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November 1996

EPA Superfund Record of Decision:

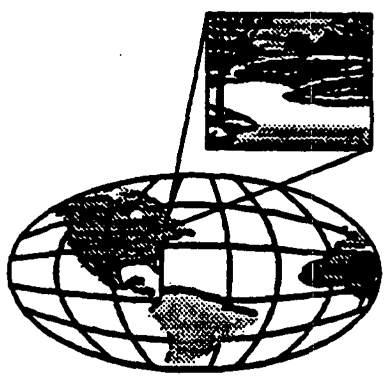
Loring Air Force Base, Operable Unit 4, Limestone, ME 9/30/1996

Final

Operable Unit 4 (OU 4) Record of Decision

September 1996

The Air Force



Rebuilding Our Environment

Installation Restoration Program

Loring Air Force Base, Maine

FINAL

Loring Air Force Base

Operable Unit 4 (OU 4) Record of Decision

September 1996

Prepared for:

Air Force Base Conversion Agency
Loring Air Force Base, Maine
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OPERABLE UNIT 4 RECORD OF DECISION
LORING AIR FORCE BASE, MAINE

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DECLARATION FOR THE RECORD OF DECISION

SITE NAME AND LOCATION

Operable Unit 4 (OU 4) addresses groundwater associated with Landfill 1 (LF-1), Landfill 2 (LF-2), Landfill 3 (LF-3), the Coal Ash Pile (CAP), and Chapman Pit Debris Area (CPDA) at the former Loring Air Force Base (LAFB), located in Aroostook County, Maine.

STATEMENT OF BASIS AND PURPOSE

This decision document presents the final remedies for OU 4:

- No Further Action (NFA) for groundwater associated with LF-1 and the CPDA
- Minimal Action for groundwater associated with LF-2 and LF-3/CAP, in conjunction with the source control remedy selected for LF-2 and LF-3 as described in the OU 2 Record of Decision (ROD) (ABB Environmental Services, Inc., [ABB-ES], 1994b).

This decision document was developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986, and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the administrative record for OU 4, which was developed in accordance with Section 113(k) of CERCLA, and is available for public review at the Air Force Base Conversion Agency, 5100 Texas Road, Limestone, Maine. Through the combined source control remedy for OU 2 (ABB-ES, 1994b) and this groundwater mitigation remedy for OU 4, the U.S. Air Force (USAF) plans to remedy the threat to human health posed by the presence of contaminated groundwater at LF-2 and LF-3/CAP.

The Maine Department of Environmental Protection (MEDEP), concurs with the selected remedy for OU4.

ASSESSMENT OF OU 4

The USAF has determined that NFA is necessary for the groundwater associated with LF-1 and the CPDA, since risk estimates for domestic use of groundwater are below U.S. Environmental Protection Agency (USEPA) target risk levels. Risks associated with bedrock groundwater at LF-1 exceed the MEDEP cancer risk guidance value of $1x10^{-5}$. However, a soil cover system has been installed as required by Maine State Solid Waste Regulations.

Actual or potential releases of hazardous substances from LF-2 and LF-3/CAP, if not addressed, may pose a risk to human health and the environment. This risk will be addressed by implementing the Minimal Action groundwater remedy selected in this ROD, in conjunction with the source control remedy outlined in the OU 2 ROD.

DESCRIPTION OF THE SELECTED REMEDY

The USAF has determined that NFA is appropriate for groundwater associated with LF-1 and the CPDA.

The selected remedy for groundwater associated with LF-2 and LF-3/CAP is Minimal Action. In addition to the low permeability cover systems, 30-year landfill post-closure monitoring, and deed restrictions for Landfill 2 and Landfill 3 contained in the OU 2 ROD, implementation of the OU 4 Minimal Action alternative would include the following activities:

- institutional controls;
- groundwater monitoring;
- five-year site reviews; and
- contingency action, if necessary.

If results of monitoring show landfill-related contaminants are detected at the compliance point at concentrations above the action levels, a contingency action will be implemented. The contingency action is discussed in Subsection 10.2 of this ROD.

STATUTORY DETERMINATIONS

The statutory requirements of CERCLA Section 121 for remedial actions are not applicable to the NFA decision for groundwater associated with LF-1 and the CPDA. Therefore, no five-year review will be undertaken for these sites.

The remedy selected by the USAF for LF-2 and LF-3/CAP is protective of human health and the environment, complies with applicable or relevant and appropriate requirements (ARARs) for this action, and is cost-effective. This remedy uses permanent solutions and alternative treatment technologies to the extent practicable. The selected remedy does not, however, satisfy the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element. Mobility of contaminants is expected to be reduced through the containment features of the landfill cover systems under OU 2, which will also reduce rainwater infiltration, leachate generation, and associated groundwater contamination. Institutional controls will restrict human exposure to contaminated groundwater in the vicinity and downgradient of the landfills.

DECLARATION

This ROD represents NFA under CERCLA for LF-1 and the CPDA and the selection of a remedial action under CERCLA for LF-2 and LF-3/CAP. The forgoing represents the selection of a remedial action by the Department of the Air Force and the United States Environmental Protection Agency Region I with the concurrence of the Maine Department of Environmental Protection.

Concur and recommend for immediate implementation:

Department of the Air Force

By: ______________________ Date: September 30, 1996

Alan K. Olsen
Director
Air Force Base Conversion Agency

United States Environmental Protection Agency

By: ______________________ Date: Sept 30, 1996

Linda M. Murphy
Director
Office of Site Remediation and Restoration
Region I

1.0 SITE NAME, LOCATION AND DESCRIPTION

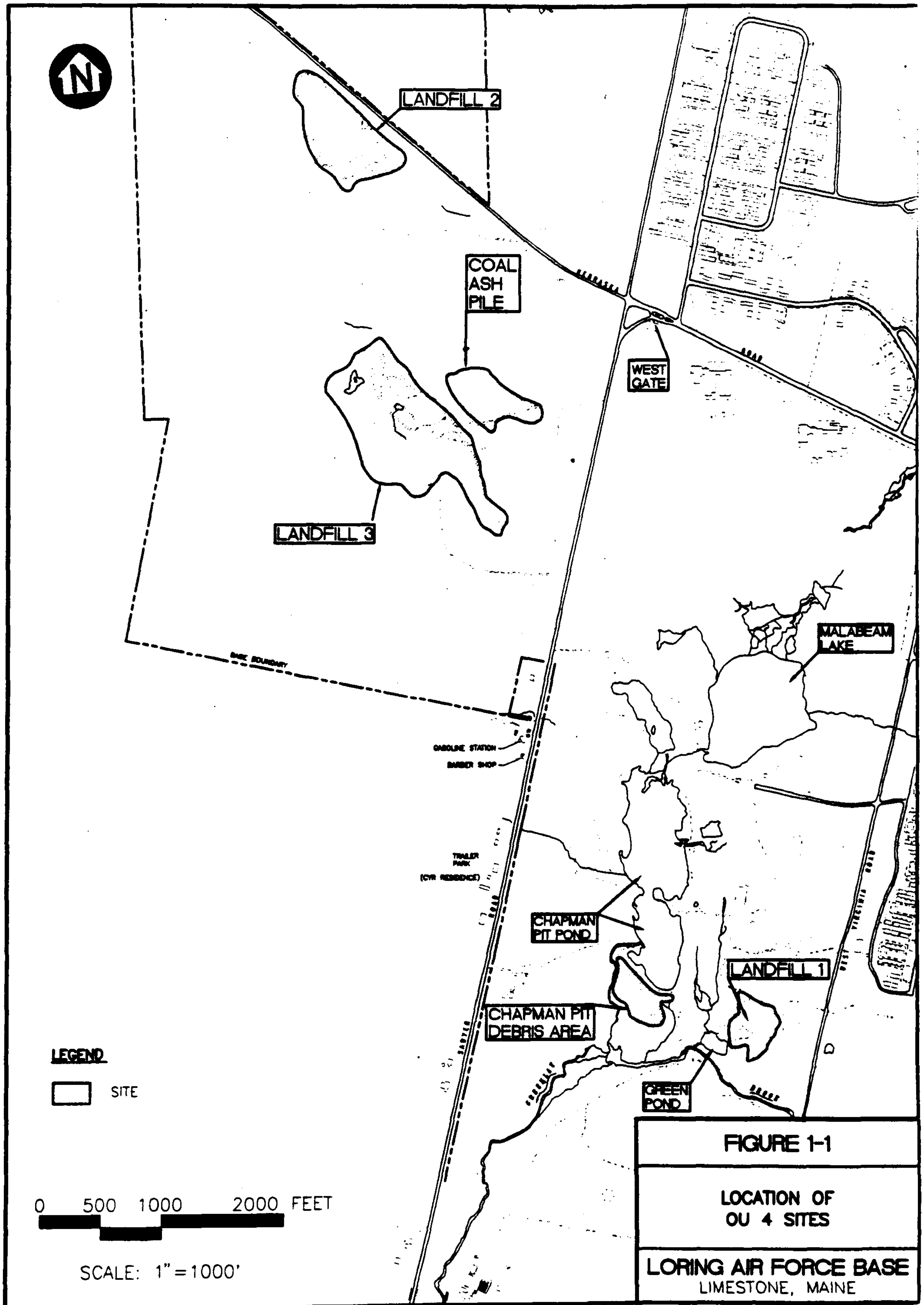
The former LAFB, in northeastern Maine, is bordered on the south and east by the Town of Limestone, on the north by the towns of Caswell and Connor, and on the west by the City of Caribou. The base is approximately 3 miles west of the United States/Canadian border and covers approximately 9,000 acres.

LAFB is a NPL site. There are currently several areas of concern under investigation within LAFB, which have been organized into Operable Units (OUs) for investigation and remediation purposes. This ROD relates to OU 4, which consists of groundwater associated with LF-1, LF-2, LF-3, the CAP, and the CPDA. Soils/sources for LF-2 and LF-3 were addressed under OU 2; soils/sources for LF-1 and the CAP were addressed under OU 2A; and soils/sources for the CPDA were addressed under OU 3. Figure 1-1 shows the location of the five OU 4 sites and their relationship to features at the western boundary of LAFB.

Landfill 1. LF-1 covers approximately 3.3 acres and is located in the southwestern part of the base west of West Virginia Road and north of Green Pond. Site features have changed since the Remedial Investigation (RI) as a result of grubbing and grading in preparation for cover system construction. For more detailed information on LF-1, including pre-construction conditions, see Section 7.1 of the OU 4 RI Report (ABB-ES, 1995) and the OU 2A ROD (ABB-ES, 1996a).

Landfill 2. LF-2 covers nine acres approximately one mile west of the West Gate on Nebraska Road and is surrounded by a densely wooded area. Site features have changed since the RI as a result of grading during on-going cover system construction. For more detailed information on LF-2, including pre-construction conditions, see Section 5.1 of the OU 4 RI Report (ABB-ES, 1995) and the OU 2 ROD (ABB-ES, 1994b).

Landfill 3. LF-3 covers approximately 17 acres, is located on Sawyer Road, about one half mile southwest of the West Gate, and is approximately 1,000 feet south of LF-2. Site features have changed since the RI as a result of grading during on-going cover system construction. For more detailed information, including pre-construction conditions, see Section 6.1 of the OU 4 RI Report (ABB-ES, 1995) and the OU 2 ROD (ABB-ES, 1994b).


N
LANDFILL 2
COAL ASH PILE
WEST GATE
LANDFILL 3
MALABEAM LAKE
GASOLINE STATION
BARBER SHOP
CHAPMAN PIT POND
LANDFILL 1
CHAPMAN PIT DEBRIS AREA
GREEN POND
LEGEND
SITE
0 500 1000 2000 FEET
SCALE: 1" = 1000'
FIGURE 1-1
LOCATION OF OU 4 SITES
LORING AIR FORCE BASE
LIMESTONE, MAINE

Coal Ash Pile. The CAP was located northeast of LF-3 and south of Nebraska Road, about one-half mile southwest of the West Gate. The CAP consisted of three distinct areas where uniform types of waste were identified. These areas have been provided unofficial names to allow them to be distinguished from one another. They are the Coal Ash Disposal Area (CADA), the Drum Disposal Area (DDA), and the Paint Can Disposal Area (PCDA). These three disposal areas combined occupied five acres: The CADA is 4.1 acres; the DDA is 0.9 acres; and the PCDA is less than 0.1 acres. For more detailed information, see Section 6.1 of the OU 4 RI Report (ABB-ES, 1995) and the OU 2A ROD (ABB-ES, 1996a).

Chapman Pit Debris Area. The CPDA is located approximately 500 feet west of LF-1, south of Chapman Pit Pond. The area is a relatively flat wooded area, approximately two acres in size. The north side of the debris area is bounded by an unimproved road and Chapman Pit Pond. The east and south sides of the debris area slope steeply to wet areas. To the west, the debris area slopes steeply to a small stream that ultimately drains into Greenlaw Brook. For more detailed information, see Section 8.1 of the OU 4 RI Report (ABB-ES, 1995) and the OU 3 RI Report (Law Environmental, Inc. [Law], 1996).

2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

This section summarizes the land use, response history, and enforcement history for each of the five OU 4 sites.

2.1 LAND USE AND SITE HISTORY

Landfill 1. Sand and gravel from the LF-1 site was mined for construction at the base until 1952. The area reportedly was used for base waste disposal from 1952 to 1956. It was suspected that during its operation, the landfill received hazardous waste generated by flightline activities. However, evidence of such wastes were not encountered during RI explorations. This waste was reportedly burned and buried on site (CH_2M Hill, 1984). Based on reconnaissance and subsurface exploration activities, the landfill area contains construction debris including asphalt, concrete and rebar. The site has been inactive since 1956, although some dumping of construction debris at the surface was reported to have occurred since that time. A soil cover system has been designed for LF-1 in accordance with Maine Solid Waste Regulations. Construction of the soil cover system was completed in 1996.

Landfill 2. The LF-2 area was quarried for gravel during construction of the base. Waste disposal began in 1956 after the gravel had been exhausted, and continued until 1974. The landfill was covered with approximately one foot of clean soil and was closed in 1974. The LF-2 area soils settled over time, leaving a depression in the LF-2 surface. In 1994 and 1995, nonhazardous contaminated soil and debris from various removal actions were placed on LF-2 as subgrade for a cover system, designed in accordance with Resource Conservation and Recovery Act (RCRA) Subtitle C and Maine Hazardous Waste Regulations, and constructed in 1996.

Wastes buried or burned at the site include: domestic garbage, construction rubble, flightline wastes, and sewage sludge. There are no records of waste segregation at the landfill and waste was reportedly distributed evenly. Flightline wastes disposed of at this site reportedly included oil, hydraulic fluids, solvents, thinners, and paints. Disposal of hazardous substances at this site reportedly ended by 1968. No additional information is available concerning daily operations at LF-2 or the burial locations of different types of waste.

In accordance with the response action specified in the OU 2 ROD (ABB-ES, 1994b), the selected source control remedial action for LF-2 is containment using a low permeability cover system. The cover system has been designed in accordance with RCRA Subtitle C and Maine Hazardous Waste Regulations. Site preparation for the cover system began in 1994, and the cover system was completed in 1996.

Landfill 3. The area occupied by LF-3 was quarried extensively for gravel during construction of the airfield runway and the Flightline Area. Gravel quarrying continued as late as 1994 in the northwestern portion of the site. The landfill received waste from 1974 to 1991, and eventually was covered with six inches of native soil. Between 1994 and 1996, nonhazardous contaminated soil and debris from various removal actions were placed on LF-3 as subgrade for a cover system.

Waste brought to this site included base refuse such as domestic garbage, contents of dumpsters from the flightline shops, and mess hall wastes. Hazardous wastes are not known to have been placed at LF-3. However, it is suspected that small quantities of hazardous substances such as partially-filled solvent cans, oily-water wastes, and fuel-saturated soil are buried at this landfill. No additional information about daily operations at LF-3 is available.

In accordance with the response action specified in the OU 2 ROD (ABB-ES, 1994b), the selected source control remedial action for LF-3 is containment using a low permeability cover system. The cover system has been designed in accordance with RCRA Subtitle C and Maine Hazardous Waste Regulations. Site preparation for the cover system began in 1994 and the cover system scheduled to be completed in 1998.

Coal Ash Pile. The CAP was used as a source of gravel during base construction. Following depletion of the gravel in this area, the excavation appeared to have been filled with coal ash and some construction debris. The time period during which the CAP was active is not known. According to the "Master Plan for Limestone AFB" dated 1957, coal ash had been dumped in an abandoned gravel pit outside the West Gate during the early 1950s.

Coal ash generated from industrial and domestic sources comprised most of the waste in the CADA, along with some construction debris. The PCDA was located south of the CADA and the DDA. Although it is not known how long this disposal area was active, paint cans are the only wastes known to have been disposed of at this location.

The CAP was eliminated in a removal action conducted in 1994 and 1995. Approximately 184,000 cubic yards of coal ash, contaminated soil, concrete rubble, and miscellaneous debris and refuse were removed from the area and placed at LF-2 and LF-3 as subgrade material for the cover systems.

Chapman Pit Debris Area. The CPDA was previously mined for sand and gravel during construction of the base. After mining activities ceased, an earthen dam was constructed across the southern portion of the pit, creating Chapman Pit Pond north of the dam. During construction of the dam, fill was deposited in the southern portion of the pit (i.e., CPDA), and unauthorized dumping may have occurred (Law, 1996).

Bituminous asphalt and concrete materials were reportedly disposed of in this area. Equipment and construction supplies may also have been placed in the pit and covered over with fill. Small amounts of household and construction debris were encountered during field investigations, but there is no evidence of widespread debris dumping.

2.2 Response and Enforcement History

The response and enforcement history of OU 4 sites is summarized as follows:

- In 1984, a Preliminary Assessment (PA) was completed detailing historical hazardous material usage and waste disposal practices at LAFB (CH_2M Hill, 1984).
- Initial Site Investigation (SI) field work was conducted in 1985 to determine if contaminants were present at the OU 4 sites (Weston, 1988).
- The RI process commenced in 1988 and continued into 1994 (ABB-ES, 1995).
- LAFB was added to the NPL in February 1990.

- The USAF entered into a Federal Facilities Agreement (FFA) (FFA, 1991) with the USEPA and MEDEP in 1991, to address the cleanup of environmental contamination at LAFB. The FFA was revised in December 1993 to address base closure related issues, such as real estate property transfer, and to revise the cleanup schedule. The FFA was further modified in January 1995 to allow the Remedial Project Managers to make minor modifications, such as schedule adjustments and removal of petroleum-contaminated sites from the agreement.

- A Feasibility Study (FS) (ABB-ES, 1996b) was completed in 1996 for OU 4 to determine remedial alternatives for LF-2 and LF-3 based on information presented in the RI report; and

- A Proposed Plan (ABB-ES, 1996c) was submitted for public review in May 1996.

- Public comment period from May 17, 1996 to June 15, 1996.

The following additional key milestones at LAFB indirectly relate to OU 4:

- Non-hazardous contaminated soils from other sites on base were excavated and placed on LF-2 and LF-3 in 1994 and 1995 as subgrade material for the cover systems. LF-3 will receive non-hazardous contaminated soils from other sites on base in 1996 and 1997.

- A removal action was conducted at the CAP in 1994 and 1995 in which excavated materials were placed at LF-2 and LF-3 as subgrade material for the cover systems.

- Construction of a soil cover system at LF-1 was completed in 1996.

- Construction of LF-2 cover system was completed in 1996.

- Construction of LF-3 cover system is scheduled for completion in 1998.

3.0 COMMUNITY PARTICIPATION

Throughout LAFB's history, the community has been active and involved in base activities at a high level. The USAF and USEPA have kept the community and other interested parties apprised of LAFB activities through informational meetings, fact sheets, press releases, public meetings, site tours and open houses, as well as Restoration Advisory Board (RAB) meetings. The RAB is chaired by USAF and community representatives.

The LAFB Community Relations Plan (CRP) was released in August 1991 and revised in May 1995. The CRP outlined a program to address community concerns and keep citizens informed and involved during remedial activities. The CRP can be found in the Administrative Record.

On June 24, 1992, the USAF made the LAFB Administrative Record available for public review. The Administrative Record is currently available for public review at the Air Force Base Conversion Agency Office, 5100 Texas Road, Limestone, Maine. The USAF published a notice and brief analysis of the OU 4 Proposed Plan in the *Bangor Daily News,* the *Aroostook Republican,* and the *Fort Fairfield Review* on May 15, 1996, and made the Proposed Plan available to the public at the Air Force Base Conversion Agency Office.

From May 17, 1996 through June 15, 1996, the USAF held a 30-day public comment period to accept public input on the alternatives presented in the FS and the Proposed Plan, as well as other documents previously released to the public. On June 11, 1996, LAFB personnel and regulatory representatives held a public meeting to discuss the Proposed Plan and to accept any oral comments. A transcript of this meeting is included as Appendix A, and a Responsiveness Summary is included as Appendix B. The Air Force received no verbal or written comments on the OU 4 Proposed Plan at a public hearing held on June 11, 1996, or during the 30 day public comment period.

4.0 SCOPE AND ROLE OF OPERABLE UNIT OR RESPONSE ACTION

The USAF has determined that NFA under CERCLA is appropriate for groundwater associated with LF-1 and the CPDA. The concentrations of organic and inorganic compounds detected in groundwater at these sites do not pose risks in exceedance of USEPA target risk levels. A determination by the USAF not to pursue further action under CERCLA for groundwater associated with LF-1 and the CPDA is not a determination that no action is warranted for source control under other regulations and statutes. The State of Maine's statutory authority is not limited by NFA under CERCLA. A soil cover system at LF-1, in accordance with Maine Solid Waste Management Regulations, was completed in 1996.

The selected remedy for LF-2 and LF-3/CAP was developed by combining components of source control and groundwater mitigation alternatives to obtain a comprehensive approach for groundwater remediation. The selected remedy for groundwater associated with LF-2 and LF-3/CAP is Minimal Action in conjunction with the source control remedy for LF-2 and LF-3 as outlined in the OU 2 ROD (ABB-ES, 1994b). In addition to the low permeability cover systems, 30-year landfill post-closure monitoring, and deed restrictions for LF-2 and LF-3 contained in the OU2 ROD, implementation of the selected alternative for OU 4 would include the following activities:

- institutional controls;
- groundwater monitoring;
- five-year site reviews; and
- contingency action, if necessary (see Subsection 10.2).

The Minimal Action alternative utilizes institutional controls to protect against human exposure to contaminated groundwater. Groundwater monitoring will be used to assess contaminant migration and to measure performance of the OU 2 cover systems in reducing leachate generation and associated groundwater contamination. The combination of OU 2 cover systems and application of activities under OU 4 Minimal Action remedy will achieve the following remedial response objectives for groundwater at LF-2 and LF-3/CAP:

- prevent human exposure to contaminated groundwater, and
- protect downgradient groundwater from contamination.

5.0 SUMMARY OF SITE CHARACTERISTICS

Section 2.0 of the FS (ABB-ES, 1996b) contains an overview of the OU 4 RI at LF-2 and LF-3/CAP, including discussions on the geology, hydrogeology, and nature and distribution of contaminants. The RI Report (ABB-ES, 1995) gives the results of the investigations at all five OU 4 sites. The significant findings of the RI are summarized below.

Landfill 1. The site geology at LF-1 is characterized by fill material consisting of landfill waste and granular soil, ablation till underlain by ice-contact deposits, basal till, and bedrock consisting of dark gray, pellitic limestone. The ablation till, ice-contact deposits, and basal till consist generally of fine to coarse sands and gravels with varying amounts of silty materials. In general, the overburden thickness at LF-1 is about 15 feet, but increases significantly toward the southwest portion of the site due to a steep drop-off in the bedrock surface. The upper 15 feet of bedrock is typically highly weathered and fractured, but becomes more competent with depth.

Groundwater in the area of LF-1 is interpreted to be flowing to the southwest and discharging to Green Pond. Downward vertical gradients near the northeastern edge of the landfill suggest downward groundwater movement, or recharge, in this area. At the southeastern edge of the landfill near Green Pond, the vertical gradients are upward, suggesting groundwater discharge into Green Pond.

Upgradient of the landfill, the water table is typically just above the top of the bedrock surface. The saturated overburden thickness increases steadily to approximately 40 feet at the downgradient or southwestern edge of the landfill. The increase in saturated thickness is a function of the rapid drop in the bedrock surface across the site from northeast to southwest. It does not appear that overburden groundwater extends into the landfill debris, with the possible exception of the toe of the landfill.

A comparison of upgradient and downgradient groundwater samples does not suggest an impact on groundwater from the landfill. Landfill leachate parameters indicated no change in groundwater conditions upgradient to downgradient. Manganese and aluminum were the only inorganics reported above maximum exposure guidelines (MEGs) for unfiltered analyses; however, no exceedances of MEGs or MCLs were noted in low-flow samples collected subsequent to the RI (ABB-ES, 1996b). Vinyl chloride was detected twice in one well at concentrations exceeding maximum contaminant levels (MCLs)/MEGs.

Landfill 2. LF-2 geology is characterized as glaciofluvial, with associated deposits consisting of ablation till underlain by ice-contact deposits, a discontinuous layer of basal till, and dark gray, weathered, pellitic limestone. Overburden thickness ranges from negligible in the central area of the landfill to about 60 feet at the northwestern portion of the site, outside the area of landfilled wastes. In most cases, landfilled wastes were placed on ice-contact deposits; however, they were also placed directly on the bedrock surface in some areas.

Based on interpretive bedrock contours, it appears that a northwest to southeast trending bedrock trough exists beneath LF-2. The topographic high of the trough is located near the northwestern end of LF-3. The trough plunges northwest in the vicinity of LF-2.

The bedrock trough beneath LF-2 apparently influences groundwater flow in both the shallow bedrock and overburden soils. Groundwater flow at LF-2 is to the north-northwest, subparallel to the trend of the bedrock trough. This direction of flow indicates that water flowing across LF-2 may also have flowed through the northern portion of LF-3. Potentiometric head data for two overburden bedrock well pairs show weak overall upward gradients in the area of LF-2.

The discontinuous shallow overburden aquifer and the fractured-bedrock aquifer appear to form one groundwater system throughout the LF-2 area, due to the permeable nature of the sand and gravel, and the weathered and fractured nature of the bedrock. The water table is located in the overburden soils over the majority of the LF-2 site. Therefore, it can be concluded that groundwater comes into contact with some of the waste throughout the year.

Volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides, inorganics above background concentrations, total petroleum hydrocarbons (TPHs), and oil and grease were detected in groundwater in and around LF-2. In addition, several miscellaneous parameters which are typical indicators of landfill plume contamination were detected in groundwater samples collected in 1993 and 1994.

Contaminants detected in overburden wells inside the landfill perimeter include fuel-related VOCs and chlorobenzenes, SVOCs (including bis(2-ethylhexyl)phthalate [BEHP] above the MCL), pesticides, and inorganics. Concentrations of contaminants detected in perimeter wells completed in the overburden adjacent to or downgradient from LF-2 were generally lower than concentrations within the limits of the waste. No significant organic contaminants were detected in overburden groundwater in perimeter wells.

Based on the most recent sampling results, inorganics above background concentrations were detected in all bedrock monitoring wells around LF-2. The SVOC BEHP was detected, and the VOC vinyl chloride was detected above its MEG, but not in excess of its MCL. Tetrachloroethene (PCE) was detected above its MEG but not its MCL. The only inorganics identified as chemicals of potential concern during low-flow sampling (LFS) were arsenic, barium, iron, and manganese.

Landfill 3/CAP. Because of the proximity of LF-3 and the CAP, these two OU 4 sites will be discussed concurrently in this section. LF-3/CAP overburden geology is characterized as a former esker deposit, consisting of ablation till underlain by ice-contact deposits, and highly weathered, pellitic limestone. Thickness of the soils outside the landfilled material ranges from about 5 feet on the northern side to a maximum of 55 feet southeast of the site in the bedrock trough. Wastes appear to have been placed directly on the ice-contact sand and gravel deposits.

Bedrock in the LF-3/CAP area is a gray pellitic limestone. The northwest-to-southeast-trending bedrock trough present beneath LF-2 appears to continue beneath LF-3, narrowing and rising to a saddle in the northwestern area of LF-3, then deepening again to the southeast of the landfill. Bedrock is interpreted to be more fractured within the trough axis than on the trough walls.

The water table was typically encountered above the bedrock surface within the perimeter of LF-3 and the CAP. LF-3 waste appears to be partially saturated by groundwater throughout the year. The groundwater system is bounded to the east and west of LF-3 by the bedrock trough, and data indicate that the water table enters bedrock in the axis of the trough south of LF-3. To the north of the divide, groundwater flows northward toward LF-2, whereas south of the divide, groundwater flow is interpreted to be southeast. Calculated vertical gradients suggest that downward groundwater movement exists on the flanks of the bedrock trough, and limited upward groundwater movement exists in the central areas of the bedrock trough.

VOCs, SVOCs, pesticides, and inorganics above background concentrations were detected in groundwater in and around LF-3. Oil and grease were also detected in groundwater samples collected within the LF-3 boundary during 1993 sampling.

Concentrations of VOCs (including benzene, trichloroethene [TCE], PCE, and vinyl chloride), SVOCs (including polynuclear aromatic hydrocarbons [PAHs]), and inorganics (including lead, nickel, and cadmium) were detected above MEGs and/or MCLs within the LF-3 boundary. The only exceedance for pesticides was heptachlor in a single well. Concentrations of VOCs, SVOCs, and inorganics are generally highest in wells within the southern half of the landfill.

Concentrations of contaminants in overburden outside the perimeter of the landfill were generally much lower than concentrations within the landfill. There were no exceedances of MEGs and/or MCLs for VOCs and pesticides/polychlorinated biphenyls (PCBs). Only one SVOC, BEHP, was detected above MEGs and/or MCLs. Arsenic, barium, iron, and manganese were identified above background concentrations in overburden groundwater low-flow samples collected outside the perimeter of the landfill.

VOCs (i.e., PCE, benzene, and vinyl chloride) were detected sporadically above the MEGs and/or MCLs in bedrock wells, generally south, east, and west of LF-3. SVOCs have been detected in several bedrock monitoring wells. The only SVOC concentrations above MCLs or MEGs were for BEHP, which was detected in three monitoring wells. Pesticides have been detected in most samples, although concentrations were generally extremely low. No pesticides or PCBs were detected above MEGs and/or MCLs in wells around LF-3. Inorganics above background concentrations have been detected in bedrock wells in the vicinity of LF-3.

Chapman Pit Debris Area. The site geology at the CPDA is characterized as fill material overlying native glacial and post-glacial deposits, which in turn are underlain by pellitic limestone. The two fill materials present consist of silts, sands, and gravels placed during LAFB gravel mining activities, and during construction of the dam after mining activities ceased. The post-glacial deposits consist of peat, silt and clay pond deposits, and medium to coarse sand and gravel stream channel deposits. The basal till, a mixture of varying amounts of silt, sand, and clay, lies directly over a highly fractured, pellitic limestone. Overburden thickness ranges from 10 to 20 feet over much of the site, to as much as 42 feet at the southern boundary of the area.

The groundwater system associated with the CPDA is bounded to the north by a recharge boundary (Chapman Pit Pond), to the east, south, and west by unnamed streams and swamps that act as discharge boundaries. These boundaries are assumed to control both overburden and bedrock groundwater flow in the CPDA. Groundwater flow is generally south and southwest away from Chapman Pit Pond.

Organic contaminants at this site are present only at very low concentrations. Methylene chloride was the only reported VOC at estimated concentrations above the MCL in 1993 samples, but it was not detected in 1994 samples. BEHP was the only SVOC detected above its MCL. Metals appear to be the primary constituents present, with aluminum and manganese consistently exceeding regulatory criteria. Lead exceeded MEGs in one overburden groundwater sample, but not at a concentration that would cause exceedance of the blood lead level, which would cause risk.

6.0 SUMMARY OF SITE RISKS

A baseline human health risk assessment (RA) was performed as part of the OU 4 RI Report (ABB-ES, 1995). A revised RA was performed as part of the OU 4 FS (ABB-ES, 1996b). The revised RA focused on the recalculation of risk based on the separation of OU 4 groundwater into bedrock and overburden samples for each of the sites, and the incorporation of LFS results for inorganic analytes, as available. The assessment was performed in accordance with USEPA guidance documents (USEPA, 1989a,b,c,d; 1991a,b), MEDEP Guidance Manual (MEDEP/DHS, 1994) and the Loring Air Force Base Risk Assessment Methodology (Hazardous Waste Remedial Actions Program [HAZWRAP], 1994). The RA estimates the probability and magnitude of potential adverse human health effects from exposure to groundwater contaminants associated with the OU 4 sites. The human health risk assessment followed a four step process:

1) **contaminant identification** identified those hazardous substances which, given the specifics of the site, were of significant concern;

2) **exposure assessment** identified actual or potential exposure pathways, characterized the potentially exposed populations, and determined the extent of possible exposure;

3) **toxicity assessment** considered the types and magnitude of adverse health effects associated with exposure to hazardous substances; and

4) **risk characterization** integrated the three previous steps to summarize the potential and actual risks posed by hazardous substances at the site, including carcinogenic and non-carcinogenic risks.

Although groundwater is not currently used on the former base, and residential development will be restricted, the RA assumed domestic use of groundwater. Exposure to residual contamination in the groundwater present at or migrating from the OU 4 sites is assumed to occur through residential use (i.e., drinking, cooking, washing, and showering). For more detail on the data sets used, contaminant identification, exposure assessment, toxicity assessment, and risk characterization, see Section 3 of the Final OU 4 FS (ABB-ES, 1996b).

Carcinogenic and noncarcinogenic risks are quantitatively evaluated for each site. Carcinogenic risks are compared to the USEPA target carcinogenic risk range of $1x10^{-4}$ to $1x10^{-6}$ and the MEDEP cancer risk guidance value of $1x10^{-5}$. Noncarcinogenic risks are compared to the USEPA noncarcinogenic Hazard Index (HI) of 1.0 (USEPA, 1989a).

6.1 HUMAN HEALTH RISK ASSESSMENT

A summary of the results of the human health risk assessment for LF-1, LF-2, LF-3/ CAP, and the CPDA groundwater is presented in the following subsections and are tabulated on Table 6-5.

6.1.1 Landfill 1

Risks from exposure to bedrock and overburden groundwater at LF-1 were evaluated separately. The contaminants of concern identified for each data set are presented on Table 6-1.

Lead was not detected in either the bedrock or overburden data sets.

LF-1 Bedrock Groundwater. The total cancer risks for the average (i.e., most probable case) and maximum (i.e. reasonable maximum exposure [RME]) scenarios are $4x10^{-5}$ and $1x10^{-4}$, respectively. These risks exceed the MEDEP cancer risk guidance value of $1x10^{-5}$, but are within the USEPA carcinogenic risk range of $1x10^{-4}$ to $1x10^{-6}$. The noncancer risks are less than an HI of 1. The HI for the average exposure is 0.02, and for the maximum exposure is 0.06.

LF-1 Overburden Groundwater. The total cancer risks for the average and maximum scenarios are $7x10^{-7}$ and $1x10^{-6}$, respectively. These risks are less than the MEDEP cancer risk guidance value of $1x10^{-5}$, and less than the USEPA carcinogenic risk range of $1x10^{-4}$ to $1x10^{-6}$. The noncancer risks are less than an HI of 1. The HI for the average exposure is 0.006, and the HI for the maximum exposure is 0.009.

6.1.2 Landfill 2

Risks from exposure to bedrock and overburden groundwater at LF-2 were evaluated separately. Because of distinct differences in the nature of contamination, shallow

TABLE 6-1
CHEMICALS OF CONCERN FOR LANDFILL 1
HUMAN HEALTH RISK ASSESSMENT

OPERABLE UNIT 4 RECORD OF DECISION
LORING AIR FORCE BASE

Compound	Minimum Detected Concentration (mg/L)	Maximum Detected Concentration (mg/L)	Mean Concentration (mg/L)	Frequency of Detection
LF-1 BEDROCK GROUNDWATER				
Chloroform	0.009	0.009	0.0027	1 / 5
Vinyl Chloride	0.00211	0.00211	0.000822	1 / 5
Aluminum	0.0641	0.177	0.09467	5 / 5
LF-1 OVERBURDEN GROUNDWATER				
bis(2-Ethylhexyl)phthalate	0.001	0.005	0.00325	2 / 2

NOTE: For information on data sets (wells, analyses, and sample dates) used in the RA, see Table 3-1 of the Draft Final FS (ABB-ES, 1996a).

bedrock (less than 200 feet bgs) and deep bedrock (greater than 200 feet bgs groundwater were evaluated separately. Similarly, overburden groundwater from within the landfill boundary was evaluated separately from overburden groundwater outside the landfill boundary. The contaminants of concern identified for each data set are presented on Table 6-2.

Lead was detected in the data sets for both shallow and deep bedrock groundwater. Lead was evaluated using the Integrated Exposure Uptake Biokinetic (IEUBK) Model only in the data set for deep bedrock, where concentrations exceeded the USEPA Action Level of 15 micrograms per liter ($\mu g/L$). IEUBK results indicate that blood lead levels due to consumption of lead at both average and maximum concentrations in drinking water would exceed the USEPA guidance blood lead level of 10 micrograms per deciliter ($\mu g/dL$).

LF-2 Shallow Bedrock Groundwater. The total cancer risks for the average and maximum scenarios are $1x10^{-4}$ and $2x10^{-4}$, respectively. These risks exceed the MEDEP cancer risk guidance value of $1x10^{-5}$. The maximum exposure risk exceeds the USEPA carcinogenic risk range of $1x10^{-4}$ to $1x10^{-6}$, and the average risk equals the upper end of the risk range. The primary contributors to the carcinogenic risk are arsenic, vinyl chloride, and 2,6-dinitrotoluene. The noncancer risks exceed an HI of 1. The HI for both the average and maximum exposure scenario is 3. The primary contributors to the noncancer risk are manganese, iron, and arsenic.

LF-2 Deep Bedrock Groundwater. The total cancer risks for the average and maximum scenarios are $6x10^{-5}$ and $1x10^{-4}$, respectively. These risks exceed the MEDEP cancer risk guidance value of $1x10^{-5}$, but are within the USEPA carcinogenic risk range of $1x10^{-4}$ to $1x10^{-6}$. The primary contributor to the carcinogenic risk is arsenic. The noncancer risks exceed an HI of 1. The HI for the average exposure is 5, The HI for the maximum exposure is 9. The primary contributors to the noncancer risk are iron, cadmium, and zinc.

LF-2 Overburden Groundwater Outside the Perimeter of the Landfill. The total cancer risks for the average and maximum scenarios are $6x10^{-6}$ and $1x10^{-5}$, respectively. These risks are less than or equal to the MEDEP cancer risk guidance value of $1x10^{-5}$, and within the USEPA carcinogenic risk range of $1x10^{-4}$ to $1x10^{-6}$. The noncancer risks are less than an HI of 1. The HI for both the average and maximum scenario is 0.1.

TABLE 6-2
CHEMICALS OF CONCERN FOR LANDFILL 2
HUMAN HEALTH RISK ASSESSMENT

OPERABLE UNIT 4 RECORD OF DECISION
LORING AIR FORCE BASE

Compound	Minimum Detected Concentration (mg/L)	Maximum Detected Concentration (mg/L)	Mean Concentration (mg/L)	Frequency of Detection
LF-2 SHALLOW BEDROCK GROUNDWATER (<200' bgs)				
Tetrachloroethene	0.002	0.004	0.001286	2 / 7
Vinyl Chloride	0.00017	0.00141	0.000351	4 / 7
cis-1,2-Dichloroethene	0.0007	0.0007	0.000533	1 / 6
1,2,4-Trichlorobenzene	0.016	0.016	0.008571	1 / 7
2,6-Dinitrotoluene	0.002	0.002	0.004571	1 / 7
bis(2-Ethylhexyl)phthalate	0.011	0.011	0.005857	1 / 7
Arsenic	0.0046	0.0046	0.0046	1 / 1
Barium	0.128	0.128	0.128	1 / 1
Iron	6.64	6.64	6.64	1 / 1
Manganese	1.46	1.46	1.46	1 / 1
LF-2 DEEP BEDROCK GROUNDWATER (>200' bgs)				
bis(2-Ethylhexyl)phthalate	0.004	0.022	0.0125	4 / 4
Aluminum	0.0576	2.14	0.71335	3 / 4
Arsenic	0.0017	0.0042	0.002488	3 / 4
Barium	0.023	0.916	0.276175	4 / 4
Cadmium	0.0042	0.0326	0.015875	4 / 4
Chromium	0.0107	0.026	0.013625	3 / 4
Iron	1.49	33	15.47	4 / 4
Lead	0.051	0.495	0.185263	4 / 4
Manganese	0.0441	0.39	0.174725	4 / 4
Zinc	4.78	13	8.24	4 / 4
LF-2 OVERBURDEN GROUNDWATER OUTSIDE THE PERIMETER OF THE LANDFILL				
Vinyl Chloride	0.00027	0.00027	0.000111	1 / 4
bis(2-Ethylhexyl)phthalate	0.003	0.003	0.006	1 / 4
Barium	0.0588	0.0588	0.0588	1 / 1
Manganese	0.144	0.144	0.144	1 / 1
LF-2 OVERBURDEN GROUNDWATER INSIDE THE PERIMETER OF THE LANDFILL				
1,4-Dichlorobenzene	0.001	0.001	0.0006	1 / 5
Benzene	0.0005	0.002	0.00091	3 / 5
Chlorobenzene	0.002	0.013	0.0033	2 / 5
Vinyl Chloride	0.00016	0.00023	0.000108	2 / 5
bis(2-Ethylhexyl)phthalate	0.003	0.01	0.0072	3 / 5
Dieldrin	0.000002	0.000002	0.000008	1 / 5
Heptachlor	0.000018	0.000018	0.000006	1 / 5
Barium	0.0588	0.0588	0.0588	1 / 1
Manganese	0.144	0.144	0.144	1 / 1

NOTE: For information on data sets (wells, analyses, and sample dates) used in the RA, see Table 3-1 of the ~~Draft~~ Final FS (ABB-ES, 1996a).

LF-2 Overburden Groundwater Inside the Perimeter of the Landfill. The total cancer risks for the average and maximum scenario are $9x10^{-6}$ and $2x10^{-5}$, respectively. Only the maximum exposure risk exceeds the MEDEP cancer risk guidance value of $1x10^{-5}$. Both the average and maximum risks are within the USEPA carcinogenic risk range of $1x10^{-4}$ to $1x10^{-6}$. The noncancer risks are less than an HI of 1. The HI for the average exposure is 0.4, and for the maximum exposure is 0.7.

6.1.3 Landfill 3/Coal Ash Pile

Risks from exposure to bedrock and overburden groundwater at LF-3/CAP were evaluated separately. Because of distinct differences in the nature of contamination, overburden groundwater from within the landfill boundary was evaluated separately from overburden groundwater outside the landfill boundary. The contaminants of concern identified for each data set are presented on Table 6-3. Lead was detected in the bedrock data set at a maximum concentration less than the USEPA Action Level of 15 μg/L; therefore, no further evaluation of lead was performed for LF-3/CAP.

LF-3/CAP Bedrock Groundwater. The total cancer risks for the average and maximum exposures are $8x10^{-5}$ and $3x10^{-4}$, respectively. These risks exceed the MEDEP cancer risk guidance value of $1x10^{-5}$, and the maximum exposure risk exceeds the USEPA carcinogenic risk range of $1x10^{-4}$ to $1x10^{-6}$. The primary contributors to the carcinogenic risks are arsenic, vinyl chloride, and heptachlor. The noncancer risks equal or exceed an HI of 1. The HI for the average exposure is 1, and the HI for the maximum exposure is 6. The primary contributors to the noncancer risks are iron and manganese.

LF-3/Cap Overburden Groundwater Outside the Perimeter of the Landfill. The total cancer risk for both the average and maximum exposure is $4x10^{-4}$. This risk exceeds the MEDEP cancer risk guidance value of $1x10^{-5}$, and the USEPA carcinogenic risk range of $1x10^{-4}$ to $1x10^{-6}$. The only contributor to the carcinogenic risk is arsenic. The noncancer risks exceed an HI of 1. The HI for both the average and the maximum scenario is 7. The primary contributors to the noncancer risk are iron, arsenic, and manganese.

LF-3/CAP Overburden Groundwater Inside the Perimeter of the Landfill. The total cancer risk for both the average and maximum exposure is $5x10^{-4}$. This risk exceeds the MEDEP cancer risk guidance value of $1x10^{-5}$, and the USEPA carcinogenic risk

TABLE 6-3
CHEMICALS OF CONCERN FOR LANDFILL 3/COAL ASH PILE
HUMAN HEALTH RISK ASSESSMENT

OPERABLE UNIT 4 RECORD OF DECISION
LORING AIR FORCE BASE

Compound	Minimum Detected Concentration (mg/L)	Maximum Detected Concentration (mg/L)	Mean Concentration (mg/L)	Frequency of Detection
LF-3/CAP BEDROCK GROUNDWATER				
Benzene	0.003	0.003	0.000727	1 / 11
Vinyl Chloride	0.0005	0.00246	0.00046	3 / 11
bis(2-Ethylhexyl)phthalate	0.001	0.007	0.005136	6 / 11
Heptachlor	0.000072	0.000072	0.000012	1 / 10
Heptachlor Epoxide	0.000001	0.000001	0.000004	3 / 10
Aluminum	0.533	1.41	0.283383	2 / 12
Arsenic	0.0026	0.0062	0.002183	5 / 12
Copper	0.0048	0.124	0.013075	2 / 12
Iron	0.0911	22.7	3.430533	9 / 12
Manganese	0.0077	2.78	0.3241	12 / 12
LF-3/CAP OVERBURDEN GROUNDWATER OUTSIDE THE PERIMETER OF THE LANDFILL				
Arsenic	0.018	0.018	0.018	1 / 1
Barium	0.337	0.337	0.337	1 / 1
Iron	23.2	23.2	23.2	1 / 1
Manganese	2.46	2.46	2.46	1 / 1
LF-3/CAP OVERBURDEN GROUNDWATER INSIDE THE PERIMETER OF THE LANDFILL				
1,1-Dichloroethane	0.003	0.053	0.053167	2 / 6
1,4-Dichlorobenzene	0.006	0.042	0.055333	3 / 6
2-Butanone	0.017	7.5	3.51675	4 / 4
Benzene	0.011	0.011	0.052583	1 / 6
Tetrachloroethene	0.004	0.004	0.051417	1 / 6
Toluene	0.25	1.8	0.677583	5 / 6
Trichloroethene	0.007	0.066	0.056	2 / 6
Vinyl Chloride	0.00084	0.00084	0.000203	1 / 6
cis-1,2-Dichloroethene	0.014	0.22	0.082833	2 / 6
4-Methylphenol	0.05	2	0.7825	4 / 6
Acenaphthene	0.002	0.002	0.132417	1 / 6
Naphthalene	0.017	0.092	0.12525	3 / 6
Arsenic	0.018	0.018	0.018	1 / 1
Iron	23.2	23.2	23.2	1 / 1
Manganese	2.46	2.46	2.46	1 / 1

NOTE: For information on data sets (wells, analyses, and sample dates) used in the RA, see Table 3-1 of the ~~Draft-Final~~ FS (ABB-ES, 1996a).

range of $1x10^{-4}$ to $1x10^{-6}$. The primary to the carcinogenic risk are arsenic, vinyl chloride, 1,4-dichlorobenzene, TCE, benzene, and PCE. The noncancer risks exceed an HI of 1. The HI for the average exposure is 16, and for the maximum exposure is 27. The primary contributors to the noncancer risk are 4-methylphenol, iron, benzene, arsenic, manganese, and cis-1,2-dichloroethene (DCE).

6.1.4 Chapman Pit Debris Area

Risks from exposure to bedrock and overburden groundwater at the CPDA were evaluated separately. The contaminants of concern identified for each data set are presented on Table 6-4.

Lead was detected in the bedrock data set at a maximum concentration less than the USEPA Action Level of 15 μg/L; therefore, no further evaluation of lead was performed for the CPDA.

CPDA Bedrock Groundwater. The total cancer risks for the average and maximum exposures are $1x10^{-6}$ and $2x10^{-6}$, respectively. These risks are less than the MEDEP cancer risk guidance value of $1x10^{-5}$, and within the USEPA carcinogenic risk range of $1x10^{-4}$ to $1x10^{-6}$. The noncancer risks are less than an HI of 1. The HI for the average exposure is 0.4, and the HI for the maximum exposure is 0.7.

CPDA Overburden Groundwater. The total cancer risks for the average and maximum exposures are $1x10^{-6}$ and $3x10^{-6}$, respectively. These risks are less than the MEDEP cancer risk guidance value of $1x10^{-5}$, and within the USEPA carcinogenic risk range of $1x10^{-4}$ to $1x10^{-6}$. The noncancer risks are less than an HI of 1. The HI for the average scenario is 0.01, and the HI for the maximum exposure scenario is 0.02.

6.2 Uncertainty Evaluation

Quantitative estimates of risk are based on numerous assumptions, most of which are intended to be protective of human health (i.e., conservative). A summary of potential sources of uncertainty, and the likely tendency of their effects (i.e., to over- or underestimate risks) is presented in the Final OU 4 FS (ABB-ES, 1996b). Although some uncertainties in the RA methodology might bias the evaluation in the

TABLE 6-4
CHEMICALS OF CONCERN FOR CHAPMAN PIT DEBRIS AREA
HUMAN HEALTH RISK ASSESSMENT

OPERABLE UNIT 4 RECORD OF DECISION
LORING AIR FORCE BASE

Compound	Minimum Detected Concentration (mg/L)	Maximum Detected Concentration (mg/L)	Mean Concentration (mg/L)	Frequency of Detection
CPDA BEDROCK GROUNDWATER				
bis(2-Ethylhexyl)phthalate	0.002	0.007	0.0045	2 / 2
Aluminum	1.12	1.12	0.64525	1 / 2
Iron	0.411	1.58	0.9955	2 / 2
Manganese	0.0968	0.513	0.3049	2 / 2
Nickel	0.0173	0.0173	0.01275	1 / 2
CPDA OVERBURDEN GROUNDWATER				
Methylene Chloride	0.0031	0.0079	0.004525	4 / 6
Di-n-butylphthalate	0.00052	0.0019	0.002327	4 / 6
bis(2-Ethylhexyl)phthalate	0.00094	0.005	0.002723	6 / 6

NOTE: For information on data sets (wells, analyses, and sample dates) used in the RA, see Table 3-1 of the ~~Draft-~~Final FS (ABB-ES, 1996a).

direction of an underestimation of risk, most assumptions will bias the evaluation in the direction of overestimation of risk.

6.3 CONCLUSION

A summary of quantitative risks for each of the OU 4 sites is presented on Table 6-5.

Landfill 1 and Chapman Pit Disposal Area. The risk estimates for domestic use of both overburden and bedrock groundwater at LF-1 and the CPDA are below MEDEP and USEPA carcinogenic and noncarcinogenic target risk levels, with the exception of bedrock groundwater at LF-1 which exceeds the MEDEP cancer risk guidance value. Although risks associated with groundwater at LF-1 are within the USEPA risk range of $1x10^{-4}$ to $1x10^{-6}$, a soil cover system is being installed in 1996 as required by the MEDEP Solid Waste Management Regulations. For these reasons, the USAF has proposed NFA under CERCLA for LF-1 and the CPDA.

Landfill 2. At LF-2, the noncarcinogenic risk estimates for domestic use of bedrock groundwater exceed an HI of 1.0. The maximum exposure carcinogenic risk for shallow bedrock groundwater exceeds the MEDEP and USEPA target risk levels. The average exposure for shallow bedrock exceeds the MEDEP cancer risk guidance value and equals the upper end of the USEPA target risk range. Both average and maximum exposures for deep bedrock groundwater, exceed the MEDEP and USEPA target risk levels. Detections of lead in bedrock groundwater were qualitatively evaluated using the IEUBK Model, which indicated that blood lead levels due to consumption of lead at both average and maximum concentrations in drinking water would exceed the USEPA guidance blood lead level of 10 μg/dL. No remedial alternatives were evaluated in the FS for overburden groundwater, because risks do not exceed MEDEP and USEPA target levels, with the exception of overburden groundwater inside the perimeter of the landfill where the maximum exposure risk slightly exceeds the MEDEP cancer risk guidance value. For bedrock groundwater, five remedial alternatives were developed and screened, and the No Action, Minimal Action, and Groundwater Collection/Treatment/Discharge alternatives were carried through detailed analysis in the FS.

Landfill 3/Coal Ash Pile. At LF-3/CAP, both average and maximum exposure risk estimates for domestic use of overburden groundwater exceed MEDEP and USEPA carcinogenic and noncarcinogenic target risk levels. The average and maximum

TABLE 6-5
QUANTITATIVE RISK SUMMARY

OPERABLE UNIT 4 RECORD OF DECISION
LORING AIR FORCE BASE

SITE	AVERAGE Total Cancer Risk	AVERAGE Total Hazard Index	MAXIMUM Total Cancer Risk	MAXIMUM Total Hazard Index
LF-1 BEDROCK GROUNDWATER	4E-05	0.02	1E-04	0.06
LF-1 OVERBURDEN GROUNDWATER	7E-07	0.006	1E-06	0.009
LF-2 SHALLOW BEDROCK GROUNDWATER (<200' bgs)	1E-04	3	2E-04	3
LF-2 DEEP BEDROCK GROUNDWATER (>200' bgs)	6E-05	6	1E-04	9
LF-2 OVERBURDEN GROUNDWATER: OUTSIDE THE LANDFILL	6E-06	0.1	1E-05	0.1
LF-2 OVERBURDEN GROUNDWATER: INSIDE THE LANDFILL	9E-06	0.4	2E-05	0.7
LF-3/CAP BEDROCK GROUNDWATER	8E-05	1	3E-04	6
LF-3/CAP OVERBURDEN GROUNDWATER: OUTSIDE THE LANDFILL	4E-04	7	4E-04	7
LF-3/CAP OVERBURDEN GROUNDWATER: INSIDE THE LANDFILL	5E-04	16	6E-04	27
CPDA BEDROCK GROUNDWATER	1E-06	0.4	2E-06	0.7
CPDA OVERBURDEN GROUNDWATER	1E-06	0.01	3E-06	0.02

NOTES:
Shaded values exceed upper end of USEPA target risk range (10-6 to 10-4) or an HI of 1.0.
Total risks include ingestion, dermal, and inhalation exposures.
bgs = below ground surface

exposure risk estimates for bedrock groundwater exceed the MEDEP cancer risk guidance value. The maximum exposure risk estimate for bedrock groundwater also exceeds USEPA target risk levels. Remedial alternatives for both overburden and bedrock groundwater were evaluated in the FS due to elevated risks.

Actual or threatened releases of hazardous substances to groundwater from LF-2 and LF-3/CAP, if not addressed by implementing the response action selected in this ROD in conjunction with the response action selected in the OU 2 ROD, may present an imminent and substantial endangerment to public health. The objective of the selected remedial action is to implement institutional controls and conduct downgradient groundwater monitoring, in conjunction with the low permeability cover systems being installed as source control under OU 2. Through this action, exposures to the contaminants in groundwater at LF-2 and LF-3/CAP will be significantly reduced.

7.0 DEVELOPMENT AND SCREENING OF ALTERNATIVES

Three alternatives for LF-2 and LF-3/CAP were developed and screened in the OU 4 FS (ABB-ES, 1996b). This section describes the response objectives and the development and screening of alternatives.

The USAF has determined that NFA under CERCLA is necessary for groundwater associated with LF-1 and the CPDA, and therefore, no remedial alternatives were developed for these sites.

7.1 STATUTORY REQUIREMENTS/RESPONSE OBJECTIVES

Under its legal authorities, the USAF's primary responsibility at NPL sites 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 USAF's remedial action, when complete, must comply with all federal and more stringent state environmental standards, requirements, criteria or limitations, unless a waiver is granted; a requirement that the USAF select a remedial action that is cost-effective and that 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 volume, toxicity or mobility of the hazardous substances is a principal element over remedies not involving such treatment. Response 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 remedial action objectives were developed to mitigate existing and future potential threats to public health and the environment. These response objectives for groundwater at LF-2 and LF-3/CAP are:

- to prevent human exposure to contaminated groundwater; and
- to protect downgradient groundwater from contamination.

7.2 TECHNOLOGY AND ALTERNATIVE DEVELOPMENT AND SCREENING

CERCLA and the NCP have set forth the process by which remedial actions are evaluated and selected. In accordance with these requirements, a range of alternatives were developed for LF-2 and LF-3/CAP.

With respect to groundwater response action, the FS developed a range of alternatives considering the CERCLA statutory preference for a treatment that reduces the toxicity, mobility, or volume of the hazardous substances. This range included an alternative that removes or destroys hazardous substances to the maximum extent feasible, eliminating or minimizing to the degree possible the need for long-term management. This range also included alternatives that treat the principal threats posed by the site but vary in the degree of treatment employed and the quantities and characteristics of the treatment residuals and untreated waste that must be managed; alternative(s) that involve little or no treatment but provide protection through engineering or institutional controls; and a no action alternative.

Of the five groundwater remedial alternatives screened in Section 6 of the FS, three were retained for detailed analysis. Tables 6-1 and 6-3 in the FS identify the three alternatives that were retained through the screening process, as well as those that were eliminated from further consideration.

8.0 DESCRIPTION OF ALTERNATIVES

This section provides a narrative summary of each alternative evaluated in the FS. The alternatives developed for LF-2 include No Action and Minimal Action. The alternatives developed for LF-3/CAP include No Action, Minimal Action, and Groundwater Collection/Treatment/Discharge. A detailed assessment of each alternative can be found in Section 7.0 of the OU 4 FS (ABB-ES, 1996b).

The landfill cover systems at LF-2 and LF-3 under OU 2 are expected to result in mitigation of groundwater contamination by isolating a large volume of the waste from groundwater contact. All alternatives presented are evaluated, with consideration given to the effects of the cover systems on contaminant concentrations.

8.1 NO ACTION

The No Action alternative was evaluated for both LF-2 and LF-3/CAP (alternatives LF2-1 and LF3-1 in the FS), as required by the NCP, to provide a baseline against which other alternatives could be compared during detailed analysis. This No Action alternative differs from the "traditional" No Action alternative in that beneficial impacts on groundwater quality are expected from remediation being done in accordance with OU 2. Therefore, the No Action alternative does not assume that current conditions, as described in the OU 4 RI Report, would remain even if this alternative were selected.

Implementation of this alternative would not limit exposure of contaminated groundwater to existing and future groundwater users outside of the area of landfilled wastes at LF-2 and LF-3 in the short term. Future residential exposure to groundwater would remain possible for both new users and existing users. There are no costs associated with this alternative.

8.2 MINIMAL ACTION

The Minimal Action alternative was also evaluated for both LF-2 and LF-3/CAP (alternatives LF2-2 and LF-3-2 in the FS). The components of this alternative, in addition to the OU 2 actions, are as follows:

- institutional controls
- groundwater monitoring
- five-year site reviews
- contingency action, if necessary (see Subsection 10.2)

This alternative would include institutional controls to protect against human exposure to contaminated groundwater. Monitoring wells downgradient of LF-2 and LF-3 would be used to monitor contaminant levels downgradient of the landfill. These monitoring locations would be used to verify and define the zone of attainment for action levels, as well as serve as compliance points between existing groundwater users and the landfills.

Five-year reviews would evaluate the monitoring system, including the frequency of monitoring, the zone of attainment, and the downgradient distribution of contaminants. If landfill-related contaminants are detected at the compliance point at concentrations above the action levels, a contingency action will be implemented. The contingency action is discussed in Subsection 10.2.

Implementation of this alternative would limit exposure of existing and future groundwater users to contaminated groundwater outside of the area of landfilled wastes at LF-2 and LF-3.

Estimated Time of Operation: 30 Years

Estimated Capital Cost: $87,000

Estimated Operation and Maintenance (O&M) Costs (net present worth): $810,000

Estimated Total Cost (net present worth): $897,000

8.3 GROUNDWATER COLLECTION/TREATMENT/DISCHARGE

The Groundwater Collection/Treatment/Discharge alternative was also evaluated for LF-3 (alternative LF3-4 in the FS). This alternative consists of components from the Minimal Action alternative, along with a groundwater collection and treatment system designed to recover contaminated groundwater from the overburden and shallow bedrock aquifers downgradient of LF-3. Key components of this alternative include:

- pre-design hydrogeologic studies
- groundwater extraction system construction
- groundwater treatment facility construction and operation
- treated groundwater discharge
- institutional controls
- groundwater monitoring
- five-year site reviews

Prior to design of this alternative, hydrogeologic studies are recommended to optimize the design of the groundwater extraction system in controlling contaminant migration from LF-3.

Because of the existence of a groundwater divide beneath LF-3, two extraction wells with variable pumping rates of up to 25 gallons per minute (gpm) would be necessary to prevent off-site migration of contaminated groundwater. One well would be placed at the northwestern end of LF-3, the other at the southeastern end of the landfill.

Extracted groundwater would be pumped to a centrally-located groundwater treatment facility. The following treatment train was selected for this alternative, based on an evaluation of available treatment technologies: chemical oxidation/ precipitation, filtration, air stripping, and carbon adsorption.

Discharge of the treated groundwater would be to the LAFB wastewater treatment plant (WWTP) via a trenched forcemain.

Implementation of this alternative would limit exposure of contaminated groundwater to existing and future groundwater users outside of the area of landfilled wastes at LF-3. It would provide added protection by preventing the migration of groundwater contaminants from beneath the landfill until the beneficial effects of the cover system on groundwater quality are realized.

Estimated Time of Operation: 5 to 30 Years

Estimated Capital Cost: $2,257,000

Estimated O&M Costs (net present worth):

Range from $1,761,000 to $3,688,000

Estimated Total Cost (net present worth):

Range from $4,018,000 to $5,945,000

9.0 SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES

Section 121(b)(1) of CERCLA presents several factors that, at a minimum, the USAF is required to consider in its assessment of alternatives. Building upon these specific statutory mandates, the NCP articulates nine evaluation criteria to be used in assessing the individual remedial alternatives.

9.1 EVALUATION CRITERIA USED FOR DETAILED ANALYSIS

A detailed analysis was performed on the alternatives using the nine evaluation criteria in order to select an interim site remedy. Section 9.2 contains a summary of the comparison of each alternative's strengths and weaknesses with respect to the nine evaluation criteria. These criteria are summarized in Subsections 9.1.1 through 9.1.3.

9.1.1 Threshold Criteria

The two threshold criteria described below must be met in order for the alternatives to be eligible for selection in accordance with the NCP.

- **Overall protection of human health and the environment** addresses whether or not 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 applicable or relevant and appropriate requirements (ARARs)** addresses whether or not a remedy will meet all of the ARARs of other Federal and state environmental laws and/or provide grounds for invoking a waiver.

9.1.2 Primary Balancing Criteria

The following five criteria are utilized to compare and evaluate the elements of one alternative to another that meet the threshold criteria.

- **Long-term effectiveness and permanence** addresses the criteria that are utilized to assess alternatives for the long-term effectiveness and permanence they afford, along with the degree of certainty that they will prove successful.

- **Reduction of toxicity, mobility, or volume through treatment** 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** addresses the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed during the construction and implementation period, until cleanup goals are achieved.

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

- **Cost** includes estimated capital costs (indirect and direct) and annual O&M costs, as well as present-worth costs.

9.1.3 Modifying Criteria

The modifying criteria are used on the final evaluation of remedial alternatives generally after the USAF has received public comment on the RI/FS and Proposed Plan.

- **State acceptance** addresses the state's position and key concerns related to the preferred alternative and other alternatives, and the state's comments on ARARs and to be considered (TBC) criteria or the proposed use of waivers.

- **Community acceptance** addresses the public's general response to the alternatives described in the Proposed Plan and RI/FS report.

9.2 SUMMARY OF COMPARATIVE ANALYSIS

During the detailed analysis of each individual alternative, a comparative analysis was conducted, focusing on the relative performance of each alternative against the nine criteria. The complete comparative analysis is presented in Section 7.0 of the OU 4 FS (ABB-ES, 1996b). The following subsections present the nine criteria and a brief narrative summary of the alternatives and their strengths and weaknesses according to the detailed and comparative analysis. A tabular assessment of each alternative according to the criteria can be found in Table 9-1.

9.2.1 Overall Protection of Human Health and the Environment

The OU 2 cover system is expected to result in eventual attainment of remediation goals at both LF-2 and LF-3. An increased level of protection to human health will be provided in the interim by the Minimal Action alternative through the implementation of institutional controls. The Groundwater Collection/Treatment/Discharge alternative would further increase protection by preventing migration of groundwater contaminants from beneath the landfill until the beneficial effects of the cover system on groundwater quality are realized.

9.2.2 Compliance with Applicable or Relevant and Appropriate Requirements

The No Action alternative would not trigger action- or location-specific ARARs, and there would be eventual attainment of Maximum Contaminant Levels (MCLs) due to the effects of the cover system. The Minimal Action alternative will not trigger location- or action-specific ARARs. Chemical-specific ARARs will be met by the eventual attainment of MCLs. The Groundwater Collection/Treatment/Discharge alternative would meet all ARARs during construction and operation, assuming modifications are made to the WWTP discharge permits.

9.2.3 Long-term Effectiveness and Permanence

Because the cover systems currently being constructed at LF-2 and LF-3 are expected to result in improved groundwater quality, all three alternatives would provide long-term effectiveness. Permanence of the alternatives is dependent upon proper maintenance and effectiveness of the cover system.

Table 9-1
Comparative Summary of Remedial Alternatives

Operable Unit 4 Record of Decision
Loring Air Force Base

Alternative	Overall Protection	Compliance with ARARs	Long-Term Effectiveness	Reduction of Mobility, Toxicity, and Volume	Short-Term Effectiveness	Implementability	Cost[1]
LF2-1/ LF3-1 No Action	OU 2 cover system expected to result in eventual attainment of action levels. Human health may not be sufficiently protected during interim.	Action- and location-specific ARARs not triggered. Eventual attainment of MCLs.	Assuming proper cover system maintenance, this alternative provides long-term effectiveness and permanence.	No reductions through treatment, but mobilizing influences would be mitigated by cover system.	Not effective during short- term. Domestic users of downgradient groundwater potentially exposed to contaminants.	Easily implementable. Activities implemented under OU 2 closure plan.	$0
LF2-2/ LF3-2 Minimal Action	OU 2 cover system expected to result in eventual attainment of action levels. Human health protected during interim by institutional controls.	Action- and location-specific ARARs not triggered. Eventual attainment of MCLs.	Assuming proper cover system maintenance, this alternative provides long-term effectiveness and permanence.	No reductions through treatment, but mobilizing influences would be mitigated by cover system.	Effective during short term. Domestic users of downgradient groundwater protected by institutional controls.	Easily implementable. Institutional controls are assumed to be implementable on and off LAFB property.	$897,000
LF3-4 Groundwater Collection/ Treatment/ Discharge	OU 2 cover system expected to result in eventual attainment of action levels. Human health protected during interim by groundwater extraction and institutional controls.	Meets ARARs during construction. Assuming permit modification to WWTP, meets ARARs during operation.	Assuming proper cover system maintenance, this alternative provides long-term effectiveness and permanence.	Contaminated groundwater treated during treatment facility operation. Mobilization influences would be mitigated by cover system.	Effective during short term. Domestic users of downgradient groundwater protected by institutional controls and groundwater extraction.	Groundwater extraction and treatment implementable. Discharge to WWTP expected to meet regulatory approval.	Variable costs depending on length of operation. 5 Years: $4,018,000 10 Years: $4,696,000 20 Years: $5,524,000 30 Years: $5,945,000

Notes:

(1) Total Present Worth

9.2.4 Reduction of Mobility, Toxicity, or Volume through Treatment

Since the No Action alternative and the Minimal Action alternative do not incorporate any treatment system, there would be no reduction due to treatment. However, the cover system may reduce infiltration and leachate generation. The Groundwater Collection/Treatment/Discharge alternative would also use the cover system to mitigate the mobilizing influences, but would provide further protection by using groundwater collection and treatment to reduce contaminant concentrations to acceptable levels.

9.2.5 Short-term Effectiveness

The No Action alternative would provide protection only to potential receptors engaged in activities in the immediate vicinity of the landfills. The Minimal Action alternative would provide expanded protection with aggressive and widespread use of institutional controls and environmental monitoring, while providing contingency plans in the event that drinking water supplies are affected by contaminated groundwater. The Groundwater Collection/Treatment/Discharge alternative would provide a higher level of short-term protection for potential human receptors by intercepting currently contaminated water that would otherwise continue to affect the aquifer downgradient of LF-3.

9.2.6 Implementability

The No Action alternative does not include remedial actions. Installation of monitoring wells and well head treatment systems for Minimal Action involves easily implementable technologies. Implementation of institutional controls would require coordination with local governments. The technologies available for the construction of a groundwater extraction and treatment system are more complex and would require significantly more time to construct.

9.2.7 Cost

The cost criterion includes both the capital costs of implementing an alternative and the O&M costs. The No Action alternative has no associated costs. The Minimal Action alternative has an estimated cost of $897,000 for each landfill, including installation and monitoring costs. The costs associated with the Groundwater

Collection/Treatment/Discharge alternative range from $4,018,000 to $5,945,000 depending on the length of operation of the treatment system.

9.2.8 State Acceptance

The MEDEP, as a party of the FFA, has provided comments on the FS and Proposed Plan, and has documented its concurrence with the remedial action. As stated in Section 13 of this ROD. A copy of the MEDEP's letter of concurrence is presented in Appendix C of this ROD.

9.2.9 Community Acceptance

The Proposed Plan presents the preferred alternative for LF-2 and LF-3/CAP, Minimal Action, and the preferred alternative for LF-1 and the CPDA, NFA. From May 17, 1996 through June 15, 1996, the USAF held a public comment period to accept public input. A public meeting was held on June 11, 1996 to discuss the Proposed Plan and to accept any oral comments.

Community acceptance of the Proposed Plan was evaluated based on comments received at the public meeting and during the public comment period. This is documented in the transcript of the Public Meeting in Appendix A, and in the Responsiveness Summary in Appendix B of this ROD.

10.0 THE SELECTED REMEDY

The selected remedy for groundwater associated with LF-2 and LF-3/CAP is Minimal Action (Alternatives LF-2-2 and LF3-2 of the FS). In addition to the source control remedy outlined in the OU 2 ROD (ABB-ES, 1994b), Minimal Action for LF-2 and LF-3/CAP will include institutional controls, downgradient groundwater monitoring, and a contingency action, if necessary, to protect against human exposure to contaminated groundwater The remedial action is a final remedy for the groundwater associated with LF-2 and LF-3/CAP.

10.1 ACTION LEVELS

In accordance with USEPA Risk Assessment Guidance for Superfund and the NCP, the USAF has established, with concurrence of the regulatory agencies, site-specific action levels that will be protective of human health and the environment. Action levels have been established for LF-2 bedrock groundwater and LF-3/CAP bedrock and overburden groundwater, based on the Chemical-specific ARARs (i.e., Drinking Water MCLs and Maximum Contaminant Level Goals (MCLGs) presented in Table 11-1 of this ROD, State MEGs, and Risk Assessment (i.e., $1x10^{-6}$ excess cancer risk level and hazard quotient equals one per compound). If a value described by any of the above methods was not capable of being detected with sufficient precision and value, then the practical quantitation limit or background value was used as appropriate for the groundwater action level. Compounds for which action levels have been established are listed in Tables 10-1 and 10-2 for LF-2 and LF-3/CAP, respectively.

Cumulative carcinogenic and noncarcinogenic risk posed by ingestion of groundwater and inhalation of VOCs from domestic water usage has been calculated for the contaminants of concern using the action level concentrations. Table 10-3 summarizes the individual and cumulative carcinogenic and noncarcinogenic risks.

TABLE 10-1
LF-2 BEDROCK GROUNDWATER[a]
ACTION LEVELS

OPERABLE UNIT 4 RECORD OF DECISION
LORING AIR FORCE BASE

CHEMICAL OF CONCERN	MAXIMUM DETECTED CONCENTRATION	PRACTICAL QUANTITATION LIMIT[1]	BACKGROUND CONCENTRATION[2]	MCL[3]	MEG[4]	RISK-BASED CONCENTRATION[5]	ACTION LEVELS[6]	RATIONALE
Bis(2-ethylhexyl)phthalate	22	10	--	6	25	4.7	10	PQL
Tetrachloroethene	4	0.5	--	5	3	0.71	3	MEG
Vinyl Chloride	1.41	0.15	--	2	0.15	0.019	0.15	MEG
Cadmium	32.6	2	0.3	5	5	14	5	MCL
Iron	33,000	25	8,330	300[b]	-	8,400	8,400	Risk-Based
Lead	495	5	5.7	15[c]	20	80	80	Risk-Based
Zinc	13,000	25	59.2	5,000[b]	-	8,400	8,400	Risk-Based

Sources:

(1) PACE, Inc., New England-ME Laboratory, Westbrook, Maine
(2) January 1995 data from OU 12 bedrock wells sampled using conventional sampling procedures
(3) Drinking Water Regulations and Health Advisories, U.S. Environmental Protection Agency, Office of Water, May 1995
(4) The source of these MEGs is the State of Maine Department of Human Services October 23, 1992 Letter Regarding Revised Maximum Exposure Guidelines.
(5) Calculated at a carcinogenic risk level of 10^{-6} or an HI of 1. Lead concentrations would not result in exceedance of USEPA Guidance Blood Lead Level of 10 micrograms per liter (calculated using Integrated Exposure Uptake Biokinetic Model)
(6) Developed by comparison of maximum detected concentration to PQL, background concentration, MCL, MEG, and risk-based concentration.

Notes:

(a) Includes shallow bedrock (<200 feet bgs) and deep bedrock (>200 feet bgs) groundwater
(b) Secondary Drinking Water Standard, suggested level, not an ARAR.
(c) Suggested action level at tap for water systems (SDWA; 40 CFR 141.80), not an MCL or ARAR.
Units micrograms per liter
MEG Maximum Exposure Guideline
MCL Maximum Contaminant Level
PQL Practical Quantitation Limit
-- No value

Table 10-2
LF-3 Bedrock and Overburden Groundwater Action Levels

Operable Unit 4 Record of Decision
Loring Air Force Base

Chemical of Concern	Maximum Detected Concentration	Practical Quantitation Limit[1]	Background Concentration[2]	MCL[3]	MEG[4]	Risk-Based Concentration[5]	Action Levels[6]	Rationale
Bedrock								
Vinyl Chloride	2.46	0.15	--	2	0.15	0.019	0.15	MEG
Iron	22,700	25	8,333	300[a]	-	8,400	8,400	Risk-Based
Manganese	2,780	5	94	50[a]	200	1,300	1,300	Risk-Based
Overburden								
1,4-Dichlorobenzene	42	0.5	--	75	27	1.5	27	MEG
4-Methylphenol	2,000	10	--	--	-	140	140	Risk-Based
Benzene	11	0.5	--	5	5	1.3	5	MCL
Tetrachloroethene	4	0.5	--	5	3	0.71	3	MEG
Trichloroethene	66	0.5	--	5	5	3.4	5	MCL
Vinyl Chloride	0.84	0.15	--	2	0.15	0.019	0.15	MEG
Iron	23,200	25	399	300[a]	-	8,400	8,400	Risk-Based
Manganese	2,460	5	112	50[a]	200	1,300	1,300	Risk-Based

Sources:

(1) PACE, Inc., New England-ME Laboratory, Westbrook, Maine
(2) Bedrock - January 1995 data from OU 12 bedrock wells sampled using conventional sampling procedures. Overburden - July 1995 data from OU 12 overburden wells sampled using low-flow sampling procedures.
(3) Drinking Water Regulations and Health Advisories, U.S. Environmental Protection Agency, Office of Water, May 1995
(4) The source of these MEGs is the State of Maine Department of Human Services October 23, 1992 Letter Regarding Revised Maximum Exposure Guidelines.
(5) Calculated at a carcinogenic risk level of 10^{-6} or an HI of 1.
(6) Developed by comparison of maximum detected concentration to PQL, background concentration, MCL, MEG, and risk-based concentration.

Notes:

(a) Secondary Drinking Water Standard, suggested level, not an ARAR.
Units micrograms per liter (µg/L)
MEG Maximum Exposure Guideline
MCL Maximum Contaminant Level
PQL Practical Quantitation Limit
-- No value

TABLE 10-3
GROUNDWATER ACTION LEVELS AND RISK SUMMARY

OPERABLE UNIT 4 RECORD OF DECISION
LORING AIR FORCE BASE

LF-2 Bedrock Groundwater

CARCINOGENIC CHEMICAL OF CONCERN	ACTION LEVEL (µG/L)	BASIS	LEVEL OF RISK
bis(2-ethylhexyl)phthalate	10	PQL	2.1×10^{-6}
Tetracholorethene	3	MEG	4.2×10^{-6}
Vinyl Chloride	0.15	MEG	7.7×10^{-6}
SUMMARY CANCER RISK			1×10^{-5}

NONCARCINOGENIC CHEMICAL OF CONCERN	ACTION LEVEL (µG/L)	BASIS	TARGET ENDPOINT OF TOXICITY	HAZARD QUOTIENT
bis(2-ethylhexyl)phthalate	10	PQL	Liver	0.018
Tetrachloroethene	3	MEG	Liver	0.02
Cadmium	5	MCL	Blood	0.36
Iron	8,400	Risk-Based	Liver	1.0
Lead	80	Risk-Based	Central Nervous System, Blood	--
Zinc	8,400	Risk-Based	Respiratory System[a]	1.0
SUMMARY HAZARD INDEX				2

LF-3 Bedrock Groundwater

CARCINOGENIC CHEMICAL OF CONCERN	ACTION LEVEL (µG/L)	BASIS	LEVEL OF RISK
Vinyl Chloride	0.15	MEG	7.7×10^{-6}
SUMMARY CANCER RISK			8×10^{-6}

NONCARCINOGENIC CHEMICAL OF CONCERN	ACTION LEVEL (µG/L)	BASIS	TARGET ENDPOINT OF TOXICITY	HAZARD QUOTIENT
Iron	8,400	Risk-Based	Liver	1.0
Manganese	1,300	Risk-Based	Central Nervous System	0.99
Summary Hazard Index				2

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Table 10-3
Groundwater Action Levels and Risk Summary

Operable Unit 4 Record of Decision
Loring Air Force Base

LF-3 Overburden Groundwater

Carcinogenic Chemical of Concern	Action Level (μg/L)	Basis	Level of Risk
1,4-Dichlorobenzene	27	MEG	1.7×10^{-5}
Benzene	5	MCL	3.9×10^{-6}
Tetrachoroethene	3	MEG	4.2×10^{-6}
Trichloroethene	5	MCL	1.5×10^{-6}
Vinyl Choloride	0.15	MEG	7.7×10^{-6}
Summary Cancer Risk			3×10^{-5}

Noncarcinogenic Chemical of Concern	Action Level (μg/L)	Basis	Target Endpoint of Toxicity	Hazard Quotient
Benzene	5	MCL	Blood	1.1
Tetrachloroethene	3	MEG	Liver	0.02
Trichloroethene	5	MCL	Liver, Respiratory System, Heart, Central Nervous System, Kidneys	0.053
4-Methylphenol	140	Risk-Based	Central Nervous System, Respiratory System	1.0
Iron	8,400	Risk-Based	Liver	1.0
Manganese	1,300	Risk-Based	Central Nervous System	0.99
Summary Hazard Index				4

Notes:

(a) based on zinc compounds
μg/L micrograms per liter
MEG Maximum Exposure Guideline
MCL Maximum Contaminant Level
PQL Practical Quantitation Limit

The action levels are consistent with ARARs criteria for groundwater and attain USEPA's risk management goal for remedial actions. The determination of the effectiveness of the remedy cannot be made until residual levels are known. If concentrations above action levels are detected at the compliance point, a risk assessment will be performed on the residual groundwater contamination to determine whether the remedial action is protective. This assessment and contingency action are discussed in Subsection 10.2.

10.2 Description of Remedial Components

The following paragraphs describe the remedial alternative developed by the USAF for groundwater associated with LF-2 and LF-3/CAP: Minimal Action. In addition to the OU 2 low permeability cover systems, 30-year landfill post-closure monitoring, and deed restrictions, implementation of the selected alternative will include the following activities:

- institutional controls;
- groundwater monitoring;
- five year site reviews; and
- contingency action, if necessary.

The components are described in the following paragraphs.

Institutional Controls. The ROD for OU 2 (ABB-ES, 1994b) specifies the use of property deed restrictions on the land in the vicinity of the landfills (i.e., limits of the cover systems) to limit subsurface development (excavation or drilling), use of the property, and excessive vehicular traffic (including off-road vehicles and dirt bikes). Consequently, installation of drinking water supply wells within the landfills will not be possible. The OU 2 deed restrictions are intended to protect human health and the environment from exposure to landfilled waste and to restrict activities that could compromise the integrity of the final cover system.

In addition to the restrictions for OU 2, institutional controls will be established for OU 4 to restrict the use of groundwater. The limits of institutional controls are presented on Figure 10-1. These limits would restrict groundwater use from the perimeter of the landfills to the adjacent property lines or a minimum of 500 feet

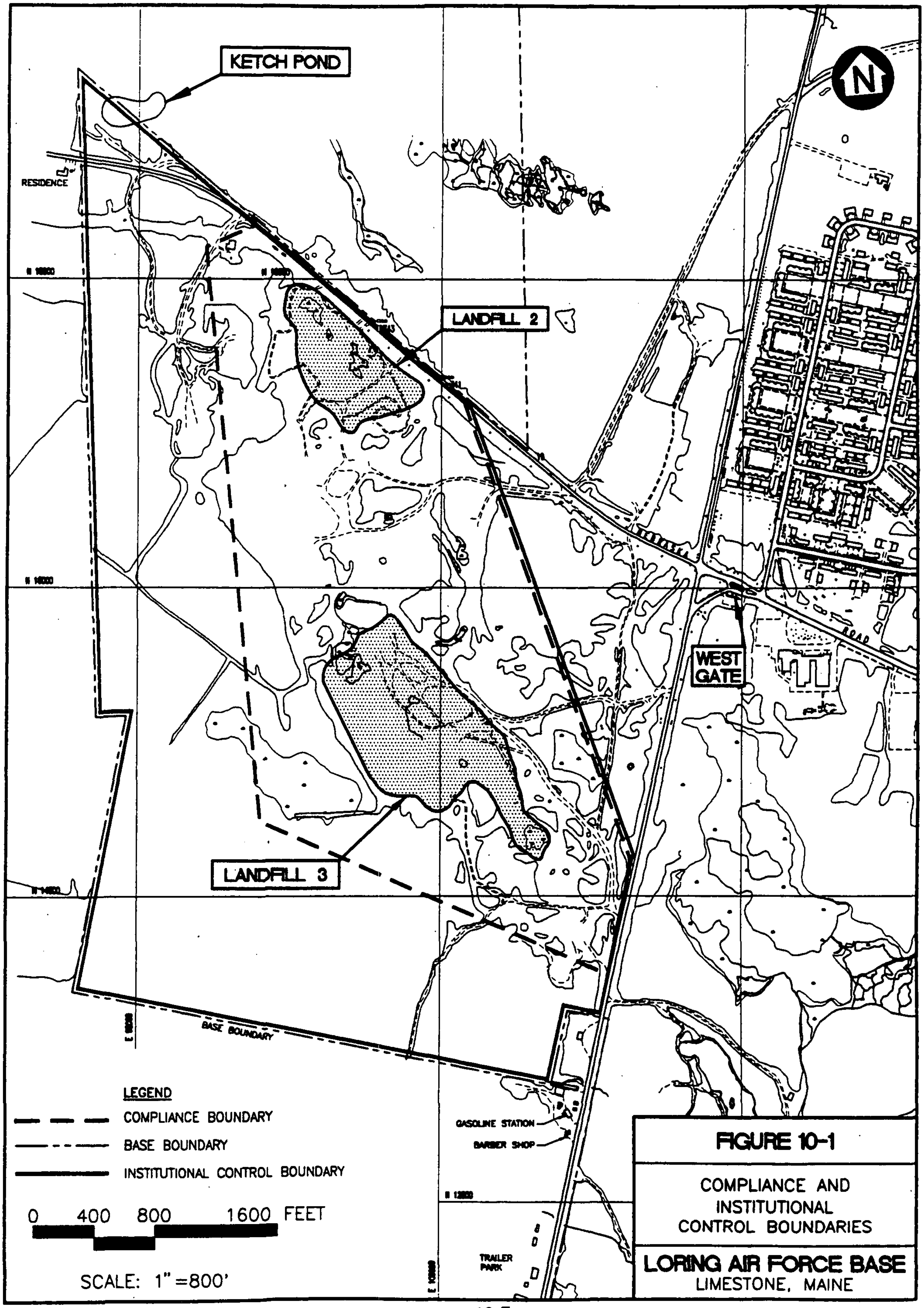

FIGURE 10-1

COMPLIANCE AND INSTITUTIONAL CONTROL BOUNDARIES

LORING AIR FORCE BASE
LIMESTONE, MAINE

J:\8741-16\ROD\FIG10-1.DWG 4/25/96

where possible, and would be inclusive of downgradient monitoring wells. Restrictions on property transferred from the USAF and located in the vicinity and downgradient of the landfills would prohibit installation of drinking water wells and prohibit the use of underlying and downgradient groundwater.

Groundwater Monitoring. Groundwater monitoring at wells located upgradient, within, and immediately downgradient of the landfill, is incorporated into the OU 2 ROD for the 30-year post-closure monitoring period. Monitoring wells will be used further downgradient as part of the Minimal Action alternative, to monitor contaminant levels downgradient of the landfill. These monitoring locations will be at the compliance boundary, shown on Figure 10-1, and will serve as compliance points between existing groundwater users and the landfills. One residential well (Hopkins Residence) downgradient of LF-2 on Nebraska Road adjacent to the base property line will also be monitored. If concentrations of contaminants above action levels are detected at a compliance point, a contingency action will be implemented.

The downgradient zone beyond the compliance boundary will be covered by groundwater use restrictions as a minimum requirement to protect human health. OU 2 groundwater monitoring performed in conjunction with OU 4 groundwater monitoring will be used not only to assess contaminant migration and geochemical attenuation, but also to measure the performance of the cover systems in reducing leachate generation and associated groundwater contamination.

The Post-Closure Plan for OUs 2 and 4 (ABB-ES, 1996d) proposes monitoring wells for OU 2 post-closure monitoring based on knowledge of local hydrogeologic conditions. At LF-2, the USAF has proposed a new upgradient bedrock and overburden pair of wells southeast of, and adjacent to, the perimeter road; existing downgradient bedrock wells JMW-0802 (Zone B) and JMW-0801 (Zone B); existing downgradient overburden wells, JMW-0805 and JMW-0806; a new downgradient overburden well to be installed next to JMW-0801; and existing overburden well JMW-0882 located within the LF-2 waste boundaries. At LF-3/CAP, the USAF has proposed existing upgradient bedrock wells JMW-0941 on the southwest, and JMW-0960 on the northeast; existing upgradient overburden well JMW-0961; a new upgradient overburden well to be installed next to JMW-0941; new overburden and bedrock well pair is proposed for the south downgradient wells; new overburden well and retrofitting bedrock well RFW-39 with a screen are proposed for north downgradient wells; and overburden well JMW-0980 located within the LF-3 waste boundaries.

The USAF proposes to use two bedrock and overburden well pairs further downgradient of LF-2 and LF-3/CAP for OU 4 monitoring to augment the proposed OU 2 groundwater monitoring plan. New bedrock and overburden wells for LF-2 will be located approximately 400 feet northwest (downgradient) of LF-2. The downgradient well pair for LF-3/CAP, JMW-0991 and JMW-0992, will be located approximately 400 feet southeast (downgradient) of LF-3/CAP.

The monitoring locations selected will be at the compliance boundary and allow for sufficient time to modify the minimal action remedy, should downgradient impacts above the action levels be identified in the monitoring program. Selected monitoring well locations as currently proposed are shown on Figure 10-2. The final selection of monitoring well locations will be presented in the Final Post-Closure Plan for OUs 2 and 4.

OU 2 and OU 4 groundwater monitoring will be conducted on the same sampling and reporting schedule. Details on the monitoring program, including sampling frequency will be presented in the Post-Closure Plan for OUs 2 and 4. The Hopkins (formally Gauvin) well downgradient of LF-2 on Nebraska Road adjacent to the base property line will be sampled and analyzed annually. The analytical program for all wells will use the same analytical methods and quality control levels presented in the Post-Closure Plan for OUs 2 and 4 (ABB-ES, 1996d). Contaminants on Table 10-3 will be charted and tracked. Analytical results from downgradient wells will be analyzed every year using statistical trend analysis to identify statistically significant increases or decreases over time. Details on the statistical trend test and reporting requirements can be found in the Post-Closure Plan for OUs 2 and 4 (ABB-ES, 1996d).

Contingency Action. Currently there are no exceedances of the action levels at the compliance boundary. The Post-Closure Plan for OUs 2 and 4, discussed previously in Subsection 10.2 of this ROD, will locate monitoring wells for evaluating the effectiveness of the LF-2 and LF-3 cover system on groundwater migration and for determining compliance. The Post-Closure Plan will also describe the manner in which the USAF will monitor these wells. The USAF will notify the USEPA and MEDEP immediately if concentrations above the action levels set forth in Tables 10-1 through 10-2 are detected in any compliance wells.

If concentrations above action levels are detected at any of these compliance wells, the USAF will also sample all potable water supplies downgradient of the landfills which might be affected by contamination originating from the landfills. In addition, the USAF will perform a risk assessment on the groundwater for OU 4 to determine whether the remedial action adopted herein is protective. This risk assessment will comply with the Loring Air Force Base Risk Assessment Methodology (HAZWRAP, 1994).

If, after review of the risk assessment, the remedial action is determined not to be protective by the USEPA and MEDEP, the remedial project managers (as defined in the FFA) shall decide what contingency action will be necessary. The contingency action will include an evaluation by the USAF of the effectiveness of the LF-2 and LF-3 cover systems to prevent groundwater migration, and may include either passive or active remedial options. Passive components may include, but are not limited to, the hook-up of threatened or affected residences to public water supplies and the implementation of institutional controls on the affected properties. Active components may include, but are not limited to, plume control measures, the construction of a slurry wall, or a groundwater extraction and treatment system. Any active component which may be implemented shall be presented in a CERCLA decision document (e.g., ROD Amendment, Explanation of Significant Differences [ESD], or a new ROD) pursuant to applicable USEPA guidance. If a future active contingency measure is determined to be appropriate, groundwater ARARs will be evaluated and designated at the time of the new CERCLA decision document.

The USEPA, MEDEP, or the Air Force have the authority to implement the Dispute Resolution process for any action conducted within the scope of the Installation Restoration Program, pursuant to Section 14.2(2) of the Loring Federal Facilities Agreement (as amended).

Five-year Site Reviews. Results of groundwater monitoring for LF-2 and LF-3/CAP will be included in an Annual Report to be submitted to the MEDEP as specified by the Post-Closure Plan for OUs 2 and 4 (ABB-ES, 1996d). In addition to the Annual Report, the USAF will review the LF-2 and LF-3/CAP monitoring program at least once every five years in accordance with applicable USEPA guidance. The five-year site reviews are intended to evaluate whether the response action continues to protect human health and the environment, assess site conditions, and propose further actions, if necessary.

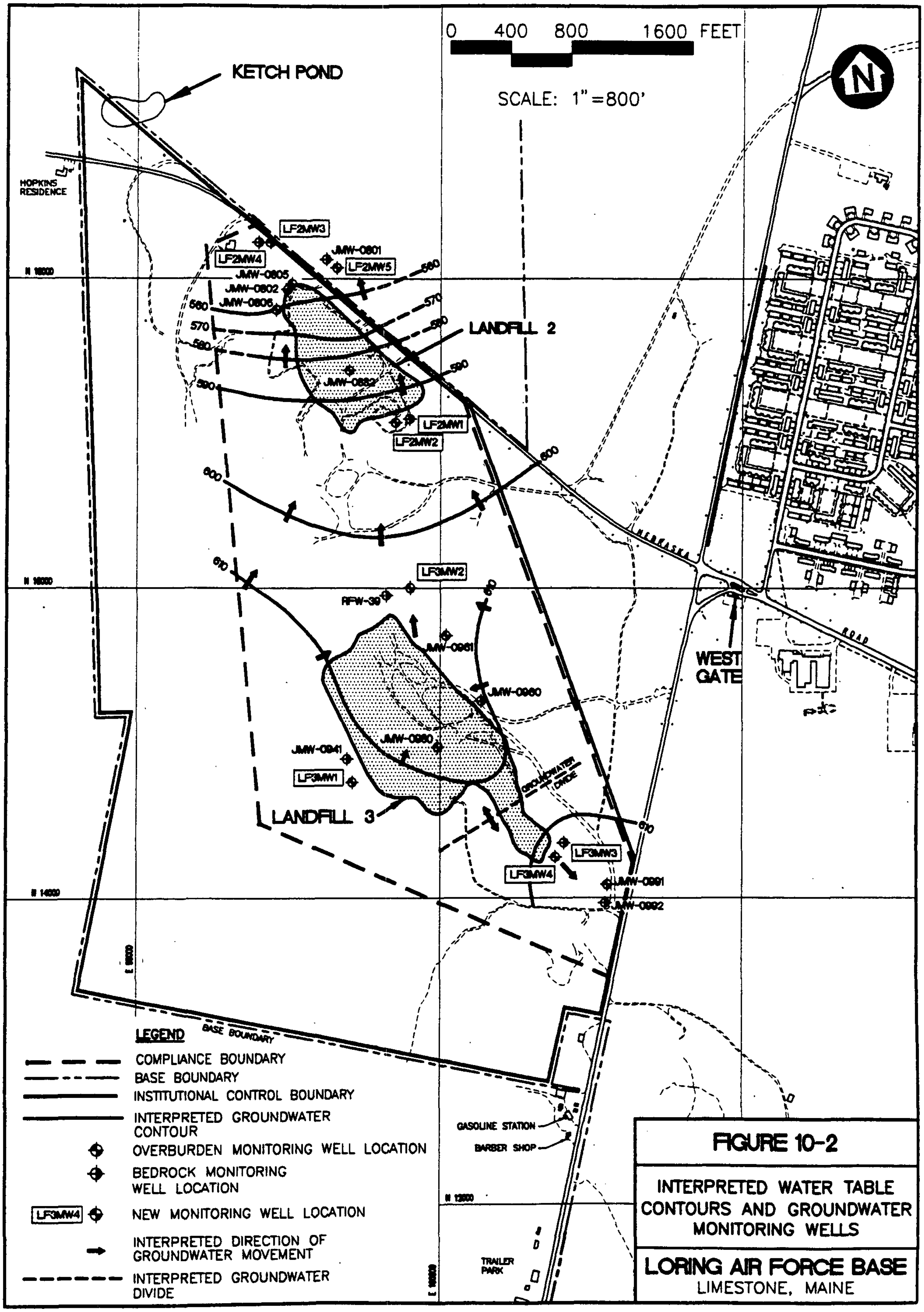

FIGURE 10-2

INTERPRETED WATER TABLE CONTOURS AND GROUNDWATER MONITORING WELLS

LORING AIR FORCE BASE
LIMESTONE, MAINE

11.0 STATUTORY DETERMINATIONS

The remedial action selected for implementation at the OU 4 locations, LF-2 and LF-3/CAP, is consistent with CERCLA and, to the extent practicable, the NCP. Implementation of this remedy is intended to be in conjunction with the LF-2 and LF-3 cover systems constructed under OU 2. The selected remedy is protective of human health and the environment, attains ARARs, and is cost- effective. The remedy, applied in combination with the cover systems, uses permanent solutions to the maximum extent practicable. The selected remedy does not satisfy the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element. However, the selected remedy, in combination with the landfill cover systems, will most likely reduce toxicity through isolation of the waste material from infiltrating rainwater, and reduce mobility of contaminants through the containment features of the cover systems.

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

The selected remedy, in conjunction with the landfill cover systems, will meet the response objectives of preventing human exposure to contaminated groundwater and protecting downgradient groundwater from contamination. Landfill capping will prevent a large volume of the pre-cap wastes above the water table from further leaching and cause a large reduction in the generation of leachate. Groundwater table conditions under the landfills are not anticipated to change to any great extent, due to exclusion of recharge areas from capping. Therefore, the net effect of capping will be a reduction in groundwater contamination beneath and downgradient of LF-2 and LF-3/CAP. Placement of the cover systems is expected to lead to the eventual attainment of remediation goals at LF-2 and LF-3, through the reduction of groundwater/waste interaction.

Elimination of human exposure to groundwater within and immediately downgradient of the landfills is incorporated in OU 2, and will be augmented in the selected remedy by the use of additional institutional controls, enhanced groundwater monitoring, and contingency actions, if necessary.

11.2 The Selected Remedy Attains ARARs

The selected remedy will attain ARARs. The ARARs for this remedy and the manner in which they will be met are summarized in Table 11-1.

11.3 The Selected Remedial Action is Cost-Effective

In the USAF's judgment, the selected remedy is cost-effective (i.e., the remedy affords overall effectiveness proportional to its costs). In selecting this remedy, once the USAF identified alternatives that were protective of human health and the environment and that attain ARARs, the USAF evaluated the overall effectiveness of each alternative by assessing the relevant three criteria – long term effectiveness and permanence; reduction in toxicity, mobility, or volume through treatment; and short-term effectiveness – in combination. The relationship of the overall effectiveness of this remedial alternative was determined to be proportional to its costs. The costs of this remedial alternative for each landfill are:

Estimated Capital Cost: $87,000
Estimated O&M Costs (net present worth): $810,000
Estimated Total Cost (net present worth): $897,000

The selection of this alternative represents a reasonable value with regard to the other alternatives. Compared to the other alternative that provides overall protection to human health and the environment and complies with ARARs, the selected remedy is much less expensive. All costs of the landfill cover systems are incurred under OU 2.

TABLE 11-1
CHEMICAL-SPECIFIC ARARs, CRITERIA, ADVISORIES, AND GUIDANCE
MINIMAL ACTION ALTERNATIVE

OPERABLE UNIT 4 RECORD OF DECISION
LORING AIR FORCE BASE

MEDIA	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARAR
GROUNDWATER				
Federal	Safe Drinking Water Act (SDWA) - Maximum Contaminant Levels (MCLs) (40 CFR 141.11 - 141.16)	Relevant and Appropriate	MCLs have been promulgated for several common organic and inorganic contaminants. These levels 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.	Use of the minimal action remedy will result in attainment of MCLs in the groundwater at the compliance boundary.
	SDWA - Maximum Contaminant Level Goals (MCLGs) (40 CFR 141.50 - 141.51)	Relevant and Appropriate	MCLGs are health-based criteria to be considered for drinking water sources. MCLGs are available for several organic and inorganic contaminants. Non-zero MCLGs are to be used as goals when MCLs have not been established.	Use of the minimal action remedy will result in attainment of non-zero MCLGs in the groundwater at the compliance boundary.

Notes:

ARAR = Applicable or Relevant and Appropriate Requirement
CFR = Code of Federal Regulations
MCL = Maximum Contaminant Level
MCLG = Maximum Contaminant Level Goal
NCP = National Contingency Plan
OU = Operable Unit
SDWA = Safe Drinking Water Act

11.4 THE SELECTED REMEDY UTILIZES PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT OR RESOURCE RECOVERY TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE

Once the USAF identified those alternatives that attain or, as appropriate, waive ARARs, and that are protective of human health and the environment, the USAF identified that alternative which utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. This determination was made by identifying the alternative that 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 or 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, when implemented in conjunction with the OU 2 landfill cover systems, provides the best balance of trade-offs among the alternatives. The selected remedy provides long-term protection of human health and the environment because once cover construction is complete, future migration of contaminants will be reduced. Landfill capping will exclude a large volume of the pre-cap wastes above the water table from further leaching, having the potential to cause a large reduction in the generation rate of leachate. The net effect will be a reduction in groundwater contamination beneath and downgradient of LF-2 and LF-3. Placement of the cover systems is expected to lead to the eventual attainment of action levels at LF-2 and LF-3 due to the reduction of groundwater/waste interaction.

The selected remedy will not reduce mobility, toxicity, or volume through treatment of source area contaminants. However, the selected remedy, in combination with the landfill cover systems, will most likely reduce toxicity through isolation of the waste material from infiltrating rainwater, and reduce mobility of contaminants through the containment features of the cover systems. Placement of the cover systems is expected to lead to the eventual attainment of action levels at LF-2 and LF-3/CAP, due to the reduction of groundwater/waste interaction.

The selected remedy provides expanded protection with use of institutional controls and environmental monitoring. Adverse effects on workers are not anticipated, provided safe working practices are followed. Adverse effects on the community are not expected as a result of implementing the selected remedy.

Installation of the selected remedy involves easily implementable, reliable, and available technologies.

The selected remedy is cost-effective in that it provides a reasonable value with regard to the other alternatives. It provides overall protection to human health and the environment, complies with ARARs, meets the response objectives, and is the least expensive.

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

The selected remedy will not reduce mobility, toxicity, or volume through treatment of source area contaminants as a principal element. However, the selected remedy. in combination with the landfill cover systems, will most likely reduce toxicity through isolation of the waste material from infiltrating rainwater, and reduce mobility of contaminants through the containment features of the cover systems. Placement of the cover systems is expected to lead to the eventual attainment of action levels at LF-2 and LF-3/CAP through the reduction of groundwater/waste interaction.

12.0 DOCUMENTATION OF NO SIGNIFICANT CHANGES

The USAF presented a Proposed Plan (ABB-ES, 1996c) outlining the proposed alternative of Minimal Action for groundwater associated with LF-2 and LF-3/CAP, and NFA for groundwater associated with LF-1, the CAP, and the CPDA. The Proposed Plan was presented to the public, and public comments have been considered prior to the selection of the preferred alternative.

No significant changes have been made to the preferred alternative described in the Proposed Plan.

13.0 STATE ROLE

The MEDEP, as a party of the FFA, has reviewed the various alternatives. The MEDEP has also reviewed the Remedial Investigation, Risk Assessment and Feasibility Study to determine if the selected remedy is in compliance with applicable or relevant and appropriate state environmental laws and regulations.

The MEDEP concurs with the selected remedy for OU 4. A copy of the letter of concurrence is presented in Appendix C of this ROD.

ABB-ES	ABB Environmental Services, Inc.
ACC	Air Combat Command
AFCEE	Air Force Center for Environmental Excellence
ARAR	Applicable or Relevant and Appropriate Requirement
BEHP	bis(2-ethylhexyl)phthalate
bgs	below ground surface
CADA	Coal Ash Disposal Area
CAP	Coal Ash Pile
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	chemical of concern
CPC	chemical of potential concern
CPDA	Chapman Pit Disposal Area
CRP	Community Relations Plan
DCA	dichloroethane
DCE	dichloroethene
DDA	Drum Disposal Area
DHS	Department of Human Services
ESD	Explanation of Significant Differences
FFA	Federal Facilities Agreement
FS	Feasibility Study
gpm	gallons per minute
HAZWRAP	Hazardous Waste Remedial Actions Program
HI	Hazard Index
IEUBK	Integrated Exposure Uptake Biokinetic
IRP	Installation Restoration Program
LAFB	Loring Air Force Base
Law	Law Environmental, Inc.

LF	Landfill
LFS	low-flow sampling
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MEDEP	Maine Department of Environmental Protection
MEG	Maximum Exposure Guideline
mg/L	milligrams per liter
NCP	National Contingency Plan
NFA	No Further Action
NPL	National Priorities List
O&M	operation and maintenance
OU	operable unit
PA	Preliminary Assessment
PAH	polynuclear aromatic hydrocarbons
PCB	polychlorinated biphenyl
PCDA	Paint Can Disposal Area
PCE	tetrachloroethene
PQL	Practical Quantitation Limit
RA	risk assessment
RAB	Restoration Advisory Board
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
RME	reasonable maximum exposure
ROD	Record of Decision
SAC	Strategic Air Command
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SI	site investigation
SVOC	semivolatile organic compound
TBC	to be considered
TCE	trichloroethene

TPH	total petroleum hydrocarbon
USAF	U.S. Air Force
USEPA	U.S. Environmental Protection Agency
μg/Dl	micrograms per deciliter
μg/L	micrograms per liter
VOC	volatile organic compound
WWTP	Waste Water Treatment Plant

ABB Environmental Services, Inc. (ABB-ES), 1994a. *OU 2 Remedial Investigation/ Focused Feasibility Study*; Final; Installation Restoration Program; Loring Air Force Base; prepared for HAZWRAP; Portland, Maine; August 1993, revised July 1994.

ABB Environmental Services, Inc. (ABB-ES), 1994b. *OU 2 Record of Decision*; Final Installation Restoration Program; Loring Air Force Base; prepared for HAZWRAP; Portland, Maine; November 1994.

ABB Environmental Services, Inc. (ABB-ES), 1995. *OU 4 Remedial Investigation Report*; Final; Installation Restoration Program; Loring Air Force Base; prepared for HAZWRAP; Portland, Maine; November 1995.

ABB Environmental Services, Inc. (ABB-ES), 1996a. *Operable Unit 2A (OU 2A) Record of Decision*; Final; Installation Restoration program; Loring Air Force Base; prepared for HAZWRAP; Portland, Maine; March 1996.

ABB Environmental Services, Inc. (ABB-ES), 1996b. *OU 4 Feasibility Study*; Final; Installation Restoration Program; Loring Air Force Base; prepared for HAZWRAP; Portland, Maine; May 1996.

ABB Environmental Services, Inc. (ABB-ES), 1996c. Proposed Plan, *No Further CERCLA Action and Minimal Action for Operable Unit 4*; Installation Restoration Program; Loring Air Force Base; prepared for HAZWRAP; Portland, Maine; May 1996.

ABB Environmental Services, Inc. (ABB-ES), 1996d. *Post-Closure Plan for OUs 2 and 4*; Draft Final; Installation Restoration Program; Loring Air Force Base; prepared for HAZWRAP; Portland, Maine; May 1996.

Advanced Sciences, Inc. (ASI), 1994. *Draft Final RI Report for OU 2A*, Loring Air Force Base; prepared for HAZWRAP; Oak Ridge, Tennessee; December 1994.

Air Force Center for Environmental Excellence (AFCEE), 1995. *Remedial Action Report/Project Closure Report, OU 2, OU 2A, OU 6, OU 7, and Other Sites*; Loring Air Force Base; January 1995.

REFERENCES

CH_2M Hill, 1984. *Records Search Report*; Installation Restoration Program; Loring Air Force Base; prepared for HAZWRAP; Limestone, Maine; January 1984.

Federal Facility Agreement (FFA) Under CERCLA Section 120, The Matter of Loring Air Force Base by U.S. Environmental Protection Agency Region I, State of Maine, and the U.S. Department of the Air Force, January 30, 1991.

Hazardous Waste Remedial Actions Program (HAZWRAP), 1994. *Loring Air Force Base Risk Assessment Methodology*; Final; Environmental Restoration and Waste Management Programs, Oak Ridge, TN; August, 1994.

Law Environmental, Inc. (Law), 1996. *Final RI/ASI Technical Report for Debris Disposal Areas – Operable Unit 3*; Loring Air Force Base; March, 1996.

Loring Air Force Base (LAFB), 1995. "Consensus Statement: Inorganic Contaminants in Overburden Groundwater"; prepared for Loring Air Force Base, the U.S. Environmental Protection Agency, Region I, and the Maine Department of Environmental Protection; August 1995.

Patterson, James W., 1985. Industrial Wastewater Treatment Technology; Butterworth Publishers; Stoneham, Massachusetts.

Maine Department of Environmental Protection and Department of Human Services (MEDEP/DHS), 1994. *Guidance Manual for Human Health Risk Assessments at Hazardous Substance Sites*; June 1994.

RKG Associates, 1995. "Executive Summary - Loring Redevelopment Plan; Financial, Marketing and Implementation Strategy"; Prepared for Loring Development Authority of Maine; Durham, New Hampshire; March 1995.

Tseng, W. P., Chu, H. M., How, S. W., Fong, J. M., Lin, C. S., and Yen, S., 1968. "Prevalence of Skin Cancer in an Endemic Area of Chronic Arsenicism in Taiwan"; J. Natl. Cancer Inst. 40: 453-463.

U.S. Environmental Protection Agency (USEPA), 1982. "Letter from Robert M. Perry, Associate Administrator, Office of General Counsel to Rita Lavelle, Assistant Administrator for Office of Solid Waste and Emergency Response"; September 1, 1982.

U.S. Environmental Protection Agency (USEPA), 1988a. *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*; Office of Solid Waste and Emergency Response; OSWER Directive 9335.01; Washington, DC; March 1988.

U.S. Environmental Protection Agency (USEPA), 1989a. *Risk Assessment Guidance for Superfund: Human Health Evaluation Manual (Part A); Volume 1*; Interim Final; USEPA 540/1-89/002; Washington, DC; December 1989.

U.S. Environmental Protection Agency (USEPA), 1989b. *Exposure Factors Handbook*; Exposure Assessment Group; Office of Health and Environmental Assessment; USEPA/600/8-89/043.

U.S. Environmental Protection Agency (USEPA), 1989c. *Ecological Assessment of Hazardous Waste Sites: A Field and Laboratory Reference*; Environmental Research Laboratory; U.S. Environmental Protection Agency; Corvallis, Oregon; EPA 600/3-89/013.

U.S. Environmental Protection Agency (USEPA), 1989d. *Supplemental Risk Assessment Guidance for Superfund Program;* USEPA Region I Risk Assessment Work Group; USEPA 901/5-89-001.

U.S. Environmental Protection Agency (USEPA), 1990a. National Oil and Hazardous Substances Pollution Contingency Plan (National Contingency Plan); Code of Federal Regulations, Title 40, Part 300; Federal Register, Volume 55, Number 46, pp. 8666 *et seq.*; March 8, 1990.

U.S. Environmental Protection Agency (USEPA), 1991a. *Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual, Part A, Supplemental Guidance*, "Standard Default Exposure Factors," Interim Final; Office of Solid Waste and Emergency Response 9285.6-03; March 25, 1991.

U.S. Environmental Protection Agency (USEPA), 1991b. Loring RI Report/Risk Assessment Approach Meeting between representatives of EPA Region I, Maine Department of Environmental Protection, U.S. Fish and Wildlife Service, Loring AFB, HAZWRAP, ABB Environmental Services; December 6, 1991.

U.S. Environmental Protection Agency (USEPA), 1995b. *Health Effects Assessment Summary Tables (HEAST), Annual FY 1995*, EPA 540/R-95/O36. PB95-921199. USEPA, Office of Solid Waste and Emergency Response. May, 1995.

TRANSCRIPT OF THE PUBLIC MEETING (JUNE 11, 1996)

STATE OF MAINE AROOSTOOK, ss.

OPERABLE UNITS 4, 9 & 11

PUBLIC HEARING

JUNE 11, 1996

CARIBOU CITY COUNCIL CHAMBER

CARIBOU, MAINE

7:26 P.M.

BENNETT LEGAL TRANSCRIPT SERVICES
P. O. Box 947
Caribou, ME 04736-0947
(207)498-2729

T A B L E O F C O N T E N T S

E X H I B I T S

NONE

June 11, 1996

PETER FORBES: Good evening. Welcome to the public hearing to receive comments on the proposed plans for Operable Units 4 and 9 and 11 at Loring Air Force Base. Today's date is June 11th, 1996. My name is Peter Forbes, the Remedial Project Manager for the Installation Restoration Program at Loring. Seated with me are Michael Nalipinski, Remedial Project Manager for the U.S. Environmental Protection Agency, and Naji Akladiss, Remedial Project Manager for the Maine Department of Environmental Protection, and they will assist me in receiving your comments.

This hearing is being held in accordance with the provisions of the Comprehensive Environmental Response Compensation and Liability Act or CERCLA as amended in 1986, also known as Superfund. The act requires federal facilities on the National Priorities List to present clean up proposals to the local community for comment and consideration before the final clean up decisions are made. The purpose of this hearing is to receive comments on the Proposed Plans for Operable Units 4 and 9 and 11.

Mr. Philip Bennett from Aroostook Legal Reporters will serve as the court reporter tonight, preparing a verbatim record of the proceedings. The verbatim record will become a part of the final clean up plan. The court reporter will be able to make a complete record only if he is able to hear and understand what you say. With that in mind, please follow these ground rules. Speak only after I recognize you and please address your remarks to me. State your name and the organization you represent and present your statement. Do not begin speaking until you have reached the microphone and speak slowly and clearly into the microphone. If you have prepared your statement beforehand, you may read it aloud or you may paraphrase it and place it on the table.

Are there individuals wishing to make a comment or statement at this time?

Ladies and gentlemen, it is 7:30 p.m., June 11, 1996 and I declare the public hearing to receive comments on the Proposed Plans for

Operable Units 4 and 9 and 11 at Loring Air Force Base closed. Thank you all for coming.

****

C E R T I F I C A T I O N

I HEREBY CERTIFY THAT the foregoing is a true and correct transcript of my stenographic notes taken at the Operable Units 4 & 9, 11 Public Hearing held on June 11, 1996.

Philip R. Bennett, Jr.,

Court Reporter

STATE OF MAINE AROOSTOOK, ss.

RESPONSIVENESS SUMMARY

The Air Force held a 30-day comment period from May 17, 1996 to June 15, 1996, to provide an opportunity for the public to comment on the Proposed Plan and other documents developed for Operable Unit (OU 4) at Loring Air Force Base, Maine. The Proposed Plan is the document that identifies remedial action objectives, evaluates remedial alternatives, and recommends the alternative that best meets the evaluation criteria for OU 4.

The Air Force made a recommendation of its preferred alternative for No Further Action for Landfill (LF) 1 and Chapman Pit Disposal Area, and Minimal Action for groundwater associated with LF-2 and LF-3/Coal Ash Pile (CAP) in the OU 4 Proposed Plan. The Proposed Plan was issued on May 17, 1996, before the start of the comment period. All documents on which the preferred alternative is based were placed in the Administrative Record for review. The Administrative Record is a collection of the documents considered by the Air Force when choosing the remedial action for OU 4 groundwater.

The Air Force received no verbal or written comments on the OU 4 Proposed Plan at a public hearing held on June 11, 1996, or during the 30 day public comment period.

The Air Force will select the Minimal Action alternative for groundwater associated with LF-2 and LF-3/CAP, which includes institutional controls, groundwater monitoring, five-year site reviews, and contingency action if necessary. Institutional controls will be established to restrict groundwater use, and groundwater monitoring will be integrated with OU 2 into a comprehensive monitoring program. Five-year site reviews will be conducted to ensure that the remedial action continues to be protective of human health and the environment. If landfill-related contaminants are detected at the compliance point at concentrations above the action levels, a contingency action will be implemented. The contingency action is discussed in Subsection 10.2 of the OU 4 ROD.

LETTER OF CONCURRENCE

DEPARTMENT OF ENVIRONMENTAL PROTECTION

ANGUS S. KING, JR.
GOVERNOR

EDWARD O. SULLIVAN
COMMISSIONER

September 25, 1996

Mr. Alan K. Olsen
AFBCA/DR
1700 N. Moore Street, Suite 2300
Arlington, VA 22209-2802

Re: Loring Air Force Base Superfund Site, Maine

Dear Mr. Olsen:

The Maine Department of Environmental Protection (MEDEP) has reviewed the Draft Final Record of Decision (ROD) regarding Operable Unit 4 (OU4) for the Loring Air Force base Superfund Site located in Limestone, Maine.

Based on the Draft Final ROD, the MEDEP concurs with the Air Force's recommendations, in Section 10.0 which is summarized as follows:

- The selected remedy for groundwater associated with LF-2 and LF-3/CAP is Minimal Action (Alternatives LF-2-2 and LF3-2 of the FS). In addition to the source control remedy outlined in the OU2 ROD (ABB-ES, 1994b), Minimal Action for LF-2 and LF-3/CAP will include institutional controls, downgradient groundwater monitoring, and a contingency plan for providing additional remedial measures. The Minimal Action is a final remedy for the groundwater associated with LF-2 and LF-3/CAP.

Clean Up Levels

The USAF has established, in conjunction with the regulatory agencies, site-specific action levels protective of human health and the environment. These action levels have been established for LF-2 bedrock groundwater and LF-3/CAP bedrock and overburden groundwater, based on background concentration. analytical detection limits, MCL's, MEG's or risk calculations. Tables 10-1 and 10-2 in the Final ROD. list the compounds and elements for which action levels have been set, as well as summaries of risk associated with the sites included in this operable unit. The State concurs with the action levels listed in the tables above.

The State's concurrence with the selected remedy, as described above, should not be construed as the State's concurrence with any conclusion of law or finding of fact which may be set forth in the Record of Decision (for OU4). The State reserves any and all rights to challenge any such finding of fact or conclusion of law in any other context.

This concurrence is based upon the State's understanding that the MEDEP will continue to participate in the Federal Facilities Agreement and in the review and approval of operation, design and monitoring plans. This concurrence is also based upon the understandings set forth in the attached Letter of Understanding dated September 27 24, 1996. NA

The MEDEP looks forward to working with the Department of the Air Force and the USEPA to resolve the environmental problems posed by this site. If you need additional information, do not hesitate to contact myself or Mark Hyland.

Sincerely,

Edward O. Sullivan
Department of Environmental Protection

attachment

pc: Mark Hyland, MEDEP
Mike Nalipinski, EPA
Hank Lowman, BCA

ONAALAN/dlb

ANDREW KETTERER
ATTORNEY GENERAL

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September 27, 1996

By Facsimile

Robert A. DiBiccaro, Esquire
U.S. EPA - Region I
JFK Federal Building
1 Congress Street
Boston, Massachusetts 02203-2211

Claire Biunno, Esquire
Assistant Chief Counsel
Air Force Base Conversion Agency
1700 North Moore Street
Arlington, Virginia 22209-2808

Re: Letter of Understanding Concerning OU4/Loring Air Force Base

Dear Bob and Claire:

The purpose of this letter is to document the understanding reached by the parties to the Loring Air Force Base Interagency Agreement ("IAG") with regard to the draft Record of Decision ("ROD") for Operable Unit 4 ("OU4"). As you know, a dispute arose among the parties as to whether Maine's Maximum Exposure Guidelines ("MEGs") should be considered as Applicable or Appropriate and Relevant Laws ("ARARs") at this Operable Unit. In order to avoid delaying signature of the ROD, the project managers have developed action levels for compounds of concern at OU4 as shown on Tables 10-1 and 10-2 of the ROD.

The parties agree that these action levels are only for the purpose of triggering the contingency action described in the ROD and are not meant to be a determination that MEGs are ARARs. The parties further agree that by entering this agreement, no party waives any defense or claim or effects any legal position with regard to the MEGs = ARARs issue. By way of example, and not by way of limitation, this agreement may not be used by any of the signatory parties in any

(MBGs = ARARs) dispute which may arise at any other operable unit, as evidence that the State has failed to be consistent with regard to designating MBGs as ARARs.

Please review this Letter of Understanding carefully and indicate your approval by signing and dating this Letter of Understanding where indicated. The State of Maine's concurrence letter for the OU4 ROD will incorporate this Letter of Understanding.

Very truly yours,

DENNIS J. HARNISH
Assistant Attorney General

DJH/tt

cc Naji Akladiss

SEEN AND AGREED TO:

Dated: September 27, 1996

Dennis Harnish
DENNIS J. HARNISH
Assistant Attorney General
For the State of Maine

Dated: 9/27/96

Robert A. DiBiccaro
ROBERT A. DIBICCARO
Senior Assistant Regional Counsel
U.S. EPA - Region I
For the U.S. EPA

Dated: September 27, 1996

Claire Biunno
CLAIRE BIUNNO
Assistant Chief Counsel
Air Force Base Conversion Agency
For the U.S. DOD