

DEMOLITION AREA NUMBER ONE

CLOSURE GUIDELINES

FORT RICHARDSON, ALASKA

Prepared for

Department of the Army
U.S. Army Engineer District, Alaska

December 1993

Prepared by

EMCON Alaska, Inc.
201 East 56th, Suite 300
Anchorage, Alaska 99518

Project 5117-072.00

CONTENTS

1 INTRODUCTION	1
1.1 Objectives and Overview	1
1.2 Regulatory Status of the Site	2
 2 SITE DESCRIPTION	 4
2.1 Site Location	4
2.2 History of Operations	4
2.3 Current Conditions	8
2.4 Regulatory Actions Involving the DEMO 1 Site	9
2.4.1 RCRA Part B Permit Application	9
2.4.2 EPA Notice of Deficiency	9
2.4.3 RCRA Facility Assessment and Visual Site Inspection	10
2.4.4 Notice of Non-Compliance	10
2.4.5 Federal Facility Compliance Agreement	10
2.4.6 RCRA Compliance Inspection Reports	11
2.4.7 Alaska Coastal Management Program	11
2.4.8 Dredge-and-Fill Permit for Wetlands	11
 3 SITE CHARACTERISTICS	 12
3.1 Hazardous Wastes and Constituents	12
3.1.1 Records and Literature	12
3.1.2 Site Investigations	13
3.1.3 Estimated Maximum Hazardous Waste Inventory	17
3.1.4 Waste and Constituents Characteristics	17
3.2 Geology and Hydrology	23
3.3 Potential Exposure Pathways	26
3.3.1 Soil	26
3.3.2 Groundwater	27
3.3.3 Surface Water	27
3.3.4 Air	28
3.4 Potential Receptors	28

CONTENTS (Continued)

3.4.1	Humans	28
3.4.2	Fish and Wildlife	29
3.4.3	Domestic Animals	30
3.4.4	Crops	30
3.4.5	Vegetation	30
3.4.6	Physical Structures	30
4	CLOSURE REQUIREMENTS AND PERFORMANCE	31
4.1	Closure Requirements	31
4.2	Closure Performance Standards	31
4.3	Demonstrating Closure Performance	32
4.3.1	Demonstrating Clean Closure	32
4.3.2	Demonstrating Closure Performance During Post-Closure Care	38
4.3.3	Cap and Surface Water Management System Construction	39
4.3.4	Visual Monitoring and Maintenance or Remedial Actions	39
4.3.5	Groundwater Monitoring and Remedial Actions	39
5	CLOSURE ACTIVITIES	43
5.1	Clean Closure Actions	43
5.2	Closure Actions For Post-Closure Care	43
5.2.1	Basis For Actions	43
5.2.2	Site Survey	44
5.2.3	Site Cap	45
5.2.4	Surface Water Management	48
5.2.5	Monitoring Wells and Sites	49
5.2.6	Site Security	52
5.2.7	Personnel and Equipment Decontamination	53
5.2.8	Personnel Safety and Health Precautions	53
5.2.9	Emergency Preparedness and Prevention	54
5.2.10	Closure Schedule	54

CONTENTS (Continued)

5.2.11	Closure Documentation and Recordkeeping	55
5.2.12	Closure Cost	56
6	POST-CLOSURE CARE ACTIVITIES	57
6.1	Post-Closure Care Contact	57
6.2	Site Monitoring	57
6.2.1	Visual Inspections	57
6.2.2	Groundwater Monitoring	59
6.3	Site Maintenance	61
6.3.1	Site Security	61
6.3.2	Cap Maintenance	61
6.3.3	Repair of Soil Subsidence or Heave Conditions	61
6.3.4	Inspection and Repair of Exposed Geomembrane	62
6.3.5	Surface Water Management Features	62
6.3.6	Monitoring Wells	62
6.4	Post-Closure Documentation, Recordkeeping, and Reporting	63
6.4.1	Post-Closure Care Documentation and Recordkeeping	63
6.4.2	Post-Closure Care Activity Reporting	63
6.4.3	Amendment of Post-Closure Plan	64
6.4.4	Post-Closure Notices	64
6.4.5	Certification of Completion of Post-Closure Care	64
	REFERENCES	65
	APPENDIX A SOIL SAMPLE DISTRIBUTION	

TABLES AND FIGURES

Tables

1	Analytical Results of 47 Soil Samples from the Fort Richardson OB/OD Pad on July 6 and 7, 1992 (AEHA, 1993)	14
2	Primary Chemical Compounds Expected in Types of Explosives and Ordnance Destroyed at the DEMO 1 Unit	20
3	DEMO 1 Unit Soil and Groundwater Clean Closure Levels and Analytical Methods	33
4	DEMO 1 Unit Groundwater Monitoring Constituents, Action Levels and Analytical Methods	40

Figures

1	Site Location Map	5
2	Site Diagram	6
3	Schematic of Vertical Profile	25
4	Conceptual Cap Design	47
5	Proposed Monitoring Well Locations	50
A-1	Locations of sample points on the OB/OD pad as depicted in the Army's data report (AEHA, 1993)	A-1
A-2	Distribution of 2,4-DNT on the OB/OD pad based on the Army's analytical results and the Army's sample point diagram shown in Figure A-1	A-2

1 INTRODUCTION

1.1 Objectives and Overview

The U. S. Army entered into a Federal Facility Compliance Agreement (FFCA) with the U. S. Environmental Protection Agency (EPA), Region 10, in 1991 to resolve hazardous waste management issues at a number of sites at Fort Richardson. Among other actions, Fort Richardson agreed to submit a closure plan for its Demolition Area Number One (DEMO 1) site that had been used for Open Burning/Open Detonation (OB/OD) of explosives. These guidelines serve to satisfy that agreement.

The objective of these guidelines is to help bring the DEMO 1 solid waste management unit into compliance with Fort Richardson's FFCA and the regulations governing hazardous waste management promulgated under the Resource Conservation and Recovery Act (RCRA). The FFCA calls for submittal of a closure plan for the OB/OD site, as stipulated in 40 CFR 265 Subpart G. For such closure plans, RCRA provides other guidelines, including 40 CFR 264.110-116, Subpart G, 40 CFR 264.600-603 Subpart X, 40 CFR 265.110-115 Subpart G, 40 CFR 270.14(b)(13), and 40 CFR 270.14(b)(15-18). These guidelines fulfill the requirements of these and other RCRA regulations that are appropriate for closure of DEMO 1. In addition, these guidelines offer initial recommendations for post-closure care, although the Army may develop a separate, more-detailed post-closure plan (40 CFR 264.118).

The purposes of the closure actions are to reduce the threat that hazardous wastes at DEMO 1 may pose or, alternatively, to demonstrate the absence of a significant threat. A variety of explosive devices were destroyed on the gravel pad adjacent to Eagle River Flats for more than 30 years until operations were halted in 1988. Explosives Ordnance Disposal (EOD) staff had burned and detonated materials from both military and civilian sources. Now, discarded metal parts and traces of explosives chemicals are still found in the surface soils of the pad. These guidelines describe the actions to prevent releases from the site that may have adverse effects on human health or the environment.

The control of these potential releases of hazardous constituents from the OB/OD pad would be demonstrated through performance standards that meet the provisions of 40 CFR 264.310(a) for landfill closures, if post-closure care is necessary. Sampling and analysis during initial closure and post-closure are expected to indicate that a low-permeability cap would maintain "non-threat" concentrations of the DEMO 1 unit's constituents of concern (COCs) in the immediately surrounding area. Therefore, landfill closure and post-closure limited to the pad are expected to control releases that may threaten human health or the environment.

These guidelines also outline a means of determining whether a decision for clean closure, as an alternative to a landfill cap and post-closure care, is warranted. Sampling and analysis of soils and groundwater would be carried out as initial closure actions. If the results indicate that COCs are at levels not threatening to human health and the environment, then the Army would forgo the post-closure care alternative.

1.2 Regulatory Status of the Site

The current regulatory status of DEMO 1 is governed by Fort Richardson's FFCA with the EPA, signed April 2, 1991. Items V.20.Q and V.22.E in the FFCA (EPA ID Number AK1210022157) required five actions by Fort Richardson regarding OB/OD activities. These required compliance actions now constitute the regulatory foundation for OB/OD activities at the site.

- All OB/OD activities were to cease until Fort Richardson received permits for them.
- Fort Richardson was to formally withdraw the RCRA permit application or submit a revised application that incorporated the Notice of Deficiency (NOD) comments.
- Closure and post-closure plans were to be submitted in accordance with 40 CFR Part 265, Subpart G within 15 days of the FFCA's effective date.
- Those plans were to be implemented once they were approved by the EPA.

- Studies were to continue to determine whether hazardous constituents have been released into the environment, and the relevant findings were to be incorporated in the OB/OD closure plan.

At this time, Fort Richardson has partially fulfilled the requirements of the FFCA regarding DEMO 1. First, OB/OD activities were halted in 1988. Second, the RCRA Part B permit application was withdrawn in 1991. Soil sampling has continued to determine whether hazardous waste constituents may have been released from the site. These guidelines, incorporating relevant results of those studies, may be submitted in accordance with 40 CFR 264, Subpart G. Because DEMO 1's interim status was withdrawn, 40 CFR 264 should govern the closure, rather than 40 CFR 265.

A more detailed discussion of the regulatory actions involving the DEMO 1 unit is provided in Section 2.4.

Currently, Fort Richardson is without a RCRA permit for OB/OD activities. The EPA stated in its Notice of Non-Compliance (NON), issued to the U. S. Army on June 19, 1990, that OB/OD activities had not been covered in Fort Richardson's Part A application. In the following year, Fort Richardson followed that condition of the FFCA and withdrew the Part B application for an OB/OD permit.

2 SITE DESCRIPTION

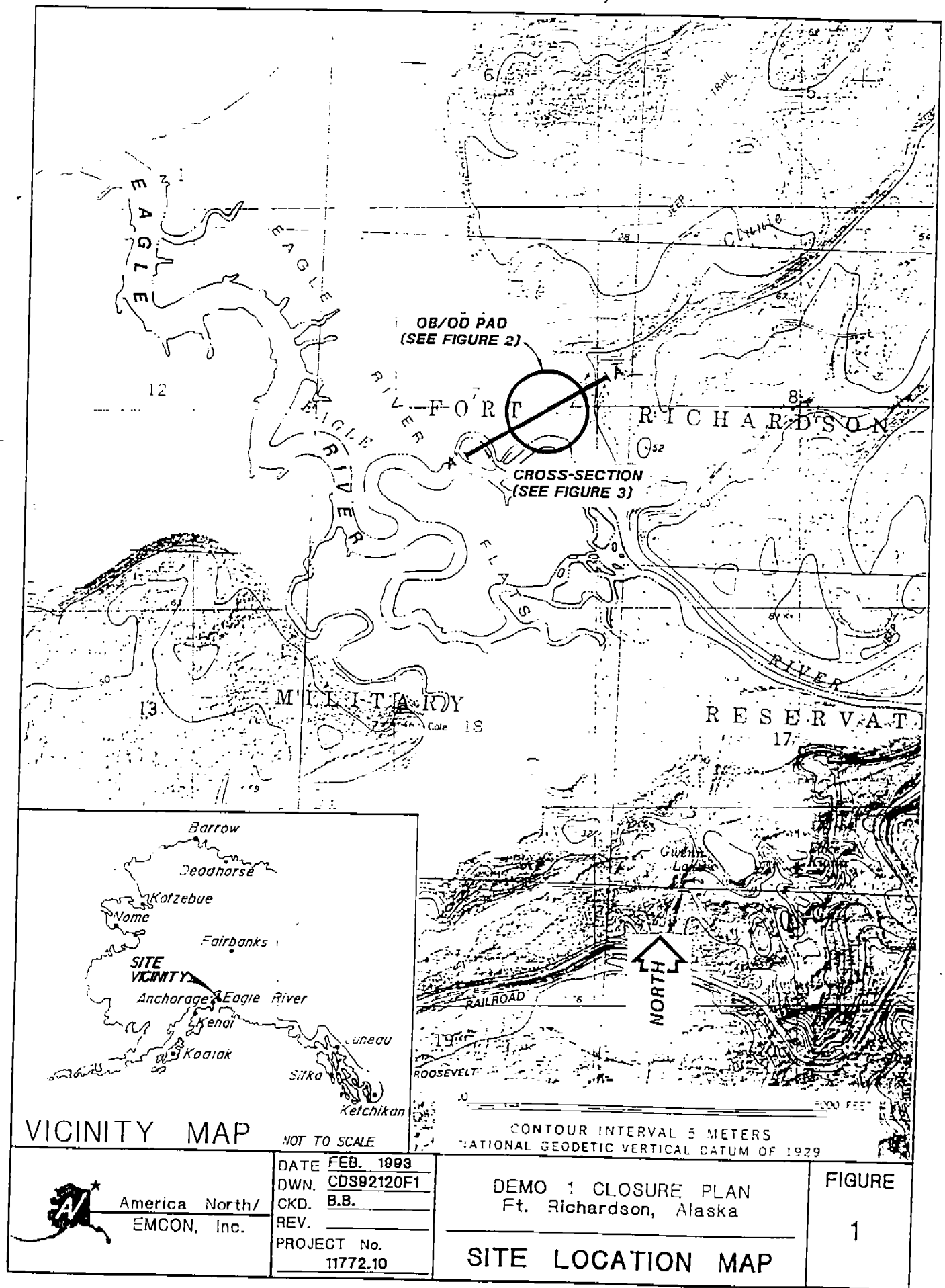
2.1 Site Location

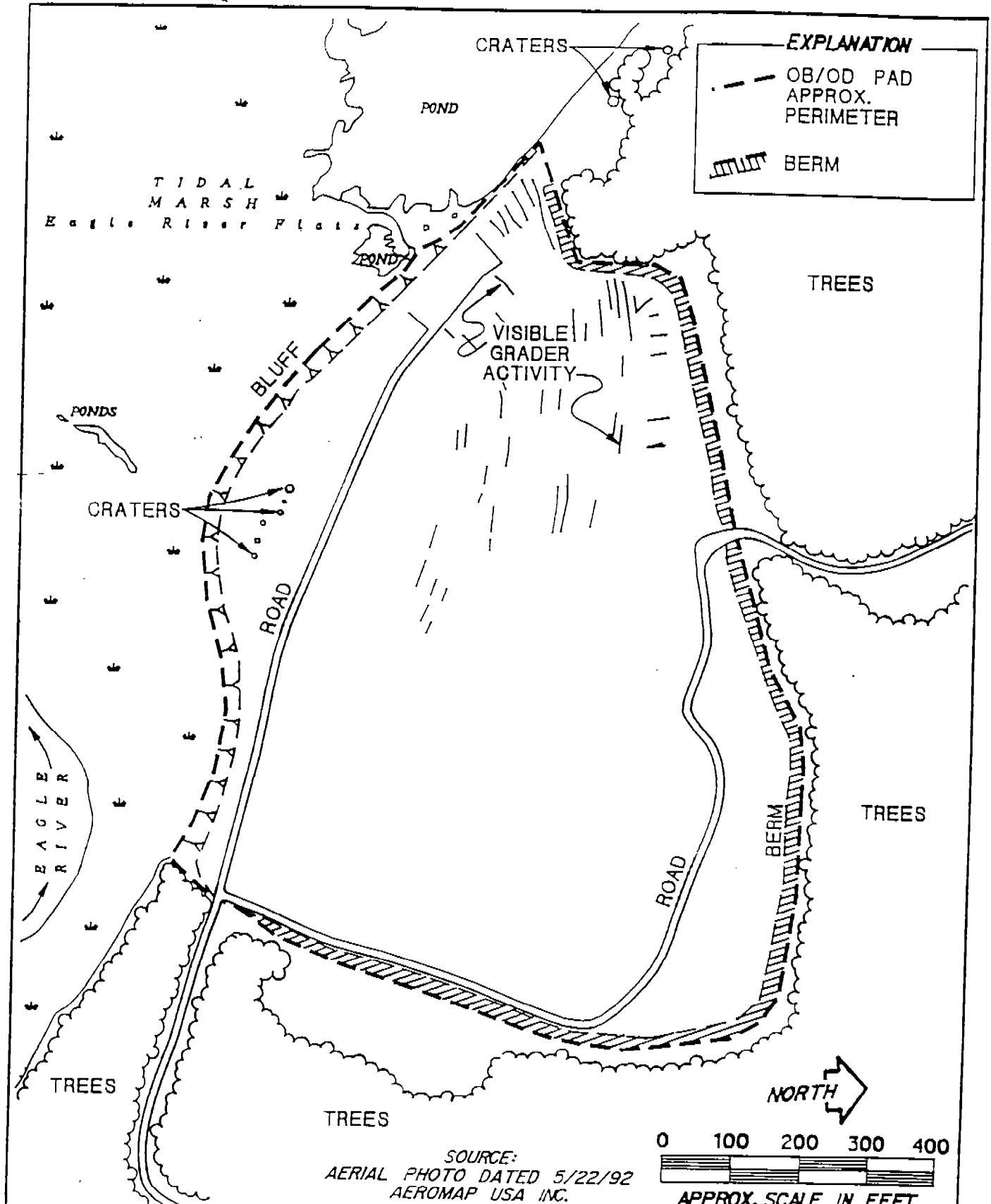
The DEMO 1 site lies adjacent to Eagle River Flats, on Fort Richardson, Alaska, and within the Eagle River active ordnance impact area. The site borders an estuarine salt marsh on the south side of Knik Arm in upper Cook Inlet. Eagle River flows within 200 feet of the site. Knik Arm lies approximately 1.5 miles to the southwest. DEMO 1 is 10 miles north-northeast of central Anchorage, 4 miles west of the town of Eagle River, and 4 miles north of Fort Richardson's main complex (Figure 1). It lies in Sec. 7, T14N/R2W of the Seward Meridian.

DEMO 1 consists of a gravel pad formerly used for OB/OD operations (Figure 2). The east, north, and west edges of the pad (the upland borders) are delineated by an earthen berm. The southern perimeter of the site is delineated by a bluff dropping approximately 10 feet to the marsh flats. The pad's perimeter is approximately 3,700 lineal feet, and the pad encompasses approximately 20 acres.

2.2 History of Operations

DEMO 1 has served as an OB/OD site for a period that may have exceeded 30 years. Racine et al. (1992b:p. 13) reported that, "Aerial photos from 1956 show the edge of the pad in approximately the same location as at present." EOD staff indicated that OB/OD was performed after 1980 on approximately 2 acres spread over the western portion of the pad between the road and the bluff. Occasionally, uncombusted material was ejected from the pad surface onto the adjacent wetlands and into the adjacent forest. Based on comments by EOD staff and a RCRA Facility Assessment Preliminary Review/Visual Site Inspection Report (RFA PR/VSI) (SAIC, 1990), no OB/OD activities have been conducted at DEMO 1 since November 1988.





SOURCE:
AERIAL PHOTO DATED 5/22/92
AEROMAP USA INC.

0 100 200 300 400
APPROX. SCALE IN FEET

America North/
EMCON, Inc.

DATE OCT. 1992
DWN. CDS92120SD
CKD. B.B.
REV. MAR. 1993
PROJECT No.
11772.10

DEMO 1 CLOSURE PLAN
Ft. Richardson, Alaska

SITE DIAGRAM

FIGURE
2

According to EOD personnel, detonation was conducted by standard procedures. Detonation activities began each spring. Each charge was limited to 100 pounds or less. A frequently used method involved sets of three to eight charges, with detonations at 30-second intervals. The first set of charges was detonated at the surface. In each resulting crater, the next round was exploded. This sequence continued, creating successively larger craters. Maximum depths of the craters reached 8 to 12 feet and widths reached 20 to 30 feet. Generally, groundwater was encountered at depths of 8 feet. Because the procedure did not allow underwater detonations, the deepest detonations were above the groundwater level.

Occasionally, pits were excavated for disposal of small arms ammunition. For example, a temporary trench 25 feet in length in the western section of the pad was used to burn .50 caliber ammunition on one occasion. Dunnage soaked in diesel was laid over the ammunition and ignited. When the detonations ceased, excavated material was replaced in the pit to cover the uncombusted material.

Every two years Army engineers graded the pad. Craters were filled and excess material was pushed over the western edge of the pad to level the OB/OD area.

Written reports and oral comments by EOD staff specified that a variety of explosive materials, including propellants, was detonated at DEMO 1 during the 1980s. Among the materials were fuses, 105-mm and 40-mm HE projectiles, smoke pots, mortar rounds, star clusters, flares, booby traps, blasting caps, detonation cord, mines, rocket motors, and missiles. Shotgun shells, rifle shells, and blanks were also destroyed. The RCRA Part B application (U.S. Army, Fort Richardson, 1988) also lists Claymore C4, 40-pound shaped charges, mine AP M16, PETN detonation cord, smoke grenades, and hand grenades. In addition, incendiary box liners for safes, thermite, and propellant bags were destroyed at the site, according to EOD staff. On at least one occasion, military police requested destruction of a small quantity of potassium and sodium chlorate.

Explosive materials from non-military sources were also occasionally detonated at DEMO 1. Discarded dynamite was destroyed for the Alaska State Troopers. Various explosives were disposed of at the request of the Alaska Department of Environmental Conservation (ADEC) once or twice per year over a period beginning as early as the mid-1970s. For example, one entry on a demolition log lists a quarter pound each of sodium, red phosphorus, and yellow phosphorus destroyed at the request of ADEC in July of 1985. Each year during the 1980s, an explosives dealer who served drilling firms on the Kenai Peninsula asked for

disposal of explosive charges on DEMO 1. On occasion, 105-mm HE projectiles from Alyeska Ski Resort were also destroyed.

EOD personnel related that diesel fuel was used to ignite smaller pieces of ordnance in the 1960s. A minimal quantity of diesel fuel, approximately five gallons, was brought to the site and poured onto objects on the ground to aid ignition.

EOD personnel stated that no liquids, such as paint thinner or anti-freeze, were disposed of at DEMO 1. The site was used only for explosive materials.

2.3 Current Conditions

At this time, limited quantities of discarded material litter the pad. Racine et al. (1992:p. 13) reported that, "Along the bottom edge of the pad, numerous Nike rocket motor casings, junk cars and scrap metal can be found," and that "Propellant grains...were found scattered on the EOD pad..." A reconnaissance visit to the site on October 14, 1992, following a light snowfall, revealed no obvious hazardous materials. Three junked automobiles were found near the southeastern section of the pad at the berm. Larger numbers of discarded items, including automobile bodies, metal screens, 55-gallon steel drums, and smaller unidentified objects protrude from the bluff. On the upper surface of the pad lie occasional smaller pieces of metal and wooden crates.

Several detonation craters, four feet deep, line the edge of the bluff. The remainder of the pad's surface appears free of craters.

The pad slopes toward the southwest, from the surrounding upland forest to the edge of Eagle River Flats. The surface soils consist of poorly sorted sandy gravels, with a mix of pebbles, cobbles, and clayey soils. The surface has been repeatedly graded. The most recent grading is apparent in the southwest corner, the same area EOD personnel said the most recent OB/OD activities were conducted. The pad supports a sparse vegetative cover in the form of woody shrubs, with some grasses and broad-leaved herbaceous plants.

A gravel berm five to eight feet high separates the pad from the forest on the northern border. The berm appears to consist of local material bulldozed from the pad's surface. The berm is more heavily vegetated than the pad, and in some areas supports small trees. Beyond the berm lies a mixed forest of white spruce, alder, paper birch, and poplar. A road, controlled by a gate one-quarter mile

from the pad, enters at the pad's southeastern corner and provides the primary vehicular access to the site.

On its southern side, DEMO 1 contacts the wetlands of Eagle River Flats. The contact appears to consist of surface material pushed from the pad a short distance onto the wetlands. This edge now forms a bluff rising approximately 10 feet from the marsh. A small pond lies at the base of the bluff.

Occasional parking of vehicles and the storage of waterfowl management equipment are the sole uses of the site at this time. Mobile observation towers and two vehicles of wildlife management staff were observed on the site in October 1992.

2.4 Regulatory Actions Involving the DEMO 1 Site

2.4.1 RCRA Part B Permit Application

At approximately the time that OB/OD operations were halted at DEMO 1, Fort Richardson submitted a RCRA Part B Permit Application (U. S. Army, Fort Richardson, 1988).

The application addressed a proposed OB/OD site, DEMO 2, rather than DEMO 1. The new site was to lie outside the 100-year floodplain of Eagle River and to be secured with a six-foot-high chain link fence topped with barbed wire, a locked gate, and a warning sign listing a point of contact. The application was later withdrawn.

2.4.2 EPA Notice of Deficiency

EPA and ADEC sent Fort Richardson a NOD, dated May 26, 1989, describing inadequacies in the RCRA Part B Application for the Fort's container storage and OB/OD areas. The NOD contained more than 40 issues requiring additional information related to the DEMO 2 OB/OD site's application.

2.4.3 RCRA Facility Assessment and Visual Site Inspection

In July 1989, Science Applications International Corporation (SAIC) visited DEMO 1 and other Fort Richardson solid waste management units. The resulting RFA PR/VSI report to the EPA stated, among other things, that "According to facility personnel, during the 1940s and 1960s, other materials may have been placed in this swampy area" (SAIC, 1990;p. 73). The report concluded that the site provides a high potential for releases of hazardous constituents to surface water and groundwater.

2.4.4 Notice of Non-Compliance

On June 19, 1990, EPA issued a joint NON to Forts Richardson, Greely, and Wainwright. The NON discussed Fort Richardson's Part B application of November 1988 for OB/OD activities, the May 26, 1989, NOD, and Fort Richardson's failure to respond. The NON further noted the June 1989, RCRA inspection report's finding that Fort Richardson had violated its interim status by failing to specify OB/OD activities in its Part A application.

The NON required Fort Richardson to cease all OB/OD until such activities were permitted. It also required Fort Richardson to submit a revised RCRA permit application or formally withdraw the permit application within 60 days of the receipt of the NON. Subsequently, Fort Richardson withdrew its Part B application for an OB/OD permit in a March 1, 1991, letter from Col. Edwin Ruff, 6th Inf. Div., to Mr. Charles Findley, EPA Region 10.

2.4.5 Federal Facility Compliance Agreement

Fort Richardson entered into an FFCA with the EPA on April 2, 1991. Item V.22.E in the FFCA requires Fort Richardson to cease all OB/OD activities until the facility became permitted for such activities. The FFCA also requires submittal of either a revised permit application or withdrawal of the permit application and submittal of closure and post-closure plans for OB/OD in accordance with 40 CFR 265, Subpart G. The FFCA requires Fort Richardson to implement the approved plans upon approval by EPA.

Fort Richardson had complied with many of the FFCA's stipulations by the time the FFCA was signed. For example, OB/OD activities had been halted in 1988, and the RCRA Part B application had been withdrawn one month earlier. Closure and post-closure plans remained to be submitted, however.

2.4.6 RCRA Compliance Inspection Reports

Two inspection reports have noted apparent violations related to permitting and closure, and have required submission of information regarding DEMO 1. ADEC and EPA conducted RCRA compliance inspections of Fort Richardson on June 8 and 9, 1989, and on May 30 and 31, 1990. The first report noted that Fort Richardson had failed to specify OB/OD in its Part A application, in violation of the Fort's interim status. None of these inspections involved a visit to DEMO 1.

Later inspection reports of Fort Richardson offered little information on DEMO 1. For example, an inspection report of April 4, 1991, reviewed compliance with the FFCA signed two days earlier, but contained no mention of the DEMO 1 site. A further report from an April 29 and 30, 1991, RCRA compliance inspection, is classified by ADEC and EPA as "enforcement sensitive" and is not available for review for these guidelines.

2.4.7 Alaska Coastal Management Program

Cleanup or construction activities related to the DEMO 1 RCRA closure guidelines may be subject to the Alaska Division of Government Coordination project consistency review process. The review is required for proposed projects in or affecting the coastal zone which are the result of direct federal action, or require federal or state permits (AS 46.40). The review is based on the Alaska Coastal Management Program (ACMP) and is initiated by completing an ACMP Coastal Project Questionnaire.

2.4.8 Dredge-and-Fill Permit for Wetlands

Closure actions in the wetlands adjoining the DEMO 1 unit may require a wetlands permit. The Alaska District, U.S. Army Corps of Engineers (COE), regulates certain activities in or upon the waters of the United States, including adjacent wetlands, under provisions of Section 404 of the Clean Water Act. Authorization must be obtained from the COE prior to initiating dredging, filling, or other related activities in those waters of the United States. This authorization may be in the form of a Nationwide Permit, a General Permit, or an individual permit.

3 SITE CHARACTERISTICS

3.1 Hazardous Wastes and Constituents

3.1.1 Records and Literature

Records and literature that specifically address the DEMO 1 site are limited, especially regarding the types and quantities of wastes burned and detonated. The Ammunition Supply Point at Fort Richardson logged the OB/OD activities on DEMO 1, but destroyed most of those records after two years. However, some documentation is available for 1983 and 1985.

Abnormally high waterfowl mortality on the adjacent Eagle River Flats has been the topic of a number of investigations since 1982. For example, the Cold Regions Research and Engineering Laboratory (CRREL) has recently reported the results of research regarding the source of poisoning of waterfowl (CRREL, 1991; Racine et al., 1992a; Racine et al., 1992b). These studies provide limited information regarding the DEMO 1 pad, although they offer useful discussions of local contamination from ordnance testing.

Earlier results of analysis of samples collected from Eagle River Flats in 1989 were offered by Environmental Science and Engineering, Inc. (ESE, 1990). This study was a broad reconnaissance survey of organic and inorganic contaminants in sediments, water, and tissue.

In a national survey involving a number of studies, environmental contamination at Army Material Command OB/OD sites was investigated (AEHA, 1986). Although no investigation was conducted at the Fort Richardson DEMO 1 site, the conclusions drawn by the Army Environmental Hygiene Agency (AEHA) may be useful for management of DEMO 1. In its summary report of Army OB/OD sites, AEHA (1986) concluded that contamination from ordnance burning is generally confined to surface soils. Subsurface contamination is unlikely unless the burning surface is buried or post-burn products are subsequently transported

by surface or groundwater. The efficiency of burning ordnance is generally high. However, occasional ordnance burning in trenches may have resulted in limited subsurface contamination. In contrast, OD activities produce a substantial portion of residual material which is either forced into the subsoils, or propelled away from the immediate vicinity of the detonation.

As part of its investigations, AEHA (1986) conducted soil sampling and analysis at 12 OB sites. Significant soil contamination was detected at 9 of 12 installations. However, the contamination was limited to the top 18 inches of soils at eight of the sites. Instances of deeper subsurface contamination were attributed to such factors as burial of the OB pad or vertical migration. The latter occurred at sites characterized by shallow groundwater or high precipitation. Run off-related contamination was present or possible at sites having low soil permeability. Facilities located within 100-year flood plains were recognized as posing severe environmental risk. The metals most frequently detected (using toxic extraction procedures) at OB sites were lead and barium. The explosives most frequently detected in significant concentrations were, in order of decreasing frequency of detection, TNT (2,4,6-trinitrotoluene), 2,4-DNT (2,4-dinitrotoluene), RDX (Hexahydro-1,3,5-trinitro-1,3,5-triazine), HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine), and 2,6-DNT (2,6-dinitrotoluene).

3.1.2 Site Investigations

The only sampling program conducted on the DEMO 1 pad has been the collection of soil surface samples by AEHA on July 6 and 7, 1992 (AEHA, 1993). The sampling was intended to screen for potential soil surface contamination from OB/OD operations. Forty-seven samples, including four field duplicates, were collected along six transects running northeast from the top of the bluff to the berm (Appendix A, Figure A-1).

The sampling results are summarized in Table 1. All five analytes were detected in one or more of the samples. In order of decreasing abundance, the contaminants were 2,4-DNT, 2,6-DNT, HMX, RDX and 2,4,6-TNT. The distribution of the five analytes on the surface of the pad suggests that most of the pad has the potential to be contaminated. A contour plot of 2,4-DNT, the most common contaminant, is provided in Appendix A, Figure A-2. The plot indicates 2,4-DNT is scattered over much of the pad, although it is generally more

TABLE 1

Analytical Results of 47 Soil Surface Samples Collected from the Fort Richardson
OB/OD Pad on July 6 and 7, 1992 (AEHA, 1993)

Transect-Station	ANALYTICAL RESULTS ($\mu\text{g/g}$)				
	HMX	RDX	2,6-DNT	2,4-DNT	2,4,6-TNT
1-1	*	*	*	*	*
1-2	*	*	*	1.8	*
1-3	*	*	*	*	*
2-1	*	*	*	*	*
2-2	*	*	*	*	*
2-3	*	*	*	*	*
2-4	1.4	*	*	*	*
2-5	*	*	2.6	58	*
3-1	*	*	*	18	*
3-2	*	*	*	11	*
3-3	*	*	*	*	*
3-4	*	*	*	*	*
3-5	*	*	*	8.2	*
3-6	*	*	*	*	*
3-7	*	*	*	6.6	*
3-8	*	*	*	*	*
3-9	*	*	*	*	*
3-10	*	*	2.1	40	*
4-1	*	*	*	*	*
4-2	1.0	3.2	*	*	*
4-3	*	*	*	*	*
4-4	*	*	*	9.5	*
4-5	*	*	*	2.8	*
4-6	*	*	*	*	*
4-7	*	*	*	*	*
4-8	1.4	12	*	*	*
4-9	*	*	2.0	65	*
4-10	*	*	*	5.6	*
4-11	*	*	*	*	*
4-12	*	*	1.7	44	*

* Asterisks show concentrations below the detection limit of 1 $\mu\text{g/g}$ (ppm).

TABLE 1 (Continued)

Analytical Results of 47 Soil Surface Samples Collected from the Fort Richardson
OB/OD Pad on July 6 and 7, 1992 (AEHA, 1993)

Transect-Station	ANALYTICAL RESULTS ($\mu\text{g/g}$)				
	HMX	RDX	2,6-DNT	2,4-DNT	2,4,6-TNT
5-1	*	*	*	*	*
5-2	*	*	*	1.7	*
5-3	*	*	*	*	*
5-4	*	*	*	6.1	*
5-5	*	*	*	16	*
5-6	*	*	*	11	*
5-7	*	*	1.8	64	*
5-8	*	*	2.4	50	*
5-9	*	*	*	4.0	*
5-10	*	*	*	*	*
5-11	*	*	*	*	*
6-1	*	*	1.9	76	*
6-2	*	*	*	*	*
6-3	*	*	*	2.0	*
6-4	*	*	1.6	37	16
6-5	*	*	*	*	*
6-6	*	*	*	5.6	*
No. samples with concentrations > 1 ppm	3	2	8	23	1
Percentage of samples with concentrations > 1 ppm	6%	4%	17%	48%	2%
Maximum concentration (ppm)	1.4	12	3.0	76	16

* Asterisks show concentrations below the detection limit of 1 $\mu\text{g/g}$ (ppm).

abundant and concentrated on the western half. The other contaminants were significantly less abundant, with more than 80 percent of the samples exhibiting non-detectable concentrations.

Studies of the abnormally high waterfowl mortality in the adjacent Eagle River Flats have provided some information relevant to the DEMO 1 site. Tweten (1989, as cited in Racine et al., 1992b) summarized studies conducted by the U.S. Fish and Wildlife Service (USFWS), the Alaska Department of Fish and Game (ADF&G), the AEHA, and other agencies. Collectively, these studies have indicated that dabbling ducks (such as northern pintails, mallards, and green winged teals) and swans (trumpeter and tundra) are the most affected species. The mortality of dabbling ducks has been concentrated in four areas where suitable pond habitat is present, including Area C, directly below the bluff of the OB/OD pad (Racine et al., 1992b).

In addition, sediment and water samples from Eagle River Flats were analyzed by the AEHA, the EPA, and ESE between 1985 and 1989. No evidence was found of major contamination from explosives, pesticides, polychlorinated biphenyls (PCBs) or other organic compounds (Racine et al. 1992b; p.5), (ESE., 1990). However, aluminum, antimony, arsenic, barium, chromium, copper, iron, magnesium, nickel, phosphate, sodium, and zinc were reported at concentrations considered elevated for Alaska but not high enough to cause waterfowl mortality.

Subsequent investigations in 1990 and 1991 by the CRREL (CRREL, 1991; Racine et al., 1992a and Racine et al., 1992b) identified two sources of contamination potentially toxic to waterfowl, 2,4-DNT and white phosphorus. After continued investigation, they concluded that white phosphorus, fired into the Eagle River Flats by mortars and howitzers, is the cause of waterfowl mortality in Eagle River Flats. In contrast, 2,4-DNT was not present in concentrations considered acutely toxic on the Flats. Furthermore, 2,4-DNT was localized in its distribution, confined to Area C in the sedge marsh adjacent to the OB/OD site.

As part of this investigation (Racine et al., 1992b), 178 sediment samples were collected from the marsh directly below the bluff of the OD/OB pad. Sixty-eight were found to contain 2,4-DNT. Eleven percent had concentrations greater than 1 part per million (ppm) dry weight, and showed a maximum concentration about 60 ppm. In this area, 42 of the 178 samples tested positive for phosphate, and subsequently 17 were analyzed for white phosphorus. Eight of the seventeen had detectable concentrations, from trace amounts up to 10.2 ppm.

Racine et. al. (1992b; p.29) stated that incomplete demolition of propellant grains on the OB/OD pad was the probable source of the 2,4-DNT contamination in the adjacent marsh. M1 propellant grains containing 2,4-DNT were found scattered on the OB/OD pad and in one deep "hole" in the adjacent marsh. Subsequent analysis of the propellant grains indicated they contained 2,4-DNT, 2,6-DNT, diphenylamine, and dibutylphthalate. In addition, in most sediment samples with concentrations of 2,4-DNT greater than 1 ppm, 2,6-DNT and TNT were also detected at lower concentrations. On occasion, trace amounts of the TNT biotransformation products 2-amino-4,6-dinitrotoluene and 4-amino-2,6-dinitrotoluene were also present along the base of the OB/OD pad.

3.1.3 Estimated Maximum Hazardous Waste Inventory

No inventory of hazardous waste is expected to be disposed of at closure. All hazardous wastes brought to DEMO 1 were burned or detonated as soon as possible and not stored on site. However, some residue and fragments of ordnance remain in the surface and subsurface soils.

The quantity of material disposed of at the site since its initial use in the 1950s is not known. However, some descriptive information is available concerning activities in the 1980s. Summarizing earlier reports, SAIC (1990) stated that DEMO 1 "was used approximately five times per year during the summer months. About 1,000 pounds of explosives were detonated with C-4 explosives in the pits during each burn." In addition, EOD personnel stated that charges were limited to 100 pounds or less, and were frequently set off in sets of three to eight charges. OD activities were typically conducted one day per month, from late spring to early fall. Exceptions were the first session in the spring, carried out for three to four days in a row to dispose of the winter backlog. Based on records for 1983, for example, the site appeared to have been used on 12 occasions for the disposal of munitions and other explosives that year.

3.1.4 Waste and Constituents Characteristics

Many of the materials destroyed at DEMO 1 were originally reactive, ignitable, and toxic. Chief among the existing residues are trace quantities of explosives in the surface soils that were measured by AEHA (1993), listed in Table 1.

The explosive chemicals encountered in the surficial soils of DEMO 1 are expected to no longer exhibit the reactivity characteristics of high explosives.

The AEHA subjected soil samples contaminated with explosive chemicals to tests of explosive reactivity. Under confinement, an explosive ignitor was applied to 19 samples with HMX up to 16,900 ppm, 26 samples with RDX up to 14,300 ppm, 46 samples with TNT up to 15,100 ppm, 28 samples with 2,4-DNT up to 312 ppm, and 8 samples with 2,6-DNT up to 24 ppm. The AEHA found that none of the samples were reactive (AEHA, 1986; p. 6).

In general, the explosive compounds detected at DEMO 1 share a number of chemical characteristics. Their rates of solubility in water and their volatility into the air are low. Breakdown pathways are limited for these explosive chemicals. Photolysis is a major breakdown pathway and is associated with compound half-lives of several hours to several weeks in exposed environments (Spanggord et al., 1980). Hydrolysis and aerobic degradation are usually insignificant, although anaerobic degradation is generally effective at low rates. Mobility in soils varies among the compounds. For example, 2,4,6-TNT, 2,4-DNT, and 2,6-DNT have low mobility. In contrast, RDX has moderate to high solubility and therefore a higher mobility than the other organic munitions compounds (Lyman, et al., 1982).

White phosphorus from smoke rounds, now buried beneath the OB/OD pad and in the marsh sediments, would be expected to be relatively persistent. White phosphorous has a low solubility in water (3 mg/L), (Racine et al., 1992a), and could be present in particulate and colloidal forms (fine particles suspended in water). Anaerobic conditions favor the preservation of white phosphorus. While assessing the environmental fate of white phosphorous, Spanggord et al. (1985, as cited in Racine et al., 1992b), predicted that the lifetime of a 1-cm-diameter piece buried 15 cm in dry soil would vary from 10 to 10,000 years. In the presence of oxygen white phosphorus oxidizes to form various phosphorus oxides. This oxidation process may form a protective coating which limits further oxygen diffusion. As a result, when white phosphorus is burned in air, approximately 10 percent of the chemical's original mass remains unburned. Racine et al. (1992b) cites two documented cases that suggest white phosphorus is persistent in aquatic environments and extremely toxic, resulting in extensive fish kills.

The smoke rounds frequently destroyed at DEMO 1 contained either white phosphorus (P_4) or HC (hexachloroethane-zinc mixture). HC contains zinc chloride and aluminum oxide. In addition, unreacted compounds and by-products include hexachlorethane, hexachlorobenzene, carbon tetrachloride, and phosgene.

Among the most important contaminants on the site are the components of the M1 mixture in propellants. M1 contains the following compounds: 85 parts nitrocellulose, 10 parts 2,4-DNT, 5 parts dibutylphthalate, and 1 part diphenylamine.

It is expected that lead on the OB/OD pad may be present in particulate form. Particulate lead should be relatively inert, presuming the pH of the soil and groundwater in the pad is approximately neutral. In addition, lead typically forms complexes with organic matter and clay minerals that limit its mobility.

Table 2 lists a number of chemical compounds expected in the explosives and ordnance disposed of at the site. The list was developed from reports of the materials destroyed at DEMO 1 in the 1980s and from literature on the chemical composition of explosive devices of the type (Racine et al., 1992a and 1992b). As discussed in Section 2.2, there was an array of munitions and other explosives of both military and non-military origin destroyed at the site. Furthermore, as discussed in Section 3.1.1, there is insufficient documentation to construct an accurate list of the specific types and quantities of materials destroyed there. EOD personnel agreed, however, that most types of explosives at Fort Richardson were disposed of on the OB/OD pad. Because Fort Richardson's records are incomplete, several studies were reviewed to determine the wastes typical of OD/OB operations at other U.S. Army installations (AEHA, 1986). Table 2 does not list secondary products expected to be generated by such processes as detonation, combustion, biotransformation, or weathering. Nor does it list trace contaminants that might have been introduced in the manufacture of the munitions.

The RCRA status comments for each compound in Table 2 assume the compound would be a solid waste and would be present in a sufficient quantity to exhibit the characteristic. Residues in empty containers or residues in the environment resulting from an intended use of a product that contained these compounds would not be regulated as a hazardous waste. A mixture or formulation containing one or more of these compounds may or may not exhibit a hazardous waste characteristic.

TABLE 2

**Primary Chemical Compounds Expected in Types of Explosives and
Ordnance Destroyed at the DEMO 1 Unit**

COMPOUND	RCRA STATUS
Ammonium nitrate	Ignitable characteristic hazardous waste (D001)
Ammonium picrate	Reactive hazardous waste (D003)
Barium nitrate	Ignitable characteristic hazardous waste (D001). Potential toxicity characteristic waste (D005) due to barium. Barium listed as a RCRA hazardous constituent in 40 CFR 261, Appendix VIII and the RCRA groundwater monitoring list in 40 CFR 264, Appendix IX.
Boric acid	Not regulated as a RCRA hazardous waste, identified as a hazardous constituent, or included as a groundwater monitoring compound.
Calcium stearate	Not regulated as a RCRA hazardous waste, identified as a hazardous constituent, or included as a groundwater monitoring compound.
Hexahydro-1,3,5,- tetranitro-1,3,5- triazine (RDX)	Reactive characteristic hazardous waste (D003).
Octahydro-1,3,5,7- tetranitro-1,3,5,7- tetrazocine (HMX)	Reactive characteristic hazardous waste (D003).
Dibutylphthalate	Identified as a RCRA hazardous constituent in 40 CFR 261, Appendix VIII and the RCRA groundwater monitoring list in 40 CFR 264, Appendix IX.
Diethylphthalate	Identified as a RCRA hazardous constituent in 40 CFR 261, Appendix VIII and the RCRA groundwater monitoring list in 40 CFR 264, Appendix IX.
2,4-Dinitrotoluene	Potential toxicity characteristic hazardous waste (D030). Identified as a RCRA hazardous constituent in 40 CFR 261, Appendix VIII and the RCRA groundwater monitoring list in 40 CFR 264, Appendix IX.
2,6 Dinitrotoluene	Identified as a RCRA hazardous constituent in 40 CFR 261, Appendix VIII and the RCRA groundwater monitoring list in 40 CFR 264, Appendix IX.

TABLE 2 (Continued)

Primary Chemical Compounds Expected in Types of Explosives and
Ordnance Destroyed at the DEMO 1 Unit

COMPOUND	RCRA STATUS
Diethylhexyl-sebacate	Not regulated as a RCRA hazardous waste, identified as a hazardous constituent, or included as a groundwater monitoring compound.
Diphenylamine	Identified as a RCRA hazardous constituent in 40 CFR 261, Appendix VIII.
Hexachloroethane	Potential toxicity characteristic hazardous waste (D034). Identified as a RCRA hazardous constituent in 40 CFR 261, Appendix VIII and the RCRA groundwater monitoring list in 40 CFR 264, Appendix IX.
Lead azide	Reactive characteristic hazardous waste (D003). Potential toxicity characteristic hazardous waste (D008). Lead identified as a RCRA hazardous constituent in 40 CFR 261, Appendix VIII and the RCRA groundwater monitoring list in 40 CFR 264, Appendix IX.
Lead styphnate (Lead trinitro-resorcinate)	Reactive characteristic hazardous waste (D003). Potential toxicity characteristic hazardous waste (D008). Lead identified as a RCRA hazardous constituent in 40 CFR 261, Appendix VIII and the RCRA groundwater monitoring list in 40 CFR 264, Appendix IX.
Mercury fulminate	Reactive characteristic hazardous waste (D003). Potential toxicity characteristic hazardous waste (D009). Mercury identified as a RCRA hazardous constituent in 40 CFR 261, Appendix VIII and the RCRA groundwater monitoring list in 40 CFR 264, Appendix IX.
Monoethylamine	Ignitable characteristic hazardous waste (D001).
Nitrocellulose	Ignitable characteristic hazardous waste (D001).
Nitroglycerine	Reactive characteristic hazardous waste (D003).
Nitromethane	Ignitable characteristic hazardous waste (D001).
Pentaerythritoltetra nitrate (PETN)	Reactive characteristic hazardous waste (D003).

TABLE 2 (Continued)

Primary Chemical Compounds Expected in Types of Explosives and
Ordnance Destroyed at the DEMO 1 Unit

COMPOUND	RCRA STATUS
Picric acid	Reactive characteristic hazardous waste (D003).
Polystyrene	Not regulated as a RCRA hazardous waste, identified as a hazardous constituent, or included as a groundwater monitoring compound.
Potassium nitrate	Ignitable characteristic hazardous waste (D001). Reactive characteristic hazardous waste (D003).
Sodium nitrate	Ignitable characteristic hazardous waste (D001). Reactive characteristic hazardous waste (D003).
Sulphur	Not regulated as a hazardous waste (D001). Reactive characteristic hazardous waste (D003).
Trinitroanisole	Reactive characteristic hazardous waste (D003).
Trinitrotoluene	Reactive characteristic hazardous waste (D003).
Trinitrophenylmeth ylnitramine (Tetryl)	Reactive characteristic hazardous waste (D003).
White phosphorus	Ignitable characteristic hazardous waste (D001).

3.2 Geology and Hydrology

Fort Richardson lies on a relatively flat outwash plain several miles wide that lies between the Chugach Mountains and Knik Arm. A thin mantle of fine-grained soil, generally about two to five feet in thickness, blankets the area. Relatively clean coarse-grained soils derived from outwash and glacial debris underlie the surface fines and extend to depths of 10 to 50 feet. The outwash material tends to become finer with increasing distance from the mountains, grading from boulders and cobbles to pebbles and coarse sands. The coarse-grained material is underlain by a bed of blue gray marine clay that is interbedded with silt and fine sand. The clay deposit extends to depths of 200 to 250 feet and thins to the east. Zones of discontinuous impermeable and permeable layers within the glacial and outwash deposits give rise to perched water table aquifers, especially in the lowlands (U.S. Army Corps of Engineers, 1990).

The groundwater system of Fort Richardson involves several routes. Groundwater seeps from bedrock fractures along the Chugach Mountains. Snowmelt and rainfall percolate into the local sediments. Streams feed groundwater in areas where the elevation of the streambed is above the groundwater table. Discharge is either by groundwater flow into Knik Arm or into streams that subsequently discharge to Knik Arm. Regionally, groundwater occurs in unconfined and confined aquifers. Wells in the Fort Richardson area are limited and contour maps of the groundwater table have only been constructed on the Fort's southern sector near Ship Creek (U.S. Army Corps of Engineers, 1990). In that region, groundwater flows in a westerly direction towards Knik Arm.

No site-specific studies of the subsurface geology or hydrology of the DEMO 1 pad or immediate area are known. Groundwater and subsurface descriptions for any area require site-specific information due to the variable nature of the glacial stratigraphy of the Fort Richardson area.

Evidence of drinking or monitoring wells near the OB/OD pad was not encountered. The closest well is an abandoned supply well approximately 1.5 miles southwest of the site. The surface elevation of this well is 249 feet, and in 1989 the depth to groundwater was 96 feet (U.S. Army Corps of Engineers, 1990).

The OB/OD pad lies on the northwestern edge of Fort Richardson. The elevation of the pad ranges from approximately 20 feet at the base of the bluff to 45 feet

near the pad's upland boundary (Figure 2). The surface soils are comprised of glacial till and outwash. The material is poorly sorted, consisting of clays, sands, pebbles, cobbles, and occasional small boulders. On the adjacent Eagle River Flats, the sediments consist of silts and clays. The marsh sediments tend to be highly organic and reduced. For example, measurements of redox potentials of 131 sediment samples collected during August of 1990 showed highly reduced sediments (less than -200mV) in 44 samples, with only one sample having a positive redox potential (Racine et al., 1992b).

Even without well data or hydrologic surveys, the depth to groundwater at the OD/OB pad is presumed to be relatively shallow, within 6 to 12 feet below ground surface (bgs), based on the site's close proximity to Eagle River Flats and to mean sea level. This assumption is supported by Fort Richardson EOD personnel who observed that craters formed from ordnance detonations generally encountered water at depths of eight feet bgs. The depth to groundwater may fluctuate with both seasonal run off and tidal cycles. The mean flow of shallow groundwater at the site probably parallels surface topography, flowing southwest towards Eagle River Flats (Figure 3).

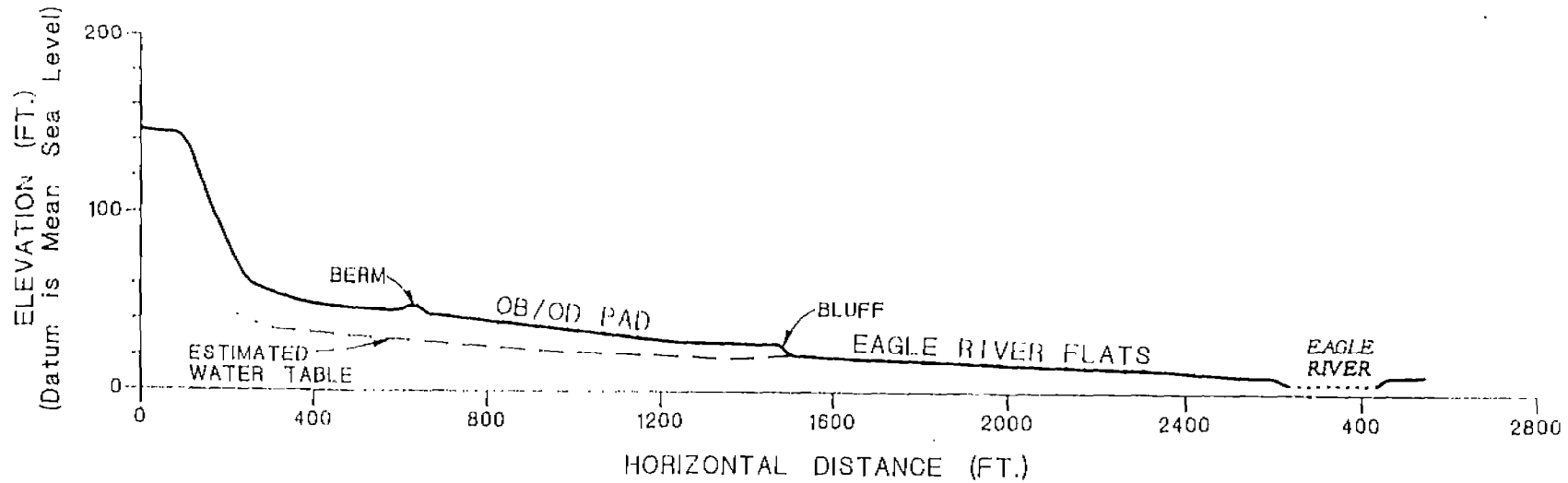
Groundwater seepage may occur at the base of the bluff and may partially account for the small pond near the western edge of the pad (Figure 2). In times of high flooding on Eagle River Flats, there may be some temporary reversals in groundwater flow direction.

The primary source of surface water on the OB/OD pad is incident rain water and snow melt. Surface water from adjacent areas is generally prevented from flowing onto the pad by the five to eight foot berm which extends along most of the upland perimeter (Figure 2). The pad appears to slope gradually, approximately 2 percent, to the southwest (Figure 3). Surface drainage probably occurs as sheet flow in that direction, toward Eagle River Flats. Flow in alternative directions is inhibited by the berm. A significant portion of the water may seep into the pad through permeable zones of the glacial till. The ground surface of the pad is not scoured by channels or small rivulets indicative of heavy surface flows.

The maximum average discharge of Eagle River occurs in July and August in association with the maximum glacial meltwater discharge of the headwaters (Racine et al., 1992). Peak discharges are usually associated with a rainfall event or large tidal inundation, in addition to glacial run off.

NORTHEAST
A

SOUTHWEST
A'



VERTICAL EXAGGERATION 4:1

SOURCE:
CROSS-SECTION IS BASED ON INTERPRETATION
OF U.S. ARMY C.O.E. GENERAL SITE MAP (E-3) OF
FORT RICHARDSON (1983), AND AERIAL PHOTOGRAPHS
(5/22/92).



America North/
EMCON, Inc.

DATE FEB. 1993
DWN. CDS82120XSA
CKD. B.B.
REV. _____
PROJECT No.
11772.10

DEMO 1 CLOSURE PLAN
Ft. Richardson, Alaska

**SCHEMATIC OF VERTICAL PROFILE
CROSS-SECTION A-A'**

FIGURE
3

Tidal flooding of the Eagle River Flats involves both the influx and rise of water from Cook Inlet and overflow from Eagle River as it is backed up by the incoming tide. Cook Inlet and Knik Arm salt marshes are subject to large semidiurnal tidal fluctuations of 30 to 35 feet. For example, based on site measurements, Racine et al. (1992b) determined that the small pond lying directly adjacent to the OB/OD pad (Figure 2) was flooded eleven times between August 16 and September 21, 1990, or whenever the Anchorage tide tables reported tides greater than 30 feet. The pond appeared to be flooded by fresh water from Eagle River rather than salt water from Knik Arm.

The location of the 100-year flood plain at the site is unknown (COE, Alaska District, personal correspondence). The 100-year flood plain has not been determined because the area is not likely to be used for residential purposes. Although site-specific calculations have not been performed, it is unlikely that the upper surface of the pad would be flooded. The discharge of Eagle River Flats is relatively small in comparison to the volume capacity of the Eagle River Flats flood plain. Therefore, the 100-year flood plain would probably reach a level along the slope of the OB/OD pad's southern bluff.

3.3 Potential Exposure Pathways

3.3.1 Soil

Residue from ordnance burning was originally confined to the surface soils. However, grading may have distributed surface material into the subsurface. In addition, in some cases, ordnance was burned in pits and covered with native material, effectively burying the residues.

Residue from ordnance detonations, including fragments of metal and unexploded explosives, may have been distributed on the surface in the vicinity of the detonation, or driven into the adjacent subsoils by the initial explosion or subsequent grading. According to EOD staff, detonation craters 8 to 12 feet deep were filled in with native material without cleanup of residue or debris. Most of the solid residue from OB/OD activities should have been confined to the OB/OD pad.

3.3.2 Groundwater

Contamination of shallow groundwater at the site may have occurred immediately following OD/OB activities. Detonation craters frequently extended down to groundwater. In addition, following burning and detonations, small particulates and water soluble constituents at the surface may have been carried downward into the subsurface by surface water percolation.

Significant vertical or horizontal transport of water soluble contaminants to potable aquifers is unlikely. There are no current or potential groundwater users within a one mile radius of the OB/OD Pad. Mobile contaminants present in the groundwater beneath the pad would be intercepted by the Eagle River drainage system, and indistinguishably co-mingle with the identical compounds in the impact area.

3.3.3 Surface Water

Surface water reaching the southern perimeter of the pad flows down the bluff and into the marsh (Figures 2 and 3). Once the water reaches the marsh it becomes incorporated into the Eagle River Flats drainage system which has net flow toward Knik Arm. At its closest point, Eagle River comes within 200 feet of the site. The silts and clays comprising the marsh sediments are probably fairly impermeable and probably do not absorb large quantities of surface water run off. Water soluble contaminants would thus be transported into Cook Inlet, undergoing dilution and dispersion. However, some particulate matter may become deposited in the adjacent marsh sediments. Marshes are frequently sinks for particulates because the marsh grasses promote deposition by reducing water velocities. Some of the water from the pad may pass into the pond below the western edge of the bluff (Figure 2), and this pond may serve as a primary catchment area for water and particulate matter carried off the pad.

The chemical stability of some contaminants, and the potential for their exposure to human and environmental targets, may change once they are introduced into the marsh. Particulate phases of contaminants may become water soluble and thus more bioavailable. For example, the solubility of lead may increase in the marsh. Highly reducing contaminants, such as white phosphorus, may be persistent in the reduced salt marsh. If exposed, these fragments could be toxic to a variety of organisms, including birds and fish. In addition, some contaminants may undergo reduction: for example, TNT may be reduced to form 2-amino-4-6 dinitrotoluene.

3.3.4 Air

The OB/OD site has been inactive for more than four years and the emission of volatile constituents in significant concentrations into the atmosphere is not expected under present circumstances. The possibility exists that some compounds buried in the subsurface would volatilize if exposed to the atmosphere. In addition, the possibility exists that surface contaminants in particulate form may become airborne if exposed to high winds.

3.4 Potential Receptors

3.4.1 Humans

3.4.1.1 Surrounding Land Use and Settlement Patterns

The most likely potential pathway for human exposure to hazardous constituents at the site would be dermal contact, ingestion, or inhalation of contaminated soil. However, the OB/OD pad is located on the Fort Richardson Army base which has restricted public access. The land immediately to the south of the pad is an active artillery range. Entry onto the pad is from the southeast or from the north, by a road with a locked gate. Access is controlled by Range Control at Fort Richardson. These restrictions are not expected to change. In addition, current Army regulations (AR 385-63, Chapter 7, Paragraph 4, subparagraph c) prohibit DEMO 1 from being used as anything other than an impact area. Therefore, civilians are not likely to come into contact with contaminants on the site.

3.4.1.2 Proximity and Withdrawal Rates of Current and Potential Surface and Groundwater Users

As discussed in Sections 3.2 and 3.3.2, the groundwater in the vicinity of the site (within at least a one mile radius) is not a current or projected source of drinking water. There are no known surface water consumptive users in the area. These usage patterns are not expected to change. Subsurface migration of contaminants to drinking water aquifers is not likely. The area downgradient of the pad, based on regional hydrology, is an active artillery range.

3.4.2 Fish and Wildlife

DEMO 1 is frequented by a variety of wildlife typical of coastal southcentral Alaska. Big game animals include moose, and grizzly and black bear. Other wildlife include coyote, red fox, muskrat, beaver, snowshoe hare, and spruce-grouse.

The adjacent Eagle River Flats provide habitat for a large number of waterfowl, shorebirds, gulls, terns, and raptors. Each of these groups is represented by an array of species, some of which are particularly numerous (Eldridge, 1991; Racine et al., 1992a). Waterfowl such as swans, geese, and dabbling ducks (particularly northern pintail, green-winged teal, and mallards) are especially abundant. Ducks use ponds and pools, including the pond directly below the OB/OD pad, for both feeding and resting. Waterfowl use the flats principally during two yearly migration periods: late April to early June and mid August to mid October. In most years, waterfowl use is greater during the fall than during the spring. A small population of ducks, cranes, and shorebirds remain and breed in Eagle River Flats throughout the summer. Bald eagles are year-round residents and frequently prey on migrating and breeding birds (Racine et al., 1992b).

Wildlife may become exposed to possible OB/OD contaminants by several pathways. Animals that frequent the OB/OD pad and adjacent areas could encounter contaminants through dermal contact and ingestion of contaminated soil and debris. Studies of waterfowl mortality on Eagle River Flats have provided evidence that waterfowl, especially dabbling ducks, have eaten explosive fragments in the marsh (Racine et al., 1992a and 1992b). The source of some of this material was attributed to the OB/OD pad. Wildlife may also be exposed to contaminants carried by surface water run off from the pad.

Various species of fish occupy Eagle River. The primary species are Dolly Varden trout, king salmon and sockeye salmon. Other fish include stickleback and whitefish, and a few chum and silver salmon (ADF&G, personal communication, 1993). Although migratory fish pass through the Flats, the area is an important rearing area for salmon fry. Juvenile king salmon inhabit lower Eagle River for up to two years. Thus, fish occupying the waters adjacent and downstream of the OB/OD pad could be exposed to contaminants carried in surface water run off or groundwater seepage.

3.4.3 Domestic Animals

Domestic animals are not present in the general vicinity and should not be impacted by contaminants at the site. The OB/OD pad is located on the Fort Richardson Army Base. The Army does not raise domestic animals and public use of the surrounding area is restricted.

3.4.4 Crops

Waste constituents from the OB/OD pad are not expected to impact food crops. Within a two-mile radius or greater, no crops are grown.

3.4.5 Vegetation

Plants recolonizing the OD/OD pad may be impacted by waste constituents in the soils. The pad appears to be in the early stages of natural revegetation. The pad currently supports a sparse vegetative cover of dispersed woody shrubs, with some grasses and broad leaved herbaceous plants. Originally, the site probably supported a mixture of spruce and birch, similar to the surrounding uplands.

The surrounding vegetation could also be impacted by contaminants transported by the wind, surface water run off, or shallow groundwater flow. Based on the expected flow of groundwater and surface water, the vegetation on Eagle River Flats would have a greater potential to receive contaminants than would the uplands. Currently, visual observations indicate no obvious impact to vegetation.

3.4.6 Physical Structures

No physical structures are expected to be impacted by waste constituents from the OB/OD pad. Buildings and other substantial physical structures are absent from the DEMO 1 site. The primary manmade structures are a gravel access road and the berm surrounding the pad. In addition, a small observation shack overlooks the site from the hilltop to the North. For the most part, the area is in an undeveloped state.

4 CLOSURE REQUIREMENTS AND PERFORMANCE

4.1 Closure Requirements

These guidelines have been prepared to meet the requirements of 40 CFR 264, Subpart G (40 CFR 264.110-.116), which apply to all hazardous waste management facilities, and to 40 CFR 264, Subpart X, (40 CFR 264.601-.602), which applies to miscellaneous hazardous waste treatment, storage, and disposal (TSD) units. These guidelines are also a part of Fort Richardson's RCRA Part B permit application as required by 40 CFR 270.14(b)(13) and 40 CFR 270.23(a)(2). Closure actions would follow a sampling and analysis work plan in association with a Quality Assurance Project Plan (QAPjP).

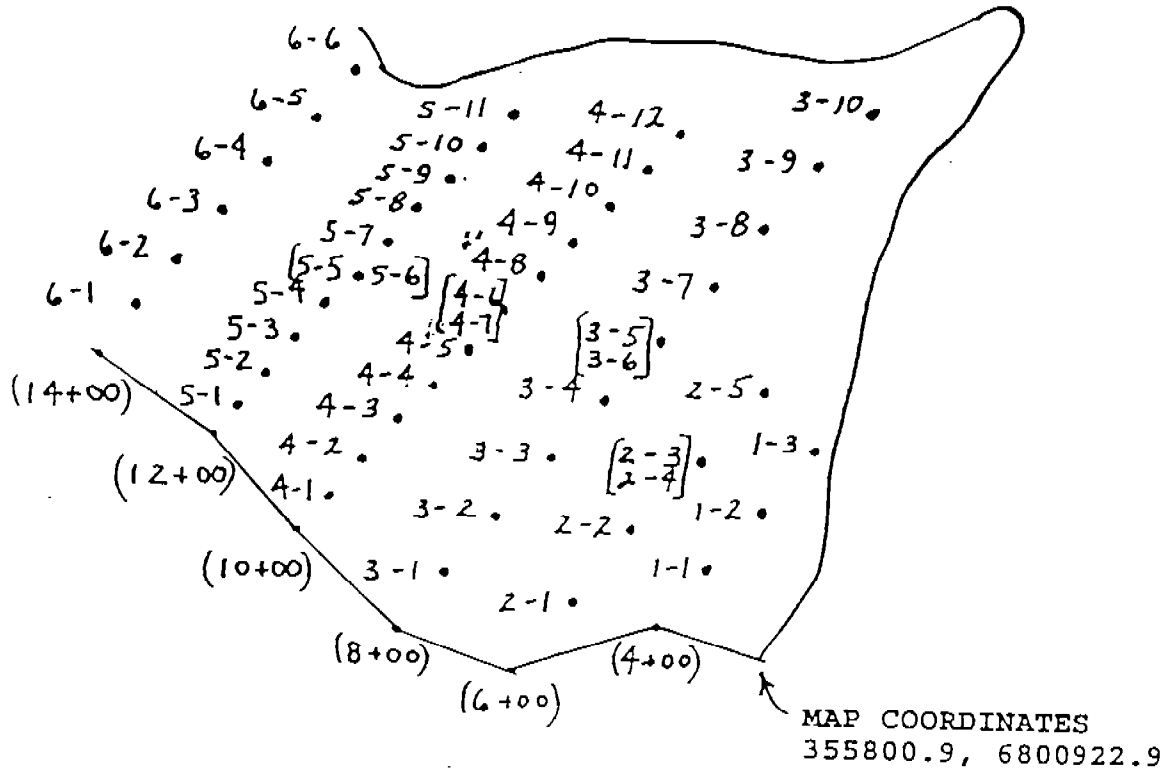
A post-closure care plan for DEMO 1 would be prepared to meet the post-closure requirements contained in 40 CFR 264.117 - 264.120, 40 CFR 264.603, and 40 CFR 270.23, if clean closure cannot be demonstrated.

4.2 Closure Performance Standards

Under 40 CFR 264.111 and 40 CFR 264.601, the closure of the DEMO 1 unit must:

- Minimize the need for further maintenance of the unit.
- Prevent post-closure releases of hazardous wastes, hazardous waste constituents, leachate, contaminated run off, and hazardous waste decomposition products to groundwater, surface water, wetlands, surface and subsurface soils, and the air that may have adverse effects on human health and the environment.
- Meet the applicable closure requirements of 40 CFR 264, Subparts G (264.110 -.119) and X (264.601 - .603).

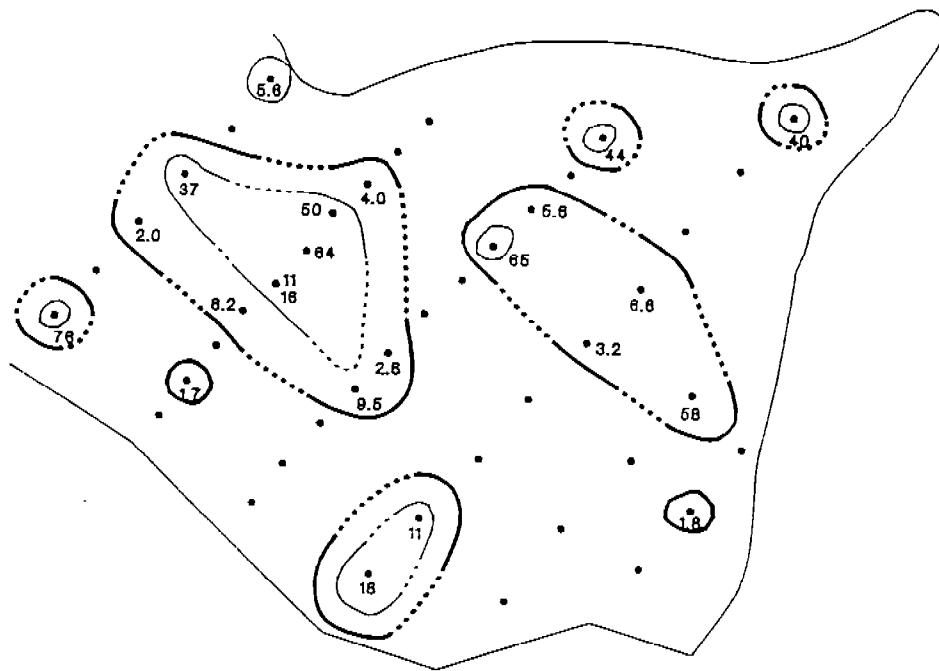
Initially, Fort Richardson would attempt to demonstrate through a sampling and analysis program that the DEMO 1 unit can be clean closed. If the clean close criteria described in Section 4.3 are met, Fort Richardson would close the site as



(X+XX) : 1990 CRREL
ERF SURVEY
STATIONS

Figure A-2.

Distribution of 2,4-DNT on the OB/OD pad based on the Army's analytical results and the Army's sample point diagram copied in Figure A-1.



2,4-DNT
Contour Intervals
- - - - 1-10 ug/g
———— > 10 ug/g



described in Section 5.1. Although not required in this case, Fort Richardson would pursue additional actions to ensure that potential post-closure releases of any residual hazardous wastes, hazardous waste constituents, and waste decomposition products are prevented and that further maintenance of the closed unit is minimized.

Alternatively, if clean closure cannot be demonstrated, the DEMO 1 unit would be closed as described in Section 5.2 and a post-closure care plan would be prepared. Because of the high potential to encounter unexploded ordnance beneath the ground surface, extensive excavation and treatment of soils at the DEMO 1 unit would not be feasible for a clean closure. Presently, no safety protocols exist for the Army to do an extensive site subsurface analysis. Army regulations (AR 385-63 Chapter 2, Paragraph 5, subparagraph d) prohibit digging on impact sites due to the hazard posed by unexploded ordnance. Due to the hazard, the site will never be suitable for most uses and will remain under the permanent control of the federal government. Under this alternative, Fort Richardson would meet the closure performance standards through completion of the closure actions and the post-closure care actions described in Chapter 6, which would be incorporated into a post-closure care plan.

4.3 Demonstrating Closure Performance

Fort Richardson would demonstrate the attainment of closure performance standards by (1) demonstrating clean closure or (2) monitoring the closed unit and acting to prevent potentially harmful releases when they are detected.

4.3.1 Demonstrating Clean Closure

Existing soil and groundwater contamination from wastes and constituents expected to be present at the unit as the result of past OB/OD activities would be characterized by a sampling and analysis program. Potentially harmful exposures to contaminants that may be released from the unit would occur mostly via soil and groundwater pathways. Thus, the characterization of existing soil and groundwater contamination at the unit would provide the basis to determine whether the unit now meets the requirements of 40 CFR 264.601 and can be clean closed.

4.3.1.1 Clean Closure Criteria

Table 3 designates the wastes, constituents, and degradation products of concern that would be included in the soil and groundwater characterization at the DEMO 1 unit. The contaminants were chosen on the basis of the types of wastes

TABL

DEMO 1 Unit Soil and Groundwater Clean Closure Levels and Analytical Methods

CONSTITUENT	Groundwater CLEAN CLOSURE LEVEL (µg/L)	SOIL CLEAN CLOSURE LEVEL (µg/g)	ANALYTICAL METHOD	PRACTICAL QUANTITATION LIMIT (µg/L or µg/g)
40 CFR 264, APPENDIX IX CONSTITUENTS				
Benz[a]anthracene	10.0 (Total PAH)	20.0 Total PAH	EPA 8270	10.0
Benzene	5.0 (DW-MCL)	0.5	EPA 8020	2.0
Benzo[a]pyrene	10.0 (Total PAH)	20.0 Total PAH	EPA 8270	10.0
Dibenz[a,h]anthracene	10.0 (Total PAH)	20.0 Total PAH	EPA 8270	10.0
Dibutyl phthalate	4,000.0 (DWEL & RCRA CA/W)	8,000.0 (RCRA CA/S)	EPA 8270	10.0
Diethyl phthalate	30,000.0 (DWEL & RCRA CA/W)	60,000 (RCRA CA/S)	EPA 8270	10.0
1,3-Dinitrobenzene	10.0 (4.0 DWEL & RCRA CA/W)	8.0 (RCRA CA/S)	EPA 8270	10.0
2,4-Dinitrotoluene	100.0 (DWEL)	100.0	EPA 8270	10.0
Diphenylamine	900.0 (RCRA CA/W)	2,000.0 (RCRA CA/S)	EPA 8270	10.0
Hexachloroethane	30.0 (DWEL & RCRA CA/W)	80.0 (RCRA CA/S)	EPA 8270	10.0
n-Nitrosodiphenylamine	10.0 (7.0 RCRA CA/W)	100.0 (RCRA CA/S)	EPA 8270	10.0
Naphthalene	100.0 (DWEL)	320.0	EPA 8270	10.0
p-Nitrophenol	300.0 (DWEL)	640.0	EPA 8270	50.0

TABLE 3 (Continued)
DEMO 1 Unit Soil and Groundwater Clean Closure Levels and Analytical Methods

CONSTITUENT	Groundwater CLEAN CLOSURE LEVEL (µg/L)	SOIL CLEAN CLOSURE LEVEL (µg/g)	ANALYTICAL METHOD	PRACTICAL QUANTITATION LIMIT (µg/L or µg/g)
Phenol	20,000.0 (DWEL & RCRA CA/W)	50,000.0 (RCRA CA/S)	EPA 8270	10.0
Toluene	1,000.0 (DWEL & RCRA CA/W)	20,000.0 (RCRA CA/S)	EPA 8020	2.0
Arsenic	50.0 (DW-MCL)	80.0 (RCRA CA/S)	EPA 7061	20.0
Barium	2,000.0 (DW-MCL)	4,000.0 (RCRA CA/S)	EPA 7080	1,000.0
Cadmium	5.0 (DW-MCL)	40.0 (RCRA CA/S)	EPA 7131	1.0
Chromium	100.0 (DW-MCL)	400.0 (RCRA CA/S)	EPA 6010	70.0
Lead	15.0 (DW Action Level)	1,000.0 (CERCLA ROD)	EPA 7421	10.0
Mercury	2.0 (DW-MCL)	20.0 (RCRA CA/S)	EPA 7470	2.0
Silver	50.0 (DW-MCL)	200.0 (RCRA CA/S)	EPA 7760	100.0
OTHER CONSTITUENTS				
2,6-Dinitrotoluene	40.0 (DWEL)	100.0	EPA 8270	10.0
2,4,6-Trinitrotoluene	20.0 (DWEL)	40.0	USAEHA HPLC	1.0
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	100.0 (DWEL)	250.0	USAEHA HPLC	1.0

TABLE 3 (Continued)
 DEMO 1 Unit Soil and Groundwater Clean Closure Levels and Analytical Methods

CONSTITUENT	Groundwater CLEAN CLOSURE LEVEL ($\mu\text{g/L}$)	SOIL CLEAN CLOSURE LEVEL ($\mu\text{g/g}$)	ANALYTICAL METHOD	PRACTICAL QUANTITATION LIMIT ($\mu\text{g/L}$ or $\mu\text{g/g}$)
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2,000.0 (DWEL)	4,000.0	USAEHA HPLC	1.0
Zinc chloride (as total Zn)	10,500.0 (DWEL)	24,000.0	EPA 7950	50.0
White Phosphorus (as total P)	0.5 (DWEL)	1.2	EPA 365.1	
Nitrate and Nitrite	10,000 (DW-MCL)	13,000.0	EPA 365.1	

and operations that are known to have been conducted at DEMO 1 and other similar waste management units. The laboratory analytical methods that would be used and clean closure levels for each contaminant are also provided in the table. Action levels were established using Drinking Water Maximum Contaminant Levels (DW-MCL), Drinking Water Equivalent Levels (DWEL), Proposed RCRA Corrective Action Levels for Water (RCRA CA/W), and Drinking Water Action Levels (DW Action Level).

Where a DW-MCL, DWEL, or RCRA CA/W is lower than the practical quantitation level (PQL) for the most sensitive analytical method, the PQL is specified as the action level and the DW-MCL, DWEL, or RCRA CA/W is shown inside the parentheses.

Because the action levels that would be established for polycyclic aromatic hydrocarbons (PAH) using these methods are lower than the PQL for individual compounds, a total PAH level equal to the PQL for each compound was used instead.

For other systemic toxicants, the action levels were calculated using the following formula, also used to calculate RCRA corrective action levels:

$$C_m = [RfD * W] / [I * A]$$

where.

C_m = Action level
 RfD = Reference dose (mg/kg/day)
 W = Body weight (16 kg child)
 I = Intake assumption (.0002 kg/day)
 A = Absorption factor (assumed to be 1)

The action levels for 2,4- and 2,6-Dinitrotoluene in soil were calculated using the following formula, also used to calculate RCRA corrective action levels:

$$C_m = [R * W * LT] / [CSF * I * A * ED]$$

where.

C_m = Action level
 R = Risk level (10^{-6} for Class B carcinogens)
 W = Body weight (70 kg adult)
 LT = lifetime (75 years)
 CSF = Carcinogenic slope factor (0.068 oral slope factor)

I = Intake assumption (.0001 kg/day)
A = Absorption factor (assumed to be 1)

4.3.1.2 Soil Sampling and Analysis

This section and the following section describe soil and groundwater sampling and analysis procedures that represent potential concepts for a work plan, but are not a draft work plan to be implemented by the Army. These concepts are based on standard sampling and analysis procedures, but are not specifically devised for an OB/OD site potentially containing unexploded ordnance. Procedures and safety protocols specific to sites similar to DEMO 1 must be developed.

Fort Richardson would consider a soil sampling program to characterize the level of contamination in the top three feet of soil at the DEMO 1 unit. A total of 48 soil samples would be collected from 16 locations within the DEMO 1 unit boundary. At the base of the bluff delineating the southern boundary of the unit, four points separated by 100 yards would be located. From each point a transect line would be extended northward to the berm. On each transect, four distances from the point of origin would be measured in units of feet to determine the sampling locations. Those distances would be selected from a random number table.

A hand auger or similar sampling equipment would be used to collect a sufficient amount of soil at each sampling location to conduct the analyses. Prior to collecting soil samples, each sampling location would be surveyed by EOD staff for the presence of buried metal objects using a magnetometer. The sampling location may be moved slightly if one or more buried metal objects are detected under the originally designated location. One composite sample of soil per foot of depth would be collected and analyzed for the contaminants shown in Table 3. Collection and shipping of samples would conform to procedures specified by the EPA (EPA, 1986).

4.3.1.3 Groundwater Sampling and Analysis

Fort Richardson would also install five groundwater monitoring wells at the DEMO 1 unit. At least two wells would be located upgradient of the site and at least three monitoring wells would be located on the downgradient side of the site. The monitoring wells would be sampled twice, one month apart, and the samples analyzed for the constituents listed in Table 3. See Section 5.2.5.1 for further discussion of the use of the wells during the post-closure period.

4.3.2 Demonstrating Closure Performance During Post-Closure Care

If clean closure cannot be demonstrated, the closure actions described in Section 5.2 would be completed and compliance with the miscellaneous unit closure performance standards (40 CFR 264.601) would be met through post-closure care actions. Construction of an impermeable cap over the unit, regularly scheduled visual inspections of the unit, and groundwater monitoring would be conducted to assure that the closure actions meet the miscellaneous unit performance standards. The following paragraphs discuss the reasons why other forms of demonstrating closure performance were not selected.

Sections 4.3.3 through 4.3.5 discuss in greater detail the demonstrations of closure performance that would be conducted during the post-closure care period.

Post-closure surface water monitoring was not selected as a method to demonstrate the performance of the closure actions at the DEMO 1 unit for two reasons. First, there would be a low potential for contaminants to migrate from the DEMO 1 unit to nearby surface water once the DEMO 1 unit has been closed. The unit would be covered by an impermeable cap and surface water management features would be employed to prevent wastes, constituents, and degradation products remaining at the unit from coming into contact with surface water. Second, the area immediately downstream of the DEMO 1 unit consists of the Eagle River Flats artillery range. After closure of the DEMO 1 unit, explosives contaminants would continue to accumulate on the active artillery range.

Post-closure surface soil sampling was not selected as a method to demonstrate the performance of the DEMO 1 unit closure actions because the existing surface of the unit would be covered by the cap. Once the cap is installed, the DEMO 1 is unlikely to be used for most human activities because of the nearby Eagle River Flats artillery range, the potential to encounter unexploded ordnance in the area, and the site's remote location on Fort Richardson. The cap would prevent the wastes, constituents, and degradation products remaining at the DEMO 1 unit from affecting animals and vegetation on the site through direct dermal contact or ingestion.

Post-closure air monitoring was not selected as a method to demonstrate the performance of the DEMO 1 unit closure actions. Wastes, constituents, and degradation products remaining at the unit would be buried by construction of the cap and there would be no potential for volatile or particulate materials to be released. In addition, the continued use of the nearby Eagle River Flats artillery range will continue to result in releases to the air of many of the same contaminant types present at the DEMO 1 unit.

4.3.3 Cap and Surface Water Management System Construction

Construction of the cap and the water management system described in Section 5 of these guidelines comprises the first demonstration in attaining the closure performance standards. The cap would prevent the release of hazardous wastes, waste constituents, or waste degradation products to the air; prevent surface water infiltration through the site; and minimize the movement of wastes, constituents, and decomposition products in the subsurface.

The surface water management system would prevent surface water from running onto the site by diverting surface water around the closed DEMO 1 unit. Run off from precipitation and snowmelt would be managed to prevent ponding of water on top of the closed DEMO 1 unit and to prevent hydraulic erosion that may damage the cap or result in the release of hazardous wastes, constituents, or degradation products.

4.3.4 Visual Monitoring and Maintenance or Remedial Actions

Regular visual inspections of the closed DEMO 1 unit would be conducted throughout the post-closure care period. These inspections would identify existing and potential problem conditions that could result in the release of hazardous wastes, constituents, and decomposition products, or otherwise compromise the effectiveness of the cap and surface water management system. Inspection, maintenance, and remedial actions would be documented in logs and reports kept at Fort Richardson and in quarterly reports to EPA on these actions. The logs and reports would demonstrate the performance of the closure and post-closure care measures.

4.3.5 Groundwater Monitoring and Remedial Actions

The quarterly collection and analysis of shallow groundwater samples from five monitoring wells, distributed upgradient and downgradient of the closed unit, also would demonstrate attainment of the closure performance standards throughout the post-closure care period. The placement and installation of the monitoring wells is discussed in Section 5.2.5.

Table 4 lists the wastes, constituents, and decomposition products that samples initially would be analyzed for during groundwater monitoring. The table also lists an action level for each constituent, the analytical method used, and the PQL for the analytical method. The action level designates the concentration threshold above which poses an unacceptable risk to the health of human and environmental targets. The analytical results from groundwater monitoring would be reported to EPA on a quarterly basis and accompanied by a narrative report on visual

TABLE 4

DEMO 1 Unit Groundwater Monitoring Constituents,
Action Levels, and Analytical Methods

CONSTITUENT	ACTION LEVEL ($\mu\text{g/L}$)	ANALYTICAL METHOD	PRACTICAL QUANTITATION LIMIT ($\mu\text{g/L}$)
40 CFR 264, APPENDIX IX CONSTITUENTS			
Benz[a]anthracene	10.0 (0.1 DW-MCL)	EPA 8270	10.0
Benzene	5.0 (DW-MCL)	EPA 8020	2.0
Benzo[a]pyrene	10.0 (0.2 DW-MCL)	EPA 8270	10.0
Dibenz[a,h]anthracene	10.0 (0.3 DW-MCL)	EPA 8270	10.0
Dibutyl phthalate	4,000.0 (DWEL & RCRA CA/W)	EPA 8270	10.0
Diethyl phthalate	30,000.0 (DWEL & RCRA CA/W)	EPA 8270	10.0
1,3-Dinitrobenzene	10.0 (4.0 DWEL & RCRA CA/W)	EPA 8270	10.0
2,4-Dinitrotoluene	100.0 (DWEL)	EPA 8270	10.0
Diphenylamine	900.0 (RCRA CA/W)	EPA 8270	10.0
Hexachloroethane	30.0 (DWEL & RCRA CA/W)	EPA 8270	10.0
n-Nitrosodiphenylamine	10.0 (7.0 RCRA CA/W)	EPA 8270	10.0
Naphthalene	100.0 (DWEL)	EPA 8270	10.0
p-Nitrophenol	300.0 (DWEL)	EPA 8270	50.0
Phenol	20,000.0 (DWEL & RCRA CA/W)	EPA 8270	10.0
Toluene	1,000.0 (DWEL & RCRA CA/W)	EPA 8020	2.0
Arsenic	50.0 (DW-MCL)	EPA 7061	20.0

TABLE 4 (Continued)
DEMO 1 Unit Groundwater Monitoring Constituents,
Action Levels, and Analytical Methods

CONSTITUENT	ACTION LEVEL ($\mu\text{g/L}$)	ANALYTICAL METHOD	PRACTICAL QUANTITATION LIMIT ($\mu\text{g/L}$)
Barium	2,000.0 (DW-MCL)	EPA 7080	1,000.0
Cadmium	20.0 (DWEL)	EPA 7131	1.0
Chromium	200.0 (DWEL)	EPA 6010	70.0
Lead	15.0 (DW Action Level)	EPA 7421	10.0
Mercury	100.0 (DWEL)	EPA 7470	2.0
Silver	200.0 (DWEL)	EPA 7760	100.0
OTHER CONSTITUENTS			
2,6-Dinitrotoluene	40.0 (DWEL)	EPA 8270	10.0
2,4,6-Trinitrotoluene	20.0 (DWEL)	USAEHA HPLC	1.0
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	100.0 (DWEL)	USAEHA HPLC	1.0
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2,000.0 (DWEL)	USAEHA HPLC	1.0
Zinc chloride (as total Zn)	10,500.0 (DWEL)	EPA 7950	50.0
White Phosphorus (as total P)	0.5 (DWEL)	EPA 365.1	
Nitrate and Nitrite	10,000 (DW-MCL)	EPA 365.1	

monitoring, maintenance, and remedial actions. The action levels in Table 4 were established using DW-MCLs, DWELs, RCRA CA/W, and DW Action Levels. Those action levels are outlined in health advisories summarized by the EPA (EPA, 1992). Where a DW-MCL, DWEL, or RCRA CA/W is lower than the PQL for the most sensitive analytical method, the PQL is specified as the action level and the DW-MCL, DWEL, or RCRA CA/W is shown inside the parentheses.

5 CLOSURE ACTIVITIES

This section discusses the actions that could be taken to close the DEMO 1 unit, whether the unit can be clean closed or whether closure and post-closure care are required. However, the purpose of this document is to provide guidance to the Army; specific closure and site characterization actions should follow detailed work plans.

5.1 Clean Closure Actions

If clean closure is successfully demonstrated by the soil and groundwater characterization analyses, Fort Richardson would take additional steps to close the DEMO 1 unit and prevent potentially harmful releases of residual contaminants to the surrounding environment. The site would be swept to remove unexploded ordnance. A soil cap would be installed over the site to prevent direct contact with any residual surface contamination that may exist and to minimize wind and surface water transport of existing surface materials. The cap would be revegetated to minimize potential wind and water erosion. In addition, controls to prevent surface water run-on and run off would be constructed as part of the clean closure efforts.

5.2 Closure Actions For Post-Closure Care

If clean closure cannot be demonstrated, Fort Richardson would conduct the closure actions described in this section and would undertake post-closure care of the DEMO 1 unit.

5.2.1 Basis For Actions

Closure activities at the DEMO 1 unit should ensure that remaining hazardous wastes, constituents, and degradation products do not migrate from the site and pose a threat to human health and the environment. In its existing condition, the DEMO 1 unit may be the source of exposure to hazardous wastes, constituents, and degradation products. These contaminants may be transported from the unit via air, surface water, or groundwater pathways. For example, water-soluble

contaminants and small particulates on the surface of the DEMO 1 pad may be carried from the site by surface water run off. Surface water infiltration and groundwater flow through the DEMO 1 unit may transport soluble contaminants in leachate to surface waters in Eagle River Flats or into groundwater. Finally, volatilization and wind-blown particulates may result in exposures to airborne contaminants from the unit.

To protect human health and the environment in the vicinity of the DEMO 1 site, contaminants contained on or within the pad should be isolated from surface water, groundwater, and high winds. Sufficient protection may be achieved by placing a low-permeability cap over the entire surface of the pad.

Closure activities at the DEMO 1 unit should be restricted to the ground surface, due to potential subsurface hazards. After several decades of OB/OD operations at DEMO 1 and ordnance firing exercises into the adjacent Eagle River Flats impact area, there is a high probability that unexploded ordnance remains beneath the surface of the pad. Where possible, the DEMO 1 site and surrounding area would be swept for unexploded ordnance. Thus, closure activities requiring subsurface soil excavation would be improper at DEMO 1 because of the safety hazards associated with encountering unexploded ordnance.

The installation of monitoring wells, completed in the uppermost water-bearing zone and located outside of, but close to, the perimeter of the closed DEMO 1 unit, would allow the effectiveness of closure actions in preventing the migration of contaminants from the unit to be evaluated throughout the post-closure care period.

In summary, the landfill closure actions described in this section are based on the following considerations:

- Worker safety and protection from explosions.
- The effectiveness of the closure actions, including a landfill cap, in preventing harm to human health and the environment as a result of exposure to the contaminants from the closed unit.

5.2.2 Site Survey

Prior to construction activities, an Army EOD team would inspect the pad and a 100-foot zone around the perimeter. Solid debris would be evaluated by the EOD team to determine whether it could be unstable and subject to detonation or explosion, if disturbed. Explosive materials would be transported off-site and

disposed of by the EOD team at a disposal facility permitted for explosives disposal under RCRA regulations.

After the site has been cleared by the EOD team, other solid debris on the surface which may interfere with the capping and drilling operations would be collected by hand, with shovels or using heavy equipment (e.g., backhoe) as warranted. The debris would be placed in 55-gallon drums, wooden boxes (for large items), or other suitable containers. It is anticipated that most of the solid debris removed from the site would consist of metal fragments which may be disposed of in a certified solid waste landfill. Material collected from the site would be removed for proper disposal, in accordance with RCRA regulations and Army standard operating procedures.

5.2.3 Site Cap

A cap would be placed over the pad to provide five basic functions:

- Prevent exposure (through dermal contact or ingestion) of site contaminants to human and environmental targets.
- Prevent surface water infiltration into the pad.
- Prevent erosion of the pad, including the bluff along its southern edge.
- Prevent contaminants' entrainment in air or surface water.
- Provide an aesthetically pleasing landform.

5.2.3.1 Conceptual Design

The cap would be constructed to landfill design standards. A bedding layer of clay or native soil approximately six inches thick would be placed first to prevent damage to the liner during installation. From that layer, in vertical profile, the cap would consist of a 30-mil geomembrane liner, a 3-inch layer of clean sand, a 9-inch layer of sandy gravel, a geofabric to prevent clogging of the sand-gravel pores, and a 6-inch layer of common fill. These approximate dimensions are at least the minimum recommended thicknesses. The geomembrane liner would be constructed of very low density polyethylene (VLDPE) with crim reinforcing or polyvinyl chloride (PVC). The common fill would contain enough organic material to support revegetation.

The cap would cover the area encircled by the berm and bluff, as depicted in Figure 4. Along the cap's upland borders, the cap would abut the inside of the berm. Along the southern perimeter, adjacent to Eagle River Flats, the cap would extend over the face of the bluff to isolate contaminants that may be present in the bluff face. The total area of the cap would be approximately 20 acres.

To protect the face of the bluff with the liner without bringing the liner down the slope, clean fill would be used to extend the pad over the existing bluff (Figure 4). The liner then would be extended over the top of the new fill, thereby covering potential contaminants within the bluff. The liner would not be extended down the face of the existing bluff for two reasons. It would be difficult to anchor the end of the liner on the marsh flats. In addition, water flowing on top of the liner would likely scour the base of the bluff and marsh flats.

A slight dip would be formed in the liner near its terminus. The dip should prevent water from draining off the liner and down the bluff face, where the potential for erosion is greatest. The dip would also allow water to be routed and discharged into the marsh. To protect the toe of the cap at the marsh, cobbles would be placed along the cap's lower face, to a height of three feet above the marsh flats (Figure 4).

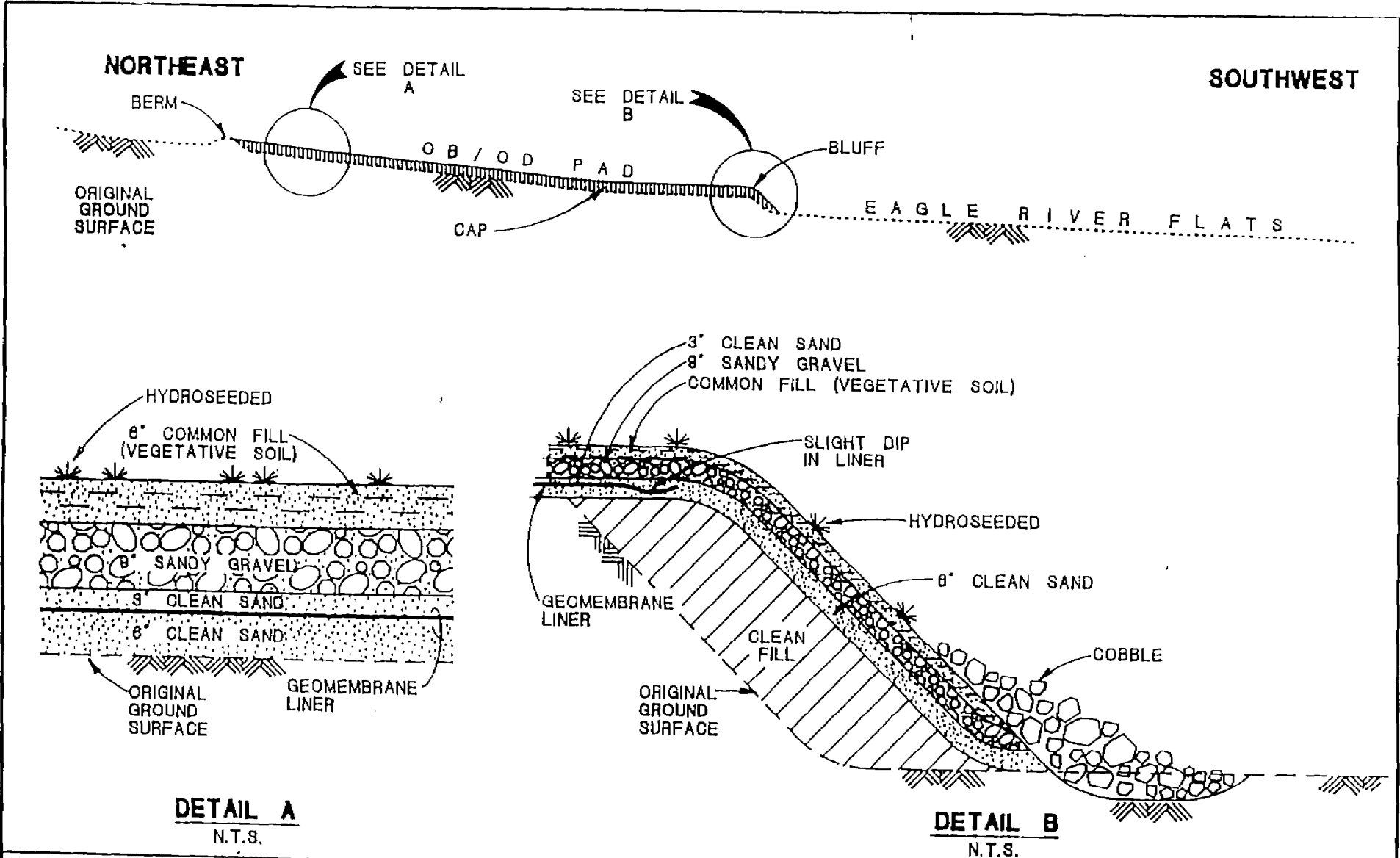
In the proposed design, net surface drainage over the cap is toward the southwest. This drainage pattern should be achievable with minimal alteration of the original ground surface. However, more detailed surveys of the pad would be needed to confirm this assumption.

5.2.3.2 Construction

Construction of the cap should take no longer than one season. After the site has been cleared for work by Army EOD personnel, no unusual construction requirements should be required. Trees and shrubs would be removed prior to placing the bedding layer on the existing ground surface. During construction, care would be taken to avoid unnecessary penetration or disruption of the pad's surface to minimize the risk of explosions.

5.2.3.3 Final Grading, Revegetation, and Fencing

Final grading would be toward the southwest with an average slope of two percent over the cap's surface. The southern bluff would have a maximum slope



**America North/
EMCON, Inc.**

DATE MAR. 1993
DWN. CD982120CD
CKD. B.B.
REV. _____
PROJECT No. 11772.10

DEMO 1 CLOSURE PLAN
Ft. Richardson, Alaska

CONCEPTUAL CAP DESIGN

FIGURE
4

OUC 0007177

of 50 percent (2:1). Once graded, the site would be hydroseeded with a mix of grasses as recommended by the Agricultural Extension Service.

The perimeter of the unit would be fenced. To prevent vehicles from disturbing the cap, a six-foot chain link fence would encircle the unit. The monitoring wells would lie outside the fence.

5.2.3.4 Construction Quality Assurance/Quality Control (QA/QC)

The critical element during construction of the cap is proper placement of the liner. Therefore, a manufacturer's representative would be on site to insure proper installation of the liner. In addition, inspections would be conducted by a qualified on-site engineer.

5.2.4 Surface Water Management

5.2.4.1 Run-on/Run Off Control

Surface water would be prevented from flowing onto the pad by the existing berm, which surrounds the site on the east, west, and north perimeter. In its present condition, the berm is heavily vegetated and stable. Thus, it appears to be an effective surface water barrier. However, prior to construction of the cap, the berm would be inspected and improvements made where necessary. For example, a gap bisects the berm where a road exits the pad (Figure 2). This gap would be filled in, and the road rerouted if necessary. Where the access road enters on the southeastern border, a culvert would be installed to allow surface water to flow under the road and away from the pad. If monitoring indicates these measures are insufficient, a drainage ditch would be extended along the outside of the berm to route water away from the pad.

With a vegetative cover, the cap's surface should not erode. Precipitation should be intercepted by the plants and soil and should flow along the sand/gravel layer towards the southwest corner of the pad. Excess surface water reaching the southwest corner would be collected in a drainage ditch and discharged onto the marsh flats. The ditch would be "V" shaped with a 50 percent (2:1) side slope and riprap channel protection. The discharge point would consist of a gravel blanket to dissipate the energy of the discharging water and prevent erosion.

5.2.4.2 Flood Protection

The bluff along the southern perimeter of the pad should prevent flooding of the cap's surface from Eagle River floods or extreme high tides. During flooding of the marsh flats, the cap would be protected from erosion by the cobbles placed along the toe and face (Figure 4).

5.2.5 Monitoring Wells and Sites

5.2.5.1 Monitoring Site Locations

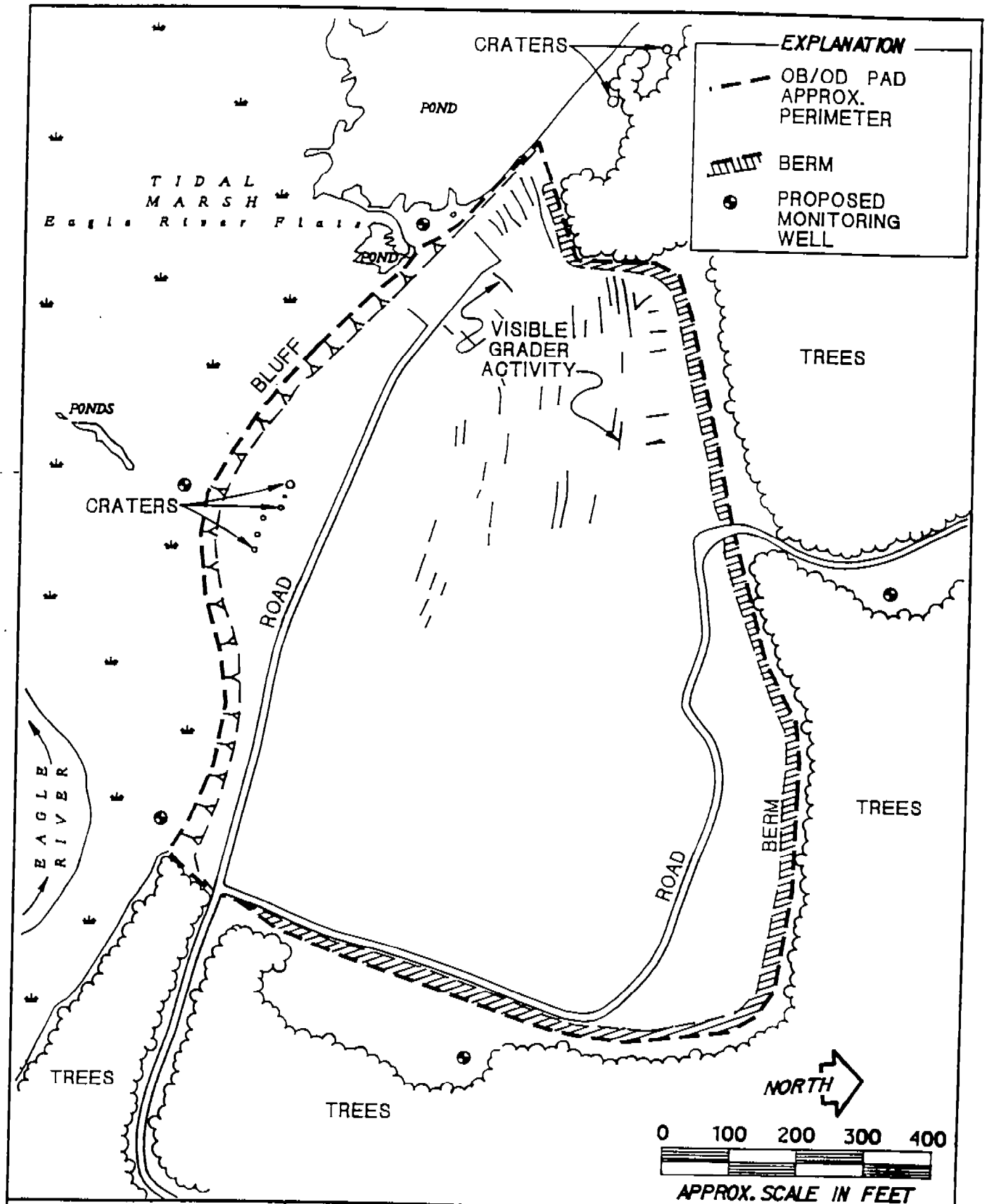

Five monitoring wells would be installed for post-closure monitoring. The arrangement would consist of two wells located beyond the berm in the upgradient direction with respect to the predicted groundwater flow, and three downgradient wells located directly below the bluff. As discussed in Section 3.3.2, net groundwater flow is assumed to be toward the south or southwest. Figure 5 illustrates the general location of these wells. These sites were selected to utilize existing roads and clearings, and thereby minimize the need to disturb or clear additional vegetation. Minor adjustments to these proposed locations may be made based on site conditions at the time of well installation.

The proposed network of wells should enable a fundamental characterization of groundwater flow patterns and background water quality. The wells would also enable the identification of a possible contaminant plume along the pad's perimeter. If groundwater impacts are detected in the downgradient wells, additional wells may be needed to adequately characterize a contaminant plume, and to determine whether additional remedial efforts are warranted.

5.2.5.2 Well Construction and Development

The monitoring wells would be installed in accordance with ADEC and EPA guidelines. Drilling would be accomplished using a hollow stem auger. A truck mounted drill rig would be used wherever possible; however, below the bluff a small, portable drill rig may be required.

The wells would be constructed of 2-inch-diameter schedule 40, flush threaded, PVC riser and screen. For the upgradient wells, the screened interval in each well would be approximately 10 feet, extending approximately 5 feet above and 5 feet below the groundwater surface encountered while drilling. For the downgradient wells on the marsh flats, the screened interval in each well would be 5 feet, with the top of the screen positioned approximately 1 foot above the groundwater at the time of drilling. While installing the downgradient wells, specific conductivity measurements would be recorded. From these

America North/
EMCON, Inc.

DATE OCT. 1992
 DWN. CDS92120PM
 CKD. B.B.
 REV. MAR. 1993
 PROJECT No.
 11772.10

DEMO 1 CLOSURE PLAN
 Ft. Richardson, Alaska

PROPOSED MONITORING WELL LOCATIONS

FIGURE
5

measurements the salinity of the groundwater can be estimated. The screened interval of the well would be located in nonsaline water, if possible. Minor adjustments to the proposed well design may be incorporated in the field depending upon the hydrogeologic conditions observed while drilling.

The depth of the water table would be determined at the time of drilling using field observations of drill cuttings and soil samples. The well screens should be factory machine slotted with openings of approximately 0.020 inches. A filter pack consisting of number 8 to 12 washed Colorado silica sand would be installed from approximately the base of the screened interval to 1 to 2 feet above the screened interval. A bentonite or bentonite-cement grout seal, at least 1 foot thick, would be placed near the ground surface to minimize infiltration of surface water into the well through the well annulus. In addition, each well would be sealed with a security casing to minimize well head access to unauthorized persons, to protect the well from damage and to meet regulatory requirements. The security casing would include a minimum 4-inch steel or anodized aluminum casing, with drain holes and a locking steel cap, concreted in place at the ground surface.

While installing the wells, efforts would be made to acquire information which would aid in interpretation of the local geology and hydrology. In at least one of the downgradient wells, drilling should be conducted to a depth of approximately 30 feet bgs, if permitted by rig capabilities, or until an aquitard below the near surface aquifer is encountered. In addition, at least one of the upgradient wells should be drilled and logged to a depth of approximately 50 feet.

Following installation, the wells would be developed to remove any water or other impurities introduced into the well while drilling, and maximize efficiency of the well. Monitoring well development would consist of removing water until the well yields water representative of actual site groundwater conditions. Removal of water would be accomplished by bailing or pumping using decontaminated equipment.

5.2.5.3 Construction QA/QC

Monitoring well installations would be supervised by a qualified geologist. Upgradient wells would be drilled before downgradient wells. The drill rig would be properly decontaminated prior to arrival on site. In addition, down-hole equipment would be decontaminated prior to use at each borehole. Well screens would be new and wrapped in plastic, or decontaminated by steam cleaning prior to use. Workers handling the well screen would wear a new pair of Solvex[®] gloves or equivalent. Any cuttings or water removed from the borehole would be managed as hazardous waste until a hazard determination is made. The water

and cuttings would be containerized on site, then moved to the Fort Richardson hazardous waste storage facility. Analytical results would be provided to the storage facility, and used to determine the final disposition of the waste. Water meeting Fort Richardson's sewer permit standards would be disposed in a sanitary sewer. Water not meeting permit standards would be sent to a permitted hazardous waste TSD facility through the Defense Reutilization Marketing Office (DRMO) contract. Soil which is not hazardous per 40 CFR 261 would be added to the soil being used to cap the Fort Richardson landfill or would be landfilled at the Anchorage municipal landfill. Soil which is determined to be hazardous would be shipped to a TSD facility permitted for that type of waste through the DRMO contract.

5.2.5.4 Initial Sampling and Analysis

Prior to sampling, each monitoring well would be purged. Well purging would consist of removing a minimum of three casing volumes of fluid, and until the pH, conductivity, and temperature have stabilized to within ten percent of three consecutive readings. Purging would be accomplished using decontaminated pumps or bailers. Purge water would be containerized on site in 55-gallon drums, or equivalent, until analytical information is available to determine the appropriate disposal method.

Once the well has been properly purged, a groundwater sample would be collected from the monitoring well using a dedicated bailer. The water would be transferred from the bailer into appropriate sample containers, stored in a chilled cooler, and sent to the laboratory for analysis within the proper holding time. A specific work plan developed by the Army would provide details on procedures for field sampling and analytical activities. Table 3 lists the analyses to be performed on each sample. In addition, field measurements of pH, conductivity, and temperature would be taken at each monitoring well.

5.2.6 Site Security

Because of the DEMO 1 site's remote location on Fort Richardson and the nature of the closure activities, special site security measures during the construction of the cap and wells would not be necessary. Access to the DEMO 1 unit is controlled at the entrance to Fort Richardson and by a locked gate with a posted warning sign on the access road to the site. As a final step in the closure activities, a six-foot-high chain link fence would be installed to exclude vehicles from the capped area.

5.2.7 Personnel and Equipment Decontamination

The need for personnel and equipment decontamination during closure activities is expected to be minimal. Personnel working on the site would be dressed in disposable Tyvek® coveralls, boots or boot covers, and gloves that are changed daily or more frequently if needed. The decision to establish a personnel decontamination area would be based on visual observations or sampling conducted by an industrial hygienist.

If needed, a personnel decontamination area would be established outside of the DEMO 1 unit. The decontamination area would consist of a series of large portable pans set on plastic sheeting where workers would wash contaminated materials off their boots, gloves, and coveralls. Decontamination residues would be collected and sampled. The residue would be managed as a RCRA hazardous waste if it exhibited a hazardous waste characteristic. Non-hazardous decontamination residues would be taken to the Fort Richardson sewage treatment plant if they were found acceptable for treatment or would be taken to a permitted solid waste landfill on Fort Richardson for disposal.

Handtools and other small items needing decontamination would be processed through the personnel decontamination area. A separate area would be established for pieces of heavy equipment that need to be decontaminated. The second area would consist of heavy plastic sheeting spread on a smooth ground surface or a plywood platform and bermed at the edges. Equipment would be washed in the area and the decontamination residues would be managed in the same manner as the personnel decontamination residues.

5.2.8 Personnel Safety and Health Precautions

5.2.8.1 Personnel Training

Workers employed to conduct the closure activities would have completed a 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) course for hazardous waste site workers and an 8-hour refresher course within the past year, both of which meet the Occupational Health and Safety Administration (OSHA) 1910 standards. Prior to beginning closure activities, additional training for workers would be conducted in general and site-specific site safety and emergency procedures. All workers would be provided with additional training about site-specific hazards and emergency response procedures prior to beginning work on DEMO 1 closure activities.

5.2.8.2 Monitoring and Inspections

DEMO 1 closure activities would be monitored and inspected by an independent registered Professional Engineer and an industrial hygienist. Field activities would adhere to a site-specific safety and health plan.

Section 5.2.2 describes the precautionary inspection and clearance of the unit and vicinity by EOD personnel prior to construction. EOD personnel and an industrial hygienist would determine that the area is safe for workers. Their monitoring and inspection results would be the basis for selecting options for worker safety.

5.2.9 Emergency Preparedness and Prevention

5.2.9.1 Contingency Plan

The existing Fort Richardson contingency plan will be used should an emergency requiring its implementation occur during DEMO 1 closure activities. A copy of the contingency plan will be maintained at the DEMO 1 unit during closure activities. Existing standard operating procedures for Army EOD areas also will be maintained at DEMO 1 as a part of the contingency plan.

5.2.9.2 Emergency Equipment and Procedures

Portable fire extinguishers, oil spill response supplies, first aid supplies, and portable radios will be maintained at DEMO 1 throughout closure activities. Additional emergency equipment and supplies maintained on Fort Richardson would be dispatched to the DEMO 1 site in an emergency upon request by radio from the site.

5.2.10 Closure Schedule

Closure of the DEMO 1 unit would occur between May and September 1994, following EPA approval of these guidelines. Closure activities are restricted to the late-spring through early-fall seasons to allow for proper construction of the site cap and surface water management features, and to permit revegetation activities to occur immediately upon completion of construction actions. Closure activities are expected to take less than 90 days to complete.

5.2.11 Closure Documentation and Recordkeeping

5.2.11.1 Notification of Closure

Upon receipt of approval of these guidelines from EPA, Fort Richardson would notify the EPA Region 10 Regional Administrator of the date that final closure activities are expected to begin. This notification would be provided at least 60 days prior to the start of the closure activities, unless a shorter notification period, acceptable to EPA, must be given so that closure activities can occur during suitable weather conditions before winter.

5.2.11.2 Certification of Closure and Survey Plat

Within 60 days after the completion of final closure activities at the DEMO 1 unit, Fort Richardson would submit a certification of closure that meets the requirements of 40 CFR 264.115 to the EPA Region 10 Regional Administrator. As a federal facility, Fort Richardson is not required to submit a survey plat of the DEMO 1 unit that meets the requirements of 40 CFR 264.116 to the EPA Regional Administrator and the Municipality of Anchorage.

5.2.11.3 Recordkeeping

Inspection, monitoring, and analytical records generated during final closure of the DEMO 1 unit would be maintained through the duration of post-closure care period by the contact person designated in the DEMO 1 post-closure care plan.

5.2.11.4 Amendment of Closure Plan

If a change to the approved DEMO 1 closure plan should be necessary prior to completion of final closure, Fort Richardson would request approval for an amendment of the closure plan from the EPA Region 10 Regional Administrator. The request would be accompanied by a copy of the amended closure plan. A request for an amendment of the approved closure plan would be requested because:

- Changes in operating plans or facility design affect the closure plan.
- There is a change in the expected year of closure.
- In conducting closure activities, unexpected events require the approved closure plan to be modified.

Fort Richardson would submit any requests for amendment of the approved closure plan more than 60 days prior to proposed changes in facility design or operation and no more than 60 days after an unexpected event has occurred. If the EPA Regional Administrator should request modifications to the approved closure plan, Fort Richardson would submit an amended plan within 60 days after receiving the request, or within 30 days if the request is received during closure activities.

5.2.12 Closure Cost

As a federal facility, Fort Richardson is exempt from the financial requirements of 40 CFR 265 Subpart H and 40 CFR 270.14(b)(15-18). Therefore, closure cost estimates and financial assurance options are not discussed in these guidelines.

6 POST-CLOSURE CARE ACTIVITIES

6.1 Post-Closure Care Contact

Post-closure care for the DEMO 1 unit will be required if the site will not be clean closed. Although the objective of this document is to guide closure activities, this section provides a summary of the post-closure care activities for the unit, if they are warranted. Post-closure care activities would be described in greater detail in a DEMO 1 unit post-closure care plan.

During the post-closure care period, the office listed below has been designated as the contact point for information about the DEMO 1 unit:

Environmental Branch
U.S. Army District of Public Works
APVR-PW-EN
Fort Richardson, Building 730
Anchorage, Alaska 99505
(907) 384-3000

6.2 Site Monitoring

Site monitoring activities during the post-closure care period would consist of monthly visual inspections and quarterly groundwater monitoring. The visual inspection program is described in Section 6.2.1. The groundwater monitoring program is described in Section 6.2.2.

6.2.1 Visual Inspections

Regular visual inspections of the site would be conducted during the post-closure care period. The frequency of these inspections, items to be inspected, actions taken in response to defective or threatening conditions identified by inspections, and inspection recordkeeping are discussed below.

Visual Inspection Frequency. Visual inspections of the DEMO 1 unit would be conducted monthly.

Visual Inspection Items. Visual inspections of the DEMO 1 unit would include:

- **Prior Inspection Corrective Action Items.** Items requiring corrective action that were noted in the previous inspection would be reviewed before inspecting the unit. The current status of those items would be noted during the inspection. Incomplete or deficient corrective action items would continue to be noted on the inspection log form for follow-up action.
- **Site Security.** The integrity and effectiveness of fences, gates, and warning signs that restrict access onto the closed DEMO 1 unit would be evaluated during each inspection. Evidence of unauthorized entry onto the unit or damage to the fences, gates, and signs would be noted on the inspection log form for follow-up action.
- **Cap Integrity.** The integrity of the cap over the DEMO 1 unit would be evaluated during each inspection. Areas of subsidence or heave, revegetation failure, thermal or hydraulic erosion, exposure of the synthetic membrane, and other conditions that may compromise the integrity of the cap would be noted on the inspection log form for follow-up action. The depth of snow cover also would be noted in the inspection log during those months when snow limits visual assessment of cap integrity.
- **Water Management and Erosion.** The condition and effectiveness of the surface water management features would be evaluated during each inspection. Conditions that permit water to run onto the DEMO 1 unit from adjacent areas would be noted on the inspection log form for follow-up action. The stability and effectiveness of the erosion control surfaces along the bank below the site also would be evaluated during each inspection. Water seepage surfacing through the cap or from under the cap must be noted.

Visual Inspection Corrective Actions. Corrective action to remedy any damage or deficiency items noted during visual site inspections would be conducted as soon as possible. A follow-up inspection to document the completion of corrective action would be recommended prior to the next monthly inspection. Photographs and other documentation of the completed action would be retained in the inspection log file.

Visual Inspection Documentation. At a minimum, each visual inspection of the closed DEMO 1 unit would be documented in the following manner:

- **Photographs.** Photographs of general site conditions and particularly of damage or deficiencies would be taken and included as part of the documentation for each inspection or corrective action follow-up.
- **Inspection Log.** An inspection form would be filled out during each visual inspection of the closed DEMO 1 unit. Follow-up actions that are needed to ensure that damage and deficiencies are corrected must be described on the form.

6.2.2 Groundwater Monitoring

The second part of the monitoring activity during the post-closure care period consists of groundwater monitoring. This section discusses the location of groundwater monitoring wells, the frequency of sampling and analysis, sample collection, analytical methods, action levels and evaluation of analytical results, actions taken in response to analytical results exceeding action levels, and groundwater monitoring recordkeeping.

Groundwater Monitoring Locations. The five monitoring wells installed during final closure of the unit, which are discussed in Section 5.2.5 of these guidelines, would be used for groundwater monitoring during the post-closure care period. Figure 5 shows the general location of these monitoring wells.

Collection and Analysis of Groundwater Samples. Samples from each of the monitoring wells would be collected and analyzed in March, June, September, and December each year. Procedures describing the collection and analysis of the samples would be included in the DEMO 1 post-closure care plan.

Groundwater Monitoring Data Evaluation. If contamination is detected in one or all of the downgradient wells, data evaluation would be necessary to determine the source of the plume. It cannot be assumed that all contaminants originated from the pad. Groundwater in the marsh next to the pad may be contaminated because the marsh is used as an artillery range. At times of flooding on the marsh flats, groundwater along the edge of the marsh may flow toward the pad, a reversal of normal flow conditions.

Therefore, if contamination is detected in any of the downgradient wells, one of the first responses may be to establish a reference well along the border of the marsh, upgradient (presumably east) of the pad. The purpose of the reference well would be to characterize "background" conditions in the marsh, and help differentiate between the possible sources of contaminants. For example, if the reference well were free of contamination, there would be more certainty that the contaminants in the groundwater adjacent to the pad's bluff actually originated

from the pad. Additional monitoring wells could also be extended out into the marsh flats to help delineate the contaminant plume.

Action levels for COCs have been established as closure performance standards in Section 4.3. These action levels are intended to protect human health and the environment from releases at the closed DEMO 1 unit. Upon receipt from the laboratory, the analytical reports for monitoring well samples would be compared to the performance standards to determine whether any groundwater samples exceed the action levels and whether corrective actions are needed.

If a groundwater monitoring sample analysis should show a constituent at a higher concentration than the action level, the following actions would be taken:

- **Re-sampling.** A second sample from a monitoring well would be collected within 10 days after Fort Richardson determines that a constituent found in that well exceeds its action level. The samples would be analyzed for the constituent of interest.
- **EPA Notification.** Within 5 working days after determining that a constituent exceeds its action level, Fort Richardson would notify EPA of the constituent, its level, and actions being taken to re-sample the monitoring well and determine the corrective action to be taken to protect human health and the environment.
- **Corrective Action Plan.** If the analysis of the second sample shows the constituent is below its action level, no corrective action would be taken. If the second analysis shows that the constituent is still above the action level, Fort Richardson would submit a corrective action plan to EPA within 60 days after the receipt of the second analytical report.

Groundwater Monitoring Documentation and Recordkeeping. Groundwater monitoring activities would be documented by the following items:

- A diagram of the monitoring well locations.
- Diagrams and descriptions of monitoring well construction details.
- Water sample field data sheets and chain-of-custody forms, field notes, photographs, and laboratory analytical reports from each sampling event.
- Laboratory analytical reports for quarterly monitoring well samples.

- Notifications to EPA.
- Groundwater corrective action plans.

These records would be retained in the post-closure care contact office for the duration of the post-closure care period.

6.3 Site Maintenance

This section describes the type and frequency of maintenance activities to be conducted at the DEMO 1 unit during the post-closure care period. These activities concentrate on site security, the site cap, surface water controls, and the unit's groundwater monitoring wells.

6.3.1 Site Security

Maintenance for gates and fences that control access onto the DEMO 1 unit would consist of the following activities to ensure that access is restricted to all but authorized personnel:

- Repair or replacement of gate.
- Repair or replacement of warning signs on the fence and gate.
- Replacement of locks on gates.

If a visual inspection identifies damage to the fence or a gate that could allow vehicles to gain access onto the unit's cap, the fence or gate would be repaired or replaced to its original condition. Repair or replacement of warning signs posted on the fence would be conducted if signs are identified as damaged or missing during a visual inspection.

6.3.2 Cap Maintenance

Maintenance activities on the DEMO 1 unit cap would be conducted on an as-needed basis to maintain the integrity of the cap and its effectiveness to contain underlying contaminants and minimize surface water infiltration.

6.3.3 Repair of Soil Subsidence or Heave Conditions

Some settlement and heave of the cap is expected to occur over time as the result of frost action. Soil subsidence or heave conditions that jeopardize the integrity of the cap would be repaired as soon as possible. Settlement areas that allow

water to pond or run off in eroded channels must be repaired by filling, contouring, and successfully revegetating the low areas.

6.3.4 Inspection and Repair of Exposed Geomembrane

If the geomembrane material becomes exposed, a thorough inspection of the exposed portion would be conducted as soon as possible to determine whether it has been damaged or degraded. A visual inspection would be conducted, at a minimum, and nondestructive physical inspection or testing methods recommended by the geomembrane manufacturer may be used. A sufficient area of the geomembrane would be uncovered to enable an adequate inspection to be conducted, which may require some excavation of the top layers of soil.

If no damage or deterioration were identified, then the soil cover over the geomembrane would be restored to its original condition as soon as possible. If damage or deterioration to the geomembrane were identified, then the damaged section would be repaired or replaced in a manner recommended by the geomembrane manufacturer. Once the geomembrane were repaired, the soil cover would be replaced and revegetated.

6.3.5 Surface Water Management Features

The structures, such as the perimeter berm, that divert surface water around the site would be maintained on an as needed basis to ensure that drainage around the closed DEMO 1 unit would continue as intended. Visual inspections would determine whether surface water drainage problems exist and the control structures require repair.

6.3.6 Monitoring Wells

General maintenance for each groundwater monitoring well would consist of re-marking or re-painting the aboveground portion of the well casing and cap to maintain the well's visibility and to keep the cap and casing in good operating condition.

If surface water begins to pond around the well casing due to settlement, bentonite and clean soil would be used to build up the area. The area surrounding the well would be recontoured to allow the free drainage of surface water away from the well.

Should a monitoring well silt in, be damaged, or otherwise become unusable, repair of the well would be evaluated as soon as possible. If feasible, monitoring

well repairs would be effected as soon as possible. If a monitoring well should become unusable and cannot be repaired, the well would be abandoned by filling the casing with concrete and a new monitoring well would be located, constructed, and maintained.

6.4 Post-Closure Documentation, Recordkeeping, and Reporting

This section discusses the documentation, retention, and the periodic submission of reports to EPA resulting from DEMO 1 unit monitoring and maintenance activities during the post-closure care period. This chapter also discusses conditions that require the post-closure plan to be amended and the requirements connected with the completion of the post-closure care period.

6.4.1 Post-Closure Care Documentation and Recordkeeping

Fort Richardson would document all activities associated with the post-closure care of the DEMO 1 unit. This documentation would be maintained in files in the custody of the unit's post-closure care contact for the duration of the post-closure care period.

All DEMO 1 unit monitoring and maintenance activities would be documented through the use of memoranda, photographs, analytical reports, specific inspection and sampling forms and logs, agency reports, and other means appropriate to the activities. Documentation for specific monitoring and maintenance activities would be discussed within the individual sections of the post-closure plan. All documentation of DEMO 1 unit monitoring and maintenance activities would be retained for the duration of post-closure care.

6.4.2 Post-Closure Care Activity Reporting

Fort Richardson would submit quarterly reports to the EPA Region 10 during the post-closure care period. The reports would provide a narrative summary of visual inspection findings, maintenance activities, and corrective action items and their status during the reporting period. The report also would contain copies of the groundwater monitoring well analytical reports for the period.

6.4.3 Amendment of Post-Closure Plan

Amendment of the approved post-closure plan and permit may be required if the design or operation changes or if events during closure or post-closure care affect the continued implementation of the plan. When an amendment to the currently approved DEMO 1 unit post-closure plan is needed, Fort Richardson must submit a written request for a post-closure permit modification to the EPA Regional Administrator. The notification or request must include a copy of the amended post-closure plan for review by the EPA Regional Administrator.

A request for a post-closure permit modification must be submitted to the EPA Regional Administrator at least 60 days prior to the proposed design or operational change in the DEMO 1 unit or no later than 60 days after an unexpected event has occurred that affects the DEMO 1 unit post-closure plan. The EPA Regional Administrator would approve, disapprove, or modify the amended post-closure plan.

6.4.4 Post-Closure Notices

Within 60 days after certification of final closure, Fort Richardson would submit the notice required by 40 CFR 264.119(a) that records the type, location, and quantity of hazardous waste within the closed DEMO 1 unit to the Municipality of Anchorage and the EPA Region 10 Regional Administrator.

Also within 60 days after certification of final closure, Fort Richardson would record a notation on the deed for the property or on another appropriate instrument which would be examined during a title search. This notation would in perpetuity notify any potential purchaser that (1) the DEMO 1 site has been used to manage hazardous wastes; (2) its use is restricted under 40 CFR 264, Subpart G; and (3) a survey plat for the site has been filed with the Municipality of Anchorage and EPA Region 10. Fort Richardson would submit a certification to the EPA Region 10 Regional Administrator that this notation has been completed and would include a copy of the document in which the notation has been placed.

6.4.5 Certification of Completion of Post-Closure Care

Within 60 days after certification of final closure, Fort Richardson would submit a certification that the post-closure care period for the DEMO 1 unit was performed in accordance with the approved post-closure care plan to the EPA Region 10 Regional Administrator. This certification would meet the requirements of 40 CFR 264.120.

REFERENCES

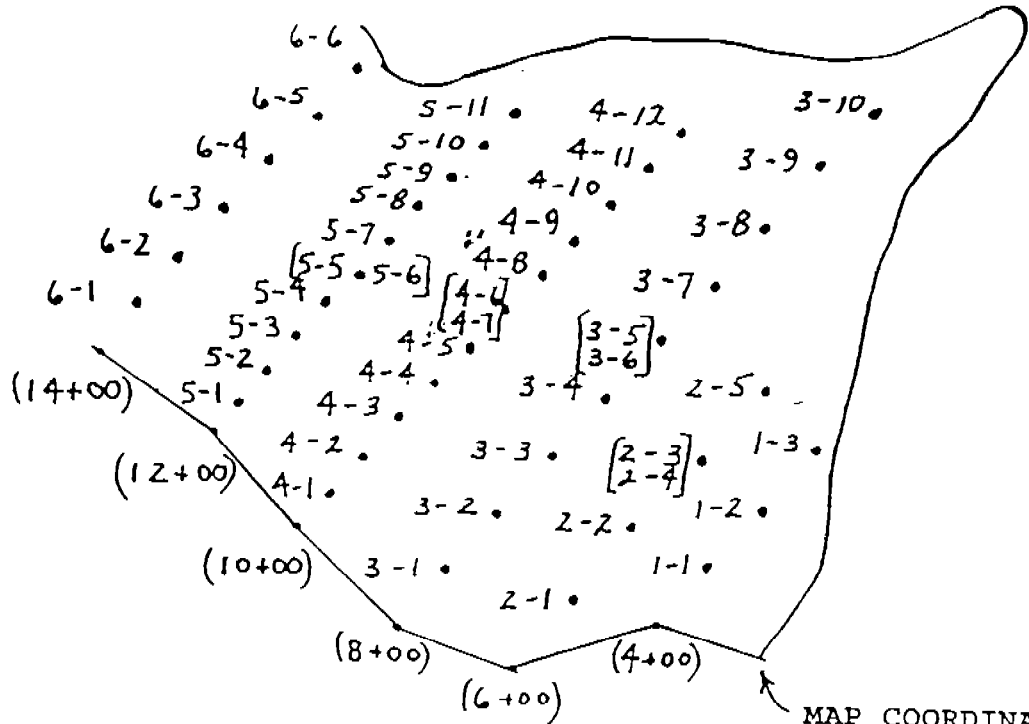
- Cold Regions Research and Engineering Laboratory (CRREL). 1991. Waterfowl Mortality in Eagle River Flats, Alaska: The Role of Munitions Compounds. For U.S. Army Toxic and Hazardous Materials Agency. For limited distribution. Final Report No. CETHA-IR-CR-91008.
- Eldridge, W.D. 1991. Waterbird Utilization of Eagle River Flats, April-October, 1991. USFWS. Anchorage, Alaska.
- Environmental Protection Agency (EPA). 1986. Test Methods for Evaluating Solid Waste. Physical/Chemical Methods, EPA SW-846, Vol. II.
- Environmental Protection Agency (EPA). 1992. Drinking Water Regulations and Health Advisories. Office of Water. Washington, D.C.
- Environmental Science and Engineering, Inc. (ESE). 1990. Eagle River Flats Expanded Site Investigation, Fort Richardson, Alaska. Final Technical Report, Data Item A011. June For U.S. Army Toxic and Hazardous Materials Agency. For limited distribution.
- Lyman, W.J. et al., 1982. Handbook of Chemical Property Estimation Methods. McGraw Hill, NY. (As cited in HSDB, 1992.)
- Racine, C. H., M. E. Walsh, C. M. Collins, D. J. Calkins, S. Taylor, B. D. Roebuck and L. Reitsma, and B. Steele. 1992a. Remedial Investigation Report: White Phosphorus Contamination of Salt Marsh Sediments at Eagle River Flats, Alaska. For U.S. Army Toxic and Hazardous Materials Agency. From U. S. Army Corps of Engineers Cold Regions Research and Engineering Laboratory. Final Report.
- Racine, C. H., M. E. Walsh, C. M. Collins, D. J. Calkins, B. D. Roebuck and L. Reitsma. 1992b. Waterfowl Mortality in Eagle River Flats, Alaska: The Role of Munitions Residues. For U. S. Army Toxic and Hazardous Materials Agency, CETHA-IR-IC-91008. From U. S. Army Corps of Engineers Cold Regions Research and Engineering Laboratory. For public distribution. CRREL Report 92-5.

- Science Applications International Corporation (SAIC). 1990. RCRA Facility Assessment PR/VSI Report, U. S. Army Fort Richardson, Anchorage, Alaska. EPA I.D. No. AK 1210022157. For U. S. Environmental Protection Agency Region X. EPA Contract No. 68-1 W9-008, WA #R10001. SAIC Project No. 6-788-03-807-00. DCN: TZ4-R10003-RN-01596.
- Spanggord, R.J. et al. 1980. Environmental Fate Studies of Certain Munitions Wastewater Constituents Phase II. NTIS AD-A099256. Menlo Park, CA. (As cited in HSDB, 1992.)
- Spanggord, R.J., R. Rewick, T.-W. Chou, R. Wilson, R.T. Podoll, T. Mill, R. Parnas, R. Platz and D. Roberts, 1985. Environmental Fate of White Phosphorus/Felt Red Phosphorus/Butyl Rubber Military Screening Smokes. SRI International, Menlo Park, CA, ADA 176922. (As cited in HSDB, 1992.)
- Tweten, R. 1989. Eagle River Flats Waterfowl Mortality Investigation Progress Report. USFWS, Anchorage, Alaska. (Unpublished.)
- U.S. Army Corps of Engineers, 1990. Geotechnical Report for Groundwater Monitoring Network, Fort Richardson, Alaska.
- U.S. Army Environmental Hygiene Agency (AEHA), 1986. Phase 5 Hazardous Waste Study No. 37-26-0593-86, Summary of AMC Open-Burning/Open-Detonation Grounds Evaluations, March 1981-March 1985. For limited distribution.
- U.S. Army Environmental Hygiene Agency (AEHA). 1989. Environmental Operations Review No. 32-24-1378-89, 6th Infantry Division (Light), Fort Richardson. Fort Wainwright, Fort Greely, Alaska, May 9-25, 1988.
- U.S. Army Environmental Hygiene Agency (AEHA). 1993. Hazardous Waste Management Consultation No. 37-66-JR11-92, Soil Sampling Results. Fort Richardson, Alaska. 6-7 July 1992. For limited distribution.
- U.S. Army, Fort Richardson. 1988. Part B Permit Application, Hazardous Waste Container Storage Facility and Open Burning/Open Detonation Facility, Fort Richardson, Alaska, EPA No. AK1210022157.

APPENDIX A
SOIL SAMPLE DISTRIBUTION

Figure A-1.

Locations of sample points on the OB/OD pad as depicted in the Army's data report (AEHA, 1993). The solid line corresponds to approximate perimeter of the pad. North lies toward the top of the page.

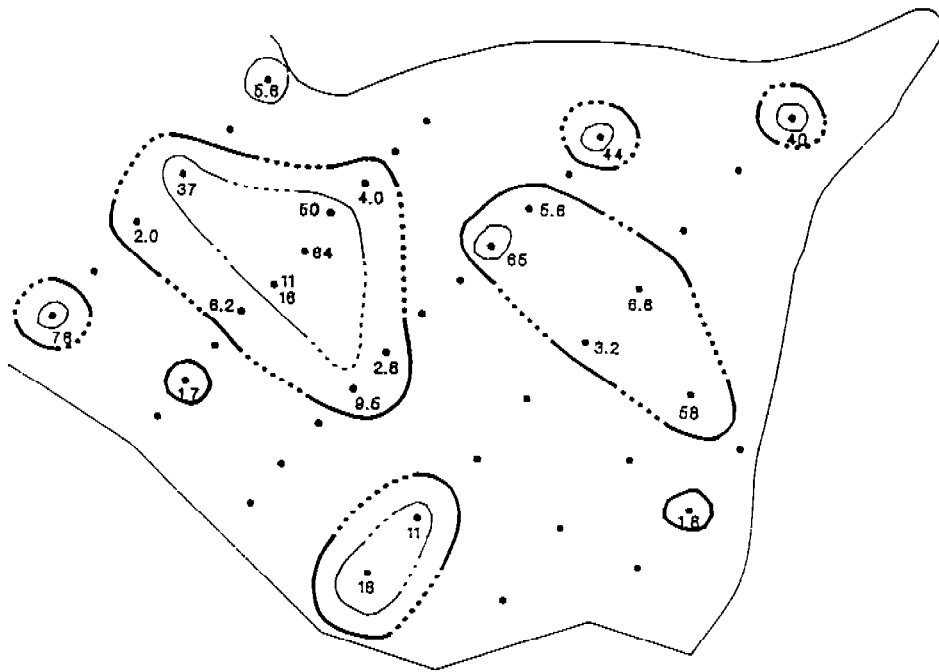


MAP COORDINATES
355800.9, 6800922.9

(X+XX): 1990 CRREL
ERF SURVEY
STATIONS

Figure A-2.

Distribution of 2,4-DNT on the OB/OD pad based on the Army's analytical results and the Army's sample point diagram copied in Figure A-1.



2,4-DNT
Contour Intervals
- - - - - 1-10 ug/g
- - - - - > 10 ug/g

