for Baltimore City. This project was conducted to evaluate the feasibility of specific sites for disposal of 5 million cu yds of material dredged from the Fort McHenry Tunnel in Baltimore. The evaluation included examination of costs, engineering feasibility, site stability, impact on biology and groundwater and ultimate use of the site as an inner-city park.

Supervision of an investigation to determine groundwater quality, delineate the extent of groundwater pollution and develop a groundwater-quality management program for a six-county area. Evaluated the adequacy of existing groundwater-quality standards and interacted with regulatory agencies.

Evaluation of groundwater quality, quantity and facilities; impact on groundwater for sites in semi-arctic environments and within the Columbia River Basin Project area.

Environmental assessment for a 200,000-BPCD refinery on a semi-arid island with extensive groundwater use in the West Indies.

Evaluation of structural stability problems in limestone solution area in Pennsylvania.

Supervision of a leachate collection system and groundwater monitoring program for an industrial landfill.

Investigation of potential sources of petroleum product found to be discharging through the subsurface, at the shore of Lake Erie.

Development of a state-of-the-art study and environmental analysis of the geothermal steam industry.

Publications

Sheedy, K.A., 1979, Three-Phase Approach to Determination of Site Stability in Limestone: presented at Association of Engineering Geologists 1979 Annual Meeting, Chicago, Illinois.

Sheedy, K.A., Schoenberger, R.J., Haderer, P., Dovey, R., 1979, Solid Waste Disposal in the Coastal Plain: A Case Study: presented at Association of Engineering Geologists 1979 Annual Meeting, Chicago, Illinois.

Sheedy, K.A., Leis, W., Thomas, A., 1980, Land Use in Limestone Terrain, Problems and Case Study Solutions. In Applied Geomorphology, (The "Binghamton" symposia; 11) George Allen and Unwin, 1982.

Sheedy, K.A., Leis, W., Bopp, F., Anderson, J., "Use of Ground Penetrating Radar in Limestone Terrain." American Geographers Association, 1981

Sheedy, K.A., "Methodology for the Selection of Low-Level Radioactive Waste Disposal Sites." American Nuclear Society, 1982.

JOHN A. GILBERT

Fields of Competence

Industrial and hazardous waste site surveys, chemical analysis and assessments, research and development of treatability studies.

Experience Summary

Experience in industrial and hazardous waste inventories, site surveys, treatability studies, waste management planning and evaluations of compliance of facilities with RCRA regulations. Past assignments include direction of analytical/research laboratory facilities and detailed responsibility for experimental set-up and practical problem solving. Substantial experience in the chemical analysis of water, wastewater and solid/hazardous waste materials.

Credentials

B.A., Chemistry -- Williams College (1978)

M.S., Civil Engineering, Environmental Health Engineering Program -- Tufts University (1980)

American Chemical Society

New England Water Pollution Control Association

Water Pollution Control Federation

Employment History

1980-Present	WESTON
1979-1980	National Council for Air and Stream Improvement Project Analyst
1978-1980	Tufts University Teaching Assistant
1979	Energy Resources Company, Inc. Laboratory Analyst
1977-1978	Williams College Research Assistant

Key Projects

Completed a site survey of metal hydroxide sludge lagoons for Texas Instruments and developed a plan for monitoring groundwater for leachate contamination and for capping and final closure of the site.

Conducted a hazardous waste site survey for The Mearl Corporation and evaluated compliance of the existing facilities with current RCRA regulations.

Carried out hazardous waste site survey and developed hazardous waste management plan for Portsmouth Naval Shipyard. Work included evaluation of

Professional Profile

hazardous waste treatability and a complete analysis of the impact of current RCRA regulations.

Compiled and analyzed information on statewide generation and disposal of hazardous wastes for the Maine Task Force on Hazardous Waste Facilities. Project included identification and evaluation of waste treatment and storage and disposal facilities within the New England region.

Responsible for data analysis for a foaming study on the Androscoggin River, Maine.

Responsible for the analysis of organic and trace metal constituents of water and wastewater.

Managed and directed analytical/research laboratory. Responsible for teaching and supervision of laboratory course.

Conducted evaluation of hazardous waste management facilities and procedures for a confidential client, including an assessment of compliance with RCRA regulations. Follow-on job included development of a management system and concept design of a hazardous waste storage building.

Determined siting and supervised drilling of groundwater monitoring wells for K.J. Quinn Company. Project included development of soil and water sampling and testing procedures to develop a profile of the extent of groundwater contamination.

Conducted preliminary identification, testing and grouping of unknown wastes in large drum storage site for Maremont Corporation to reduce number and costs of detailed laboratory analysis required. Project included development of disposal alternatives based on waste identifications.

<u>Publications</u>

"Evaluation of An Asymmetric Rotor Approximation."

DAVID J. RUSSELL

Registration

Engineer-in-Training in the State of Pennsylvania

Fields of Competence

Wastewater treatability studies; municipal and industrial wastewater sampling; wastewater treatment plant operations; monitor and control analyses for plant performance and operations; biodegradation studies.

Experience Summary

Four years experience in environmental engineering. Primary experience has been in concept engineering and process development specifically in the areas of hazardous waste, soil decontamination, wastewater treatability studies, bench-scale modeling of industrial wastewater treatment systems, and fate and effects studies.

Execution of static aquatic bioassays; RCRA testing to include EP toxicity and ignitability testing; establishment and operation of standardized bench-scale tests for biodegradability and anaerobic digestion inhibition; water quality sampling of rivers and streams.

Credentials

B.S., Environmental Engineering — Temple University (1980)

National Society of Professional Engineers

American Red Cross Certification in Cardiopulmonary Resuscitation (CPR)

Basic life support course in Self-Contained Breathing Apparatus (SCBA)

Safety planning training

Employment History

1981-Present	WESTON
1980-1981	Hatfield Township Municipal Authority
1979	Environmental Protection Agency

Key Projects

Participated in legislation (literature) searches for regulations data referring to soil, contamination and groundwater at two Army installations under WESTON's existing USATHAMA R&D contract.

Team Leader on a project at Brunner Island Unit 3, responsible for conducting particulate and SO_x tests at one of four sites sampled concurrently for Pennsylvania Power and Light Company, Hazleton, Pennsylvania.

Professional Profile

Team Leader responsible for conducting particulate, SO_x, and scrubber liquor entrainment tests during programs at Eddystone Units 1 and 2 for Philadelphia Electric Company, Philadelphia, Pennsylvania.

Assistant Project Scientist for a bench-scale modeling study of an industrial treatment system being evaluated for upgrading of cyanide and chromium removal.

Assistant Project Scientist for establishment, certification, and operation of a standardized test for screening the anaerobic digestion inhibition potential of materials prior to introduction to commerce.

Assistant Project Scientist for execution of static bioassays for a pharmaceutical firm as part of NPDES compliance testing.

Participant in large-scale review of NPDES permit and compliance information for a West Virginia coal mine.

Project Scientist for preparation and execution of RCRA testing to include EP toxicity and equitability for a variety of clients.

Participant in large-scale water quality sampling project along 35 miles of a Pennsylvania river for three Pennsylvania power utilities.

APPENDIX B

LIST OF INTERVIEWEES

APPENDIX B

LIST OF INTERVIEWEES

Position	Area of Knowledge	Years of Service
Civilian	Grounds	3
Civilian	Seiler Laboratory	14
NCO	Seiler Laboratory	3
Civilian	Doss Aviation	8
Civilian	Pesticide	27
Fireman	Fire Department	26
NCO	Hospital	3
Civilian	Pesticide	27
Commissioned Officer	Seiler Laboratory	3
Civilian	Aviation	
Civilian	Landfill Operations	24
Civilian	Pesticide	20 +
Civilian	Engineering	16
Civilian	Forestry	3
Civilian	Farrish	10
Civilian	Vehicle Maintenance	20
Commissioned Officer	Base Engineering	7.5
Civilian	Forestry	2
Civilian	Water/Wastewater Treatment	15
NCO	Fuel Supply	2
NCO	Munitions Storage	<3
Civilian	Engineer (Retired)	24
Civilian	Photo Lab	<1
Civilian	Fuels	2
Civilian	Wastewater Treatment Plant	15
Civilian	Academy History	>3
Civilian	Land Aquisition	>3
Civilian	Hazardous Waste Disposal	5
Commissioned Officer	Chemistry Department	>5
Commissioned Officer	Biology Department	5
Civilian	DPDO at Ft. Carson (employee)	10
NCO	Landfill Operations	<3
Civilian	Landfill Operations	>20

APPENDIX C

LIST OF OUTSIDE AGENCIES CONTACTED

WESTON

APPENDIX C

LIST OF OUTSIDE AGENCIES CONTACTED

Jim Beyers
National Archives and National Records Center
Research Assistance and Information
Washington, D.C.
(202) 523- 3218

Steve Bern
Records Officer
Washington National Records Center
Suitland, Maryland
(301) 763-1710

Bill Lewis
Washington Natinal Records Center
Suitland, Maryland
(301) 763- 1710

Mr. Eldridge
Army Records Office
(703) 325-6179

Ed Reese
Records Officer
Military Archives Division
Modern Military Headquarters Branch
Washington, D.C.
(202) 523- 3340

Grace Rowe
Air Force Records Management
Air Force Rcords
Washington, D.C.
(202) 694- 3527

Soil Scientist
Colorado Soil Consevation Service
Colorado Springs, Colorado
(303) 473- 7104

APPENDIX C (cont.)

Mr. Al Hornebaker
U.S. Geological survey
Colorado Springs, Colorado
(303) 866- 2611

Mr. Ted Hurr
Water Resources Division
Colorado District
U.S. Geological Survey
Denver, Colorado
(303) 236- 4882

Mr. Mark Van Nostrand
Camp, Dresser & McKee
Denver, Colorado
(303) 458- 1311

Mr. Sidney Wood
Mark Hurd Aerial Surveyors
Minneapolis, Minnesota
(612) 545- 2583

Mr. Hugland
Water Resources Division
Colorado District
U.S. Geological Survey
Denver, Colorado
(303) 236- 4882

Mr. John Ebling
Water Resources Division
Colorado District
U.S. Geological Survey
Denver, Colorado
(303) 234- 4890

Mr. Kim Hedley
El Paso County Water Resources
Colorado Springs, Colorado
(303) 471- 5742

APPENDIX D1

HAZARD ASSESSMENT RATING METHODOLOGY

APPENDIX D

USAF INSTALLATION RESTORATION PROGRAM
HAZARD ASSESSMENT RATING METHODOLOGY

BACKGROUND

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

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

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

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

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

PURPOSE

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

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

DESCRIPTION OF MODEL

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

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

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

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

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

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

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

FIGURE 1

HAZARD ASSESSMENT RATING METHODOLOGY FLOW CHART

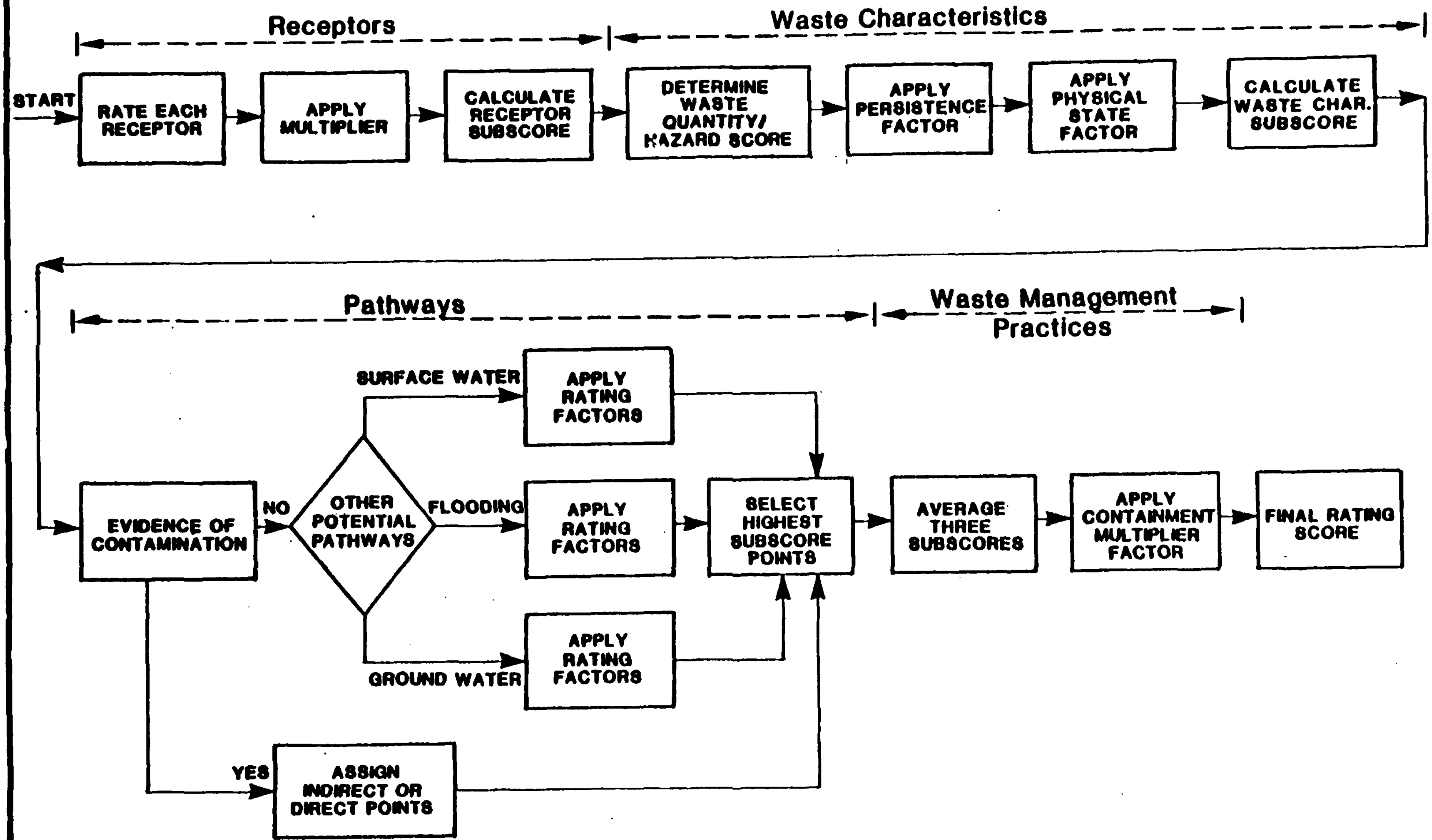


FIGURE 2

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

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

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:

<u>Landfills:</u>

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

<u>Spills:</u>

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

<u>Surface Impoundments:</u>

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

<u>Fire Proection Training Areas:</u>

- 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.

TABLE 1 (Continued)

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

III. PATHWAYS CATEGORY

A. Evidence of Contamination

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

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

B-1 POTENTIAL FOR SURFACE WATER CONTAMINATION

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

B-2 POTENTIAL FOR FLOODING

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

B-3 POTENTIAL FOR GROUND-WATER CONTAMINATION

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

APPENDIX D2

Site HARM Score Calculations

FIGURE 2

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE Visitors Center - Site 1 on Figure 4.4

LOCATION Clump of trees north of Visitors Center

DATE OF OPERATION OR OCCURRENCE Prior to Academy purchase, World War II

OWNER/OPERATOR Unknown

COMMENTS/DESCRIPTION Exact nature of the waste is unknown, but is rel munitions.

SITE RATED BY Sheedy

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	2	3	6	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	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
		Subtotals	111	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 62

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

LTNT Used 40 x .4 = 16

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

16 x .5 = 8

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.

No direct evidence — 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	1	8	8	24
Net precipitation	1	6	6	18
Surface erosion	1	8	8	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
Subtotals			36	108

Subscore (100 X factor score subtotal/maximum score subtotal) 33

2. Flooding

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

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	2	8	16	24
Net precipitation	1	6	6	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	1	8	8	24
Subtotals			46	114

Subscore (100 x factor score subtotal/maximum score subtotal) 40

C. Highest pathway subscore.

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

Pathways Subscore 40

IV. WASTE MANAGEMENT PRACTICES

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

Receptors	62
Waste Characteristics	8
Pathways	40

Total 110 divided by 3 = 37 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

37 x 1 = 37

FIGURE 2

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE LANDFILL #1

LOCATION Near Sewage Treatment Plant

DATE OF OPERATION OR OCCURRENCE 1972-78

OWNER/OPERATOR US AFA

COMMENTS/DESCRIPTION Used for all Academy trash, now used for rubble

SITE RATED BY SHEEDY

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	0	3	0	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	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
		Subtotals	97	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 54

II. WASTE CHARACTERISTICS (Paint and paint thinners were used)

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) L

Factor Subscore A (from 20 to 100 based on factor score matrix) 30

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

30 x .8 = 24

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

24 x 1 = 24

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 0

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

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	1	6	6	18
Surface erosion	2	8	16	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
		Subtotals	52	108

Subscore (100 X factor score subtotal/maximum score subtotal) 48

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

Subscore (100 x factor score/3) 33

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	2	8	16	24
Net precipitation	1	6	6	18
Soil permeability	2	8	16	24
Subsurface flows	1	8	8	24
Direct access to ground water	1	8	8	24
		Subtotals	54	114

Subscore (100 x factor score subtotal/maximum score subtotal) 47

C. Highest pathway subscore.

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

Pathways Subscore 48

IV. WASTE MANAGEMENT PRACTICES

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

Receptors	54
Waste Characteristics	24
Pathways	48
Total 126 divided by 3 =	42 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

42 x 1 = 42

FIGURE 2

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE LANDFILL #2

LOCATION SOUTH OF AIRFIELD

DATE OF OPERATION OR OCCURRENCE 1960-1972

OWNER/OPERATOR USAFA

COMMENTS/DESCRIPTION From 1965 to 1972 all solid waste from Academy went in landfill.

SITE RATED BY SHEEDY

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	1	6	6	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	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
		Subtotals	97	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 54

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) L

Factor Subscore A (from 20 to 100 based on factor score matrix) 30

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

30 x .8 = 24

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

24 x 1 = 24

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	1	8	8	24
Net precipitation	1	6	6	18
Surface erosion	2	8	16	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
Subtotals			44	108

Subscore (100 X factor score subtotal/maximum score subtotal) 41

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

Subscore (100 x factor score/3) 33

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	2	8	16	24
Net precipitation	1	6	6	18
Soil permeability	2	8	16	24
Subsurface flows	1	8	8	24
Direct access to ground water	1	8	8	24
Subtotals			54	114

Subscore (100 x factor score subtotal/maximum score subtotal) 47

C. Highest pathway subscore.

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

Pathways Subscore 47

IV. WASTE MANAGEMENT PRACTICES

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

Receptors	54
Waste Characteristics	24
Pathways	47

Total 125 divided by 3 = 42 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

42 x 1 = 42

FIGURE 2

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE DIGESTER SLUDGE DISPOSAL SITE

LOCATION North of Sewage Treatment Plant

DATE OF OPERATION OR OCCURRENCE 1974 and 1982-83

OWNER/OPERATOR USAFA

COMMENTS/DESCRIPTION Site is in two parts, each used only once.

SITE RATED BY Sheedy

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	0	3	0	9
D. Distance to reservation boundary	1	6	6	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	2	6	12	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
		Subtotals	97	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 54

II. WASTE CHARACTERISTICS (Residual metals were used for rating)

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) L

Factor Subscore A (from 20 to 100 based on factor score matrix) 30

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

30 x 1 = 30

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

30 x .5 = 15

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	2	8	16	24
Net precipitation	1	6	12	18
Surface erosion	2	8	16	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
Subtotals			52	108

Subscore (100 X factor score subtotal/maximum score subtotal) 48

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

Subscore (100 x factor score/3) 33

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	2	8	16	24
Net precipitation	1	6	6	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	1	8	8	24
Subtotals			46	114

Subscore (100 x factor score subtotal/maximum score subtotal) 40

C. Highest pathway subscore.

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

Pathways Subscore 48

IV. WASTE MANAGEMENT PRACTICES

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

Receptors 54
Waste Characteristics 15
Pathways 48

Total 117 divided by 3 = 39
Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

39 x 1 = 39

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE: DREDGE SPOIL DISPOSAL SITE

LOCATION: NORTHEAST PORTION OF ACADEMY

DATE OF OPERATION OR OCCURRENCE: APPROXIMATELY 1974

OWNER/OPERATOR: USAFA

COMMENTS/DESCRIPTION: ONE TIME USE - FOR DREDGE SPOIL FROM NON-POTABLE RESERVOIR

SITE RATED BY: SHEEDY

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	0	3	0	9
D. Distance to reservation boundary	1	6	6	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	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
Subtotals			91	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 51

II. WASTE CHARACTERISTICS (Laboratory chemicals are considered to be worst case.)

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 1 = 40

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

40 x 1 = 40

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	2	8	16	24
Net precipitation	1	6	6	18
Surface erosion	2	8	16	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
Subtotals			52	108

Subscore (100 X factor score subtotal/maximum score subtotal) 48

2. Flooding

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

Subscore (100 x factor score/3) 33

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water	2	8	16	24
Net precipitation	1	6	6	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	1	8	8	24
Subtotals			46	114

Subscore (100 x factor score subtotal/maximum score subtotal) 40

C. Highest pathway subscore.

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

Pathways Subscore 48

IV. WASTE MANAGEMENT PRACTICES

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

Receptors	51
Waste Characteristics	40
Pathways	48

Total 139 divided by 3 = 46 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

46 x 1 = 46

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE JP4 SPILL

LOCATION SOUTH SIDE OF BLDG. 2410

DATE OF OPERATION OR OCCURRENCE 1983

OWNER/OPERATOR USAFA

COMMENTS/DESCRIPTION Quantity of spill - 5,000 to 6,000 gals.

SITE RATED BY Sheedy

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	1	10	10	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	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
		Subtotals	94	180

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

II. WASTE CHARACTERISTICS

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

1. Waste quantity (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 .8 = 80

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

80 x 1 = 80

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	0	8	0	24
Net precipitation	1	6	6	18
Surface erosion	0	8	0	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
Subtotals			20	108

Subscore (100 X factor score subtotal/maximum score subtotal) 19

2. Flooding

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

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	2	8	16	24
Net precipitation	1	6	6	18
Soil permeability	2	8	16	24
Subsurface flows	1	8	8	24
Direct access to ground water	2	8	16	24
Subtotals			62	114

Subscore (100 x factor score subtotal/maximum score subtotal) 54

C. Highest pathway subscore.

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

Pathways Subscore 54

IV. WASTE MANAGEMENT PRACTICES

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

Receptors	52
Waste Characteristics	80
Pathways	54

Total 186 divided by 3 = 62 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

62 x 1 = 62

FIGURE 2

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE FIRE TRAINING AREA

LOCATION WEST OF BLDG. 6102

DATE OF OPERATION OR OCCURRENCE SINCE 1975

OWNER/OPERATOR USAFA

COMMENTS/DESCRIPTION 1200 gals. of fuel per year, includes solvents

SITE RATED BY Sheedy

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	1	10	10	30
C. Land use/zoning within 1 mile radius	0	3	0	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	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
		Subtotals	77	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 43

II. WASTE CHARACTERISTICS (Based on solvents)

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 .9 = 54

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

54 x 1 = 54

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	3	8	24	24
Net precipitation	1	6	6	18
Surface erosion	2	8	16	24
Surface permeability	2	6	12	18
Rainfall intensity	1	8	8	24
		Subtotals	66	108

Subscore (100 X factor score subtotal/maximum score subtotal) 61

2. Flooding

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

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	2	8	16	24
Net precipitation	1	6	6	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	1	8	8	24
		Subtotals	46	114

Subscore (100 x factor score subtotal/maximum score subtotal) 40

C. Highest pathway subscore.

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

Pathways Subscore 61

IV. WASTE MANAGEMENT PRACTICES

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

Receptors	43
Waste Characteristics	54
Pathways	61
Total 158 divided by 3 =	53
	Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

53 x 1 = **53**

FIGURE 2

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE FIRING RANGE

LOCATION NORTHWEST CORNER OF ACADEMY

DATE OF OPERATION OR OCCURRENCE TO PRESENT

OWNER/OPERATOR USAFA

COMMENTS/DESCRIPTION IMPACT AREA HAS SIGNIFICANT LEAD RESIDUE

SITE RATED BY SHEEDY

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	1	10	10	30
C. Land use/zoning within 1 mile radius	0	3	0	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	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	3	6	18	18
		Subtotals	77	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 43

II. WASTE CHARACTERISTICS (lead)

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 1 = 60

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

60 x .5 = 30

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	0	8	0	24
Net precipitation	1	6	6	18
Surface erosion	2	8	16	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
Subtotals			36	108

Subscore (100 X factor score subtotal/maximum score subtotal) 33

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

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	2	8	16	24
Net precipitation	1	6	6	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	1	8	8	24
Subtotals			46	114

Subscore (100 x factor score subtotal/maximum score subtotal) 40

C. Highest pathway subscore.

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

Pathways Subscore 40

IV. WASTE MANAGEMENT PRACTICES

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

Receptors	43
Waste Characteristics	30
Pathways	40

Total 113 divided by 3 = 38 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

38 x 1 = 38

FIGURE 2

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE DREDGE SPOIL SITE

LOCATION FARISH RECREATION AREA

DATE OF OPERATION OR OCCURRENCE 1983

OWNER/OPERATOR USAFA

COMMENTS/DESCRIPTION DREDGED MATERIAL FROM LAKE. SODIUM ARSENATE IS CONTAMINANT.

SITE RATED BY SHEEDY

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	0	3	0	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	2	10	20	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	3	6	18	18
I. Population served by ground-water supply within 3 miles of site	2	6	12	18
Subtotals			135	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 75

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 1 = 60

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

60 x .5 = 30

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	3	8	24	24
Net precipitation	1	6	6	18
Surface erosion	3	8	24	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
		Subtotals	68	108

Subscore (100 X factor score subtotal/maximum score subtotal) 63

2. Flooding

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

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	2	8	16	24
Net precipitation	1	6	6	18
Soil permeability	2	8	16	24
Subsurface flows	1	8	8	24
Direct access to ground water	1	8	8	24
		Subtotals	54	114

Subscore (100 x factor score subtotal/maximum score subtotal) 47

C. Highest pathway subscore.

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

Pathways Subscore 63

IV. WASTE MANAGEMENT PRACTICES

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

Receptors	75
Waste Characteristics	30
Pathways	63

Total 168 divided by 3 = 56 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

56 x 1 = 56

FIGURE 2

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE LANDFILL

LOCATION FARISH RECREATION AREA

DATE OF OPERATION OR OCCURRENCE APPROXIMATELY 1974

OWNER/OPERATOR USAFA

COMMENTS/DESCRIPTION SODIUM ARSENATE IN FILL

SITE RATED BY SHEEDY

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	1	4	4	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	0	3	0	0
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	2	10	20	30
F. Water quality of nearest surface water body	1	6	6	18
G. Ground water use of uppermost aquifer	3	9	27	27
H. Population served by surface water supply within 3 miles downstream of site	3	6	18	18
I. Population served by ground-water supply within 3 miles of site	2	6	12	18
		Subtotals	135	180

Receptors subscore (100 X factor score subtotal/maximum score subtotal) 75

II. WASTE CHARACTERISTICS (sodium arsenate used for rating)

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 1 = 60

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

60 x .5 = 30

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	3	8	24	24
Net precipitation	1	6	6	18
Surface erosion	3	8	24	24
Surface permeability	1	6	6	18
Rainfall intensity	1	8	8	24
Subtotals			68	108

Subscore (100 X factor score subtotal/maximum score subtotal) 63

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

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	2	8	16	24
Net precipitation	1	6	6	18
Soil permeability	2	8	16	24
Subsurface flows	1	8	8	24
Direct access to ground water	1	8	8	24
Subtotals			54	114

Subscore (100 x factor score subtotal/maximum score subtotal) 47

C. Highest pathway subscore.

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

Pathways Subscore 63

IV. WASTE MANAGEMENT PRACTICES

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

Receptors	75
Waste Characteristics	30
Pathways	63

Total 168 divided by 3 = 56 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

56 x 1 = 56

APPENDIX E

DESCRIPTION OF PRIMARY MISSION/UNITS AND MISSIONS AT USAF ACADEMY

APPENDIX E

DESCRIPTION OF PRIMARY MISSION/TENANT UNITS AND MISSIONS AT USAF ACADEMY

2.2.D.1 MISSION

2.2.D.1. PRIMARY MISSION

The United States Air Force Academy Mission is to provide instruction and experience to each cadet so that he graduates with the knowledge and character essential to leadership and the motivation to become a career officer in the United States Air Force.

Organizations responsible for carrying out the primary mission are:

SUPERINTENDENT

Exercises Command jurisdiction over the United States Air Force Academy consonant with his responsibilities to the Chief of Staff, USAF, for implementation of the Academy mission. Responsible for the formulation, establishment, and execution of policies and plans to accomplish the mission.

DIRECTORATE OF PROTOCOL

Responsible for planning and/or performing activities pertaining to distinguished visitors and official guests of the USAF Academy. Prepares budget estimates and financial plans for the USAF Academy Contingency Fund. Administers the USAFA (P-491) Contingency Fund. Plans and initiates action for VIP visits, arranging for the following: Agenda, Briefings, Honors, Ceremonies, Transportation, Billeting, Entertainment, and other related aspects. Is a member of all special activities planning committees if the special activity will involve the Superintendent.

INSPECTOR GENERAL

Plans and implements the Command Inspection System and administers the Command Complaint System in accordance with Air Force Regulations. Conducts personal conference periods and special subject investigations. Responsible for liaison with USAF Office of Special Investigations.

CHIEF OF STAFF

Advises and assists the Superintendent in the formulation, establishment, and execution of policies and plans to accomplish the command mission. Transmits to appropriate agencies the decisions, plans, and policies of the Superintendent, and supervises their coordination and implementation. Responsible for the promulgation of plans and policies and the direction of the Headquarters staff. Has additional duty as Deputy Base Commander and, as such, supervises all base support activities for the Superintendent.

DIRECTOR OF ATHLETICS

Advises the Superintendent on all matters concerning participation of Air Force cadets in intercollegiate, intramural, and physical education athletic programs. Submits to the Superintendent all proposals and activities concerning varsity sports, presently consisting of 18 major sports. Coordinates with the Commandant of Cadets and Dean of Faculty relative to allied sports functions concerning use of certain facilities and support and schedule of cadet time. Schedules utilization and operates facilities necessary for the physical education, intramural, and intercollegiate athletic programs. Establishes liaison with athletic conferences, universities, and colleges concerning promotion and conduct of athletic contests. Acts as President of the Air Force Academy Athletic Association and, as such, is executive head and administrator of the affairs of the AFAAA.

COMMANDANT OF CADETS

Responsible to the Superintendent, USAF Academy, for command and control, staff supervision, planning and management, and overall control of the USAF Academy Cadet Wing. Responsible for administering the leadership and military training program to the Cadet Wing, instruction in military and airmanship courses, application of the Cadet Honor Code, and supervision of cadet life activities.

DEAN OF THE FACULTY

The Dean of the Faculty directs and supervises activities relating to the academic program including faculty organization, administration, and curriculum development. Acting within the broad policies prescribed by the Superintendent, and in consultation with department heads, establishes academic and faculty policies. Manages resources allocated to the faculty. In the absence of both the Dean and the Vice Dean, the senior professor present for duty will act for the Dean.

DIRECTORATE OF ADMISSIONS AND REGISTRAR

Plans, develops, and administers the programs of candidate contact, nomination and selection of candidates, appointment and registration of cadets, technical aptitude and achievement, counseling of cadets, and maintenance of cadet records. Includes responsibility for Air Force admissions to service academy preparatory schools. Serves as Secretary of the Academy Board and Chairman of the Admissions Committee.

USAF ACADEMY PREPARATORY SCHOOL

Mission is to prepare selected personnel for entrance into the cadet wing of the USAF Academy.

SOCIAL ACTIONS OFFICE

Plans, develops, coordinates, evaluates, and administers social programs: Drug Abuse Education, Rehabilitation and Counseling; Equal Opportunity and Treatment; Domestic Actions; Race Relations Instruction; Dissident and Protest Activities; Alcoholism; and Dependent's Delinquency.

DIRECTOR OF INFORMATION

Creates and maintains, through all possible public relations endeavors and channels, a climate of opinion, both within and outside the Academy, which will help the Academy and the Air Force attain their goals and accomplish their respective missions. Conducts information programs and policies as directed by the Superintendent and Director of Information, USAF.

DIRECTOR OF HISTORICAL STUDIES

Supervises non-instructional historical activity of the Command; prepares books, monographs, and special studies; closely coordinates with the Professor of History on the possible assignment of USAFA special historical projects to members of DFH; works closely with DFIT and DFH on oral history projects; prepares an annotated annual history of the Academy; collects historical data on problem areas and the results of corrective action; maintains a continuing program to improve and facilitate the use of historical data as a tool of management.

DIRECTOR OF ADMINISTRATION

Establishes and implements policies, programs, and procedures relating to administrative communications, publications, forms, and documentation management; publications distribution management; administrative orders; printing, duplicating, and copying; classified document security and registry, postal and courier service; administrative communications and message distribution centers; document release and fee schedules; effective writing; abbreviations and terminology; maintenance of publications library; Air Force indicia program, AIG monitor; and the Academy Nickname Program.

CHIEF OF SAFETY

Establishes, manages, and conducts comprehensive flying, explosive, and ground safety programs, including formulation of policies and procedures investigation of accidents/incidents and hazardous conditions. Conducts annaul safety surveys and promotes safety consciousness among military and civilian personnel. Maintains a continuous safety education program. Manages and conducts a motor vehicle, industrial, and explosive safety program. Analyzes accident causes and trends; surveys areas and activities to eliminate hazards; investigates accidents and hazardous conditions; provides staff assistance and supervision during hazardous operations. Responsible for implementation of the Driver Education Program.

STAFF JUDGE ADVOCATE

Acts as legal advisor to the Superintendent and Chief of Staff. Responsible for the supervision and administration of Military Justice, Civil and Military Law, including but not limited to claims, procurement law, contract review, military affairs, and legal assistance.

COMMAND CHAPLAIN

Advises the Superintendent and the Chief of Staff on all matters pertaining to religion, morals, morale, and related activities. Plans, administers, supervises, and evaluates the Total Chaplain Program within the command. Also serves as Senior Cadet Chaplain. Supervises Cadet Chapel Guides.

UNITED STATES AIR FORCE ACADEMY HOSPITAL (SURGEON)

Provides medical, dental and veterinary services to Headquarters USAF Academy, all assigned and attached units; and other medical services support as directed by Headquarters USAF Academy Hospital will operate the fixed medical treatment facility and its auxiliary facilities.

DIRECTOR OF SECURITY POLICE - 7625TH SECURITY POLICE SQUADRON

Exercises staff supervision over Security Police activities, as well as the security of fund and weapon storage activities. Prepares Academy directives relating to law enforcement. Provides personnel security clearance services for command and tenant units. Prepares, reviews, and evaluates all MAJCOM Security Police reports relating to security violations. Develops plans for collective unit response to bomb threats on-Academy civil disorders, and plans special security measures for events involving large gatherings of the public on the Air Force Academy.

Exercises command jurisdiction over all personnel assigned to the 7625th Security Police Squadron. Responsible for accomplishment of the assigned mission to equip, administer, and train all assigned personnel in order to enforce and maintain standards of conduct and discipline. The Chief of Security Police will also act as Squadron Commander, reporting directly to the Chief of Staff.

DCS/CIVIL ENGINEERING - 7625TH CIVIL ENGINEERING SQUADRON

Exercises Headquarters USAF design and construction responsibility as the Air Force Regional Civil Engineer. Advises the Superintendent and the Chief of Staff on Civil Engineering matters including facilities planning and programming for active and proposed mission requirements. Responsible for resource planning for effective mission support. Delegates the Base Commander level of approval authority for funds utilization. Represents the Command on community projects and municipal committees pertaining to real property activities. Serves on zoning boards, pollution abatement groups, conservation and beautification committees, etc., and performs duties of Command Utilities Management and Conservation Officer. As Base

Civil Engineer responsible for planning, directing, and coordinating all civil engineer activities on the following broad areas regardless of source of funds or method of accomplishment: Management of Academy real property; provision of utilities; maintenance and repair of structures and equipment; provision of custodial, sanitation, and entomological services; fire protection and rescue; recovery from damage to facilities from any cause; management of the Base Engineer Emergency Force (Prime BEEF). Develops and directs the Base Snow Removal Plan. Accomplishes disaster preparedness actions and provides assistance in disasters in accordance with AF 355 series of directives. Reports, through the Air Force Operational Reporting System, installation damage, assistance, and funding required to cover the base. The DCS/Civil Engineering has the additional duty as Commander, 7625th Civil Engireering Squadron.

DCS/LOGISTICS - 7625TH MATERIEL SQUADRON

Advises the Superintendent and the Chief of Staff or logistic matters. Supervises the direction and operation of logistics functions, including logistics plans and programs, supply services, maintenance, transportation, and procurement. The DCS/Logistics also has the additional duty of Commander, 7625th Materiel Squadron. The Squadron is responsible for accomplishment of the assigned mission to equip, administer, train, and provide personnel for normal base material support for all assigned, attached and tenant units. This support includes all supply, maintenance, procurement, transportation, and service activities.

DCS/COMPTROLLER

Provides management and financial advice to the Superintendent and his staff. Responsible for the supervision and performance of the Accounting and Finance, Budget and Analysis, Data Automation, and Fiscal Control office functions. Insures that timely correction is made of all deficiencies noted in any audit report and initiates semi-annual procedures for nonappropriated funds and for the operation of the central accounting system prescribed in current directives.

DCS/OPERATIONS

Supervises, coordinates, and administers interagency mission and support plans and programs, and manpower and organizational programs. Acts as the single point of contact for coordination with ATC and ADC (Consolidated Aircraft Managers) on aircraft and pilot scheduling for all Academy flying programs conducted with their support. Coordinates closely with the Deputy Commandant for Military Instruction on the conduct of all Airmanship Programs; monitors all aircraft operations involving Academy personnel and missions. Determines aircraft requirements and related flying hours for all the USAF Academy flying programs. Operates the USAF Academy Airstrip, manages the airlift program which includes coordination with other Major Commands to obtain airlift in support of various cadet and staff activities. Acts as Senior Advisor to and monitors operation of the Academy Aero Club

DCS/PERSONNEL

Manages the civilian and military personnel programs. Advises the Chief of Staff, the Superintendent, and Heads of mission and support agencies on matters with personnel implications. Supervises the Officer and NCO Open Messes.

USAF ACADEMY BAND

Provides marching and concert bands, concert orchestras, dance orchestras, instrumental combinations, and individual musicians whenever required in support of the USAF Academy. Provides technical assistance to cadet musical activities.

HEADQUARTERS SQUADRON SECTION

Provides overall responsibility, direction, planning, supervision, management, and administration of the Headquarters Squadron Section.

2.2.2 TENANT MISSION

Tenant units located at the United States Air Force Academy and the mission of each follows:

THE FRANK J. SEILER RESEARCH LABORATORY

Plans and executes USAF research programs in aerospace mechanics, applied mathematics, and chemistry; supporting research by USAF Academy faculty and cadets; and functioning as the AFSC focal point of all USAF Academy research and development (R&D) efforts proposed for AFSC sponsorship. This laboratory provides scientific advice and consultation on the application and interpretation of research results in support of studies, analysis, and R&D planning activities within its areas of technical responsibility.

1876TH COMMUNICATIONS SQUADRON

Provides overall administration, maintenance and operation of Communications-Electronics (C-E) functions and facilities for the USAF Academy. The Squadron Commander also acts as the Communications Electronics Staff Officer for the Academy Superintendent.

MEDICAL REVIEW BOARD

Responsible for the scheduling, evaluation and certification of medical qualification of all applicants to the five service academies (Army, Navy, Air Force, Coast Guard, and Merchant Marine), and the four service ROTC four year scholarship programs.

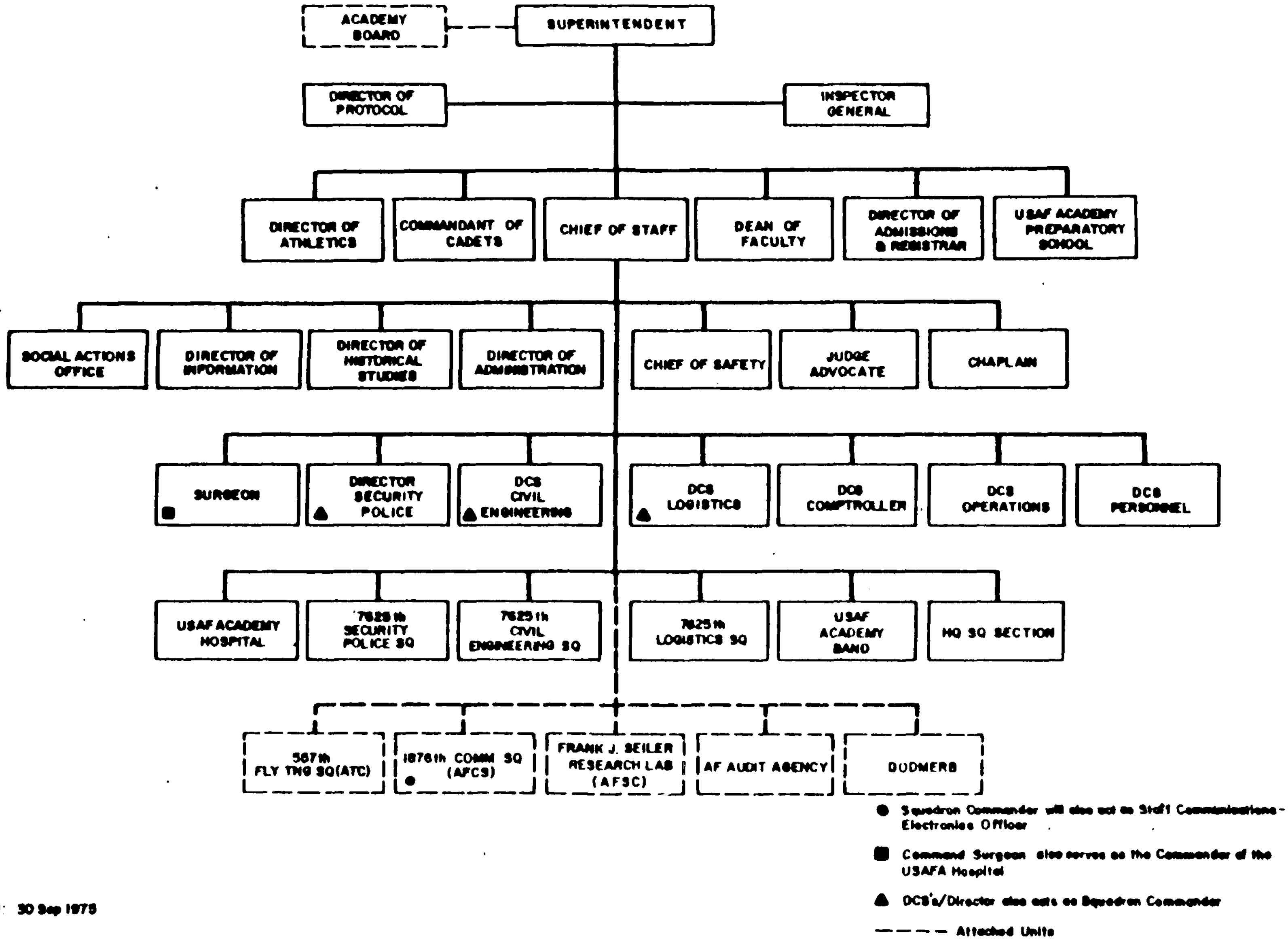
557TH FLYING TRAINING SQUADRON

Motivates all physically qualified United States Air Force Academy cadets toward a rated career in the Air Force. Identification, while at the Academy, of those cadets with a basic aptitude to be Air Force pilots. Minimization of attrition of United States Air Force Academy graduates in the undergraduate Pilot Training Program.

AUDIT AGENCY

Provides all levels of Air Force management with an independent, objective, and constructive evaluation of the effectiveness and efficiency with which management responsibilities (including financial, operational, and support activities) are carried out.

USAF ACADEMY ORGANIZATIONAL CHART



As of: 30 Sep 1975

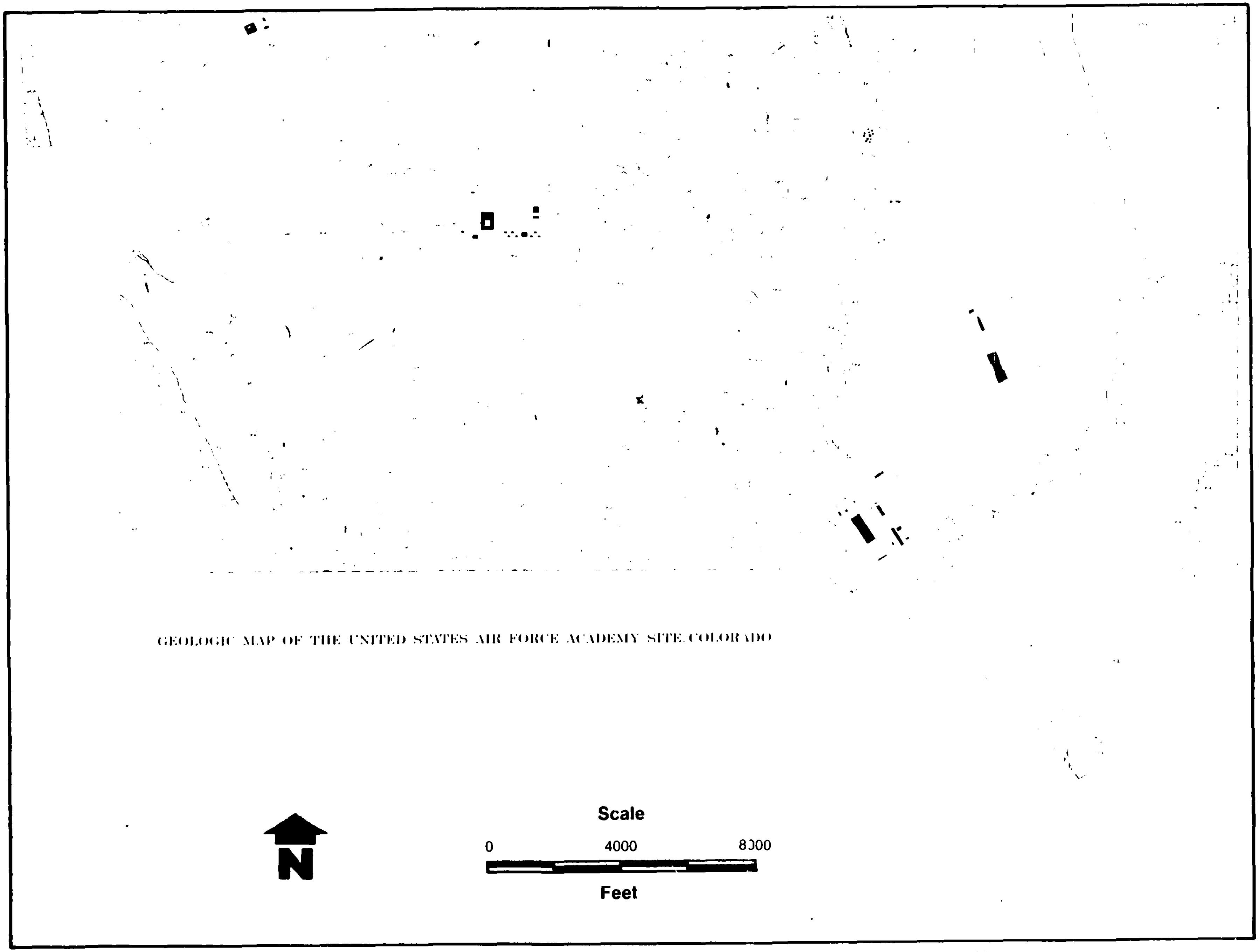
APPENDIX F

SUPPLEMENTAL ENVIRONMENTAL INFORMATION

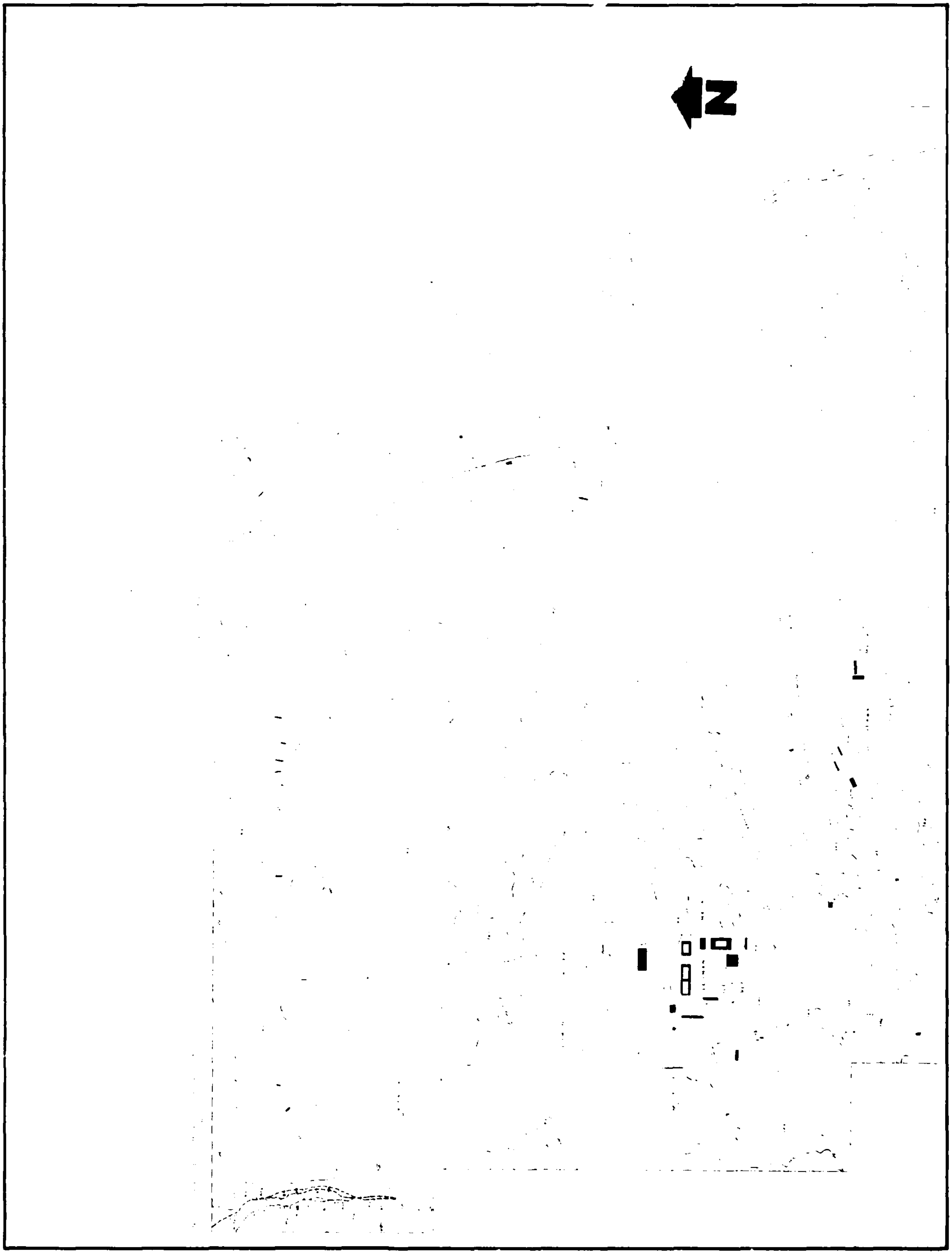
APPENDIX F-1

GEOLOGIC MAP OF

THE U. S. AIR FORCE ACADEMY



GEOLOGIC MAP OF THE UNITED STATES AIR FORCE ACADEMY
(SOUTHERN HALF OF ACADEMY SITE)



GEOLOGIC MAP OF THE UNITED STATES AIR FORCE ACADEMY
(NORTHERN HALF OF ACADEMY SITE)

EXPLANATION

Qm

Monument Creek Alluvium

Generally light-gray or grayish-yellow silty or sandy alluvium 20–25 feet thick; terrace 20–25 feet above stream level. Locally is pebbly and has iron-stained gravel layers. Local clay beds 4 inches to 1 foot thick

Qk

Kettle Creek Alluvium

Reddish-brown coarse granite-derived sand and pebbles, 5–15 feet thick, top forms terrace 15–40 feet above stream level

Qp **Qpe**

Pine Valley Gravel

Reddish-brown coarse granite-derived sand and pebbles, 5–30 feet thick

Qp, *contains boulders, occurs mainly west of Monument Creek. Most boulders at surface faceted and polished from abrasion by windblown sand*

Qpe, *lacks boulders, occurs east of Monument Creek*

Qd

Douglass Mesa Gravel

Reddish-brown coarse granite-derived sand, pebbles, and boulders. Boulders are more numerous and larger toward mountains. 5–50 feet thick

Ql

Lehman Ridge Gravel

Reddish-brown coarse granite-derived sand, pebbles, and large boulders, 15-to 20-foot boulders are not uncommon near mountains. Thickness may exceed 65 feet locally

Pleistocene — QUATERNARY

TKd / **Kda**

Dawson Arkose

TKd, *light-gray coarse quartz-feldspar-mica sandstone, light-reddish-brown siltstone and silty shale, and local beds of firm silty claystone as much as 4 feet thick, contains hard sandy ironstone layers that cap monumentlike erosion remnants. Crossbedding and cut-and-fill channel deposits are characteristic of sandstone parts*

Kda, *andesitic lens, dark-olive-gray sandstone or sandy shale composed almost entirely of fragments of altered andesite. Contains flat clay ironstone nodules. Bedding is more regular than in upper part of Dawson. Some shale beds swell when wet*

Paleocene — TERTIARY

Kl

Laramie Formation

Iron-stained fine-grained friable sandstone. Contains small sandy ironstone nodules

Kfh

Fox Hills Sandstone

Olive-brown friable sandstone in upper and lower parts, olive-gray sandy shale in middle. Contains phosphatic nodules

Kp

Pierre Shale

Olive-gray clayey and silty shale, sandstone at top and near middle. Contains phosphatic nodules in upper sandstone and fossiliferous limestone concretions throughout

Kns

Knf

Niobrara Formation

Kns, *Smoky Hill Shale Member, pale-yellowish-orange chalky silty calcareous shale*

Knf, *Fort Hays Limestone Member, yellowish-gray dense moderately hard limestone*

Kcgg

Carlile Shale, Greenhorn Limestone, and Graneros Shale

Dark-yellowish-orange limy sandstone at top, light-gray platy limestone in middle, olive-black blocky shale in lower part

Kd

Dakota Sandstone

Yellowish-gray and moderate-brown fine-grained friable sandstone containing hollow sandy ironstone nodules

Upper Cretaceous — *Lower Cretaceous* — CRETACEOUS

Jm

Morrison Formation

Variegated siltstone containing sandstone and limestone beds

Upper Jurassic

TRPl

Lykins Formation

Moderate-reddish-brown silty shale and thin-bedded finely laminated gray sandy limestone

PERMIAN(?), JURASSIC AND TRIASSIC(?)

Ply

Lyons Sandstone

Yellowish-gray fine-grained friable to loose thin-bedded well-laminated sandstone

PERMIAN

PIPf

Fountain Formation

Moderate-reddish-brown arkosic conglomerate, coarse sandstone, and thin layers of dark-reddish-brown shale

PERMIAN — PENNSYLVANIAN — CARBONIFEROUS

pCp

Pikes Peak Granite

Moderate-reddish-orange coarse-grained granite containing microperthite grains as much as 1 inch in diameter, quartz grains as much as ¼ inch in diameter, and flat biotite grains as much as ¼ inch in diameter

PRECAMBRIAN

LEGEND OF GEOLOGIC MAP

EXPLANATION

Recent

af

Artificial fill

Qf

Flood-plain alluvium

Coarse sand; some pebbles and cobbles; locally includes a 5-foot terrace composed of sandy alluvium containing small deposits of clay and silt, especially east of Monument Creek

Pleistocene and Recent

Qc

Colluvium

Coarse granite-derived sand, pebbles, and some boulders

Qh

Husted Alluvium

Humic stratified and unstratified silty alluvium containing some clay and sand layers, peat, local boulder beds, and iron-stained layers; 5-10 feet thick. Top of alluvium forms terrace about 10 feet above most streams in area

Qs

Windblown sand

Coarse to fine light-yellowish-gray quartz sand in dunelike ridges as much as 30 feet high

QUATERNARY

Contact

Long dashed where approximately located; short dashed where inferred

U
D

Fault

Dashed where approximately located; dotted where concealed; queried where probable. U, upthrown side; D, downthrown side

30

Strike and dip of beds

Strike of vertical beds

LEGEND OF GEOLOGIC MAP (CONTINUED)

APPENDIX F-2

NATIVE VEGETATIVE SPECIES
AT THE USAF ACADEMY

APPENDIX F

NATIVE VEGETATIVE SPECIES AT THE USAF ACADEMY

In Order of Highest Frequency of Occurrence

SOURCE: U.S. Air Force Academy, Tab A-1, Environmental Narrative

Woodland Biome Zone (6000-7000 feet)

SPECIES

Trees

1.	Ponderosa pine	Pinus ponderosa var scopulorum

Shrubs

1.	Gambel oak	Quercus gambeli
2.	Mountain mahogany	Cercocarpus montanus
3.	Serviceberry	Amelanchier alnifolia
4.	Skunkbush	Rhus tribolata
5.	Chokecherry	Prunus virginiana var melanocarpa
6.	Wild plum	Prunus americana
7.	Snowberry	Symphoricrpos occidentalis
8.	Currant	Ribes spp.
9.	Gooseberry	Ribes inerme
10.	Rose	Rosa woodsii

Herbs

1.	Thimbleweed	Anemone cylindrica gray
2.	Sandwort	Arenaria fendleri gray
3.	Penstemon	Penstemon virens p. secundiflours p. virgatus ssp. asa-grayi
4.	Milkvetch	Astragalus adsurgens var robostier
5.	Draba	Draba nemorosa

6. Bastardtoadflax — Comandra umbellata
7. Bluebells — Mertensia lanceolata
8. Globe flower — Anemone multifida globosa
9. Yarrow — Achillea lanulosa
10. Strawberry — Fragaria vesca
11. Violet — Viola daunca
12. Golden banner — Thermopsis divaricata
13. Clover — Trifolium fendleri
14. Pasque flower — Anemone pulsatillo
15. Evening primrose — Oenothera caespitosa

Grass Types

1. Sedges, dry — Carex spp.
2. Tufted Hairgrass — Deschampsia caesritosa
3. Blue grama — Boutelous gracilis
4. Needle-grass — Stipa spartea
5. Wheatgrass — Agropyron sp.
6. Mountain muhly — Muhlenbergia montana

Mountane Zone (7000-9000 feet) In Order of Highest Frequency of Occurrence

SPECIES

Trees

1. Ponderosa pine — Pinus ponderosa var scopulorum
2. Douglas fir — Pseudotsuga menziesii
3. White fir — Abies concolor
4. Aspen — Populus tremuloides

Shrubs

1.	Common juniper	Juniperus communis
2.	Kinnikinnic	Arctostaphylos uva-ursi
3.	Cinquefoil	Potentilla fruiticosa
4.	Rose	Rosa woodsii
5.	Chokecherry	Prunus virginiana var melanocarpa
6.	Wild plum	Prunus americana
7.	Serviceberry	Amelanchier canadensis
8.	Bitterbrush	Purshia tridentata

Herbs

1.	Fleabane daisy	Erigeron flagellaris
2.	Penstemon	Penstemon virens
3.	Pussytoes	Antennaria rosea
4.	Pussytoes	Antennaria paruifolia
5.	Bluebells	Mertensia lanceolata
6.	Stonecrop	Sedum spp.
7.	Wild onion	Allium geyeri
8.	Fleabane	Erigeron divergens
9.	Commonwild geranium	Geranium fremonti
10.	Knotweed	Polygonum sawatchense p. douglasi
11.	Mariposa lily sego lilly	Calochortu gunnisonii
12.	Cinquefoil	Potentilla spp.
13.	Harebell	Campanula rotundifolia
14.	Bedstraw	Galium aparine
15.	Gilia	Gilia aggregate

16. Yarrow — Achillea lanulosa

17. Paintbrush — Castilleja coccinia

18. Fringed sage — Artemisia frigida

19. Stiff Goldenrod — Solidago rigida

20. Aster — Aster porteri

21. Nebraska lupine — Lupinus plattensis

22. Prairie Spiderwort — Tradescantia occidentalis

<u>Grasses</u>

1.	Colorado wild rye	Elymus ambiguus
2.	Western wheatgrass	Agropyron smithii
3.	Nodding brome	Bromus Anomalus
4.	Needle and thread grass	Stipa comata
5.	Blue grama	Bouteloua gracilis
6.	June grass	Koeleria cristata
7.	Indian ricegrass	Oryzopsis hymenoides
8.	Mountain muhly	Muhlenbergia montana

APPENDIX G

GLOSSARY OF TERMS AND ABBREVIATIONS

APPENDIX G

GLOSSARY OF TERMS AND ABBREVIATIONS

ACCUMULATION POINT	A designated location for the accumulation of wastes prior to removal from the installation.
ACFT MAINT	Aircraft Maintenance
AF	Air Force
AFA	Air Force Academy
AFB	Air Force Base
AFESC	Air Force Engineering and Services Center
AFFF	Aqueous Film Forming Foam (a fire extinguishing agent).
AFR	Air Force Regulation
Ag	Chemical symbol for silver.
Al	Chemical symbol for aluminum.
ALLUVIUM	Materials eroded, transported, and deposited by surface water.
ARTESIAN	Groundwater contained under hydrostatic pressure.
AQUIFER	A geologic formation, group of formations, or part of a formation that is capable of yielding water to a well or spring.

AROMATIC	Organic chemial compounds in which the carbon atoms are arranged into a ring with special electron stability associated. Aromatic compounds are often more reactive than nonaromatics.
AVGAS	Aviation Gasoline (contains lead).
Ba	Chemical symbol for barium.
BIOACCUMULATE	Tendency of elements or compounds to accummulate or buildup in the tissues of living organisms when they are exposed to elements in their environments, e.g., heavy metals.
BIODEGRADABLE	The characteristic of a substance to be broken down from complex to simple compounds by microorganisms.
BOWSER	A mobile tank, usually 1,000 gallons or less in capacity.
BX	Base Exchange
$CaCO_3$	Chemical symbol for calcium carbonate.
Cd	Chemical symbol for cadmium.
CE	Civil Engineering
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CIRCA	About, used to indicate an approximate date.
CN	Chemical symbol for cyanide.
COD	Chemical Oxygen Demand, a measure of the amount of oxygen required to oxidize organic and oxidizable inorganic compounds in water.
COE	Corps of Engineers

CONFINED AQUIFER	An aquifer bounded above and below by geologic units of distinctly lower permeability than that of the aquifer itself.
CONFINING UNIT	A geologic unit with low permeability which restricts the vertical movement of groundwater.
Cr	Chemical symbol for chromium.
Cu	Chemical symbol for copper.
2,4-D	Abbreviation for 2,4-dichlorophenoxyacetic acid, a common weed killer and defoliant.
DEQPPM	Defense Environmental Quality Program Policy Memorandum
DIP	The angle at which a geologic structural surface is inclined from the horizontal.
DOD	Department of Defense
DOT	Department of Transportation
DOWNGRADIENT	In the direction of decreasing hydraulic static head; the direction in which groundwater flows.
DPDO	Defense Property Disposal Office
DUMP	An uncontrolled land disposal site where solid and/or liquid wastes are deposited.
EFFLUENT	A liquid waste, untreated or treated, that discharges into the environment.
EP	Extraction Procedure - the EPA standard laboratory procedure for simulation of leachate generation.
EPA	U.S. Environmental Protection Agency

EROSION	The wearing away of land surface by wind, water, or chemical processes.
FAA	Federal Aviation Administration
FAULT	A fracture in rock along the adjacent rock surfaces which are differentially displaced.
Fe	Chemical symbol for iron.
FLOOD PLAIN	The low land and relatively flat areas adjoining inland and coastal areas of the mainland and off-shore islands, including, at a minimum, areas subject to 1 percent or greater chance of flooding in any given year.
FLOOD PATH	The direction of movement of groundwater as governed principally by the hydraulic gradient.
FMS	Field Maintenance Squadron
FPTA	Fire Protection Training Area
FY	Fiscal Year
GC/MS	Gas chromatograph/mass spectrophotometer, an analytical instrument for qualitative and quantitative measurement of organic compounds having a maximum molecular weight of 800.
GROUNDWATER	Water beneath the land surface in the saturated zone that is under atmospheric or artesian pressure.
GROUNDWATER RESERVOIR	The earth materials and the intervening open spaces that contain groundwater.
HALON	A fluorocarbon fire extinguishing compound.
HALOGEN	The class of chemical elements including fluorine, chlorine, bromine, and iodine.

WESTON

HARM	Hazard Assessment Rating Methodology
HAZARDOUS SUBSTANCE	Under CERCLA, the definition of hazardous substance includes: • All substances regulated under Paragraphs 311 and 307 of the Clean Water Act (except oil). • All substances regulated under Paragraph 3001 of the Solid Waste Disposal Act. • All substances regulated under Paragraph 112 of the Clean Air Act. • All substances which the Administrator of EPA has acted against under Paragraph 7 of the Toxic Substance Control Act. • Additional substances designated under Paragraph 102 of the Superfund Bill.
HAZARDOUS WASTE	As defined in RCRA, a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical/chemical, or infectious characteristics may cause or significantly contribute to an increase in mortality or an increase in serious, irreversible, or incapacitating reversible illness; or pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed.
HAZARDOUS WASTE GENERATION	The act or process of producing a hazardous waste.
HEAVY METALS	Metallic elements, including the transition series, which include many elements required for plant ard animal nutrition in trace concentrations but which become toxic at higher concentrations.

Hg	Chemical symbol for mercury
HQ	Headquarters
HYDROCARBONS	Organic chemical compounds composed of hydrogen and carbon atoms chemically bonded. Hydrocarbons may be straight chain, cylic, branched chain, aromatic, or polycyclic, depending upon arrangement of carbon atoms. Halogenated hydrocarbons are hydrocarbons in which one or more hydrogen atoms has been replaced by a halogen atom.
INFILTRATION	The movement of water across the atmosphere-soil interface.
IRP	Installation Restoration Program
ISOPACH	Graphic presentation of geologic data, including lines of equal unit thickness that may be based on confirmed (drill hole) data or indirect geophysical measurement.
JP-4	Jet Propulsion Fuel (unleaded) No. 4, military jet fuel.
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.
LITHOLOGY	The description of the physical character of a rock.
LOESS	An essentially unconsolidated unstratified calcareous silt; commonly homogeneous, permeable, and buff to gray in color.
LYSIMETER	A vacuum operated sampling device used for extracting pore waters at various depths within the unsaturated zone.

MEK	Methyl Ethyl Ketone
METALS	See "Heavy Metals".
MGD	Million gallons per day.
MOA	Military Operating Area
MIK	Methyl Isobutyl Ketone
MOGAS	Motor Gasoline
Mn	Chemical symbol for manganese.
MONITORING WELL	A well used to obtain groundwater samples and to measure groundwater elevation
MSL	Mean Sea Level
NDI	Nondestructive inspection.
NET PRECIPITATION	The amount of annual precipitation minus annual evaporation.
Ni	Chemical symbol for nickel.
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
OEHL	Occupational and Environmental Health Laboratory
OIC	Officer-In-Charge
ORGANIC	Being, containing, or relating to carbon compounds, especially in which hydrocarbon is attached to carbon.
OSI	Office of Special Investigations

O&G	Symbols for oil and grease.
Pb	Chemical symbol for lead.
PCB	Polychlorinated Biphenyl - liquids used as a dielectrics in electrical equipment.
PERCOLATION	Movement of moisture by gravity or hydrostatic pressure through interstices of unsaturated rock or soil.
PERMEABILITY	The capacity of a porous rock, soil, or sediment for transmitting a fluid.
PERSISTENCE	As applied to chemicals, those which are very stable and remain in the environment in their original form for an extended period of time.
PD-680	Kerosene-based cleaning solvent
pH	Negative logarithm of hydrogen ion concentration.
PL	Public Law
POL	Petroleum, Oils, and Lubricants
POLLUTANT	Any introduced gas, liquid, or solid that makes a resource unit for a specific purpose.
POLYCYCLIC COMPOUND	All compounds in which carbon atoms are arranged into two or more rings, usually in nature.
POTENTIOMETRIC SURFACE	The surface to which water in an aquifer would rise in tightly cased wells open to the aquifer.
PPB	Parts per billion by weight.
PPM	Parts per million by weight.

PRECIPITATION	Rainfall.
QUATERNARY MATERIALS	The second period of the Cenozoic geologic era, following the Tertiary, and including the last 2 to 3 million years.
RCRA	Resource Conservation and Recovery Act of 1976
RECEPTORS	The potential impact group or resource for a waste contamination source.
RECHARGE AREA	A surface area in which surface water or precipitation percolates through the unsaturated zone and eventually reaches the zone of saturation.
RECHARGE	The addition of water to the groundwater system by natural or artificial processes.
RIPARIAN	Living or located on a riverbank.
SANITARY LANDFILL	A site using an engineered method of disposing solid wastes on land.
SATURATED ZONE	Soil or geologic materials in which all voids are filled with water.
SAX's TOXICITY	A rating method for evaluating the toxicity of chemical materials.
SCS	U.S. Department of Agriculture Soil Conservation Service
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).
SPILL	Any unplanned release or discharge of a material 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 manner as not to constitute permanent disposal of such hazardous waste.
STP	Sewage Treatment Plant
2,4,5-T	Abbreviation for 2,4,5-trichlorophenoxyacetic acid, a common herbicide.
TCE	Trichloroethylene
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
TOXICITY	The ability of a material to produce injury or disease upon exposure, ingestion, inhalation, or assimilation by a living organism.
TRANSMISSIVITY	The rate at which water is transmitted through a unit width of aquifer under a hydraulic gradient.

TREATMENT OF HAZARDOUS WASTE	Any method, technique, or process including neutralization designed to change the phsyical, chemical, or biological character or composition of any hazardous waste so as to neutralize the waste or so as to render the waste non-hazardous.
TSD	Treatment, storage, or disposal.
TSDF	Treatment, storage, or disposal facility.
UPGRADIENT	In the direction of increasing hydraulic static head; the direction from which groundwater flows.
USAF	United States Air Force
USAFA	United States Air Force Academy
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WATER TABLE	Surface of a body of unconfined groundwater at which the pressure is equal to that of the atmosphere.
WWTP	Wastewater Treatment Plant
Zn	Chemical symbol for zinc

APPENDIX H

MASTER LIST OF SHOPS

WESTON

APPENDIX H

MASTER LIST OF SHOPS

Shop	Handles Hazardous Materials	Generates Hazardous Wastes	Disposal of Hazardous Mtls. Past	Present
Cadet Athletics				
SCUBA	Yes	No		
Equipment Repair Branch	Yes	No		
Facilities Maint. Shop	Yes	No		
Ice Rink Management	Yes	No		
Stadium Maintenance	Yes	No		
Sports Information	Yes	No		
Facilities	Yes	No		
Team Dorm	Yes	No		
Concession (Fld. House)	Yes	No		
Intercollegiate Supply	Yes	No		
Band				
Band Instrument Repair	Yes	No		
Commandant of Cadets				
Firing Range (indoor)	Yes	No		
Firing Range (outdoor)	Yes	No		
Cadet Armory	Yes	No		
Military Training Div.	Yes	No		
Soaring Maintenance	Yes	No		
Cadet Supply & Serv.	Yes	No		
Civil Engineering				
Corrosion Control	Yes	No		
Entomology	Yes	No		
Equipment Operations	Yes	No		
Exterior Electric	Yes	No		
Golf Course/Cart Maint.	Yes	No		
Grounds, Sec. A	Yes	No		
Grounds, Sec. B	Yes	No		
Grounds, Sec. C	Yes	No		
Heating Plant #1	Yes	No		
Heating Plant #2	Yes	No		
Housing Maintenance	Yes	No		
Instrument Control & Calibration	Yes	No		
Interior Electric	Yes	No		
Masonry Shop	Yes	No		
Mechanical Branch #1	Yes	No		
Mechanical Branch #2	Yes	No		
Mechanical Branch #3	Yes	No		

WESTON

APPENDIX H (Continued)

Shop	Handles Hazardous Materials	Generates Hazardous Wastes	Disposal of Hazardous Mtl. Past	Disposal of Hazardous Mtl. Present
Civil Engr. (Cont.)				
Mechanical Branch #4	Yes	No		
Mechanical Branch #5	Yes	No		
Mechanical Branch #6	Yes	No		
Bldg.Svc.Heat Water AC Elec.	Yes	No		
Natural Resources	Yes	No		
Power Production	Yes	No		
Pluming Shop	Yes	No		
Protective Coating	Yes	No		
Sheet Metal & Welding	Yes	No		
Structural Maint. & Locksmith	Yes	No		
Structural Maint. & Repair Team	Yes	No		
Waste Water Treatment/ Water Plant	Yes	No		
Custodial Services	Yes	No		
Sanitation Branch	Yes	No		
Dean of Faculty				
Dept of Aeronautics	Yes	No		
Dept. of Biology	Yes	No		
Dept. of Behavioral Sci. & Leadership	Yes	No		
Dept. of Chemistry	Yes	No		
Dept. of Civil Engr.	Yes	No		
Dept. of Engr. Mech.	Yes	No		
Dept. of Physics & Planetarium/Observatory	Yes	No		
Dept. of Philosophy & Fine Arts	Yes	No		
Anodizing Shop	Yes	No		
Machine Shop	Yes	No		
Paint Shop	Yes	No		
Sheetmetal & Plastic	Yes	No		
Welding	Yes	No		
Training Devices	Yes	No		
Photographic Div.	Yes	No	------Recycled---------	
PME Lab	Yes	No		
Graphics	Yes	No		

Appendix H (Continued)

Shop	Handles Hazardous Materials	Hazardous Wastes	Disposal of Hazardous Mtl. Past	Disposal of Hazardous Mtl. Present
Personnel	Yes	No		
Logistics				
Packing & Crating	Yes	No		
Body & Uphostery	Yes	No		
Heavy Equipment	Yes	Yes	Waste oil tank to contractor.	
Genl. Purpose Maint.	Yes	No		
Unit Rebuild	Yes	No		
Base Maintenance	Yes	No		
Fuels Management	Yes	No		
Preparatory School				
Chemistry	Yes	Yes	Diluted to Sanitary Sewer.	
Admissions & Registrar	Yes	No		
Hospital				
Medical Material Serv.	Yes	Yes	To incinerator, dumpster and sanitary sewer.	
Radiology	Yes	Yes	Directly to sanitary sewer.	
Security Police				
Arms and Equipment	Yes	No		
Administration				
Printing Plant #1	Yes	Yes	Diluted to sanitary sewer.	
Printing Plant #2	Yes	Yes	Diluted to sanitary sewer.	
Microform Serv. Ctr.	Yes	No		
Morale, Welfare, Recreation				
Auto Hobby	Yes	Yes	Waste Oil Tank to contractor.	
Arts & Crafts Ctr.	Yes	No		
Wood Hobby	Yes	No		
Aero Club	Yes	Yes	West Oil Tank or Fire Dept.	Waste oil tank to contractor.
Community Ctr. Gym	Yes	No		
Eisenhower Golf Club	Yes	No		
Special Recreation Ctr.	Yes	No		
Farrish Memorial	Yes	Yes	Landfill	Contractor
Pre-School	Yes	No		

Appendix H (Continued)

	Handles Hazardous Materials	Generates Hazardous Wastes	Disposal of Hazardous Mtl. Past	Disposal of Hazardous Mtl. Present
Plans & Operations				
Des/Plans & Operations	Yes	No		
Dir. of Preparedness	Yes	No		
1876 Communications Squadron (AFCC)				
City Maintenance	Yes	No		
Public Adress Maintenance	Yes	No		
ATC Radio	Yes	No		
Frank J. Seiler Research Lab.	Yes	Yes	Diluted to Sanitary Sewer	

APPENDIX I

INDEX OF SITES

APPENDIX I

INDEX OF SITES

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APPENDIX J

REFERENCES

APPENDIX J

REFERENCES

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