AD-A275 361

REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

2. REPORT DATE	1993
3. REPORT TYPE AND DATES COVERED	THESIS/~~DISSERTATION~~
4. TITLE AND SUBTITLE	Remedial Investigation/Feasibility Study Analysis Asphalt Storage Area, Elmendorf AFB, AK
5. FUNDING NUMBERS	
6. AUTHOR(S)	Capt Miller
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)	AFIT Student Attending: Univ of Texas at Austin
8. PERFORMING ORGANIZATION REPORT NUMBER	AFIT/CI/CIA- 93-117b
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	DEPARTMENT OF THE AIR FORCE AFIT/CI 2950 P STREET WRIGHT-PATTERSON AFB OH 45433-7765
10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES	
12a. DISTRIBUTION/AVAILABILITY STATEMENT	Approved for Public Release IAW 190-1 Distribution Unlimited MICHAEL M. BRICKER, SMSgt, USAF Chief Administration
12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words)	
14. SUBJECT TERMS	
15. NUMBER OF PAGES	60
16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT	
18. SECURITY CLASSIFICATION OF THIS PAGE	
19. SECURITY CLASSIFICATION OF ABSTRACT	
20. LIMITATION OF ABSTRACT	

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89) Prescribed by ANSI Std. Z39-18

93-1176

Nancy Susan Miller, B.S.
Captain, United States Air Force

Remedial Investigation/Feasibility Study Analysis
Asphalt Storage Area, Elmendorf AFB, AK

1993

61 pages

M.S. Environmental Engineering
University of Texas at Austin

Accesion For		
NTIS CRA&I	☑	
DTIC TAB	☐	
Unannounced	☐	
Justification		
By		
Distribution /		
Availability Codes		
Dist	Avail and / or Special	
A-1		

ABSTRACT

REMEDIAL INVESTIGATION/FEASIBILITY STUDY ANALYSIS

ASPHALT STORAGE AREA, ELMENDORF AFB, AK

This report is focused on an abandoned material storage area located on Elmendorf Air Force Base (EAFB), Alaska. The site is located approximately 2000 feet from the east end of the east/west runway and includes approximately 25 acres. The site was used for asphalt storage and preparation activities during the 1940s and 1950s. Approximately 4,500 drums of asphalt and 29 drums of unknown materials have been abandoned at the site. The drums are located in 32 areas throughout the 25-acre site. Following several decades of exposure to the elements, many of the drums have corroded and leaked to the ground surface. Several acres of soil are inundated with liquid asphalt that has leaked from the drums. Depths of the asphalt range from 6 to 10 inches in areas where surface anomalies have created depressions, and thus a collection point for the asphalt. A 14-x 18-x 4 foot wood frame pit used to support previous asphalt operations is located at the north end of the site. The pit contains approximately 2300 gallons of asphalt. There are also locations where the soil appears to be contaminated by petroleum products other

than asphalt. Currently, EAFB, in its entirety, is included in a Federal Facility Agreement (FFA) to complete the investigation of known and potential releases and to provide for environmental restoration.

The feasibility of five remedial options for this abandoned asphalt storage area was evaluated using data obtained during previous investigations of this site.

The following options were evaluated:

- No action
- Close In Place (Cap)
- Drum Removal/Soil Excavation - Off-Site Disposal
- Drum Removal/Soil Excavation - Off-Site Recycling (Resale)
- Drum Removal/Soil Excavation - On-Site Recycling and Reuse

Based upon analyses of the five options, the off-site recycling option is the most desirable option, followed by the on-site recyling option and the off-site disposal option. The no action and the close in place option are not recommended unless none of the other three options is viable.

REMEDIAL INVESTIGATION/FEASIBILITY STUDY ANALYSIS

ASPHALT STORAGE AREA, ELMENDORF AFB, AK

APPROVED:

Raymond C. Loehr

Joe O. Ledbetter

REMEDIAL INVESTIGATION/FEASIBILITY STUDY ANALYSIS

ASPHALT STORAGE AREA, ELMENDORF AFB, AK

by

NANCY SUSAN MILLER, B.S.

Departmental Report

Presented to the Faculty of the Environmental and

Water Resources Departement of

The University of Texas at Austin

in Partial Fulfillment

of the Requirements

for the Degree of

MASTER OF SCIENCE IN ENGINEERING

THE UNIVERSITY OF TEXAS AT AUSTIN

August 1993

ACKNOWLEDGEMENTS

I thank my husband, Chris, whose continual support, patience, and encouragement enabled me to complete this report as well as my entire graduate program.

I thank Dr. Raymond Loehr, Lt Col James Montgomery, Mr. Lewis Ivers, and Dr. Joe Ledbetter for their timely and invaluable assistance, without which I could not have completed this report.

Lastly, I thank my parents, Dr. and Mrs. T. S. Hedgecock, for making me believe that I have the ability to do anything I want.

EXECUTIVE SUMMARY

REMEDIAL INVESTIGATION/FEASIBILITY STUDY ANALYSIS

ASPHALT STORAGE AREA, ELMENDORF AFB, AK

This report is focused on an abandoned material storage area located on Elmendorf Air Force Base (EAFB), Alaska. The site is located approximately 2000 feet from the east end of the east/west runway and includes approximately 25 acres. The site was used for asphalt storage and preparation activities during the 1940s and 1950s. Approximately 4,500 drums of asphalt and 29 drums of unknown materials have been abandoned at the site. The drums are located in 32 areas throughout the 25-acre site. Following several decades of exposure to the elements, many of the drums have corroded and leaked to the ground surface. Several acres of soil are inundated with liquid asphalt that has leaked from the drums. Depths of the asphalt range from 6 to 10 inches in areas where surface anomalies have created depressions, and thus a collection point for the asphalt. A 14-x 18-x 4 foot wood frame pit used to support previous asphalt operations is located at the north end of the site. The pit contains approximately 2300 gallons of asphalt. There are also locations where the soil appears to be contaminated by petroleum products other than asphalt. Currently, EAFB, in its entirety, is included in a Federal Facility Agreement (FFA) to complete the investigation of known and potential releases and to provide for environmental restoration.

The feasibility of five remedial options for this abandoned asphalt storage area was evaluated using data obtained during previous investigations of this site.

The following options were evaluated:

- No action
- Close In Place (Cap)
- Drum Removal/Soil Excavation - Off-Site Disposal
- Drum Removal/Soil Excavation - Off-Site Recycling (Resale)
- Drum Removal/Soil Excavation - On-Site Recycling and Reuse

Based upon analyses of the five options, the off-site recycling option is the most desirable option, followed by the on-site recyling option and the off-site disposal option. The no action and the close in place option are not recommended unless none of the other three options is viable.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

I. INTRODUCTION

Elmendorf Air Force Base (EAFB) is located on the north side of the municipality of Anchorage, Alaska (Figure 1) (adapted from EA Engineering, Inc., 1993). Currently, EAFB, in its entirety, is included in a Federal Facility Agreement (FFA) to complete the investigation of known and potential releases and to provide for environmental restoration.

This report is focused on one EAFB site, an abandoned material storage area. The site is located approximately 2000 feet from the east end of the east/west runway and includes approximately 25 acres (Figure 2) (adapted from EA Engineering, Inc., 1993). The site was used for asphalt storage and preparation activities during the 1940s and 1950s. Approximately 4,500 drums of asphalt and 29 drums of unknown materials have been abandoned at the site. The drums are located in 32 areas throughout the 25-acre site. Following several decades of exposure to the elements, many of the drums have corroded and leaked to the ground surface. Approximately 40 percent of the drums are full or partially full of hardened asphalt. Several acres of soil are inundated with liquid asphalt that has leaked from the drums. Depths of the asphalt range from 6 to 10

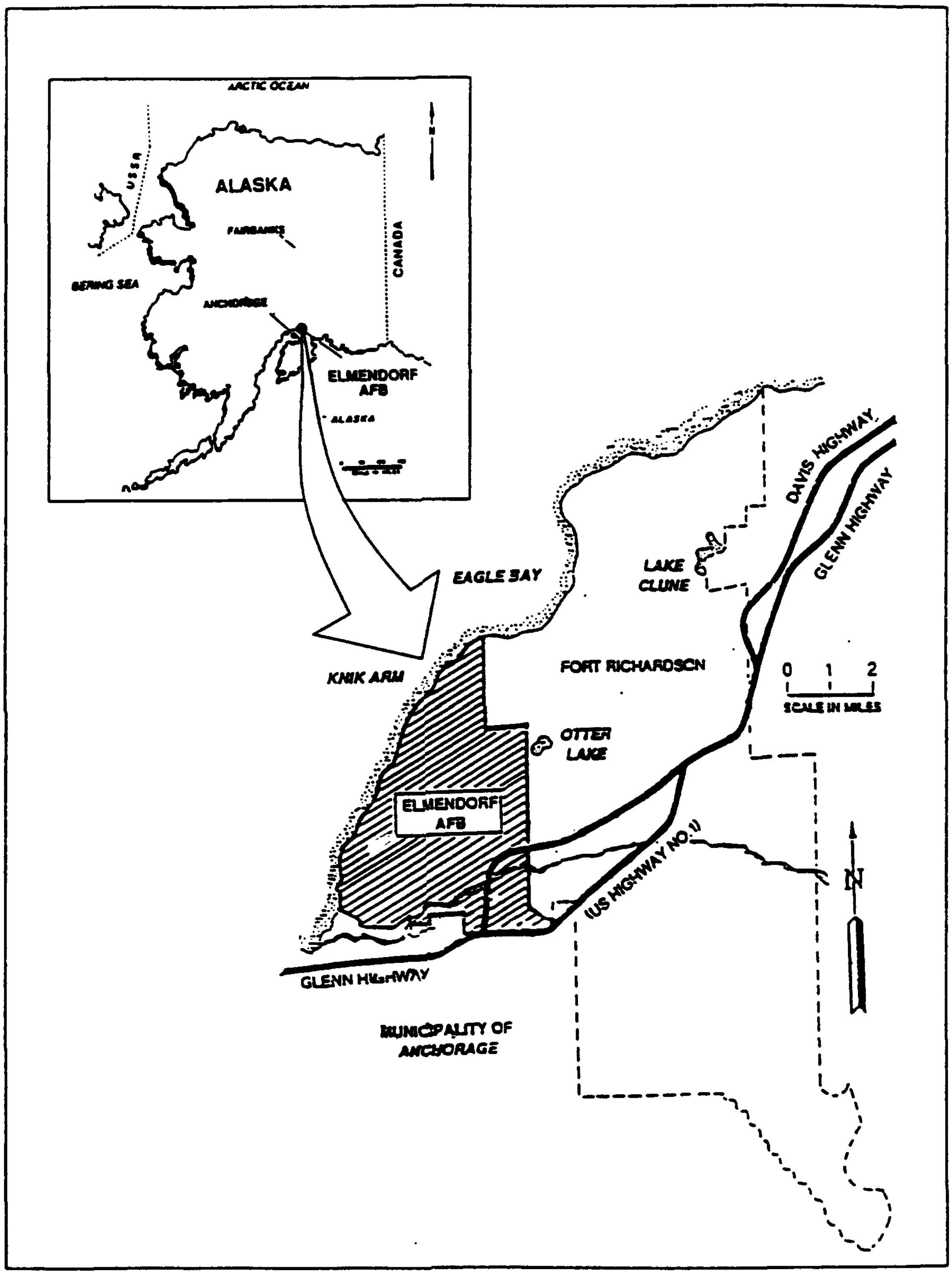


Figure 1: Location of Elmendorf AFB
(adapted from EA Engineering, Inc., 1993)

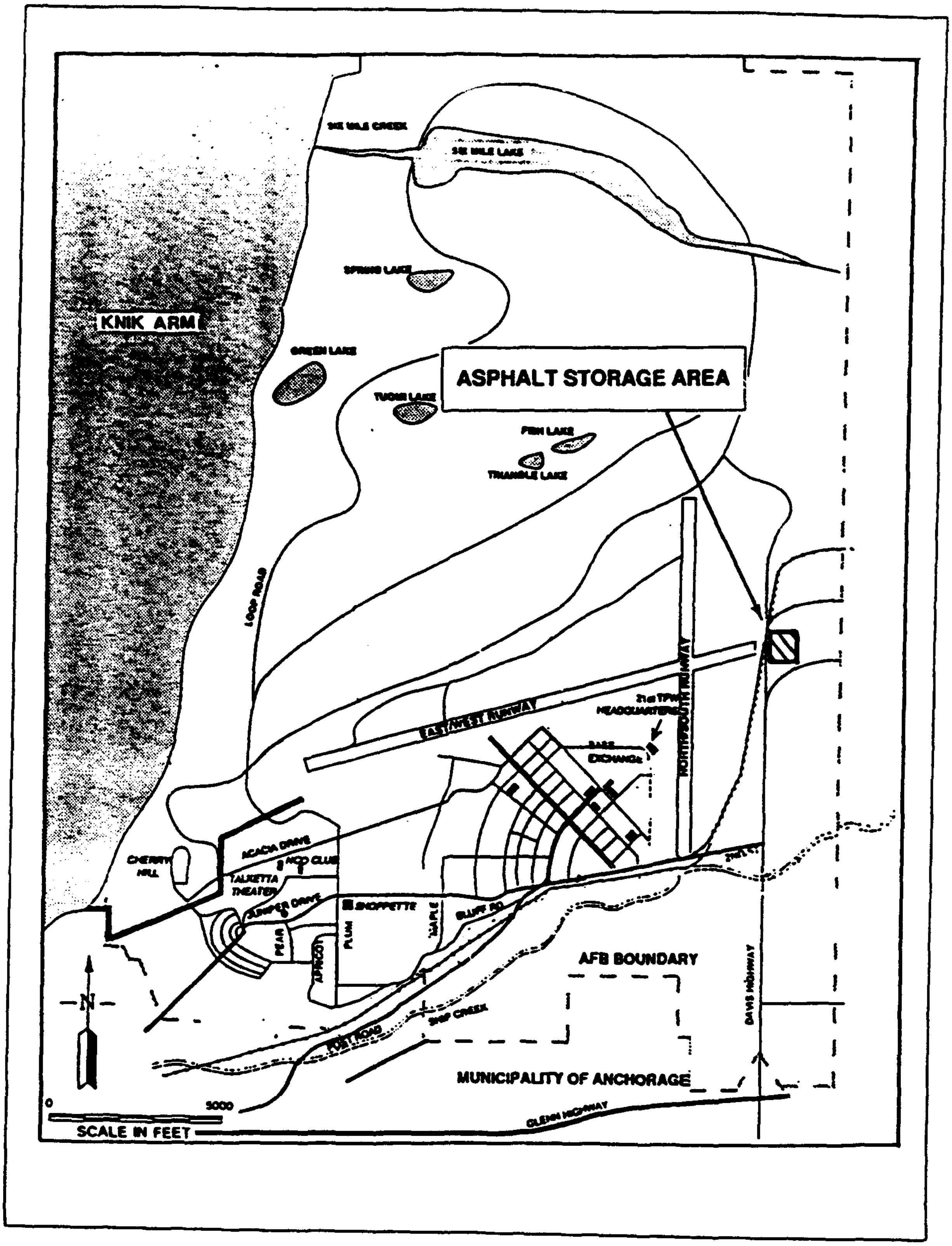


Figure 2: Location of asphalt storage area on Elmendorf AFB (adapted from EA Engineering, Inc., 1993)

inches in areas where surface anomalies have created depressions, and thus a collection point for the asphalt. Also, a 14-x 18-x 4-foot wood frame pit used to support previous asphalt operations is located at the north end of the site. The pit contains approximately 2300 gallons of asphalt (James M. Montgomery, Consulting Engineers, Inc., 1989). There are also locations where the soil appears to be contaminated by petroleum products other than asphalt (by visual inspection, this appears to be fuel contamination) .

II. OBJECTIVE

The objective of this study was to evaluate, using existing data obtained from the site, the feasibility of five remedial options for the EAFB materials storage area in order to comply with the FFA and to reduce the potential for environmental contamination. Protection of the environment and control of asphalt contamination sources through known methods, consistent with the FFA, comprised the rationale for this effort. The primary focus of this report was on the drums containing asphalt. The following options were evaluated:

- No action

- Close in place

- Drum Removal/Soil Excavation - Off-Site Disposal

- Drum Removal/Soil Excavation - Off-Site Recycling (Resale)

- Drum Removal/Soil Excavation - On-Site Recycling and Reuse

III. BACKGROUND INFORMATION

A. Potential Affected Population

The site is located approximately fifty (50) feet from the Davis Highway (Figure 2) which leads to EAFB aircraft maintenance facilities located on the north side of EAFB and to numerous EAFB recreational areas. The nearest base housing area is located approximately 2.3 miles (via 2nd street and Davis Highway) from the site. The site is not secured, with the exception of the asphalt cutting pit which is surrounded by a chain link fence. The potential for humans to come in contact with the asphalt exists, especially during the winter months when the site is not obvious due to snow cover. However, due to the physical location of the site, it is unlikely that humans will enter the area. There is no record of human injury at the site to date. Nevertheless, the potential for human exposure and physical injury does exist at the site.

The animal population is another population potentially affected by the chemicals at the site. Numerous small and large animals have free range on EAFB, including rabbits, squirrels, moose, elk, and caribou. During the summer months the smaller animals could become entrapped in the spilled asphalt on the ground as well as in the asphalt pit. The larger animals would not become entrapped in the spilled asphalt but could become entrapped in the asphalt pit. A large animal skeleton has been found in the asphalt pit. As a result the chain link fence surrounding the pit was installed.

B. Ecological, Geological and Hydrogeological Site Information

Since the time when the asphalt drums were deposited at the site, the site has heavily revegetated with spruce trees, low level scrub brush, and various indigenous grasses and mosses. The trees have diameters of up to approximately four (4) inches. There is more vegetation located within the contaminated areas than in uncontaminated areas adjacent to the site. Studies were not performed to statistically validate this observation or to attempt to prove why this may have occurred. One hypothesis is that the sun heated the asphalt which in turn raised the ambient soil temperatures enough to promote more rapid vegetation growth. Other than the actual presence of the drums and the asphalt pit, which are very unsightly during the summer months when they are visible, there have not been any obvious ecological problems caused by the materials at the site.

The site soils consist of a glacial till composed of silt to well-rounded gravel which has approximately a 3/4-inch mean diameter. A large majority of the soil (>80%) is gravel. The soils do not appear to contain any clay (Ivers, 1993). Extensive laboratory or field soils analyses have not been performed at the site. However, based upon the high gravel content and the lack of clay, it is reasonable to assume that the soils are very permeable and have a high hydraulic conductivity.

Groundwater monitoring wells have not been installed at this site. The depth to groundwater on EAFB is typically 40 feet. In Alaska, all aquifers are considered to be potential drinking water sources (ADEC, 1991). There are drinking water supply wells in the vicinity of the site which are not used. At this time, the groundwater from this area of EAFB is considered to be nonpotable and is not pumped or used for any purpose. Groundwater contamination is present in monitoring wells located approximately 0.5 miles south of the site. This contamination (trichloroethylene) was caused by a leaking closed landfill. Data regarding the groundwater/contaminant plume flow direction is not available for inclusion in this report (CH2M Hill, 1991).

C. Site Field Activities to Date

The site was addressed in the initial Phase 1 records search conducted in 1983 by Engineering-Science, Inc. This search was the initial effort performed to locate potential areas of environmental contamination on EAFB. The site was not included in the January 1988 EAFB Remedial Investigation/Feasibility Study (RI/FS) or in other subsequent reports. The August 1988 ADEC RCRA Facilities Assessment Report concluded that the site had the potential for causing environmental contamination; however, the site was given a lower priority than other solid waste management units located on EAFB (CH2M Hill, 1991).

In 1988, an initial site investigation was conducted by James Montgomery Consulting Engineers, Inc. (JMM) and Harza Environmental Services, Inc. The purpose of the site investigation was to prepare a scope of work for future remedial activities. However, funds were not available to EAFB to begin the recommended activities until 1991. In 1991, EAFB environmental engineering personnel discovered that the remedial activities recommended by JMM were no longer valid due to regulatory changes. In May 1991, EAFB contacted the Armstrong

Laboratory Environmental Engineering Division, Brooks AFB, Texas for technical assistance. In September 1991, EAFB entered into a contract with EA Engineering, Science and Technology Inc. through Armstrong Laboratory to begin remedial activities at the site.

Due to budget and weather constraints, work at the site must be performed in phases. The primary concern of EAFB and the ADEC was the removal of the pit contents, the pit structure, and as many of the drums and spilled asphalt from the ground surface as possible. Phase 1 of the project was performed during the summer and early fall of 1992. A synopsis of the removal approach and recovery methods utilized is provided below:

- Areas around drums and asphalt pools were cleared of vegetation to allow access of heavy equipment to the drums, asphalt pools, and the asphalt pit.

- Asphalt pools on the ground surface were recovered with conventional front-end loaders by shallow scraping.

- Drums containing asphalt were removed using conventional drum handling equipment.

- Asphalt was removed from drums by heating using a drum heater apparatus and placed into temporary storage containers.

- The empty drums were crushed and stockpiled

- All asphalt-covered material was stockpiled in a bermed area lined with 24 mil high-density polyethylene (HDPE) material, placed between geotextile fabric for improved puncture resistance.

The removed materials are being stored at the site until a feasibility study is performed and more funds are available to continue the remediation effort.

D. Analytical Results

Three sampling schemes were utilized during the Phase 1 field investigations. Asphalt samples were taken from asphalt drums, soil samples were taken from the drum storage area, and soil samples were taken from areas adjacent to the asphalt pit. Samples had previously been taken from the asphalt pit and from some of the drums containing unknown materials during previous investigations. Laboratory analyses were performed by an independent laboratory under contract with EA Engineering, Science, and Technology Inc. This laboratory was Columbia Analytical Services, Inc.; Kelso, Washington.

1. Asphalt Drum Samples

Samples were collected from drums containing asphalt located at 15 different areas of the site (Figure 3) (adapted from EA Engineering, Inc., 1993). Visual inspection of the drum contents showed that the majority of the asphalt appeared to have the same viscosity. Therefore, it was assumed that the asphalt from each area was composed of relatively the same constituents. The ADEC required that sixteen samples be taken from the asphalt-containing drums. The drum to be sampled from each area was randomly selected. The samples were analyzed for volatile organic compounds using EPA method 8240. The Toxicity Characteristic Leaching Procedure (TCLP) was the preferred sample extraction procedure. However, due to the physical characteristics of the material sampled, (i.e., petroleum product rather than aqueous solution and sample viscosity) TCLP extraction was physically impossible. All analyses were performed in accordance with Columbia Analytical Services, Inc.'s quality assurance program. The laboratory participates in the EPA's Contract Laboratory Program (CLP). The findings are shown in Table 1 (EA Engineering, Inc., 1993). Table 1, column 1 (stockpile area) indicates the sampling locations which are shown on Figure 3. The remaining columns indicate the constituent and the respective chemical concentrations.

The following volatile organic constituents were detected in the samples: benzene, toluene, ethylbenzene, p- and m-xylene, o-xylene, acetone, and 2-butanone. These samples were expected to contain these constituents. Methylene chloride was also detected in all samples but one (D7). However, since laboratory data indicated the presence of methylene chloride in blank samples, the actual presence of methylene chloride in the field samples is questionable.

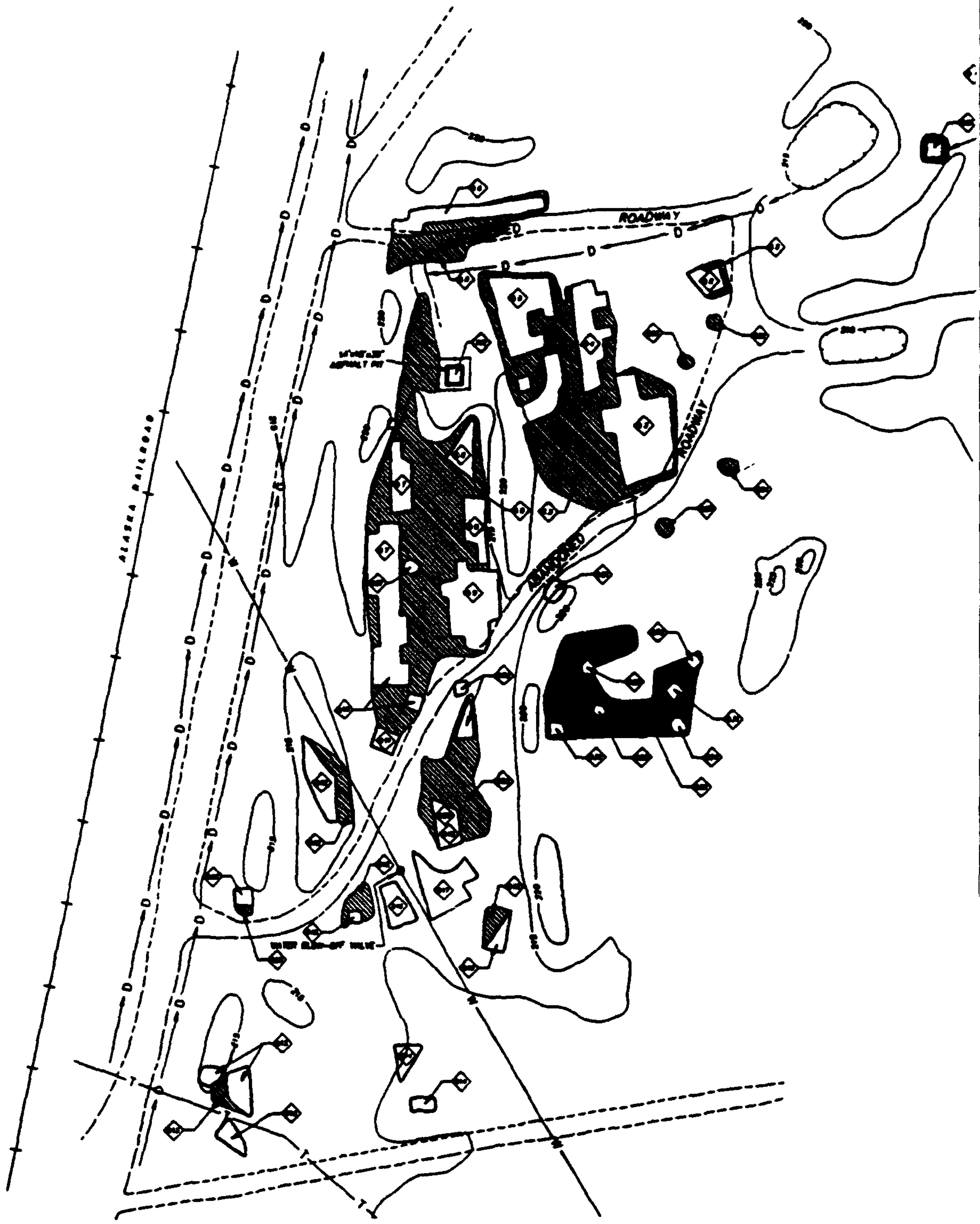
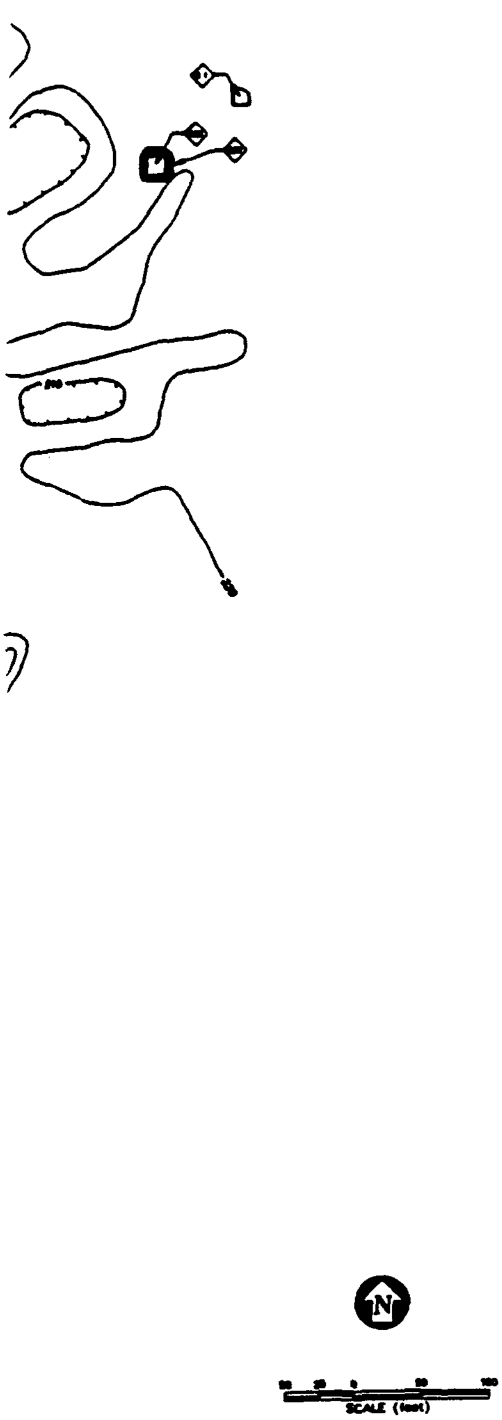


Figure 3: Asphalt storage area map showing drum and spill areas (adapted from EA Engineering, Inc., 1993)



Location Number*	Quantity	Volume	Comment
D1	27	Empty	
D2	42	Full	
D3	422	Full	
D4	182	Full	
D5	400	Full	
D6	146	Full	
	35	Part Full	
	80	Empty	
D7	200	Full	
	12	Part Full	
	179	Empty	
D8	17	Empty	Misc. random debris
D9	100	Full	
	12	Part Full	
	42	Empty	
D10	80	Full	
	9	Part Full	
	95	Empty	
D11	325	Empty	Crushed
D12	25	Empty	Scattered and partially buried
D13	300+	Empty	Unknown number buried
D14	Unknown	Unknown	Buried and partially buried
D15	3	Full	
	17	Empty	
D16	836	Empty	Crushed
D17	1100	Empty	Crushed
D18	60	Empty	
	8	Full	
D19	21	Full	Scattered
	1	Empty	
D20	20	Empty	
D21	Unknown	Unknown	Buried
	2	Unknown	Partially buried
D22	5	Full	
D23	0	Empty	
	1	Full	
D24	6	Full	
	11	Empty	
D25	6	Full	
	1	Empty	
D26	24	Empty	Includes Sample 9 (insufficient liquid for sample – no results) –crush and dispose of drums
	11	Full	Includes samples 2–8, 10–12 –dispose contaminated diesel fuel/gasoline –dispose of at EPA-certified facility
D27	2	Full	Sample 13 –drain water –dispose water, crush and dispose of drums
D28	12	Empty	Includes Sample 17 (insufficient liquid for sample – no results) –crush and dispose of drums
	7	Part Full	Sample 19 –drain water –dispose water, crush and dispose of drum
	4	Part Full	Samples 1, 18, 20, 21 contaminated diesel fuel –dispose of at EPA-certified facility
D29	1	Part Full	Sample 22 –sediment –dispose of at EPA-certified facility
D30	6	Empty	Includes Sample 15 (insufficient liquid for sample – no results) –crush and dispose of drums
	3	Full	Includes Sample 14 –dispose contaminated kerosene/gasoline –dispose of at EPA-certified facility
	8	Full	Asphalt –dispose of as asphalt
D31	1	Full	Includes Sample 16 –dispose contaminated gasoline/toluene –dispose of at EPA-certified facility
S1–S26	NA	NA	Spill area and type of spill (asphalt or fuel) determined from USAF (1989)

* Location number corresponds to that in the original USAF (1989) drum area location and content description.

LEGEND:

GRAVEL ROADWAY

D DITCH

T COMMUNICATIONS LINE

W WATER LINE

220 ELEVATION CONTOUR (FEET ABOVE SEA LEVEL)

DRUM LOCATION

ASPHALT SPILL

SUSPECTED FUEL SPILL AREA - CONTAMINATED BY FUELS

AREA DESIGNATIONS

DRUM AREAS WITH NUMBER

ASPHALT PIT

SPILL AREAS WITH NUMBER

d spill areas

6

Table 1

Analytical Results of Drum Sampling Effort

Concentration (mg/kg, dry weight)

Stockpile Area	Benzene	Toluene	Ethyl-Benzene	P+M Xylene	O-Xylene	Methylene Chloride	Other Compounds
D2	ND	14	92	420	120	ND	acetone, 2
D3	ND	40	120	530	150	ND	
D4	ND	31	170	710	280	9.2	
D5	ND	ND	0.32	0.73	0.33	0.81	2-butanone, 1.1
D6	ND	0.5	0.85	1.7	0.92	0.78	
D7	ND	ND	0.37	0.82	0.62	ND	
D8	ND	20	100	500	140	2.6	
D9	ND	15	88	410	120	2.4	
D10	ND	0.21	0.37	0.83	0.43	0.68	
D18	5.1	93	100	350	180	1.3	
D19	10	110	240	600	240	9	
D22	ND	27	830	6000	2000	8.2	
D24	3.8	77	600	2000	450	12	
D25	3.2	70	650	2000	470	11	
D30	ND	30	160	820	210	10	
D30	ND	25	120	690	170	8.5	

Legend: D - denotes stockpile area as shown on Figure 3.

ND - None of the constituent detected at or above the method reporting limit

2. Soil Samples from Drum Storage Area

Twenty-two (22) soil samples were taken from the asphalt storage area. The soil sampling locations are identified in Table 3 (EA Engineering, Inc., 1993) and in Figure 4 (adapted from EA Engineering, Inc., 1993). The soil sampling and analysis scheme is summarized as follows:

- Five (5) samples were taken from the suspected fuel spill areas (SF). These samples (A, B, E, F, and G of Table 3) were analyzed for Total Petroleum Hydrocarbons-gasoline (TPH-g), TPH-d (diesel), and Benzene, Toluene, Ethylbenzene, Xylene (BTEX). TPH-g analyses were performed using EPA methods 5030/8020/8015. These analytical results are reported as mg/Kg (dry weight basis) of volatile petroleum hydrocarbons as gasoline. TPH-d analyses were performed using EPA methods 3540/8100 modified. These analytical results are reported as mg/Kg (dry weight basis) of extractable petroleum hydrocarbons as diesel. BTEX analyses were performed using EPA methods 5030/8020/8015. These analytical results are reported as mg/Kg, dry weight basis, of benzene, toluene, ethylbenzene, and total xylenes

- Eight (8) samples were taken from asphalt spill/suspected fuel spill sites (SB). These samples (C, D, and H through M of Table 3) were analyzed for TPH-total, TPH-g, TPH-d, and BTEX using the methods described above.

- Nine (9) soil samples were taken from areas where spilled asphalt (SA) was removed during soil excavation activities. These samples (N through V of Table 2) were analyzed for TPH using EPA methods 9071/418.1. These analytical results are reported as mg/Kg, dry weight basis, of total petroleum hydrocarbons. The analytical results are summarized in Table 3. A comparison of data in Table 3 to ADEC guidance governing cleanup levels for non-UST contaminated soils (Table 4) indicates the following:

- TPH-g levels are below recommended cleanup levels.

- TPH-d levels exceed recommended cleanup levels in two samples (B and F), both of which were collected in areas of suspected fuel spills,

- Benzene and BTEX concentrations are below detection limits.

- TPH concentrations are below detection limits except in areas where spilled asphalt was recovered. In these areas, concentrations ranged from below detection limits to 7600 mg/kg (Sample R).

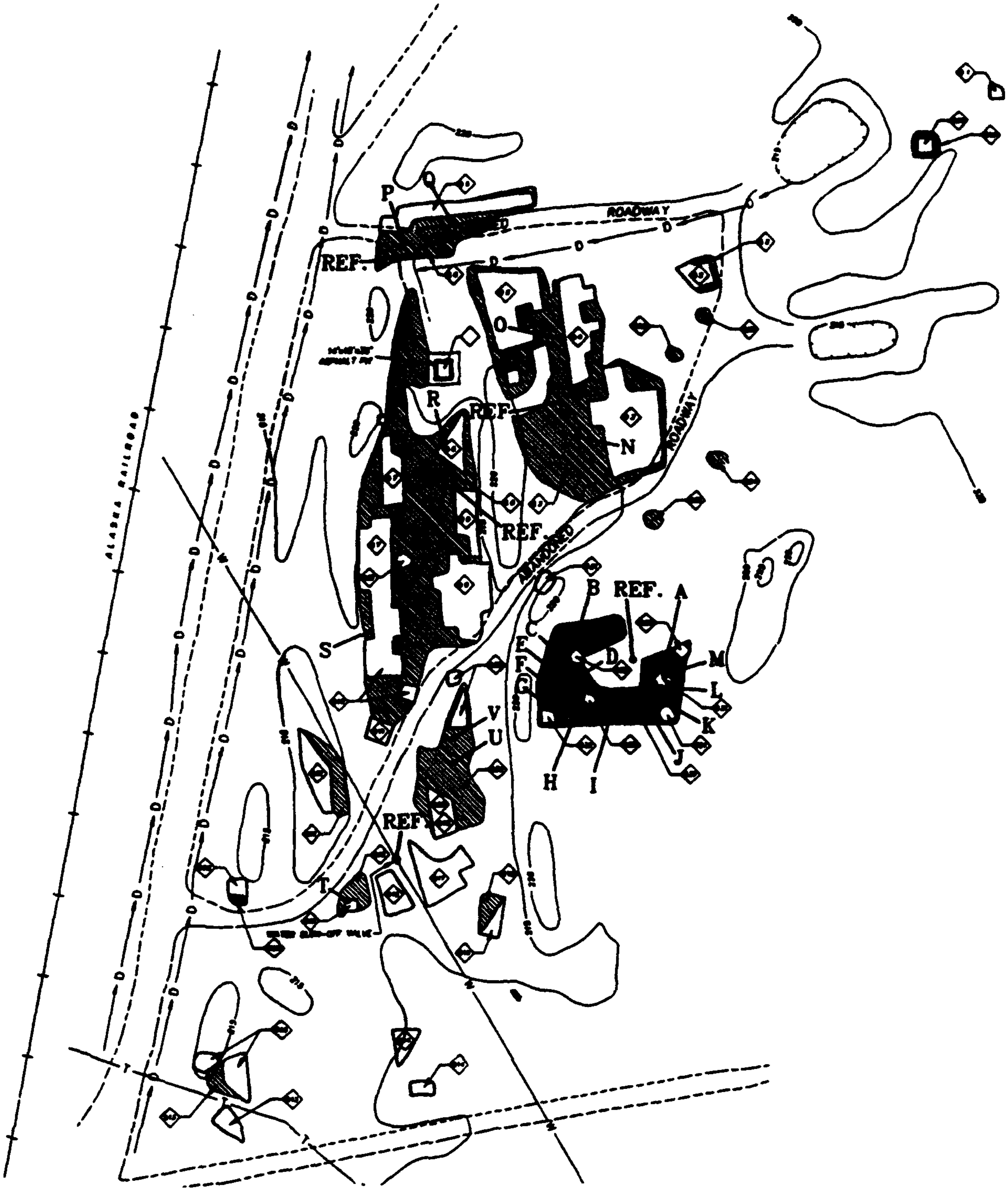
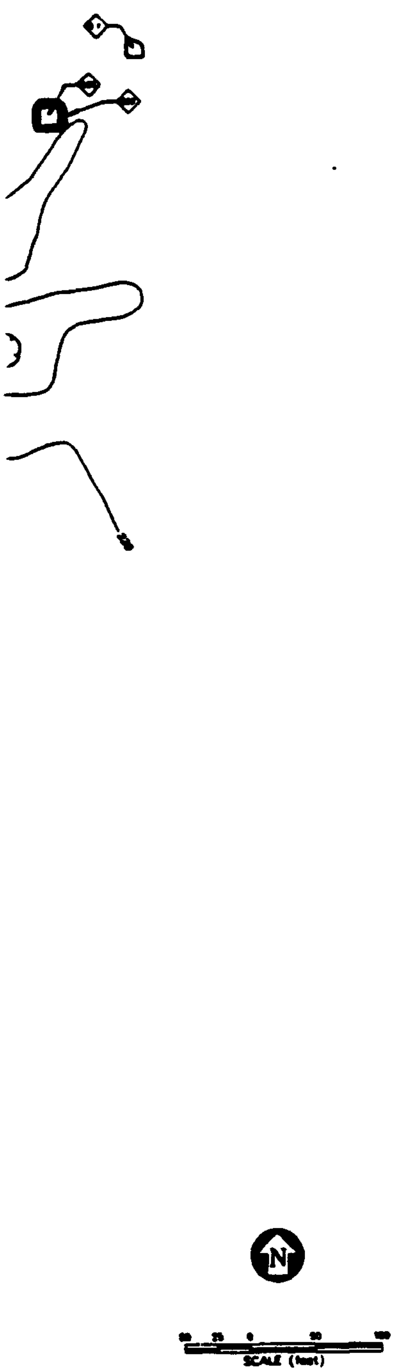


Figure 4: Asphalt storage area map showing soil sampling locations (adapted from EA Engineering, Inc., 1993)



Location Number*	Quantity	Volume	Comment
D1	27	Empty	
D2	42	Full	
D3	422	Full	
D4	[illegible]	Full	
D5	[illegible]	Full	
D6	146	Full	
	20	Part Full	
	[illegible]	Empty	
D7	[illegible]	Full	
	12	Part Full	
	175	Empty	
D8	17	Empty	[illegible]
D9	[illegible]	Full	
	12	Part Full	
	42	Empty	
D10	[illegible]	Full	
	9	Part Full	
	[illegible]	Empty	
D11	223	Empty	Crushed
D12	20	Empty	Scattered and partially buried
D13	100+	Empty	Unknown number buried
D14	[illegible]	[illegible]	Buried and partially buried
D15	3	Full	
	17	Empty	
D16	[illegible]	Empty	Crushed
D17	[illegible]	Empty	Crushed
D18	[illegible]	Empty	
	5	Full	
D19	21	Full	Scattered
	1	Empty	
D20	20	Empty	
D21	[illegible]	[illegible]	Buried
	7	[illegible]	Partially buried
D22	5	Full	
D23	9	Empty	
	1	Full	
D24	6	Full	
	11	Empty	
D25	6	Full	
	1	Empty	
D26	24	Empty	Includes Sample 8 (insufficient liquid for sample - no results) -crush and dispose of drums
	11	Full	Includes samples 2-6, 10-12 [illegible]
D27	2	Full	Sample 13 [illegible]
D28	12	Empty	Includes Sample 17 (insufficient liquid for sample - no results) -crush and dispose of drums
	1	Part Full	Sample 19 [illegible]
	4	Part Full	Samples 1, 15, 20, 21 [illegible]
D29	1	Part Full	Sample 22 [illegible]
D30	6	Empty	Includes Sample 15 (insufficient liquid for sample - no results) -crush and dispose of drums
	3	Full	Includes Sample 14 [illegible]
	6	Full	Asphalt [illegible]
D31	1	Full	Includes Sample 18 [illegible]
S1-S30	NA	NA	Spill area and type of spill (asphalt or fuel) determined from USAF (1988)

* Location number corresponds to that in the original USAF (1988) drum area location and content description.

LEGEND:

- GRAVEL ROADWAY
- DITCH
- COMMUNICATIONS LINE
- WATER LINE
- 220 — ELEVATION CONTOUR (FEET ABOVE SEA LEVEL)
- DRUM LOCATION
- ASPHALT SPILL
- SUSPECTED FUEL SPILL AREA - CONTAMINATED BY FUELS
- M — SOIL SAMPLE LOCATION (see Table 1.)

AREA DESIGNATIONS

- DRUM AREAS WITH NUMBER
- ASPHALT PIT
- SPILL AREAS WITH NUMBER

ions

VITA

Nancy Susan Miller was born in Texarkana, Texas, on December 21, 1964, the daughter of Dr. and Mrs. T. S. Hedgecock. After graduating from Hamburg High School, Hamburg, Arkansas, in 1983, she entered Texas A&M University in College Station, Texas. During the summer of 1986 she worked as an intern for ENSERCH Engineering, Inc., Washington, D.C. During the summer of 1987 she received a National Science Foundation Undergraduate Fellowship in conjunction with the Texas Engineering Experiment Station, College Station, Texas and published a report entitled "Remote Sensing Techniques and Interpretive Methodologies Used to Identify Magnetic Anomalies and Side Scan Sonar Contacts on the Continental Shelf of the Gulf of Mexico." She received a Bachelor of Science degree from Texas A&M University in December, 1987. Upon graduation, she was commissioned as a second lieutenant in the United States Air Force. She worked as a hazardous waste consultant and contract program manager at the Armstrong Laboratory, Brooks Air Force Base, Texas from February 1988 to July 1992. Currently, she is a captain in the United States Air Force. In August 1992, she enter The Graduate School of The University of Texas.

Permanent Address: 20031 Encino Cabin
San Antonio, Texas 78259

This report was typed by the author.

Table 2

Location of Soil Samples Collected from Drum Storage Area

Sample	Sample Number	Sample Location	Notes
A	AL.ASA.SF.S30.1	28'N X 6'E	All area 30
B	AL.ASA.SF.S30.2	12'N X 66'W	samples (A-M)
C	AL.ASA.SB.S130.1	6'S X 66'W	are referenced
D	AL.ASA.SB.S30.1	6'S X 66'W	from a lone
E	AL.ASA.SF.S30.3	6'S X 90'W	spruce tree.
F	AL.ASA.SF.S30.4	54'S X 90'W	Spruce tree is
G	AL.ASA.SF.S30.5	78'S X 90'W	tagged with a
H	AL.ASA.SB.S30.6	70'S X 60'W	red ribbon
I	AL.ASA.SB.S30.7	70'S X 33'W	labeled
J	AL.ASA.SB.S30.8	64'S X 3'E	"REFERENCE".
K	AL.ASA.SB.S30.9	30'S X 6'E	
L	AL.ASA.SB.S30.10	12'S X 12'E	
M	AL.ASA.SB.S130.10	12'S X 12'E	
N	AL.ASA.SA.S3.2	18'S X 2'E	Spruce tree w/red ribbon
O	AL.ASA.SA.S3.1	51'N X 18'E	
P	AL.ASA.SA.S6.2	60'N X 12'W	Spruce tree w/red ribbon
Q	AL.ASA.SA.S6.1	78'N X 75'E	Stake for S6.2 set back 7' N
R	AL.ASA.SA.S9.2	51'N X 9'W	Poplar tree w/ red ribbon
S	AL.ASA.SA.S9.1	135'S X 90'W	Stake for S9.2 set back 10'E

T	AL.ASA.SA.S15.1	0'S X 48'W	Reference is water blow-off pipe (T-V).
U	AL.ASA.SA.S20.1	28'N X 78'E	
V	AL.ASA.SA.S20.2	48'N X 78'E	

Note - Sampling reference points on site plan map (Figure 4) were located and measured without surveying equipment.

Table 3
Analytical Results of Soil Sampling Effort
Concentration (mg/kg, dry weight)

Sample	TPH-g	TPH-d	TPH	Benzene	Toluene	Ethyl-benzene	Total Xylene
Suspected Fuel Spill (SF)							
A	ND	ND	-	ND	ND	ND	ND
B	ND	1320	-	ND	ND	ND	ND
E	ND	ND	ND	ND	ND	ND	ND
F	7	300	ND	ND	ND	ND	0.3
G	ND	163	ND	ND	ND	ND	ND
Asphalt Spill/Suspected Fuel Spill (SB)							
C	ND	ND	ND	ND	ND	ND	ND
D	ND	ND	ND	ND	ND	ND	ND
H	ND	ND	ND	ND	ND	ND	ND
I	ND	ND	-	ND	ND	ND	ND
J	5	180	-	ND	ND	ND	ND
K	ND	ND	-	ND	ND	ND	ND
L	ND	ND	-	ND	ND	ND	ND
M	ND	100	-	ND	ND	ND	ND
Spilled Asphalt Area (SA)							
N	-	-	ND	-	-	-	-
O	-	-	47	-	-	-	-
P	-	-	ND	-	-	-	-
Q	-	-	ND	-	-	-	-
R	-	-	7600	-	-	-	-
S	-	-	32	-	-	-	-
T	-	-	32	-	-	-	-
U	-	-	323	-	-	-	-
V	-	-	33	-	-	-	-

Legend
ND - None of the constituent detected at or above the method reporting limit.
'-' - indicates sample not analyzed for the constituent

CONSTITUENT	EPA METHOD
TPH-g	5030/8015
TPH-d	3540/8100(modified)
TPH	9071/418.1
BTEX	5030/8020/8015

Table 4

ADEC Guidance for Cleanup Levels of Non-UST Contaminated Soils

Constituent	Concentration (mg/kg, dry weight)
TPH-total	300
TPH-gasoline + all other unknowns	100
TPH-diesel	200
Benzene	0.1
BTEX	15

3. Soil Sampling Adjacent to Asphalt Pit

Following excavation of the asphalt pit materials, four samples were collected in the vicinity of the pit and analyzed for TPH-total using EPA methods 9071/418.1. The results are reported as mg/Kg, dry weight basis, of total petroleum hydrocarbons. The analytical results along with the vertical and horizontal distances of samples from the pit sidewall at grade are summarized in Table 5 (EA Engineering, Inc., February 1, 1992). A comparison of these data with the ADEC guidance for cleanup levels of non-UST contaminated soils (Table 4) shows that these TPH concentrations are well above the cleanup levels. More extensive soil sampling is necessary to delineate the actual extent of petroleum hydrocarbon contamination. ADEC regulations require that the site be remediated to the cleanup levels contained in Table 4.

Table 5

Analytical Results of Pit Sampling Effort

Sample	Distance from bottom of pit (ft) Absolute	Horizontal	Vertical	TPH (mg/Kg) Dry Weight
Pit-1	0	0	0	180000
Pit-2	1.8	1.5	1.0	16000
Pit-3	4.67	4.5	1.25	11000
Pit-4	8.32	7.0	4.5	7100

Constituent	EPA Method
TPH-total	9071/418.1

4. Asphalt Pit Material Samples

Prior to Phase 1 field activities, three samples of the asphalt contained in the pit were taken and analyzed for volatile organic compounds using EPA method 8240 and for pesticides/polychlorinated biphenyls (PCBs) using EPA method 8080. The samples contained both a water phase and an asphalt phase. The results are reported as mg/Kg, dry weight basis. The detected constituents along with the sampling locations are summarized in Table 6 (EA Engineering, Inc., 1993). It is suspected that the pit was originally constructed for use as an asphalt cutting facility. Based upon this assumption, it is assumed that the small quantities of non-chlorinated solvents detected in the samples came from fuels used to cut the asphalt.

5. Drums Containing Materials Other than Asphalt

Fifty drums containing materials other than asphalt were identified during the JMM site investigation and during the EA Phase 1 remedial activities. The ADEC requires that these drums be sampled and analyzed to determine the characteristics of the contents. Based upon the analytical results, the contents of the drums shall be classified and disposed as either a hazardous or nonhazardous waste according to the regulations set forth in 40 CFR Part 261.

Table 6

Analytical Results of Asphalt Pit Material Samples

Sample Location	Matrix	Volatile Organic Compound	Concentration mg/Kg, dry wt
Pit Surface	Tar	Methylene Chloride	7.2
		Toluene	23
		Ethylbenzene	49
		Xylenes	220
18 inches below Pit Surface	Water	Acetone	0.084
		Toluene	0.23
		Ethylbenzene	0.22
		Xylenes	1.3
	Tar	ND	
Bottom of Pit	Water	ND	

Constituent	EPA Method
Volatile organic compounds	8240
PCBs/Pesticides	8080

Twenty-nine (29) drums that contained non-asphalt materials were identified during the site investigation conducted by JMM. The locations of these 29 drums, Areas 26 - 31, are shown in Figure 3. Eighteen of these drums were sampled during the JMM site investigation. The samples were analyzed for metals, PCBs, flash point, reactivity, and chlorinated hydrocarbons. A "fuel scan" was also performed. The complete analytical data set was not available for inclusion in this report. The liquid contents of 16 drums contained #2 diesel and kerosene with a flash point greater than 60°C. Two of the drums contained water with low concentrations of metals (JMM, 1989). Based upon these analytical results, the contents of 16 drums were not classified as a hazardous waste, but as a waste fuel. In accordance with EAFB procedures, only drums which were fully characterized were transported to the EAFB treatment, storage, and disposal (TSD) facility for disposal as waste fuel. Therefore, 16 drums were transported to the TSD facility and the remaining 13 drums were left in Area 3, which is designated as the non-asphalt drum staging area, as shown in Figure 5 (adapted from EA Engineering, Inc., 1993). The remaining 13 drums will be sampled and analyzed according to ADEC requirements when additional funds are available. After complete characterization, the waste will be classified as

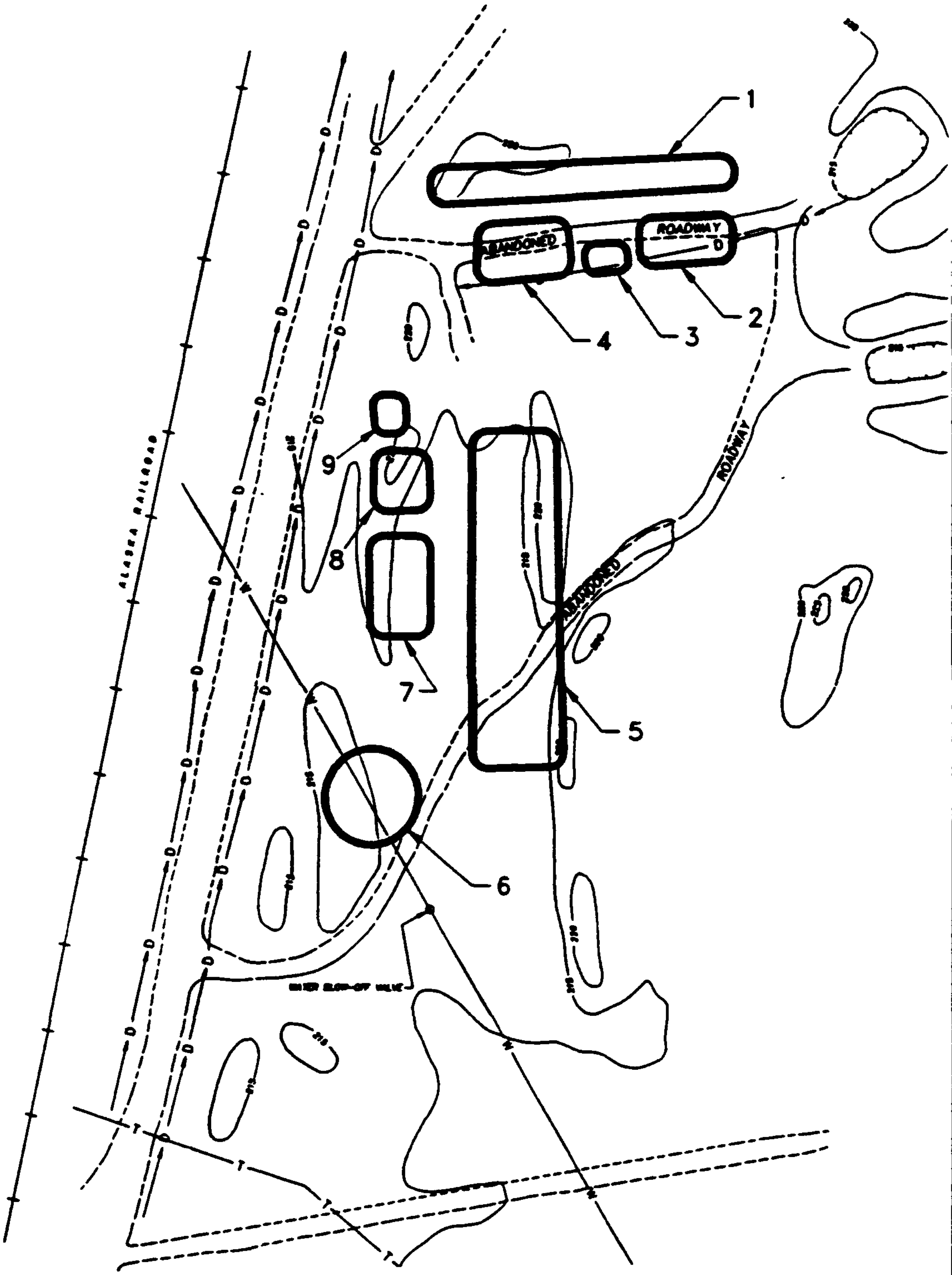
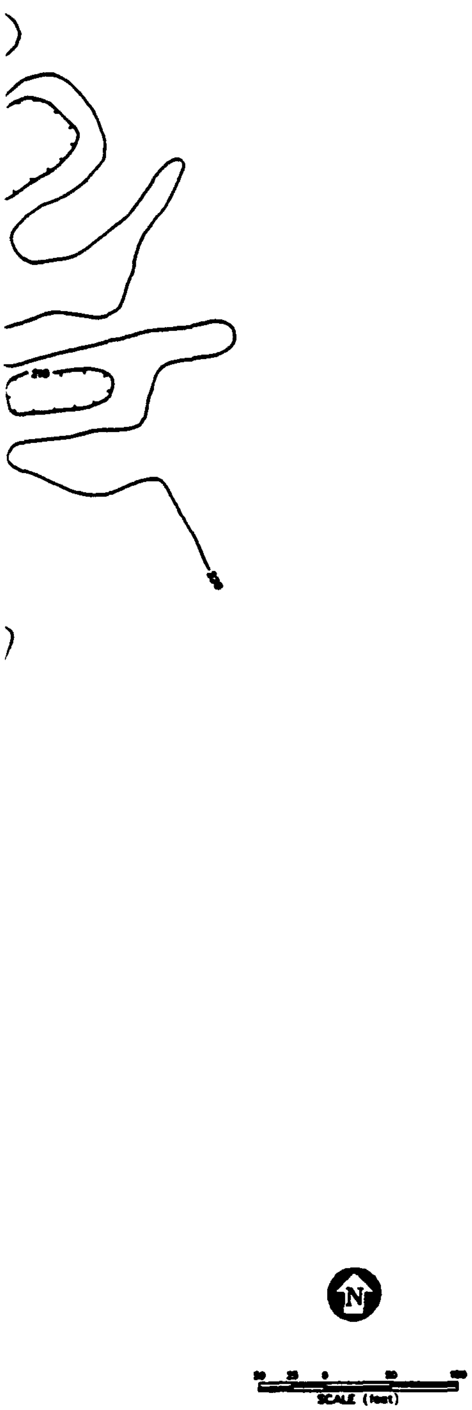


Figure 5: Asphalt storage area map showing work areas and
(adapted from EA Engineering, Inc., 1993)



s and features

LEGEND:

- GRAVEL ROADWAY
- DITCH
- COMMUNICATIONS LINE
- WATER LINE
- ELEVATION CONTOUR

KEY TO WORK AREAS AND FEATURES:

1. ASPHALT STORAGE CONTAINERS (FULL)
2. CRUSHED/EMPTY DRUMS
3. NON-ASPHALT DRUMS
4. ASPHALT STORAGE CONTAINERS (EMPTY)
5. SOIL STOCKPILES (ASPHALT ENRICHED)
6. CLEAN (CUT) TREES
7. ASPHALT DRUM STAGING AREA
8. DRUM OPENING AREA
9. HEATER BOX UNIT

either hazardous or nonhazardous waste, according to 40 CFR Part 261, and transported to the EAFB TSD facility for disposal in a manner consistent with the regulations related to either waste classification.

Also, during the Phase 1 investigation, 21 additional drums were found which contained materials other than asphalt. These drums were found in Areas 9, 21, 24, 28, and 31. These drums were placed in overpack containers and transported to Area 3. These drums will be sampled and analyzed according to ADEC requirements when additional funds are available. After complete characterization, they will also be classified as either hazardous or nonhazardous waste, according to 40 CFR Part 261, and transported to the EAFB TSD facility for appropriate disposal based upon the waste classification.

IV. REMEDIAL OPTIONS

The feasibility of five remedial options for the EAFB materials storage area was evaluated using existing data obtained from the site. The primary objectives of the efforts at the site are to comply with the FFA and to reduce the potential for environmental contamination. The evaluations consisted of determining the tasks which would be required in order to exercise any one of the five options. The following paragraphs describe each of the options and the associated tasks.

A. No Action

The no action remedial option involves simply leaving the asphalt materials at the site. In order for the materials to be left at the site, it must be demonstrated that the site has not caused any environmental contamination and does not pose the threat of any future environmental contamination.

1. Additional Evaluations

Several evaluations should be performed in order to determine the feasibility of this option. These include:

a. Soil Sampling - A soil sampling survey should be performed to determine if the materials at the site have caused soil contamination. This survey should involve taking soil samples from the vadose zone at various relatively shallow depths (6 in to 3 ft). The soil samples should be taken from the areas where the potential for contamination is the greatest, beneath the spilled asphalt, and in any areas of fuel contamination. Spilled fuel, in contact with the spilled asphalt, will reduce the asphalt viscosity, possibly increasing the migration potential of the asphalt through the soil. If soil contamination has not occurred over the estimated 50-year period that the drums have been stored at the site, it is unlikely that contamination will occur in the future. Therefore, the soil sampling survey and the results of the soil analyses are critical in determining if the no action option would be feasible. If soil contamination has occurred, the no action alternative is not a feasible option and additional investigations, such as a groundwater investigation and a more extensive soil sampling survey involving more samples, covering a larger area and taken at greater depths, particularly, should be performed.

b. Drum Contents Inventory - There is a suspicion that there are buried drums at the site whose contents have not been determined. All of the drums at the site must be located and the contents of those drums determined. The drums could be located by physical excavation and/or geophysical methods. Drums which are determined to contain materials other than asphalt should be removed from the site, sampled, analyzed and disposed accordingly. If any of the drums show evidence of leaking, the soil beneath those drums should also be sampled. If soil contamination is discovered, the no action alternative is not a feasible option for the areas at which the drums were located. Under such conditions, additional investigations, such as a detailed groundwater investigation and a more extensive soil sampling survey, should be performed.

2. Associated Risks

Even if it is demonstrated that the materials at the site do not pose an environmental threat, there are certain risks listed below associated with the no action option:

a. There is a possibility that not all of the suspected buried drums would be located. It would be very unfortunate to discover later that additional drums containing unknown materials had leaked into the subsurface and caused environmental contamination. To cover this eventuality, a broad, randomized soil and groundwater survey and analysis could be conducted throughout the suspected area.

b. Regulatory requirements and remediation costs will probably increase in the future. The site ultimately may have to be remediated. Therefore, leaving the drums at the site may cost more in the long run.

c. The potential does exist for human and animal injury and/or death.

d. Even if the site does not pose an environmental problem, the public perception will be that the Air Force is being negligent, resulting in negative public relations.

3. Advantages

There are two advantages to employing the no action option: a) it may cost less than other remediation options, even after performing the necessary sampling and analyses, and b) it may be environmentally sound.

4. Disadvantages

There are disadvantages to employing the no action option: a) the unsightly asphalt remains in place, b) future regulations may require that the site be remediated, and c) the possibility for human and/or animal injury exists.

Note: This option was totally unacceptable to both EAFB and ADEC. Therefore, it was not considered in great detail and immediate removal actions were undertaken the to remove the asphalt materials from the site. The no action option may be a technical option for the materials remaining at the site.

B. Close In Place

The close in place option involves the construction of an on-site facility to contain the asphalt material.

1. Factors Affecting Feasibility of Option

The following factors affect the feasibility of constructing an on-site containment facility:

a. Regulatory Requirements - ADEC guidance does not provide for the option of closing a site in place. The ADEC requires that all sites be remediated to the greatest extent feasible. According to the ADEC, closing a site in place is generally not a viable option; other remedial options should be evaluated. However, the regulatory agency will consider proposals recommending the close in place option as a last resort. In the event that the ADEC agrees to the close in place option, the ADEC would require that the containment facility be constructed according to 40 CFR 264.300 including primary and secondary liners, leachate collection and treatment systems, vadose and groundwater monitoring systems, and a cover.

b. Site Conditions - Geological conditions at the site are not favorable for the construction of an onsite containment facility. If the containment facility leaks, the high hydraulic conductivity and low organic content of the native soils may enable any leachate from the containment facility to migrate rapidly to the underlying aquifer.

Groundwater remediation activities associated with the existing leaking landfill may affect the desirability of constructing a containment facility at the existing site.

c. Site Location - The close proximity of the site to the end of the active runway is a concern of EAFB. An aircraft mishap could occur in the site area causing environmental contamination from the aircraft itself and/or actual physical damage to the containment facility. This is a remote possibility; but the possibility is a concern. However, the containment facility could be constructed in another area of EAFB, thereby, eliminating this concern.

d. Materials Availability - Clay, with a hydraulic conductivity less than or equal to 1×10^{-7} cm/s, normally required to construct the secondary liner of a containment facility is not readily available in the Anchorage, Alaska area. Low permeability clay is usually transported from the continental United States or imported from Canada. Materials transportation costs would significantly increase the containment facility construction costs.

Other materials typically used to construct a containment facility, i.e., gravel, sand, and geomembranes, can be obtained in the area.

2. Additional Evaluations

Additional evaluations should be performed in order to determine the feasibility of this option. These include:

a. Regulatory Negotiations - Only cursory discussions have been held with the regulatory agency regarding this option. Additional discussions and negotiations are required in order to determine if this option will meet ADEC requirements.

b. Containment Facility Location - If the containment facility cannot be constructed at the current site, a study should be performed to determine the optimum location for the containment facility.

c. Cost Analysis - Due to the site location, a cost estimate should be performed to determine the approximate cost of constructing the containment facility. Since materials costs as well as labor costs are significantly higher in Alaska than in the continental United States, it is not recommended that a cost estimate from a similar facility in the continental United States be used directly.

d. Leachate Potential - An analysis should be performed to determine the characteristics of the leachate that could be expected from the containment facility. This analysis should take rainfall, snowmelt, and temperature into consideration.

e. Additional Facilities - Facilities other than the containment facility are also required. Vadose and groundwater monitoring systems will be required to monitor the containment facility integrity. Leachate collection and treatment facilities will be required to collect and treat any leachate from the containment facility. It may be possible for the leachate to be treated in an available municipal wastewater treatment facility; this possibility should be evaluated.

f. Operation and Maintenance Costs - An evaluation should be performed to determine the long-term operational and maintenance costs associated with the containment facility. Vegetation on the cover may have to be controlled. The vadose monitoring system, groundwater monitoring system and leachate monitoring system must be maintained and sampled on a regular basis. Manpower requirements should be addressed during this evaluation.

g. Closure Plan - A closure plan should be developed detailing the procedures required to close each of the thirty-two sites where clean closure can be achieved. The plan should address the soil and groundwater sampling and analyses required to demonstrate that the site is clean. This plan must be approved by the ADEC. The plan should also address site restoration activities including grading and seeding with natural grasses.

h. Remediation Plan - If further soil and/or groundwater remediation is required at any of the sites, additional remedial investigations/ feasibility studies may be required to determine future remedial activities. This plan must be approved by the ADEC. These activities should be performed based upon results of the sampling and analyses performed according to the closure plan.

3. Advantages and Disadvantages

There are advantages to maintaining the asphalt in an on-site containment facility: a) the threat of environmental contamination is reduced, b) the possibility of animal and human injury is eliminated, and c) the site can restored to its original state, provided extensive contamination is not found during future sampling surveys. There are also disadvantages associated with this option: a) liability associated with possible future environmental contamination, b) long term monitoring and maintenance costs, and c) the material has not been treated; it has only been moved from one site to another.

C. Drum Removal/Soil Excavation - Off-Site Disposal

This option involves disposing of the drummed asphalt material, the asphalt pit contents, and the asphalt removed from the ground surface at an off-site disposal facility. Prior to Phase 1 activities, most of the asphalt was contained in 55-gallon drums. Most of the drums were corroded and could not be used to contain the asphalt during transportation. To transport the asphalt to an off-site disposal facility, the asphalt would have had to be placed into 85-gallon overpack containers or some other type of container before it could be transported off-site. Prior to Phase 1 activities, it was decided that it would be beneficial to remove the asphalt from the 55-gallon drums and the pit and place it into 2,500-gallon transportable storage containers. Currently, the asphalt removed from the ground surface is stored in a lined and bermed storage area, Area 5 as shown in Figure 5. This asphalt could be placed in similar containers and transported to the disposal facility. Storing the asphalt in bulk rather than in 85-gallon overpack containers minimized materials handling costs.

1. Factors Affecting Feasiblity of Option

The factors affecting the feasibility of this option are:

a. Disposal Facility Availability - There is not a disposal facility permitted to dispose petroleum products in Alaska. The three nearest disposal facilities are Klickitat Landfill, Roosevelt, Washington; Arlington Landfill, Arlington,Oregon; and Envirosafe Landfill, Grandview,Idaho. Acceptance of the asphalt material at these facilities is contingent upon the asphalt being stabilized to prevent flow at ambient temperatures. If the asphalt cannot be stabilized, it cannot be disposed at these facilities.

b. Costs - An approximate cost estimate for asphalt disposal at the three landfills is contained in Table 7 (Northwest EnviroServices, Inc., 1992). This estimate includes the costs associated with disposing of the asphalt, spilled asphalt, and the asphalt pit contents. The estimate is based upon disposal of 275,000 gallons of asphalt and asphalt contaminated soil. It does not address the costs associated with additional sampling and analysis required to close the site, pit construction material disposal, and site restoration activities.

2. Additional Evaluations

Several additional evaluations should be performed to determine the feasibility of this option. These include:

a. Regulatory Agency Approval - Approval must be obtained from the ADEC prior to implementation of this option. The ADEC has indicated that this option will satisfy regulatory requirements.

b. Asphalt Stabilization - Before this option is further considered, EAFB must determine if the asphalt can be stabilized. If stabilization is not possible, this option is not feasible.

Table 7

Approximate Costs

Drum Removal/Soil Excavation - Off-Site Disposal Option

Facility	**Klickitat Washington**	**Arlington Oregon**	**Envirosafe Idaho**
Costs (dollars/55-gallon drum)			
Packaging/Overpacking	3,910	3,910	3,910
Loading	1,840	1,840	1,840
Disposal	2,300	6,394	3,634
Transportation	1,702	2,208	3,312
Administration	1,472	1,472	1,472
Decanting	3,450	0	0
Contractor Oversight	1,380	1,012	1,334
Total	16,054	16,836	15,502
Total (110 containers)	1,765,940	1,851,960	1,705,220

3. Additional Procedures

Several additional procedures are required by the ADEC to close the site completely using this option. They include:

a. Material Disposal - The pit construction materials, wooden timbers, can be disposed in the Anchorage Municipal Landfill. The regulating agency requires that the timbers be steam-cleaned to remove excess asphalt from the surface prior to transportation to the landfill for disposal. A cost estimate for materials disposal is not available for inclusion in this report.

The used liners and geo-textile materials can be evaluated to determine the feasibility of reuse. Liners deemed to be reusable can be maintained by EAFB for future use. Liners deemed not reusable can be transported to and disposed of at the Anchorage Municipal Landfill.

b. Decontamination Fluids - All rinsate generated during equipment and material decontamination procedures should be sampled and analyzed to determine its chemical characterization. After characterization, these drums should be transported to the EAFB TSD facility for disposal.

c. Closure Plan - A closure plan should be developed addressing the procedures required to close each of the 32 sites where clean closure can be achieved. The plan should address the soil and groundwater sampling and analyses required to demonstrate that the site is clean. This plan must be approved by the ADEC. The plan should also address site restoration activities including grading and seeding with natural grasses.

d. Remediation Plan - If further soil and/or groundwater remediation is required at any of the sites, additional remedial investigations/feasibility studies may be required to determine future remedial activities. This plan must be approved by the ADEC. These activities should be performed based upon results of the sampling and analyses performed according to the closure plan.

4. Advantages and Disadvantages

There are advantages to disposing the asphalt off-site. They include: a) the project can be completed in one working season, b) human health and/or the environment are protected, c) animals are protected, d) the asphalt is removed from EAFB. There are also disadvantages to disposing the asphalt off-site: a) the Air Force maintains liability for the asphalt, b) the option is very costly, c) the asphalt may not be amenable to stabilization, and d) the option does not meet Air Force environmental philosophy.

D. Drum Removal/Soil Excavation - Off-Site Recycling

The off-site recycling option involves offering the containerized asphalt and the soil/asphalt mixture for reprocessing and reuse.

1. Preliminary Evaluations

Two preliminary evaluations have been performed to determine the feasibility of this option. Physical tests were performed using a sample of the asphalt and test batches of asphalt concrete were prepared using aggregate available on EAFB. The asphalt and soil mixtures scraped from the ground surface during Phase 1 activities are being tested to determine whether it can be used to produce crushed asphalt base (CAB) material. These evaluations are described in the following paragraphs.

a. Asphalt and Aggregate Physical Testing - One asphalt sample combined with an aggregate sample from EAFB was evaluated to determine if an asphaltic concrete meeting Alaska Department of Transportation specifications could be mixed. The laboratory, Matrecon Materials Testing Laboratory, Alameda, California, determined that the asphalt grade is AC-2.5 asphalt cement, which is an asphalt suitable for cold weather use and can be used to make paving mixtures. The laboratory results obtained from the asphalt sample are shown in Table 8 (Matrecon, 1992).

Table 8

Asphalt Physical Testing Results

Parameter	**Test Method**	**Results**
Viscosity		299 poise at 144°F
Penetration	ASTM D5	286 dmm at 77°F
Foaming		212°F
Asphalt Grade	ASTM D3381	AC-2.5

The aggregate sample appeared to be crushed gravel, with most of the particles having two or more fractured faces. The grading determined on a representative portion is shown below:

Cumulative % passing	3/4 in.	99
	1/2 in.	85
	3/8 in.	72
	No. 4	47
	No. 8	32
	No. 16	22
	No. 30	14
	No. 50	7.6
	No. 100	4.7
	No. 200	3.5

The above grading is within the requirements for 3/4-in. maximum dense-graded bituminous paving mixtures in ASTM D3515, and, except at the No. 30 sieve, within Caltrans grading requirements for 3/4-in. maximum, coarse asphalt concrete (Matrecon, 1992).

Since the water-contaminated asphalt foams when heated, the asphaltic concrete will have to be used at low temperatures. Also, the aggregate will have to be dried to achieve uniform coating of the aggregate.

Three test batches of asphaltic concrete were mixed with 3.2, 3.6, and 4.0 parts asphalt (by weight) per 100 parts aggregate of asphalt at 140°F and aggregate at 275°F. These were compacted by kneading compaction into 4-in. diameter briquets. The bulk specific gravity and Stabilometer values are shown in Table 9.

Table 9

Asphalt Concrete Test Batch Results

	Asphalt content, per 100 parts of aggregate 4.0		3.6		3.2	
Specimen number	1A	1B	2A	2B	3A	3B
Bulk density at 77°F, pcf, ASTM D2726	148.7	143.8	147.8	149.8	147.1	150.3
Stabilometer value at 140°F ASTM D1560	33	*	30	35	36	*

* - These briquets were damaged during transfer to the testing equipment and were not tested.

These results indicate that the materials can be used to make satisfactory paving mixtures. These tests did not establish a mix design, or determine an optimum asphalt content. Due to the coarseness of the aggregate grading and the relatively low asphalt content, freeze-thaw damage might occur if these mixtures are used for surface courses. Finer-graded aggregate may be used to produce a more compact asphalt concrete. Further testing should be performed on additional asphalt samples to assure asphalt uniformity and to develop the optimum mix design (Matrecon, 1992).

b. Asphalt and Soil Mixture Evaluation - The asphalt and soil generated during the scraping process can be used in the production of CAB material provided it meets Alaska Department of Transportation specification D-1. The D-1 specification generally refers to the aggregate only, with an allowance for the presence of 2.5 to 5% asphalt content. The addition of asphalt to the aggregates increases the CAB cohesiveness and reduces the frequency of required maintenance. The material is currently undergoing testing to determine if the material meets the D-1 specification. Initial indications are that the material does meet the specification. The initial results were not available for inclusion in this report. An Anchorage road materials company has expressed an interest in performing this process. Applicable guidance for CAB production are found in ASTM C-131, D-2172, and AASHTO T-164 (EA Engineering, Inc. 1993).

2. Additional Evaluations

Several additional evaluations should be performed to determine the feasibility of this option. These include:

a. Reprocessor Availability - To utilize this option there must be a petroleum processor or road materials manufacturer willing to accept the asphalt for r...ocessing. Initially, the Chevron Oil Company expressed an interest in reprocessing the asphalt. Later, the company expressed a fear of future liability if any problems should occur as a result of the asphalt reprocessing. There are no other petroleum processors with the capability to perform the reprocessing procedure in the Anchorage, Alaska area. Further investigations should be performed to determine if another processor will accept the material.

b. Regulatory Agency Approval - Final approval must be obtained from the ADEC prior to implementation of this option. Initially, the ADEC was reluctant to consider approving any type of reprocessing activity. The agency preferred that the asphalt be land disposed. After many negotiations, the ADEC has indicated that this option will satisfy regulatory requirements.

c. Cost Estimate - If a reprocessor is available and willing to recycle the asphalt, a cost estimate should be performed to determine the feasibility of this option.

3. Additional Procedures

Several additional procedures are required by the ADEC to close the site completely using this option. They include:

a. Material Disposal - The pit construction materials, wooden timbers, can be disposed in the Anchcrage Municipal Landfill. The regulating agency requires that the timbers be steam-cleaned to remove excess asphalt from the surface prior to transportation to the landfill for disposal. A cost estimate for materials disposal is not available for inclusion in this report.

The used liners and geo-textile materials can be evaluated to determine the feasibility of reuse. Liners deemed to be reusable can be maintained by EAFB for future use. Liners deemed not reusable can be transported and disposed at the Anchorage Municipal Landfill.

b. Decontamination Fluids - All rinsate generated during equipment and material decontamination procedures should be sampled and analyzed to determine its chemical characterization. After characterization, these drums should be transported to the EAFB TSD facility for disposal.

c. Closure Plan - A closure plan should be developed addressing the procedures required to close each of the 32 sites where clean closure can be achieved. The plan should address the soil and groundwater sampling and analyses required to demonstrate that the site is clean. This plan must be approved by the ADEC. The plan should also address site restoration activities including grading and seeding with natural grasses.

d. Remediation Plan - If further soil and/or groundwater remediation is required at any of the sites, additional remedial investigations/feasibility studies may be required to determine future remedial activities. This plan must be approved by the ADEC. These activities should be performed based upon results of the sampling and analyses performed according to the closure plan.

4. Advantages and Disadvantages

There are advantages to recycling the asphalt off-site. They include: a) the process is environmentally sound and responsible, the material is being used rather than disposed, b) human health and/or the environment is protected, c) animals are protected, d) the asphalt is removed from EAFB, e) future liability is reduced, f) the project can be completed in one working season. There are also disadvantages to recycling the asphalt off-site: a) the Air Force maintains liability for the asphalt, should problems occur during the recycling process, b) It may be cost prohibitive to transport the material to a reprocessor, and c) the process will take a longer period of time to complete than some of the other options.

E. Drum Removal/Soil Excavation - On-Site Recycling

The on-site recycling option involves recycling the recovered material by operating an asphalt batch plant on EAFB and using the recycled material to pave road or parking surfaces on EAFB.

1. Preliminary Evaluations

a. Asphalt and Aggregate Physical Testing - The results of the preliminary evaluations presented in Section IV.D.1.a are applicable tc the on-site recylcing option.. The results indicated that the recovered asphalt materials can be used to make useful paving mixtures. However, further testing should be performed on additional asphalt samples to assure asphalt uniformity and to develop the optimum mix design.

b. Asphalt and Soil Mixture Evaluation - The results of the asphalt and soil mixture evaluation presented in Section IV.D.1.b are also applicable to the on-site recycling option. The initial results indicated that the asphalt and soil generated during the scraping process can be used to produce CAB material.

c. Costs - An approximate cost estimate for recycling the asphalt material on-site is contained in Table 10 (EA Engineering, Inc., May 7, 1992). This estimate includes the costs associated with the previously performed Phase 1 activities ($690,000) and the activities associated with operating an asphalt batch plant, preparing a surface for paving and paving the prepared surface. The estimate is based upon recycling

250,000 gallons of asphalt and 3,000 cubic yards of asphalt contaminated soil. It does not address the costs associated with additional sampling and analysis required to close the site, pit construction material disposal, and site restoration activities.

Table 10

Approximate Costs - On-Site Recycling Option

Mobilization Costs	$150,000
Site Clearing (trees, brush)	88,000
Drum Staging	207,102
Asphalt Recovery	139,000
Operate Asphalt Batch Plant	575,000
Prepare Paving Surface	36,000
Pave	92,000
Decontamination	55,000
G&A	206,000
Project Management	206,000
Documentation	20,000
Total:	$1,774,102

2. Additional Evaluations

Several additional evaluations should be performed to determine the feasibility of this option. These include:

a. Regulatory Agency Approval

Final approval must be obtained from the ADEC prior to implementation of this option. Initially, the ADEC was reluctant to consider approving any type of reprocessing activity. The agency preferred that the asphalt be land disposed. After many negotiations, the ADEC has indicated that this option will satisfy regulatory requirements.

3. Additional Procedures

Several additional procedures are required by the ADEC to completely close the site using this option. They include:

a. Material Disposal - The pit construction materials, wooden timbers, can be disposed in the Anchorage Municipal Landfill. The regulating agency requires that the timbers be steam-cleaned to remove excess asphalt from the surface prior to transportation to the landfill for disposal. A cost estimate for materials disposal is not available for inclusion in this report.

The used liners and geo-textile materials can be evaluated to determine the feasibility of reuse. Liners deemed to be reusable can be maintained by EAFB for future use. Liners deemed not reusable can be transported and disposed at the Anchorage Municipal Landfill.

b. Decontamination Fluids - All rinsate generated during equipment and material decontamination procedures should be sampled and analyzed to determine its chemical characterization. After characterization, these drums should be transported to the EAFB TSD facility for disposal.

c. Closure Plan - A closure plan should be developed addressing the procedures required to close each of the thirty-two sites where clean closure can be achieved. The plan should address the soil and groundwater sampling and analyses required to demonstrate that the site is clean. This plan must be approved by the ADEC. The plan should also address site restoration activities including grading and seeding with natural grasses.

d. Remediation Plan - If further soil and/or groundwater remediation is required at any of the sites, additional remedial investigations/feasibility studies may be required to determine future remedial activities. This plan must be approved by the ADEC. These activities should be performed based upon results of the sampling and analyses performed according to the closure plan.

4. Advantages and Disadvantages

There are advantages to recycling the asphalt on-site. They include: a) the process is environmentally sound and responsible, the material is being used rather than disposed, b) human health and/or the environment are protected, c) animals are protected, d) the asphalt is maintained on EAFB, and e) future liability associated with off-site facilities is eliminated. There are also disadvantages to recycling the asphalt on-site: a) the Air Force maintains liability for the asphalt, should problems occur in the future, b) maintenance of surfaces paved with the recycled asphalt will be the responsibility of EAFB, and c) the process will take a longer period of time to complete than some of the other options.

V. CONCLUSIONS AND RECOMMENDATIONS

Additional studies are required to fully evaluate each of the five remedial options described above. Performing all of the additional evaluations is not feasible due to time and budget constraints. However, based upon the information currently available, several of the remedial options can be eliminated and additional attention can be devoted to the remaining remedial options. Conclusions and recommendations regarding each of the five remedial options are as follows:

A. No Action

As described in Section IV.A.4, the no action option was unacceptable to both ADEC and EAFB and actions were undertaken to remove the asphalt materials from the site.

There are approximately 700 drums of asphalt remaining at the site which have not been recovered. Potentially, the no action alternative could be utilized for these materials. However, since the majority of the materials have been removed from the site, the no action option is not the best alternative for the remaining material. If this option were chosen for the remaining materials, the additional investigations required for the no action option have to be performed as well as the additonal evaluations required for the option chosen for the material already recovered. These additional efforts would probably increase the total cost of the remedial effort. Also, leaving the additional material at the site is not acceptable to the ADEC or EAFB.

B. Close In Place

The ADEC and EAFB prefers that the material be removed from the site if feasible. Based upon the known site geological conditions, lack of readily available landfill construction materials, future maintenance requirements, and potential liabilities associated with this option, the close in place option is probably not the best option and should be further considered only if other options are not possible.

C. Drum Removal/Soil Excavation - Off-Site Disposal

This option is technically feasible, provided the material can be stabilized. Off-site disposal is the most expedient remedial option and is cost competitive with recycling the material. However, the Air Force does maintain liability for the landfilled material and would be required to pay for future remedial activities associated with the disposal facility, if problems were to occur. Based upon this uncertainty, other options are more desirable.

D. Drum Removal/Soil Excavation - Off-Site Recycling

Initial evaluations indicate that the material can be successfully recycled. This approach is environmentally sound; the material does not contain chemical constituents other than those of "new" asphalt. Since asphalt is normally used for paving surfaces, there is no reason that this material should not be used for paving surfaces. This option would also be expedient. However, if a processor is not available in the Anchorage area, the transportation costs to a processor may be prohibitive. Additonal efforts should be made to find a local processor.

E. Drum Removal/Soil Excavation - On-Site Recycling

The material also can be successfully recycled on-site as well as off-site. This approach is also environmentally sound. Initial cost estimates indicate that on-site recycling is cost competitive with off-site disposal. A positive aspect is that the Air Force maintains control of the reprocessing and paving operations. The most negative aspects associated with this option are that entire project will take a longer period of time to complete and the Air Force will have to maintain the paved surface. However, if a processor cannot be located to reprocess the asphalt or if off-site recycling is cost prohibitive, this option is the most viable option.

F. Summary

This evaluation has indicated that the no action and close in place options are not desirable unless none of the other options are possible. The off-site disposal option is technically feasible, but is not recommended because the Air Force maintains liability for the asphalt. The off-site recycling option is the most desirable option because it is environmentally

environmentally sound and is more expedient than on-site recycling. Implementation of this option depends upon the availability of a cost-effective recycler. If the off-site recycling option is not possible or cost-effective, the on-site recycling option should be implemented. This option is technically feasible, cost-effective, and the Air Force maintains control over all uses of the asphalt.

VI. REFERENCES

Alaska Department of Environmental Conservation, (July 17, 1991). *Interim Guidance for Non-UST Contaminated Soil Cleanup Levels,* Anchorage, AK.

CH2M Hill, (1991). *Technical Memorandum to EAFB, Site SS10, Asphalt Drum Storage Area,* Anchorage, AK.

EA Engineering, Inc., (February 1, 1992). Memo for Record, Armstrong Laboratory Order Number 20, Concord, CA.

EA Engineering, Inc., (May 7, 1992). Memo for Record, Armstrong Laboratory Order Number 20, Concord, CA.

EA Engineering, Inc., (February, 1993). *Asphalt Storage Area Site Assessment Draft Report and Appendices,* Anchorage, AK.

Ivers, Lewis. Project Manager, EA Engineering, Inc., Anchorage, AK, Telephone conversation with Nancy Miller, April 30, 1993.

James M. Montgomery, Consulting Engineers, Inc., (June 1989). *Defense Environmental Restoration, Restoration of Asphalt Storage Area, Elmendorf AFB, Alaska,* Anchorage, AK.

Matrecon, Alameda, CA, (April, 28, 1992). Laboratory Report, Asphalt and Gravel Aggregate from EAFB, submitted to EA Remediation Technologies; Concord, CA.

Northwest EnviroServices, Inc., Anchorage, AK, (April 27, 1992). Letter to EA Remediation Technologies; Concord, CA.