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RICHARDS-GEBAUR AFB
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INSTALLATION RESTORATION PROGRAM

PHASE II
CONFIRMATION/QUANTIFICATION

STAGE 2

RICHARDS-GEBAUR AIR FORCE BASE
MISSOURI

Prepared by:

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July 1988

FINAL REPORT
(September 1986 to November 1987)

VOLUME 1: TEXT

Approved for Public Release:
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Prepared for:

UNITED STATES AIR FORCE
Headquarters Air Force Reserve (HQ AFRES/SGPB)
Robins Air Force Base, Georgia 31098-6001

UNITED STATES AIR FORCE
Occupational and Environmental Health Laboratory/
Technical Services Division (USAFOEHL/TS)
Brooks Air Force Base, Texas 78235-5501

DF-4900-D1529

INSTALLATION RESTORATION PROGRAM PHASE II
CONFIRMATION/QUANTIFICATION
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FOR
RICHARDS-GEBAUR AIR FORCE BASE
MISSOURI

UNITED STATES AIR FORCE
HEADQUARTERS AIR FORCE RESERVE (HQ AFRES/SGPB)
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USAF CONTRACT NO. F33615-83-D-4003, DELIVERY ORDER NO. 13
CONTRACTOR CONTRACT NO. F33615-83-D-4003, DELIVERY ORDER NO. 13

Approved for Public Release;
Distribution is Unlimited

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NOTICE

This report has been prepared for the United States Air Force by Ecology and Environment, Inc., for the purpose of aiding in the implementation of the Air Force Installation Restoration Program (IRP). 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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National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161

REPORT DOCUMENTATION PAGE

1a REPORT SECURITY CLASSIFICATION Unclassified	1b RESTRICTIVE MARKINGS N/A
2a SECURITY CLASSIFICATION AUTHORITY N/A	3 DISTRIBUTION / AVAILABILITY OF REPORT Approved for public release; distribution is unlimited
2b DECLASSIFICATION / DOWNGRADING SCHEDULE N/A	
4 PERFORMING ORGANIZATION REPORT NUMBER(S) N/A	5 MONITORING ORGANIZATION REPORT NUMBER(S) N/A
6a NAME OF PERFORMING ORGANIZATION Ecology and Environment, Inc. 6b OFFICE SYMBOL (If applicable)	7a NAME OF MONITORING ORGANIZATION USAFOEHL/TS
6c ADDRESS (City, State, and ZIP Code) 368 Pleasantview Drive Lancaster, New York 14086	7b ADDRESS (City, State, and ZIP Code) Brooks Air Force Base, Texas 78235-5501
8a NAME OF FUNDING / SPONSORING ORGANIZATION Same as 7a 8b OFFICE SYMBOL (If applicable)	9 PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER F33615-83-D-4003/0013
8c ADDRESS (City, State, and ZIP Code) Same as 7b	10 SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO / PROJECT NO / TASK NO / WORK UNIT ACCESSION NO

11 TITLE (Include Security Classification)
Installation Restoration Program; Phase II, Stage 2, Richards-Gebaur AFB, Missouri

12 PERSONAL AUTHOR(S)
Ecology and Environment, Inc.

13a TYPE OF REPORT	13b TIME COVERED	14 DATE OF REPORT (Year, Month, Day)	15 PAGE COUNT
Final	FROM 9/86 TO 11/87	July 1988	148

16 SUPPLEMENTARY NOTATION

17 COSATI CODES			18 SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	Installation Restoration Program; Richards-Gebaur AFB; Superfund; CERCLA; Hazardous Waste; Groundwater

19 ABSTRACT (Continue on reverse if necessary and identify by block number)

Ecology and Environment, Inc., was retained by the USAFOEHL/TS to provide technical and analytical services in support of the Air Force Installation Restoration Program (IRP). These services were applied to the Phase II, Stage 2 investigation at Richards-Gebaur AFB. The field investigation was conducted between September 1986 and November 1986, and involved work at sites at the base. The investigation included records searches, geophysical studies, and sampling of surface and subsurface soils and groundwater. Samples were analyzed for various parameters including volatile organics, oil and grease, base/neutrals and acid extractable compounds, and heavy metals. Results of the investigation indicated that past waste handling and disposal practices had caused various degrees of soil and groundwater contamination at six of the seven sites. Follow-up (Stage 3) work has been recommended at three sites to better define the extent of contamination. One site was judged to require no follow-up action, and three sites are recommended for the next stage of the IRP. One site requires additional investigation and remedial action.

20 DISTRIBUTION / AVAILABILITY OF ABSTRACT	21 ABSTRACT SECURITY CLASSIFICATION
☐ UNCLASSIFIED/UNLIMITED ☒ SAME AS RPT ☐ DTIC USERS	Unclassified
22a NAME OF RESPONSIBLE INDIVIDUAL Capt. Patrick N. Johnson	22b TELEPHONE (Include Area Code) (512) 536-2158 22c OFFICE SYMBOL USAFOEHL/TS

DD FORM 1473, 84 MAR 83 APR edition may be used until exhausted
All other editions are obsolete

PREFACE

The purpose of this report is to document the Phase II Stage 2 investigation of the United States Air Force (USAF) Installation Restoration Program (IRP) at Richards-Gebaur Air Force Base, Missouri. This work was conducted by Ecology and Environment, Inc., (E & E) under Contract No. F33615-83-D-4003, Task Order 13.

Mr. Gerald Strobel is Program Manager for this Contract. The Task Order was managed by Mr. Paul R. Kopsick. Laboratory analyses were accomplished at E & E's Analytical Services Center in Buffalo, New York, under the supervision of Mr. Andrew Clifton and Ms. Cathy Syracuse.

This work was accomplished during the period from September 1986 to November 1986. Captain Patrick N. Johnson, USAF, Technical Services Division, USAF Occupational and Environmental Health Laboratory (USAFOEHL/TS), was the Technical Program Manager.

Approved

Gerald Strobel
Program Manager

TABLE OF CONTENTS

Section		Page
	EXECUTIVE SUMMARY	1
1	INTRODUCTION	1-1
	1.1 LOCATION AND HISTORY OF OPERATIONS	1-3
	1.2 SITE DESCRIPTIONS	1-6
	1.2.1 Site 1, South Landfill	1-6
	1.2.2 Site 2, Northeast Landfill	1-10
	1.2.3 Site 6, North Burn Pit Area	1-12
	1.2.4 Site 8, Herbicide Burial Area	1-12
	1.2.5 Site 9, Oil-Saturated Area	1-12
	1.2.6 Site 10, Hazardous Waste Drum Storage Area	1-16
	1.2.7 Site 12, POL Storage Yard	1-16
	1.3 SITES NOT INVESTIGATED DURING STAGE 2	1-19
	1.4 TYPES OF CONTAMINANTS INVESTIGATED	1-21
	1.5 FIELD PERSONNEL	1-28
	1.6 SUBCONTRACTORS	1-28
2	ENVIRONMENTAL SETTING	2-1
	2.1 GEOGRAPHIC SETTING	2-1
	2.1.1 Physiography	2-1
	2.1.2 Topography	2-1
	2.2 GEOLOGY	2-1
	2.2.1 Geologic Setting	2-1
	2.2.2 Soils	2-3
	2.2.3 Stratigraphy	2-3
	2.2.4 Structure	2-6

Table of Contents (Cont.)

Section			Page
	2.3	HYDROLOGY AND WATER USE	2-6
		2.3.1 Surface Water	2-6
		2.3.2 Hydrogeology	2-8
	2.4	CLIMATE	2-8
3		FIELD PROGRAM	3-1
	3.1	PROGRAM DEVELOPMENT	3-1
	3.2	FIELD INVESTIGATION	3-4
		3.2.1 Schedule of Field Activities	3-4
		3.2.2 Records Search	3-4
		3.2.3 Geophysical Survey Procedures	3-6
		3.2.4 Soil Gas Sampling	3-6
		3.2.5 Soil, Sediment, and Water Sampling	3-6
		3.2.6 Handling of Investigation-Derived Waste	3-16
		3.2.7 Site-Specific Investigation Activities	3-18
		3.2.8 Laboratory Program	3-29
		3.2.9 Variations from Description of Work	3-32
4		RESULTS AND SIGNIFICANCE OF FINDINGS	4-1
	4.1	INTRODUCTION	4-1
	4.2	RESULTS	4-4
		4.2.1 Site 1, South Landfill	4-4
		4.2.2 Site 2, Northeast Landfill	4-7
		4.2.3 Site 6, North Burn Pit Area	4-11
		4.2.4 Site 8, Herbicide Burial Area	4-17
		4.2.5 Site 9, Oil-Saturated Area	4-19
		4.2.6 Site 10, Hazardous Waste Drum Storage Area	4-22
		4.2.7 Site 12, POL Storage Yard	4-26
	4.3	SIGNIFICANCE OF FINDINGS	4-30
		4.3.1 Site 1, South Landfill	4-30
		4.3.2 Site 2, Northeast Landfill	4-30
		4.3.3 Site 6, North Burn Pit Area	4-30

Table of Contents (Cont.)

Section			Page
	4.3.4	Site 8, Herbicide Burial Area	4-31
	4.3.5	Site 9, Oil-Saturated Area	4-31
	4.3.6	Site 10, Hazardous Waste Drum Storage Area	4-32
	4.3.7	Site 12, POL Storage Yard	4-33
5	ALTERNATIVE MEASURES		5-1
	5.1	SITE 1, SOUTH LANDFILL	5-1
	5.2	SITE 2, NORTHEAST LANDFILL	5-2
	5.3	SITE 6, NORTH BURN PIT AREA	5-2
	5.4	SITE 8, HERBICIDE BURIAL AREA	5-3
	5.5	SITE 9, OIL-SATURATED AREA	5-4
	5.6	SITE 10, HAZARDOUS WASTE DRUM STORAGE AREA	5-4
	5.7	SITE 12, POL STORAGE YARD	5-4
6	RECOMMENDATIONS		6-1
	6.1	SITE 1, SOUTH LANDFILL - CATEGORY I	6-1
	6.2	SITE 2, NORTHEAST LANDFILL - CATEGORY III	6-5
	6.3	SITE 4, WEST BURN AREA	6-5
	6.4	SITE 6, NORTH BURN PIT AREA - CATEGORIES II AND III	6-6
	6.5	SITE 8, HERBICIDE BURIAL AREA - CATEGORY II	6-6
	6.6	SITE 9, OIL-SATURATED AREA - CATEGORY III	6-8
	6.7	SITE 10, HAZARDOUS WASTE DRUM STORAGE AREA - CATEGORY III	6-11
	6.8	SITE 12, POL STORAGE YARD - CATEGORY II	6-11
	6.9	WELL ABANDONMENT	6-11

14 009

LIST OF APPENDICES
(Volume 2)

Appendix		Page
A	GLOSSARY OF TERMS	A-1
B	CONTRACT DESCRIPTION OF WORK	B-1
C	HEALTH & SAFETY PLAN	C-1
D	BORING LOGS/MONITORING WELL DATA	D-1
E	CHAIN-OF-CUSTODY FORMS	E-1
F	AF 103 ENGINEERING PERMIT	F-1
G	NORTHEAST LANDFILL TRENCH LOCATIONS	G-1
H	ANALYTICAL DATA	H-1
I	OVERVIEW OF RISK ASSESSMENT AND THE DEVELOPMENT OF STANDARDS AND CRITERIA	I-1
J	TOXICOLOGICAL PROFILES FOR SELECTED CONTAMINANTS	J-1
K	REFERENCES	K-1
L	BIOGRAPHIES OF KEY PERSONNEL	L-1
M	GEOPHYSICAL SURVEY TRACINGS	M-1
N	TECHNICAL OPERATIONS PLAN	N-1
O	MONITORING WELL LOCATIONS AND SURVEY NOTES	O-1
P	WATER WELLS WITHIN ONE MILE OF THE BASE	P-1

LIST OF ILLUSTRATIONS

Figure		Page
1	Richards-Gebaur Air Force Base IRP Sites	3
1-1	Location Map of Richards-Gebaur Air Force Base, Missouri	1-4
1-2	Real Property Areas, Richards-Gebaur AFB, Missouri	1-7
1-3	Richards-Gebaur Air Force Base IRP Sites	1-8
1-4	Site 1, South Landfill Location Map	1-9
1-5	Site 2, Northeast Landfill Location Map	1-11
1-6	Site 6, North Burn Pit Area Location Map	1-13
1-7	Site 8, Herbicide Burial Area Location Map	1-14
1-8	Site 9, Oil-Saturated Area Location Map	1-15
1-9	Site 10, Hazardous Waste Drum Storage Area Location Map	1-17
1-10	Site 12, POL Storage Yard Location Map	1-18
2-1	Study Area Physiographic Provinces	2-2
2-2	Stratigraphic Succession of Bedrock Units	2-5
2-3	Structural Features of Bedrock in Study Area	2-7
2-4	Storm Water Drainage and Topographic Map, Richards-Gebaur AFB, Missouri	2-9
3-1	Sampling Locations at Site 1, South Landfill	3-19
3-2	Site 2, Northeast Landfill, Geophysical Survey Area	3-21

List of Illustrations (Cont.)

Figure		Page
3-3	Sampling Locations at Site 2, Northeast Landfill	3-22
3-4	Site 6, North Burn Pit Area, Soil Gas Survey Locations	3-24
3-5	Sampling Locations at Site 6, North Burn Pit Area	3-25
3-6	Sampling Locations at Site 8, Herbicide Burial Area	3-27
3-7	Sampling Locations at Site 9, Oil-Saturated Area	3-28
3-8	Sampling Locations at Site 10, Hazardous Waste Drum Storage Area	3-30
3-9	Sampling Locations at Site 12, POL Storage Yard	3-31
4-1	Location of Site 2, Northeast Landfill, Based on Geophysical Survey and Historical Aerial Photographs (3/19/77)	4-9
4-2	Summary of Soil Gas Survey Locations and Concentrations at Site 6, North Burn Pit Area	4-15
6-1	Proposed Locations of Monitoring Wells at Site 6, North Burn Pit Area	6-7
6-2	Proposed Location of Conductivity Survey at Site 8, Herbicide Burial Area	6-8
6-3	Proposed Location of Removal Option at Site 9, Oil-Saturated Area	6-10
6-4	Location of Proposed Well Locations at Site 12, POL Storage Yard	6-12

LIST OF TABLES

Table		Page
1	Summary of Sites - Phase II Stage 2 Investigation	2
2	Summary of Fieldwork/Analyses Performed	5
3	Summary of Recommendations	6
1-1	Sample Analyses Performed at Richards-Gebaur AFB	1-23
1-2	Analytical Parameters and Detection Limits Used for Richards-Gebaur AFB Investigation	1-24
2-1	Soil Characteristics on Richards-Gebaur AFB	2-4
2-2	Temperature and Precipitation Data for Richards-Gebaur AFB	2-11
3-1	Fieldwork Performed at Each Site	3-2
3-2	Schedule of Major Field Activities	3-5
3-3	Summary of Historic Aerial Photographs for Area Around Richards-Gebaur AFB	3-7
3-4	Summary of Surface Soil Sampling	3-9
3-5	Summary of Soil Borings	3-10
3-6	Summary of Subsurface Soil Sampling	3-12
3-7	Summary of Surface Water Sampling	3-14
3-8	Summary of Monitoring Well Construction Details	3-15
3-9	Summary of Groundwater Sampling	3-17
4-1	Threshold Values Applied to Soil Concentrations for Samples from Richards-Gebaur AFB as Compared with Literature Values for Western Missouri	4-2

Table		Page
4-2	Results of Water Sample Analyses for Site 1, South Landfill	4-6
4-3	Results of Soil Sample Analyses for Site 1, South Landfill	4-8
4-4	Results of Water Sample Analyses for Site 2, Northeast Landfill	4-12
4-5	Results of Soil Sample Analyses for Site 2, Northeast Landfill	4-13
4-6	Results of Water Sample Analyses for Site 6, North Burn Pit Area	4-16
4-7	Results of Soil Sample Analyses for Site 6, North Burn Pit Area	4-18
4-8	Results of Water Sample Analyses for Site 8, Herbicide Burial Area	4-19
4-9	Results of Soil Sample Analyses for Site 8, Herbicide Burial Area	4-21
4-10	Results of Water Sample Analyses for Site 9, Oil-Saturated Area	4-23
4-11	Results of Soil Sample Analyses for Site 9, Oil-Saturated Area	4-24
4-12	Results of Water Sample Analyses for Site 10, Hazardous Waste Drum Storage Area	4-25
4-13	Results of Soil Sample Analyses for Site 10, Hazardous Waste Drum Storage Area	4-27
4-14	Results of Water Sample Analyses for Site 12, POL Storage Yard	4-28
4-15	Results of Soil Sample Analyses for Site 12, POL Storage Yard	4-29
6-1	List of Sites by Category	6-2
6-2	Summary of Recommendations	6-3
6-3	Methods of Analysis for Recommended Samples	6-4

EXECUTIVE SUMMARY

Ecology and Environment, Inc., (E & E) was retained by the United States Air Force Occupational and Environmental Health Laboratory (USAFOEHL) under Contract No. F33615-83-D-4003, Task Order 13, to provide technical and analytical services in support of the Air Force Installation Restoration Program (IRP). This report concerns the Phase II Stage 2 investigation of Richards-Gebaur Air Force Base (AFB), Missouri.

The Phase II Stage 2 Presurvey (June 7, 1985) listed 13 sites where the potential for environmental problems existed. A total of seven sites were selected for additional investigation. Table 1 lists all 13 sites and denotes the seven sites investigated during this Stage. Figure 1 shows the locations of all 13 sites at Richards-Gebaur AFB.

SUMMARY OF FIELD PROGRAM

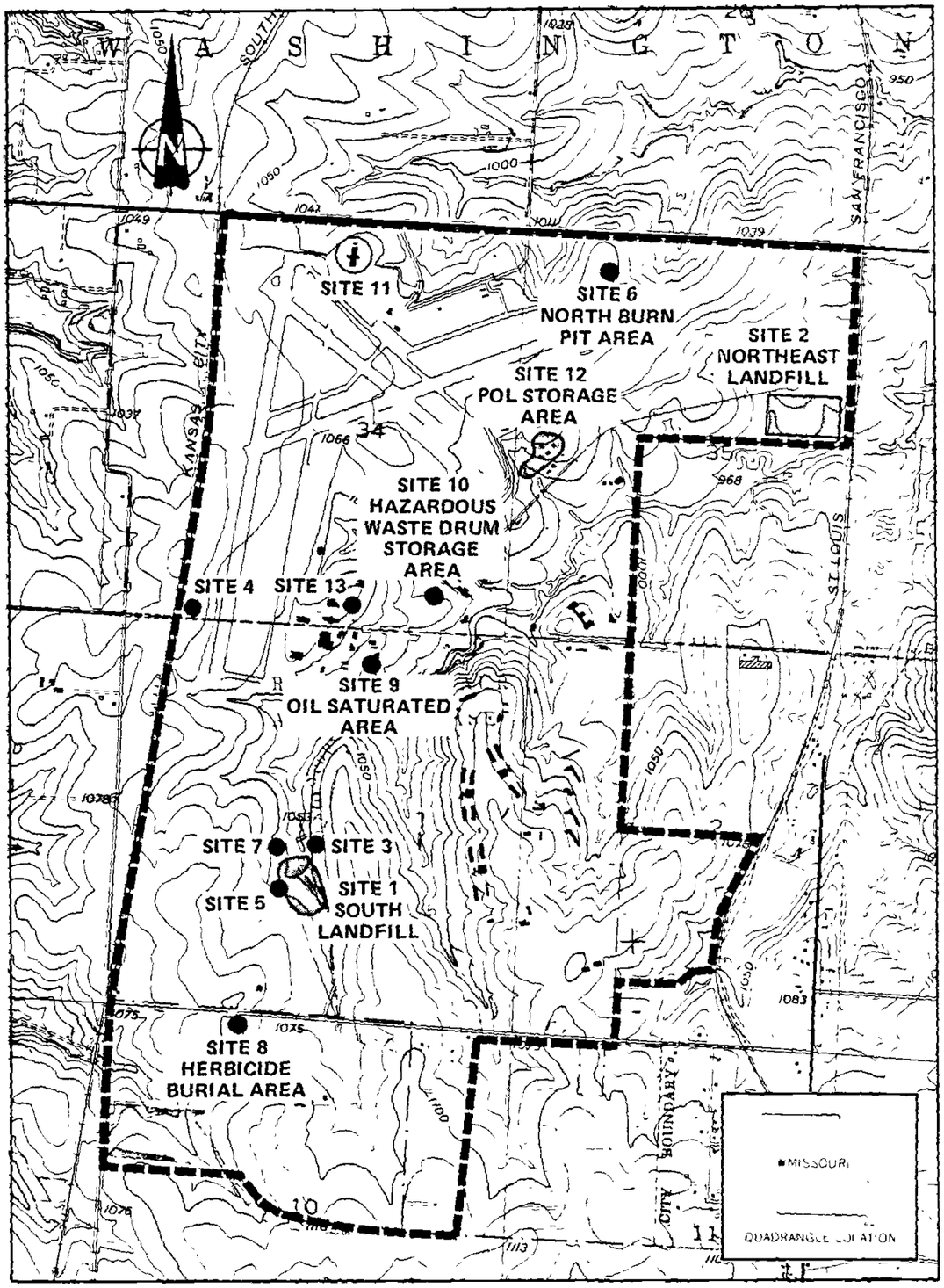
The fieldwork began on 2 October and ended on 4 November 1986. Twenty-seven surface soil samples were collected from the seven sites. A total of 38 subsurface soil samples were collected from 14 boreholes. Thirteen surface water samples were collected, along with nine groundwater samples. A total of six new monitoring wells were installed, bringing the current number of wells at the base to nine.

Two concurrent geophysical surveys (magnetometer and electromagnetic conductivity) were performed at Site 2, the Northeast Landfill, to help define the locations of burial trenches. At Site 6, the North Burn Pit Area, a soil gas survey was performed to help delineate the area of volatile organics contamination and to aid in the siting of monitoring wells and soil borings. Available aerial photographs were

Table 1

SUMMARY OF SITES - PHASE II STAGE 2 INVESTIGATION

Site Number	Site Name	Investigated During this Stage
Site 1	South Landfill	Yes
Site 2	Northeast Landfill	Yes
Site 3	Contractor Rubble Burial Area	No
Site 4	West Burn Area	No
Site 5	South Burn Area	No
Site 6	North Burn Pit Area	Yes
Site 7	Radioactive Disposal Well	No
Site 8	Herbicide Burial Area	Yes
Site 9	Oil-Saturated Area	Yes
Site 10	Hazardous Waste Drum Storage Area	Yes
Site 11	Paint Stripper Hangar	No
Site 12	POL Storage Yard	Yes
Site 13	Hazardous Material Storage Area	No



SOURCE U.S.G.S. 7.5' Quadrangle, Belton, Mo.—Kans., 1975.

SCALE

0 ½ 1 MILE

Figure 1 RICHARDS–GEBAUR AIR FORCE BASE IRP SITES

reviewed to define waste disposal practices and disposal area boundaries. Field and analytical activities at each site are listed in Table 2.

Findings

One site has been classified as Category I (No Further Action Recommended). Three sites have been classified as Category III (remedial action) sites. Two of these sites can proceed to the cleanup phase based on current information and one is recommended for long-term monitoring. One site has been classified as a Category III and Category II (additional site assessment) and is recommended for long-term monitoring with additional site assessment. Three sites are classified as Category II sites to determine the extent and magnitude of identified contamination. The following discussion summarizes the findings and their significance for each site. Table 3 presents a summary of the recommendations for future work at each of the sites along with corresponding rationale.

Site 1, South Landfill

Located in the south-central portion of the base, Site 1 was used as a sanitary landfill from 1954 to 1956. Construction rubble, yard waste, and some industrial waste were disposed of in the landfill until 1961. Waste paints, thinners, strippers, solvents, and oils were all known to have been disposed of at this site, although significant quantities were not reported.

Results of soil samples analyses showed relatively low levels of petroleum hydrocarbons (1.2 to 16 mg/kg). No contamination was found to be leaving the site via surface migration into adjacent Scope Creek. Therefore, no further work is recommended.

Site 2, Northeast Landfill

Site 2 is located in the northeast part of the base, adjacent to Scope Creek. The site was used as a demolition and industrial waste landfill from 1961 to 1972. Waste paints and thinners were reportedly dumped on the ground at this site.

Table 2

SUMMARY OF FIELDWORK/ANALYSES PERFORMED

Site	Fieldwork Performed	Analyses Performed
Site 1, South Landfill	• 1 borehole drilled • 7 soil samples collected • 4 surface water samples collected	Soils: petroleum hydrocarbons, VOC. Waters: petroleum hydrocarbons, TDS, VOC, priority pollutants, common anions, phenols.
Site 2, Northeast Landfill	• geophysical survey • 4 boreholes drilled • 2 monitoring wells installed • 10 soil samples collected • 5 groundwater samples collected • 3 surface water samples collected	Soils: petroleum hydrocarbons, VOC. Waters: petroleum hydrocarbons, TDS, VOC, priority pollutants, common anions, phenols
Site 6, North Burn Pit Area	• soil gas survey • 3 boreholes drilled • 3 monitoring wells installed • 15 soil samples collected • 3 groundwater sample collected • 1 surface water sample collected	Soils: petroleum hydrocarbons, VOC. Waters: petroleum hydrocarbons, VOC.
Site 8, Herbicide Burial Area	• 4 soil samples collected • 1 surface water sample collected	Soils: pesticides, arsenic, mercury. Waters: TDS, pesticides, arsenic, mercury.
Site 9, Oil-Saturated Area	• 1 borehole drilled • 8 soil samples collected • 1 surface water sample collected	Soils: petroleum hydrocarbons, VOC, lead. Waters: petroleum hydrocarbons, TDS, VOC, lead.
Site 10, Hazardous Waste Drum Storage Area	• 1 borehole drilled • 9 soil samples collected • 1 surface water sample collected	Soils: petroleum hydrocarbons, VOC, EP TOX metals. Waters: petroleum hydrocarbons, TDS, priority pollutant metals, barium.
Site 12, POL Storage Yard	• 3 boreholes augered • 1 monitoring well installed • 1 soil sample collected • 4 groundwater samples collected • 2 surface water samples collected	Soils: petroleum hydrocarbons, VOC. Waters: petroleum hydrocarbons, TDS, VOC.

Table 3

SUMMARY OF RECOMMENDATIONS

Site	Recommendation	Rationale
Site 1, South Landfill	Category I. No further action.	No significant contamination was found during the Stage 2 investigation.
Site 2, Northeast Landfill	Category III. Biannual monitoring for 2 years. Collect and analyze groundwater samples from five existing monitoring wells twice yearly.	To determine changes in groundwater quality because elevated sulphate concentrations were the only indicators of contamination above acceptable limits.
Site 4, West Burn Area	Category II. Perform a soil gas survey and geophysical survey. Install three monitoring wells and collect and analyze groundwater samples. Collect subsurface and surface soil samples.	To determine the exact location of the site and determine if hazardous constituents have migrated from the site.
Site 6, North Burn Pit Area	Category III and II. Biannual monitoring for 2 years. Install two more monitoring wells. Collect and analyze groundwater samples from five monitoring wells twice yearly.	To better characterize the organic contamination of the groundwater.
Site 8, Herbicide Burial Area	Category II. Additional geophysical surveys. Drill four boreholes and collect two soil samples from each borehole.	To determine exact location of trench and analyze soil from within the trench.
Site 9, Oil-Saturated Area	Category III. Excavate and remove contaminated soils.	To reduce risk of potential direct human contact to soils contaminated with petroleum hydrocarbons and lead.
Site 10, Hazardous Waste Drum Storage Area	Category III. Excavate and remove contaminated soils.	To reduce risk of potential direct human contact petroleum hydrocarbons.
Site 12, POL Storage Yard	Category II. Install four monitoring wells. Collect and analyze groundwater samples twice yearly.	To determine if volatile organic compound contamination has migrated from the site.

The water samples showed detectable concentrations of common anions; however, only sulfate, at 280 mg/L, exceeded EPA secondary drinking water standards. No detectable levels of organics or metals were found in the water samples. For soils, concentrations of petroleum hydrocarbons were detected up to a maximum of 440 mg/kg, indicating the need for further characterization.

Site 4, West Burn Area

The West Burn Area was used for 1 year in 1955 for fire training. Jet fuel, solvents, and oil were all believed to have been burned on-site.

The West Burn Area was not investigated because the site was believed to be off base. However, since the investigation began, new aerial photographic data indicate the site may actually be located east of the railroad tracks. During a tour of the site on August 12, 1987, a material believed to be tank sludge was found in an area just north of the county line and just east of the railroad tracks. Additional investigation at this site is recommended. This site is on property which is either leased or owned by the City of Kansas City, Missouri. New access agreements must be agreed to by the City prior to further investigation.

Site 6, North Burn Pit Area

The North Burn Area is located north of the flight line and was constructed in 1965. This facility is currently used for fire training. The same materials used at the West Burn Area are used at this site.

Several organics (chloroform--0.50 to 0.61 µg/L, tetrachloroethylene--0.41 to 0.71 µg/L, methylene chloride--37 µg/L) were found above detection limits in the water samples at this site. The concentrations found, however, were well below EPA standards. For soils, low levels of petroleum hydrocarbons were detected (up to 5.7 mg/kg). A single surface sample had a value of 34 mg/kg. In order to better characterize the organic contamination in the groundwater, additional groundwater testing has been recommended.

Site 8, Herbicide Burial Area

The Herbicide Burial Area is reportedly located near the south end of the runway. A stressed vegetation area, located in this general area, is believed to be the site. About four cases of pint-sized plastic bottles of a herbicide containing mercury were buried at this site.

No detectable concentrations of any contaminants were reported in the water sample from this site and values of metals in the soil samples were within the range of normal concentrations for western Missouri soils. In addition, no organic contamination was detected in the soil. However, the exact location of the trench could not be determined. Therefore, it is recommended that further investigations focus on locating the trench using geophysics. The general area where the trench was to have been dug is indicated in a Air Force document which was made available during the Phase II Stage 2 investigation. Following confirmation of the trench location, sampling has been recommended to characterize any potential contamination.

Site 9, Oil-Saturated Area

In the southwest corner of the Motor Pool Compound (Building 704) is an area that is saturated with waste oil and possibly hydraulic fluids and solvents. The area is covered with gravel, but there is evidence of recurring oil discharge at the Motor Pool fence line.

Results of soil sample analyses indicate lead and petroleum hydrocarbon contamination in the 0- to 1-foot depth. Lead levels ranged from 9.22 mg/kg to 169 mg/kg. The potential for direct contact by humans with these soils warrants consideration of removal. A cleanup level of 160 mg/kg has been derived based on a conservative potential health risk scenario using the EPA Recommended Maximum Contaminant Level (RMCL) for lead. Six of the nine samples contained less than 9 mg/kg of petroleum hydrocarbons; however, three samples had concentrations ranging from 670 to 3,800 mg/kg. This indicates possible spill areas, for which removal of the surficial soils should be considered.

Site 10, Hazardous Waste Drum Storage Area

The Hazardous Waste Drum Storage Area was located at the southwest corner of Building 923. This area, which is fenced and paved, was used for an undetermined number of years for storage of drummed waste prior to disposal.

Contaminants found in the soils from this area were limited to petroleum hydrocarbons (ND to 1900 mg/kg). Lead and barium were detected in the surface water; however, the levels were well below EPA's Maximum Contaminant Limit (MCL), RMCL and Health Advisories (HA) for these compounds. Petroleum hydrocarbons and volatile organics were not detected in the surface water samples.

Site 12, Petroleum, Oil, and Lubricants (POL) Storage Yard

The POL Storage Yard is an aboveground tank farm located east of the flight line. One major and several minor fuel spills have occurred in this area. Also, the integrity of the floor drain system inside the pump houses is in question.

Water samples from this site showed no contamination above detection limits. Soil samples showed contamination with petroleum hydrocarbons. Five of the samples contained concentrations of 6.9 to 44 mg/kg. The remaining seven samples ranged from 67 to 2,800 mg/kg. Removal of soils with the higher concentrations is recommended. Additional contamination found in soil samples indicated spills of JP4 or some other petroleum hydrocarbon around one of the buildings at this site. This, however, is to be expected at an active storage facility. The installation of monitoring wells to determine if contaminants are moving from the site is recommended.

Four sites identified in the Phase I investigation or the Phase II, Stage 1 Presurvey Report are located on land now owned or leased by the City of Kansas City, Missouri, and were not included in this study. These sites are:

- Site 3, Contractor Rubble Burial Site;
- Site 5, South Burn Area;

- Site 7, Radioactive Disposal Well; and
- Site 11, Paint Stripper Hangars.

Access to these sites was not granted by the City, based on the recommendations of the Phase II Stage 1 report (see Appendix B of this report).

An additional site (Site 13, Hazardous Material Storage Building 927) was not included in the "Description of Work" for this investigation.

E & E recommends that Sites 3, 11, and 13 be included in any future RI/FS investigations at Richards-Gebaur AFB for the following reasons:

- Site 3 was investigated in Phase I, but no samples were taken. It is recommended that sampling be conducted to confirm the conclusions drawn from the records search.
- Site 11 was not identified in earlier work. It was included in Phase II Stage 2, but access was not granted by the City of Kansas City.
- Site 13 was recommended for further investigation in the Phase II Stage 1 report, but was not included in Stage 2. It was noted at the pre-survey meeting that a milky-white-colored discharge was observed at the site.

1. INTRODUCTION

The Installation Restoration Program (IRP) was initiated by the Department of Defense (DOD) to investigate environmental contamination that may be present at DOD facilities as the result of past operations and waste disposal activities. Following passage of the Resource Conservation and Recovery Act (RCRA) of 1976 and the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) of 1980, DOD issued the Defense Environmental Quality Program Policy Memorandum (DEQPPM) 80-6 in June 1980. DEQPPM 80-6 mandated that hazardous waste disposal sites on DOD facilities be identified. The United States Air Force (USAF) implemented DEQPPM 80-6 in December 1980. DOD revised and expanded existing IRP directives through DEQPPM 81-5 in 1981, and the USAF implemented it in January 1982. The IRP was developed as a four-phase program as follows:

- Phase I - Records Search;
- Phase II - Confirmation and Quantification;
- Phase III - Technology Base Development; and
- Phase IV - Corrective Action.

This report documents work performed by Ecology and Environment, Inc., (E & E) for the USAF at Richards-Gebaur Air Force Base (Richards-Gebaur AFB), Missouri. The work was done as part of Phase II Stage 2 of the IRP under Contract No. F33615-83-D-4003, Task Order 13. The purpose of Phase II Stage 2 work was:

- To determine the presence or absence of contamination at specified areas;

- To define the magnitude and potential of contaminant migration, if possible; and
- To identify potential health and/or environmental hazards based on state or federal standards.

A Phase I Initial Records Search had been conducted by CH2M Hill as outlined in a report dated March 1983. The Phase I report identified sites with potential contamination problems and made recommendations for Phase II investigation. Based on these recommendations, a Phase II Stage 1 investigation was performed on the two sites, Site 1, the South Landfill, and Site 2, the Northeast Landfill, which ranked above 50 on the USAF Hazard Assessment Rating Methodology (HARM) scale ranking system. Preliminary investigation was performed by Water and Air Research, Inc. The results of this investigation were finalized in a report dated December 1983.

In 1985, Richards-Gebaur AFB was scheduled to be reevaluated under the IRP. A presurvey meeting was arranged and all past and current potential sites were visited and evaluated. The presurvey was conducted by E & E and their recommendations were provided in a Presurvey Report dated June 1985.

The sites included in that survey are:

- Site 1, South Landfill,
- Site 2, Northeast Landfill,
- Site 3, Contractor Rubble Burial Area,
- Site 4, West Burn Area,
- Site 5, South Burn Area,
- Site 6, North Burn Area,
- Site 7, Radioactive Disposal Well,
- Site 8, Herbicide Burial Area,
- Site 9, Oil-Saturated Area,
- Site 10, Hazardous Waste Drum Storage Area,
- Site 11, Paint Stripper Hangar,

- Site 12, Petroleum, Oils, and Lubricants (POL) Storage Yard, and
- Site 13, Hazardous Material Storage--Building 927.

Based on this report and after review by state and federal offices, the USAF contracted Phase II Stage 2 investigation of the following sites:

- Site 1, South Landfill,
- Site 2, Northeast Landfill,
- Site 6, North Burn Pit Area,
- Site 8, Herbicide Burial Area,
- Site 9, Oil-Saturated Area,
- Site 10, Hazardous Waste Drum Storage Area, and
- Site 12, POL Storage Yard.

1.1 LOCATION AND HISTORY OF OPERATIONS

The primary source of historical information on the base was the Phase I report by CH2M Hill (1983). The information was confirmed and updated by E & E as part of the Phase II Stage 2 investigation.

Richards-Gebaur AFB is located in west-central Missouri, 2.6 miles from the Kansas-Missouri state line (see Figure 1-1). The Jackson County and Cass County line runs east-west through the middle of the base. The base is bounded on the north by the City of Grandview, on the north and west by Kansas City, and on the south and east by the City of Belton. The base is about 18 miles southeast of downtown Kansas City. Access to the base is via U.S. Highway 71.

The legal description of the base includes the following ranges and townships:

Range	Township	Sections
R46N	T33W	2, 3, 10, 11
R47N	T33W	34, 35

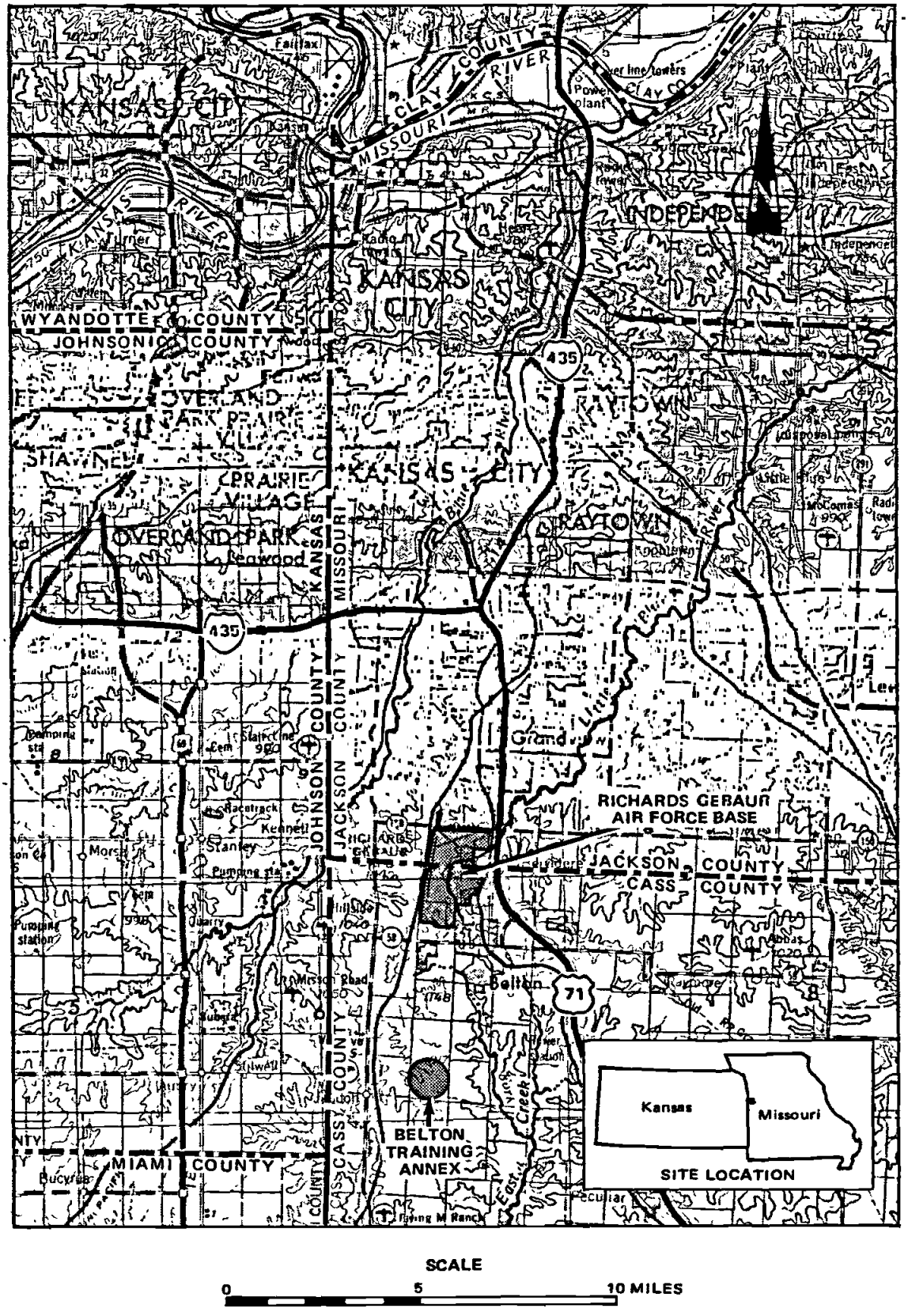


Figure 1–1 LOCATION MAP OF RICHARDS-GEBAUR AIR FORCE BASE, MISSOURI

The base has undergone a number of changes since the Phase I and Phase II Stage 1 surveys and the 1985 Phase II Stage 2 presurvey. The changes regard the turning over of large portions of the original installation to several new landlords. These landlords include the City of Belton and Kansas City Aviation Department, which operates air service out of Richards-Gebaur Airport. Other portions of the base are now used by various branches of the military.

The area which is now Richards-Gebaur AFB was acquired by Kansas City in 1941 for use as an auxiliary airport, which was then called Grandview Airport. In 1952, the Air Defense Command (ADC) leased the airport from the city for use in air defense operations, and in 1953 the property was formally conveyed to the U.S. Government. The base was redesignated Richards-Gebaur AFB in 1957 in honor of two Kansans, First Lieutenant John F. Richards and Lieutenant Colonel Arthur W. Gebaur, Jr.

ADC had the primary mission on the base until 1970, when the Air Force Communications Command (AFCC) assumed command and relocated its headquarters from Scott AFB, Illinois. In 1977, AFCC moved back to Scott AFB, and Richards-Gebaur AFB came under the Military Airlift Command.

Between 1977 and 1979, the number of active duty and civilian forces at Richards-Gebaur AFB was drastically reduced from a maximum of about 5,000 personnel during the active years of the base to less than 500 full-time personnel. In September 1979, the majority of the operating support functions were transferred to a civilian contractor, Talley Services, Inc.

The 442nd Tactical Fighter Wing currently has the primary mission on the base. The Air Force Reserves (AFRES) unit was originally activated in 1949 at Fairfax Field in Kansas City, Kansas, and was relocated to Naval Air Station (now Johnson County Industrial Airport), Olathe, Kansas, in 1950 before arriving at Richards-Gebaur AFB in 1955. The co-located AFRES units have an authorized strength of 197 full-time Air Reserve technicians, 1,073 reservists, and 224 civilian employees.

Active duty support units remaining at Richards-Gebaur AFB include the 1879th Communications Squadron (AFCC) and Operating Location A, Detachment 19, 26th Weather Squadron (MAC). Other federal government agencies presently using base facilities include U.S. Marine Corps

occupation of the former base officer housing area; the U.S. Department of Agriculture Standardization Division; the U.S. Navy Seabee Reserve Mobile Construction Battalion No. 15; 308th Psychological Operations Company; nine U.S. Army reserve units; and the General Services Administration (GSA).

In October 1980, the majority of the base facilities and properties were accessed to the GSA in an interim lease, and joint use of the airport with Kansas City became effective. Base support facilities are currently shared by AFRES, Kansas City, and Talley Services, Inc.

A more detailed description of the base history and its mission can be found in the Phase I Records Search Report.

The Air Force controlled property at Richards-Gebaur AFB involves a fairly complex arrangement of ownership, permit use, leases, and easements. Figure 1-2 illustrates the current distribution of various land parcels within the base boundaries. Base property at the present time includes about 2,160 acres, of which 375 acres are retained by the USAF; 1,673 acres are leased to Kansas City and the City of Belton; 101 acres are being transferred to the Department of the Navy; and 11 acres have been transferred to the Department of the Army. An off-base drop zone, the Belton Training Annex, represents another 472 acres of land under the control of Richards-Gebaur AFB.

1.2 SITE DESCRIPTIONS

The primary source of information on the following site descriptions was the Phase I report prepared by CH2M Hill. The information was confirmed and updated by E & E as part of the Phase II Stage 2 investigation. The locations of the sites are shown on Figure 1-3.

1.2.1 Site 1, South Landfill

The South Landfill is located in the south-central part of the base near the nondestructive inspection (NDI) laboratory and adjacent to Scope Creek (see Figure 1-4). Between 1954 and 1956, this site was the main sanitary landfill for Richards-Gebaur AFB. In 1956, contract off-base disposal of most common refuse was begun, although some wastes, including building rubble, yard debris, and waste from some industrial shop areas, were disposed of at the site until about 1961. Materials

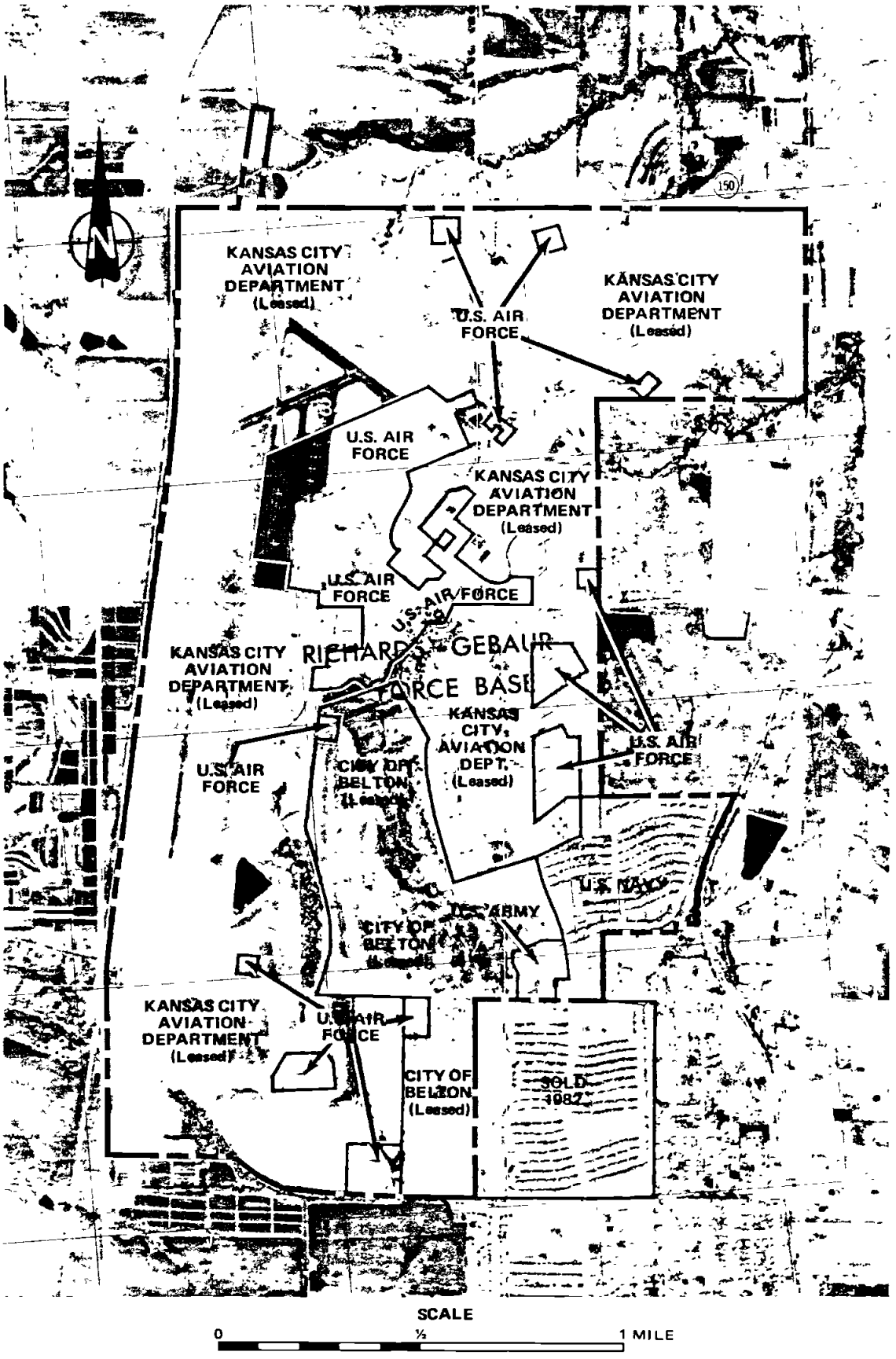
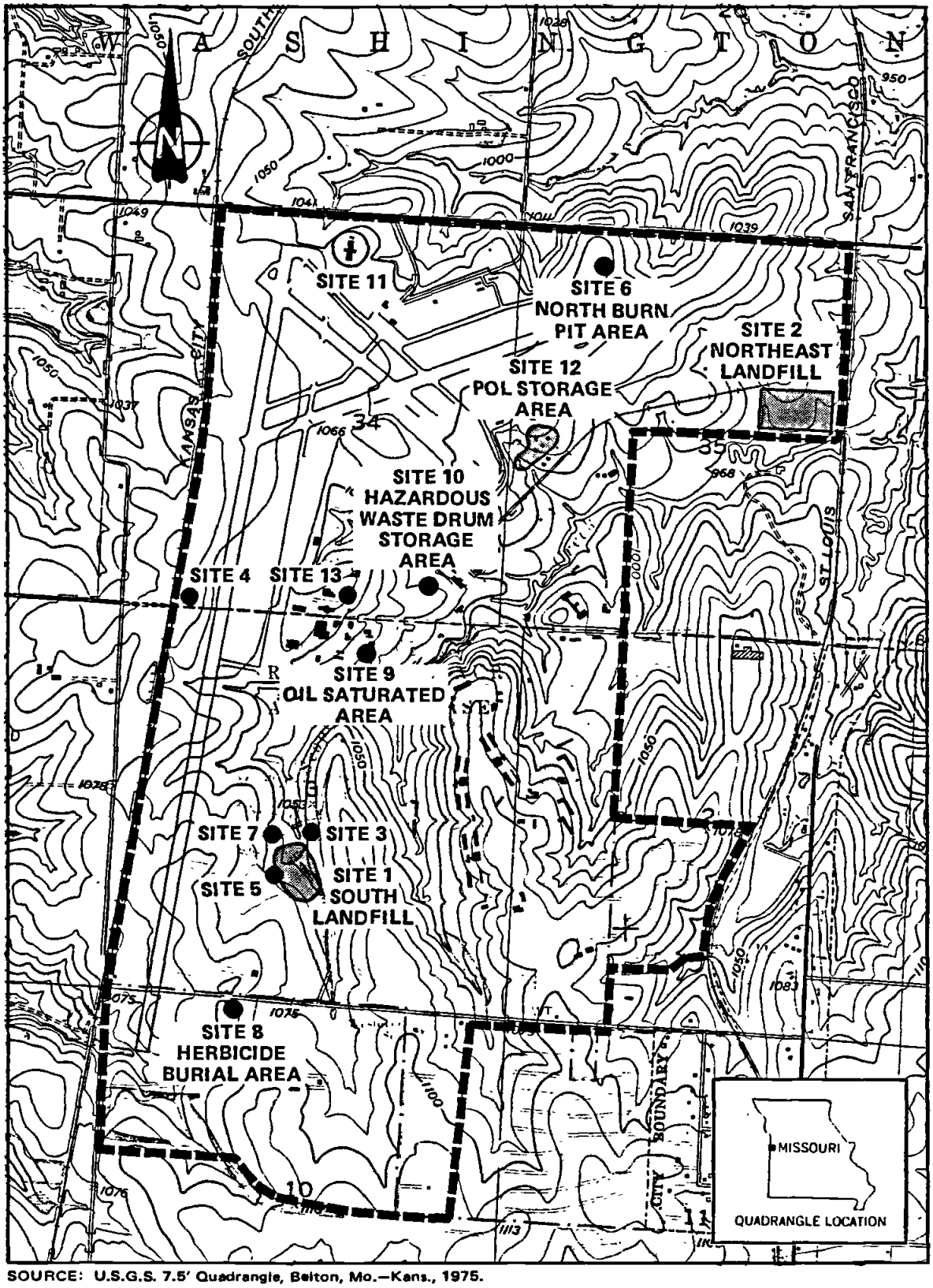


Figure 1–2 REAL PROPERTY AREAS, RICHARDS-GEBAUR AFB, MISSOURI



SOURCE: U.S.G.S. 7.5' Quadrangle, Belton, Mo.—Kans., 1975.

SCALE
0 ½ 1 MILE

Figure 1–3 RICHARDS–GEBAUR AIR FORCE BASE IRP SITES

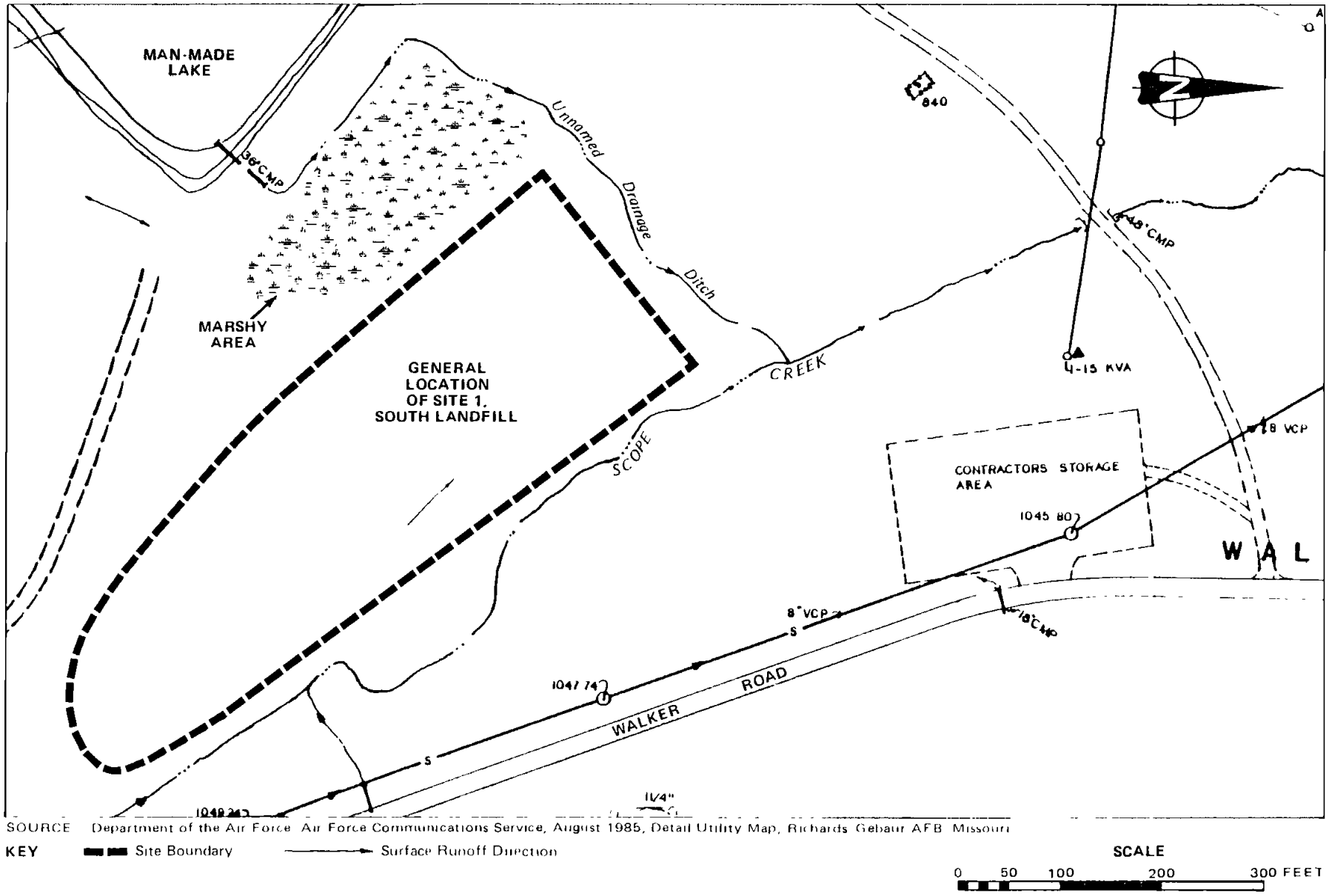


Figure 1–4 SITE 1, SOUTH LANDFILL LOCATION MAP

which may have been disposed of in the South Landfill include small quantities of waste paints, thinners, strippers, solvents, and oils, although it was not standard procedure to dispose of such materials here. Operation of the landfill included burning of the disposed wastes. Since 1961, the area has been used only intermittently for unauthorized dumping, including residues from tar pots and some household wastes. Small quantities of hazardous wastes may have been placed in this landfill; however, no significant hazardous waste quantities were reported. An earthen barricade has been erected at the entrance to the site, and current access to the site is through a locked road gate.

Scope Creek runs along the eastern edge of the landfill and there is a small man-made lake directly west of and upgradient from the landfill. The northwest area of the landfill is marshy due to this lake, and seeps were observed in this area. Scope Creek empties into Little Blue River, which drains most of eastern Jackson County. The Little Blue River empties into the Missouri River.

1.2.2 Site 2, Northeast Landfill

The Northeast Landfill is located in the northeasternmost portion of the base adjacent to Scope Creek (see Figure 1-5). The site was used between 1961 and 1972 for the disposal of miscellaneous wastes, including building rubble, yard debris, and wastes from some industrial shop areas. The eastern portion of Site 2 was used for open storage of materials, including construction materials, pipes, empty tanks, waste paint and thinners in drums and buckets, and empty 55-gallon drums. As many as 400 drums were located in this area at one time. Less than 20 drums, mostly empty, were on-site as of 1986. The wastes were typically burned and buried in trenches. Most of the sanitary wastes at Richards-Gebaur AFB during this time were disposed of off-base through contract removal. Waste paints and thinners at the base were reportedly disposed of on the ground surface as late as 1978.

The Little Blue Valley Sewer District installed a 24-inch diameter reinforced concrete pipe (RCP) interceptor sewer line through the southeast corner of Site 2 in 1983. There was no indication that trash or other landfill material was encountered during construction. The

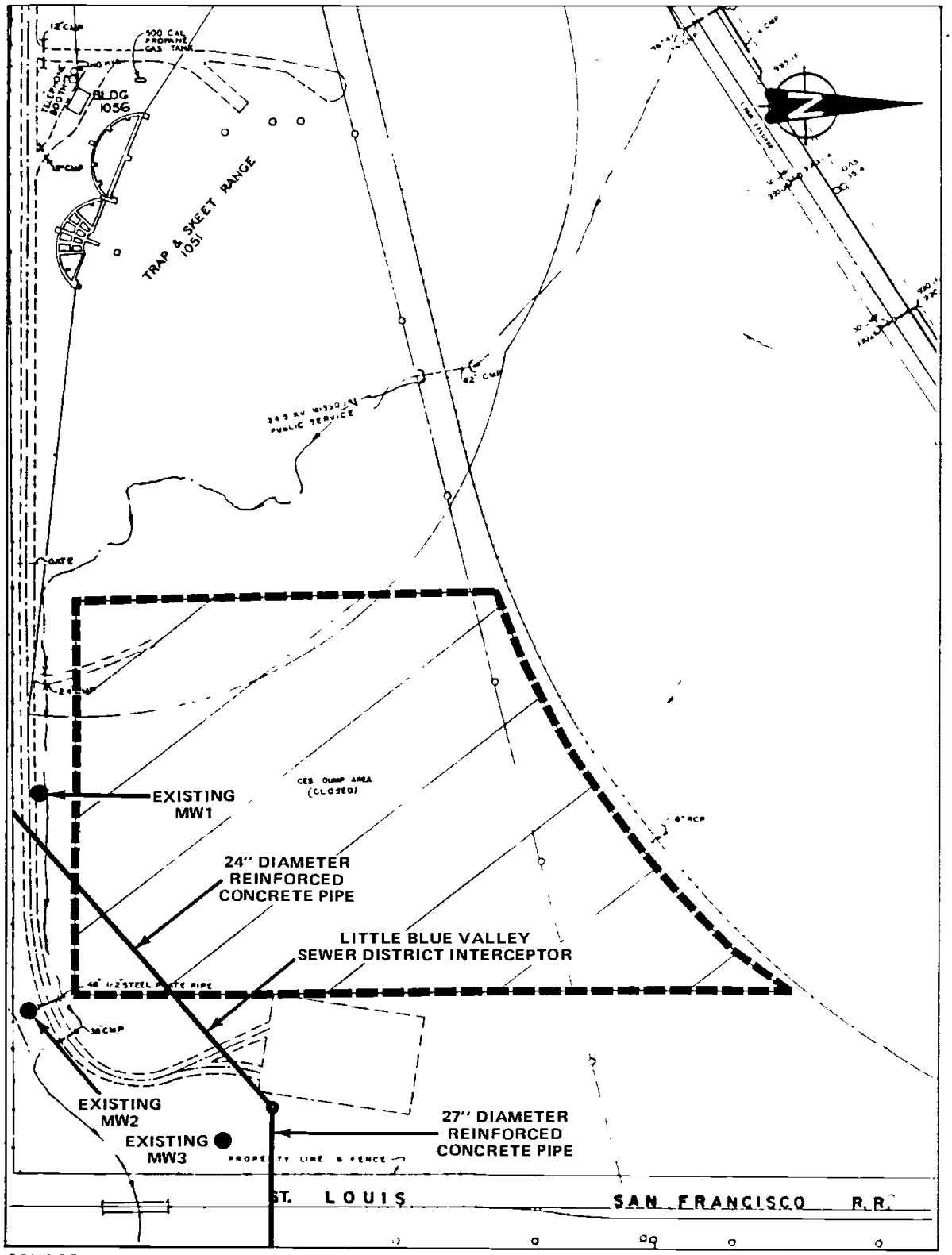


Figure 1–5 SITE 2, NORTHEAST LANDFILL LOCATION MAP

average depth of the line is 15 feet and the excavation width at the surface was 90 to 100 feet. Figure 1-5 shows the location of the interceptor.

1.2.3 Site 6, North Burn Pit Area

Site 6, the North Burn Pit Area, is located north of the flight line, just below the northern boundary of the base (see Figure 1-6). It was built in 1965 and is used for fire department training. A recent improvement to the facility is a 6-inch concrete rim around a concrete-lined burn pit, which is a circle with a radius of 50 feet. The drain that carries runoff from the pit is equipped with an oil-water separator. At least one incident of failure of the separator has been noted. In 1985-86, a chain-link fence was constructed around this facility. A slight depression was formed on the east side of the site as a result of the fence addition. During wet weather, some water is ponded in this area.

Fuel for the fire department training fires consisted of waste oils and possibly solvents, mixed with JP-4 fuel. An aboveground fuel storage tank is located in the southwest corner of the facility near the access gate. Reportedly, small quantities of fuel have been spilled during fuel transfer.

1.2.4 Site 8, Herbicide Burial Area

In 1971, about four cases of herbicide, reportedly containing mercury, in plastic pint-sized bottles, were reportedly buried in a trench near the south end of the runway (see Figure 1-7). Previous studies located this site in the general area of the south end and approximately 1,000 feet east of the original north-south runway. Since the city of Kansas City took over the air field, this runway has been extended approximately 3,000 feet. Vegetation stress was noted in the area at the time of the presurvey meeting. A small pond is located about 150 feet southeast of the supposed burial area.

1.2.5 Site 9, Oil-Saturated Area

Site 9, the Oil-Saturated Area, is located in the southwest corner of the Motor Pool Compound (Building 704) (see Figure 1-8). This

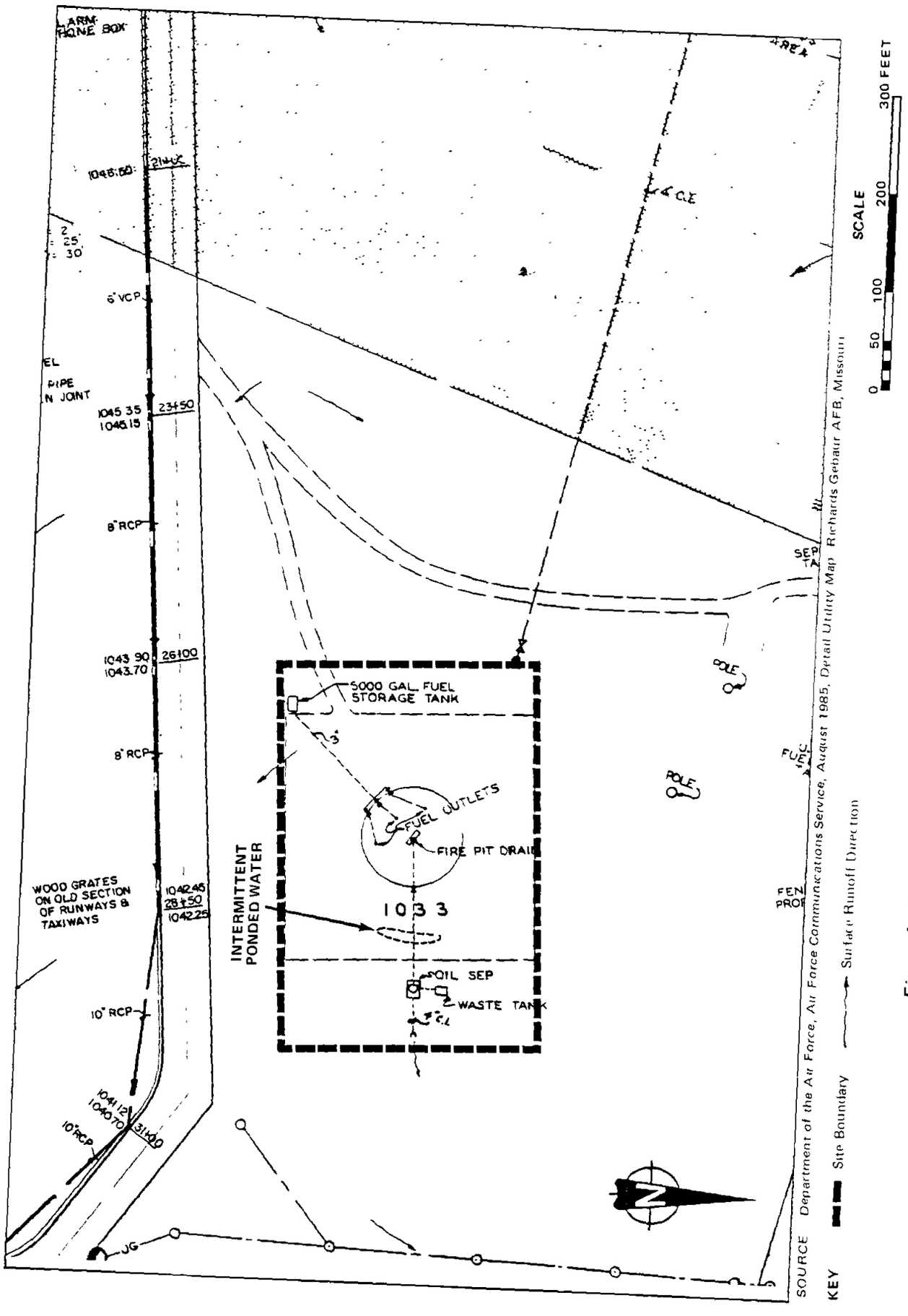
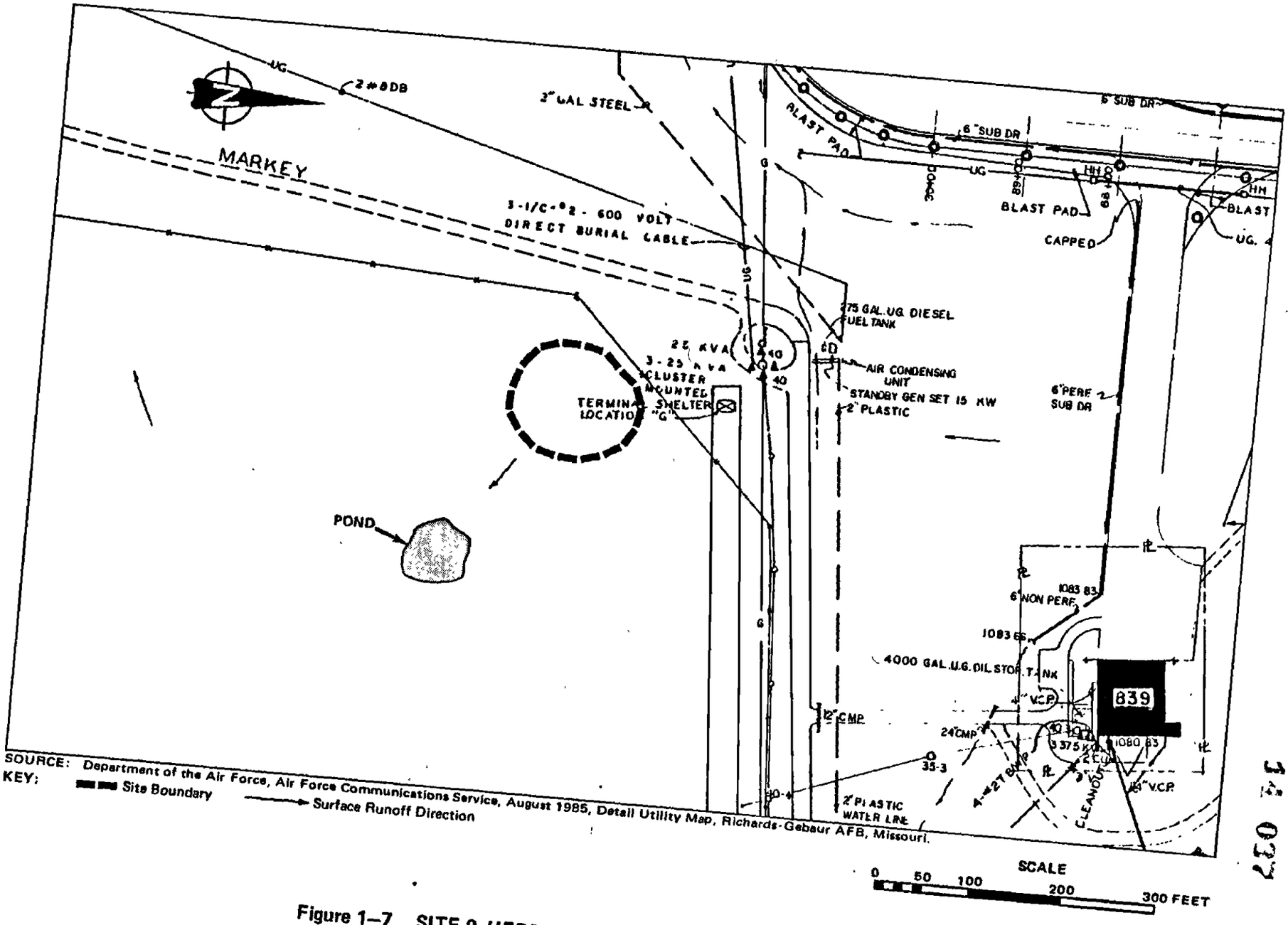


Figure 1–6 SITE 6, NORTH BURN PIT AREA LOCATION MAP



SOURCE: Department of the Air Force, Air Force Communications Service, August 1985, Detail Utility Map, Richards-Gebaur AFB, Missouri.

KEY: Site Boundary; Surface Runoff Direction

Figure 1–7 SITE 8, HERBICIDE BURIAL AREA LOCATION MAP

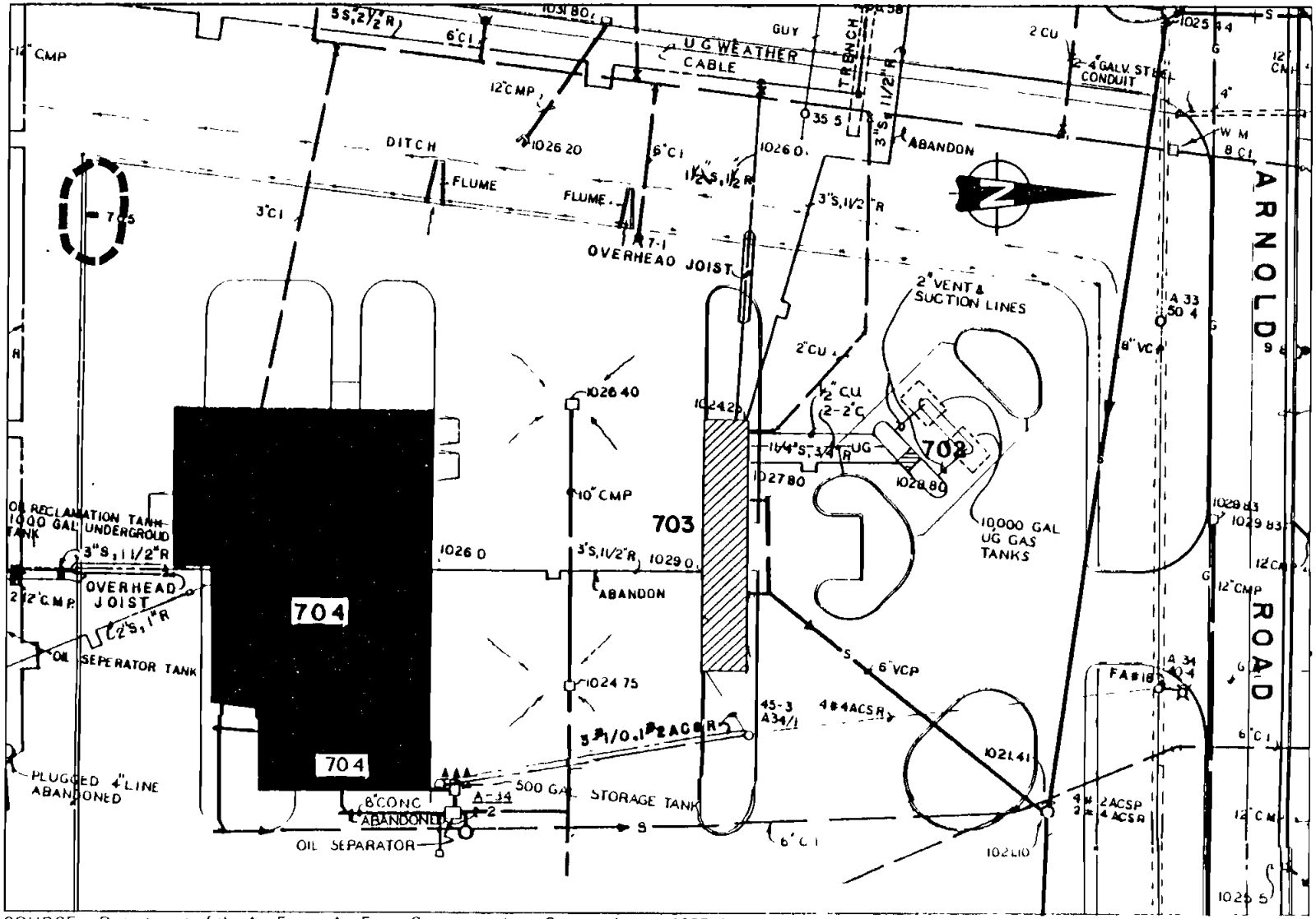


Figure 1–8 SITE 9, OIL SATURATED AREA LOCATION MAP

maintenance and storage area has been in operation since the mid-1950s. It is adjacent to a fuel-handling area to the north and recreation fields to the south. The site showed evidence of long-term saturation with waste oil and possibly hydraulic fluids and solvents. The area has been covered with gravel on several occasions, but there is evidence of recurring discharges of oil at the fence line in this area.

1.2.6 Site 10, Hazardous Waste Drum Storage Area

Site 10, the Hazardous Waste Drum Storage Area, was located along the southwest corner of Building 923 (see Figure 1-9). This fenced-in area was used for an undetermined number of years for storage of drums of waste prior to disposal. No hazardous materials are currently stored in this area. The area is partially surfaced with asphalt and tarmac, but surface water runoff flows unchecked into a grassy drainage ditch to the west of the area. During the 1985 Presurvey meeting, Site 6 and an adjacent Quonset hut were being used for categorization and overpacking of the drummed hazardous material which was still present on the site. This site was not part of the Phase I or Phase II Stage 1 investigations. The site is currently a staging area for contract groundskeepers.

1.2.7 Site 12, POL Storage Yard

Site 12, the POL Storage Yard, is a compound which contains several pump houses and four aboveground fuel storage tanks (see Figure 1-10). It is located east of the flight lines, downgradient from a small man-made pond and approximately 500 feet northwest and upgradient from the sewage treatment facility. Seepage from the pond feeds a marshy area west of the site and drains into a system of culverts. An iridescent sheen was noted on the marshy area during the presurvey site visit. One major and several minor spills have occurred in this compound. There is also concern regarding the integrity of floor drains inside the pump houses. The tanks are bermed, but the berms are weathered and cracked.

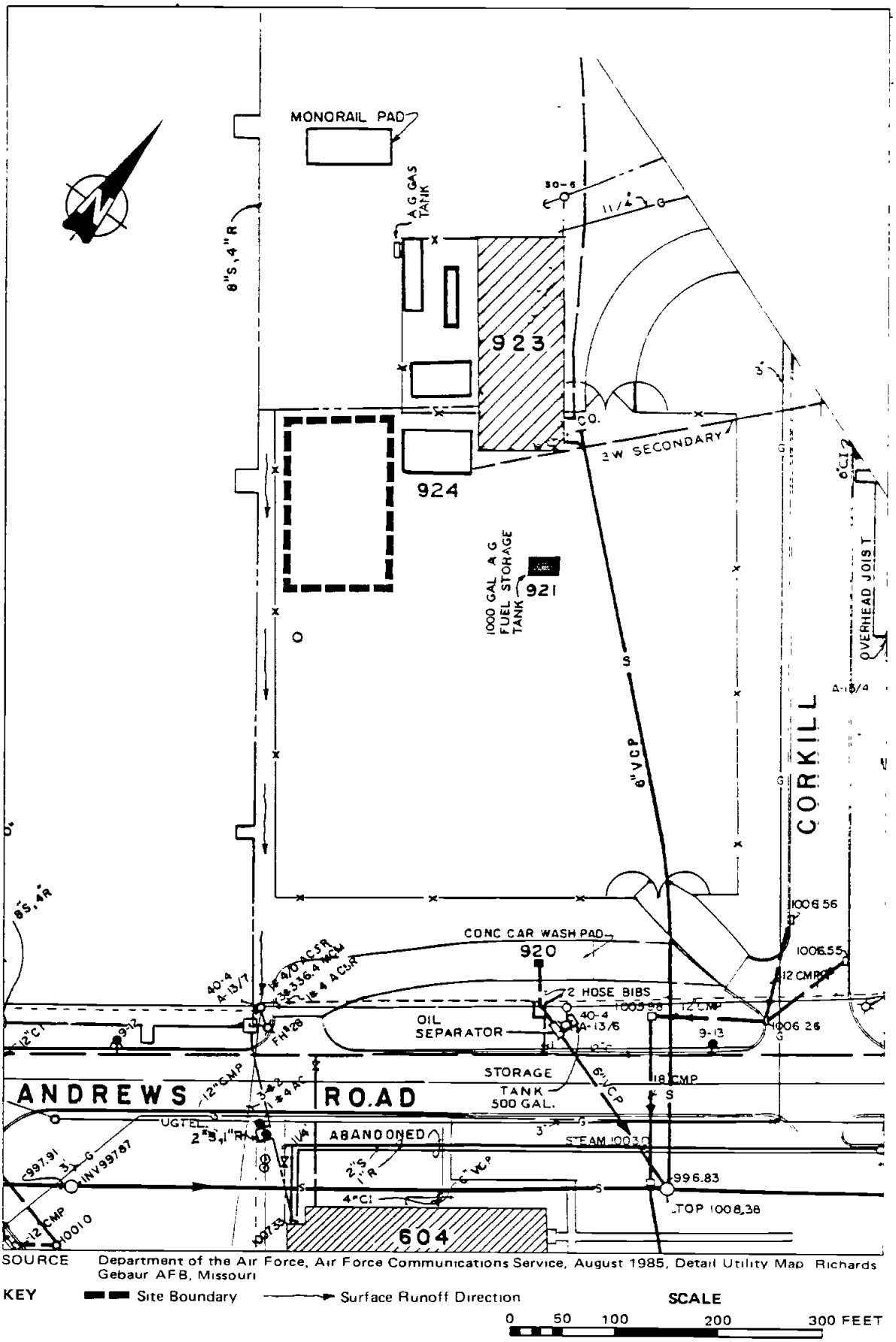
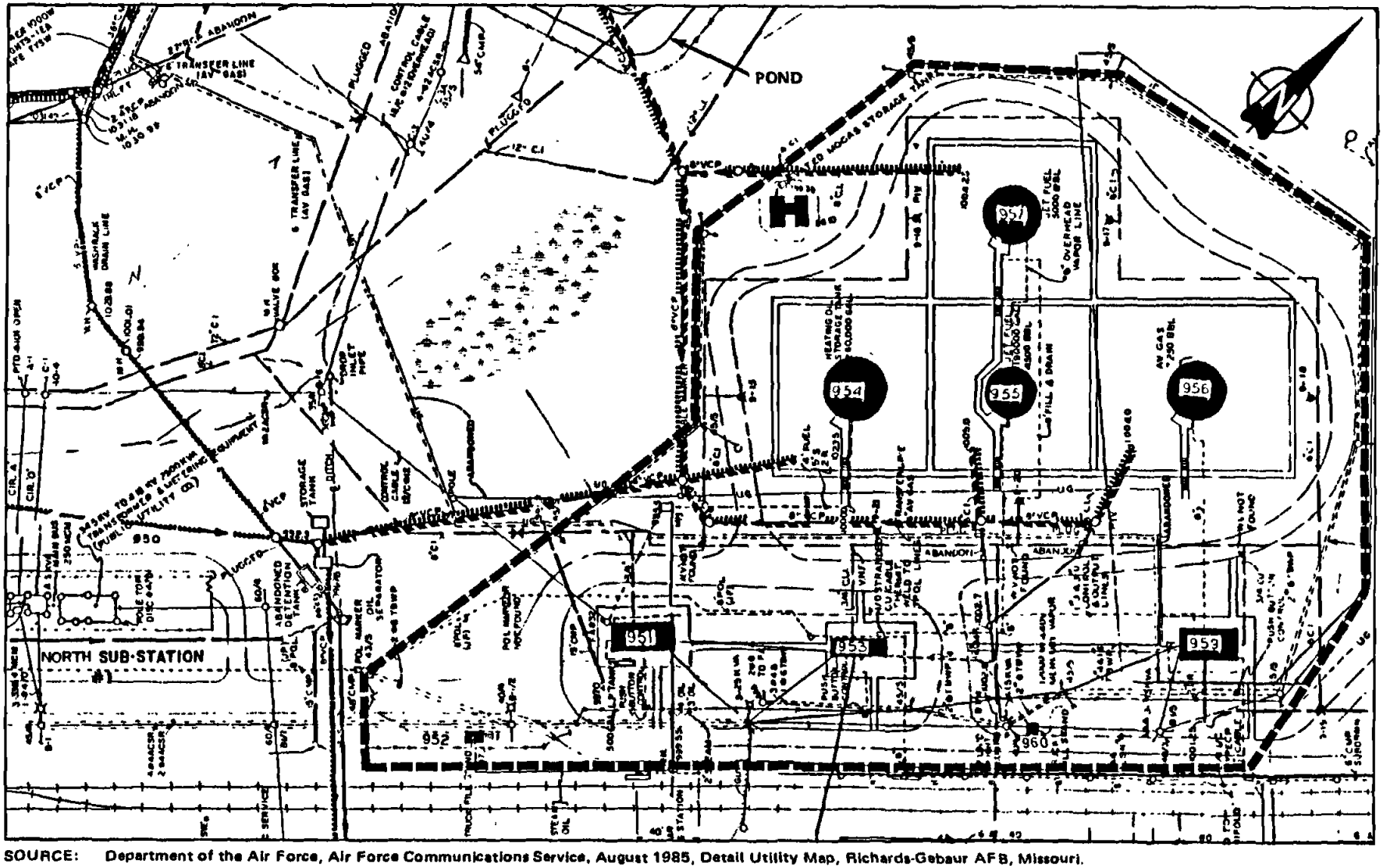


Figure 1–9 SITE 10, HAZARDOUS WASTE DRUM STORAGE AREA LOCATION MAP



SOURCE: Department of the Air Force, Air Force Communications Service, August 1985, Detail Utility Map, Richards-Gebaur AFB, Missouri.

KEY: Site Boundary — Surface Runoff Direction

SCALE
0 50 100 200 FEET

Figure 1–10 SITE 12, POL STORAGE YARD LOCATION MAP

1.3 SITES NOT INVESTIGATED DURING STAGE 2

Several sites were not investigated during the Stage 2 program. The sites were deleted because they either could not be located or they were located on property leased to the Kansas City Aviation Department, which denied access to all sites on Kansas City Aviation land, except the South and Northeast landfills. Access was not granted because the Phase II Field Evaluation Report, dated December 1983, recommended no further action. The letters denying access to sites 3, 5, 7, and 11 are found in Appendix B. The reason Site 13 was not investigated is unknown. This site was not listed in the Description of Work. The following is a discussion of those sites.

Site 3, Contractor Rubble Burial Site

The Rubble Burial Site is located on the east bank of Scope Creek in the south-central part of the base. It reportedly was in operation from 1954 through 1978. The area is not posted or fenced and appears to have been used more recently than 1978. The area is fairly level and most of the debris is discharged over the bank at the treeline. During the presurvey visit, construction materials, including wood, concrete, masonry, and metal, were observed; however, dense foliage prevented a more thorough investigation. A 5-gallon sealed plastic container of an unidentified liquid was discovered at the base of the fill and brought to the attention of the Richards-Gebaur AFB civil engineer. This area is on land either sold or leased to the City of Kansas City. The Kansas City Aviation Department did not grant access to this site.

Site 4, West Burn Area

The West Burn Area was tentatively identified as being located off the base to the west on the west side of the railroad track and north of the Jackson County line. During the presurvey fieldwork, no evidence of this site could be found. Since the West Burn Area was in operation for only 1 year (1955) approximately 30 years ago, it was thought that there was no physical evidence of this site. However, since the Phase II Stage 2 Field Investigation, aerial photographs not previously available indicate the site may actually be located east of the railroad. During a familiarization tour on August 12, 1987, a material believed to be

tank sludge was found in an area just north of the county line and just east of the railroad tracks. At the time of the fieldwork, the site location was unknown and believed to be off base. Therefore, the site was not investigated.

Any impact that this site might have had will have to take into account the presence of the Knoche oil field 3,000 feet to the southeast. The uplands here are fairly level and the area of the site currently is farmed in corn. A tree nursery is located across the county line to the south.

This site should be investigated further if Kansas City will grant access.

Site 5, South Burn Area

The South Burn Area tentatively has been identified as being located to the southwest of the South Landfill (Site 1). During the presurvey fieldwork, no evidence of this site could be found. Since the South Burn Area was in operation for 10 years (1955 to 1965) approximately 20 years ago, it is possible that there will be no physical evidence of this site at all. Because of its proximity to the South Landfill, any environmental contamination detected at this site will be reviewed in light of findings from the South Landfill investigation. This site is believed to be on land either owned or leased by the City of Kansas City, Missouri. The Kansas City Aviation Department did not grant access for this investigation.

Site 7, Radioactive Disposal Well

The Radioactive Disposal Well is located north of the South Landfill and east of the major flight line. It is believed to have been operated from 1955 to 1970. Discussion during the presurvey visit indicated that low-level radioactive material, typically radium dials, were disposed into this cased well. The site currently is behind a locked gate in an open field. The well itself is very visible, standing 4 to 5 feet high and painted red. This well is located on land owned or leased by the City of Kansas City, Missouri. The Kansas City Aviation Department did not grant access for this investigation. Therefore, no work was performed at this site.

Site 11, Paint Stripper Hangars--Building 1010

This site was not identified in either the Phase I or II reports nor was it included in the 15 April 1985 memorandum listing additional sites for confirmation. This site was visited during the presurvey meeting and was included in this stage of the investigation by Dr. John Yu (OEHL). The building consists of a set of four hangars, parts of which had been used in the past to strip paint from helicopters. One of the hangars continues to operate in this manner, but as a nonmilitary operation. Records indicate that while the site was under the control of the Kansas City Aviation Department, a spill of a commercial paint stripper contaminated the surface ditches draining this facility. Two metal drum sumps are located outside of two of the hangars and overflow into the surface ditches.

Building 1010 is located on land owned or leased by the City of Kansas City, Missouri. The Kansas City Aviation Department did not grant access for this investigation.

Site 13, Hazardous Material Storage--Building 927

This site was listed in the 15 April 1985 memorandum for inclusion in the confirmation stage of this investigation. The building is an engine and propeller maintenance shop using a number of degreasers, solvents, oils, and lubricants--all of which are stored in metal barrels on racks outside the back of the shop. The slope behind this shop gives indications of vegetation stress and minor runoff from the storage platform. The drainage from this building exits via an oil/water separator out to the surface, at the southeast corner of the compound. A milky-white colored discharge was observed flowing from this pipe during the presurvey site inspection. One floor drain in this building bypasses the oil/water separator and discharges directly to the surface.

This site was not addressed during this effort, but should be included in any future RI/FS efforts at Richards-Gebaur AFB.

1.4 TYPES OF CONTAMINANTS INVESTIGATED

The investigation was designed to determine the presence or absence of contamination in surface waters and groundwaters, sediments, and

subsurface soils at the defined sites of interest. Table 1-1 shows the analysis performed for each environmental matrix at each site.

Volatile Organics

Halogenated and aromatic hydrocarbons were analyzed using EPA Methods 601 and 602 for water samples and EPA Methods 8010 and 8020 for soil samples. A listing of the compounds detected by these methods and the corresponding detection limits (DL) are presented in Table 1-2.

Pesticides, Herbicides, and PCBs

Soil samples analyzed for organochlorine pesticides and PCBs were extracted using EPA Method 3550. EPA Method 8080 was used to analyze for organochlorine pesticides and PCBs in soil samples. EPA Method 8150 was used to analyze for chlorinated herbicides in soil samples. EPA Method 608 was used to analyze for organochlorine pesticides and PCBs in water samples. Standard Method 509B was used to analyze for chlorinated herbicides in water samples. A listing of the compounds detected by these methods and the corresponding DLs are presented in Table 1-2.

Base/Neutral/Acids (BNAs) - Extractable Organics

Water samples were analyzed using EPA Method 625. A listing of the compounds detected by these methods and the corresponding DLs are presented in Table 1-2.

Petroleum Hydrocarbons

Soil samples analyzed for petroleum hydrocarbons were extracted using EPA Method 3550, and analyzed using EPA Method 418.1. The DL for this method was 1.0 mg/kg. Water samples were analyzed using EPA Method 418.1. The DL for this method was 1.0 mg/L.

Phenols

Water samples were analyzed using EPA Method 604 (see Table 1-2). A listing of the compounds detected by this method and the corresponding DLs are presented in Table 1-2.

Table 1-1

SAMPLE ANALYSES PERFORMED AT RICHARDS-GEBAUR AFB

Parameter	Site 1	Site 2	Site 6	Site 8	Site 9	Site 10	Site 12
Halogenated Volatile Organics	Sd, S, W	Sd, S, W	Sd, S, W	--	Sd, S, W	Sd, S, W	Sd, S, W
Aromatic Volatile Organics	Sd, S, W	Sd, S, W	Sd, S, W	--	Sd, S, W	Sd, S, W	Sd, S, W
Base/Neutral/Acid Extractables	W	W	--	--	--	--	--
Pesticides	--	--	--	W	--	--	--
Herbicides	--	--	--	S, W	--	--	--
Petroleum Hydrocarbons	Sd, S, W	Sd, S, W	Sd, S, W*	--	Sd, S, W	Sd, S, W	Sd, S, W
Phenols	W	W	--	--	--	--	--
Primary Metals	W	W	--	--	--	W	--
EP TOX Metals	--	--	--	--	--	S	--
Arsenic	--	--	--	S, W,	--	--	--
Barium	--	--	--	--	--	W	--
Mercury	--	--	--	S, W	--	W	--
Lead	--	--	--	--	S, W	--	--
Common Anions	W	W	--	--	--	--	--
Total Dissolved Solids	W	W	W	W	W	W	W*

Key: Sd = Sediment
S = Soil
W = Water

*Scheduled but not analyzed

Table 1-2

ANALYTICAL PARAMETERS AND DETECTION LIMITS
USED FOR RICHARDS-GEBAUR AFB INVESTIGATION

Parameter	DL* Soil	DL* Water
Purgeable Halogenated Hyrdrocarbons (Methods 601 and 8010)		
Bromodichloromethane	1.0	0.10
Bromoform	1.0	0.20
Bromomethane	1.0	1.18
Carbon tetrachloride	1.0	0.12
Chlorobenzene	1.0	0.2
Chloroethane	1.0	0.52
2-Chloroethylvinyl ether	1.0	0.13
Chloroform	1.0	0.05
Chloromethane	1.0	0.08
Dibromochloromethane	1.0	0.09
1,2-Dichlorobenzene	1.0	0.4
1,3-Dichlorobenzene	1.0	0.4
1,4-Dichlorobenzene	1.0	0.3
Dichlorodifluoromethane	1.0	1.81
1,1-Dichloroethane	1.0	0.07
1,2-Dichloroethane	1.0	0.03
1,1-Dichloroethene	1.0	0.13
trans-1,2,Dichloroethene	1.0	0.10
1,2-Dichloropropane	1.0	0.04
cis-1,3-Dichloropropene	1.0	0.20
trans-1,3-Dichloropropene	1.0	0.34
Methylene chloride	1.0	0.25
1,1,2,2-Tetrachloroethane	1.0	0.03
Tetrachloroethene	1.0	0.03
1,1,1-Trichloroethane	1.0	0.03
1,1,2-Trichloroethane	1.0	0.02
Trichloroethene	1.0	0.12
Trichlorofluoromethane	1.0	2.0
Vinyl chloride	1.0	0.18
Purgeable Aromatics (Methods 602 and 8020)		
Benzene	1.0	0.2
Chlorobenzene	1.0	0.2
1,2-Dichlorobenzene	1.0	0.4
1,3-Dichlorobenzene	1.0	0.4
1,4-Dichlorobenzene	1.0	0.3
Ethylbenzene	1.0	0.2
Toluene	1.0	0.2
Xylenes (Total)	1.0	1.0
Phenolic Compounds (Method 604)		
4-Chloro-3-methylphenol	—	5.0
2-Chlorophenol	—	5.0
2,4-Dichlorophenol	—	5.0
2,4-Dimethylphenol	—	5.0
2,4-Dinitrophenol	—	13.0
2-Methyl-4,6-dinitrophenol	—	16.0
2-Nitrophenol	—	5.0
4-Nitrophenol	—	5.0
Pentachlorophenol	—	7.4
Phenol	—	5.0
2,4,6-Trichlorophenol	—	5.0

Table 1-2 (Cont.)

Parameter	DL* Soil	DL* Water
Pesticides, Herbicides, PCB Compounds (Methods 608, 8080, 8150, and 509)		
Aldrin	1.0	0.05
a-BHC	1.0	0.05
b-BHC	1.0	0.05
g-BHC	1.0	0.05
d-BHC	1.0	0.05
Chlordane	1.0	0.50
4,4'-DDD	1.0	0.10
4,4'-DDE	1.0	0.10
4,4'-DDT	1.0	0.10
Dieldrin	1.0	0.10
Endosulfan I	1.0	0.05
Endosulfan II	1.0	0.10
Endosulfan sulfate	1.0	0.10
Endrin	1.0	0.10
Endrin aldehyde	1.0	0.10
Heptachlor	1.0	0.05
Heptachlor epoxide	1.0	0.05
Toxaphene	1.0	1.0
2,4-D	1.0	0.5
2,4,5-TP (Silvex)	1.0	0.05
2,4,5-T	1.0	0.05
2,4-DB	1.0	--
Dicamba	1.0	--
Dalapon	1.0	--
PCB-1016	1.0	0.50
PCB-1221	1.0	0.50
PCB-1232	1.0	0.50
PCB-1242	1.0	0.50
PCB-1248	1.0	0.50
PCB-1254	1.0	1.0
PCB-1260	1.0	1.0
Priority Pollutant Metals (Methods 200.7, 245.1, 206.2, 270.2		
Antimony	--	60
Arsenic	--	5
Beryllium	--	5
Cadmium	--	5
Chromium	--	10
Copper	--	10
Lead	--	5
Mercury	--	0.2
Nickel	--	15
Selenium	--	5
Silver	--	10
Thallium	--	5
Zinc	--	10

Table 1-2 (Cont.)

Parameter	DL* Soil	DL* Water
Base Neutral/Acid Extractable Organics (Methods 625 and 8270)		
1,3-Dichlorobenzene	--	10
1,4-Dichlorobenzene	--	10
Hexachloroethane	--	10
Bis(2-chloroethyl)ether	--	10
1,2-Dichlorobenzene	--	10
Bis(2-chloroisopropyl)ether	--	10
Nitrobenzene	--	10
Hexachlorobutadiene	--	10
1,2,4-Trichlorobenzene	--	10
Isophorone	--	10
Naphthalene	--	10
Bis(2-chloroethoxy)methane	--	10
Hexachlorocyclopentadiene	--	10
2-Chloronaphthalene	--	10
Acenaphthylene	--	10
Acenaphthene	--	10
Dimethyl phthalate	--	10
2,6-Dinitrotoluene	--	10
Fluorene	--	10
4-Chlorophenyl phenyl ether	--	10
2,4-Dinitrotoluene	--	10
Diethylphthalate	--	10
N-Nitrosodiphenylamine	--	10
Hexachlorobenzene	--	10
4-Bromophenyl phenyl ether	--	10
Phenanthrene	--	10
Anthracene	--	10
di-butyl phthalate	--	10
Fluoranthene	--	10
Pyrene	--	10
Benzidine	--	50
Butyl benzyl phthalate	--	10
Bis(2-ethylhexyl)phthalate	--	10
Chrysene	--	10
Benzo(a)anthracene	--	10
3,3'-Dichlorobenzidine	--	30
Di-n-octylphthalate	--	10
Benzo(b)fluoranthene	--	10
Benzo(k)fluoranthene	--	10
Benzo(a)pyrene	--	10
Indeno(1,2-c,d)pyrene	--	10
Dibenzo(a,h)anthracene	--	10
Benzo(ghi)perylene	--	10
phenol	--	10
2-chlorophenol	--	10
2-nitrophenol	--	10
2,4-dimethylphenol	--	10
2-4-dichlorophenol	--	10
4-chloro-3-methylphenol	--	10
2,4,6-trichlorophenol	--	10
2-4-dinitriphenol	--	30
4-nitrophenol	--	10
4,6-dinitro-2-methylphenol	--	30
pentachlorophenol	--	30

Table 1-2 (Cont.)

Parameter	DL* Soil	DL* Water
Other Parameters		
Petroleum Hydrocarbons (using IR)	1.0	1.0 mg/L
EP Toxicity (SW 846-1310)	a**	--
Barium (Method 200.7)	--	0.05

*Detection limits (DLs) are provided for soil in mg/kg and for water in ug/L, except where noted otherwise.

**Key: a

Metal	ug/L of leaching solution
As	500
Ba	5000
Cd	100
Cr	500
Pb	500
Hg	0.8
Se	500
Ag	500

Total Dissolved Solids

Total dissolved solids in water samples were determined using EPA Method 160.1. The detection limit was 1 mg/L.

Arsenic, Barium, Mercury, Lead

Soil samples for these metals were extracted using EPA Method 3050. Analysis was done using the EPA methods and DLs listed in Table 1-2.

pH

The pH of the water samples was determined using EPA Method 150.1.

EP Toxicity (Metals)

EP toxicity on soil samples was determined using the methods in SW846. DLs are listed in Table 1-2.

1.5 FIELD PERSONNEL

E & E field personnel participating in this project and their responsibilities were:

- P. Kopsick - Project Manager, Chief Geologist;
- W. Kwoka - Soil Gas Survey Manager;
- J. Chandler - Health and Safety Officer;
- M. Mayo - Environmental Specialist;
- S. Martin - Geophysical Survey Manager;
- M. Michalowski - Environmental Specialist;
- J. Cook - Environmental Specialist, Geophysics Crew; and
- T. Faile - Assistant Geophysical Survey Manager.

1.6 SUBCONTRACTORS

Geotechnology, Inc., of St. Louis, Missouri, provided drilling, drum handling, well installation, and well purging services. Field personnel from Geotechnology were:

- L. Rosen - Field Supervisor, Decontamination;

- M. Maniaci - Driller, Decontamination; and
- D. Meyer - Driller's Helper, Decontamination.

2. ENVIRONMENTAL SETTING

2.1 GEOGRAPHIC SETTING

2.1.1 Physiography

Richards-Gebaur AFB is located in the Osage Plains region of the Central Lowlands physiographic province (see Figure 2-1). This region is characterized by low overall relief; broad, maturely dissected uplands yield to somewhat steeper valley slopes. Prominent escarpments have resulted from the presence of thick erosion-resistant limestone.

2.1.2 Topography

The base is located on a broad plateau called the Blue Ridge, between the Blue River on the west and the Little Blue River on the east. Land surface elevations range from about 960 feet above mean sea level (AMSL) on the east to over 1,100 feet AMSL on the south.

2.2 GEOLOGY

2.2.1 Geologic Setting

Richards-Gebaur AFB is located near the Kansas-Missouri border in an area of gently to steeply rolling upland that forms part of the Scarped Plain, a province of the Interior Lowland Region of the United States (Hinds and Green 1915).

Unconsolidated late Pleistocene-Holocene surficial deposits consist of residual clay mixed with sand and chert on the uplands and slope areas, and thin alluvial deposits on the larger streams. A thin blanket of loess overlies the bedrock in much of the upland area.

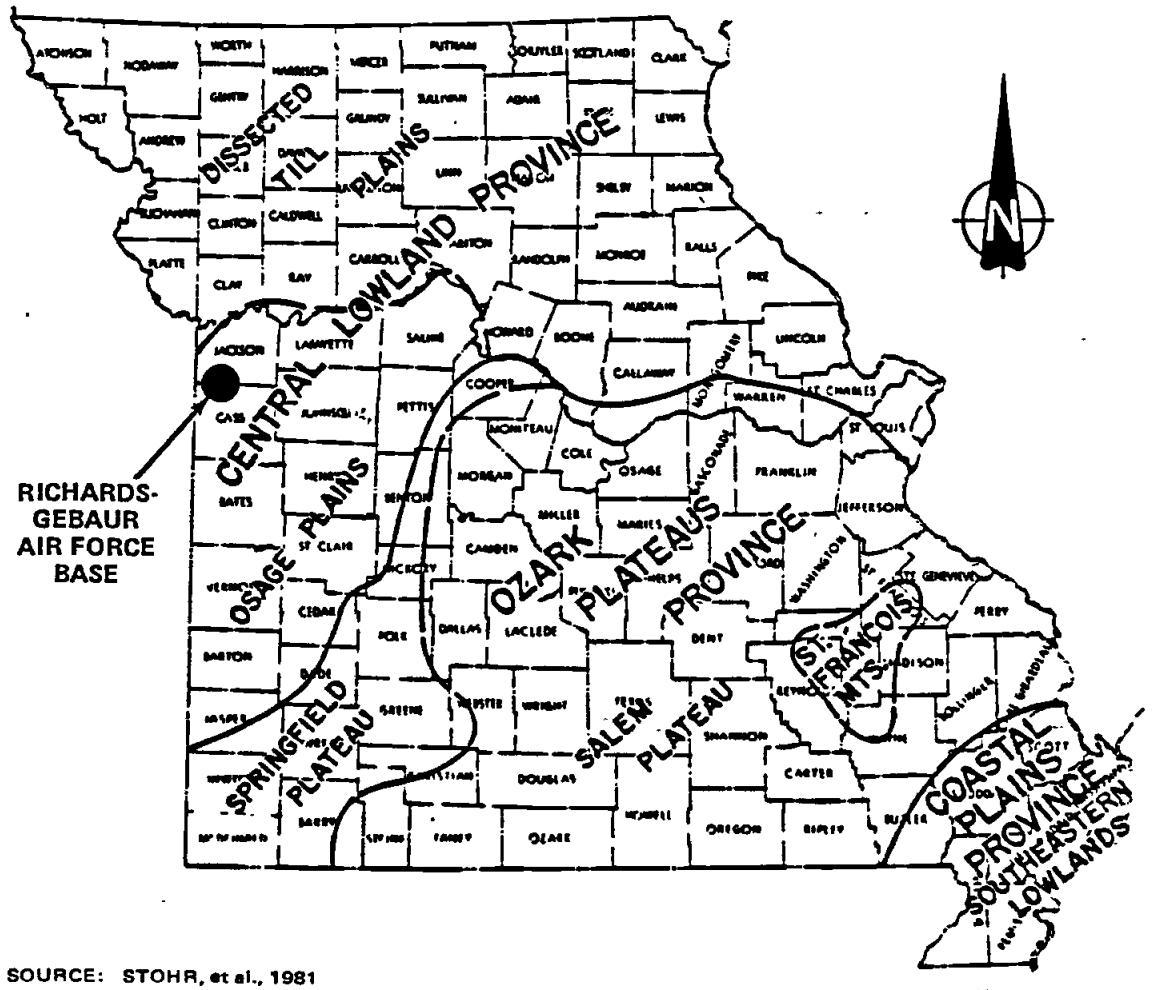


Figure 2–1 STUDY AREA PHYSIOGRAPHIC PROVINCES

2.2.2 Soils

The surface soils at Richards-Gebaur AFB consist primarily of very thin loess deposits over residual soil derived from the in situ weathering of the underlying limestone and shale bedrock. Soil cover normally varies from 2 to 15 feet in thickness. The soils on the upland surfaces belong to the Sharpsburg and Macksburg series and consist of poorly drained silty clay loams. Greenton and Polo series are moderately well-drained silty clay and clay soils formed on the eroded convex side slopes. Where shale is exposed along creeks, soils consist of residual clays and silty clays belonging to the Snead and Sampsel series. Moderately well-drained alluvium has filled stream valleys to a depth of about 50 feet. Alluvial soils belonging to the Verdigris (Kennebec) series are present in the level bottomland area along Scope Creek. These alluvial soils have a high groundwater table and are subject to occasional flooding.

Permeabilities of the surficial soils are generally low, less than 10^{-6} centimeters per second (cm/s). Permeability of the Verdigris (Kennebec) alluvial soils is moderate, approximately 10^{-3} to 10^{-6} cm/s. A summary of soil characteristics is presented in Table 2-1.

2.2.3 Stratigraphy

The exposed bedrock, Pennsylvanian in age, averages about 250 feet thick. It consists of relatively thin interbedded deposits, predominantly limestone and shale with isolated lenticular bodies of sandstone belonging to the Douglas Group, the Lansing Group, and the upper part of the Kansas City Group, Missourian Series (see Figure 2-2).

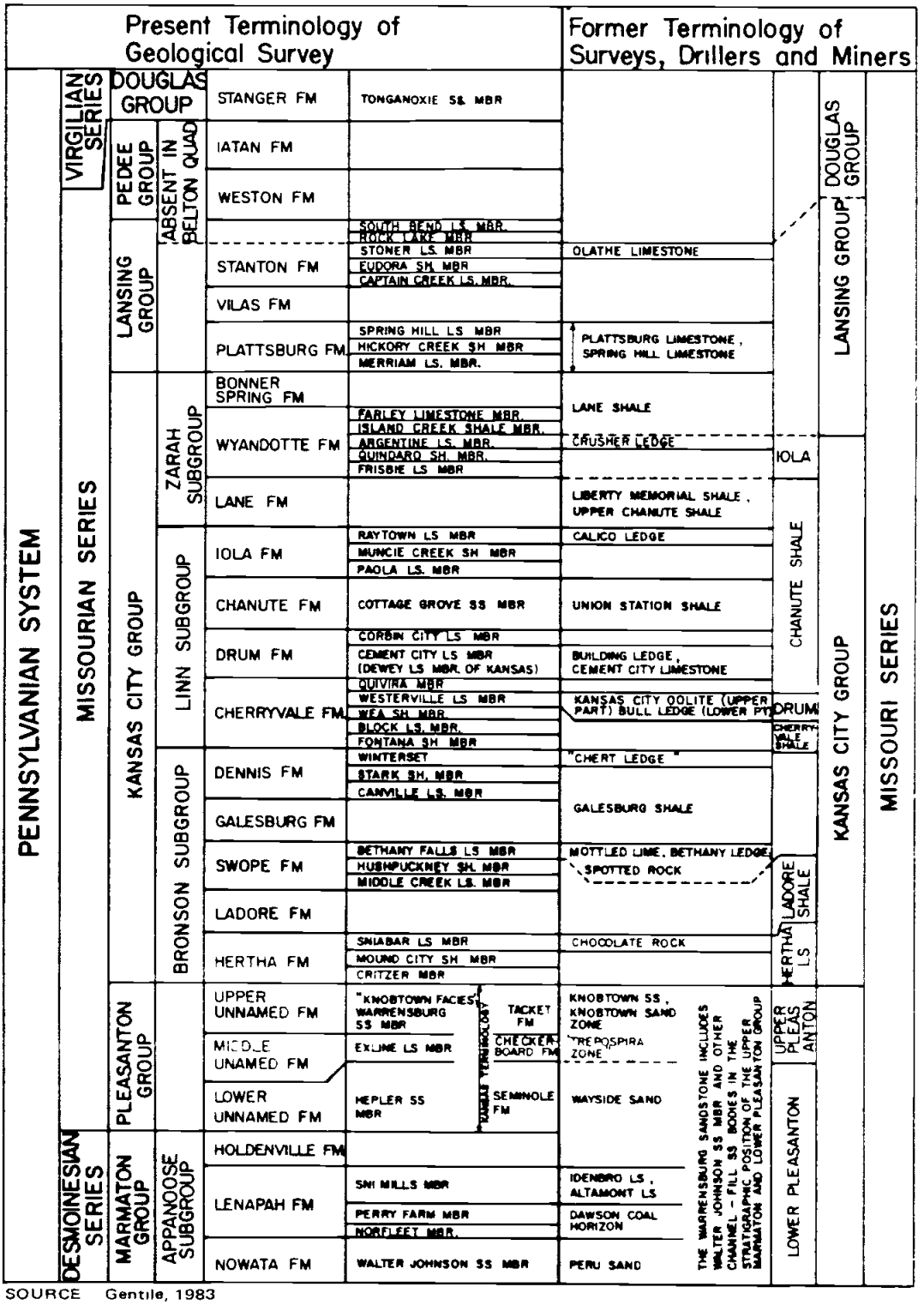
The subsurface Pennsylvanian rocks, averaging about 675 feet thick, include, in descending order, the Missourian, Desmoinesian, and Atokan series. The Missourian Series includes the Kansas City and Pleasanton groups. The lower part of the Kansas City Group, consisting of approximately 75 feet of relatively thick beds of limestone interbedded with shale, is present in the subsurface but does not crop out on the base. Lithologically, the Kansas City Group contrasts with the underlying, predominantly shale with channel-filled sandstones, 90- to 150-foot-thick sequence of beds forming the Pleasanton Group. The

Table 2-1

SOIL CHARACTERISTICS ON RICHARDS-GEBAUR AFB

Soil Name and Slopes	Depth (in)	Permeability (in/hr)	Description
Sharpsburg	0 - 13	0.6 - 2.0	Silt loam
	13 - 55	0.2 - 0.6	Silty clay loam, silty clay
	55 - 60	0.6 - 2.0	Silty clay loam, silt loam
Greenton	0 - 16	0.2 - 0.6	Silty clay loam
	16 - 46	0.06 - 0.2	Silty clay loam, silty clay
	46 - 60	0.06 - 0.2	Silty clay, clay
Macksburg	0 - 16	0.6 - 2.0	Silt loam, silty clay loam
	16 - 43	0.2 - 0.6	Silty clay loam, silty clay
	43 - 54	0.6 - 2.0	Silty clay loam
	54 - 60	0.6 - 2.0	Silty clay loam
Polo	0 - 14	0.6 - 2.0	Silt loam
	14 - 19	0.6 - 2.0	Silty clay loam
	19 - 45	0.6 - 2.0	Silty clay, silty clay loam
	45 - 60	0.6 - 2.0	Silty clay, shaly silty clay
Verdigris (Kennebec)	0 - 19	0.6 - 2.0	Silt loam
	19 - 60	0.6 - 2.0	Silt loam, silty clay loam

Source: USDA Soil Surveys for Jackson and Clay Counties.



SOURCE Gentile, 1983

Figure 2–2 STRATIGRAPHIC SUCCESSION OF BEDROCK UNITS

Desmoinesian Series includes the Marmaton and Cherokee groups. The Marmaton is 125 to 200 feet thick, consisting predominantly of limestone and shale and including thick bodies of channel fill, cross-bedded sandstone, and conglomerate. The Cherokee Group is a clastic sequence of beds with numerous thin coal beds; its average thickness is 325 feet. Rocks tentatively assigned to the Atokan Series are lithologically similar to those of the Cherokee Group but are limited in areal extent and are up to 75 feet thick. Below the Pennsylvanian rocks and above the Precambrian igneous and metamorphic complex are about 1,500 feet of Mississippian, Devonian, Ordovician, and Cambrian sedimentary rocks.

Several small oil fields are located adjacent to the base. They produce low-gravity oil from wells averaging a few barrels a day. The major production is from the upper Cherokee and lower Marmaton sandstone beds 450 to 650 feet below the surface.

2.2.4 Structure

A mile south of the base, the normally flat-lying Pennsylvanian rocks are fractured and broken by a circular fault complex called the Belton Ring Fault Complex. This structure has no real bearing on the geology of the base and only the hydrology south of the base is affected by this feature (see Figure 2-3). The Western Anticline (also known as the Walton Nose) runs to the west of the base. The Penn Valley Syncline (also known as the Jost Syncline) is very nearly below the north-south runway. These structures generally have little effect on the groundwater, which is normally influenced by surface topography.

2.3 HYDROLOGY AND WATER USE

2.3.1 Surface Water

Except for a portion of the western edge of the north-south flight line, and the extreme southwest corner of the base, all surface runoff is eventually channeled into Scope Creek or other smaller tributaries of the Little Blue River. Scope Creek flows north and northeast through the center of the base and runs adjacent to both Site 2, the Northeast Landfill, and Site 1, the South Landfill. Two man-made ponds are found on the base, one above Site 7, the POL Storage Yard, and another near the south end of the flight line, west of Site 1, the South

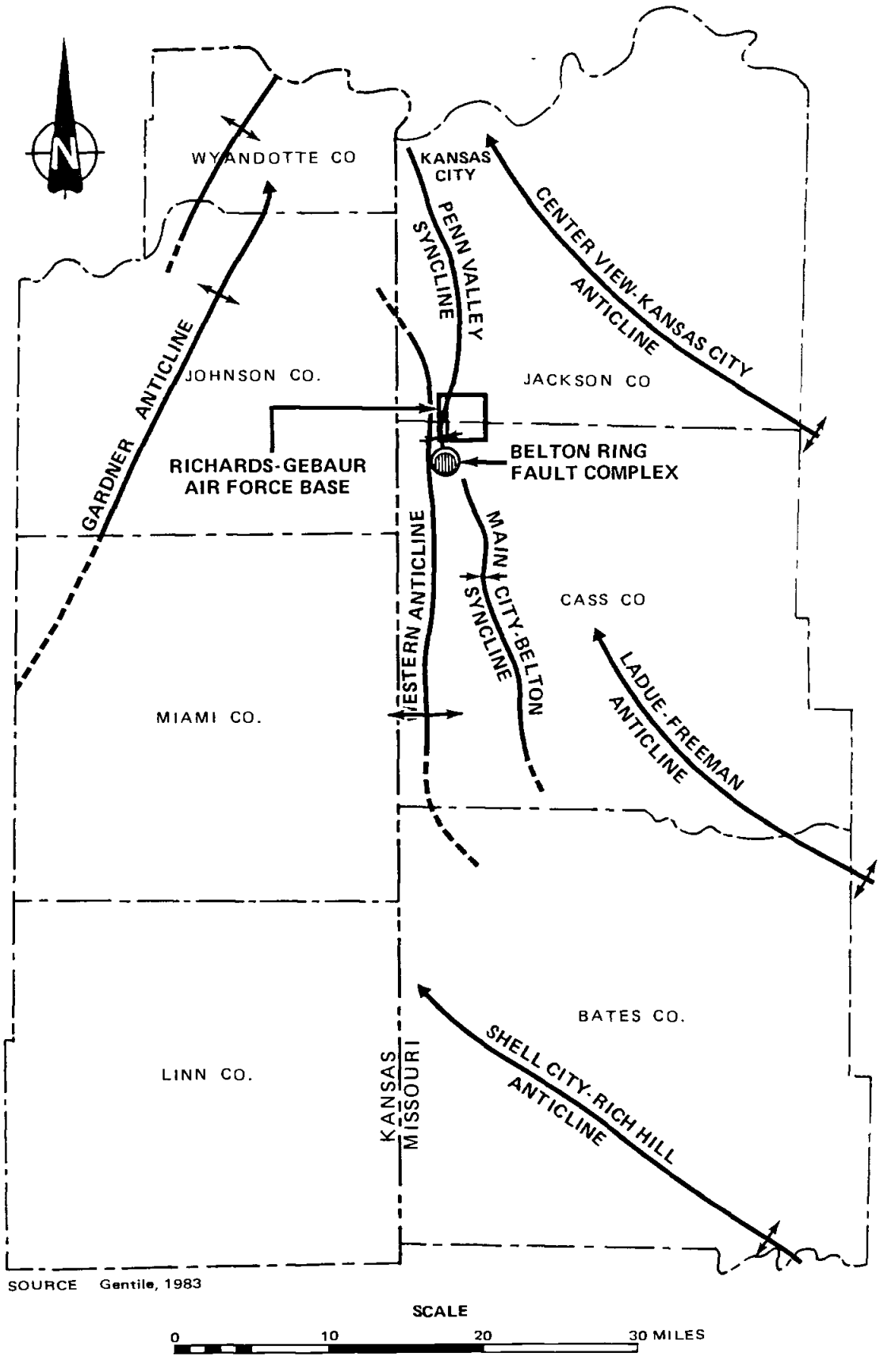


Figure 2–3 STRUCTURAL FEATURES OF BEDROCK IN STUDY AREA

Landfill. Neither pond is used for recreation. Scope Creek is largely intermittent in its headlands, but becomes perennial in the northeast part of the base, where it joins the Little Blue River. Scope Creek is used by assorted wildlife as well as farm animals. Surface water drainage pathways are shown in Figure 2-4.

2.3.2 Hydrogeology

Groundwater resources in the area are very limited. Water is supplied to the base and the City of Belton in pipelines from the Missouri River. Several older water wells are located within a mile of the base. These wells have yields ranging from 1 to 20 gallons per minute (gpm). These wells are typically less than 250 feet deep and draw mineralized waters from Pennsylvanian shales and lenticular sandstone bodies. The Pennsylvanian rocks are generally too thick and too barren of water to provide water for single-family homes, particularly given the accessibility of cheap hook-ups to the Missouri River water system. Two wells were still in use in a City of Belton mobile home park a half mile southeast of the base until about 10 years ago. One of the wells produced 17 gpm, the other 8 gpm. Production was from a system of vertical joints in a black fissile shale of the Hushpuckney Shale member, at a depth of 275 feet. Currently, there is only one well in use within 1 mile of the base. It is used to irrigate a private garden plot only during extremely dry conditions. All known well locations were verified, but samples were not taken since the wells were inactive during the time the fieldwork was conducted. Additional data on wells within 1 mile of the base given in Appendix P.

Locally, there may be some older farmsteads where shallow, hand-dug wells are still used. These wells would draw water from the valley of Scope Creek and at the intersection of the unconsolidated deposits and the weathered bedrock.

2.4 CLIMATE

Richards-Gebaur AFB and the surrounding area exhibit a modified continental climate in which conditions normally expected to prevail at that latitude are often distorted by air currents freely entering from the southeast, the Gulf of Mexico, or other distant areas. Average

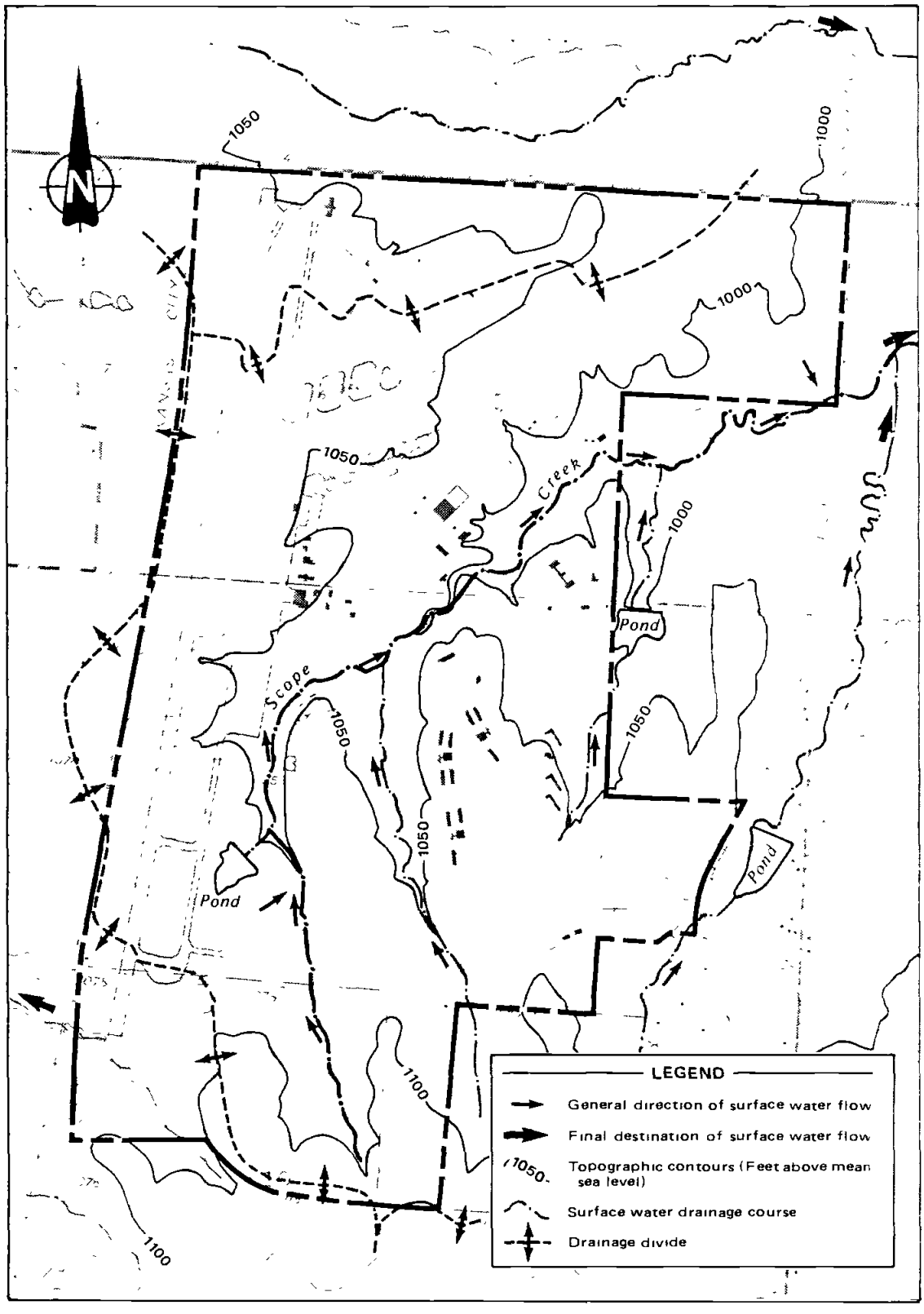


Figure 2–4 STORM WATER DRAINAGE AND TOPOGRAPHIC MAP, RICHARDS-GEBAUR AIR FORCE BASE, MISSOURI

monthly temperatures range from 26°F in January to 78°F in July, with an average mean temperature of 54°F (see Table 2-2). Most precipitation falls in the late spring and early summer and in the early fall. Average monthly precipitation ranges from 1.15 inches in February to 5.05 inches in June. Average annual precipitation is 36.8 inches. Maximum and minimum precipitation is 63.6 and 28.8 inches, respectively. Pan evaporation and lake evaporation rates are approximately 60 inches and 42 inches, respectively.

Prevailing winds at the base are from the south all year, and the mean annual windspeed is 9 knots. Weather changes can be rapid. Tornadoes and severe thunderstorms are most likely to occur in the spring and summer.

Table 2-2

TEMPERATURE AND PRECIPITATION DATA
FOR RICHARDS-GEBAUR AFB

	Temperature			Precipitation			Snowfall
	Daily/Monthly			Monthly			Monthly
Month	Maximum	Minimum	Average	Maximum	Minimum	Average	Average
January	37.8	19.8	28.8	1.87	0.28	1.17	6.9
February	43.5	25.1	34.3	1.88	0.57	1.28	4.1
March	52.7	32.8	42.8	3.65	1.19	2.51	5.1
April	66.6	45.7	56.2	4.58	1.94	3.34	0.7
May	76.6	56.8	66.7	5.25	2.89	4.12	0.0
June	85.0	66.3	75.7	7.30	2.77	5.18	0.0
July	89.2	70.8	80.0	6.80	1.54	4.42	0.0
August	88.5	69.2	78.9	5.62	1.37	5.62	0.0
September	81.2	60.7	71.0	6.42	1.17	4.08	0.0
October	70.3	49.5	59.9	4.71	0.94	3.20	0.0
November	54.8	35.9	45.4	2.54	0.26	1.56	0.9
December	42.8	26.2	34.5	2.12	0.48	1.38	4.5
Annual	65.8	46.6	56.2				

Note: Period of Record: 1954 - 1982.

Source: Department of the Air Force, Richards-Gebaur AFB.

3. FIELD PROGRAM

3.1 PROGRAM DEVELOPMENT

A field program for the Phase II Stage 2 Confirmation/Quantification investigation was developed by E & E and presented in the Presurvey Report submitted on 7 June 1985. The program was reviewed and modified by the Air Force and set forth in the Description of Work for Contract F33615-83-D-4003, Task Order 13.

Elements of the field program included: a soil gas survey, a geophysical survey, sediment sampling, subsurface soil sampling, surface water sampling, installation of groundwater monitoring wells, and groundwater sampling. Various combinations of these program elements were performed at the various sites. Table 3-1 outlines the types of work conducted at each site. By site, the objectives of the fieldwork were:

Site 1 - South Landfill

- Determine if contaminated leachate from the landfill is entering Scope Creek.
- Evaluate potential for vertical migration of contamination.

Site 2 - Northeast Landfill

- Determine past disposal practices at the landfill.
- Delineate the locations of several suspected waste disposal trenches and determine if contamination has resulted.
- Expand monitoring well network to investigate migration of groundwater contamination from possible leaching of landfilled materials.

Table 3-1

FIELDWORK PERFORMED AT EACH SITE

	Geophysics	Boreholes	New Monitoring Wells	Soil Samples*	Groundwater Samples*	Surface Water Samples*
Site 1 - South Landfill	--	1	--	6	--	3
Site 2 - Northeast Landfill	MAG, EM	4	2	10	5	3
Site 6 - North Burn Pit Area	Soil Gas	3	3	15	3	1
Site 8 - Herbicide Burial Area	--	--	--	4	--	1
Site 9 - Oil-Saturated Area	--	1	--	9	--	1
Site 10 - Hazardous Waste Drum Storage Area	--	1	--	9	--	1
Site 12 - POL Storage Yard	--	4(h)	1	11	1	2
TOTALS		14	6	64	9	12

*Numbers do not include duplicates or blanks.

Key: MAG = Magnetometer survey
EM = Electromagnetic survey
(h) = Hand-augered boreholes

Site 6 - North Burn Pit Area

- Determine occurrence of contamination from the site using a soil gas survey.
- Determine occurrence of subsurface soil contamination.
- Determine whether groundwater contamination has occurred.

Site 8 - Herbicide Burial Area

- Identify actual burial area by examining available background information.
- Identify any contaminants in soil in the vicinity of the burial area.
- Evaluate extent of migration of any contaminants via surface drainage pathway.

Site 9 - Oil-Saturated Area

- Evaluate type and extent of surface and subsurface soil contamination.
- Determine if contaminants are migrating via surface drainage pathway.

Site 10 - Hazardous Waste Drum Storage Area

- Evaluate type and extent of surface and subsurface soil contamination.
- Evaluate potential migration of contaminants via surface drainage pathway.

Site 12 - POL Storage Yard

- Determine the extent of any subsurface soil contamination.
- Evaluate extent of migration of contaminants via buried drain lines and surface drainage pathways.
- Determine whether groundwater contamination has occurred and evaluate extent of contamination.

3.2 FIELD INVESTIGATION

The field investigation consisted of:

- Literature and aerial photograph records search;
- A magnetometer and electromagnetic (EM) terrain conductivity survey;
- A soil gas survey;
- The drilling of 10 boreholes;
- The installation of six monitoring wells; and
- Collection and analysis of 27 surface soil and sediment samples, 38 subsurface soil samples, 13 surface water samples, and 9 groundwater samples.

3.2.1 Schedule of Field Activities

Field activities were scheduled so as to optimize the utilization of manpower and resources. Field activities were coordinated with the USAFOEHL, the base Point of Contact (POC), and subcontractors to minimize delays and potential problems.

Throughout the course of the field activities, daily contact was maintained with the designated base personnel. The principal contact was Ms. Felipita Benson, R.N. Additional coordination was through Mr. John Hurd, Base Civil Engineer.

The fieldwork was completed during the period from 6 October 1986 to 4 November 1986. Table 3-2 provides the sequence of major field activities.

Health and safety protocols, as outlined in the Health and Safety Plan (see Appendix N), were followed throughout the project. Modifications of specific elements of the Health and Safety Plan were based on field conditions and executed only after discussion with E & E's Health and Safety Coordinator.

3.2.2 Records Search

During the course of the Phase II Stage 2 investigation, discussions were held with personnel from the Base Environmental Engineering Staff and the Base Civil Engineering Staff regarding past waste disposal practices and likely contaminants. Historical aerial photographs were

Table 3-2

SCHEDULE OF MAJOR FIELD ACTIVITIES

(October to November 1986)

6 October	Fieldwork begins with a reconnaissance of all sites and collection of surface soil samples.
6-8 October	Geophysical survey at Site 2, Northeast Landfill.
7-9 October	Soil gas survey at Site 6, North Burn Pit Area.
14 October	Drillers on site, set-up decontamination areas at Site 6, North Burn Pit Area and vehicle wash racks.
15 October	Three soil borings drilled, sampled, and grouted at Site 6, North Burn Pit Area.
16 October	Six monitoring wells drilled, pipe set, soil samples collected, and wells completed; three are at Site 6, North Burn Pit; two at Site 2, Northeast Landfill; and one at Site 12, POL Storage Yard. One well at Site 6, North Burn Pit Area was a borehole completed as a well.
17 October	Six soil borings drilled, samples collected, and the holes grouted, one at the Motor Pool Compound; one at the former hazardous waste storage yard; one at Site 1, South Landfill; and three at Site 2, Northeast Landfill.
18 October	Development of new wells and cleanup of drilling and staging areas.
21 October	Wells purged and groundwater samples collected.
23 October	The remaining surface soil and surface water samples collected from Site 2, Northeast Landfill; and Site 1, South Landfill.
28 October, 4 November	Hand-auger borings at Site 12, POL Storage Yard.
4 November	End of sampling.

examined to provide information on waste disposal practices at the base. Aerial photos were helpful in locating and delineating several sites which were not clearly visible during the Presurvey field trip. Table 3-3 lists the photos which were available for review.

3.2.3 Geophysical Survey Procedures

Magnetometer and EM surveys were performed concurrently at Site 2, Northeast Landfill, in an effort to locate what were thought to be discrete landfill trenches at this site, preliminary to placing groundwater monitoring wells. The magnetometer survey is designed to locate magnetically conductive materials in landfills, which are generally more conductive than the surrounding soils. Anomalies in magnetic flux are measured by the magnetometer and recorded in the field notebook. The EM conductivity survey measures the conductivity of the soil or any variations in the conductivity of the soil. Excavations for landfills change the natural conductivity by changing the porosity and density of the soils and altering the normal values of conducting fluids in the soils. Presumed locations of the trenches were delineated in a map provided by the Base Civil Engineer.

A Geometrics Model G-846 proton procession magnetometer with a sensitivity of 0.1 gammas and a Geonics Model EM-31 terrain conductivity meter with an effective exploration depth of 6 meters were used.

3.2.4 Soil Gas Sampling

A soil gas survey was performed at Site 6, the North Burn Pit Area, in an effort to identify potential residual contamination from the burning and handling of flammable liquids. The soil gas data were used to aid in locating the groundwater monitoring wells. The survey was performed by hand-driving perforated pipes in and around the compound. After capping each pipe and allowing it to stand for 15 minutes, the hole was monitored using an Organic Vapor Analyzer (OVA) to determine the presence or absence of volatile compounds.

3.2.5 Soil, Sediment, and Water Sampling

Soil, sediment, and water sampling protocols were followed as outlined in the Technical Operations Plan (Appendix N), except for

Table 3-3

SUMMARY OF HISTORIC AERIAL PHOTOGRAPHS
FOR AREA AROUND RICHARDS-GEBAUR AFB

Year	Scale	Source	Availability
1936	1:20,000	NARS	--
1940	1:20,000	MARC	--
1948	1:17,000	EROS, USGS	--
1950	1:70,000	EROS, USA	--
1953	1:20,000	ASCS	--
1955	1:13,000	EROS, USGS, USAF (shows West Burn Pit)	Reviewed
1957	1:20,000	ASCS	--
1959	1:12,000	COE	--
1960*	1:12,000	City of Grandview (shows borrow pits north of Northeast Landfill)	Reviewed
1963	1:18,000	USGS	Reviewed
1963	1:20,000	ASCS	--
1970	1:24,015	EORS	--
1972*	1:12,000	City of Grandview (shows active Northeast Landfill)	Reviewed
1975	1:40,000	EROS	--
1978	1:72,500	EROS	--
1980	1:80,000	EROS	--
1982	1:58,000	EROS	--
1982	1:80,000	EROS	--

Key: EROS = EROS Data Center, SD
MARC = Mid America Regional Council, MO
ASCA = American Soil Conservation Agency
CDOE = Army Corps of Engineers
USGS = United States Geological Survey
USA = United States Army
NARS = National Archives

*Not on federal archive list; does not cover south half of base.

samples collected for volatile organic analysis (VOAs). These were discrete samples collected prior to homogenization (blended to result in a more uniform sample). The portion of the sample collected for VOAs was cut from the center of the sample and placed directly into 40-ml vials.

All samples were split in the field when enough sample material was available. Split samples were delivered to the base POC. The POC determined those splits which were to be submitted to OEHL/SA for analysis. The split samples for analysis were provided by the POC to E & E for shipment to OEHL/SA.

Sediment Sampling

Sediment sampling was conducted in association with Site 1, South Landfill; Site 6, North Burn Pit Area; Site 8, Herbicide Burial Area; Site 9, Oil-Saturated Area; Site 10, Hazardous Waste Drum Storage Area; and Site 12, POL Storage Yard. A total of 27 samples were collected and submitted for chemical analysis. Table 3-4 presents a summary of the samples collected.

Sediment samples were collected using shovels to loosen an 8-inch cube of sediment from which a vertical column was removed using a stainless steel spoon. The soil column was homogenized in a disposable aluminum pan and then splits were placed in two sampling containers. Spoons were decontaminated and all pans were disposed of after sample collection from each location.

Subsurface Soil Sampling

Subsurface soil samples were collected from 5-foot-long split-spoon samplers during the drilling of the boreholes and monitoring wells. Borehole and monitoring well drilling was performed by Geotechnology, Inc., of St. Louis, Missouri. Table 3-5 provides a summary of borehole depths.

Ten boreholes were drilled and 28 subsurface soil samples were collected and submitted for analysis. Boreholes were drilled for the specific purpose of obtaining subsurface soil samples; however, one borehole (Boring 4) was scheduled to be completed as a monitoring well. A total of 186.5 linear feet of drilling was accomplished using a Mobile

Table 3-4

SUMMARY OF SURFACE SOIL SAMPLING

Site No.	Field Sample No.	Sample Location and Description
1	DF4067	Scope Creek - Background at Markey and Bates
	DF4069	Scope Creek - Downstream of South Landfill
	DF4070	Scope Creek - Seep 1 east of South Landfill
	DF4077	Scope Creek - Seep 2 northeast of South Landfill
6	DF4001	North Burn - 100 feet east of eastern fence center
	DF4002	North Burn - 200 feet east of eastern fence center
	DF4003	North Burn - 100 feet north of northern fence drainage
	DF4004	North Burn - Southeast corner fence, 200-300 feet
	DF4005	North Burn - 25 feet south of southwestern corner of fence
	DF4014	North Burn - 100 feet northwest of northwest corner of fence
8	DF4015	Herbicide Burial Area - 300 feet south of Markey
	DF4016	Herbicide Burial Area - 25 feet east of DF4015
	DF4017	Herbicide Burial Area - 25 feet east of DF4016
	DF4018	Herbicide Burial Area - 100 feet south of Markey
9	DF4007	Oil-Saturated Area - Southwest corner of Motor Pool
	DF4008	Oil-Saturated Area - Southwest corner +25 feet
	DF4009	Oil-Saturated Area - Southwest corner +50 feet
	DF4010	Oil-Saturated Area - Outside southwest corner, 0-100 feet
	DF4011	Oil-Saturated Area - Outside southwest corner, 100-200 feet
	DF4012	Oil-Saturated Area - Outside southwest corner, 200-300 feet
10	DF4019	Hazardous Waste Drum Storage Area - Background from athletic field
	DF4020	Hazardous Waste Drum Storage Area - North of gate to compound
	DF4021	Hazardous Waste Drum Storage Area - West corner of fence, 0-26 feet
	DF4022	Hazardous Waste Drum Storage Area - West corner of fence, 26-60 feet
	DF4023	Hazardous Waste Drum Storage Area - West corner of fence, 60-120 feet
	DF4024	Hazardous Waste Drum Storage Area - South corner +25 feet
12	DF4088	POL Storage Yard - Culvert at Bldg. 952

Table 3-5

SUMMARY OF SOIL BORINGS

Site No.	Boring Designation	Total Depth (feet)
1	Boring #7	7.1
2	Boring #4	9.8
	Boring #8	7.9
	Boring #9	13.0
	Boring #10	8.5
3	Boring #1	12.9
	Boring #2	13.0
	Boring #3	14.5
5	Boring #5	16.5
6	Boring #6	15.0
7	Hand Boring #1	6.0
	Hand Boring #2	6.0
	Hand Boring #3	6.0
12	Hand Boring #4	6.0

CME-55 rig equipped with continuous-flight hollow-stem augers. Samples were collected using a 5-foot continuous CME tube sampler with a 3 3/4-inch inside diameter. Boreholes were scheduled to be completed at 15 or 20 feet. Most borings encountered bedrock within 10 to 15 feet. Refusal was defined as the point when unweathered bedrock was hit.

Samples from the boreholes were collected at 5-foot intervals. Percent recovery from the long sampling tubes was generally 100%. This method of drilling allowed for a continuous sample of the subsurface and direct observation of the entire stratigraphic sequence of the borehole. Cores were laid out next to one another and then logged. From observations of the cores and after scanning with an OVA, samples were taken from depths where positive readings were recorded on the OVA or where there were indications of contamination or breaks in stratigraphy. Table 3-6 summarizes the subsurface soil sampling.

Upon completion of the drilling and sampling of the boreholes, each borehole was grouted to the surface using a cement/bentonite slurry.

Sampling equipment was decontaminated between each sample; three 5-foot CME sampling tools were available at all times. This allowed a 15-foot-deep boring to be sampled before decontamination was necessary. The decontamination stations were set up at the North Burn Pit Area and at the vehicle wash rack area of the base. Decontamination procedures followed those outlined in the Technical Operations Plan (see Appendix N), except for samples collected for VOAs. These were discrete samples collected prior to homogenization.

No subsurface soil samples were scheduled to be taken from any of the borings slated to be monitoring wells. However, three samples were collected from Boring 4 at Site 2, the Northeast Landfill, which was completed as a monitoring well. To save time in retooling the drill rig, the CME continuous sampler was also used for the drilling of the monitoring wells. This provided the added benefit of allowing observation of the continuous stratigraphy at the monitoring well locations.

Hand-Auger Boring

The investigation of Site 12, the POL Storage Yard, required the use of hand-powered subsurface sampling within the berms of the POL

Table 3-6

SUMMARY OF SUBSURFACE SOIL SAMPLING

Site No.	Boring No.	Sample No.	Sample Depth (ft)
1	Boring #7	DF4047	1.0 - 2.0
		DF4048	4.0 - 5.0
		DF4049	6.0 - 7.0
2	Boring #4	DF4036	1.0 - 2.0
		DF4037	6.0 - 7.0
		DF4038	8.0 - 8.5
	Boring #8	DF4050	7.0 - 7.9
	Boring #9	DF4051	4.0 - 5.0
		DF4052*	6.0 - 7.0
		DF4053	9.0 - 10.0
	Boring #10	DF4054	1.0 - 2.0
		DF4055	4.0 - 5.0
		DF4056	7.0 - 8.0
6	Boring #1	DF4027	3.5 - 4.5
		DF4028	7.0 - 8.0
		DF4029	12.0 - 12.4
	Boring #2	DF4030	2.0 - 3.0
		DF4031	5.0 - 6.0
		DF4032*	11.0 - 12.0
	Boring #3	DF4033	2.0 - 3.0
		DF4034	5.0 - 6.0
		DF4035	11.0 - 12.0
9	Boring #5	DF4039	3.0 - 4.0
		DF4040	8.0 - 9.0
		DF4041	15.5 - 16.5
10	Boring #6	DF4042	0.5 - 1.5
		DF4043	9.0 - 10.5
		DF4044	4.5 - 5.5
12	Hand Boring #1 Tank 955	DF4079	1.0
		DF4080	2.10
		DF4081	6.0
	Hand Boring #2 Tank 957	DF4082	1.0
		DF4083	2.8
		DF4084	6.0
	Hand Boring #3 Tank 954	DF4085	1.0
		DF4086	3.0
		DF4087*	6.0
	Hand Boring #4 Outside Building 953	DF4089	3.0

*Duplicate sample

tanks. Mechanized equipment could not be utilized in these areas due to fire safety regulations and the lack of access into the tank berms. A single stainless steel soil bucket auger with extensions was used and advanced to a depth of 6 feet. The tightness of the soils and the depths to which sampling was required made sampling difficult. The hand auger was decontaminated between each sampling location by washing with a sodium triphosphate solution, and rinsing with distilled deionized water and methanol. Table 3-6 includes summary information on hand-auger sampling.

Surface Water Sampling

Surface water samples were collected from creeks, drainageways, and impoundments at all seven sites. Surface water samples were collected only once during the field investigation. Table 3-7 provides a summary of the surface water sampling.

Surface water samples were collected by immersing the sampling container into the water. VOAs were collected by immersing the VOA vials directly into the water and capping the submerged bottle before removing it from the water. At each sampling location, a 1-liter glass bottle was used to fill 80-ounce jugs for other parameters. The 1-liter bottles were also used as sample containers for certain analytical parameters. Filtering, when needed, was provided in the field. All samples were prepared and preserved according to the analytical methods outlined in the Description of Work.

Monitoring Well Installation and Groundwater Sampling

Six monitoring wells were installed at three sites on the base, two at Site 2, Northeast Landfill, three at Site 6, North Burn Pit Area, and one outside Site 12, POL Storage Yard. The monitoring well screens and casings were 2-inch outside diameter (O.D.) Schedule 40 polyvinyl chloride (PVC). Table 3-8 summarizes well construction data. Well construction diagrams and borehole logs are presented in Appendix D. In general, the screens and casings were set in an 8-inch diameter borehole. The annular space was then filled with clean, coarse sand to an average height of 2 feet above the top of the screen. A minimum of 2 feet of bentonite pellets were placed above the sand pack. The

Table 3-7

SUMMARY OF SURFACE WATER SAMPLING

Site No.	Field Sample No.	Sample Location Description
1	DF4066	Scope Creek - Background
	DF4068	Scope Creek - Downstream from South Landfill
	DF4071	Seep 1 adjacent to Scope Creek
	DF4076	Seep 2 adjacent to Scope Creek
2	DF4073	Tributary draining Northeast Landfill
	DF4074	Scope Creek - Downstream from Northeast Landfill
	DF4075	Scope Creek - Upstream from Northeast Landfill
3	DF4006	Local impoundment by east fence line
4	DF4027*	Local impoundment - Small pond
5	DF4013	Drainage ditch - Lateral to stain area
6	DF4025	Drainage ditch - Downgradient
7	DF4045	Drainage ditch - Upstream
	DF4046	Drainage ditch - Downstream

*Sample number repeated in field by mistake. Correct laboratory number was assigned.

Table 3-8

SUMMARY OF MONITORING WELL CONSTRUCTION DETAILS

(Schedule 40 PVC, 2-inch O.D.)

Site	Well No.	Total Depth (ft)	Screened Interval (ft)	Filtered Interval (ft)	Bentonite Interval* (ft)
2	6-MW #6**	13.1	6.1 - 11.1	5.6 - 13.1	3.0 - 5.0
	5-MW #5	17.1	7.1 - 17.1	5.0 - 17.1	2.0 - 5.0
6	1-NBA-NEMW	20.0	10 - 20.0	7.0 - 20.0	2.0 - 7.0
	2-NBA-NWMW	10.5	6.5 - 10.5	5.0 - 10.5	2.0 - 5.0
	3-NBA-SWMW	7.5	5 - 7.5	4.0 - 7.5	2.0 - 4.0
12	4-POL-DMW	9.8	5.8 - 9.8	4.8 - 9.8	2.5 - 4.8

*All wells were grouted to surface and finished with a metal locking well cap set in a concrete pad.
**Boring 4 was completed as Monitoring Well 6.

remaining annular space to the ground surface was grouted with a powdered bentonite/cement slurry grout. Well protection was provided by a locking steel well casing set into the 2-foot by 2-foot cement pad. Wells located in active areas or areas that are mowed were also fitted with protective posts set outside the concrete pad. The locations of the wells and survey data are given in Appendix O.

Three monitoring wells were already in existence at Site 2, Northeast Landfill. The integrity of these wells was confirmed during the field investigation. The locking caps were still intact. The locks were then cut and replaced with similarly keyed locks.

The groundwater wells were sampled once during the field investigation. A total of nine groundwater samples were collected, although two of the wells did not recharge enough to provide sufficient water for all the requested chemical analysis. Table 3-9 summarizes the groundwater sampling. Prior to sampling of the monitoring wells, each well was purged of three well volumes of fluid. Purging and sampling was done by hand, using 1.5-inch PVC bailers. Sampling and decontamination followed standard procedures, as outlined in the Technical Operations Plan (see Appendix N).

Groundwater samples were allotted for each of the boreholes, in case water was found in any of the borings. Only the borehole at Site 1, South Landfill, gave any indication of groundwater. However, recharge was not sufficient for sampling.

3.2.6 Handling of Investigation-Derived Waste

Drill cuttings and development and purge waters were screened in the field visually and with an OVA. Based on visual and OVA screening of the cuttings, only the cuttings from Site 6, North Burn Pit Area, and Site 10, Hazardous Waste Drum Storage Area, were containerized. The materials from these borings were placed in 55-gallon drums lined with plastic bags. The drums were sealed, labeled, and dated, and then stored inside the fenced area of Site 6, North Burn Pit Area, pending the results of chemical analyses of subsurface samples from those borings. The results of these analyses indicated that the cuttings are not contaminated and the material can be safely disposed of or,

Table 3-9

SUMMARY OF GROUNDWATER SAMPLING

Site	Well No.	Sample No.	Descriptions
2	0-MW #1	DF4063	Phase II Stage 2 well #1
	0-MW #2	DF4064	Phase II Stage 2 well #2
	0-MW #3	DF4065	Phase II Stage 2 well #3
	6-MW #6*	DF4062	Perimeter well at entrance gate
	5-MW #5	DF4061	Background well north of Northeast Landfill
6	1-NBA-NEMW	DF4058	Northeast corner monitoring well
	2-NBA-NWMW	DF4057	Northwest corner monitoring well
	3-NBA-SWMW	DF4059	Southeast corner monitoring well
12	4-POL-DMW	DF4060	Downgradient monitoring well

*Boring 4 was completed as Monitoring Well 6.

alternatively, dispersed in Site 6, North Burn Pit Area. Development and purge waters were placed in the North Burn Pit to evaporate.

3.2.7 Site-Specific Investigation Activities

As discussed above, fieldwork at each site consisted of some combination of geophysics, soil boring, subsurface soil sampling, and groundwater sampling. Activities at the individual sites are discussed below.

Site 1, South Landfill

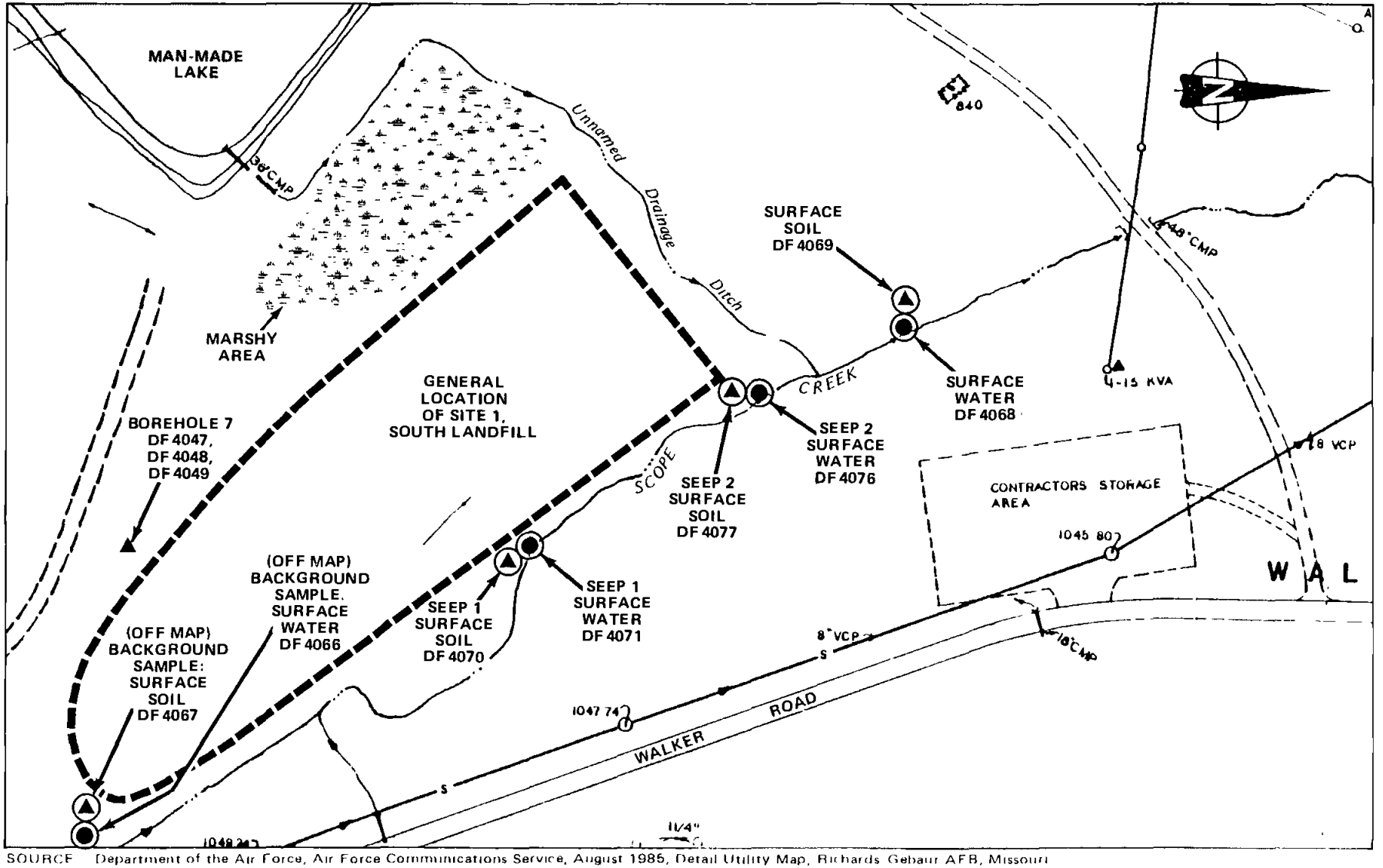
A single upgradient soil boring was drilled southwest of the landfill (Boring 7) and three subsurface soil samples collected. The actual eastern boundary of the landfill is the west bank of Scope Creek. Therefore, it was impossible to drill a boring downgradient without penetrating the waste and jeopardizing the integrity of the landfill. Four surface soil samples were collected: a background sample adjacent to Scope Creek upstream of the landfill; one at Seep 1 where the seep enters Scope Creek; one at Seep 2 where the seep enters Scope Creek; and one adjacent to Scope Creek downstream from the landfill. Four surface water samples were collected: from Seep 1 and Seep 2 where the seeps enter Scope Creek, and from Scope Creek at the upstream (background) and downstream sampling points.

Figure 3-1 shows the sampling locations for this site.

The four water samples were analyzed for petroleum hydrocarbons, total dissolved solids, halogenated and aromatic volatile organics, 13 priority pollutant metals, extractable priority pollutants (GC/MS), common anions, and phenols. The soil samples were analyzed for halogenated and aromatic organics and petroleum hydrocarbons.

Site 2, Northeast Landfill

Magnetometer and conductivity surveys were performed at this site to locate what were originally believed to be three discrete trenches. A grid system was staked over the survey area. The grid extended beyond the expected landfill boundaries in order to define the boundaries. The grid sections were 100 by 100 feet. Every 25 feet along each grid line, three readings were taken with the magnetometer and averaged, and one



SOURCE Department of the Air Force, Air Force Communications Service, August 1985, Detail Utility Map, Richards Gebaur AFB, Missouri

KEY: Site Boundary; Surface Runoff Direction; Subsurface Soil Sampling Location; Surface Soil Sampling Location; Groundwater Sampling Location; Surface Water Sampling Location

SCALE 0 50 100 200 300 FEET

Figure 3–1 SAMPLING LOCATIONS AT SITE 1, SOUTH LANDFILL

reading was taken with the EM-31. Background readings were taken periodically in an undisturbed area of the base. The geophysical survey revealed, rather than the three discrete landfill trenches, that the entire survey area had been landfilled. Additional historical aerial photos revealed landfill operations throughout the area delineated in Figure 3-2. The drilling program was modified based on this new understanding of Site 2 . Four boreholes were drilled in areas adjacent to the presumed boundary of the landfill. Boring 4 was located near the southwest corner of the landfill. Borings 8 and 9 were located near the southeast corner of the site, downgradient from the landfill; and Boring 10 was located upgradient, across the railroad tracks to the north.

Three subsurface soil samples were collected from Borings 4, 9, and 10, and one was collected from Boring 8.

In addition to the three existing monitoring wells (MW1, directly south of the site; MW2, south of the site near the southeast corner; and MW3, east of the site, near the southeast corner), two new monitoring wells were installed: MW6, a completion of Boring 4, and MW5, in the northeast corner of the site. One groundwater sample was collected from each of the five wells.

Three surface water samples were collected. One from the surface drainage flowing off the landfill near the southeast corner of the landfill, and two from Scope Creek, one upstream of the landfill and one downstream.

Figure 3-3 shows the sampling locations for this site and the location of the geologic cross section. The cross section is presented in Appendix D.

The eight water samples were analyzed for petroleum hydrocarbons, total dissolved solids, halogenated and aromatic volatile organics, 13 priority pollutant metals, extractable priority pollutants (GC/MS), common anions, and phenols. The soil samples were analyzed for halogenated and aromatic organics and petroleum hydrocarbons.

Site 6, North Burn Pit Area

A soil gas survey was performed at this site to determine if organic vapor contamination exists in the subsoil and to delineate the extent of contamination in order to determine the placement of boreholes

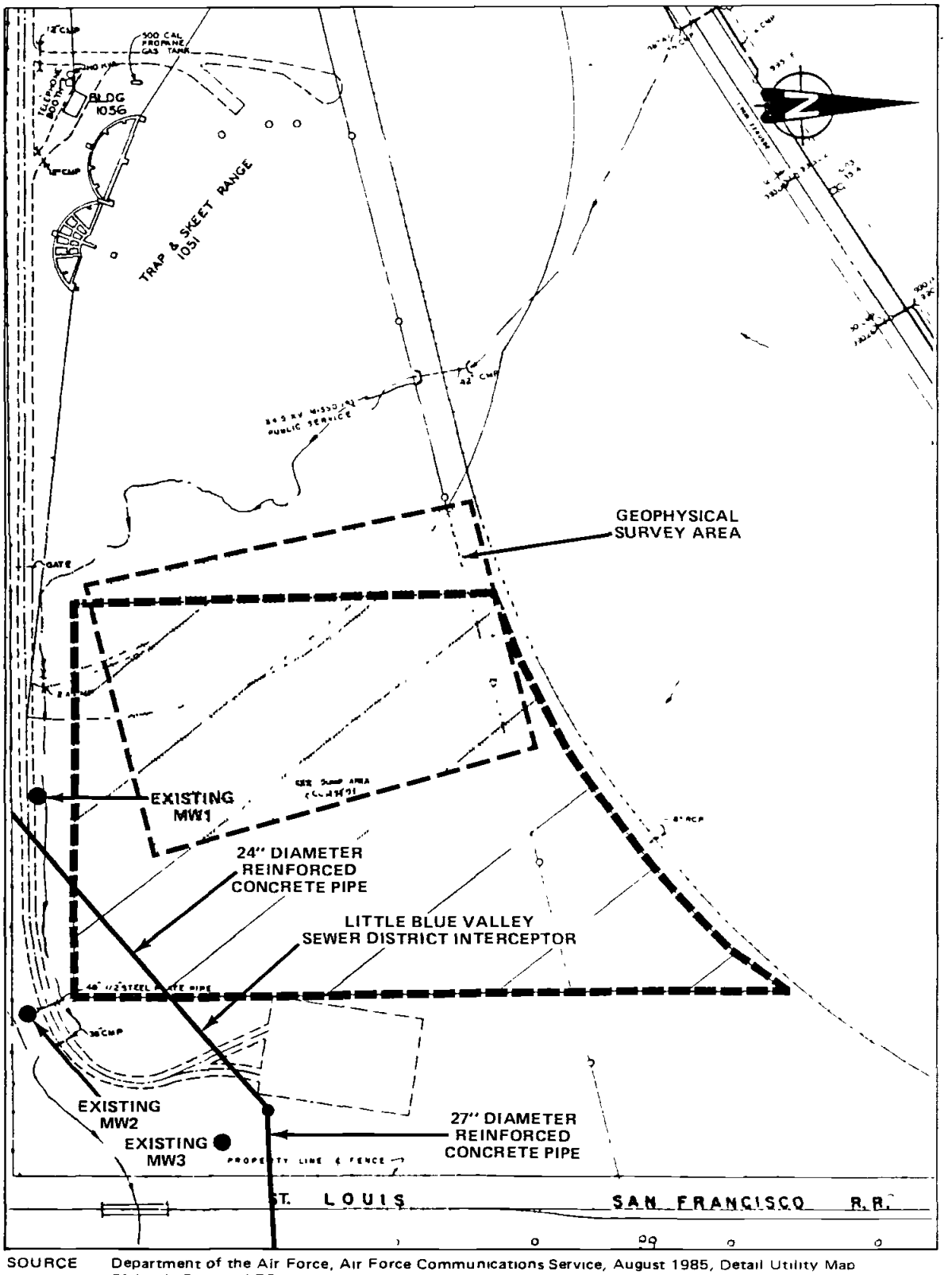
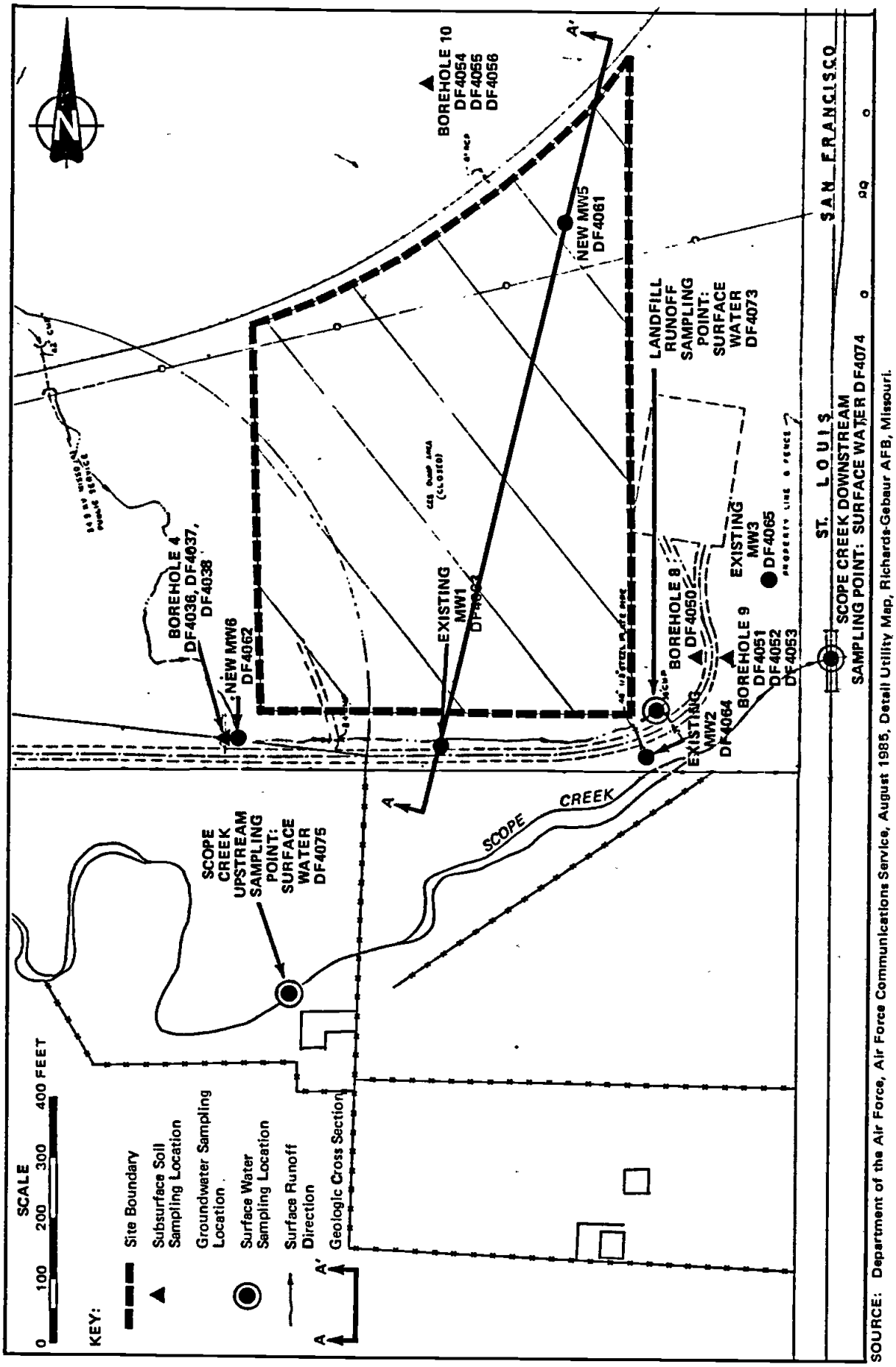


Figure 3–2 SITE 2, NORTHEAST LANDFILL, GEOPHYSICAL SURVEY AREA



SOURCE: Department of the Air Force, Air Force Communications Service, August 1985, Detail Utility Map, Richards-Gebaur AFB, Missouri.

Figure 3–3 SAMPLING LOCATIONS AT SITE 2, NORTHEAST LANDFILL

and monitoring wells and soil and water sampling points. Twenty-seven soil gas probe locations were tested with an OVA. Figure 3-4 shows the location of the soil gas sampling points.

Based on the results of the soil gas sampling and previous data on the site, three soil boreholes were drilled outside the perimeter of the concrete burn pit; three subsurface soil samples were collected from each borehole; and three monitoring wells were installed within the fenced area. One groundwater sample was taken from each monitoring well, although only MW1, the only well which did not reach bedrock, had sufficient recharge for all the proposed analyses. MW2 and MW3 yielded only one 40-mL sample each.

Six surface soil samples were collected from outside the burn area. One surface water sample was collected from an area of standing water inside the fence line. OVA readings were also taken during the drilling of the boreholes and monitoring wells.

Figure 3-5 shows the sampling locations for this site and the location of the geologic cross section. The cross section is located in Appendix D.

The surface water sample and the groundwater sample from MW1 were analyzed for halogenated and aromatic volatile organics. The surface water sample was also analyzed for petroleum hydrocarbons. The groundwater samples from MW2 and MW3, which yielded only small amounts of water, were analyzed only for volatile organic compounds. The 15 soil samples were analyzed for halogenated and aromatic organics and petroleum hydrocarbons.

Site 8, Herbicide Burial Area

Air Force Civil Engineer's Construction Permit (AF 103), dated 6 August 1971, documents the location of a burial pit 6 feet long by 6 feet wide by 6 feet deep 100 yards south of a weather station at the south end of the runway. The weather station (known as Facility 847) no longer exists. However, a concrete foundation near the south end of the runway is thought to be the remains of the weather station.

A broad, shallow depression was observed in the area of the suspected trench location based on AF 103.

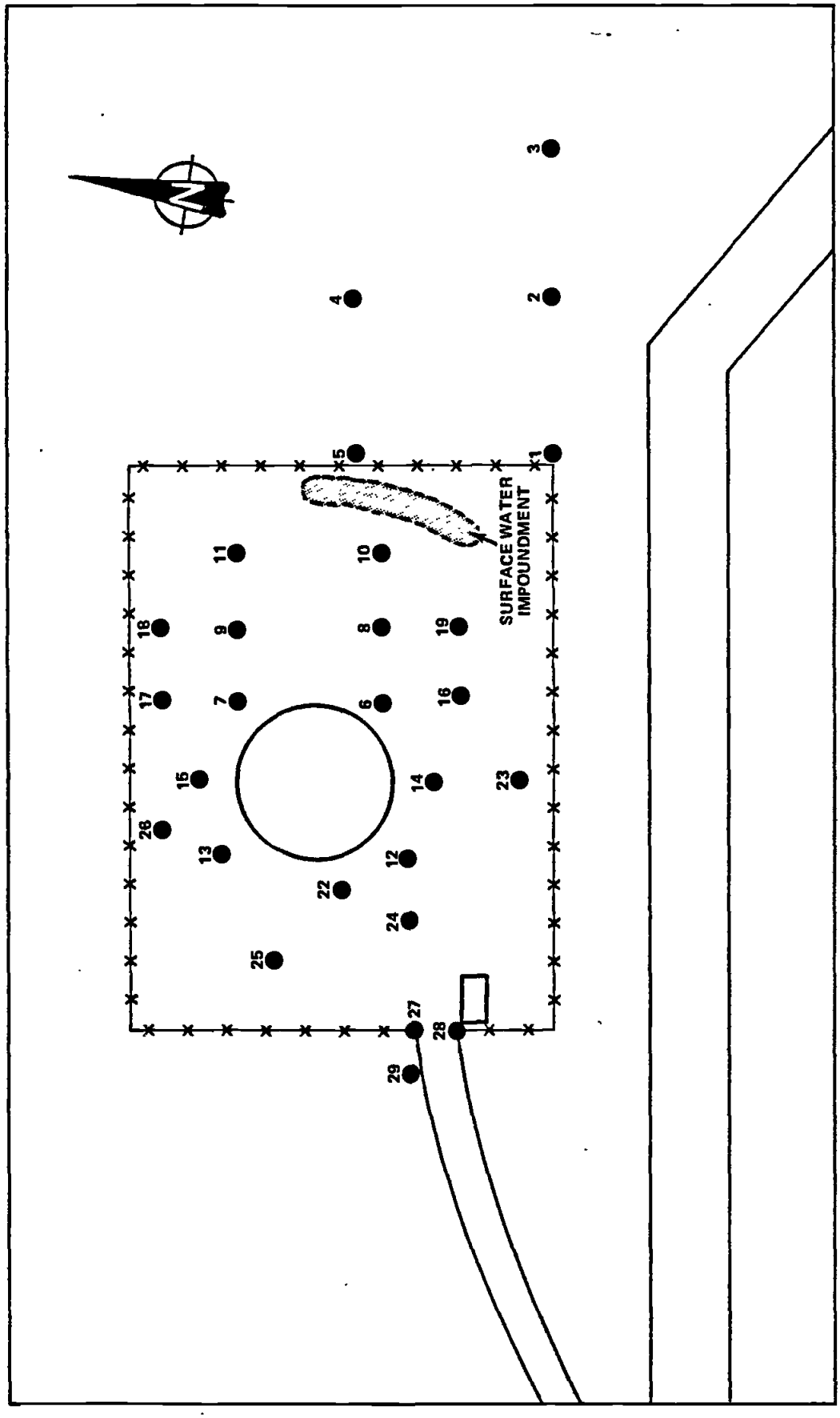
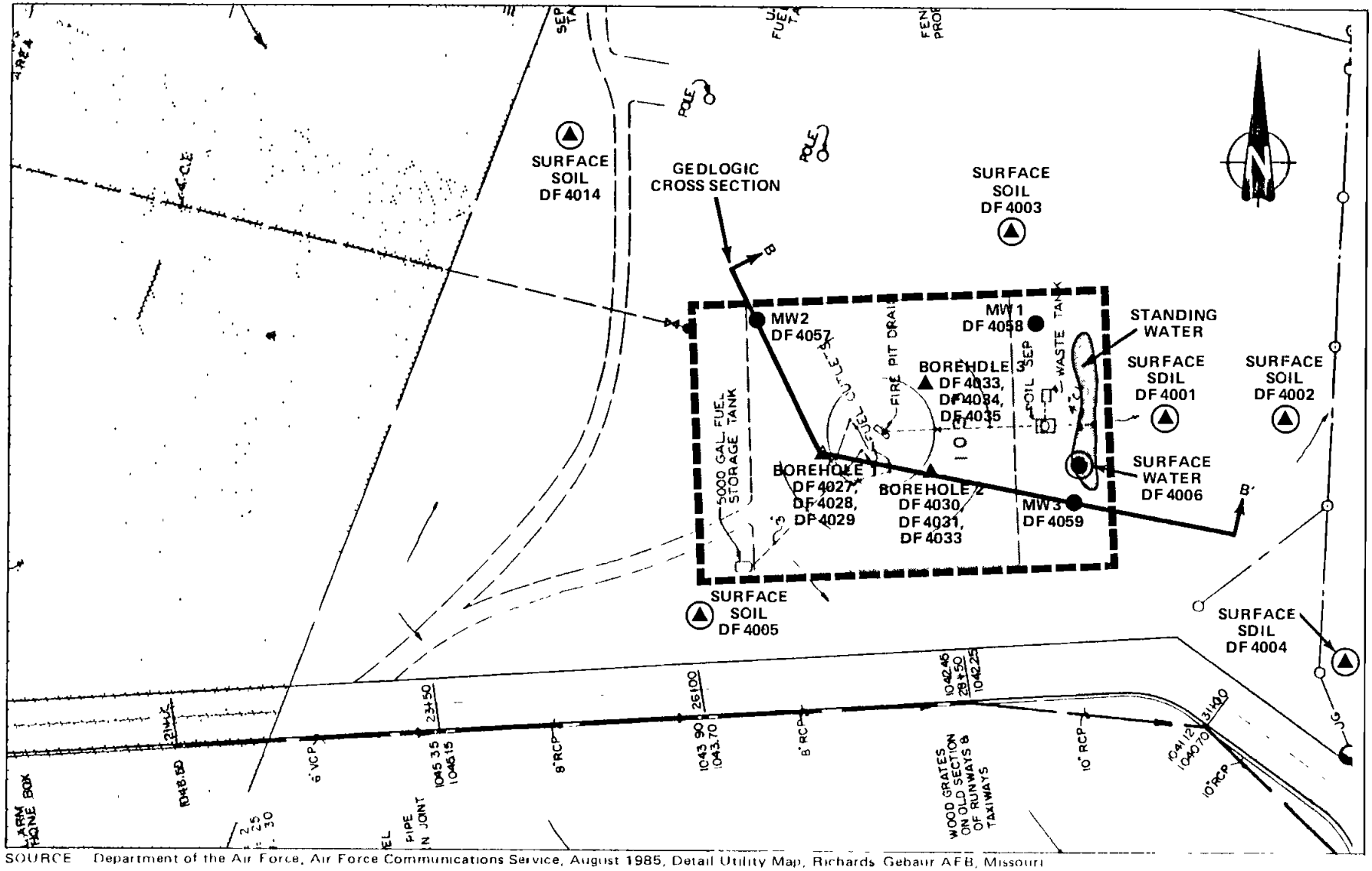


Figure 3–4 SITE 6, NORTH BURN PIT AREA, SOIL GAS SURVEY LOCATIONS



SOURCE Department of the Air Force, Air Force Communications Service, August 1985, Detail Utility Map, Richards Gebaur AFB, Missouri

KEY
- Site Boundary
- Surface Runoff Direction
- Subsurface Soil Sampling Location
- Surface Soil Sampling Location
- Groundwater Sampling Location
- Surface Water Sampling Location

SCALE 0 50 100 200 300 FEET

Figure 3–5 SAMPLING LOCATIONS AT SITE 6, NORTH BURN PIT AREA

Four composite surface soil samples were collected from the area where the burial pit is thought to be located based on AF 103 and previous evidence of vegetation stress. A single surface water sample was collected from a small pond located downgradient from the soil sampling area.

Figure 3-6 shows the sampling locations for this site.

The water sample was analyzed for total dissolved solids, arsenic, mercury, pesticides, and herbicides. The soil samples were analyzed for herbicides, arsenic, and mercury.

Site 9, Oil-Saturated Area

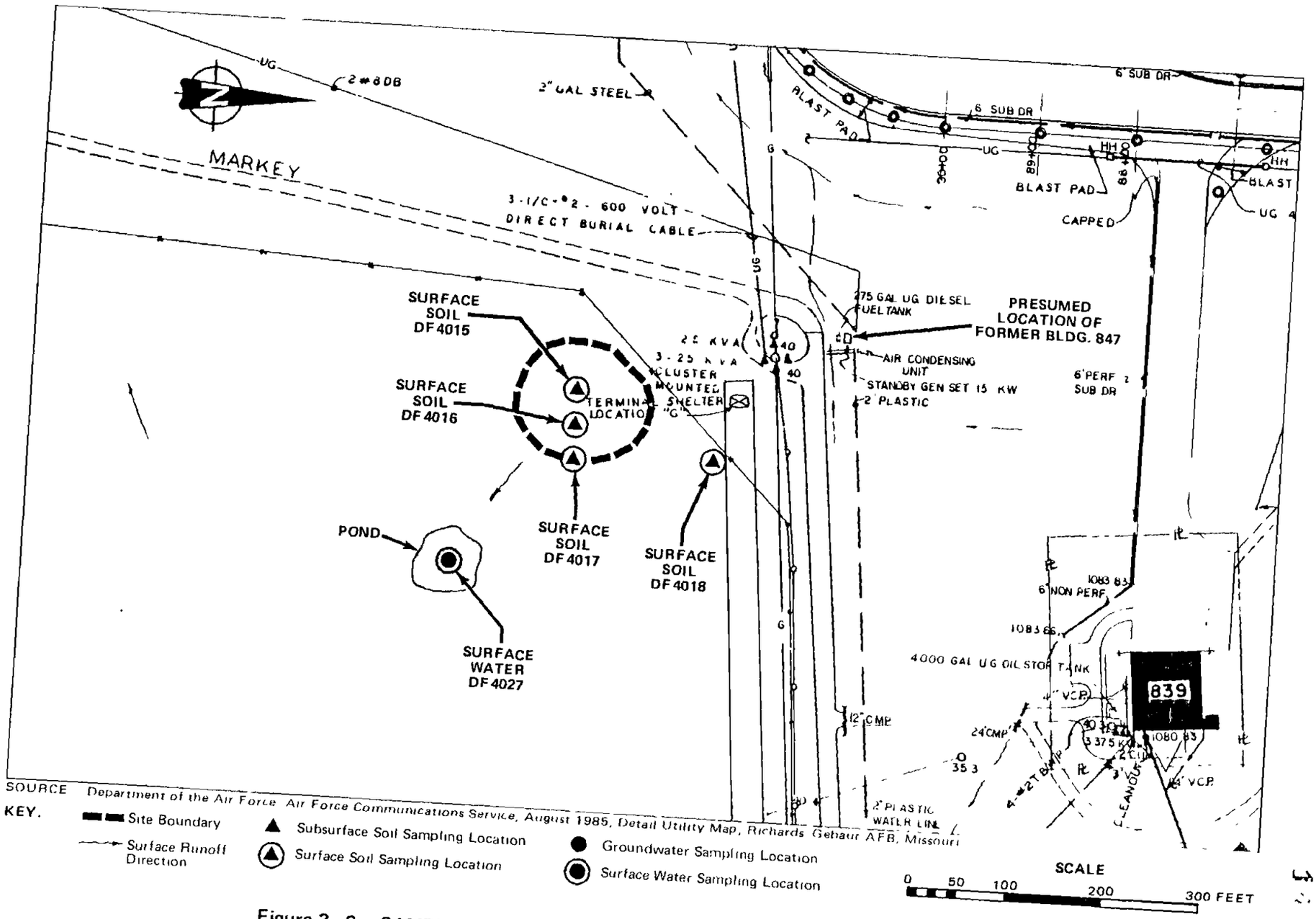
A single soil boring was drilled immediately adjacent to the stained area, to the northeast. Three subsurface soil samples were collected from this borehole. No sample was taken from the top 3 feet of the borehole, however, because of the presence of coarse fill and gravel. Six surface soil samples were collected downgradient from the oil-saturated area of the motor pool complex. Three of these surface soil samples were taken from the natural drainage path to the south of the area. One surface water sample was collected from the drainage ditch adjacent to a stained area. Two surface water samples were allocated for this site, however, there was only one small pool of standing water available to be sampled at the time of the field investigation.

Figure 3-7 shows sampling locations for this site.

The surface water sample was analyzed for petroleum hydrocarbons, total dissolved solids, halogenated and aromatic volatile organics, and lead. The soil samples were analyzed for halogenated and aromatic organics, petroleum hydrocarbons, and lead.

Site 10, Hazardous Waste Drum Storage Area

A single soil boring was drilled outside the site. The boring location was determined to be the most likely to be contaminated due to natural drainage patterns in the area. Three subsurface soil samples were collected from this borehole. Six surface soil samples were collected at and downgradient from the site. One surface water sample was collected from the drainage ditch downgradient of the site.



SOURCE: Department of the Air Force, Air Force Communications Service, August 1985, Detail Utility Map, Richards Gebaur AFB, Missouri

Figure 3–6 SAMPLING LOCATIONS AT SITE 8, HERBICIDE BURIAL AREA

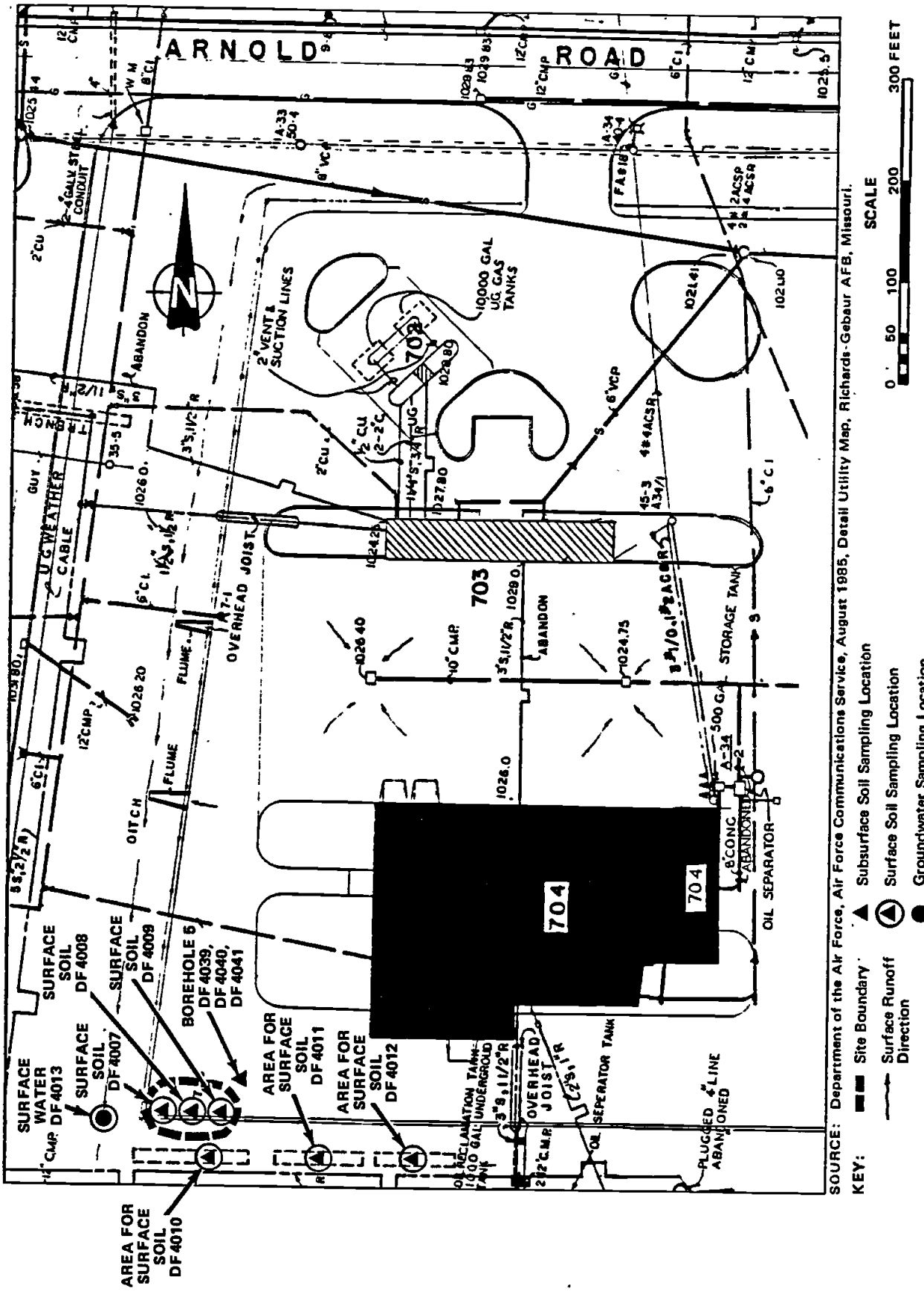


Figure 3–7 SAMPLING LOCATIONS AT SITE 9, OIL-SATURATED AREA

Figure 3-8 shows the sampling locations for this site.

The surface water sample was analyzed for petroleum hydrocarbons, total dissolved solids, halogenated and aromatic volatile organics, 13 priority pollutant metals, and barium. The nine soil samples were analyzed for halogenated and aromatic organics, petroleum hydrocarbons, and EP Toxicity metals.

Site 12, POL Storage Yard

Authorization could not be obtained for drilling inside Site 12, the POL Storage Yard, so a single downgradient monitoring well was installed outside the perimeter of the yard; one groundwater sample was collected and analyzed. Two surface water samples were collected from the drainage ditch west of the site, one from an upstream location and one from a downstream location.

Six-foot hand-augered boreholes were drilled inside three of the four bermed areas and three soil samples were taken from each boring. One subsurface soil sample was collected at a depth of 3 feet outside Building 953. One surface soil sample was collected outside Building 951.

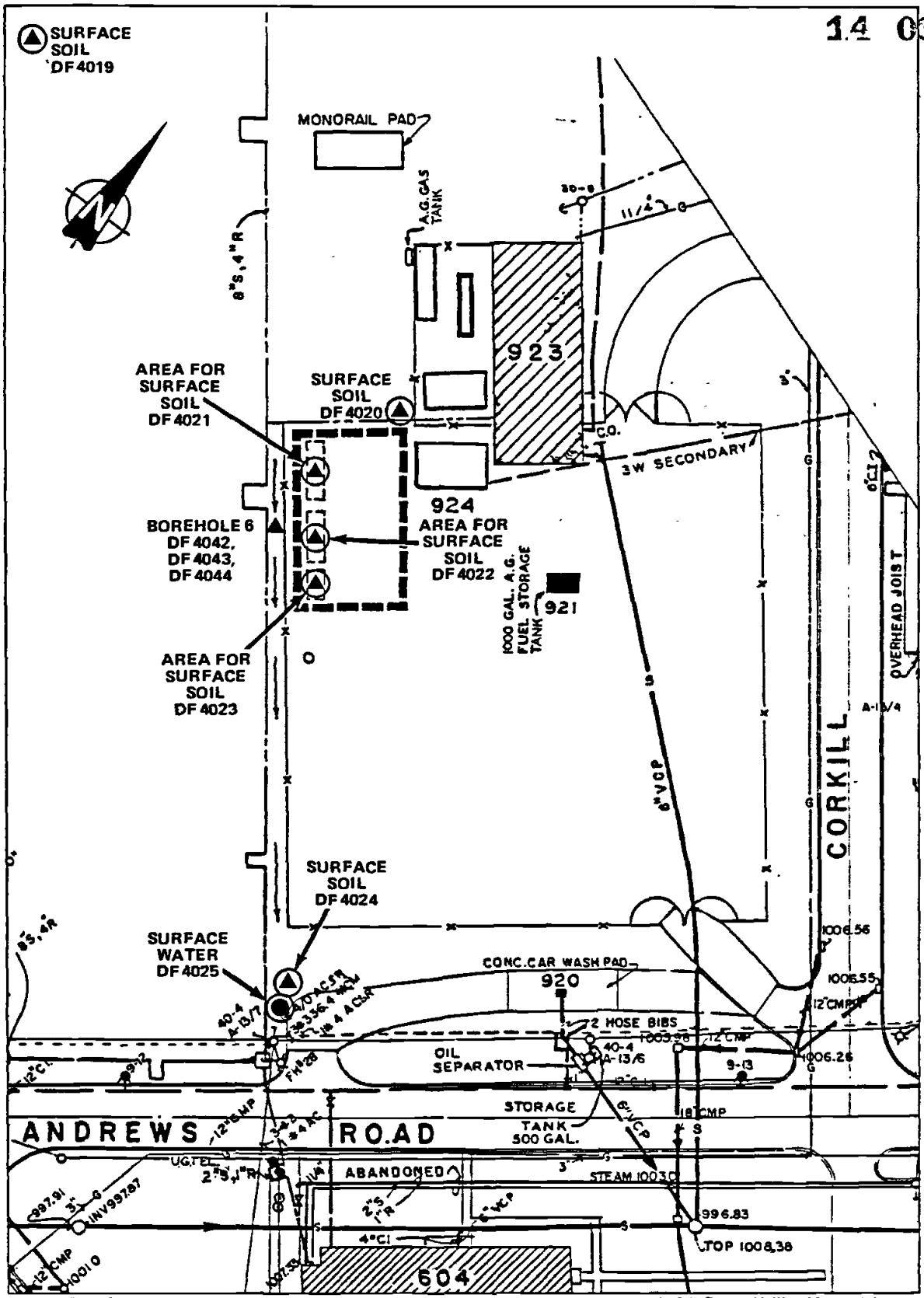
Figure 3-9 shows the sampling locations for this site.

The three water samples were analyzed for petroleum hydrocarbons, total dissolved solids, and halogenated and aromatic volatile organics. The 11 soil samples were analyzed for aromatic halocarbons and petroleum hydrocarbons.

3.2.8 Laboratory Program

All samples where sufficient matrix was retrievable were split in the field, and the split samples submitted to the base POC. When sufficient numbers of samples were generated, 10% of the samples were returned to E & E for processing and shipment to OEHL/SA at Brooks Air Force Base, Texas. Field collection, preservation, packaging, and shipping protocols were followed as specified in the Technical Operations Plan (see Appendix N).

Copies of the chain-of-custody forms for the samples are provided in Appendix E. Information on detection limits for the analytical parameters is given in Table 1-2. Additional information on holding



SOURCE: Department of the Air Force, Air Force Communications Service, August 1985, Detail Utility Map, Richards-Gebaur AFB, Missouri.

KEY: Site Boundary; Surface Runoff Direction; Subsurface Soil Sampling Location; Surface Soil Sampling Location; Groundwater Sampling Location; Surface Water Sampling Location

SCALE 0 50 100 200 300 FEET

Figure 3–8 SAMPLING LOCATIONS AT SITE 10, HAZARDOUS WASTE DRUM STORAGE AREA

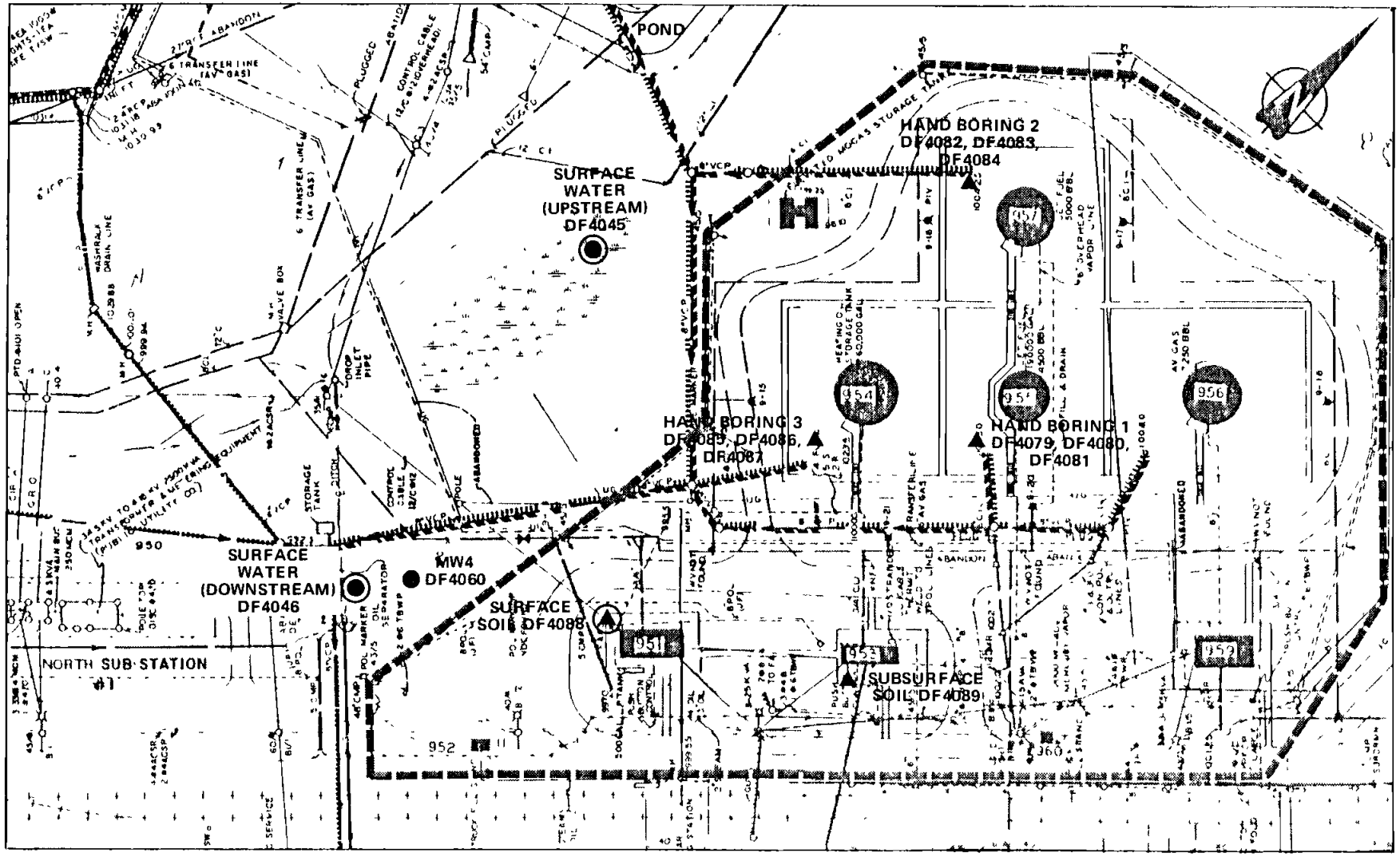


Figure 3–9 SAMPLING LOCATIONS AT SITE 12, POL STORAGE YARD

times is provided in Appendix H. All samples were shipped to the E & E Analytical Services Center (ASC) or to OEHL/SA by overnight Federal Express. Analytical protocols are discussed in Appendix N.

3.2.9 Variations from Description of Work

During the execution of the fieldwork, several changes from the Description of Work were implemented due to field conditions and findings. Changes were implemented after discussion with and concurrence of the OEHL project manager. A site-specific summary of the variations follows.

All Sites

Subsurface soil borings were taken using a CME continuous sampler. This unit is essentially a 5-foot-long split-spoon soil sampler that is advanced ahead of the hollow-stem auger. It provides a continuous undisturbed sample of the sediment column.

Optional water samples, allocated in case groundwater was intersected during the borehole drilling for subsurface soil samples, were not utilized as no appreciable amounts of groundwater were observed in any boreholes.

Site 1, South Landfill

No modifications in the proposed scope of work occurred at this site.

Site 2, Northeast Landfill

The geophysical surveys were adjusted in the field to cover areas adjacent to the targeted area, based on instrument readings which indicated the entire targeted area as landfill. This was later corroborated based on aerial photographs.

Boring 7 was aborted after encountering the apparent edge of the landfill. Only one of the three scheduled soil samples from this borehole was collected.

An additional surface water sample was collected, from a flowing tributary to Scope Creek just before it enters the creek. This sample represented runoff from the landfill prior to dilution in Scope Creek.

The sample replaced a water sample which could not be taken at Site 6, where no water was encountered.

Site 6, North Burn Pit Area

Due to the absence of any appreciable amounts of water in two of the three monitoring wells at the site, analyses could only be performed for halogenated and aromatic organics. Petroleum hydrocarbons had to be omitted. Two additional attempts to collect sufficient sample volumes also failed.

No determination could be made as to upgradient versus downgradient with respect to monitoring wells. The facility is situated on the top of a ridge.

Site 8, Herbicide Burial Area

No modifications in the proposed scope of work were made at this site.

Site 9, Oil-Saturated Area

No modifications in the proposed scope of work occurred at this site.

Site 10, Hazardous Waste Drum Storage Area

An upstream surface water sample could not be obtained since no water was encountered.

Site 12, POL Storage Yard

A surface water sample from the outfall drain from Building 953 was allocated. However, there was no outfall from this building, and so no sample was collected.

Due to errors in sample labeling in the field, two analytical parameters listed in the Description of Work were inadvertently omitted. These errors affected the proposed analytical program as follows:

- Sample DF4045 - No TDS analysis was performed on this sample.

- Sample DF4046 - No TDS analysis was performed on this sample.

4. RESULTS AND SIGNIFICANCE OF FINDINGS

4.1 INTRODUCTION

Water and soil samples were analyzed by E & E's Analytical Services Center (ASC) in Buffalo, New York. Analytical results, together with the QA/QC data for each job number, are included in Appendix H. Results are grouped in Appendix H corresponding to sample sets received by the ASC (in many cases, results from several sites are included under one job number, i.e., one laboratory data report). Soils data are wet weight values. To facilitate locating data in Appendix H, a "Sample Identification Cross Reference" is presented at the beginning of the appendix.

Methods of Evaluating Chemical Data

The Phase II Stage 2 investigation of Richards-Gebaur AFB involved the analysis of 64 soil samples and 25 water samples. The results section (Section 4.2) provides two data tables for each site, one containing soils results and one containing groundwater and/or surface water results. The concentrations of contaminants found at each site are compared to applicable and relevant federal standards, health criteria, and natural background concentrations. Specific procedures have been used for evaluating the soil, groundwater, and surface water data, as described below.

For soils, there are no mandatory federal standards or health criteria. Consequently, concentrations of trace metals found in the samples were compared to background levels reported as normal by the United States Geological Survey (USGS) for western Missouri (Connor and Shacklette 1975) (see Table 4-1). Only those metal concentrations found above background are reported in the results tables in Section

Table 4-1

THRESHOLD VALUES APPLIED TO
SOIL CONCENTRATIONS FOR
SAMPLES FROM RICHARDS-GEBAUR AFB
AS COMPARED WITH LITERATURE VALUES
FOR WESTERN MISSOURI

(mg/kg)

	Literature Value*	
	Mean	Normal Range
Arsenic	8.3	3 - 13
Cadmium	<1	<1 - 2.5
Chromium, Total	66	50 - 100
Copper	18	10 - 30
Lead	15	10 - 20
Mercury	0.035	<0.01-0.06
Nickel	22	15 - 30
Zinc	61	37 - 90

*Source: Connor, J.J., and H.T. Shacklette 1975.

4.2. Organic compounds detected in soils are listed individually in the results tables. In general, most organic chemicals reported in the soils are not natural soil constituents, and therefore should not be attributed to natural sources. In the absence of background data, it is assumed that all organic contamination not attributable to laboratory contamination should be considered to be related to site activities.

For organics and inorganics in groundwater and surface water, individual contaminant concentrations detected are reported in the results tables. The principal concern is the potential adverse health hazard related to human drinking water consumption. Therefore, concentrations found were compared to EPA drinking water standards and criteria [Recommended Maximum Contamination Limits (RMCLs), Maximum Contamination Limits (MCLs), or lifetime Health Advisories (HAs)]. These standards and criteria were selected for use because they represent mandatory drinking water limits or criteria for protection of human health.

Laboratory Quality Assurance/Quality Control (QA/QC)

The laboratory quality control (QC) activities followed throughout this project support the accuracy of the technical data generated. These activities included analysis of calibration standards, duplicates, matrix spikes, surrogate spikes, standard reference materials, and method blanks.

Duplicate results and spike recoveries were judged in comparison to historical laboratory quality assurance (QA) data, or where applicable, EPA guidelines. Of the samples whose surrogate spike recoveries did not fall within EPA guidelines, a representative number were re-extracted and reanalyzed to confirm a sample matrix effect.

Method blanks were analyzed to assess possible laboratory contamination. Common laboratory solvents, such as methylene chloride, and common phthalate esters were identified and reported in some method blanks. Levels up to five times the detection limit for these contaminants are considered to have no negative impact upon data quality. EPA has determined from its CLP program that most, if not all, labs have a problem with low levels of common lab solvents and phthalate esters in lab blanks (USEPA CLP Contract 1985). Sample results with

levels of these compounds five times the detection limit should be considered suspect. Low levels of common solvents or common phthalates reported in site samples should be viewed with caution. Results of 10 to 20 µg/L in water samples are often attributable to laboratory contamination. Similarly, levels of 1 to 3 mg/kg in soil or sediment samples may not reflect site contamination.

4.2 RESULTS

4.2.1 Site 1, South Landfill

Geology

Based on published maps and observations made in the field during the Phase II Stage 2 investigation, Site 1, the South Landfill, is situated on a thin cover of unconsolidated silts and clays overlying Pennsylvanian age rocks of the Zarah subgroup. The unconsolidated deposit is less than 8 feet thick and thins to disappearance along the banks of Scope Creek. A single boring was made into this material. The sediments were similar to those found in other upland soil borings. Typically, the sediments are silts and clays which have weathered for a long time, as indicated by the well-developed soil structures (peds) and oxidized colors (reddish browns). Another key indicator to the history of these sediments is the occurrence of a layer of chert at some depth in the profile. In the boring, a chert gravel layer was observed at 4 feet below the ground surface. The chert layer acted as a permeable layer through which minor amounts of perched water could flow.

Hydrogeology

The hydrology at the site is relatively complex. The site is located adjacent to an intermittent stream (Scope Creek) and is down-gradient from a man-made lake which creates a hydraulic head west of the site and feeds a marshy area west of the landfill and east of the lake. This situation causes numerous seeps to flow from the northeast corner of the landfill. The lake also serves to recharge the permeable layers at and above the interface of the unconsolidated sediments with local bedrock units.

Several intermittent streams were observed on the east side of the landfill adjacent to Scope Creek. Most of them were dry and were probably surface water drainage pathways rather than individual seeps. Two of the seeps were flowing, allowing water samples to be taken before entering the creek. The creek was not flowing at the time of sampling, even though rainfalls of 0.41 and 0.24 inches were recorded at the base on the day before and the day of surface water sampling. Upstream and downstream samples were taken of pooled water. The month of October 1986 was wetter than normal. During the month, 6.03 inches of rain fell, which was more than 2 inches above normal. The south part of the base is very near the headwaters and drainage divide for Scope Creek and the Little Blue River.

Chemical Results

The four water samples collected at the site were analyzed for petroleum hydrocarbons, total dissolved solids, halogenated and aromatic volatile organics, 13 priority pollutant metals, extractable priority pollutants (GC/MS), common anions, and phenols. The seven surface and subsurface soil samples were analyzed for volatile organics and petroleum hydrocarbons.

The four water samples did not show any contamination for the parameters tested. The extractable organic compound di-n-butyl phthalate (DBP) was present in all four samples but at concentrations below the method detection limit (30 µg/L). It was also found to be present in the method blank (<10 µg/L). Therefore, the low concentrations of this compound have been attributed to laboratory contamination. In addition, four anions were reported for the most part minimally above detectable limits. The concentrations for two of the three anions subject to EPA secondary (non-mandatory) drinking water standards, fluoride and sulfate, were significantly below these standards. For the third, chloride, concentrations were below the World Health Organization criterion for aesthetic purposes. The values for total dissolved solids (TDS) range from 290 mg/L upstream to 400 mg/L downstream. Table 4-2 summarizes the results of the water analyses.

The soil samples were not contaminated for the parameters tested, with the exception of petroleum hydrocarbons. A low concentration (1.2

Table 4-2

RESULTS OF WATER SAMPLE ANALYSES FOR SITE 1, SOUTH LANDFILL

(ug/L, unless otherwise specified)

Parameter	EPA Drinking Water Standards and Health Advisories*			Date Sampled: Location: Field Sample No.: Lab Sample No.:	Surface Water			
	EPA MCL	EPA RMCL	EPA HA		10/21 Background DF4066 9085	10/21 Downstream DF4068 9086	10/21 Seep 1 DF4071 9087	10/23 Seep 2 DF4076 9233
Petroleum Hydrocarbons (mg/L)	--	--	--		ND	ND	ND	ND
Halogenated Volatile Organics	--	--	--		ND	ND	ND	ND
Aromatic Volatile Organics	--	--	--		ND	ND	ND	ND
Priority Pollutant Metals	--	--	--		ND	ND	ND	ND
Extractables: di-n-butyl phthalate**	--	--	--		<30	<30	<30	<30
Total Dissolved Solids (mg/L)	--	--	--		290	390	400	380
Common Anions (mg/L)								
Flouride	4	--	--		0.64	0.75	0.74	0.65
Chloride	--	--	250†		4.6	29	32	5.2
Nitrite	--	1(p)	--		ND	ND	ND	ND
Phosphate	--	--	--		ND	ND	ND	ND
Nitrate	--	10(p)	--		ND	2.4	2.7	ND
Bromide	--	--	--		ND	ND	ND	0.24
Sulfate	250 (secondary standard)	--	--		36	35	28	18
Phenols	--	--	--		ND	ND	ND	ND

*Key: MCL = Maximum Contaminant Limit.
RMCL = Recommended Maximum Contaminant Limit.
HA = Lifetime Health Advisories developed by EPA for noncarcinogenic effects.
(p) = Proposed.
ND = Not Detected.

**Detected in the method blank, therefore attributed to laboratory contamination.

†World Health Organization criterion for aesthetic quality.

NOTE: The values for di-n-butyl phthalate are listed as "[illegible]" which means that the compound is present but below me[illegible]

mg/kg) of petroleum hydrocarbons detected near the bottom of the borehole was thought to be associated with the permeable chert layer. A higher concentration (16 mg/kg) was found in a surface soil sample taken at Seep 2. This is not really a seep, however. The water is surface runoff from the upgradient lake and marshy area located along the west flank of the landfill. This area is adjacent to the runway and air traffic. It is possible that runoff from runway operations contributed to the higher concentration of petroleum hydrocarbons detected in the surface soil sample taken at Seep 2. Table 4-3 summarizes the results of the soil analyses.

4.2.2 Site 2, Northeast Landfill

Geophysics

A previous report (CH2M Hill 1985) showed Site 2, the Northeast Landfill, as consisting of three discrete trenches. In order to locate these trenches precisely, magnetometer and EMC geophysical surveys were conducted. No discrete trenches could be delineated from the geophysical data. Instead, the data indicated wide anomalies over the entire survey area. A historical aerial photograph was also found which showed the location of trenches as of 1970. This photo, like the geophysical survey data, contradicted the theory of three discrete trenches. The photo showed the Northeast Landfill in 1970 to be a series of trenches oriented north-south and east-west.

Based on the geophysical surveys and the aerial photo, the area delineated in Figure 4-1 was considered to have been trenched and landfilled. Further investigation, including the drilling of four boreholes, installation of two monitoring wells, and collection and analysis of soil samples and water samples, was based on the understanding of the trenched and landfilled area as delineated in Figure 4-1.

Geology

Based on published maps and observations made in the field during the Phase II investigation, Site 2, the Northeast Landfill, is situated on a thin cover of unconsolidated silts and clays overlying a gray to

Table 4-3

RESULTS OF SOIL SAMPLE ANALYSES
FOR SITE 1, SOUTH LANDFILL

(mg/kg; all soil concentrations
expressed on an as received basis)

Parameter	Date Sampled: / Boring: / Depth: / Field No.: / Lab No.:	10/17 / 7 / 1-2' / DF4047 / 8972	10/17 / 7 / 4-5' / DF4048 / 8973	10/17 / 7 / 6-7' / DF4049 / 8974	10/21 / Upstream / 0 - 6" / DF4067 / 9090	10/21 / Downstream / 0 - 6" / DF4069 / 9091	10/21 / Seep 1 / 0 - 6" / DF4070 / 9092	10/21 / Seep 2 / 0 - 6" / DF4077 / 9236
Volatile Organic Compounds		ND	ND	ND	ND	ND	ND	ND
Petroleum Hydrocarbons		ND	ND	1.2	ND	ND	1.9	16

ND = Not Detected

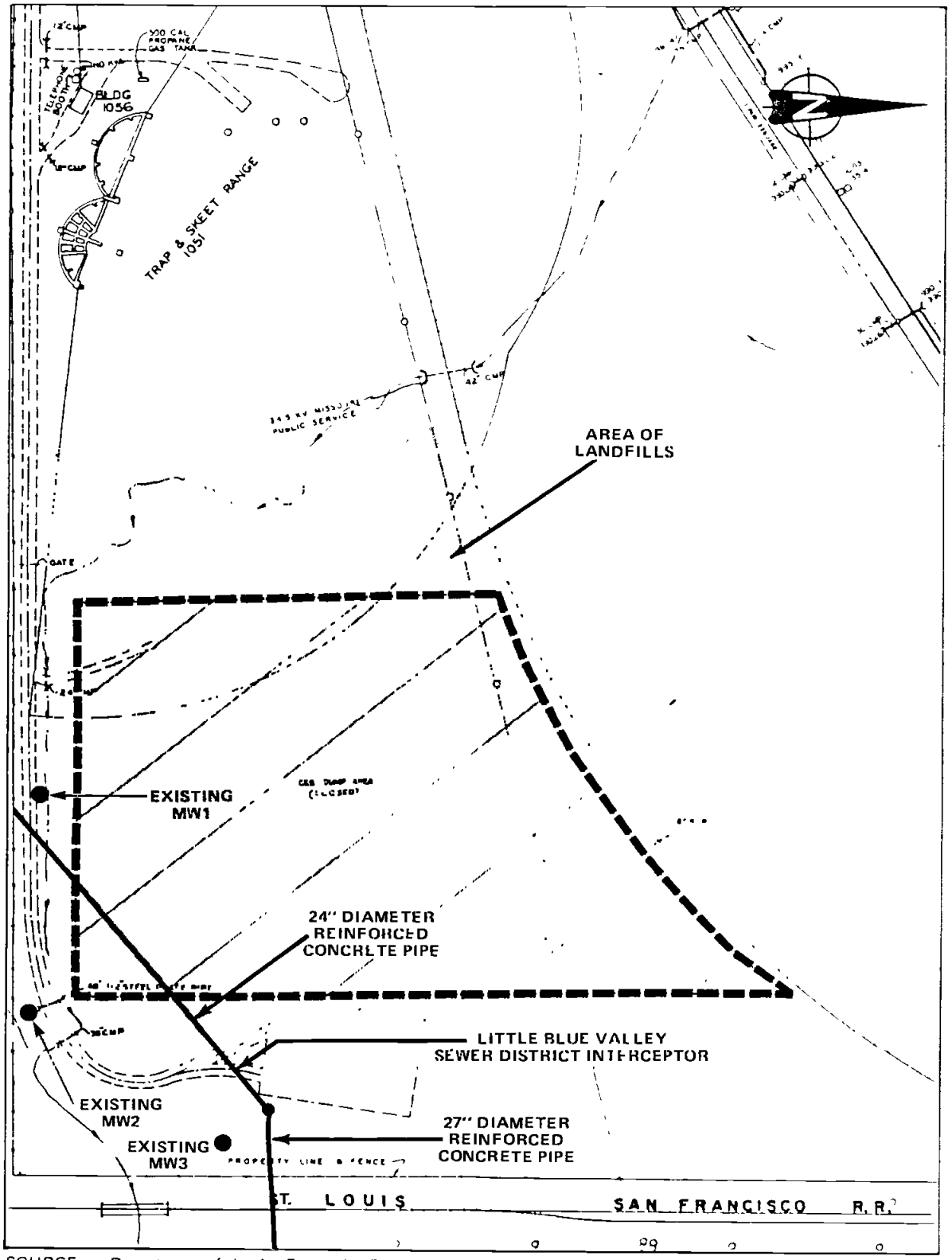


Figure 4–1 LOCATION OF SITE 2, NORTHEAST LANDFILL, BASED ON GEOPHYSICAL SURVEY AND HISTORICAL AERIAL PHOTOGRAPHS (3/19/77)

green shale which averages 22 feet in thickness. The unconsolidated deposit is less than 8 feet thick, and thins to disappearance along the banks of Scope Creek. Four borings were made into this material. Drilling logs are presented in Appendix D. The soils were similar to those found in other soil borings on the base, in that they consist of silts and clays but are darker than soils from borings on upland surfaces, which are reddish-brown in color. A chert layer was found at the base of borings just above the bedrock. The chert acts as a permeable layer through which minor amounts of groundwater could flow. Boring 4 was completed as a monitoring well and designated MW6. The log for this boring is given in Appendix D and is referred to as MW6.

Hydrogeology

The Northeast Landfill is located adjacent to a section of Scope Creek that more frequently contains water than other sections of the creek. The site is located in the lowest portion of the base. The three existing monitoring wells are completed in the Chanute Formation, a shale. Of the new wells, the downgradient well (MW4) was completed at the top of the Chanute shale. The background well (MW5) was completed at the interface of the unconsolidated deposits with the Raytown Member of the Iola Formation. The Raytown is a gray limestone about 10 feet thick. Sufficient quantities of groundwater were retrieved from each well for analytical purposes.

Chemical Results

The eight water samples (3 surface water and 5 groundwater) were analyzed for petroleum hydrocarbons, total dissolved solids, halogenated and aromatic volatile organics, 13 priority pollutant metals, extractable priority pollutants (GC/MS), common anions, and phenols. The soil samples were analyzed for volatile organics and petroleum hydrocarbons.

Generally, the water samples showed no contamination for most of the parameters tested. The extractable organic compound DBP was present in the surface water samples at concentrations below the method detection limit (39 µg/L). It was detected in the method blank at 13 µg/L. DBP was also found to be present in the groundwater samples at

concentrations below the method detection limit (30 µg/L). It was detected in the method blank at <10 µg/L. Because DBP was detected in the method blanks, its presence in the samples has been attributed to laboratory contamination. Five anions, fluoride, chloride, nitrate, bromide, and sulfate, were reported above detectable limits. Only one sample for sulfate (280 µg/L) minimally exceeded the EPA secondary drinking water standard (250 µg/L). The TDS values for the monitoring wells (380 to 940 mg/L) are 2 to 4 times greater than for the creek (250 to 470 mg/L). The highest TDS value came from new MW6 (940 mg/L). The surface water collected from runoff from the landfill before it enters Scope Creek had a TDS value of 420 mg/L. Table 4-4 summarizes the results of the water analyses.

The soil samples showed no organic contamination, with the exception of petroleum hydrocarbons. Petroleum hydrocarbons were detected at a high concentration (440 mg/kg) in the uppermost sample and a lower concentration (19 mg/kg) at a lower depth, from Boring 4. Table 4-5 summarizes the results of the soil analyses.

4.2.3 Site 6, North Burn Pit Area

Geology

Based on published maps and field observations made during the Phase II Stage 2 investigation, Site 6, the North Burn Pit Area, is situated on a thin cover of unconsolidated silts and clays overlying Pennsylvanian age rocks of the Zarah subgroup. These rock units are primarily limestones and shales, with the thickest member being the Argentine, a gray limestone with abundant chert nodules. The Argentine is one of the more resistant bedrock units in the area and is found at the tops of most of the hills in southern Jackson County and northern Cass County. The unconsolidated deposit is less than 8 feet thick and thins to disappearance along the flanks of the hills. Three soil borings and three monitoring wells were drilled into this material. Drilling logs are presented in Appendix D. The soils were similar to those found in other borings at the base. Typically, the soils are silts and clays which have weathered for a long time, as indicated by

Table 4-4

RESULTS OF WATER SAMPLE ANALYSES FOR SITE 2, NORTHEAST LANDFILL

(ug/L, unless otherwise specified)

Parameter	EPA Drinking Water Quality Standards and Health Advisories*			Well No.: / Date Sampled: / Field Sample No.: / Lab Sample No.:	Groundwater					Surface Water		
	EPA MCL	EPA RMCL	EPA HA		MW5 10/21 DF4061 9080	MW6 10/21 -62 9081	P21 10/21 -63 9082	P22 10/21 -64 9083	P23 10/21 -65 9084	NELFC 10/23 -73 9230	NELFD 10/23 -74 9231	NEFLU 10/23 -75 9232
Petroleum Hydrocarbons (mg/L)	--	--	--		ND	ND	ND	ND	ND	ND	ND	ND
Halogenated Volatile Organics	--	--	--		ND	ND	ND	ND	ND	ND	ND	ND
Aromatic Volatile Organics	--	--	--		ND	ND	ND	ND	ND	ND	ND	ND
Priority Pollutant Metals (mg/L)	--	--	--		ND	ND	ND	ND	ND	ND	ND	ND
Extractables di-n-butyl phthalate**	--	--	--		<30	<30	<30	<30	<30	<39	<39	<39
Total Dissolved Solids (mg/L)	--	--	--		380	940	430	650	510	470	250	260
Common Anions (mg/L)												
Flouride	4	--	--		1.0	2.7	0.79	3.2	1.2	0.81	0.49	0.53
Chloride	--	--	250†		4.3	47	22	22	41	54	16	16
Nitrite	--	1(p)	--		ND	ND	ND	ND	ND	ND	ND	ND
Phosphate	--	--	--		ND	ND	ND	ND	ND	ND	ND	ND
Nitrate	--	10(p)	--		2.2	ND	6.7	0.24	0.60	0.15	2.7	2.5
Bromide	--	--	--		ND	0.25	ND	0.20	0.24	0.15	0.16	0.11
Sulfate	250	--	--		61	280	110	60	91	64	28	25
Phenols	--	--	--		ND	ND	ND	ND	ND	ND	ND	ND
Lead (mg/L)	0.05	0.02	--		0.008	0.005	0.005	0.008	<0.005	<0.005	<0.005	<0.005

*Key: MCL = Maximum Contaminant Limit.
RMCL = Recommended Maximum Contaminant Limit.
HA = Lifetime Health Advisories developed by EPA for noncarcinogenic effects.
(p) = Proposed.
ND = Not Detected.
†World Health Organization recommended criterion for aesthetic quality.
**Detected in the method blank, therefore attributed to laboratory contamination.

NOTE: The values for di-n-butyl phthalates are listed as "<" which means the compound is present but below method detection limits.

Table 4-5

RESULTS OF SOIL SAMPLE ANALYSES
FOR SITE 2, NORTHEAST LANDFILL

(mg/kg; all concentrations expressed on an as received basis.)

Parameter	Date Sampled: / Boring: / Depth: / Field No.: / Lab No.:	10/16 NELFB4 1-2' DF4036 8963	10/16 NELFB4 6-7' DF4037 8964	10/16 NELFB4 8-8.5' DF4038 8965	10/17 NELFB8 7-7.9' DF4050 8975	10/17 NELFB9 4-5' DF4051 8976	10/17 NELFB9 6-7' DF4052 8977	10/17 NELFB9 6-7' DF4052D 8978	10/17 NELFB9 9-10' DF4053 8979	10/17 NELFB10 1-2' DF4054 8980	10/17 NELFB10 4-5' DF4055 8981	10/17 NELFB10 7-8' DF4056 8982
Volatile Organics Compounds		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Petroleum Hydrocarbons		440	19	ND	ND	ND	ND	ND	ND	ND	ND	1.0

ND = Not Detected

the well-developed soil structures (peds) and oxidized colors (reddish-browns). A chert layer was observed in the three borings at various subsurface depths. The chert layer could act as a permeable layer through which minor amounts of perched water could flow.

Soil Gas Survey

Twenty-seven soil gas stations were monitored at Site 6. The survey helped delineate the extent of organic vapor contamination in the soils around the burn pit. The contamination appears to be contained within the fenced area. The highest concentrations were recorded adjacent to the burn pit. At progressive distances away from the pit, the values dropped off dramatically and could not be detected outside the compound. Based on this information, the three monitoring wells were located within the compound, and all borehole and well cuttings were containerized at the site pending the results of soil analysis for volatile organic compounds. The laboratory analysis showed no volatile organic contamination in any of the soil samples. Results of the soil gas survey are shown on Figure 4-2.

Hydrogeology

A permeable layer of chert was encountered at depths which varied between 6 and 9 feet below ground surface. Small quantities of water are perched and seep through this chert layer. Only MW1 yielded sufficient water for all proposed analyses. The reason for this may have been due to the presence of recharge from the surface impoundment in the vicinity of the well.

Chemical Results

No contaminants were detected in the surface water. Volatile organics were detected in each of the three monitoring wells. Wells MW2 and MW3, which were completed at the bedrock interface, showed minor contamination with chloroform (0.50 and 0.61 µg/L, respectively) and tetrachlorethylene (0.71 and 0.41 µg/L). The deeper well, MW1, had no trace of these compounds, but had methylene chloride (37 µg/L) at a concentration below the EPA lifetime drinking water advisory of 350 µg/L. Table 4-6 summarizes the results of the water analyses.

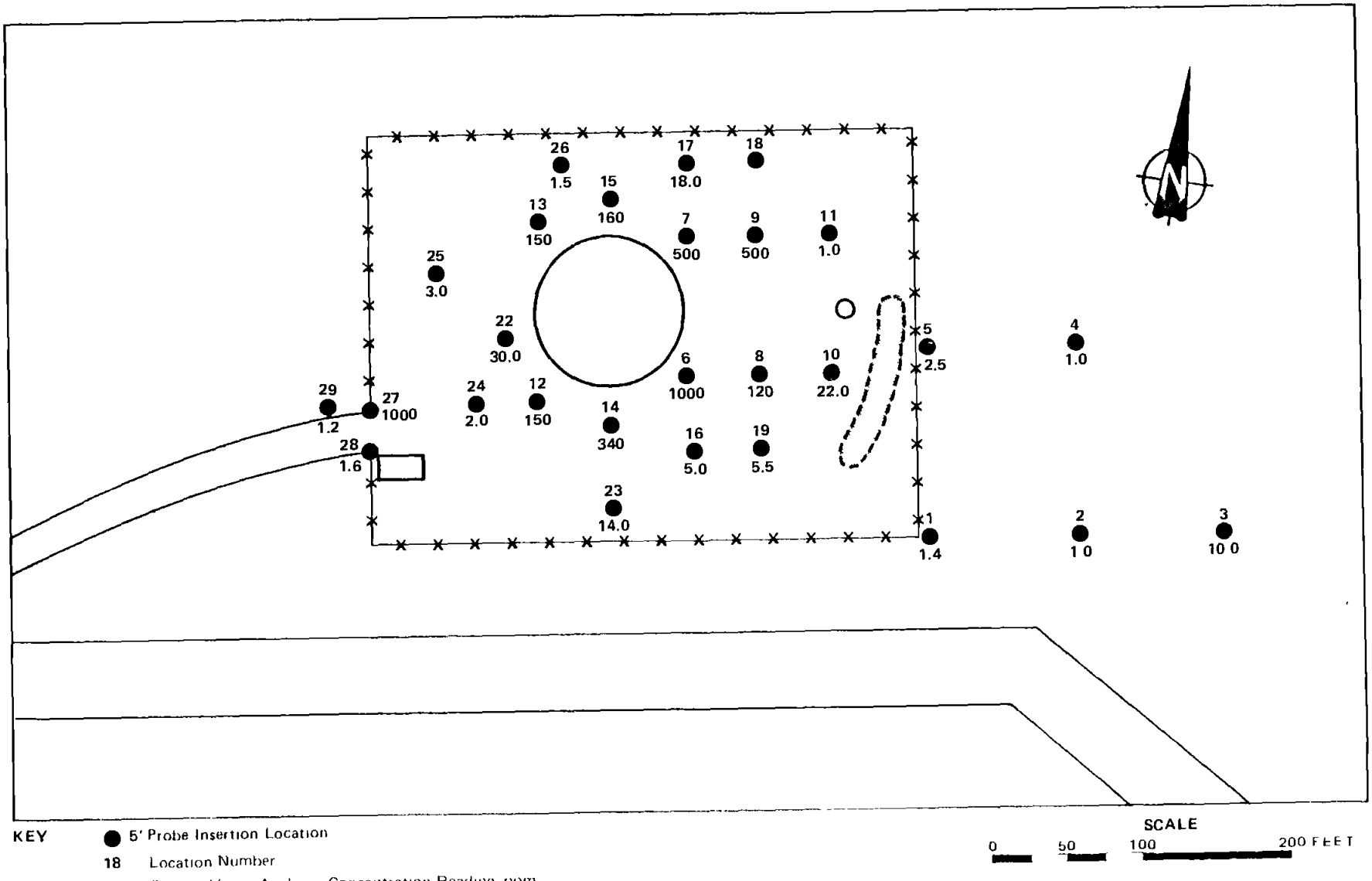


Figure 4–2 SUMMARY OF SOIL GAS SURVEY LOCATIONS AND CONCENTRATIONS AT SITE 6, NORTH BURN PIT AREA

Table 4-6

RESULTS OF WATER SAMPLE ANALYSES FOR SITE 6, NORTH BURN PIT AREA

(ug/L, unless otherwise specified)

Parameter	EPA Drinking Water Standards and Health Advisories*				Surface Water	Groundwater		
	EPA MCL	EPA RMCL	EPA HA	Well No.: / Date Sampled: / Field Sample No.: / Lab Sample No.:	NBW1 10/9 DF4006 8776 (9088)	NWMW 10/21 DF4057 9076	NEMW 10/21 DF4058 9077	SEMW 10/21 DF4059 9078
Petroleum Hydrocarbons (mg/L)	--	--	--		ND	NR	NR	NR
Halogenated Volatile Organics								
Chloroform	100	--	--		ND	0.50	ND	0.61
Methylene Chloride	--	--	350**		ND	ND	37	ND
Tetrachloroethylene	--	--	680**		ND	0.71	ND	0.41
Aromatic Volatile Organics	--	--	--		ND	ND	ND	ND

*Key: MCL = Maximum Contaminant Limit
RMCL = Recommended Maximum Contaminant Limit
HA = Lifetime Health Advisories developed by EPA for noncarcinogenic effects
ND = Not Detected
NR = Not run due to insufficient sample volume

**EPA is currently reviewing the potential carcinogenicity of this chemical. If the agency concludes the chemical ought to be regulated as a carcinogen in drinking water, the agency will establish a health advisory significantly lower than the current HA.

Nearly all Organic Vapor Analyzer (OVA) readings were positive. The laboratory analyses indicated that none of the nine subsurface samples was contaminated with volatile organics. The probable explanation for the positive result in the soil gas survey and the negative result in the subsurface soil samples is that the OVA was detecting methane, which would not be detected in the soil samples. The fact that OVA readings remained constant when using a carbon filter further supports this conclusion.

The values for petroleum were also low and consistent among the samples (ND to 5.7 mg/kg), with the exception of sample DF4001, collected 100 feet east of the southeast corner of the fence line, which contained 34 mg/kg. Table 4-7 summarizes the results of the soil analyses.

4.2.4 Site 8, Herbicide Burial Area

Geology

Site 8, the Herbicide Burial Area, is similar in setting to Site 6, the North Burn Pit Area, and the Site 1, the South Landfill. The site is on an upland surface where silts and clays cover a weathered limestone bedrock. The original topography of the base has been modified by construction and extension of the major north-south runway. The area is nearly level, with broad shallow depressions and a small pond downgradient to the south.

A broad shallow depression was observed in the area of the suspected trench location based on AF 103. Water had ponded in this area and drained east into other wet areas. It is not known if the shallow depression was caused by possible subsidence of the 1971 trench or is due to construction activities since that date.

Hydrogeology

Based on observations made on other upland sites on the base, it can be assumed that the thickness of the unconsolidated deposits above the bedrock at this site is less than 7 feet. The burial trench was projected to be 6 feet in depth, which places the bottom of the trench very close to, if not directly on, the weathered bedrock surface. The hydrological implication is that the material that was buried, and

Table 4-7

RESULTS OF SOIL SAMPLE ANALYSES FOR SITE 6, NORTH BURN PIT AREA

(mg/kg, all concentrations on an as received basis.)

Parameter	Date Sampled: / Boring: / Depth: / Field No.: / Lab No.:	10/9 NBAS-1 0-1' DF4001 8765	10/9 NBAS-2 0-1' DF4002 8766	10/9 NBAS-3 0-1' DF4003 8767	10/9 NBAS-4 0-1' DF4004 8768	10/9 NBAS-5 0-1' DF4005 8769	10/10 NBAS-6 0-1' DF4014 8795	10/15 NBAB-1 3.5-4.5' DF4027 8894	10/15 NBAB-1 7-8' DF4028 8895	10/15 BNAB-1 12-12.4' DF4029 8896	10/15 NBAB-2 2-3' DF4030 8897	10/15 NBAB-2 5-6' DF4031 8898	10/15 NBAB-2 11-12' DF4032 8899	10/15 NBAB-2 11-12' DF4032D 8900	10/15 NBAB-3 2-3' DF4033 8901	10/15 NBAB-3 5-6' DF4034 8902	10/15 BNAB-3 11-12' DF4035 8903
Volatile Organics Compounds		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Petroleum Hydrocarbons		34	1.4	5.4	2.8	5.7	2.8	ND	3.8	3.8	1.9	1.6	2.0	1.4	ND	ND	ND

ND = Not Detected

probably compacted, is either contained in generally impermeable silts and clays, or, if bedrock was shallower, has breached containment and entered the permeable weathered zone located at the bedrock/sediment interface.

Chemical Results

The surface water sample from the downgradient pond showed no contamination for the parameters tested (see Table 4-8). No pesticide or mercury contamination was detected in any of the four surface soil samples (see Table 4-9). Arsenic was detected in three of the four surface soil samples in concentrations ranging from 1.8 to 5.0 mg/kg. Samples DF4015 and DF4016, located closest to the suspected location of the trench, had arsenic values of 1.8 mg/kg and 5.0 mg/kg, respectively, whereas sample DF4017, from a point 25 feet further downgradient, showed no arsenic. Sample DF4018, more than 200 feet from the suspected trench area, had an arsenic value of 4.5 mg/kg. All soil concentrations for arsenic fell within the normal range for area soils (3 to 13 mg/kg).

4.2.5 Site 9, Oil-Saturated Area

Geology

The single 15-foot boring drilled at this site did not intersect bedrock. Based on previous information, the bedrock below this site is a gray shale (Lane Formation). This shale can be sandy in its upper parts and is generally 30 feet or more in thickness.

Hydrogeology

No groundwater was encountered in the borehole from this site. Storm runoff is channeled through a ditch across the southwest corner of the compound. No seeps or traces of petroleum were observed flowing from the oil-stained area into the storm water runoff.

Table 4-8

RESULTS OF WATER SAMPLE ANALYSES FOR
SITE 8, HERBICIDE BURIAL AREA

(ug/L, unless otherwise specified)

Parameter	EPA Drinking Water Standards and Health Advisories*				Surface Water
	EPA MCL	EPA RMCL	EPA HA	Well No.: / Date Sampled: / Field Sample No.: / Lab Sample No.:	HBAW-1 / 10/10 / DF4027 / 8807
Pesticides	—	—	—		ND
Arsenic	50	50	50		ND
Mercury	2	3	3		ND
TDS (mg/L)	—	—	—		110

*Key: MCL = Maximum Contaminant Limit
RMCL = Recommended Maximum Contaminant Limit
HA = Lifetime Health Advisories developed by EPA for noncarcinogenic effects

ND = Not Detected

Table 4-9

RESULTS OF SOIL SAMPLE ANALYSES FOR
SITE 8, HERBICIDE BURIAL AREA

(mg/kg; all soil concentrations on an as received basis)

Parameter	Date Sampled: / Boring#: / Depth: / Field No.: / Lab No.:	10/10 HBAS-1 0-1' DF4015 8796	10/10 HBAS-2 0-1' DF4016 8797	10/10 HBAS-3 0-1' DF4017 8798	10/10 HBAS-4 0-1' DF4018 8799
Herbicides		ND	ND	ND	ND
Arsenic		1.83	5.0	ND	4.53
Mercury		ND	ND	ND	ND

ND = Not Detected

Chemical Results

The surface water sample showed no chemical contamination for the parameters tested. TDS was also low (270 mg/L). Results are provided in Table 4-10.

No VOCs were detected in any of the soil samples. Lead was detected in all nine soil samples in concentrations ranging from 9.22 to 343 mg/kg. Three of the nine, all in surface soils, greatly exceed the normal range for lead in loess soils from Missouri (10 to 20 mg/kg). The highest lead value (343 mg/kg) was observed from along the south fence line. Petroleum hydrocarbons were detected at high concentrations ranging from 670 to 3,800 mg/kg. Results of soil analyses are provided in Table 4-11.

4.2.6 Site 10, Hazardous Waste Drum Storage

Geology

Site 10, the Hazardous Waste Drum Storage Area, is located on the slopes of the valley of Scope Creek, where the sediments can be thicker than on the uplands. The single soil boring at this site was drilled to 15 feet without encountering bedrock or water. A chert layer was recorded at 11.5 feet. The bedrock below this site is either a portion of the Lane Formation (a shale) or the Raytown Member of the Iola Formation (a limestone).

Hydrogeology

No groundwater was found at this site. However, a grassy surface water runoff path was found along the southwest flank of the site. Surface water was found downgradient but not upgradient of the site.

Chemical Results

Barium (85 µg/L) and lead (5 µg/L) were the only compounds detected in the single surface water sample. The values are slightly above the detection limits. Results are provided in Table 4-12.

No metals were detected in soils in the EP toxicity analysis. No VOCs were detected. Petroleum hydrocarbon values fluctuated for the subsurface samples, with values ranging from a relatively low value of

Table 4-10

RESULTS OF WATER SAMPLE ANALYSES FOR
SITE 9, OIL-SATURATED AREA

(ug/L, unless otherwise specified)

Parameter	Water Quality Standards and Health Advisories* EPA MCL	EPA RMCL	EPA HA	Well No.: / Date Sampled: / Field Sample No.: / Lab Sample No.:	Surface Water HBAW-1 10/09 DF4013 8777
Petroleum Hydrocarbons (mg/L)	--	--	--		ND
Volatile Organic Compounds	--	--	--		ND
Lead	50	20	20		ND
TDS (mg/L)	--	--	--		270

*Key: MCL = Maximum Contaminant Limit
RMCL = Recommended Maximum Contaminant Limit
HA = Lifetime Health Advisories developed by EPA for non-carcinogenic effects

ND = Not Detected

Table 4-11

RESULTS OF SOIL SAMPLE ANALYSES FOR
SITE 9, OIL-SATURATED AREA

(mg/kg; all concentrations on an as received basis)

Parameter	Date Sampled: / Boring: / Depth: / Field No.: / Lab No.:	10/9 OSAS-1 0-1' DF4007 8770	10/9 OSAS-2 0-1' DF4008 8771	10/9 OSAS-3 0-1' DF4009 8772	10/9 OSAS-4 0-1' DF4010 8773	10/9 OSAS-5 0-1' DF4011 8774	10/10 OSAS-6 0-1' DF4012 8775	10/17 OSAB-1 3-4' DF4039 8966	10/17 OSAB-1 8-9' DF4040 8967	10/17 BNAB-1 15.5-16.5' DF4041 8968
Volatile Organic Compounds		ND	ND	ND	ND	ND	ND	ND	ND	ND
Lead		169	117	343	14.1	14.8	18.5	20.2	9.22	10.2
Petroleum Hydrocarbon		2000	3800	670	ND	2	3	9.0	ND	ND

ND = Not Detected

Table 4-12

RESULTS OF WATER SAMPLE ANALYSES FOR
SITE 10, HAZARDOUS WASTE DRUM STORAGE AREA

(ug/L, unless otherwise specified)

Parameter	Water Quality Standards and Health Advisories* EPA MCL	EPA RMCL	EPA HA	Station No.: / Date Sampled: / Field Sample No.: / Lab Sample No.:	Surface Water HWDSAW-1 10/10 DF4025 8806
Petroleum Hydrocarbons (mg/L)	--	--	--		ND
Volatile Organic Compounds	--	--	--		ND
Lead**	50	20	20		5
Mercury	2	3	3		ND
Barium	1,000	--	--		85
TDS (mg/L)	--	--	--		180

*Key: MCL = Maximum Contaminant Limit
RMCL = Recommended Maximum Contaminant Limit
HA = Lifetime Health Advisories developed by EPA for noncarcinogenic effects

ND = Not Detected

**Analyzed as part of a priority pollutants scan

1.2 mg/kg to a very high value of 1,900 mg/kg for the area directly outside the fence where the drums were stored. No contamination was reported in the surface soil samples. This portion of the compound is now used to store equipment. The results of the soils analyses are provided in Table 4-13.

4.2.7 Site 12, POL Storage Yard

Geology

Site 12, the POL Storage Yard, is situated on the slopes of the valley of Scope Creek. The MW4 well log indicates bedrock at 10 feet. This bedrock unit is probably the Raytown Member of the Iola Formation. A chert layer was encountered several feet above the bedrock. Groundwater was encountered at the base of the well.

Hydrogeology

The POL storage tanks are situated on a leveled, compacted hillside, and are connected by underground transfer lines. Northwest and upgradient of the site is a man-made pond several acres in extent. Seepage from this pond feeds a marshy area directly northwest of the site and drains into a system of culverts next to the groundwater monitoring well.

Chemical Results

The groundwater and surface water samples show no contamination for the parameters tested. Results of water sample analyses are provided in Table 4-14.

The soil samples from the three hand-auger borings inside the bermed areas show varying amounts of petroleum hydrocarbons but no metals or volatile organics. Soil sample results are provided in Table 4-15. Sample DF4089 was collected from the area of the drain pipe for Building 953, from a depth of 3 feet. This sample showed volatile organic contamination with three purgeable aromatic compounds: benzene (1.25 mg/kg), total xylenes (2.25 mg/kg), and ethylbenzene (6.25 mg/kg).

Table 4-13

RESULTS OF SOIL SAMPLE ANALYSES FOR
SITE 10, HAZARDOUS WASTE DRUM STORAGE AREA

(mg/kg; all concentrations on an as received basis)

Parameter	Date Sampled: / Station No.: / Depth: / Field No.: / Lab No.:	10/10 HWDSAS-1 0-6" DF4019 8800	10/10 HWDSAS-2 0-6" DF4020 8801	10/10 HWDSAS-3 0-6" DF4021 8802	10/10 HWDSAS-4 0-6" DF4022 8803	10/10 HWDSAS-5 0-6" DF4023 8804	10/10 HWDSAS-6 0-6" DF4024 8805	10/17 HWDSAB-1 0.5-1.5' DF4042 8969	10/17 HWDSAB-1 9-10' DF4043 8970	10/17 HWDSAB-1 4.5-5.5' DF4044 8971
Volatile Organic Compounds		ND	ND	ND	ND	ND	ND	ND	ND	ND
EP TOX Metals		ND	ND	ND	ND	ND	ND	ND	ND	ND
Petroleum Hydrocarbons		ND	1900	55	46	140	2.9	ND	ND	1.2

ND = Not Detected

Table 4-14

RESULTS OF WATER SAMPLE ANALYSES FOR
SITE 12, POL STORAGE YARD

(ug/L, unless otherwise specified)

Parameter	Water Quality Standards and Health Advisories* EPA MCL	EPA RMCL	EPA HA		Ground-Water	Surface Water	
				Well No.:	POLW-1	POLUP	POLDN
				Date Sampled:	10/21	10/17	10/17
				Field Sample No.:	DF4060	DF4045	DF4046
				Lab Sample No.:	8979	8983	8984
Petroleum Hydrocarbona	—	—	—		ND	ND	ND
Volatile Organic Compounds	—	—	—		ND	ND	ND
TDS (mg/L)	—	—	—		540	NR**	NR**

*Key: MCL = Maximum Contaminant Limit
RMCL = Recommended Maximum Contaminant Limit
HA = Lifetime Health Advisories developed by EPA for noncarcinogenic effects

ND = Not Detected

**Not run due to error in field sheets.

Table 4-15

RESULTS OF SOIL SAMPLE ANALYSES FOR
SITE 12, POL STORAGE YARD

(mg/kg; all concentrations on an as received basis)

Parameter	Date Sampled: / Station No.: / Depth: / Field No.: / Lab No.:	10/28 POLHB-1 1.0' DF4079 9343	10/28 POLHB-1 2.1' DF4080 9344	10/28 POLHB-1 6.0' DF4081 9345	10/28 POLHB-2 1.0' DF4082 9346	10/28 POLHB-2 2.8' DF4083 9347	10/28 POLHB-2 6.0' DF4084 9348	10/28 POLHB-3 1.0' DF4085 9349	10/28 POLHB-3 3.0' DF4086 9350	10/28 POLHB-3 5.0' DF4087 9351	10/28 POLHB-3 5.0' DF4087D 9352	10/28 POLS-1 0.5' DF4088 9353	10/28 POLS-2 3.0' DF4089 9596
Volatile Organic Compounds													
• Benzene		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.25
• Total Xylenes		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.25
• Ethylbenzene		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	6.25
EP TOX Metals		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Petroleum Hydrocarbons		93	390	6.9	67	270	44	9.9	1500	11	28	2800	100

ND = Not Detected

4.3 SIGNIFICANCE OF FINDINGS

4.3.1 Site 1, South Landfill

No contamination was detected leaving this site via surface migration into Scope Creek, based on the analyses of surface soil and water samples. Relatively low concentrations of petroleum hydrocarbons (1.2 mg/kg, 16 mg/kg) were detected in the subsurface soils. The extractable organic compound DBP, the only organic compound detected, was at low concentrations (10 to 16 µg/L), but it also appeared in the method blank (below 10 µg/L). Consequently, DBP has been attributed to laboratory contaminants.

4.3.2 Site 2, Northeast Landfill

With the exception of the extractable DBP, no organic chemicals or metals were reported in any water samples taken at the site. Because DBP was reported in concentrations (14 to 17 µg/L) minimally above sample blank value (13 µg/L), the presence of this chemical has been attributed to laboratory contamination.

Five anions were reported above detection limits. Only a single sample of sulfate at 280 µg/L exceeded a standard or criterion. Since this is a non-mandatory secondary standard set for aesthetic (taste and odor) considerations, the relatively minor exceedance, and the fact that there is no drinking water well nearby, should not represent any material threat to human health.

For soils, no metals exceeded normal ranges for western Missouri soils. The only detectable contaminant was petroleum hydrocarbons, reported at concentrations ranging from non-detectable to 440 mg/kg.

4.3.3 Site 6, North Burn Pit Area

Only three organics (chloroform, tetrachloroethylene, and methylene chloride) were detected in water samples from Site 6. Concentrations of two of the organics (below 1 µg/L) were significantly below EPA HAs. The third, methylene chloride, detected in a single groundwater sample, was well below the EPA HA.

No metals were reported above normal ranges for western Missouri soils. The only organic contaminant reported in soils above detection

limits was petroleum hydrocarbons. Concentrations of petroleum hydrocarbons in 14 of the 15 samples taken at various depths ranged from non-detectable to 5.4 mg/kg. A single surface sample had a value of 34 mg/kg. In summary, the low concentrations found at the site indicate no undue risk to human health or the environment.

4.3.4 Site 8, Herbicide Burial Area

No detectable concentrations of any contaminant were reported in the single surface water sample taken at Site 8. Concentrations of metals in the four surface soil samples did not exceed the normal range of concentrations reported in western Missouri soils. In addition, no organic contamination was detected in the soil samples. Consequently, the data do not indicate that Site 8 presents an undue risk to human health or the environment.

4.3.5 Site 9, Oil-Saturated Area

No contaminants were detected in the single surface water sample at Site 9.

Results of the soil sample analyses indicate significant lead and petroleum hydrocarbon contamination of site soils. In six of nine samples, concentrations of lead fell within the normal range for western Missouri soils. In the same samples, petroleum hydrocarbon concentrations were relatively low (non-detectable to 9 mg/kg). In the remaining three samples, however, lead concentrations (117 to 343 mg/kg) greatly exceeded the normal range (10 to 20 mg/kg). In these same samples, petroleum hydrocarbons were also high (670 to 3,000 mg/kg). As these were samples taken from the surface (0- to 1-foot depth), humans would be subject to direct contact with high concentrations of lead from the site, warranting consideration of removal.

For the purpose of analyzing the potential human health risk related to lead exposure, it is assumed that humans ingest a maximum of 1 gram of soil daily during activities at the site. This number is extremely conservative (health protective), as it is based on the soil intake for small children--that segment of the population with highest soil intake as estimated by the Agency for Toxic Substances and Disease Registry (ATSDR 1986). Assuming 100% absorption of soil contaminants in

1 gram of soil, these intakes attributable to ingestion of onsite soils are then compared to the daily intake of lead regarded by EPA as acceptable as demonstrated by the current use of this limit in developing the RMCL of 20 µg/L for lead.

An Acceptable Daily Intake (ADI) for adults related to soil lead ingestion has been derived based on the EPA proposed RMCL of 20 µg/L and the following assumptions:

- Ingestion of 2 liters per day (L/day) for a 70-kg adult.
- Twenty percent of the ADI is contributed by water ingestion. This assumption is based on methodologies used to estimate revised drinking water standards (EPA 1985a).
- Intake of lead except by ingestion of drinking water and by the soil-related pathways is minimal.
  For an adult:

  20 µg/L x 2 L/day = 40 µg/day from ingestion of water

  40 µg/day ÷ 0.2 = 200 µg/day from all sources

  200 µg/day - 40 µg/day = 160 µg/day from all sources excluding water ingestion, which is the Adjusted Acceptable Daily Intake (AADI) for soil for adults

In order that the AADI not be exceeded, the corresponding soil concentration must be no higher than 160 mg/kg.

4.3.6 Site 10, Hazardous Waste Drum Storage Area

The storage of hazardous waste drums in this compound does not appear to have contaminated the surface and subsurface soils. The only contaminants in soil were petroleum hydrocarbons, with concentrations ranging from non-detectable to 1,900 mg/kg. In six of the nine samples, concentrations were low (less than 9 mg/kg). However, concentrations were high (670 to 3,000 mg/kg) in three samples taken at 0- to 1-foot intervals, and removal of soils from these areas should be considered. The single surface water sample contained barium (85 µg/L) and lead (5 µg/L) significantly below the EPA standards or criteria. No other contaminants were detected in the sample. It appears that the remedial efforts undertaken at this site have cleaned up any problems that may

have been associated with the storage of drummed hazardous materials here. These efforts included: overpacking drums, removal of stained soil, and scraping the asphalt surface. These efforts were undertaken as a result of a Notice of Violation issued by EPA.

4.3.7 Site 12, POL Storage Yard

The one groundwater and two surface water samples taken at Site 12, the POL Storage Yard, revealed no contamination above detection limits. In the 12 soil samples, petroleum hydrocarbon concentrations were relatively low (6.9 to 44 mg/kg). Removal of soils in the areas of the seven samples with higher concentrations (67 to 2,800 mg/kg) should be considered. In addition, a single sample collected near the drain pipe outlet for Building 953 at a depth of 3 feet contained concentrations of benzene (1.25 mg/kg), total xylenes (2.25 mg/kg), and ethylbenzene (6.25 mg/kg), indicative of contamination by gasoline or a similar petroleum hydrocarbon.

5. ALTERNATIVE MEASURES

This section discusses the alternative measures that can be taken at each of the seven sites. The alternatives have been devised based on the results of the Phase II Stage 2 investigations. A "no-action" alternative is considered for each site. Recommendations as to the most appropriate alternatives are presented in Section 6.

5.1 SITE 1, SOUTH LANDFILL

No significant contamination of surface water, surface soils, or subsurface soils was found at this site. Minor amounts of petroleum hydrocarbons (less than 16 mg/kg) were detected in one of the surface runoff pathways and at the base of the borehole. No monitoring wells exist on this site.

Alternatives for this site include:

- No action. This alternative is applicable should it be decided that the levels of contaminants detected in the samples do not require further action.

- Long-term monitoring. Seasonal fluctuations in groundwater and rainfall could have accounted for the minor amount of seepage found in the Phase II Stage 2 investigation. Under this alternative, areas of the two known seeps would be resampled periodically and searches would be made for additional seeps.

- Installation of upgradient monitoring wells. Two wells could be installed in association with this landfill, one to the west and one to the south. The west well would test the marshy area which is the source for Seep 2; the south well would determine if sufficient recharge for water samples to be taken could be developed from the area of Borehole 7. This borehole showed a small amount of water and traces of hydrocarbons near its base. The south well

might also indicate whether contaminants have migrated from the South Burn Pit Area, an area that was never clearly located and was not part of the Phase II Stage 2 investigation. The South Burn Pit Area was believed to be located south of the South Landfill.

5.2 SITE 2, NORTHEAST LANDFILL

No significant contamination was detected in association with this site. The utilization of the site for landfilling operations is much more extensive than was previously thought. A soil sample taken from below the fill material indicates that the liquids in the landfill are not penetrating into underlying soil. In two samples at the 1- to 2-foot depth, petroleum hydrocarbons were reported at 78 and 440 mg/kg. This landfill, no longer USAF property, is leased to Kansas City Aviation Company and is being used to store excess property and large refuse items. The USAF should survey the perimeter of the landfill area and present this information to the current property owner and include it in the deed to the property. This will alert the owner as to any limitations on future uses of the land, including future construction and improvements. Already, a sewer line has been cut through the south edge of the landfill. It is not known what effect the intersection with the landfill will have on the integrity of that sewer system in the years to come.

Alternatives for this site include:

- No action. If it is determined that there is no threat to the surrounding environment, no further action would be necessary.
- Long-term monitoring. As part of the base groundwater sampling plan, the five wells at the landfill could be sampled to monitor the continued integrity of the landfill and as a check on the area groundwater quality.

5.3 SITE 6, NORTH BURN PIT AREA

Three volatile organics were detected in perched groundwater at this site--chloroform and tetrachloroethylene at concentrations significantly below drinking water standards or criteria, and methylene chloride in a single sample at a concentration of 37 µg/L, an order of magnitude below the EPA drinking water health advisory. There is very little groundwater, and no deep aquifers are threatened. Soil gas

readings indicated that organic vapor contamination is confined within the perimeter of the site. Soil contamination was limited to low concentrations of petroleum hydrocarbons, which were not found in any water sample.

Alternatives for this site include:

- No action. This alternative would be applicable if it is decided that the levels of contaminants detected in these samples do not warrant action. The concentrations observed have been below federal drinking water standards and there are no receptors.

- Long-term monitoring. Seasonal rainfall could recharge the two wells on this site which were essentially dry at the time of the Phase II Stage 2 investigation. The wells could be monitored for evidence of a contaminant plume by sampling for organic contamination.

- Installation of additional monitoring wells. The northeast monitoring well could be nested with a deeper well (drilled to bedrock) to determine if the organic contamination observed in the shallow wells is migrating along the weathered bedrock interface. A monitoring well could be installed outside the compound to the east, near the outfall from the oil-water separator. This would provide a check on the efficiency of this unit and could aid in locating seeps from lower stratigraphic units.

5.4 SITE 8, HERBICIDE BURIAL AREA

There is no conclusive data on the location of the trench or the characterization of this site. No soil borings were made and so no subsurface soil samples were collected.

Alternatives for this site include:

- No action. If it is determined on the basis of present information that the amounts of herbicides buried at this site and the mode of containment do not constitute an environmental problem, no further action would be necessary.

- Additional investigation. Additional effort to locate the trench should include locating and examining aerial photographs not previously available and performing a ground conductivity survey over the suspected area. Once the trench is located, testing and sampling could begin by drilling a series of 10-foot boreholes in the four corners of the trench area. Also, a sediment sample could be taken from the pond downgradient of the trench.

5.5 SITE 9, OIL-SATURATED AREA

Surface soil was found to be contaminated with petroleum hydrocarbons and lead. Levels of lead exceeded 160 mg/kg, the criterion derived for protection of human health (see Section 4.3.5). In addition, concentrations of petroleum hydrocarbons in three of the nine soil samples in the 0- to 1-foot depth were very high. Access to the site, and therefore to these materials, is limited.

Alternatives for this site include:

- No action. Since there is little chance of direct contact, it may be determined that the levels of contaminants detected do not warrant further action.
- Preparation for Phase IV actions. This action would require the removal of contaminated soils and gravel, after identifying the volume to be removed.

5.6 SITE 10, HAZARDOUS WASTE DRUM STORAGE AREA

Only minor contamination of surface water was detected in association with this site. The concentrations of the two contaminants detected, lead and barium, were below drinking water standards. Petroleum hydrocarbon values were high (up to 1,900 mg/kg) along the south fence line. The sources may include spillage, dripping from the numerous heavy vehicles and smaller vehicles (grass mowers) now present in this compound. Storage of drums containing petroleum products in the compound may also have been a source.

Alternatives for this site include:

- No action. Due to the absence of detectable contamination resulting from the storage of hazardous waste drums at this site, no further action is warranted.
- Identification of petroleum hydrocarbon hot spots. This option would require delineating the areas of high petroleum hydrocarbon contamination, in preparation for removal actions (Phase IV).

5.7 SITE 12, POL STORAGE YARD

Site 12, the POL Storage Yard, is the distribution center for all fuels and propellants on the base. The groundwater south of the

facility is free from contamination. Soils inside the tank berms indicate significant petroleum hydrocarbon accumulations (concentrations ranged upwards to 2,800 mg/kg). Volatile organic contamination was detected in the subsurface outside of Building 953, a pumphouse. Additional pumphouses are present, but were not sampled. The contaminated soil sample came from an area where a broken drain pipe from the pumphouse is thought to be located.

Alternatives for this site include:

- No action. If the levels of contaminants identified are determined not to be excessive for present operation of the site, then no further action is warranted.

- Long-term monitoring. After the installation of a monitoring well during Phase II Stage 2, sampling and analysis of this well on a periodic basis would serve to monitor groundwater conditions at this site.

- Additional subsurface soil sampling. The area of greatest environmental concern is located east of the pumphouses. A series of shallow hand-auger borings could be taken in a grid pattern to determine the extent of organic contamination in the soil.

6. RECOMMENDATIONS

The recommendations presented in this section are based on the results of the Phase II Stage 2 investigation. Each of the sites investigated has also been listed by category (I, II, or III) based on requirements for work (see Table 6-1). Category I sites, where sufficient data exist to rule out public health or environmental hazards, require no further action. Category II sites require additional investigations to better quantify or assess the extent of contamination. Category III sites require remedial actions as part of the next stage of the IRP. Such actions may include long-term monitoring. Several of the sites fall within more than one category. The site-specific recommendations presented in this section were selected as the most appropriate of the alternatives presented in Section 5. Table 6-2 summarizes the recommendations. Table 6-3 lists the methods of analysis.

6.1 SITE 1, SOUTH LANDFILL - CATEGORY I

No further action is recommended for this site since no contamination was found except for very low concentrations of petroleum hydrocarbons in the subsurface soil samples. The presence of petroleum hydrocarbons may be attributed to major oil production at locations just west of the site. Groundwater at the site could not be monitored due to the proximity of the landfill to Scope Creek. The surface water samples in the creek should have detected groundwater contamination, if present, as this is the most likely migration route of contamination.

Table 6-1

LIST OF SITES BY CATEGORY

Category I - No Further Action Recommended

- Site 1: South Landfill

Category II - Additional Site Assessment Recommended

- Site 4: West Burn Area
- Site 6: North Burn Pit Area
- Site 8: Herbicide Burial Area
- Site 12: POL Storage Yard

Category III - Remedial Action Recommended

- Site 2: Northeast Landfill
- Site 6: North Burn Pit Area
- Site 9: Oil-Saturated Area
- Site 10: Hazardous Waste Drum Storage Area

Table 6-2

SUMMARY OF RECOMMENDATIONS

Site 1 - South Landfill

- No further action.

Site 2 - Northeast Landfill

- Monitor five monitoring wells biannually for 2 years.
- Monitor land use at landfill biannually for 2 years.

Site 4 - West Burn Area

- Perform a soil gas survey to locate the site.
- Install three monitoring wells.
- Sample the surface and subsurface soils.

Site 6 - North Burn Pit Area

- Install two additional monitoring wells, a second well in northeast corner of site, well to be drilled to bedrock or 30 feet, and one outside the compound to the east (20 feet).
- Monitor five wells biannually for 2 years.

Site 8 - Herbicide Burial Area

- Locate the burial trench using aerial photos and a ground conductivity survey. Drill four shallow borings (10 feet) and sample soil for pesticides, mercury, and arsenic.
- Excavate and remove buried pesticides from trench.

Site 9 - Oil-Saturated Area

- Remove oil-contaminated sediments from along the fence line.

Site 10 - Hazardous Waste Drum Storage Area

- Remove oil-contaminated surficial soils.

Site 12 - POL Storage Yard

- Install four monitoring wells to bedrock.
- Monitor wells.

Table 6-3

METHODS OF ANALYSIS FOR RECOMMENDED SAMPLES

Parameter	Methods	
	Soil	Water
Halogenated Volatile Organics	SW 5030/8240	SW 5030/8010
Aromatic Volatile, plus xylenes	SW 5030/8240	SW 5030/8020
Semi-Volatile Organics	SW 3550/8270	SW 3510/8270
Pesticides	SW 3550/8080	SW 3510/8080
Herbicides	SW 8150	SW 8150
Petroleum Hydrocarbons	SW 3550/E418.1	EPA 418.1
Phenols	SW 8270	EPA 625
Metals		
Arsenic	SW 3050/6010	SW 7060
Cadmium	SW 3050/6010	SW 3005/6010
Chromium	SW 3050/6010	SW 3005/6010
Copper	SW 3050/6010	SW 3005/6010
Lead	SW 3050/7421	SW 3005/7421
Mercury	SW 7471	SW 7470
Nickel	SW 3050/6010	SW 3005/6010
Zinc	SW 3050/6010	SW 3005/6010
Soil Moisture Content	EPA 160.3	

6.2 SITE 2, NORTHEAST LANDFILL - CATEGORY III

Long-term monitoring is recommended for this site to detect changes in groundwater quality. Sampling of the five wells twice each year is recommended. One sampling period should occur during peak seasonal recharge (May-June). The second sampling period should occur six months later (January-February) during the dry season. Water samples should be tested in the field for pH, conductivity, and temperature. Laboratory analysis should be performed for: VOAs plus xylenes, metals, and petroleum hydrocarbons. The results should be compared for two years. If no contamination is observed, monitoring can be eliminated and the wells removed.

If sampling results indicate contamination, resampling should be performed more frequently to determine if concentrations change throughout the year. The results of the sampling would be used to develop additional alternative measures.

Long-term monitoring would also provide a check on the general status of the landfill.

A detailed survey of the landfill should be made and provided to the landowner for inclusion with the deed to the property. The landfill was found to be much more extensive than originally thought.

6.3 SITE 4, WEST BURN AREA

A soil gas and geophysical survey is recommended to more precisely locate this site and to help determine the locations for soil borings. Also, aerial photographic analysis should be performed to determine the location and the approximate period of operation.

Three soil borings should be drilled around the site. Soil and groundwater samples should be collected from the borings and analyzed for volatile organics and petroleum hydrocarbons. If contamination is found, wells should be installed to determine the extent of contamination.

This site is located on land owned or leased by the City of Kansas City. Access to the site must be granted by the Kansas City Aviation Department.

6.4 SITE 6, NORTH BURN PIT AREA - CATEGORIES II and III

Two additional wells and long-term monitoring are recommended for this site to detect changes in groundwater quality and to confirm concentrations of volatile organics and methylene chloride. One 20-foot well would be located outside the east boundary of the site near the outfall for the oil-water separator, and the other would be nested with the existing well in the northeast corner of the compound (see Figure 6-1). The nested well would be drilled to bedrock (or 30 feet) and would be used to determine if the volatile organic compounds detected in the two shallow wells are traveling along the soil/bedrock interface. Resampling of the three existing wells is recommended, since so little water was available for sampling during October, even though a major rainfall event had recently occurred. Sampling of the five wells twice each year is recommended. One sampling period should occur during peak seasonal recharge (May-June). The second sampling period should occur six months later (January-February) during the dry season. Water samples should be analyzed in the field for pH, conductivity, and temperature. Laboratory analyses should be performed for VOAs plus xylenes, metals, and petroleum hydrocarbons. The results for two years should be compared. If no contamination is observed, monitoring can be eliminated and the wells abandoned.

If sampling results continue to indicate contamination, resampling should be done more frequently to determine if concentrations change throughout the year. If no contamination is detected or if concentrations are so low as not to present any environmental problems, this would allow for recategorization of the site to Category I status. If contamination is found, the results of the samplings would be used to determine additional alternative measures.

6.5 SITE 8, HERBICIDE BURIAL AREA - CATEGORY II

Since there is no direct evidence of the location of Site 8, the Herbicide Burial Area, additional investigations are recommended. During the presurvey investigation information was sketchy about the amounts of herbicide buried and dimensions of the burial area. with currently available information, it is recommended that a soil conductivity survey be run over a grid pattern designed to precisely locate

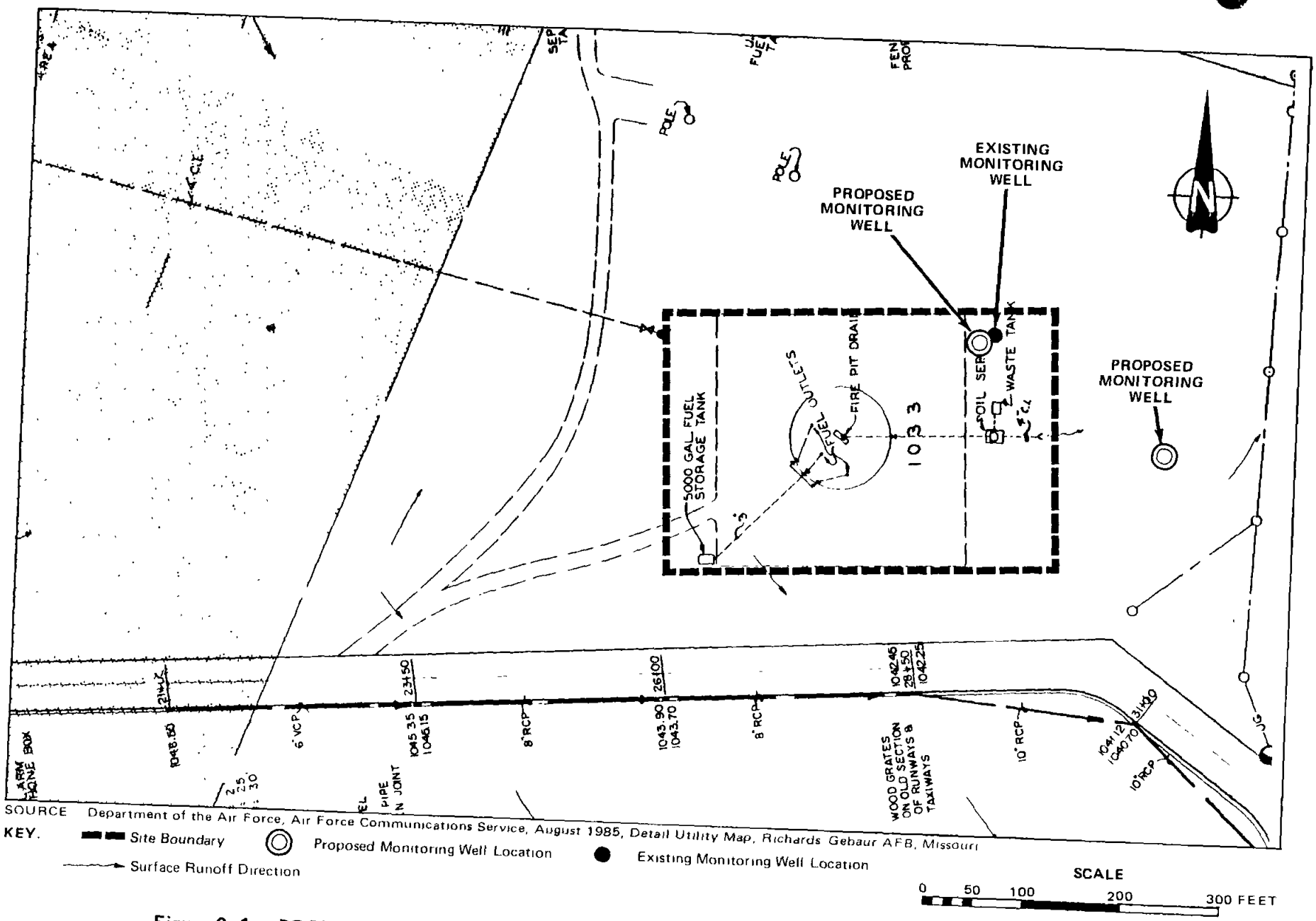


Figure 6–1 PROPOSED LOCATIONS OF MONITORING WELLS AT SITE 6, NORTH BURN PIT AREA

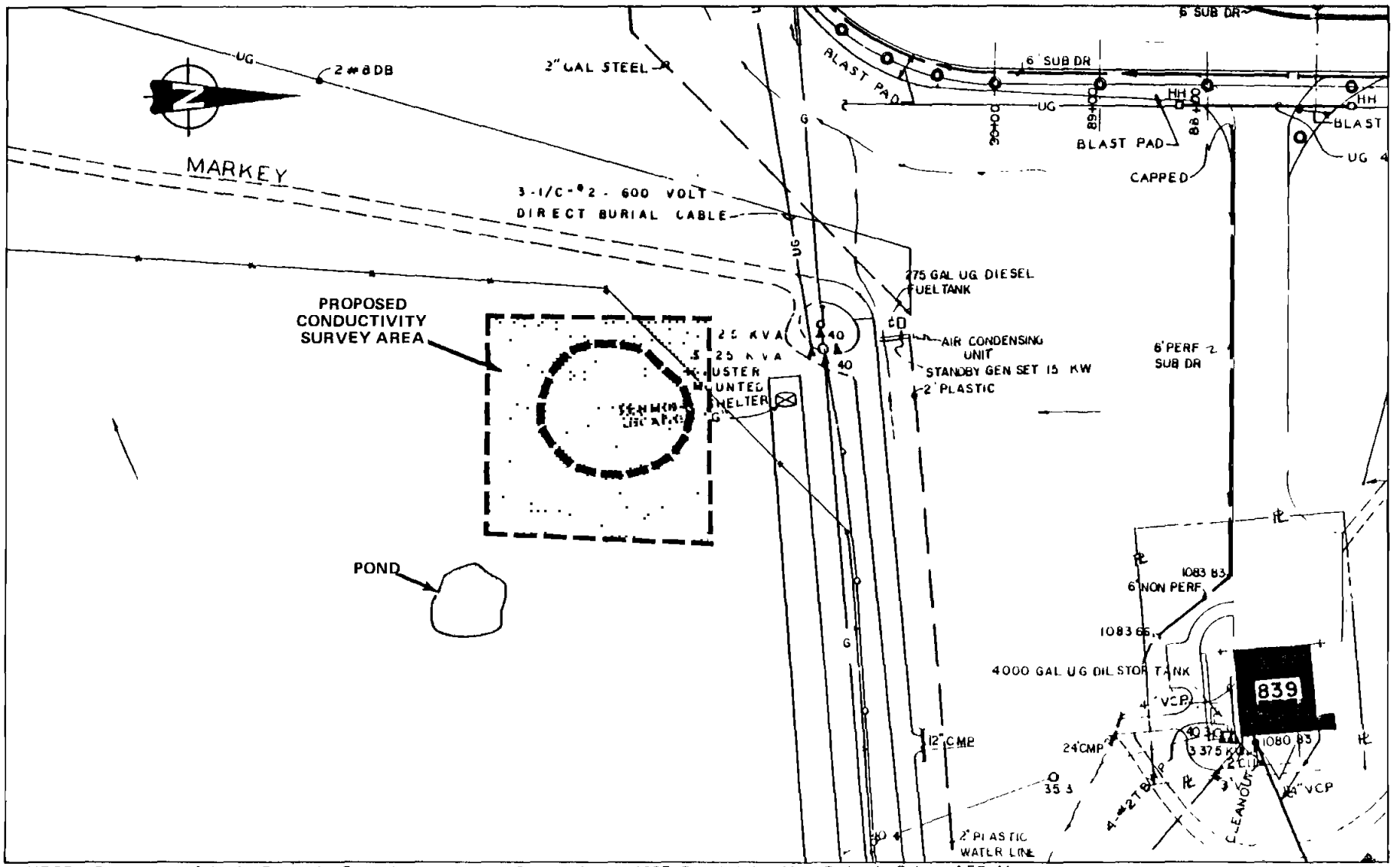
a 10- by 10-foot trench (see Figure 6-2). If additional aerial photos can be found, they should be reviewed. When the trench is located, four shallow soil borings (10 feet deep) should be drilled downgradient of the trench area. Two soil samples should be taken from the borings and tested for herbicides, mercury, and arsenic. If no contamination is detected, a decision should be made whether to leave the material in place or remove it from the soil. If contamination is detected, install two monitoring wells into the chert layer, downgradient of the site.

6.6 SITE 9, OIL-SATURATED AREA - CATEGORY III

Although access to the site is limited, the concentrations of lead and petroleum hydrocarbons are considered unacceptable, and a remedial cleanup of the southwest corner of the fence line can be undertaken. Based on samples taken during the field investigation, the greatest contamination occurs at the fence line. An unknown amount of fill has been used at the site to level the ground surface. As much as 3 feet of fill was observed in the borehole. It is not known for certain if the high concentrations along the fence line are due to disposal of waste oil at the fence line or if contamination is due to oil leaks associated with vehicle maintenance in the parking lot which drains to the southwest corner of the fence line. No sample could be taken of the fill material in the top few feet of the borehole. Judging from the thickness of the fill material, this corner of the compound has apparently been resurfaced or regraded several times.

To remove the oil-contaminated material, as much as 56 cubic yards of material might have to be removed (see Figure 6-3) from an area 50 feet long by 10 feet wide by 3 feet deep. This amount can be cut by two-thirds if the contamination is limited to an area near the fence line. Limited cleanup could be performed to reduce hydrocarbon and lead values to an acceptable level. Confirmatory sampling should be conducted prior to backfilling.

Since the contamination is restricted to ditches and behind the fence, users of the field adjacent to the site are not at risk.



SOURCE Department of the Air Force, Air Force Communications Service, August 1985, Detail Utility Map, Richards Gebaur AFB, Missouri

KEY: Site Boundary — Boundary of Proposed Conductivity Survey

Surface Runoff Direction

Figure 6–2 PROPOSED LOCATION OF CONDUCTIVITY SURVEY AT SITE 8, HERBICIDE BURIAL AREA

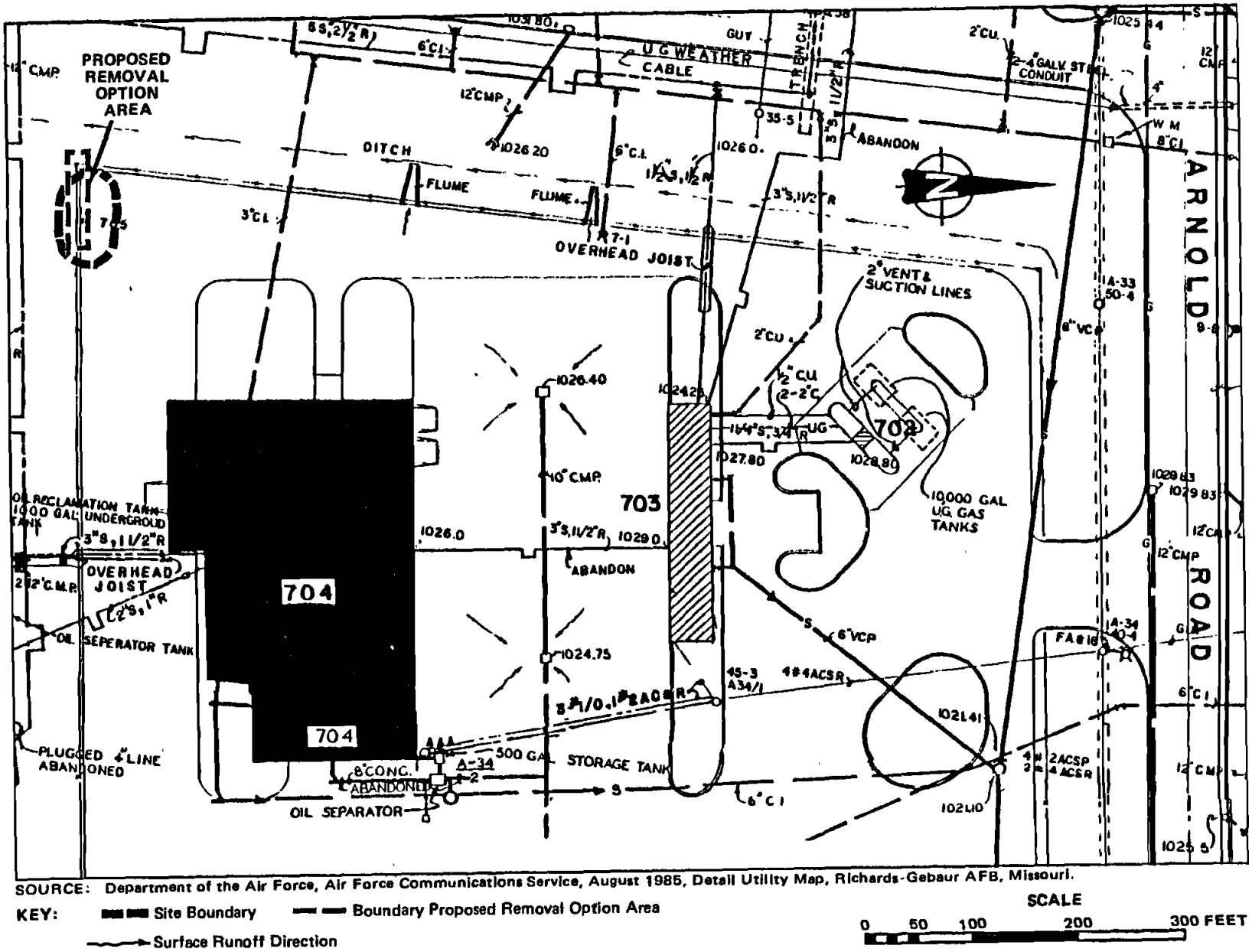


Figure 6–3 PROPOSED LOCATION OF REMOVAL OPTION AT SITE 9, OIL SATURATED AREA

6.7 SITE 10, HAZARDOUS WASTE DRUM STORAGE AREA - CATEGORY III

Removal of the surficial soils containing high levels of petroleum hydrocarbons is recommended for this site. No evidence of contamination associated with the storage of hazardous waste drums was found in surface water samples or surface and subsurface soil samples. Analyses for semi-volatiles are recommended as part of the monitoring program during the removal process.

6.8 SITE 12, POL STORAGE YARD - CATEGORY II

Because the POL Storage Yard is an active fuel storage area, spills of petroleum products are to be expected and contaminated soil within the yard is not unusual. It is necessary to determine if contaminants are migrating from the yard. Installation of four monitoring wells is proposed to monitor the site. The upgradient well would be located along the road on the north side of the yard. Three downgradient wells would be located along the road southeast of the yard. Piping diagrams of the area will be studied and geophysical methods employed in order to determine the exact location of these wells prior to drilling. Figure 6-4 shows the locations of the proposed wells.

The monitoring wells would be sampled during the peak recharge season (May and June) and again during the dry season (January and February). Water samples should be analyzed in the field for pH, conductivity, and temperature. Laboratory analysers should be performed for VOAs plus xylenes, metals, and petroleum hydrocarbons. If no contamination is observed, monitoring can be eliminated and the wells removed.

If sampling results indicate contamination, resampling should be performed more frequently during the year. These results would be used to determine additional alternative measures.

6.9 WELL ABANDONMENT

Currently, there are no wells to be abandoned; however, after additional sampling, some sites may require no further action. At these sites the monitoring wells which may have been installed should be properly abandoned.

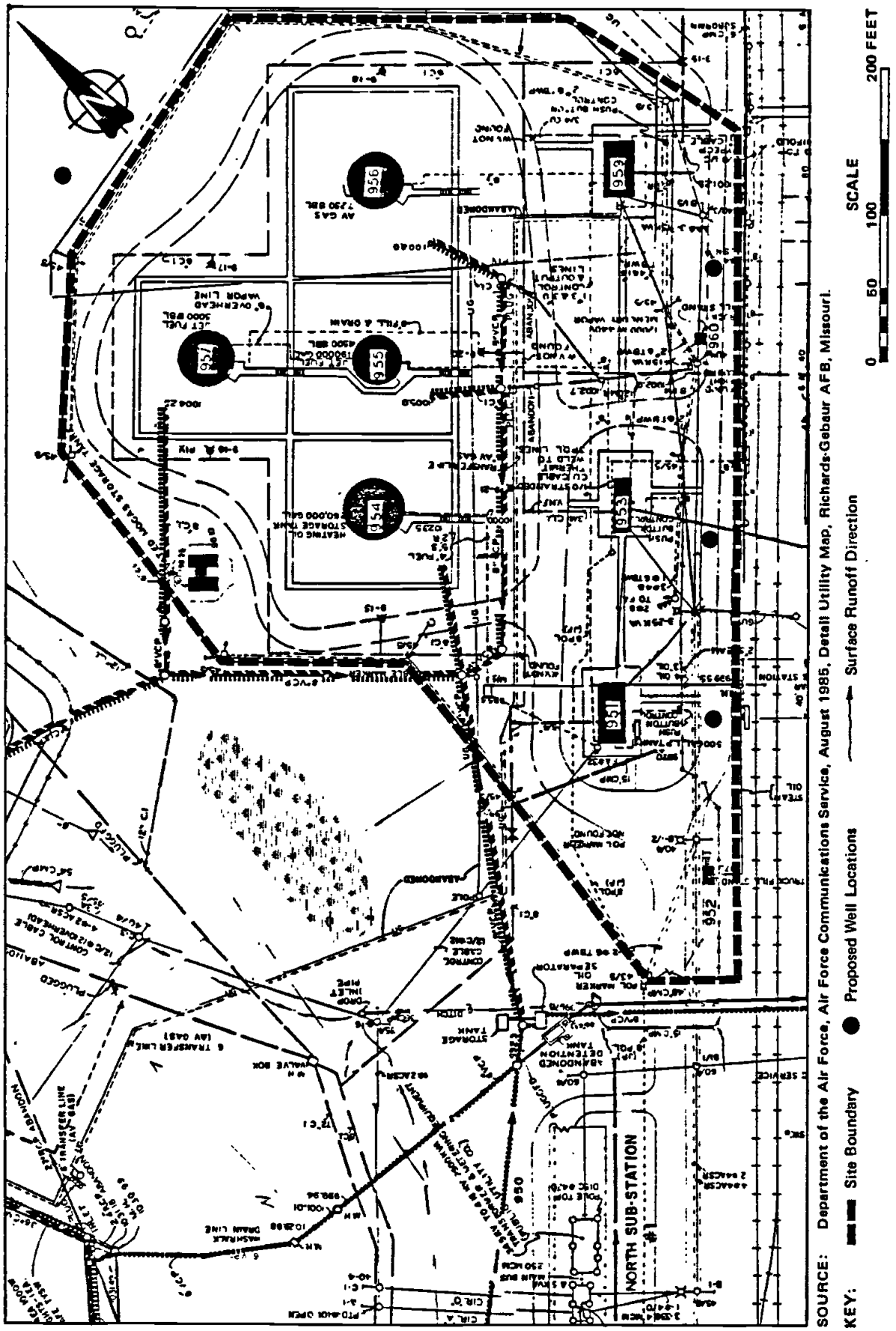


Figure 6–4 LOCATION OF PROPOSED WELL LOCATIONS AT SITE 12, POL STORAGE YARD

In accordance with Missouri Department of Natural Resources, Division of Geology and Land Survey requirements for well abandonment, E & E recommends that the outer steel casing be removed and the inner PVC casing be cut off below the ground surface. The remaining well casing should be filled with a neat cement grout to within 3 feet of the surface and the remainder filled with native soil. The surface soil should be mounded slightly, so that runoff does not collect around the abandoned well.

FINAL PAGE

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FINAL PAGE

FINAL PAGE

ADMINISTRATIVE RECORD

FINAL PAGE