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Agency

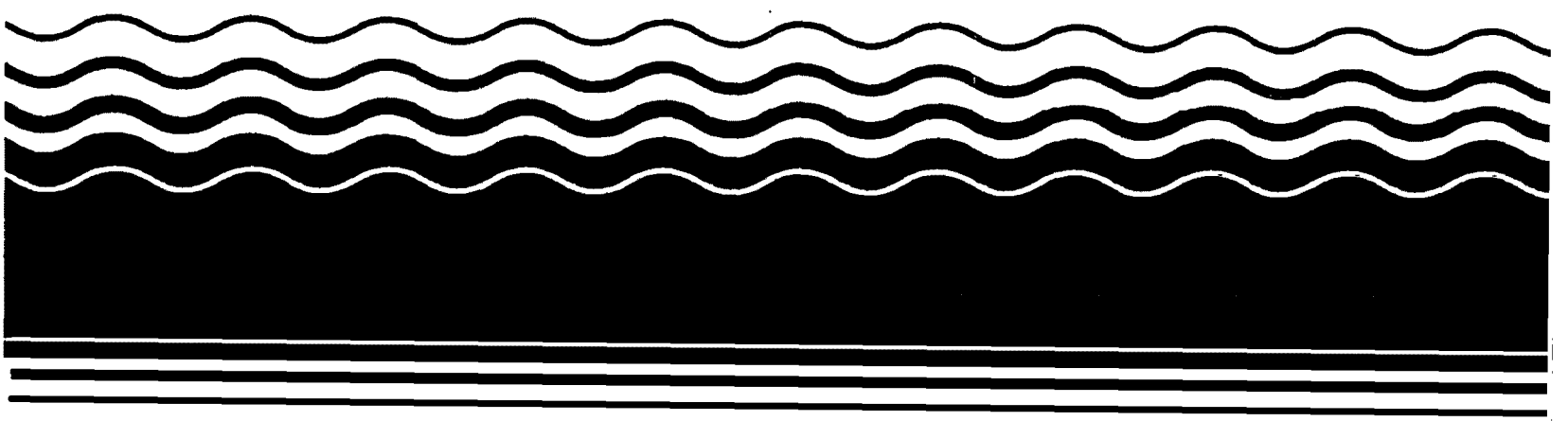
Office of
Emergency and
Remedial Response

EPA/ROD/R01-93/084
January 1993

EPA

Superfund Record of Decision:

Otis Air National Guard/ Camp Edwards, MA



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Otis Air National Guard/Camp Edwards, MA
Second Remedial Action

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16. Abstract (Limit: 200 words)

The 100-acre Otis Air National Guard/Camp Edwards site is an inactive Federal disposal facility located on the 22,000-acre Massachusetts Military Reservation (MMR) within the boundaries of Falmouth, Mashpee, Sandwich, and Bourne, Massachusetts. Land use in the area is predominantly residential and light industrial, with an onsite woodlands area. From the 1940s to 1984, the U.S. Army, Air National Guard, U.S. Air Force, U.S. Navy, Coast Guard, Department of Agriculture Experiment Stations, and the Veterans Administration used the site for unregulated disposal activities. The Area of Contamination (AOC) Main Base Landfill Number 1 (LF-1) Source Area is located on the southern half of the MMR and contains areas of open and heavily wooded terrain. The area consists of six landfill cells, which are designated by the approximate end dates of disposal activity. The 1947, 1951, and 1957 cells occupy approximately 40 acres of the total AOC LF-1 area; while the 1970 Cell, Post-1970 Cell and Kettle Hole landfills occupy approximately 50 acres—the additional 10 acres includes the space that exists between the cells. Solid waste disposal in the Post-1970 Cell ceased in June 1989, and domestic waste disposal at Kettle Hole ceased in 1990. The landfills were covered with soil to minimize the potential for direct exposure to landfilled waste and

(See Attached Page)

17. Document Analysis a. Descriptors
Record of Decision - Otis Air National Guard/Camp Edwards, MA
Second Remedial Action
Contaminated Medium: soil
Key Contaminants: VOCs (benzene, TCE, toluene, xylenes), other organics (phenols), metals (arsenic, lead)

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report) None	21. No. of Pages 86
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EPA/ROD/R01-93/084
Otis Air National Guard/Camp Edwards, MA
Second Remedial Action

Abstract (Continued)

contaminants. Types of waste disposed of in the landfill cells include general refuse, fuel tank sludge, herbicides, solvents, transformer oils, fire extinguisher fluids, blank small arms ammunition, paints, paint thinners, batteries, DDT powder, hospital waste, municipal sewage sludge, coal ash, and possibly live ordnance. A number of investigations conducted as part of the Department of Defense's Installation Restoration Program, revealed unacceptable concentrations of VOCs, SVOCs, and inorganics in onsite ground water. This ROD addresses an interim remedy for the AOC at Main Base Landfill Number 1 (LF-1), as OU1. Future RODs will address long-term cleanup goals to reduce contaminant concentrations in ground water. The primary contaminants of concern affecting the soil are VOCs, including benzene, TCE, toluene, and xylenes; other organics, including phenols; and metals, including arsenic and lead.

The selected remedial action for this site includes installing a low permeability cover with a passive gas venting system over the 1970 Cell, Post-1970 Cell, and Kettle Hole; regrading and revegetating these areas; implementing a semi-annual ground water monitoring and soil cover inspection program; and implementing site access restrictions such as fencing. The estimated present worth cost for this remedial action ranges from $27,800,000 to $34,800,000, which includes an estimated total present worth O&M cost ranging from $2,000,000 to $2,500,000.

PERFORMANCE STANDARDS OR GOALS:

Not applicable.

INSTALLATION RESTORATION PROGRAM

RECORD OF DECISION
INTERIM REMEDIAL ACTION
MAIN BASE LANDFILL (AOC LF-1)
SOURCE AREA OPERABLE UNIT

MASSACHUSETTS MILITARY RESERVATION
CAPE COD, MASSACHUSETTS

FINAL

JANUARY 1993

95

Hazardous Waste Remedial Actions Program
Oak Ridge K-25 Site
Oak Ridge, Tennessee 37831-7606
Managed by MARTIN MARIETTA ENERGY SYSTEMS, INC.
For the U.S. DEPARTMENT OF ENERGY under contract DE-AC05-84OR21400

INSTALLATION RESTORATION PROGRAM

RECORD OF DECISION
INTERIM REMEDIAL ACTION
MAIN BASE LANDFILL (AOC LF-1)
SOURCE AREA OPERABLE UNIT

MASSACHUSETTS MILITARY RESERVATION
CAPE COD, MASSACHUSETTS

FINAL

Prepared for:

Hazardous Waste Remedial Actions Program
Oak Ridge, Tennessee

Managed by:

Martin Marietta Energy Systems, Inc.
for the
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Under Contract No. DE-AC05-840R21400

Prepared by:

ABB Environmental Services, Inc.
Portland, Maine
Project No. 7030-03

JANUARY 1993

AOC LF-1 SOURCE RECORD OF DECISION
MASSACHUSETTS MILITARY RESERVATION

TABLE OF CONTENTS

AOC LF-1 SOURCE RECORD OF DECISION
MASSACHUSETTS MILITARY RESERVATION

TABLE OF CONTENTS
(continued)

TABLE OF CONTENTS
(continued)

LIST OF FIGURES

LIST OF TABLES

1.0 DECLARATION FOR THE RECORD OF DECISION

SITE NAME AND LOCATION

The Massachusetts Military Reservation (MMR) on Cape Cod, Massachusetts, lies within the boundaries of Falmouth, Mashpee, Sandwich, and Bourne. The Area of Contamination (AOC) Main Base Landfill Number 1 (LF-1) Source Area is located on the southern half of MMR and is bounded by Turpentine and Frank Perkins Road to the east and west, and Herbert Road and Connery Avenue to the north and south, respectively.

STATEMENT OF BASIS AND PURPOSE

This document presents the selected interim remedial action for the MMR AOC LF-1 Source Area chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986. To the extent practicable, the National Contingency Plan (NCP) was considered. This decision to select this interim remedial action is based on the administrative record file for this site, which was developed in accordance with Section 113(k) of CERCLA and is available for public review at the information repositories located at: (1) the Falmouth Public Library, Falmouth, Massachusetts; (2) the Air National Guard (ANG) Installation Restoration Program Office at Otis ANG Base, Massachusetts; and (3) the U.S. Environmental Protection Agency (USEPA) Regional Office at 90 Canal Street, Boston, Massachusetts. The attached index (Appendix A) identifies the items in the Administrative Record upon which the selection of a remedial action is based. The Commonwealth of Massachusetts concurs with the selected remedial action (see Appendix B).

ASSESSMENT OF AOC LF-1 SOURCE

Actual or threatened releases of hazardous substances from this AOC, if not addressed by implementing the remedial action selected in this Record of Decision (ROD), may pose an imminent and substantial endangerment to human health, welfare, or the environment.

DESCRIPTION OF THE SELECTED INTERIM REMEDY

In summary, the interim remedy consists of the following:

- constructing a landfill cover system on the 1970 Cell, Post-1970 Cell, and Kettle Hole
- conducting post-closure maintenance and monitoring of the cover system for a minimum of 30 years after construction is complete
- monitoring landfill gas and groundwater quality semiannually from existing and proposed well locations at AOC LF-1
- reviewing the performance of the remedy every five years after implementation

This operable unit interim remedial action will minimize infiltration and percolation of precipitation through the 1970 Cell, Post-1970 Cell, and Kettle Hole. Selection of a final remedy will depend on the study of the AOC LF-1 groundwater plume and investigation of AOCs downgradient of LF-1. The interim and final remedies proposed must be consistent with the clean-up goals established for the entire MMR site.

STATUTORY DETERMINATIONS

This interim action is protective of human health and the environment, complies with federal and state Applicable or Relevant and Appropriate Requirements (ARARs) for this limited scope action, and is cost-effective. Because this action may not constitute the final remedy for the AOC LF-1 Source Area, the statutory preference for remedies that reduces toxicity, mobility, or volume through treatment as a principal element, although partially addressed in this remedy, will be addressed by the final remedial action. Subsequent actions are planned to fully address the threats posed by conditions at this operable unit. Because this remedy will result in hazardous substances remaining on-site, a review will be conducted to ensure that the remedy continues to provide adequate protection of human health and the environment every five years after commencement of the remedial action. Because this is an interim action ROD, review of this site and this remedy will be continuing

as the National Guard Bureau (NGB) continues to develop final remedial alternatives for the AOC LF-1 source operable unit.

The foregoing represents the selection of an interim remedial action by the Department of Defense, NGB, and USEPA Region I, with concurrence of the Commonwealth of Massachusetts.

Department of Defense, NGB

By: _____ Date: 4 Jan 1993

Ronald Watson, P.E.
Chief, Environmental Division
Air National Guard Readiness Center

U.S. Environmental Protection Agency, Region I

By: _____ Date: Jan. 14 1993

Julie Belaga
Regional Administrator

2.0 SITE NAME, LOCATION, AND DESCRIPTION

MMR is a National Priorities List (NPL) site. There are currently 77 areas within MMR that are under investigation. Some of these areas have been grouped into operable units for remediation purposes. This ROD relates to the interim remedial action for the AOC LF-1 Source Area.

MMR, which lies within the boundaries of Bourne, Falmouth, Mashpee, and Sandwich, Massachusetts, occupies approximately 22,000 acres (Figure 2-1) and consists of several cooperating command units: Massachusetts ANG, Massachusetts Army National Guard, U.S. Air Force (USAF), Veterans Administration (VA), and U.S. Coast Guard (USCG). The site is described in more detail in the focused feasibility study (FFS) (ABB Environmental Services, Inc., 1992b). The USAF managed the base until 1973, when base management was transferred to the ANG.

The NGB is proposing an interim remedial plan, referred to as a preferred alternative, to address AOC LF-1 source control (Figure 2-2). This ROD recommends a method of minimizing further contamination from occurring using containment options evaluated during the FFS.

Property usage surrounding MMR is primarily residential and light industrial in each of the surrounding towns.

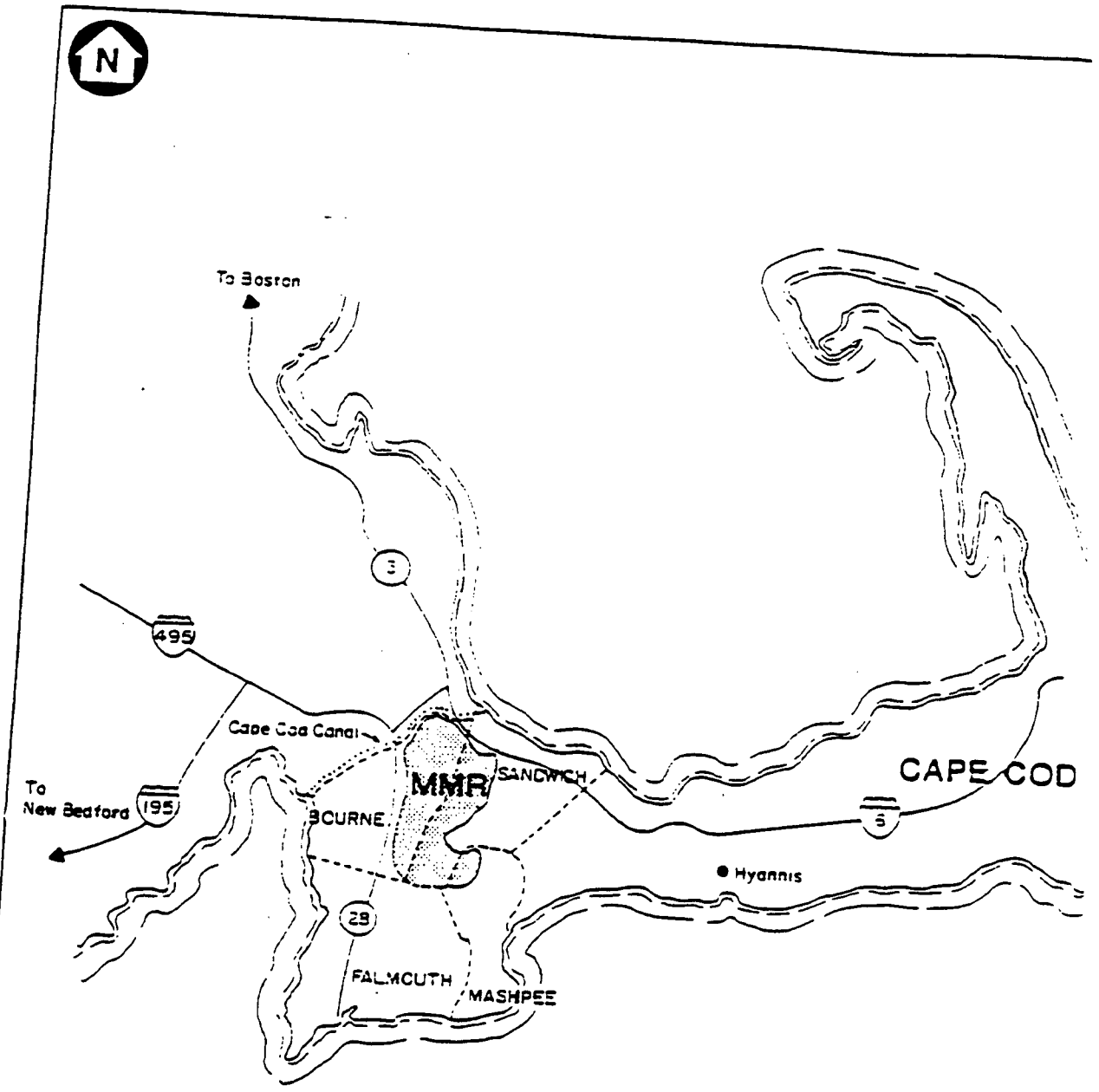

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ABB ABB Environmental Services, Inc.			SITE LOCATION MAP
INSTALLATION RESTORATION PROGRAM MASSACHUSETTS MILITARY RESERVATION		AOC LF-1 ROD	FIGURE 2-1

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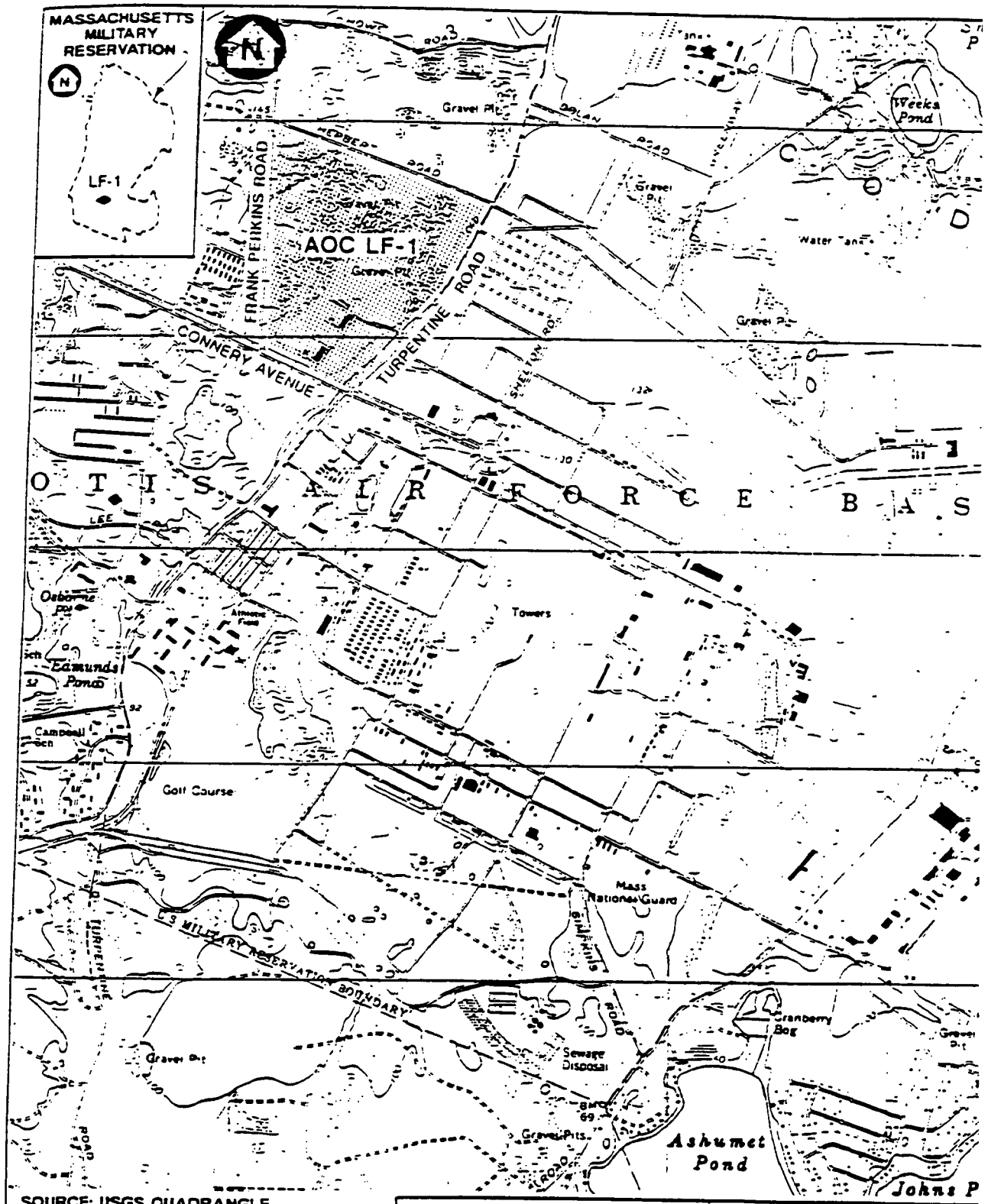

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3.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

In accordance with Section 117(a) of CERCLA, the NGB is publishing this ROD to address public comment on the selected interim containment alternative, known as a remedial alternative, considered for AOC LF-1 Source Area as the interim remedy. The NGB, in consultation with USEPA, considered public comments as part of the final decision-making process for selecting the remedy for AOC LF-1 Source Area. This ROD summarizes results and conclusions of the FFS and the Proposed Plan.

In response to environmental contamination that has occurred as a result of the use, handling, storage, or disposal of hazardous materials at military installations across the United States, the DOD initiated investigation and clean-up activities under the IRP. The IRP parallels the Superfund program and is conducted in the following seven stages:

- identification of potential hazardous waste sites
- confirmation of the presence of hazardous materials at the site
- determination of the type and extent of contamination
- evaluation of alternatives for clean up of the site in the FFS
- proposal of a clean-up remedy in the Proposed Plan
- selection of a remedy
- implementation of the remedy for clean up of the site

Both private sector and federal facility sites are eligible for placement on the USEPA NPL, which is used to prioritize investigations and responses at hazardous waste sites. MMR was added to the NPL on November 21, 1989. Private sector sites placed on the NPL are eligible to receive funding from the nation's environmental trust fund (i.e., Superfund), and are often called Superfund sites. Federal military facilities such as MMR receive funding from the DOD Defense Environmental Restoration Account.

3.1 LAND USE AND RESPONSE HISTORY

AOC LF-1 Source Area, which occupies approximately 100 acres of open to heavily wooded terrain, has operated since 1944 as the primary solid waste disposal facility

at MMR. From the late 1940s until 1984, unregulated disposal activities were conducted by the U.S. Army, ANG, USAF, U.S. Navy, USCG, U.S. Department of Agriculture Experiment Stations, and VA. From 1984 to 1990, the ANG has regulated disposal at AOC LF-1 as a component of the MMR Hazardous Waste Management Plan.

Disposal at the landfill reportedly occurred in five distinct cells and a natural Kettle Hole (Figure 3-1). The cells are designated by the years representing the approximate end date of waste disposal, which were estimated by reviewing historical aerial photographs (ABB Environmental Services, Inc., 1992a). The six disposal areas include the 1947, 1951, 1957, 1970, and Post-1970 cells, and the Kettle Hole. The interpreted location of the landfill cell boundaries is based on: (1) review of historical aerial photographs taken by the base; (2) review of the basewide aerial survey data collected in April 1990; (3) field reconnaissance surveys that indicated landfilled areas delineated by existing topography, and comparisons of the age of vegetation in landfill cell areas (regrowth) versus undisturbed areas and geophysical survey of the five landfill cells; and (4) personal communications with landfill operators.

The 1947, 1951, and 1957 cells occupy approximately 40 acres of the total AOC LF-1 area, while the 1970 Cell, Post-1970 Cell and Kettle Hole occupy approximately 50 acres. The additional 10 acres is comprised of the space between cells. The depth of waste burial has not been determined accurately, but is estimated to be about 20 feet below ground surface for the two cells; the depth to waste in the Kettle Hole is unknown (E.C. Jordan Co., 1988 and 1990).

Accurate documentation of wastes landfilled at AOC LF-1 does not exist. The wastes are believed to include general refuse, fuel tank sludge, herbicides, solvents, transformer oils, fire extinguisher fluids, blank small arms ammunition, paints, paint thinners, batteries, dichlorodiphenyltrichloroethane (DDT) powder, hospital wastes, municipal sewage sludge, coal ash, and possibly live ordnance. Recent waste disposal practices and the existing surface topography at older cell areas indicate that the trench method was used for landfilling in the five cells. Refuse was buried in linear trenches and covered daily with soil excavated from the trench. At the Kettle Hole, wastes were dumped into the center from the top edge.

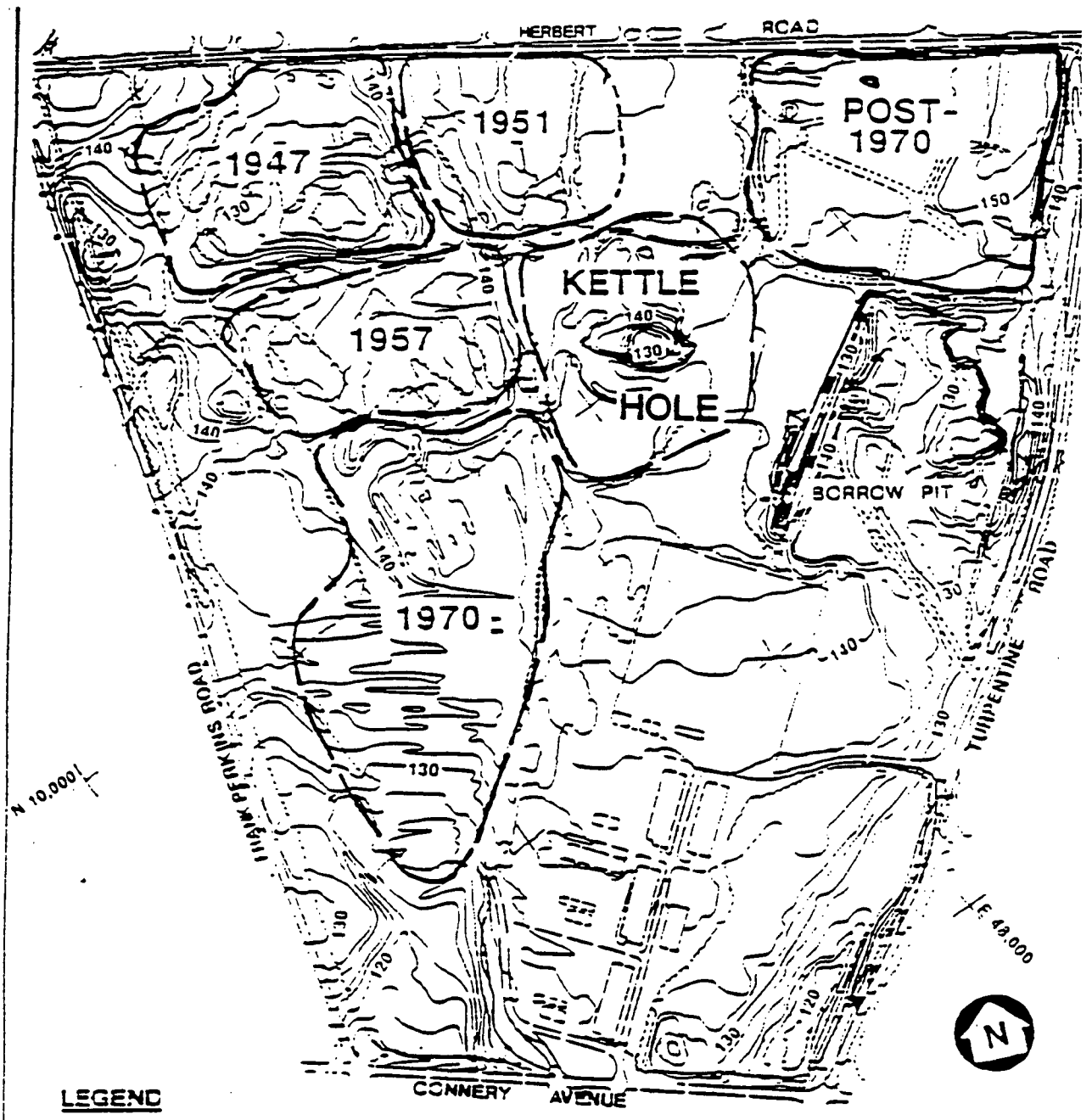


ABB Environmental Services, Inc.	PHOTOGRAMMETRIC MA SHOWING DISPOSAL CEL	
INSTALLATION RESTORATION PROGRAM MASSACHUSETTS MILITARY RESERVATION	AOC LF-1	FIGURE 3-

7030-03

In June 1989, solid waste disposal in the Post-1970 cell ceased. Domestic waste disposal at the Kettle Hole ceased in 1990; construction debris from on-base building demolition will cease prior to cap construction. Solid waste has since been sent to a transfer station on MMR, with final disposal at the SEMASS incinerator in Rochester, Massachusetts; this is the current solid waste disposal practice for MMR.

Previous investigations conducted to characterize AOC LF-1 Source Area include a records research completed in 1983; an initial site inspection (SI) in 1985; and a geophysical investigation in 1986 (Metcalf and Eddy, Inc., 1983; R.F. Weston, Inc., 1985; and E.C. Jordan Co., 1988). A second phase of the SI was completed in 1988 and a Remedial Investigation (RI) in 1989 (E.C. Jordan Co., 1990; and ABB Environmental Services, Inc., 1992a).

3.2 Enforcement History

The NGB has followed USEPA guidelines for most of the IRP investigations conducted at MMR since 1986 and for all investigations completed since 1989. Placement on the NPL has not necessitated substantive changes in the overall technical approach to remediation studies. However, upon formalization of the NPL status, the NGB entered into an Interagency Agreement with USEPA and USCG on July 17, 1991, to define responsibilities, documentation requirements, and future regulatory interaction regarding remedial activities at MMR under CERCLA authority. The ANG is the NGB component directly responsible for carrying out NGB's responsibilities under the agreement.

4.0 COMMUNITY PARTICIPATION

Throughout MMR's history, community concern and involvement has been high. The NGB and USEPA have kept the community and other interested parties apprised of site activities through informational meetings, fact sheets, news releases, public hearings, and Technical Environmental Affairs Committee (TEAC) meetings. The TEAC was organized in 1986 by the NGB to provide a forum for public input on MMR remedial response activities. Membership on the TEAC comprises USEPA, Massachusetts Department of Environmental Protection (MADEP), and representatives from local, regional, and state groups. Beginning with the October 7, 1992, TEAC meeting, members of the public could request attendance as observers through their TEAC representative.

During May 1991, the MMR community relations plan was released; this outlined a program to address community concerns and keep citizens informed and involved in the remediation process at MMR.

On June 30, 1992, the NGB made the administrative record available for public review at NGB's IRP Office, Otis ANG Base, Massachusetts; USEPA's offices in Boston, Massachusetts; and the Falmouth Public Library, Falmouth, Massachusetts. The NGB published a notice and brief analysis of the Proposed Plan in the Cape Cod Times, and in the Falmouth/Mashpee/Bourne Enterprise on June 26, 1992. The NGB made the FFS and Proposed Plan available to the public at Falmouth Public Library and the administrative records locations.

On June 30, 1992, the NGB held an informational meeting at Bourne High School in Bourne, Massachusetts to discuss the results of the field investigations and the clean-up alternatives presented in the FFS and to present the Proposed Plan. Also during this meeting, the NGB answered questions from the public. From July 1 to August 29, 1992, the NGB held a 30-day public comment period with a 30-day extension, to accept public comments on the alternatives presented in the FFS and the Proposed Plan. On July 22, 1992, the NGB held a public hearing to discuss the Proposed Plan and to accept any oral comments. A transcript of this hearing and the NGB's responses to the comments are included in the responsiveness summary (see Appendices C and D).

5.0 SCOPE AND ROLE OF RESPONSE ACTION

The proposed remedy was selected to take action to protect human health and the environment in the short term while additional information is collected to better assess the response of the aquifer and contaminants to remediation efforts. Thus the selected remedy is an interim remedy. The interim remedy will operate for a minimum of five years, during which time a final remedial action plan for AOC LF-1 Source Area will be developed. A final ROD for AOC LF-1 Source Area will be based on the data collected during the design, operation, and monitoring of the interim remedy and the findings of further characterization of the groundwater downgradient of 1947, 1951, and 1957 cells. Additional interim actions may be proposed if data collected prior to the final ROD indicate that such actions are warranted.

In summary, the interim remedy consists of: (1) constructing a landfill cover system on the 1970 Cell, Post-1970 Cell, and Kettle Hole; (2) conducting post-closure maintenance and monitoring of the cover system on these cells for a minimum of 30 years after the completion of the cover; (3) monitoring landfill gas and groundwater quality semi-annually and submit results for regulatory agency review; (4) the NGB and appropriate regulatory agencies will review the effectiveness of the AOC LF-1 source interim remedial action every five years.

The interim remedial action will allow time to further evaluate the impact of the 1947, 1951, and 1957 cells on groundwater quality, while minimizing further impact on the environment from the 1970 Cell, Post-1970 Cell, and Kettle Hole. The final remedial action will be consistent with the interim action and the NGB's long-term clean-up goals of reducing contaminant concentrations in groundwater at MMR.

The interim remedial actions will address the following response objectives:

- Reduce contaminant leaching to groundwater.
- Minimize migration of liquids through closed landfill cells.
- Maintain compatibility with the final remedial measures.

6.0 SUMMARY OF SITE CHARACTERISTICS

Section 3.0 of the FFS provides an overview of the AOC LF-1 environmental contamination assessment. The significant findings of the contamination assessment are summarized in the following subsections.

6.1 LANDFILL WASTE CONTAMINATION ASSESSMENT

Intrusive explorations, such as test pitting and drilling, were not conducted within the landfill cells because of the possibility that live ordinance disposal occurred at the AOC. Non-invasive explorations including a soil gas survey and a magnetometer survey have been conducted at this AOC. Accurate documentation of the waste disposed of in AOC LF-1 does not exist; however, based on record searches and interviews, waste materials including general refuse, fuel tank sludge, solvents, herbicides, transformer oils, fire extinguisher fluids, blank small arms ammunition, paints, paint thinners, batteries, DDT powder, hospital wastes, municipal sewage sludge, coal ash, and possibly live ordnance were deposited in the landfill cells.

6.2 GROUNDWATER CONTAMINATION ASSESSMENT

Chlorinated volatile organic compounds (VOCs), aromatic hydrocarbons, and inorganic analytes were observed in groundwater downgradient of AOC LF-1. The highest concentrations and largest number of contaminants were associated with the Post-1970 Cell, confirming that this cell is a continuing source of contaminants impacting groundwater. These three chemical groups were also detected in groundwater immediately downgradient of the 1970 Cell, suggesting that some leaching may still be occurring from materials within this cell. Data from long-screened wells adjacent to the Post-1970 Cell (i.e., MW-1 and MW-2) and the 1970 Cell (i.e., MW-9) suggest that contamination extends 75 feet into the aquifer; however, VOCs were detected in the upper 40 feet of the aquifer in multilevel well clusters MW-11 and MW-16, suggesting that results from long-screened wells may overestimate the actual depth of groundwater contamination.

With the exception of chloroform, which was detected at a concentration less than or equal to 5 µg/L downgradient of the 1957 Cell, contaminants were not detected downgradient of the 1947, 1951, and 1957 cells. Inorganic concentrations that would be indicative of current leaching were not found downgradient of the 1947, 1951, and 1957 cell areas. Table 6-1 summarizes the groundwater analytical results from these cells. Due to regulatory agency concerns about data gaps with the existing monitoring well network, additional investigation will be conducted to further characterize groundwater downgradient of these cells.

The areal distribution of total chlorinated ethenes and carbon tetrachloride migrating from AOC LF-1 is shown in Figure 6-1. Contaminants were detected as far away as the MMR boundary, approximately 8,000 feet from AOC LF-1. The chlorinated VOC plume is approximately 3,000 feet across at downgradient monitoring well locations. The presence of TCE in deep monitoring wells at AOC LF-1 (MW-19) and downgradient (MW-23) was potentially attributed to a source upgradient of the landfill, and is interpreted as a zone where contamination originating from AOC LF-1 and from AOC CS-10 shares a common boundary or is merging together downgradient. The total concentration of chlorinated VOCs measured in MW-20A (198 µg/L) represented the highest concentrations detected downgradient of the Post-1970 Cell. MCLs for PCE, TCE, and carbon tetrachloride were exceeded in monitoring wells both within the boundary of the landfill and at downgradient locations. The MCL for vinyl chloride was also exceeded in two sampling rounds in one monitoring well immediately downgradient of the 1970 Cell.

The general shape of the solvent plume probably reflects contaminants released from the different landfill cell areas active during different periods (i.e., the total area of impacted groundwater is potentially a composite of contaminants originating from the 1970 Cell, active between 1958 and 1970; the Post-1970 Cell; and the Kettle Hole). The area toward the northern lateral border of the plume is downgradient of the older 1970 Cell, whereas contaminants distributed along the southern lateral region of the plume are downgradient of the more recent Post-1970 Cell. Groundwater flow lines in the middle of the solvent plume could have intercepted either cell or the Kettle Hole. Contaminants originating from the 1970 Cell would have had up to an additional 12 years of travel time, compared to contaminants first released from the Post-1970 Cell, which may explain the apparent asymmetrical plume geometry observed downgradient. In addition, because the 1970 Cell is

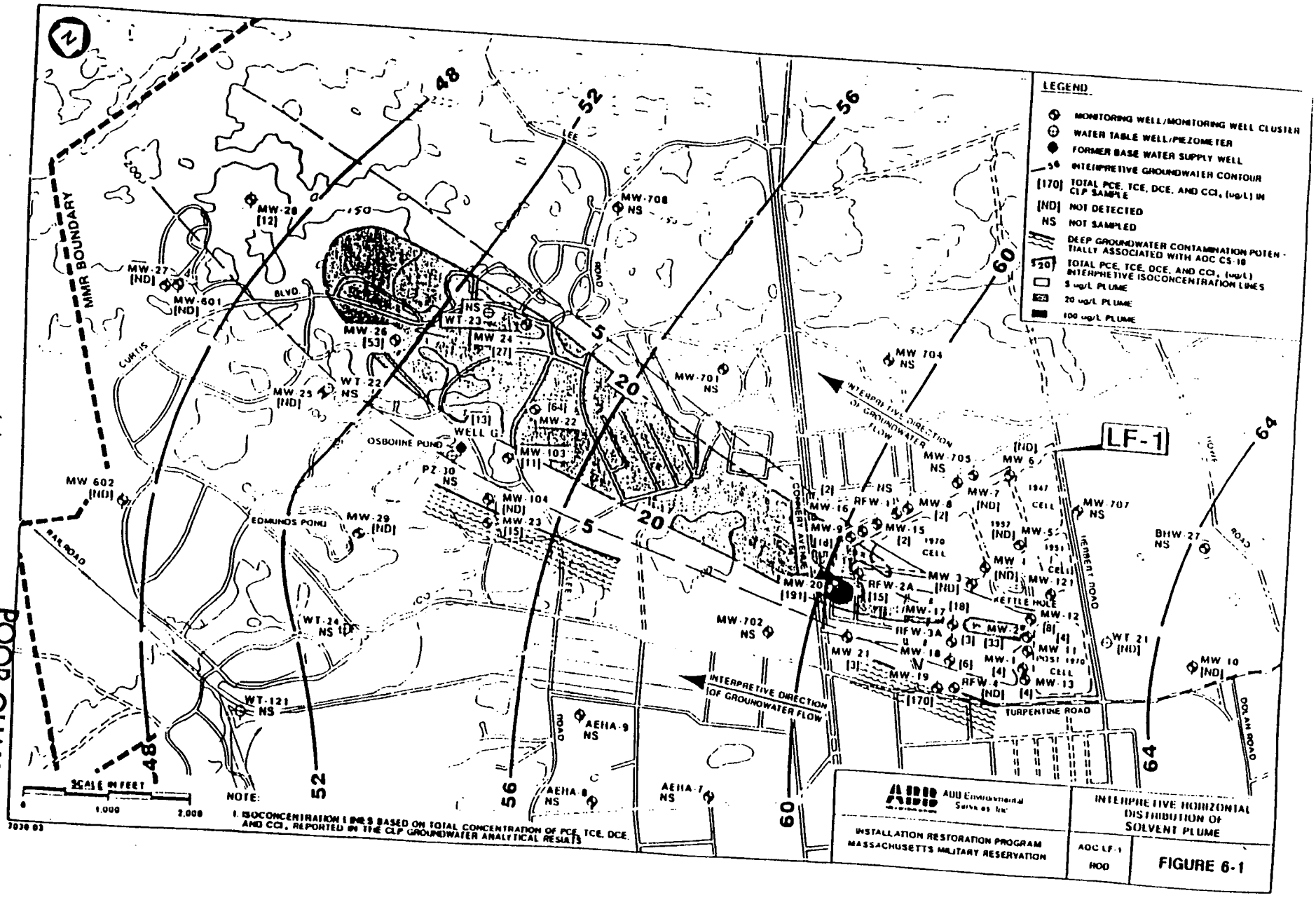
TABLE 6-1
SUMMARY OF LABORATORY ANALYTICAL GROUNDWATER RESULTS
FROM THE 1947, 1951, AND 1957 CELLS

AOC LF-1 RECORD OF DECISION
MASSACHUSETTS MILITARY RESERVATION

ANALYTE (UNIT)	DETECTION LIMIT	RANGE	FREQUENCY[1]
Volatile Organic Compounds (µg/L):			
Chloroform	1	3-5	6/22
Inorganics (µg/L):			
Calcium	5,000	7,080-15,700	5/5
Sodium	5,000	5,860-5,980	3/5

Notes:

[1] Number of detections per total number of samples analyzed.
µg/L = micrograms per liter



approximately 2,000 feet downgradient from the Post-1970 Cell, contaminants leaving the 1970 Cell will travel farther downgradient from the landfill boundary in a given period than those migrating from the Post-1970 Cell. Tables 6-2 and 6-3 summarize the results from two groundwater sampling rounds at the 1970 Cell and Kettle Hole. Table 6-4 summarizes analytical results from groundwater at the Post-1970 Cell.

The solvent plume is sinking at a rate between 1.25 and 2.5 feet per 100 feet of horizontal migration, between the Post-1970 Cell and Connery Avenue (near the MW-20 cluster) 2,700 feet downgradient. Adjacent to the Post-1970 Cell, the bottom of contamination was detected to a depth of approximately 40 feet in the aquifer. Further downgradient of the Post-1970 Cell near Connery Avenue, the bottom of contamination was detected to a depth of approximately 100 feet in the aquifer. Chemical data from Fence No. 2 and Fence No. 3 monitoring wells indicate that the solvent plume is leveling off downgradient at an elevation approximately 50 feet below mean sea level (MSL). A summary of laboratory analytical results from downgradient groundwater is provided in Table 6-5.

Potential reasons for this leveling off include: (1) decreased hydraulic conductivity with depth, and (2) the influence of the regional groundwater flow pattern. Soil boring logs, screened-auger logs, and in situ hydraulic conductivity (i.e., permeability) testing of some deep monitoring wells (i.e., MW-20Z, MW-27, and MW-28A,B) show finer-grained deposits at depth, with hydraulic conductivities 10 times lower than corresponding values measured in coarser grained shallow outwash deposits. Preferential contaminant migration would occur in regions of higher hydraulic conductivity (i.e., groundwater movement may be restricted in the finer strata at depth). In addition, the regional groundwater flow pattern established between the principal recharge area (located in the northern portion of MMR) and the natural discharge boundary (i.e., the ocean and Buzzards Bay) will influence the geometry of the plume. At some distance downgradient of the major recharge zone, the regional groundwater flow lines will level off, and eventually rise in elevation toward the natural discharge boundary. These two factors will affect the depth the solvent plume attains, especially a plume characterized by relatively low contaminant concentrations.

In addition to the chlorinated compounds comprising the bulk of the plume, aromatic hydrocarbons were also found in monitoring wells immediately downgradient of the Post-1970 Cell and the 1970 Cell, and in one monitoring well near Well G. MCLs

TABLE 6-2
SUMMARY OF LABORATORY ANALYTICAL RESULTS FOR
OCTOBER 1989 GROUNDWATER SAMPLING AT THE 1970 CELL AND KETTLE HOLE

AOC LF-1 RECORD OF DECISION
MASSACHUSETTS MILITARY RESERVATION

ANALYTE (UNIT)	DETECTION LIMIT	RANGE	FREQUENCY[1]
Volatile Organic Compounds (µg/L):			
Benzene	1	3-8	8/35
Chlorobenzene	1	2-3X	2/35
Chloroform	1	1	2/35
1,1-Dichloroethane	1	1-2	7/35
1,2-Dichloroethylene (total)	1	8-18	8/35
Ethylbenzene	1	1-3	7/35
Tetrachloroethylene	1	1-2	7/35
Toluene	1	3-4	3/35
Vinyl Chloride	2	3-4	8/35
Xylenes (total)	1	3X	1/35
Inorganics (µg/L):			
Arsenic	10	22.5	2/17
Cadmium	5	5.8J	1/17
Calcium	5,000	11,200-20,900	11/17
Iron	100	99,800-116,000	2/17
Lead	5	9.5-25.6	6/17
Magnesium	5,000	5,390-5,710	2/17
Manganese	15	479-1,770	3/17
Mercury	0.2	0.22-0.37	2/17
Sodium	5,000	5,250-9,540	17/17
Zinc	20	30.6-134	4/17
Miscellaneous (mg/L):			
Chemical Oxygen Demand	5	14.9-28.6	5/6
Phenolics	0.01	0.011	1/6
Total Dissolved Solids	10	90-193	6/6
Hardness	-	41.9-62.3	5/5

Notes:

[1] Number of detections per total number of samples analyzed.
J = Indicates an estimated value.
X = Mass spectrum does not meet USEPA CLP criteria; however, compound presence strongly suspected.
µg/L = micrograms per liter
mg/L = milligrams per liter

W079225.T80/2

TABLE 6-3
SUMMARY OF LABORATORY ANALYTICAL RESULTS FOR
APRIL 1990 GROUNDWATER SAMPLING AT THE 1970 CELL AND KETTLE HOLE

AOC LF-1 RECORD OF DECISION
MASSACHUSETTS MILITARY RESERVATION

ANALYTE (UNIT)	DETECTION LIMIT	RANGE	FREQUENCY[1]
Volatile Organic Compounds (µg/L):			
Benzene	1	1X-7	7/20
Chlorobenzene	1	2X	3/20
Chloromethane	2	5X	1/20
1,1-Dichloroethane	1	1-2X	5/20
1,2-Dichloroethylene (total)	1	1-13	7/20
Tetrachloroethylene	1	1	1/20
Trichloroethylene	1	2	1/20
1,1,1-Trichloroethane	1	1	2/20
Inorganics (µg/L):			
Arsenic	10	19.6-30.2	5/8
Calcium	5,000	7,440-18,500	6/8
Iron	100	14,800-126,000	7/8
Magnesium	5,000	5,220	1/8
Manganese	15	735-2,120	7/8
Potassium	5,000	5,310	1/8
Sodium	5,000	5,190-8,140	8/8
Miscellaneous (mg/L):			
Chemical Oxygen Demand	5	7.7-38.5	6/8
Total Organic Carbon	0.5	3.8-8.1	2/8

Notes:

[1] Number of detections per total number of samples submitted.
µg/L = micrograms per liter
mg/L = milligrams per liter
X = Mass spectrum does not meet USEPA CLP criteria, however, compound presence strongly suspected.

TABLE 6-4
SUMMARY OF LABORATORY ANALYTICAL GROUNDWATER RESULTS
FROM THE POST-1970 CELL

AOC LF-1 RECORD OF DECISION
MASSACHUSETTS MILITARY RESERVATION

ANALYTE (UNIT)	DETECTION LIMIT	RANGE	FREQUENCY[1]
Volatile Organic Compounds (µg/L):			
Benzene	1	7.1	1/56
Carbon Tetrachloride	1	2-71	4/56
Chloroethane	2	4.2X	1/56
Chloroform	1	1	3/56
1,1-Dichloroethane	1	1-8.5	26/56
1,2-Dichloroethylene (total)	1	2-33	27/56
Ethylbenzene	1	1.2-10	8/56
2-Hexanone	2	10-11	3/56
4-Methyl-2-Pentanone	2	6.4-32	9/56
Tetrachloroethylene	1	2-54	11/56
1,1,1-Trichloroethane	1	1-4	13/56
Trichloroethylene	1	1-170	14/56
Toluene	1	25-100	14/56
Xylenes (total)	1	2.1X-41	8/56
Semivolatile Organic Compounds (µg/L):			
Benzoic acid	50	52X	1/19
bis(2-ethylhexyl)phthalate	10	25	1/19
4-Methylphenol	10	290-340	7/19
Inorganics (µg/L):			
Antimony	60	62.2-150	11/31
Arsenic	10	12.2-31.1	20/31
Calcium	5,000	6,170-23,800	26/31
Iron	100	22,100-184,000	24/31
Lead	5	5.6-36.3	8/31
Magnesium	5,000	5,100-19,700	18/31
Manganese	15	27.7-5,170	27/31
Potassium	5,000	5,830-6,060	2/31
Sodium	5,000	5,270-13,500	30/31
Zinc	20	26.9-191	6/31
Pesticides/PCBs (µg/L):			
None detected			0/26
Miscellaneous (mg/L):			
Chemical Oxygen Demand	5	5.0-144	12/22
Total Petroleum Hydrocarbons	0.2	12-14	3/10
Phenolics	0.01	0.018-0.021	2/22
Total Dissolved Solids	10	12-353	19/22
Hardness	-	3.9-240.9	22/22

Notes:

[1] Number of detections per total number of samples analyzed.

mg/L = milligrams per liter
µg/L = micrograms per liter
PCBs = polychlorinated biphenyls

TABLE 6-5
SUMMARY OF LABORATORY GROUNDWATER ANALYTICAL RESULTS
FROM THE DOWNGRADIENT MONITORING WELLS

AOC LF-1 RECORD OF DECISION
MASSACHUSETTS MILITARY RESERVATION

ANALYTE (UNIT)	DETECTION LIMIT	RANGE	FREQUENCY[1]
Volatile Organic Compounds (µg/L)			
Benzene	1	9	1/28
Carbon Tetrachloride	1	11-20	2/28
1,1-Dichloroethane	1	5	1/28
1,2-Dichloroethylene	1	5-48	4/28
1,1,1-Trichloroethane	1	5-15	3/28
Trichloroethylene	1	6-15	4/28
Tetrachloroethylene	1	5-14	4/28
1,1,2,2-Tetrachloroethane	1	6-9	2/28
Inorganics (µg/L):			
Sodium	5,000	7,960-15,400	3/3

Notes:

[1] Number of detections per total number of samples submitted.
µg/L = micrograms per liter

for benzene were slightly exceeded at each location. The highest total concentration of aromatic hydrocarbons was found immediately downgradient of the Post-1970 Cell, where a maximum concentration of 142 μg/L was measured. Toluene was the predominant aromatic compound detected in groundwater. Except for benzene near Well G (i.e., in MW-103A), aromatic hydrocarbons do not appear to be migrating appreciable distances downgradient from the Post-1970 Cell. However, the presence of benzene in monitoring wells near Well G was not detected in any previous groundwater sampling rounds, and may actually represent a sampling anomaly.

Concentrations of inorganic analytes in samples from monitoring wells located downgradient of the Post-1970 Cell, 1970 Cell, and Kettle Hole were higher than in samples from an upgradient (i.e., background) monitoring well. These results indicate that inorganic leachate is potentially moving from these portions of the landfill. Groundwater MCLs were not exceeded for any inorganics; however, the lead concentration exceeded the USEPA action level for groundwater in locations of the landfill plume where fuel-related compounds were detected.

Several indicator leachate parameters were measured at AOC LF-1 to ascertain whether the landfill was still actively leaching contamination. These parameters included specific conductivity, chemical oxygen demand (COD), total organic carbon (TOC), pH, alkalinity (total and phenolphthalein), hardness, and a variety of anions (i.e., nitrate, nitrite, chloride, and sulfate). Many of these parameters are related and together provide valuable information about landfills. COD, for example, is a gross measure of organic content of a sample (not merely Target Compound List [TCL] compounds), as is TOC. However, the TOC procedure is more likely to detect VOCs than the COD procedure.

Leachate parameters were measured upgradient of AOC LF-1 (MW-10) to establish background levels. The same parameters were then measured downgradient of the landfill and the differences were interpreted. These indicator parameters are not a measure of the toxicity of the leachate. Rather, they are used as gross indicators of organic and inorganic contamination in the form of landfill leachate.

Downgradient levels of leachate parameters did not differ significantly from the background levels, except in samples from a few monitoring wells located along the axis of the contaminant plume. Specific conductivity, an indicator of inorganic leachate, exhibited the most variability (approximately one order of magnitude); this

information was used to confirm current transport information concerning the contaminant plume migrating from AOC LF-1.

7.0 SUMMARY OF SITE RISKS

A human health risk assessment was conducted to estimate the probability and magnitude of potential adverse human health effects from exposure to contaminants associated with AOC LF-1. The risk assessment focused only on potential human health risks associated with exposure to source area groundwater. The groundwater risk assessment is described in detail in the FFS (ABB Environmental Services, Inc. 1992b). Human health and ecological risks associated with exposure to surface soil contamination were not evaluated for two reasons. First, no data exist on the nature and extent of soil contamination at AOC LF-1. As described, no sampling has been done in the areas of actual waste disposal because of the possibility of encountering buried live ordnance. Therefore, the characterization and quantification of risk resulting from potential soils contamination would be impossible to summarize. Landfilled wastes have been covered with soil, thereby minimizing the potential for direct exposure to landfilled wastes and contaminants. Second, the potential risks associated with exposure to source area groundwater are sufficient to require source remedial action. Of the remedial actions evaluated, a landfill cover system will be constructed. The cover system and proposed fencing will effectively prevent receptors from contacting contaminated surface soils at AOC LF-1. Therefore, because no exposure will occur, no risks from exposure to AOC LF-1 source contamination will exist.

The human health risk assessment followed a four-step process:

1. Contaminant identification, which identified those hazardous substances that, given the specifics of the site, were of significant concern.

2. Exposure assessment, which identified actual or potential exposure pathways, characterized the potentially exposed populations, and determined the extent of possible exposure.

3. Toxicity assessment, which considered the types and magnitude of adverse health effects associated with exposure to hazardous substances.

4. Risk characterization which integrated the three earlier steps to summarize the potential and actual carcinogenic and noncarcinogenic risks posed by hazardous substances at the site.

Results of the human health risk assessment for the AOC LF-1 are discussed in the following paragraphs.

Nineteen contaminants of concern (COCs) were selected for evaluation in the risk assessment. All COCs were detected at least once in the groundwater, and are listed in Table 7-1. The health effects of each COC are summarized in Appendix B of the FFS (ABB Environmental Services, Inc., 1992b).

Potential human health effects associated with exposure to the COCs were estimated quantitatively through the development of hypothetical exposure pathways. These pathways were developed to reflect the potential future uses and location of AOC LF-1. The following is a brief summary of the exposure pathways evaluated; a more thorough description is in the FFS (ABB Environmental Services, Inc., 1992b). The receptor population exposure pathway was assumed to be future downgradient residents. A lifetime (i.e., 70 years) of consuming 2 liters of groundwater per day for 350 days per year was assumed for an average body weight of 70 kilograms. It was assumed that the same size person would inhale volatilized contaminants at a rate of 0.6 cubic meter per hour during daily 12-minute showers. For each evaluated pathway, an average and a reasonable maximum exposure estimate was generated corresponding to exposure to the average and the maximum concentration detected in groundwater.

Lifetime cancer risks were determined for each exposure pathway by multiplying the exposure level by the chemical-specific cancer slope factor. Cancer slope factors have been developed by USEPA from epidemiological or animal studies to reflect a conservative "upper bound" of the risk posed by potentially carcinogenic compounds. That is, the true risk is unlikely to be greater than the predicted risk. The resulting risk estimates are expressed in scientific notation as a probability (e.g., $1x10^{-6}$ for 1/1,000,000) and indicate (using this example) that an individual has a one-in-a-million chance of developing cancer as a result of site-related exposure over 70 years to the particular compound at the stated concentration. Current USEPA practice considers carcinogenic risks to be additive when assessing exposure to a mixture of hazardous substances.

TABLE 7-1
CONTAMINANTS OF CONCERN IN GROUNDWATER

AOC LF-1 RECORD OF DECISION
MASSACHUSETTS MILITARY RESERVATION

CONTAMINANT	CONCENTRATION RANGE (µg/L)	AVERAGE CONCENTRATION[1] (µg/L)	MAXIMUM CONCENTRATION (µg/L)	FREQUENCY OF DETECTION
Volatile Organic Compounds				
Benzene	ND[2] - 5.8	3.0	5.8	2/11
Carbon Tetrachloride	ND - 71	12	71	5/11
Chlorobenzene	ND - 3.0	2.5	3.0	2/11
1,1-Dichloroethane	ND - 8.0	3.0	8.0	9/11
1,2-Dichloroethylene	ND - 48	14	48	10/11
Ethylbenzene	ND - 9.0	3.0	9.0	2/11
2-Hexanone	ND - 7.7	5.2	7.7	1/11
4 Methyl-2-Pentanone	ND - 28	7.1	28	1/11
1,2,2,2-Tetrachloroethane	ND - 9.0	3.4	9.0	2/11
Tetrachloroethylene	ND - 54	9.3	54	6/11
Toluene	ND - 92	11	92	1/11
1,1,1-Trichloroethane	ND - 8.0	3.2	8.0	3/11
Trichloroethylene	ND - 55	9.6	55	6/11
Vinyl Chloride	ND - 4.1	4.7	4.1	2/11
Xylenes	ND - 37	5.6	37	1/11
Semivolatile Organic Compounds				
4-Methylphenol	--[3]	310	310	1/1
Inorganics				
Arsenic	22 - 27	25	27	2/2
Lead	ND - 7.0	4.2	7.0	1/2
Manganese	1,700 - 4,300	3,000	4,300	2/2

Notes:

1 Arithmetic means were used to average data. Half the Contract Required Quantitation Limits were substituted for nondetect values.

2 ND = Not detected

3 -- = No range concentrations because only one sample analyzed for SVOCs

µg/L = micrograms per liter

The Hazard Index (HI) was also calculated for each pathway as USEPA's measure of the potential for noncarcinogenic health effects. The HI is calculated by dividing the exposure level by the reference dose (RfD) or other suitable benchmark for noncarcinogenic health effects. RfDs have been developed by USEPA to protect sensitive individuals over the course of a lifetime, and they reflect a daily exposure level that is likely to be without an appreciable risk of an adverse health effect. RfDs are derived from epidemiological or animal studies and incorporate uncertainty factors to help ensure that adverse health effects will not occur. The HI is often expressed as a single value (e.g., 0.3) indicating the ratio of the stated exposure to the RfD value (in this example, the exposure is approximately one-third of an acceptable exposure level for the given compound). The HI is only considered additive for compounds that have the same or similar toxic endpoints (for example: the HI for a compound known to produce liver damage should not be added to an HI for a second compound whose toxic endpoint is kidney damage).

Table 7-2 summarizes the carcinogenic and noncarcinogenic risks for the hypothetical exposure to contaminated groundwater downgradient of AOC LF-1 by ingestion and inhalation of volatilized contaminants in the shower. More detailed tables of the risk assessment are in Appendix B of the AOC LF-1 FFS (ABB Environmental Services, Inc., 1992b).

Carcinogenic risks are compared to the USEPA target carcinogenic risk range of 10^{-4} to 10^{-6}. Noncarcinogenic risks are compared to the USEPA target noncarcinogenic HI of 1.0 (USEPA, 1990). Future potential carcinogenic risks for downgradient residents ingesting and inhaling groundwater contaminants were estimated to be $7x10^{-4}$ (average case) and $9x10^{-4}$ (reasonable worse case). Noncarcinogenic risks were estimated to be 4 (average case) and 7 (reasonable worse case). Both carcinogenic and noncarcinogenic risks exceed the USEPA target risk ranges.

Arsenic contributed 74 percent of the carcinogenic (average case) and 67 percent of the carcinogenic (reasonable worst case) risk in groundwater. The non-carcinogenic risks were also influenced by the presence of arsenic: 61 percent of the average case and 36 percent of the reasonable worst case were attributed to the arsenic detected in groundwater.

TABLE 7-2
SUMMARY OF CARCINOGENIC AND NONCARCINOGENIC
RISKS FROM EXPOSURE TO GROUNDWATER

AOC LF-1 RECORD OF DECISION
MASSACHUSETTS MILITARY RESERVATION

	LIFETIME INCREMENTAL CANCER RISK		NONCARCINOGENIC HAZARD INDEX	
EXPOSURE PATHWAY	AVERAGE CASE	WORST CASE	AVERAGE CASE	WORST CASE
Ingestion	7×10^{-4}	8×10^{-4}	4	7
Inhalation of Volatilized Contaminants	5×10^{-6}	6×10^{-5}	0.004	0.00005
Combined	7×10^{-4}	9×10^{-4}	4	7

Risk estimates are subject to a wide variety of uncertainties. Risk assessments do not calculate absolute risks, but rather provide conservative analyses to evaluate the potential for adverse impacts. In most risk assessments, uncertainties tend to err on the side of conservatism. Therefore, the calculated risks usually provide an upper bound of risks likely to be encountered at the site. Actual risks will probably be much lower than these calculated risks.

There are uncertainties involved in adding risks from individual chemicals to estimate total risks. Many individual chemicals act through different mechanisms on different target organs; therefore, the risks are not necessarily additive. However, some chemicals may potentiate the effects of other chemicals, so that the combined risks may be greater than the sum of the individual risks.

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the remedial action selected in this ROD, may present an imminent and substantial endangerment to human health, welfare, or the environment. Risks resulting from releases to groundwater are considered in this ROD.

8.0 DEVELOPMENT AND SCREENING OF ALTERNATIVES

Three alternatives were developed and screened in the FFS. This section describes the response objectives and the development and screening of alternatives.

8.1 STATUTORY REQUIREMENTS/RESPONSE OBJECTIVES

Under its legal authorities, NGB's primary responsibility at this NPL site is to undertake remedial actions that are protective of human health and the environment. In addition, Section 121 of CERCLA establishes several other statutory requirements and preferences, including a requirement that the remedial action, when complete, must comply with all federal and more stringent state environmental standards, requirements, criteria, or limitations, unless a waiver is invoked; a requirement that the selected remedial action is cost-effective and utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and a preference for remedies in which treatment that permanently and significantly reduces the toxicity, mobility, or volume of the hazardous substances is a principal element over remedies not involving such treatment. Remedial alternatives were developed to be consistent with these Congressional mandates.

Based on preliminary information relating to types of contaminants, environmental media of concern, and potential exposure pathways, remedial action objectives were developed to aid in the development and screening of alternatives. These interim remedial action objectives were developed to mitigate existing and future potential threats to human health and the environment:

- Reduce contaminant leaching to groundwater.
- Minimize of migration of liquids through closed landfill cells.
- Maintain compatibility with the final remedial measures.

8.2 ALTERNATIVES DEVELOPMENT AND SCREENING

CERCLA and the NCP set forth the process by which remedial actions are evaluated and selected. In accordance with these requirements, a range of alternatives were developed for AOC LF-1 source control.

The FFS for AOC LF-1 developed a minimal no-action alternative and a limited number of interim remedial alternatives that attain site-specific remediation objectives (ABB Environmental Services, Inc., 1992b).

Section 6.0 of the FFS identified, assessed, and screened technologies based on effectiveness, implementability, and cost. The FFS focused only on source control technologies. A separate report will address groundwater contaminant migration technologies. This will be done after groundwater characterization is complete (ABB Environmental Services, Inc., 1992b). Section 7.0 of the FFS presented the interim remedial alternatives developed by combining the technologies identified in the initial screening process per Section 300.430(e)(3) of the NCP. The purpose of the initial screening was to narrow the number of potential remedial actions for further detailed analysis. Cover system alternatives were then developed and evaluated in Section 7.0 of the FFS.

Of the 11 remedial technologies initially screened and assembled into alternatives in the FFS, a detailed evaluation was conducted on a cover system. Two different cover system alternatives were evaluated: one which involved covering all cells of the landfill, and one which involved covering only those cells which have conclusively shown to be leaching contaminants of concern. The third alternative, minimal no action, was used as a baseline for comparison with the two cover system alternatives.

9.0 DESCRIPTION OF ALTERNATIVES

This section provides a narrative summary of each evaluated alternative. Detailed assessments of each alternative are presented in Section 7.0 of the FFS (ABB Environmental Services, Inc., 1992b).

9.1 SOURCE CONTROL ALTERNATIVES ANALYZED

Based on selection of cover systems as a remedial technology, three remedial alternatives were developed for source area control at AOC LF-1:

- minimal no action
- cover new landfill cells
- cover all landfill cells

The following subsections describe each alternative.

9.1.1 Alternative No. 1: Minimal No Action

The minimal no-action alternative serves as the baseline alternative for source control at AOC LF-1. This alternative would include the long-term groundwater monitoring program described in Subsection 7.1.2.9 of the FFS (ABB Environmental Services, Inc., 1992b). However, no remedial actions or administrative controls would be implemented.

9.1.2 Alternative No. 2: Cover New Landfill Cells

This alternative consists of installing a final cover system conforming to RCRA guidance over the 1970 Cell, Post-1970 Cell, and Kettle Hole to isolate contaminants and minimize migration to groundwater. In addition, this alternative includes a semiannual groundwater monitoring program, semiannual cover inspection and maintenance, and semiannual reporting to USEPA and MADEP as described in Subsection 7.1.2.9 of the FFS. The interim remedial action at AOC LF-1 also consists of leaving wastes in place beneath the soil and vegetative cover at the 1947, 1951, and 1957 cells, and installing additional downgradient groundwater monitoring

wells. Groundwater investigations will be performed downgradient of the 1947, 1951, and 1957 cells to assess current groundwater impacts from these older cells and to determine if the interim remedial action is an appropriate long-term remedial action.

The final cover system for the 1970 Cell, Post-1970 Cell, and Kettle Hole would be designed to accomplish the following goals:

- minimize surface water infiltration through the landfilled wastes
- promote drainage
- minimize surface erosion
- accommodate landfill settlement
- isolate landfilled wastes from the environment
- control air pollutants

To meet these goals and the remedial objectives, the final cover system would consist of the following components from top to bottom (Figure 9-1):

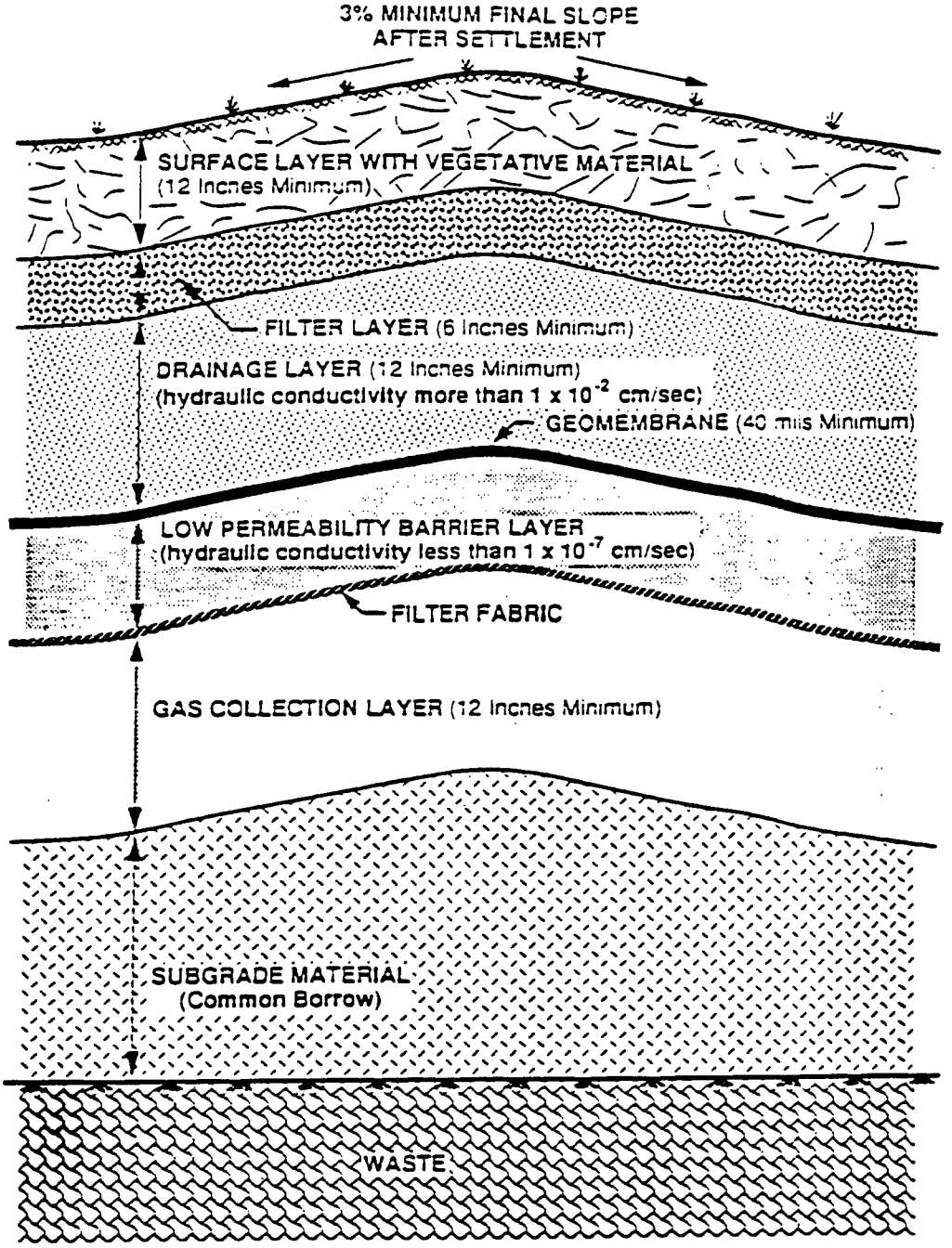
- surface layer with vegetative material
- drainage layer
- low permeability barrier layer with geomembrane
- gas collection layer
- subgrade material (i.e., common borrow)

The composite hydraulic barrier layer would be a geomembrane underlain by a low-permeability barrier layer.

Detailed descriptions of cover system components can be found in Section 7.0 of the FFS (ABB Environmental Services, Inc., 1992b).

9.1.3 Alternative No. 3: Cover All Landfill Cells

This alternative consists of installing a final cover system at the 1970 Cell, Post-1970 Cell, and Kettle Hole as described in the previous subsection. This alternative also includes installing a cover system conforming to current MADEP guidance, at the 1947, 1951, and 1957 cells. The MADEP guidance cover, although less rigorous than a RCRA cover system, may be adequate at the 1947, 1951, and 1957 cells. In



Note: Cover profile for 1970 Cell, Post-1970 Cell, and Kettle Hole.

ABB Environmental Services Inc.	LANDFILL COVER SYSTE PROFILE	
INSTALLATION RESTORATION PROGRAM MASSACHUSETTS MILITARY RESERVATION	AOC LF-1 ROD	FIGURE 9-

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addition, these older cells do not appear to be currently affecting groundwater. In addition, this alternative includes the same semiannual groundwater monitoring program, semiannual cover inspection and maintenance program, and semiannual reporting to USEPA and MADEP proposed for Alternative No. 2. The cover systems will isolate contaminants and minimize migration to groundwater. The proposed cover for the 1947, 1951, and 1957 cells will be 2 feet thick and consist of the following layers from top to bottom:

- a 6-inch surface layer with vegetative material
- a 12-inch drainage layer above the geomembrane
- a geomembrane material
- a 6-inch gas collection layer

Each of the 1947, 1951, and 1957 cells will be covered separately. Each cover system will be graded to have a minimum final slope of 3 percent after settlement. Long-term monitoring and maintenance for a solid waste cover system would be consistent with the program described for the 1970 Cell, Post-1970 Cell, and Kettle Hole. The 1947, 1951, and 1957 cell areas would also be fenced. This cover system would exceed the remedial objectives presented in Section 5.0.

Extensive site preparation of the 40-acre area above the 1947, 1951, and 1957 cells would be necessary before a cover system could be installed. All trees (including stumps), shrubs, and tall grasses would be cleared from the three cells, shredded or chipped, and spread on the landfill or disposed of elsewhere. A large amount of subgrade fill would be necessary to achieve a minimum final cover slope of 3 percent to promote surface water runoff.

Tables 9-1, 9-2, and 9-3 show the present worth of estimated costs to implement Alternative 1, Alternative 2, and Alternative 3, respectively.

9.2 GROUNDWATER CONTAINMENT ALTERNATIVES ANALYZED

No groundwater containment alternatives were evaluated as part of this ROD. AOC LF-1 groundwater will be addressed separately (ABB Environmental Services, Inc., 1992b). This separation of the source area and the downgradient groundwater is consistent with the operable unit approach outlined in the NCP. If implemented in

TABLE 9-1
COST SUMMARY TABLE FOR ALTERNATIVE 1

AOC LF-1 RECORD OF DECISION
MASSACHUSETTS MILITARY RESERVATION

DIRECT COST	**$380,000-$480,000**
Direct costs include monitoring well and fence installation adjacent to the six disposal areas at AOC LF-1.	
INDIRECT COST	**$130,000-$170,000**
Indirect costs include health and safety, legal, administration, permitting, engineering, and services during construction.	
TOTAL CAPITAL (DIRECT AND INDIRECT) COSTS	**$510,000-$650,000**
PRESENT WORTH OF O&M COSTS (@ 10% FOR 30 YEARS)	**$800,000-$1,000,000**
Operating and maintenance costs include site inspections, groundwater sampling and analysis, maintenance of monitoring wells, report preparation, and 5-year site reviews.	
TOTAL PRESENT WORTH FOR ALTERNATIVE 1	**$1,310,000-$1,650,000**

Notes:

Cost estimates are based on available information and professional judgment. Changing market conditions and regulatory requirements may cause actual costs to vary from the estimated costs.

Estimated costs correspond to an ENR CCI of 4896.

A contingency of 20 percent has been included in each direct and indirect cost item.

TABLE 9-2
COST SUMMARY TABLE FOR ALTERNATIVE 2

AOC LF-1 RECORD OF DECISION
MASSACHUSETTS MILITARY RESERVATION

DIRECT COST	**$19,800,000-$24,800,000**
Direct costs include mobilization/demobilization; debris consolidation; access road construction; subgrade fill placement; settlement monitoring; cover system construction for 1970 Cell, Post-1970 Cell, and Kettle Hole; and fence construction and groundwater monitoring well installation adjacent to the six disposal areas at AOC LF-1.	
INDIRECT COST	**$6,000,000-$7,500,000**
Indirect costs include health and safety, legal, administration, permitting, engineering, and services during construction.	
TOTAL CAPITAL (DIRECT AND INDIRECT) COSTS	**$25,800,000-$32,300,000**
PRESENT WORTH OF O&M COSTS (@ 10% FOR 30 YEARS)	**$2,000,000-$2,500,000**
Operating and maintenance costs include site inspections, mowing, settlement monitoring, groundwater monitoring and analysis, gas monitoring, maintenance of cover system and groundwater monitoring wells, report preparation, and 5-year site reviews.	
TOTAL PRESENT WORTH FOR ALTERNATIVE 2	**$27,800,000-$34,800,000**

Notes:

Cost estimates are based on available information and professional judgment. Changing market conditions and regulatory requirements may cause actual costs to vary from the estimated costs.

Estimated costs correspond to an ENR CCI of 4896.

A contingency of 20 percent has been included in each direct and indirect cost item.

TABLE 9-3
COST SUMMARY TABLE FOR ALTERNATIVE 3

AOC LF-1 RECORD OF DECISION
MASSACHUSETTS MILITARY RESERVATION

DIRECT COST	**$30,600,00-$38,200,000**
Direct costs include mobilization/demobilization, clearing and grubbing, debris consolidation, access road construction, subgrade, fill placement, settlement monitoring, cover system construction, monitoring well installation, and fence construction for all six disposal areas at AOC LF-1.	
INDIRECT COST	**$9,200,000-$11,500,000**
Indirect costs include health and safety, legal, administration, permitting, engineering, and services during construction.	
TOTAL CAPITAL (DIRECT AND INDIRECT) COSTS	**$39,800,000-$49,700,000**
PRESENT WORTH OF O&M COSTS (@ 10% FOR 30 YEARS)	**$2,000,000-$2,500,000**
Operating and maintenance costs include site inspections, mowing, settlement monitoring, groundwater monitoring and analysis, gas monitoring, maintenance of cover system and groundwater monitoring wells, report preparation, and 5-year site reviews.	
TOTAL PRESENT WORTH FOR ALTERNATIVE 3	**$41,800,000-$52,200,000**

Notes:

Cost estimates are based on available information and professional judgment. Changing market conditions and regulatory requirements may cause actual costs to vary from the estimated costs.

Estimated costs correspond to an ENR CCI of 4896.

A contingency of 20 percent has been included in each direct and indirect cost item.

conjunction with groundwater containment/remediation, these source contro alternatives would provide a site-wide response plan for AOC LF-1.

10.0 SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES

10.1 EVALUATION CRITERIA USED FOR DETAILED ANALYSIS

Section 121(b)(1) of CERCLA presents several criteria that, at a minimum, NGB is required to consider in its assessment of alternatives. Building on these specific statutory mandates, the NCP articulates nine evaluation criteria to be used in assessing the individual remedial alternatives. These criteria and their definitions are discussed in the following subsections. A detailed analysis of the alternatives was performed using the nine evaluation criteria to select an interim site remedy.

10.1.1 Threshold Criteria

The following two threshold criteria must be met for alternatives to be eligible for selection in accordance with the NCP:

- Overall Protection of Human Health and the Environment. This criteria addresses whether a remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

- Compliance with ARARS. This criteria addresses whether a remedy will meet ARARs and/or provide grounds for invoking a waiver.

10.1.2 Balancing Criteria

The following five criteria are used to compare and evaluate the alternatives that meet the threshold criteria:

- Long-term Effectiveness and Performance. This criteria assesses alternatives for their long-term effectiveness and permanence, along with the degree of certainty that they will prove successful.

- Reduction of Toxicity, Mobility, or Volume Through Treatment. This criteria addresses the degree to which alternatives employ recycling or

treatment that reduces toxicity, mobility, or volume, including how treatment is used to address the principal threats posed by the site.

- Short-term Effectiveness. This criteria addresses any adverse impacts on human health and the environment during implementation and the time needed to achieve protection.

- Implementability. This criteria addresses the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement a particular option.

- Cost. This criteria addresses the estimated capital and operations and maintenance costs on a present-worth basis.

10.1.3 Modifying Criteria

The modifying criteria are used on the final evaluation of remedial alternatives, generally after NGB has received public comment on the FFS and Proposed Plan:

- State Acceptance. This criteria addresses the Commonwealth's position and key concerns related to the preferred alternative and other alternatives including comments on ARARs or the proposed use of waivers.

- Community Acceptance. This criteria addresses the public's general response to the alternatives described in the FFS and Proposed Plan reports.

10.2 SUMMARY OF COMPARATIVE ANALYSIS

Following the detailed analysis of each alternative, a comparative analysis, focusing on the relative performance of each alternative against the nine criteria, was conducted. The comparative analysis is presented in the FFS (ABB Environmental Services, Inc., 1992b).

The following subsections present the nine criteria and a brief narrative summary of each alternative's strengths and weaknesses with respect to the evaluation criteria.

10.2.1 Overall Protection of Human Health and the Environment

All the remedial alternatives would provide an increased level of protection to human receptors. Alternatives 2 and 3 include the installation of a cover system that would effectively reduce contaminant migration into groundwater. Protection will be provided by isolating waste from surface exposure pathways. Downgradient groundwater monitoring, a part of all alternatives, will protect human health by tracking contaminant migration. This will allow timely notice to persons potentially affected by contaminant migration.

10.2.2 Compliance With ARARs

Alternative 1 (minimal no action) would not satisfy the requirements of RCRA Subtitle C closure/post-closure action-specific ARAR for the 1970 Cell, Post-1970 Cell, and Kettle Hole. This ARAR requires the containment closure of landfills. In addition, Alternative 1 would not meet the Massachusetts Solid Waste Management action-specific ARAR for any of the cells without approval of an alternative cover system design (existing cover) by the State.

Alternative 2 would need MADEP approval of the existing cover system only for the older cells (1947, 1951, and 1957 cells). Because Alternatives 2 and 3 include the installation of a composite low-permeability hydraulic barrier in the cover system over the 1970, Post-1970, and Kettle Hole cells, the Massachusetts Solid Waste Management action-specific ARAR would be met for those cells. The Massachusetts Solid Waste Management action-specific ARAR would be met for the older cells in Alternative 3.

10.2.3 Long-Term Effectiveness and Permanence

Alternative 2 and 3 offer equivalent long-term effectiveness and permanence. Both alternatives rely on containment technology to control infiltration and long-term groundwater monitoring to document an alternative's effectiveness. Both are reliable as long as integrity of the cover system is maintained. Each alternative includes a cover inspection and maintenance program to maintain cover integrity. The minimal

no-action alternative would achieve the same long-term effectiveness as other Alternative 2 for the older cells, by way of long-term groundwater monitoring. The minimal no-action alternative would not achieve long-term effectiveness at the newer cells because no remedial measures would be taken.

10.2.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

The three alternatives would not reduce toxicity, mobility, or volume of source area contaminants through treatment. The reduction of toxicity, mobility, and volume can be accomplished through treatment of groundwater, leachate, or landfill gas. The reduction of toxicity, mobility, or volume of contaminants in groundwater will be addressed in the groundwater operable unit report.

10.2.5 Short-Term Effectiveness

The minimal no-action alternative would not have any short-term effects on the community because remedial actions would not be required. Workers conducting environmental monitoring would require specialized health and safety training. The proposed remedial action of Alternatives 2 and 3 would also require health and safety training for workers who construct, maintain, and monitor the remedial action. An additional issue is the effect on the community of increased truck traffic as large quantities of cap material are hauled onto AOC LF-1. Because Alternative 2 involves less construction than Alternative 3, Alternative 2 presents less risk to the workers, environment, and community, and has greater short-term effectiveness.

10.2.6 Implementability

Overall, Alternative 2 would be easy to implement. The proposed remedial action, which entails covering approximately half the landfill cell area has greater technical feasibility than Alternative 3, which requires covering all landfill cells at AOC LF-1.

The proposed interim remedial action would provide a low-permeability cover system over the 1970 Cell, Post-1970 Cell, and Kettle Hole and would install additional groundwater monitoring wells downgradient of all cells at AOC LF-1. Factors that increase the technical feasibility of the proposed remedial action include: (1) cover systems and groundwater monitoring wells are feasible and commonly implemented technologies; (2) site preparation (i.e., clearing trees) would only be required at the

1970 Cell; and (3) materials and services would only be required for 50 acres of cover system construction.

The minimal no-action alternative would be technically feasible because it would only involve installing and sampling groundwater monitoring wells. The minimal no-action alternative does not provide a cover system for all cells. The minimal no-action alternative has low administrative feasibility because no remedial action is proposed.

Overall, Alternative 3 would be more difficult to implement. This alternative has high administrative feasibility because variance from regulations would likely not be required. However, technically it would be more difficult to implement due to the following factors: (1) extensive site preparation (i.e., clearing trees) would be required on the densely vegetated 1947, 1951, and 1957 cells; and (2) approximately double the amount of fill material would have to be transported and placed to provide a cover system over 90 acres of landfill cells.

10.2.7 Cost

The cost criterion includes the capital (i.e., up-front) cost of implementing an alternative, as well as the cost of operating and maintaining the alternative over the long term. The estimated total cost on a present-worth basis considers both up-front capital costs and long-term operation and maintenance costs. The capital, operation and maintenance, and total costs for each alternative are discussed in Sections 9.0.

The least expensive alternative is the minimal no-action alternative, estimated to cost up to $650,000. For Alternative 2 and 3, the costs of the two different cover system scenarios were compared. The total costs of the these are discussed briefly in Section 9.0 of this ROD.

10.2.8 State Acceptance

The Commonwealth of Massachusetts has indicated its concurrence with the selected interim remedial action (i.e., Alternative 2). A letter expressing their concurrence is presented in Appendix B.

10.2.9 Community Acceptance

Based on the written and oral comments received during the recent comment period, there is some disagreement with the NGB's selected remedy. Responses to community comments are in Appendix C.

11.0 THE SELECTED INTERIM REMEDY

The NGB has selected Alternative 2. Alternative 2 is an interim remedy, the goals of which are to reduce contaminants leaching to groundwater, limit migration of liquids through landfill cells, and maintain compatibility with the final remedial measures, while the AOC LF-1 groundwater plume is characterized and final remedial alternatives are studied.

11.1 CLEAN-UP LEVELS

A 10^{-6} excess cancer risk level for carcinogenic effects or a concentration corresponding to a Hazard Index of 1.0 for compounds with noncarcinogenic effects is typically used to set cleanup levels. Risk-based target cleanup levels were not developed for LF-1 source control because the source (landfill wastes) were not sampled. Remedial alternatives developed for AOC LF-1 Source Area included three containment options. These alternatives were developed to address migration potential for contaminants leaching to groundwater.

Cleanup levels for groundwater contaminants associated with the AOC will be developed in the FFS for groundwater.

Periodic assessments of the protection afforded by remedial action (i.e., five-year reviews) will be made as the remedy is being implemented and at the completion of the remedial action. If, during a five-year site review, the source control remedial action is not found to be protective, further action will be required.

11.2 DESCRIPTION OF REMEDIAL COMPONENTS

The installation of a composite low-permeability cover system (i.e., Alternative 2) will achieve the response objectives identified in Section 5.0 of this document. The maximum permeability of the low-permeability layer would be $1x10^{-7}$ centimeters per second (cm/sec). The landfill cover would be designed to meet or exceed RCRA guidance as described in USEPA's *Design and Construction of RCRA/CERCLA Final Covers* (USEPA, 1991) and sound engineering practices.

Existing vegetation on the 1970 Cell, Post-1970 Cell and Kettle Hole such as brus and grass would be cleared, grubbed, and possibly spread over the AOC in a thi layer. The cleared area would be regraded to control rainwater runoff and minimiz erosion. The installation of a gas detection system around these cells would be use to monitor for the presence or migration of methane and other landfill gases afte closure of these three cells. A passive gas venting system also would be part of the landfill cover.

The cover's low permeability barrier layer would be constructed of a low-permeability barrier layer and a geomembrane to keep rainwater or snowmelt from infiltrating the landfill. The low-permeability barrier layer will be covered by a drainage layer to effectively minimize water infiltration into the low-permeability layer. Topsoil would be placed on top of the drainage layer to support grass, which will minimize soil erosion and enhance evapotranspiration to effectively minimize water infiltration into the low-permeability layer. Figure 9-1 illustrates the profile of the landfill cover system. The landfill will be fenced to protect the integrity of the cover system and eliminate access to casual trespassers.

A post-closure plan will be developed specifying the inspection, monitoring, and maintenance programs for the closed landfill to be continued for a minimum of 30 years. These post-closure activities will be subject to five-year site reviews as required by the NCP when contaminants remain at the site.

12.0 STATUTORY DETERMINATIONS

The interim action selected for implementation at AOC LF-1 Source Area is consistent with CERCLA and, to the extent practicable, the NCP. The selected remedy is protective of human health and the environment, attains ARARs, and is cost-effective. The selected remedy uses permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable for this site. However, it (as well as the other alternatives evaluated) does not satisfy the statutory preference for treatment which permanently and significantly reduces the toxicity, mobility, or volume of hazardous substances as a principal element.

12.1 THE SELECTED REMEDY IS PROTECTIVE OF HUMAN HEALTH AND THE ENVIRONMENT

The remedy at AOC LF-1 will permanently reduce the risks posed to human health and the environment by eliminating, reducing, or controlling direct contact exposures to human and environmental receptors through engineering controls (i.e., low-permeability barrier cover system). Moreover, the selected remedy will minimize infiltration of precipitation into landfilled waste material and minimize the potential for contaminant migration from waste materials. Finally, implementation of the selected remedy will not pose unacceptable short-term risks or cross-media impacts because the selected remedy includes elements to mitigate potential impacts (e.g., erosion control measures, gas detection and management, and maintenance and monitoring programs).

12.2 THE SELECTED REMEDY ATTAINS ARARS

This remedy will attain all ARARs/federal and state requirements that apply to the selected source control remedy for AOC LF-1. ARARs that pertain to groundwater will be identified in separate FS and ROD documents, and selected remedies for those media will be required to comply with ARARs. Environmental laws from which ARARs for the selected source control remedial action are derived, and the

Specific ARARs are listed in Tables 12-1 through 12-3. A brief narrative o significant ARARs is provided in the following subsections.

12.2.1 Location-specific ARARs

Location-specific ARARs for AOC LF-1 Source are identified in Table 12-1.

Sole-source Aquifer Regulations. In general, projects that would be subject to review under the sole-source aquifer program include highway or building construction projects, either of which could have potentially detrimental effects on human health and the surrounding environment. The proposed CERCLA activities would not increase current contaminant concentrations in the sole-source aquifer; the proposed interim remedial action would decrease the amount of rainwater infiltrating AOC LF-1 Source and the amount of contaminants entering the aquifer.

12.2.2 Chemical-specific ARARs

Chemical-specific ARARs that have been identified in Table 12-2 were used in the risk assessment for AOC LF-1.

12.2.3 Action-specific ARARs

Action-specific ARARs for the selected remedy are presented in Table 12-3. A summary of requirements that must be attained are discussed in the following brief descriptions.

Air Regulations. Federal and state air quality standards exist for particulate matter and control of fugitive emissions and would be used in assessing excavation and construction emission controls. These standards are relevant and appropriate, rather than applicable, because they were originally developed to control stack and automobile emissions. Threshold Limit Values established by OSHA regulations provide an extensive list of control levels applicable to on-site remediation activities such as construction of the cover system. Air-related ARARs would be met through the use of engineering controls and monitoring during construction of the remedy.

Water Regulations. Substantive requirements of the Massachusetts Groundwater Discharge Permits would be relevant and appropriate to the on-site infiltration of

TABLE 12-1
LOCATION-SPECIFIC ARARs, CRITERIA, ADVISORIES, AND GUIDANCE

AOC LF-1 SOURCE RECORD OF DECISION
MASSACHUSETTS MILITARY RESERVATION

MEDIA	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE INTERIM ROD
SOLE SOURCE AQUIFERS				
Federal	SDWA Sole Source Aquifers (40 CFR 149)	Relevant and Appropriate	USEPA is authorized to designate aquifers as sole source and review federal financially assisted projects in the area to determine the project's potential to contaminate the aquifer. No federal assistance may be made for projects that may contaminate the aquifer. Conversely, federal funds may be used to modify projects to ensure they will not contaminate the aquifer.	The classification of groundwater beneath Cape Cod as a sole-source aquifer was given consideration in the risk assessment.

Notes:

ACEC = Area of Critical Environmental Concern
ARAR = Applicable or Relevant and Appropriate Requirements
CFR = Code of Federal Regulations
CMR = Code of Massachusetts Regulations
RI/FS = remedial investigation/feasibility study
SDWA = Safe Drinking Water Act
USEPA = U.S. Environmental Protection Agency

TABLE 12-2
CHEMICAL-SPECIFIC ARARs, CRITERIA, ADVISORIES, AND GUIDANCE

AOC LF-1 SOURCE RECORD OF DECISION
MASSACHUSETTS MILITARY RESERVATION

MEDIA	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE INTERIM ROD
GROUNDWATER/ SURFACE WATER				
Federal	SDWA - MCLs (40 CFR 141.11 - 141.16)	Relevant and Appropriate	MCLs have been promulgated for several common organic and inorganic contaminants. MCLs regulate the concentration of contaminants in public drinking water supplies, but may also be considered relevant and appropriate for groundwater aquifers used for drinking water.	To assess the potential risks to human health due to consumption of groundwater, contaminant concentrations were compared to their MCLs.
	SDWA - MCLGs (40 CFR 141.50 - 141.51)	Relevant and Appropriate	MCLGs are health based criteria. As promulgated under SARA, MCLGs are to be considered for drinking water sources. MCLGs are available for several organic and inorganic contaminants.	The 1990 National Contingency Plan states that non-zero MCLGs are to be used as goals. Contaminant concentrations in groundwater were compared to their MCLGs.
	RCRA - Subpart F Groundwater Protection Standards, Alternate Concentration Limits (40 CFR 264 94)	Relevant and Appropriate	This requirement outlines standards, in addition to background concentrations and MCLs, to be used in establishing clean-up levels for remediating groundwater contamination.	These requirements may be relevant and appropriate if certain conditions relating to transport and exposure are met.
Federal Guidance and Criteria To Be Considered	USEPA Risk Reference Doses (RfDs)	To Be Considered	RfDs are considered the levels unlikely to cause significant adverse health effects associated with a threshold mechanism of action in human exposure for a lifetime.	USEPA RfDs were to characterize risks due to noncarcinogens in various media.
	USEPA Carcinogen Assessment Group, Cancer Slope Factors (CSFs)	To Be Considered	CSFs represent the most up-to-date information on cancer risk from USEPA's Carcinogen Assessment Group.	USEPA CSFs were used to compute the individual incremental cancer risk resulting from exposure to certain chemicals.
State	Massachusetts Drinking Water Standards (310 CMR 22.00)	Relevant and Appropriate	Massachusetts Drinking Water Standards, except for sodium, are equivalent to federal MCLs. When state levels are more stringent than federal levels, the state levels may be used.	To assess the potential risks to human health due to consumption of groundwater, contaminant concentrations were compared to their MCLs.
	Massachusetts HWMR Maximum Concentration of Constituents for Groundwater Protection (310 CMR 30 668)	Relevant and Appropriate	This requirement establishes three categories of groundwater protection standards: background concentrations, maximum concentrations, and alternate concentrations. The maximum concentrations are identical to federal SDWA MCLs.	Complying with federal MCLs will be consistent with state standards.

continued

TABLE 12-2
CHEMICAL-SPECIFIC ARARs, CRITERIA, ADVISORIES, AND GUIDANCE

AOC LF-1 SOURCE RECORD OF DECISION
MASSACHUSETTS MILITARY RESERVATION

MEDIA	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE INTERIM ROD
State Guidance and Criteria to Be Considered	Massachusetts Drinking Water Guidelines	To Be Considered	The Office of Research and Standards uses a methodology similar to the USEPA Office of Drinking Water when setting guidelines. Carcinogens have guidelines set at the lowest practical quantitation limit or a level that would pose an excess cancer risk of 10 [illegible]. For noncarcinogens, a percentage (usually 20 percent) is applied to published or derived route-specific RfDs and standard exposure assumption to derive a drinking water concentration.	In the absence of other more stringent standards, these guidelines will be considered during the risk assessment

Notes:

ARAR = Applicable or Relevant and Appropriate Requirement
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
CFR = Code of Federal Regulations
CMR = Code of Massachusetts Regulations
CSF = carcinogenic slope factor
FS = feasibility study
HWMR = Hazardous Waste Management Rules
MMR = Massachusetts Military Reservation
MCL = Maximum Contaminant Level
MCLG = Maximum Contaminant Level Goal
MMR = Massachusetts Military Reservation
OSWER = Office of Solid Waste and Emergency Response
RI = remedial investigation
RCRA = Resource Conservation and Recovery Act
RfD = reference dose
SARA = Superfund Amendments and Reauthorization Act
SDWA = Safe Drinking Water Act
USEPA = U.S. Environmental Protection Agency
WQC = Ambient Water Quality Criteria

TABLE 12-3
ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

AOC LF-1 SOURCE RECORD OF DECISION
MASSACHUSETTS MILITARY RESERVATION

REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE INTERIM ROD
Federal			
RCRA - Releases from Solid Waste Management Units (40 CFR 264.90-264.109)	Relevant and Appropriate	This regulation details groundwater monitoring requirements for hazardous waste treatment facilities. The regulation outlines general groundwater monitoring standards, as well as standards for detection monitoring, compliance monitoring, and corrective action monitoring.	General groundwater monitoring standards should be addressed as part of any proposed alternative. The need for any of the specific monitoring programs will depend on whether source materials are removed, treated, or left in place.
RCRA - Closure and Post-closure (40 CFR 264.110-264.120)	Relevant and Appropriate	This regulation details general requirements for closure and post-closure of hazardous waste facilities, including installation of a groundwater monitoring program	Those parts of the regulation concerned with long-term monitoring and maintenance of the site will be considered during remedial design.
RCRA - Landfills (40 CFR 264.300-264.339)	Relevant and Appropriate	Owners or operators of existing landfills should close the unit in a manner that is consistent with these regulations. The landfill cover system should be designed to provide long-term minimization of migration of liquids through the closed landfill, to promote drainage and minimization erosion of the cover, to function with minimum maintenance, to accommodate settling and subsidence so that cover integrity is maintained, and to have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present	A cover system on the landfill would be constructed to meet the landfill closure requirements
RCRA-Criteria for Municipal Solid Waste Landfills (40 CFR 258)	Relevant and Appropriate	This requirement establishes the minimum national criteria under RCRA for all municipal solid waste landfill units and under Clean Water Act for municipal solid waste landfills that are used to dispose of sewage sludge. This requirement specifies the closure and post-closure care criteria for municipal solid waste landfills.	The parts of these regulations that outline the groundwater monitoring requirements and the schedule for compliance with these requirements will be references during the post closure plan development.
OSHA - General Industry Standards (29 CFR Part 1910)	Applicable	These regulations specify the 8 hour time-weighted average concentration for various organic compounds. Training requirements for workers at hazardous wastes operations are specified in 29 CFR 1910.120.	Proper respiratory equipment will be worn if it is impossible to maintain the work atmosphere below the concentration. Workers performing activities would be required to have completed specific training requirements.
OSHA - Safety and Health Standards (29 CFR Part 1926)	Applicable	This regulation specifies the type of safety equipment and procedures to be followed during site remediation.	All appropriate safety equipment will be on-site. In addition, safety procedures would be followed during on-site activities.

continued

TABLE 12-3
ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

AOC LF-1 SOURCE RECORD OF DECISION
MASSACHUSETTS MILITARY RESERVATION

REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE INTERIM ROD
OSHA - Recordkeeping, Reporting, and Related Regulations (29 CFR 1904)	Applicable	This regulation outlines the recordkeeping and reporting requirements for an employer under OSHA.	These requirements apply to all site contractors and subcontractors, and must be followed during all site work.
RCRA - Standards Applicable to Generators of Hazardous Waste (40 CFR Part 262)	Relevant and Appropriate	This requirement sets standards for generators of hazardous waste that address (1) accumulating waste, (2) preparing hazardous waste for shipment, and (3) preparing the uniform hazardous waste manifest. These requirements are integrated with DOT regulations.	If any alternative proposes shipping wastes off-site, the material must be shipped in proper containers that are accurately marked and labeled, and the transporter must display proper placards. All waste shipments must be accompanied by an appropriate manifest.
DOT Rules for Transportation of Hazardous Materials (49 CFR Parts 107, 171.1-172.558)	Relevant and Appropriate	This regulation outlines procedures for the packaging, labeling, manifesting, and transporting of hazardous materials.	Hazardous and contaminated materials will be packaged, manifested, and transported to a licensed off site disposal facility in compliance with these regulations.
Clean Air Act - National Primary and Secondary Ambient Air Quality Standards (40 CFR 50)	Applicable	Primary ambient air quality standards define levels of air quality to protect human health.	The particulate standard for matter less than 10 microns in diameter is 150 $\mu g/m^3$, 24-hour average concentration. These standards would be adhered to during construction activities.
	Applicable	Secondary ambient air quality standards protect human welfare from known or anticipated adverse effects from pollutants.	These standards would be complied with for remedial construction activities.
State			
Massachusetts HWMR - Management Standards for All Hazardous Waste Facilities (310 CMR 30.500 - 30.561)	Relevant and Appropriate	The rules provide a comprehensive program for handling, storage, and recordkeeping at hazardous waste facilities. They supplement the RCRA regulations.	Because these requirements supplement RCRA hazardous waste regulations, they must also be considered.
Massachusetts HWMR - Requirements for Closure and Post-Closure (310 CMR 30.590-30.595)	Relevant and Appropriate	These requirements are similar to the federal regulations. Post-closure care usually continues for 30 years with groundwater monitoring and air quality monitoring.	The remedial actions will include groundwater monitoring and air quality monitoring.

continued

TABLE 12-3
ACTION SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
AOC LF-1 SOURCE RECORD OF DECISION
MASSACHUSETTS MILITARY RESERVATION

REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE INTERIM ROD
Massachusetts HWMR - Groundwater Protection (310 CMR 30.660 - 30.679)	Relevant and Appropriate	The regulations outline monitoring and analytical procedures. Groundwater monitoring should be conducted during and following remedial actions. Concentration limits for hazardous constituents are specified in Section 30.667. The monitoring program outlined in these regulations specifies that groundwater must be treated or removed where hazardous waste constituents exceed the established concentration limits	Groundwater monitoring will generally follow the program outlined in Section 30.372
Massachusetts HWMR - Requirements for Generators (310 CMR 30.300 - 30.371)	Relevant and Appropriate	These requirements are similar to the federal RCRA regulations for generators. Massachusetts specifies requirements for very small- quantity generators, as well as small- and large quantity generators	When a waste or residual waste is moved, the generator requirements should be complied with
Massachusetts HWMR - Requirements for Transporters (310 CMR 30.400 - 30.416)	Relevant and Appropriate	These regulations are similar to the federal RCRA transportation requirements. In addition, liability insurance must be obtained by all licensed hazardous waste transporters and each vehicle must have a vehicle identification device	Hazardous materials will be transported by a licensed operator to an off site disposal facility as specified in these requirements
Massachusetts HWMR - Landfills (310 CMR 30.620 - 30.639)	Relevant and Appropriate	These regulations outline design standards and operating requirements for landfills used to dispose of hazardous waste. The requirements include standards for liners, monitoring, equipment, and leak detection. At closure, the landfill or cells should be covered with a final cover and post closure care should be provided	Design of the landfill cover system according to the federal RCRA closure requirements would comply with these regulations.
Massachusetts Solid Waste Management Regulations (310 CMR 19.000 et. seq.)	Applicable	These regulations specify design standards for solid waste landfills. The requirements outline standards for landfill final cover systems, groundwater, surface water, and air monitoring systems, and post-closure care.	Design of a solid waste landfill cover system would comply with these requirements.
Massachusetts Groundwater Discharge Permits (314 CMR 5.00)	Relevant and Appropriate	Permit information, including conditions and variances, is specified in these regulations.	Discharge of stormwater to the ground or groundwater would comply with the substantive requirements of these regulations
Massachusetts Air Pollution Control Regulations (310 CMR 6.00 - 8.00)	Relevant and Appropriate	These regulations outline the standards for air pollution control, including particulate matter, carbon monoxide, nitrogen dioxide, and lead	Particulate standard is 75 $\mu g/m^3$ annual geometric mean and 150 $\mu g/m^3$ 24 hour average concentration

continued

TABLE 12-3
ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

AOC LF-1 SOURCE RECORD OF DECISION
MASSACHUSETTS MILITARY RESERVATION

REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE INTERIM ROD
Implementation of MGL Chapter 111F, Employee and Community Right-to-Know (310 CMR 33.00)	Relevant and Appropriate	The regulations establish rules and requirements for the dissemination of information related to toxic and hazardous substances to the public.	Information applicable to site activities and characteristics will be made available to the public.
Worker Right-to-Know (441 CMR 21.00)	Relevant and Appropriate	These regulations establish requirements for workers' right to know.	Information applicable to site activities and characteristics will be made available to on site workers.

Notes:

CFR = Code of Federal Regulations
CMR = Code of Massachusetts Regulations
DOT = Department of Transportation (U.S.)
HWMR = Hazardous Waste Management Rules
MGL = Massachusetts General Law
OSHA = Occupational Safety and Health Administration
ROD = Record of Decision
RCRA = Resource Conservation and Recovery Act
$\mu g/m^3$ = micrograms per cubic meter

stormwater runoff. The groundwater downgradient of the landfill would monitored as part of the post-closure plan.

Solid and Hazardous Waste Regulations. The federal and state requirements fo closure of landfills are relevant and appropriate to the closing of the 1970 Cell, Pos 1970 Cell, and Kettle Hole. The landfill was operated for the disposal of municipa type wastes. The selected landfill cover system would be designed to provide long term minimization of migration of liquid through the closed cells, to promot drainage and minimize erosion of the cover, to function with minimum maintenance to accommodate settling and subsidence so that cover integrity is maintained, and to have a permeability less than the natural soils present.

The off-site shipment of hazardous materials would be subject to U.S. Department of Transportation rules.

Other Action-specific Regulations. Federal OSHA requirements that regulate worker and employee records should be followed during all on-site work. These regulations include safety and health standards for federal service contracts and recordkeeping, reporting , and related regulations. Because these regulations govern general working conditions within industry and provide minimum protection standards for workers involved in remedial actions, these regulations are applicable.

Massachusetts has hazardous substance right-to-know regulations that establish requirements to protect the health and safety of employees and community residents through the communication of information regarding toxic and hazardous substances. These regulations are relevant and appropriate to on-site workers during the remedial action.

12.3 THE SELECTED REMEDIAL ACTION IS COST-EFFECTIVE

In the NGB judgment, the selected remedy is cost-effective (i.e., the remedy affords overall effectiveness proportional to its costs). In selecting this remedy, once the NGB identified alternatives that are protective of human health and the environment and that attain ARARs, they evaluated the overall effectiveness of each alternative by assessing the relevant criteria. The relationship of the overall effectiveness of this

remedial alternative was determined to be proportional to its costs. The costs of this remedial alternative are:

Estimated Capital Cost:	$26-32 million
Estimated Present Worth of O&M Costs (30 years):	$2-3 million
Estimated Total Present Worth (30 years):	$28-35 million

Alternative 2 is considered the most cost-effective alternative because it provides the protection against contaminant leaching. The need for source remediation in the older cells has not been shown to date, therefore, Alternative 3 is less cost-effective. Alternative 1, although less costly, will not protect against contaminant leaching to the groundwater. None of the alternatives evaluated in detail include a treatment component.

12.4 The Selected Remedy Utilizes Permanent Solutions and Alternative Treatment or Resource Recovery Technologies to the Maximum Extent Practicable

The selected remedy is protective of human health and the environment, complies with federal and state requirements (with approval of alternate cover system) that are legally applicable or relevant and appropriate to the source control remedial action, and is cost-effective. The selected remedy uses permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable for this site.

The source control remedy was selected by deciding which one of the identified alternatives provides the best balance of trade-offs among alternatives in terms of: (1) long-term effectiveness and permanence; (2) reduction of toxicity, mobility, or volume through treatment; (3) short-term effectiveness; (4) implementability; and (5) cost. The balancing test emphasized long-term effectiveness and permanence and the reduction of toxicity, mobility, and volume through treatment; and considered the preference for treatment as a principal element, the bias against off-site land disposal of untreated waste, and community and state acceptance. The selected remedy provides the best balance of trade-offs among the alternatives.

The principal element of the selected remedy is source control. This elemer addresses the primary threats at AOC LF-1: future human health risks associate with potential leaching of contaminants from the waste to groundwater. The selecte remedy was chosen primarily because it affords the most protection to human healt and the environment. The short-term effects of implementing the selected remedy are comparable to the other alternatives. None of the three source contro alternatives evaluated in the FFS included a treatment component to reduce mobility, toxicity, or volume.

The selected alternative complies with federal and state regulations governing closure and post-closure of solid waste landfills, and regulatory agencies have had the opportunity to review and comment on all documents produced for AOC LF-1. Regulatory agency and public comments received on AOC LF-1 Source Control have been incorporated into this ROD.

12.5 THE SELECTED REMEDY DOES NOT SATISFY THE PREFERENCE FOR TREATMENT THAT PERMANENTLY AND SIGNIFICANTLY REDUCES THE TOXICITY, MOBILITY, OR VOLUME OF THE HAZARDOUS SUBSTANCES AS A PRINCIPAL ELEMENT

Because treatment of the principal threats at the AOC was not found to be practicable, this remedy does not satisfy the statutory preference for treatment as a principal element of the remedy. Treatment technologies were considered during the identification of remedial technologies and the development and initial screening of alternatives, but were considered to be infeasible at AOC LF-1. The size of the landfill cells and the fact that there is no information on the location of contaminants preclude a remedy in which contaminants could be excavated and treated effectively. In addition, the variety of waste potentially disposed of in the AOC LF-1 eliminated most treatment alternatives from consideration. The reduction of toxicity, mobility, and volume can be accomplished through treatment of groundwater, leachate, and landfill gas. The FS report to be prepared for other site media (i.e., groundwater) will consider treatment options if cleanup goals are appropriate for those media. This interim ROD will be followed by a final ROD that will determine what further actions, if any, will be necessary to meet the preference for treatment that will permanently and significantly reduce the toxicity, mobility, or volume of hazardous substances.

13.0 DOCUMENTATION OF NO SIGNIFICANT CHANGES

The NGB presented a Proposed Plan for remediation of AOC LF-1 in June 1992. The preferred interim remedial alternative included the covering of the 1970 Cell, Post-1970 Cell, and Kettle Hole. There have been no significant changes made to the plan as stated in the Proposed Plan.

14.0 COMMONWEALTH ROLE

MADEP, on behalf of the Commonwealth of Massachusetts, reviewed the various alternatives and indicated its support for the selected interim remedy. MADEP also reviewed the FFS to determine if the selected remedy is in compliance with applicable or relevant and appropriate state environmental regulations. MADEP concurs with the selected remedy for AOC LF-1 source. A copy of the declaration of concurrence is in Appendix B.

ABB-ES	ABB Environmental Services, Inc.
ANG	Air National Guard
AOC	Area of Contamination
ARAR	Applicable or Relevant and Appropriate Requirement
BTEX	benzene, toluene, ethylbenzene, and xylenes
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLP	Contract Laboratory Program
cm/sec	centimeters per second
COD	chemical oxygen demand
COC	contaminant of concern
cy	cubic yards
DCA	dichloroethane
DCE	dichloroethylene
DCFM	dichlorofluoromethane
DDT	dichlorodiphenyltrichloroethane
DOD	Department of Defense (U.S.)
FFS	focused feasibility study
FS	feasibility study
HAZWRAP	Hazardous Waste Remedial Actions Program
HI	Hazard Index
IRP	Installation Restoration Program
LF-1	Landfill No. 1
MADEP	Massachusetts Department of Environmental Protection
MCL	Maximum Contaminant Level
mg/L	milligrams per liter
MMR	Massachusetts Military Reservation
MSL	mean sea level

GLOSSARY OF ACRONYMS AND ABBREVIATIONS

NCP	National Contingency Plan
NGB	National Guard Bureau
NPL	National Priorities List
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
ROD	Record of Decision
RfD	Reference Dose
SF	slope factor
SI	site inspection
SVOC	semivolatile organic compound
TCE	trichloroethylene
TCL	Target Compound List
TOC	total organic carbon
µg/L	micrograms per liter
USAF	U.S. Air Force
USCG	U.S. Coast Guard
USEPA	U.S. Environmental Protection Agency
VA	Veterans Administration
VOC	volatile organic compound

ABB Environmental Services, Inc., 1992a. "Interim Remedial Investigation, Main Base Landfill (AOC LF-1)"; Installation Restoration Program; Massachusetts Military Reservation; prepared for HAZWRAP; Portland, Maine; March 1992.

ABB Environmental Services, Inc., 1992b. "Focused Feasibility Study, Main Base Landfill (AOC LF-1)"; Installation Restoration Program; Massachusetts Military Reservation; prepared for HAZWRAP; Portland, Maine; June 1992.

E.C. Jordan Co., 1986. "U.S. Air Force Installation Restoration Program, Phase I: Records Search, Air National Guard, Camp Edwards (ARNG), U.S. Air Force, and Veterans Administration Facilities at Massachusetts Military Reservation, Task 6"; prepared for Oak Ridge National Laboratory; Oak Ridge, Tennessee; December 11, 1986.

E.C. Jordan Co., 1988. "Field Investigations, Summer/Fall 1986; Task 2-1; Base Landfill, Petroleum Fuels Storage Area, and Fire-Training Area"; Installation Restoration Program; Massachusetts Military Reservation; prepared for HAZWRAP; Portland, Maine; July 1988.

E.C. Jordan Co., 1989. "Task 2-3A Site Inspection, Field Investigation Work Conducted Fall 1987"; Installation Restoration Program; Massachusetts Military Reservation; prepared for HAZWRAP; Portland, Maine; March 1989.

E.C. Jordan Co., 1990. "Task 2-3B Site Inspection, Field Investigation Work Conducted Spring-Summer 1988"; Installation Restoration Program; Massachusetts Military Reservation; prepared for HAZWRAP; Portland, Maine; February 1990.

Metcalf and Eddy, Inc., 1983. "Installation Restoration Program, Phase I - Records Search"; Otis Air National Guard Base, Massachusetts; prepared for HAZWRAP; January 1983.

R.F. Weston, Inc., 1985. "Installation Restoration Program; Phase II, Stage 1 - Confirmation/Quantification"; Otis Air National Guard Base, Massachusetts;

prepared for the U.S. Air Force Occupational and Environmental Healt Laboratory; October 1985.

U.S. Environmental Protection Agency (USEPA). 1988. "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA"; Office of Solid Waste and Emergency Response; OSWER Directive 9335.3-01; March 1988.

U.S. Environmental Protection Agency (USEPA), 1989. "40 CFR Part 300, National Priorities List of Uncontrolled Hazardous Waste Sites. Final Rule"; *Federal Register*; Vol. 54, No. 223; p. 48187; November 21, 1989.

U.S. Environmental Protection Agency (USEPA), 1991. "Design and Construction of RCRA/CERCLA Final Covers"; Office of Research and Development; USEPA/625/4-91/025; May 1991.

APPENDIX B

COMMONWEALTH CONCURRENCE LETTER

Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Department of Environmental Protection

William F. Weld
Governor
Daniel S. Greenbaum
Commissioner

January 4, 1993

Ms. Julie Belaga
Regional Administrator
U.S. EPA Region 1
JFK Federal Building
Boston, Massachusetts 02203

and

Mr. Ronald Watson
Chief, Environmental Division
ANGRC/CER
National Guard Bureau
Building 3500
Andrews AFB, Maryland 20331-6008

RE: BOURNE--BWSC SA4-0037
Massachusetts Military Reservation (MMR) Area of Contamination Landfill-1 (LF-1) Source Area Operable Unit Interim Record of Decision Concurrence

Dear Ms. Belaga and Mr. Watson:

The Department of Environmental Protection (DEP) has reviewed the preferred remedial action alternative recommended by the National Guard Bureau and the U.S. EPA for an interim remedial action at the LF-1 Source Area Operable Unit of the MMR National Priority List Site. The Department hereby concurs with the interim remedy.

The proposed alternative includes the installation of a composite low-permeability cover system on the 1970 Cell, Post-1970 Cell and the Kettle Hole areas of the LF-1 Source Area Operable Unit and the conducting of post-closure monitoring and maintenance. The interim remedy will minimize infiltration and percolation of precipitation through the three proposed landfill cells, reduce contaminant leaching to groundwater and maintain compatibility with final remedial measures.

Subsequent actions are planned to fully address threats posed by conditions at the LF-1 Source Area Operable Unit. The final remedial action for the LF-1 source area will include necessary remedial actions to address the 1947 Cell, 1951 Cell and 1957 Cell. In addition, remedial actions associated with the LF-1 Groundwater Operable Unit may be needed to address groundwater contamination originating at LF-1 and to protect public health and environmental resources.

The DEP has determined that the interim remedy is a remedial ac
on a portion of the disposal site which would be consistent wi
future permanent solution for the entire disposal site. The
final remedy to be developed for the LF-1 Source Area Operable
must be in compliance with state Applicable or Relevant
Appropriate Requirements (ARARs), including the Massachusetts S
Waste Management Regulations (310 CMR 19.000 et seq.). The DEP
continue to evaluate compliance with ARARs during remedial desi
construction and operation of the interim remedy and development
the final remedy.

The DEP looks forward to working with you in implementing
interim remedy and facilitating an expeditious cleanup of the
site. If you have any questions, please contact the Regio
Director, George Crombie at (508) 946-2712.

Very truly yours,

Daniel S. Greenbaum, Commissioner
Department of Environmental Protection

G/JFB

cc: BWSC Boston
James F. Begley, SERO
TEAC Distribution