



**U.S. Army
Environmental
Center**

**NO FURTHER ACTION DECISION UNDER
CERCLA**

**STUDY AREA 14
LANDFILL NO. 10**

FORT DEVENS, MASSACHUSETTS

CONTRACT DAAA15-91-0008

**U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND**

JANUARY 1995

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Prepared for:

U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland
Contract DAAA15-91-0008

Prepared by:

ABB Environmental Services, Inc.
Portland, Maine
Project No. 7053-12

JANUARY 1995

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EXECUTIVE SUMMARY

Investigations of Study Area (SA) 14 (Landfill No. 10) at Fort Devens, Massachusetts have resulted in the decision that no further hazardous waste studies or remediation are required at this site. SA 14 was identified in the Federal Facilities Agreement between the U.S. Environmental Protection Agency and the U.S. Department of Defense as a potential site of contamination.

SA 14 is an abandoned and flooded slate quarry approximately 1 acre in size, located on an unnamed dirt road in the north central portion of the South Post. The quarry pond is up to 50 feet deep. There are no inlets or outlets for surface water, and the water in the quarry appears to be an expression of the water table in this area of the South Post.

Fort Devens was placed on the National Priorities List under the Comprehensive Environmental Response, Compensation and Liability Act, as amended by the Superfund Amendments and Reauthorization Act, on December 21, 1989. In addition, under Public Law 101-510, the Defense Base Realignment and Closure Act of 1990, Fort Devens was selected for cessation of operations and closure. In accordance with these acts, numerous studies, including a Master Environmental Plan, an Enhanced Preliminary Assessment, and a Site Investigation have been conducted which address SA 14.

The field investigation of SA 14 was initiated in 1992 in conjunction with the five other Group 7 SAs Site Investigations (SIs) at Fort Devens. The SI at SA 14 consisted of geophysical surveys, which included an unexploded ordnance (UXO) clearance of the bottom of the quarry, surface water sampling, and sediment sampling from the bottom of the quarry. The samples were collected to assess whether the historic dumping of automobiles and small arms UXO had generated conditions that may have posed a risk to human health or ecological receptors.

A UXO subcontractor was retained to investigate the bottom of the quarry to determine if any UXO hazards were present prior to sampling. Several metallic objects were located with the metal detector. The UXO subcontractor employed a diver who recorded an underwater video of the conditions on the quarry bottom to aid in mapping the physical features and debris.

To assess potential risks to human health and ecological receptors, two sediment samples were collected from the thin sediment layer on the bottom of the quarry by the diver

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employed by the UXO subcontractor. These samples were analyzed for organics, inorganics, total petroleum hydrocarbon compounds (TPHC), explosives, total organic carbon (TOC), and grain size. One surface water sample was collected from the surface of the quarry pond and submitted for laboratory analyses for organics, inorganics, TPHC, explosives, and water quality parameters.

Visual observations of the bottom of the quarry indicated the quarry bottom was covered with a thin layer of sediment which contained a large percentage of tree litter and bedrock chips. Some wooden timbers (possibly related to the quarrying activities) were observed, and numerous unfired and fired small caliber rounds were recovered in the sediment samples. No car bodies or other significant debris were found. A thermocline was identified at approximately 24 feet below the pond surface during the sediment sample collection.

The results of the surface water sample collected during the SI showed that no organic compounds were present in the surface water. TPHC was not detected, and all water quality parameters were within typical Fort Devens concentrations. Mercury was the only inorganic analyte detected at a notable concentration.

The laboratory analytical results from the sediment samples collected during the SI indicated that low concentrations (less than 0.1 micrograms per gram [$\mu\text{g/g}$]) of benzene and xylenes were present in one of the two samples. One semivolatile organic compound (SVOC) (n-nitrosodiphenylamine: an explosive by-product) was detected in the other sample, along with explosives and TPHC. Several pesticides were also detected in both samples at low concentrations (less than 1.0 $\mu\text{g/g}$). Several inorganics (arsenic, beryllium, cadmium, copper, iron, lead, manganese, nickel, and zinc) were detected at notable concentrations in both sediment samples.

Based on the results of the surface water and sediment sampling completed during the SI, additional water sampling was recommended and completed during the Supplemental SI (SSI) conducted in 1993. A bathymetric survey of the quarry's bottom and a temperature and dissolved oxygen profile of the quarry water were completed prior to water sampling. Three water samples were collected from different depths within the quarry to determine if historical dumping had impacted the quarry's water quality. Samples were collected from 10 feet, 20 feet, and 45 feet below the surface of the quarry pond. The 10- and 20-foot samples were collected above the measured thermocline while the 45-foot sample was collected just above the quarry bottom and below the

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thermocline. The water samples were submitted for laboratory analysis consisting of project analyte list organics, inorganics, explosives, and water quality parameters.

The results of the temperature and dissolved oxygen profiles indicated that the thermocline began at approximately 24 feet below the pond surface and that the dissolved oxygen concentration was consistently lower below the thermocline than above.

The results of the water samples collected during the SSI showed that no SVOCs, explosives, pesticides or polychlorinated biphenyls were detected. One volatile organic compound (VOC) was detected in the 45-foot sample. Other VOCs were detected, however, their presence appears to be related to laboratory contamination. Several inorganics were detected.

The human health and ecological preliminary risk evaluations (PREs) completed for SA 14 included the data collected from both the SI and the SSI. The results of the human health PRE indicated that due to the depth of the quarry, the contaminants detected in the sediment would not be expected to present a risk to public health. The human health PRE also indicated that exposure to the quarry's water would not likely pose a threat to public health. The ecological PRE completed for SA 14 indicated that the sediment at the bottom of the quarry would not pose a risk to ecological receptors because the thin layer of sediment would provide little, if any, benthic habitat. The ecological PRE also found that the quarry's water would not pose a risk to ecological receptors.

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1.0 INTRODUCTION

This decision document has been prepared to support a no further action decision at Study Area (SA) 14 at Fort Devens, Massachusetts. The report was prepared as part of the U.S. Department of Defense (DoD) Base Realignment and Closure (BRAC) program to assess the nature and extent of contamination associated with site operations at Fort Devens.

In conjunction with the U.S. Army's Installation Restoration Program (IRP), Fort Devens and the U.S. Army Environmental Center (USAEC; formerly the U.S. Army Toxic and Hazardous Materials Agency) initiated a Master Environmental Plan (MEP) in 1988. The MEP consists of assessments of the environmental status of SAs, specifies necessary investigations, and provides recommendations for response actions with the objective of identifying priorities for environmental restoration at Fort Devens. SA 14 was identified in the MEP as a potential area of contamination. On December 21, 1989, Fort Devens was placed on the National Priorities List under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act.

An Enhanced Preliminary Assessment (PA) was also performed at Fort Devens to address areas not normally included in the CERCLA process, but requiring review prior to closure. A final version of the PA report was completed in April 1992. In 1992, DoD, through USAEC, also initiated a site investigation (SI) for the six SAs in Group 7 at Fort Devens. The SI was conducted by ABB Environmental Services, Inc. (ABB-ES).

Under Public Law 101-510, the Defense Base Realignment and Closure Act of 1990, Fort Devens has been selected for cessation of operations and closure. An important aspect of BRAC actions is to determine environmental restoration requirements before property transfer can be considered. Studies at SA 14 were conducted to support this overall mission.

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2.0 BACKGROUND AND PHYSICAL SETTING

2.1 DESCRIPTION AND LAND USE

Fort Devens is located approximately 35 miles northwest of Boston, Massachusetts, within Middlesex and Worcester counties. The installation consists of approximately 9,280 acres and includes portions of the towns of Ayer, Harvard, Lancaster, and Shirley. Cities in the vicinity include Fitchburg, Leominster, and Lowell. Land surfaces range from about 200 feet above mean sea level (MSL) along the Nashua River in the northern portion of the installation to 450 feet above MSL in the southern portion of the installation.

Fort Devens was established in 1917 as Camp Devens, a temporary training camp for soldiers from the New England area. In 1931, the camp became a permanent installation and was redesignated as Fort Devens. Throughout its history, Fort Devens has served as a training and induction center for military personnel and a unit mobilization and demobilization site. All or portions of these functions occurred during World Wars I and II, the Korean and Vietnam conflicts, and operations Desert Shield and Desert Storm. The primary mission of Fort Devens is to command, train, and provide logistical support for non-divisional troop units. The installation also supports that portion of the U.S. Army Intelligence School located at Fort Devens, the Army Readiness Region, Reserve Components, and Army Reserve and National Guard in the New England area.

Fort Devens currently consists of three major land use areas: Main Post, South Post, and North Post.

The majority of the facilities on Fort Devens are located in the Main Post area, north of Massachusetts Highway 2. The Nashua River intersects the Main Post along its western edge. The Main Post provides all of the on-post housing, including over 1,700 family units and 9,800 bachelor units (barracks and unaccompanied officer's quarters). Other facilities on the Main Post include community support activities (such as a shoppette, cafeteria, post exchange, commissary, bowling alley, golf course, and hospital), administrative buildings, classrooms and training facilities, maintenance facilities, and ammunition storage facilities.

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The South Post is located south of Massachusetts Highway 2 and contains individual training areas designated for troop training, range activities, and a drop zone. The Nashua River bounds the South Post on the northeast side. The Group 7 SAs, including SA 14, are located in the South Post portion of Fort Devens (Figure 2-1).

The North Post is directly north of the Main Post. The principal activities on the North Post are the Douglas E. Moore Army Airfield, and the installation Waste Water Treatment Plant.

2.2 REGIONAL GEOLOGY

Fort Devens is near the western boundary of the Seaboard Lowland Section of the New England-Maritime Physiographic province (Jahns, 1953). It is adjacent to the Worcester County Plateau of the Central Uplands province, and part of the installation lies within the province (Koteff, 1966). The land surface is almost completely covered with unconsolidated glacial outwash deposits, resulting in few bedrock outcrops. The surficial deposits are underlain by a highly complex assemblage of intensely folded and faulted metasedimentary rocks with occasional igneous intrusions. The geomorphology of the region is dominated by glacial features such as outwash plains, kames, kame terraces, drumlins, and eskers.

2.3 REGIONAL HYDROGEOLOGY

Groundwater at Fort Devens occurs largely in the permeable glacial-deltaic outwash deposits of sand, gravel, and boulders. Well yields within these sediments are dependent upon the hydraulic characteristics of the aquifer and can range from 2 to over 300 gallons per minute (gpm). Small amounts of groundwater can be obtained from fractured bedrock with yields ranging from 2 to 10 gpm. Minor amounts of groundwater may be found in thin, permeable glacial lenses elsewhere on the installation. The primary hydrogeologic feature at Fort Devens is the Nashua River, which flows through the installation in a south to north direction, with an average discharge rate of 55 cubic feet per second. In addition to the Nashua River, the terrain is crossed by numerous brooks and attendant wetlands. There are also several kettle ponds and one kettle lake located within the installation.

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2.4 STUDY AREA DESCRIPTION AND HISTORY

SA 14 is an abandoned and flooded slate quarry approximately 1 acre in size, located on an unnamed dirt road south of Attu Road on the South Post (Figure 2-2). The quarry pond reaches a maximum depth of 50 feet. The quarry has no surface water inlet or outlet, and the water in the quarry appears to be an expression of the water table in this area of the South Post.

The quarry was mined for slate from the late 1700's until it flooded and became uneconomical sometime in the 1800's. Automobiles and other debris were illegally dumped in the quarry, and in the past the installation has hired divers to remove debris. UXO was observed on the bottom of the quarry during those dives. Because disposal in the quarry was not authorized, no records are available of disposal quantities. Military personnel have historically used the quarry as a swimming hole, but that activity was reportedly discontinued in 1992.

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3.0 RELATED INVESTIGATIONS

3.1 MASTER ENVIRONMENTAL PLAN

SA 14, Landfill No. 10, was identified as a possible source for release of contaminants into the environment. The MEP recommended that the suspected landfill material be investigated (Biang, et al., 1992).

3.2 ENHANCED PRELIMINARY ASSESSMENT

The PA included a review of the study and recommendations presented in the MEP and considered other areas that might require evaluation due to the closure of Fort Devens. No additional findings or recommendations for SA 14 were provided in the PA.

3.3 SITE INVESTIGATION REPORT

The SI was initiated in June 1992 and included the following 13 Group 2 and 7 SAs originally identified in the MEP.

- SA 13 Landfill No. 9
- SA 43 Historic Gas Stations (19 Sites)
- SA 45 Lake George Street Vehicle Wash Area
- SA 49 Building 3602 Leaking Underground Storage Tank (LUST) Site
- SA 56 Building 2417 LUST Site
- SA 57 Building 3713 Fuel Oil Spill
- SA 58 Buildings 2648 and 2650 Fuel Oil Spills
- SA 12 Landfill No. 8
- SA 14 Landfill No. 10
- SA 27 Waste Explosive Detonation Range (Hotel)
- SA 28 Waste Explosive Detonation Range (Training Area 14)
- SA 41 Unauthorized Dumping Area (Site A)
- SA 42 Popping Furnace

The SI was conducted by ABB-ES under contract with the USAEC. The Final Site Investigation Report was issued May 1993 (ABB-ES, 1993). The purpose of the SI was

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to verify the presence or absence of environmental contamination and to determine whether further investigation or remediation was warranted.

The SI field investigation of SA 14 was initiated in August 1992 in conjunction with the other five Group 7 SAs at Fort Devens. The SI at SA 14 consisted of geophysical surveys, which included an unexploded ordnance (UXO) clearance of the bottom of the quarry with a metal detector. The field investigation also included surface water sampling and sediment sampling from the bottom of the quarry. The samples were collected to assess whether the historic dumping of automobiles and small arms UXO had generated conditions that may have posed a risk to human health or ecological receptors.

A UXO subcontractor was retained to investigate the bottom of the quarry to determine if any UXO hazards were present prior to sampling. The UXO subcontractor first pulled a metal detector across the bottom of the quarry to determine if there were any metallic objects located on the bottom of the quarry. Several metallic objects were located with the metal detector. The UXO subcontractor employed a diver who recorded an underwater video of the conditions on the quarry bottom to aid in mapping the physical features and debris.

Two sediment samples were collected from the thin sediment layer on the bottom of the quarry by the UXO diver. These samples were analyzed for Project Analyte List (PAL) organics, inorganics, total petroleum hydrocarbon compounds (TPHC), explosives, total organic carbon (TOC), and grain size. One surface water sample was collected from the surface of the quarry pond and submitted for laboratory analysis consisting of PAL organics, inorganics, TPHC, explosives, and water quality parameters (Figure 3-1).

Based on the results of the surface water and sediment sampling completed during the SI, additional water sampling was recommended and conducted during the Supplemental Site Investigation (SSI) field investigation completed in August 1993. A bathymetric survey and a temperature and dissolved oxygen profile of the quarry water were completed prior to water sampling (see Figure 3-1). Three water samples were collected from different depths within the quarry to determine if historical dumping had impacted the quarry's water quality. All three water samples were collected at sampling location 14D-93-05X (see Figure 3-1). Samples were collected from 10 feet, 20 feet, and 45 feet below the surface of the quarry pond. The 10- and 20-foot samples were collected above the measured thermocline while the 45-foot sample was collected just above the quarry

bottom and below the thermocline. The water samples were submitted for laboratory analysis consisting of PAL organics, inorganics, explosives, and water quality parameters.

The results of the temperature and dissolved oxygen profiles indicated that the thermocline began at approximately 24 feet below the pond surface and that the dissolved oxygen concentration was consistently lower below the thermocline (see Figure 3-2 and Table 3-1).

3.4 PRELIMINARY RISK EVALUATIONS

Preliminary Risk Evaluations (PREs) were performed as part of the SI and SSI to assess environmental contamination and help establish future actions at SA 14. This section presents the general approach employed for the SI PREs. Details of the SA 14 human health and ecological PREs are presented in Sections 5.0 and 6.0, respectively.

As detailed in Section 3.3, environmental investigations at SA 14 entailed sampling the following environmental media:

- Surface Water
- Sediment

For SA 14, the human health and ecological PREs were conducted to evaluate contamination in surface water and sediments. Because periodic revisions and updates to the standards and guidelines used in the PREs have occurred during the multiple phases of investigation, revised PREs were conducted using the most current set of standards and guidelines on environmental media sampled during subsequent phases of investigation. In such cases, the entire set of SI data for any resampled medium would be used in the PRE.

3.4.1 Human Health Risk Evaluation

The Human Health PRE at SA 14 included the following elements:

- **Current and Future Land Use:** Current and foreseeable future land uses are particularly relevant with respect to the applicability of soil screening values used as the guidelines for sediment contamination in the PRE. For the PREs performed on SA 14 data, a residential land use scenario was assumed. SA 14 is

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expected to remain within the base following closure. Therefore, the use of a residential land use scenario represents a conservative or health-protective approach.

- **Comparison to Public Health Standards and Guidelines:** For sediment and surface water, human health standards and/or guidelines for soil and groundwater were used as screening criteria to evaluate the significance of the sampling data. To evaluate the concentrations of compounds detected in surface water, drinking water standards and guidelines were used in the absence of available standards for exposure to surface water. The USEPA's Region III residential soil risk-based concentrations were used to evaluate the results of the sediment sampling program. Health-based sediment standards do not exist. The basis and applicability of these standards and guidelines are discussed below.

USEPA Drinking Water Regulations. Federal drinking water standards (both final and proposed) are used to evaluate the significance of the surface water sampling data. These standards were extracted at the time of the SSI from the USEPA Office of Water's "Drinking Water Regulations and Health Advisories," May 1993.

Massachusetts Drinking Water Standards and Guidelines. For some compounds, MADEP has promulgated drinking water standards that are more stringent than the federal drinking water standards. MADEP has also developed drinking water guidelines for compounds for which no federal standards exist. The Autumn 1993 publication of Massachusetts Drinking Water Standards and Guidelines was used in the SSI PRE.

USEPA Region III Risk-Based Concentration Table. This table is used by USEPA Region III toxicologists as a risk-based screening tool for Superfund sites, as a benchmark for evaluating preliminary site investigation data and preliminary remediation goals. Although it has no official status either as regulation or guidance, it is useful as a screening tool. The table is updated quarterly and therefore regularly incorporates new USEPA toxicity constants as they are developed. The First Quarter 1993 was the current update used in the PRE at the time of the initial SI.

For the SA 14 Human Health PRE, Region III risk-based concentrations for residential soil were used. Risk-based concentrations for residential

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soil assume that an individual ingests soil 350 days per year for a residential lifetime of 30 years, at an age-adjusted ingestion rate of 100 mg/day. Exposure to sediment would be expected to be much less than in a residential setting, particularly at SA 14 where sediment is at sufficient depths (up to 50 feet) that direct human contact is unlikely.

3.4.2 Ecological Risk Evaluation

The ecological PRE at SA 14 included the following elements:

- **Ecological Characterization:** The purpose of the ecological characterization is to identify ecological receptors potentially exposed to contamination at the SA. For part of research being conducted for the U.S. Army Corps of Engineers, ABB-ES has developed a database of all flora and fauna known to seasonally or permanently occur at, or migrate through, Fort Devens (ABB-ES, 1992). Particular emphasis has been paid to rare and endangered biota; the term "rare and endangered" is used to refer to those species with protected status under the Federal Endangered Species Act (FESA) of 1973, as amended in 1988, and the Massachusetts Endangered Species Act (MESA) of 1990. The most current versions of both state and federal rare and endangered species lists have been included in this Fort Devens Biological Database. Information regarding all rare and endangered species known to occur at Fort Devens has been obtained from the Massachusetts Natural Heritage Program (MNHP) and the U.S. Fish and Wildlife Services (USFWS). In addition, the ABB-ES database contains records that have not yet been incorporated into the MNHP database. This database was used to ascertain whether or not SA 14 is providing rare and endangered species habitat.
- **Comparison to Ecological Standards and Criteria:** This element of the ecological PRE identifies possible ecological exposure pathways, and serves to characterize the risk to terrestrial and aquatic receptors potentially exposed to environmental contamination at the SA. Exposure pathways describe the mechanism(s) by which ecological receptors are exposed to contaminated media, and consist of a: (1) contaminant source; (2) environmental transport medium; (3) point of receptor contact; and (4) the exposure route (e.g., ingestion of prey items that have bioaccumulated contaminants in their tissues, drinking of contaminated surface water, incidental sediment ingestion, dermal absorption, inhalation, etc.). Potential receptors at SA 14 include:

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- Terrestrial biota in uplands
- Aquatic biota in the quarry pond
- Semi-terrestrial biota in and around the quarry pond

The screening-level evaluation of exposure to aquatic and semi-terrestrial receptors in the PRE was conducted through direct comparison of state and federal standards and guidance values to maximum concentrations of detected chemicals of potential concern (CPCs) in SA 14 sediments and surface water. Information available to evaluate the toxicity of SA 14 surface water contaminants include state and federal water quality criteria, laboratory-derived toxicity data, and toxicity threshold values developed using toxicological extrapolation techniques. Limited data are available to evaluate the potential for toxic effects of SA 14 quarry sediment contaminants on aquatic and semi-terrestrial life. Available information includes state and federal sediment quality criteria and guidance, laboratory-derived toxicity data, and toxicity threshold values developed using toxicological extrapolation techniques. Sediment and surface water standards and guidelines used for the PRE at SA 14 are discussed below.

USEPA Sediment Quality Criteria (SQC). SQC for several hydrophobic organic compounds have been developed and published by the USEPA (1988). No USEPA SQC are available to evaluate the effects of inorganic constituents on aquatic life. The USEPA SQC are intended to protect benthic organisms which are primarily impacted by contaminants in the interstitial water between sediment particles. USEPA developed SQC using an equilibrium partitioning approach to identify sediment concentrations which could be associated with interstitial water concentrations equal to chronic federal Ambient Water Quality Criteria (AWQC).

N.Y. State Department of Environmental Conservation (NYSDEC) SQC. The NYSDEC Bureau of Environmental Protection, Division of Fish and Wildlife of NYSDEC has published a document entitled "Sediment Criteria - December 1989" (NYSDEC, 1989). This report is a guidance document, not a NYSDEC standard or policy. The NYSDEC SQC document contains a methodology for developing sediment criteria, a description of the use of these criteria in risk management decision-making processes, and a table of sediment criteria derived for various human and ecological

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receptors. The NYSDEC (1989) guidance document contains recommended criteria for several analytes found in SA 14 sediments.

National Oceanographic and Atmospheric Administration (NOAA) Sediment Threshold Values. Long and Morgan (1990) have developed biological effects-based criteria for evaluating sediment contaminant data. Although this NOAA study is designed primarily for evaluating the toxicity of marine and estuarine sediments, USEPA has suggested that Long and Morgan (1990) criteria may also be used as a source of information for the evaluation of freshwater sediments at hazardous waste sites. The Effects Range-Medium (ER-M) of Long and Morgan (1990) represents the 50th percentile concentration of contamination in estuarine sediments with observed (or predicted) effects. The Effects Range-Low (ER-L) of Long and Morgan (1990) represents the 10th percentile concentration of contamination in estuarine sediments with observed (or predicted) effects. The NOAA ER-L was used as a sediment screening tool for the SA 14 PRE.

USEPA Ambient Water Quality Criteria (AWQC). AWQC have been developed and published by the USEPA for the protection of aquatic life and human health. The aquatic life AWQC are intended to be protective of all life stages of aquatic animals and plants. These criteria specify the contaminant concentration in ambient surface water that, if not exceeded, should protect most species of aquatic life and their uses. The chronic criterion represents the contaminant concentration that should not be exceeded by the four-day average chemical concentration more than once every three years (USEPA, 1983). In developing a chronic AWQC, USEPA estimates protective contaminant levels based on chronic toxicological data for animals, plants, and on residue levels in aquatic organisms. The acute criterion represents the level that should not be exceeded by the one-hour average concentration more than once every three years. For the purpose of the PRE, the chronic AWQC was used as a screening tool for evaluation of risk in surface waters. When USEPA Water Quality documents did not contain chronic AWQC, the Lowest Observed Effects Level (LOEL) was identified from USEPA Water Quality Criteria documents and used as the screening tool for surface water.

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Collectively, the state and federal standards and guidance values for surface water and sediment have been referred to as benchmark values. When more than one benchmark value is available per analyte per medium, professional judgment was used to select the appropriate value for use in the PRE.

Screening of ecological risk at SA 14 was based on establishing a contaminant-specific ratio between the average exposure concentrations and the benchmark values. This comparison of the exposure concentration with the appropriate benchmark results in an index of potential impact associated with exposure to environmental contaminants. When the average exposure concentration is less than the benchmark value (i.e., the ratio of the exposure concentration to the benchmark value < 1), ecological risk was assumed to be insignificant. When the value exceeds the exposure concentration (i.e., the ratio of the exposure concentration to the benchmark value > 1), a discussion of the ecological significance of this exceedance was included in the PRE. This conservative approach provides a screening-level evaluation of potential effects of individual CPCs on ecological receptors.

4.0 CONTAMINATION ASSESSMENT

4.1 SURFACE WATER

The laboratory analytical results of the surface water sample collected during the SI indicated that no organic compounds were present. TPHC was not detected, and all water quality parameters were within typical Fort Devens concentrations. Mercury (1.07 micrograms per liter [$\mu\text{g}/\text{L}$]) was the only inorganic analyte detected at a notable concentration (Table 4-1 and Figure 4-1).

The results of the water samples collected during the SSI showed that no semivolatile organic compounds (SVOCs), explosives, pesticides or polychlorinated biphenyls were detected. One volatile organic compound (VOC) (1,2-dichloroethene) was detected in the 45-foot sample at $0.53 \mu\text{g}/\text{L}$. Other VOCs were detected, however, their presence appears to be related to laboratory contamination. Several inorganics were detected at notable concentrations, however, mercury (which was detected during the SI) was not detected in the SSI samples (see Table 4-1 and Figure 4-2).

4.2 SEDIMENT

The results of the sediment samples collected during the SI indicated that low concentrations (less than $0.1 \mu\text{g}/\text{g}$) of benzene and xylenes were detected in one of the two samples. One SVOC (n-nitrosodiphenylamine: an explosive by-product) was detected in the other sample, along with explosives and TPHC. Several pesticides were also detected in both samples at low concentrations (less than $1.0 \mu\text{g}/\text{g}$). Several inorganics (arsenic, beryllium, cadmium, copper, iron, lead, manganese, nickel, and zinc) were detected at notable concentrations in both sediment samples (Table 4-2 and Figure 4-3).

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5.0 PRELIMINARY HUMAN HEALTH RISK EVALUATION

The human health Preliminary Risk Evaluation (PRE) completed for SA 14 included the data collected from both the SI and the SSI. Iron and manganese were the only analytes detected above drinking water standards in the four surface water samples collected from SA 14 (Table 5-1). The standards exceeded were Secondary Maximum Contaminant Levels, which are set for aesthetic, not health reasons. The use of drinking water standards for comparison to surface water concentrations is a conservative approach and is used due to a lack of available health-based guidelines for exposure to surface water. The exposure to surface water at SA 14 would be expected to be much less than that upon which drinking water standards are based. There is no evidence that exposure to surface water at the quarry would pose a significant risk to human health.

The results of the human health PRE conducted on the sediment quality data are presented in the Final Groups 2, 7, and Historic Gas Station SI Report (ABB-ES, 1993). Several organic analytes were detected in the sediment samples collected from the quarry bottom. However, all organics were below residential soil risk-based concentrations. Of the inorganic analytes detected in sediment, only arsenic and beryllium exceeded residential soil risk-based concentrations. Residential concentrations are designed to be protective of daily exposures for an exposure duration of 30 years. Exposure to sediment in the quarry would be much less frequent. Furthermore, direct contact with the sediment on the quarry bottom is unlikely. For the preceding reasons, the human health PRE concluded that sediment at SA 14 would not pose a significant risk to public health (Table 5-2).

The thermocline identified in the quarry appears to indicate that relatively little mixing occurs between the shallow and deep quarry water. Therefore, it appears that contaminants which may partition out of the sediment and into the deeper water would not migrate to the shallower quarry water. Because of this, it appears that the contaminants detected in the sediments at the quarry bottom would not pose a significant risk to human health.

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6.0 PRELIMINARY ECOLOGICAL RISK EVALUATION

The SI and SSI ecological PREs reported that the maximum concentrations of some pesticides and inorganics exceeded their respective sediment benchmark values. Because several site conditions (sediment is a thin layer, hard slate bottom, 50 foot depth) provide little benthic habitat, and; due to very low dissolved oxygen at depths below 10 feet and limited sediment/surface water mixing due to a deep water column with a small surface area, aquatic receptor exposure to sediments in the quarry is unlikely.

Some surface water analytes exceeded their respective benchmark values. The inorganic exceedances were from samples collected at depths of 10 feet and lower. The lack of dissolved oxygen at depths below 10 feet make it unlikely the aquatic organisms would inhabit deeper portions of the quarry.

Although mercury exceeded its benchmark value, the mercury Ambient Water Quality Criteria represents a very conservative screening guideline (Table 6-1).

Recent USEPA guidance (USEPA, 1993) states that the use of total contaminant surface water data (used in the PRE), instead of dissolved contaminant data, may result in an overestimate of risks associated with surface water exposures by aquatic organisms (Table 6-2).

Based on the surface water data and the preceding reasons, the SSI ecological PRE concluded that adverse effects to ecological receptors from exposure to quarry surface water is unlikely.

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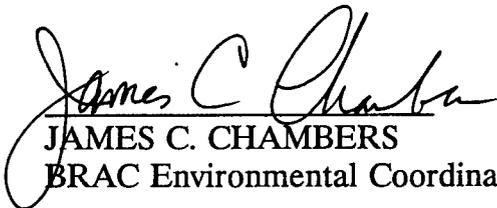
7.0 CONCLUSIONS

The objective of the SI and the SSI field investigations at SA 14 was to determine if the historic disposal activities had adversely impacted the surface water and sediment quality at the site. Based on the results of the samples collected from SA 14, it does not appear that the surface water at SA 14 has been impacted by past activities. However, it does appear that sediment quality has been impacted, but the contaminants detected in the sediment do not appear to be impacting the water quality and do not appear to be posing a risk to human or ecological receptors. Therefore, no further action is recommended for SA 14.

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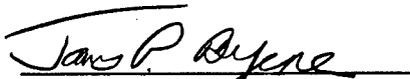
8.0 DECISION

On the basis of findings at SA 14, there is no evidence or reason to conclude that contaminants detected at this SA pose a threat to human health or the environment. The decision has been made to remove SA 14 from further consideration in the IRP process. In accordance with CERCLA 120 (h) (3), all remedial actions necessary have taken place, and the USEPA and MADEP signatures constitute concurrence in accordance with the same.


JAMES C. CHAMBERS
BRAC Environmental Coordinator

18 JAN 95
Date

U.S. ENVIRONMENTAL PROTECTION AGENCY

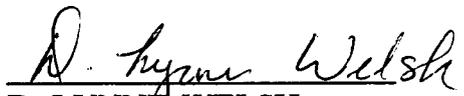

JAMES P. BYRNE
Fort Devens Remedial Project Manager

1/18/95
Date

Concur

Non-concur (Please provide reasons for non-concurrence in writing)

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION


D. LYNNE WELSH
Section Chief, Federal Facilities - CERO

1/18/95
Date

Concur

Non-concur (Please provide reasons for non-concurrence in writing)

ABB Environmental Services, Inc.

GLOSSARY OF ACRONYMS AND ABBREVIATIONS

ABB-ES	ABB Environmental Services, Inc.
BRAC	Base Realignment and Closure
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DoD	U.S. Department of Defense
gpm	gallons per minute
IRP	Installation Restoration Program
LUST	leaking underground storage tank
MEP	Master Environmental Plan
MSL	mean sea level
PA	Enhanced Preliminary Assessment
PAL	project analyte list
PRE	Preliminary Risk Evaluation
SA	Study Area
SI	site investigation
SSI	supplemental site investigation
SVOC	semivolatile organic compound
TOC	total organic carbon
TPHC	total petroleum hydrocarbon compounds
USAEC	U.S. Army Environmental Center
$\mu\text{g/g}$	micrograms per gram
$\mu\text{g/L}$	micrograms per liter
UXO	unexploded ordnance
VOC	volatile organic compound

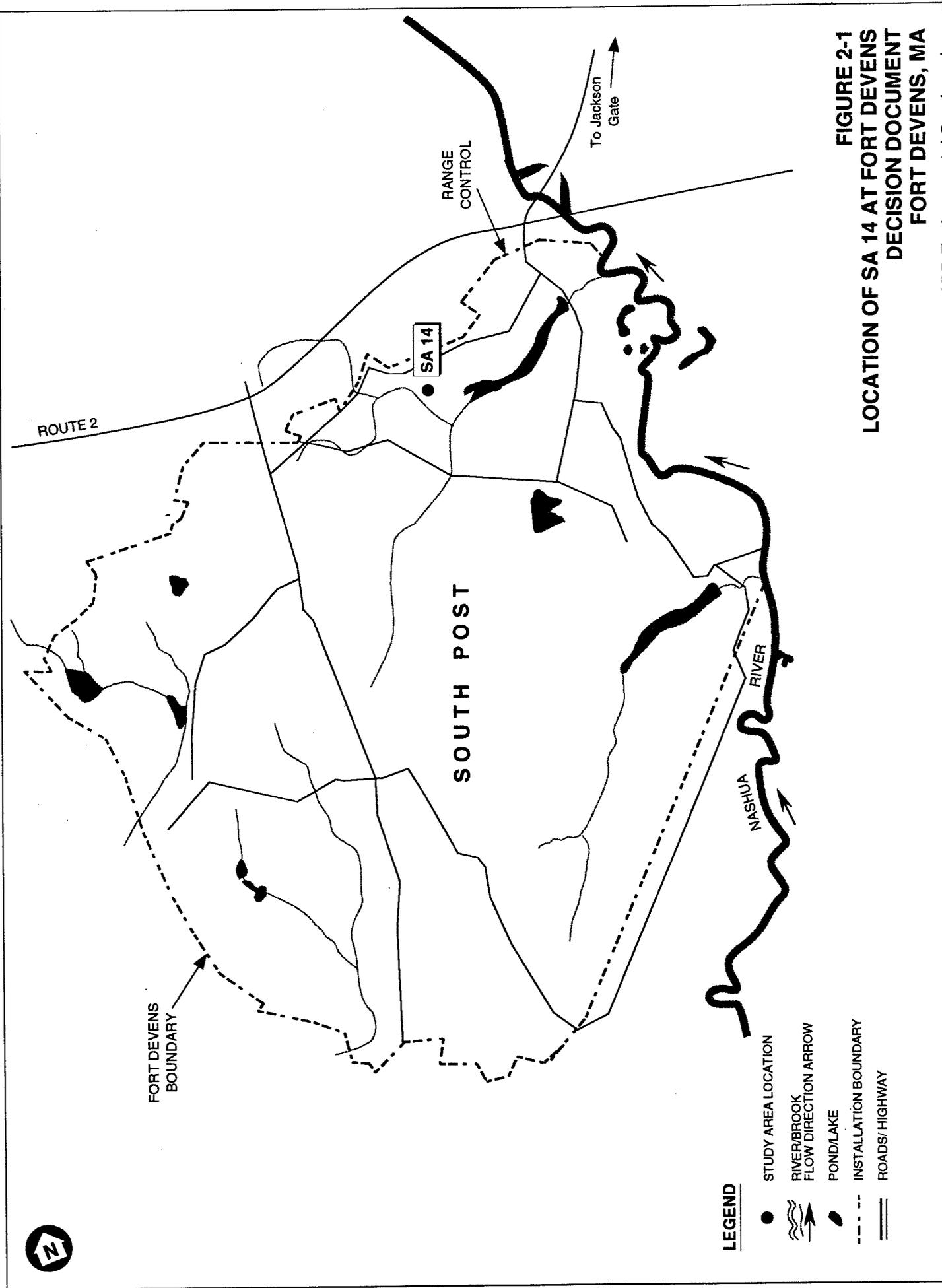
ABB Environmental Services, Inc.

REFERENCES

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- Biang, C.A., R.W. Peters, R.H. Pearl, and S.Y. Tsai, 1992. "Master Environmental Plan for Fort Devens, Massachusetts"; prepared for U.S. Army Toxic and Hazardous Materials Agency; prepared by Argonne National Laboratory, Environmental Assessment and Information Sciences Division; Argonne, IL; Final, April.
- Jahns, R.H., 1953. "Surficial Geology of the Ayer Quadrangle, Massachusetts"; Scale 1:31,680; U.S. Geological Survey.
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LEGEND

- STUDY AREA LOCATION
- ~ RIVER/BROOK
- FLOW DIRECTION ARROW
- POND/LAKE
- - - - - INSTALLATION BOUNDARY
- == ROADS/ HIGHWAY

FIGURE 2-1
LOCATION OF SA 14 AT FORT DEVENS
DECISION DOCUMENT
FORT DEVENS, MA

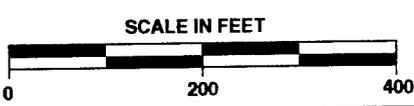
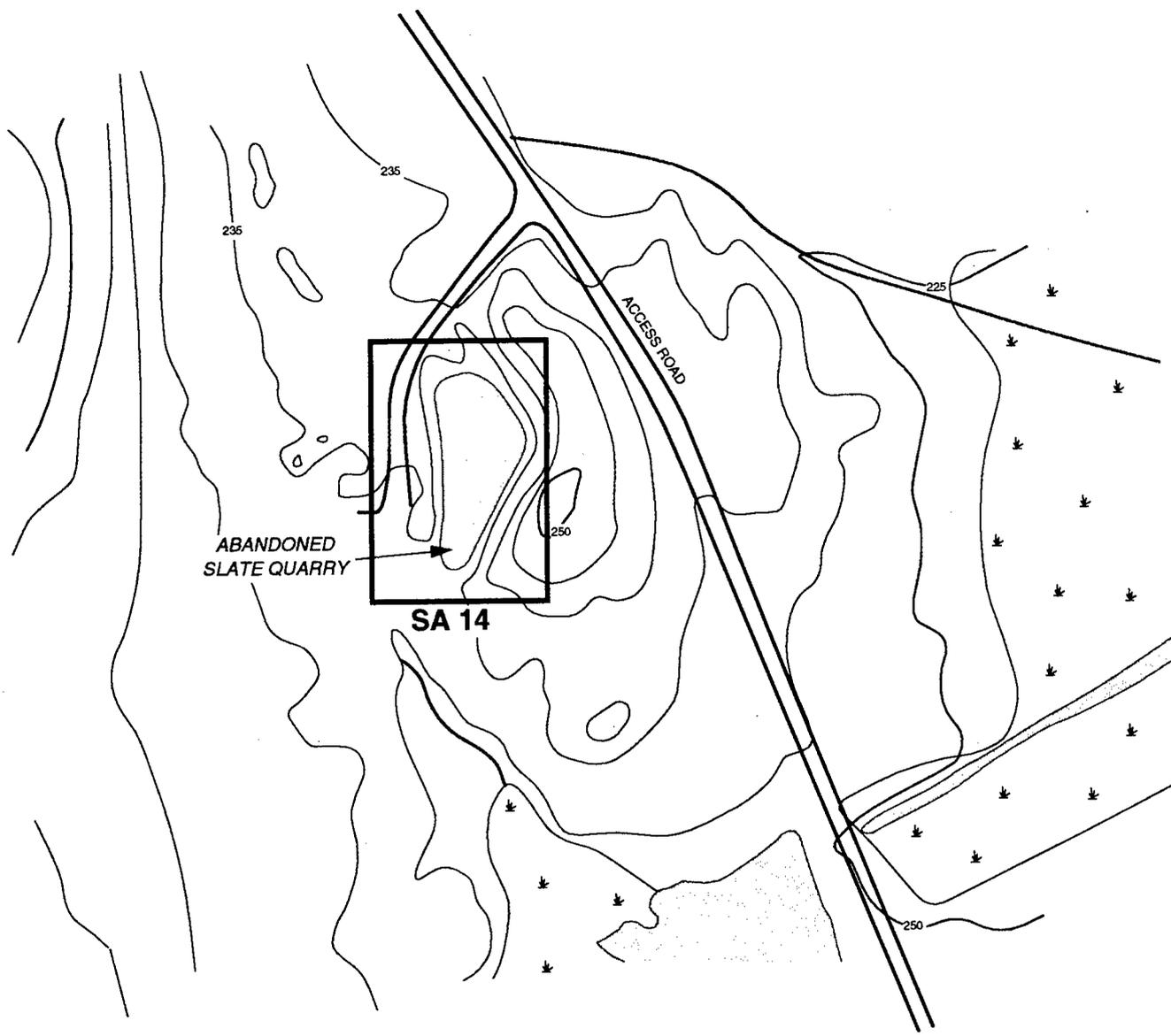


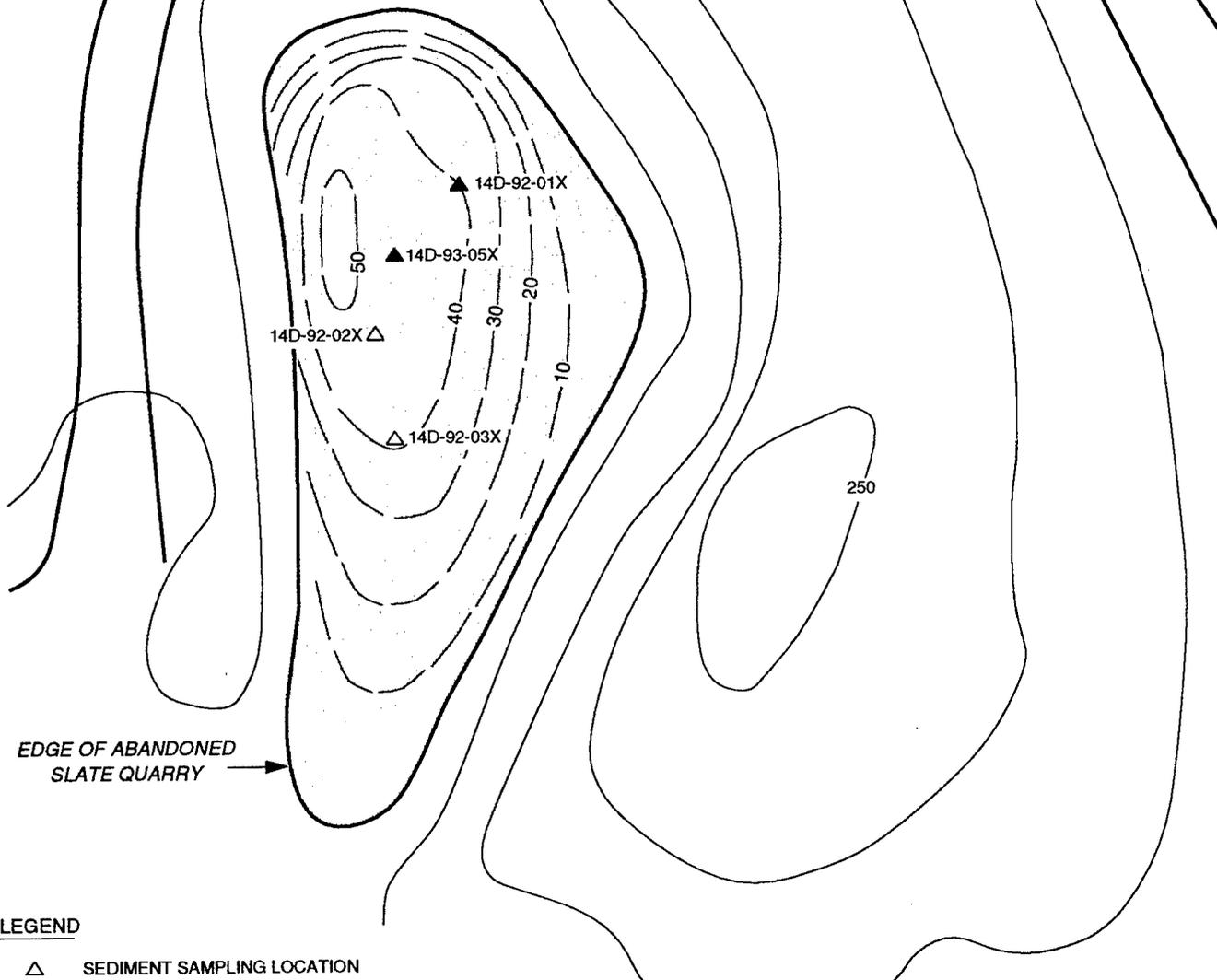
FIGURE 2-2
LOCATION OF SA 14
DECISION DOCUMENT
SA 14 LANDFILL NO. 10
FORT DEVENS, MA

ABB Environmental Services, Inc.



ACCESS ROAD

ACCESS ROAD



EDGE OF ABANDONED
SLATE QUARRY

LEGEND

- △ SEDIMENT SAMPLING LOCATION
- ▲ SURFACE WATER SAMPLING LOCATION
- 40 BATHYMETRY IN QUARRY POND IN FEET BELOW POND SURFACE (August 11, 1993)

SCALE IN FEET



**FIGURE 3-1
BATHYMETRY AND SAMPLING LOCATIONS
DECISION DOCUMENT
SA 14 LANDFILL NO. 10
FORT DEVENS, MA**

ABB Environmental Services, Inc.

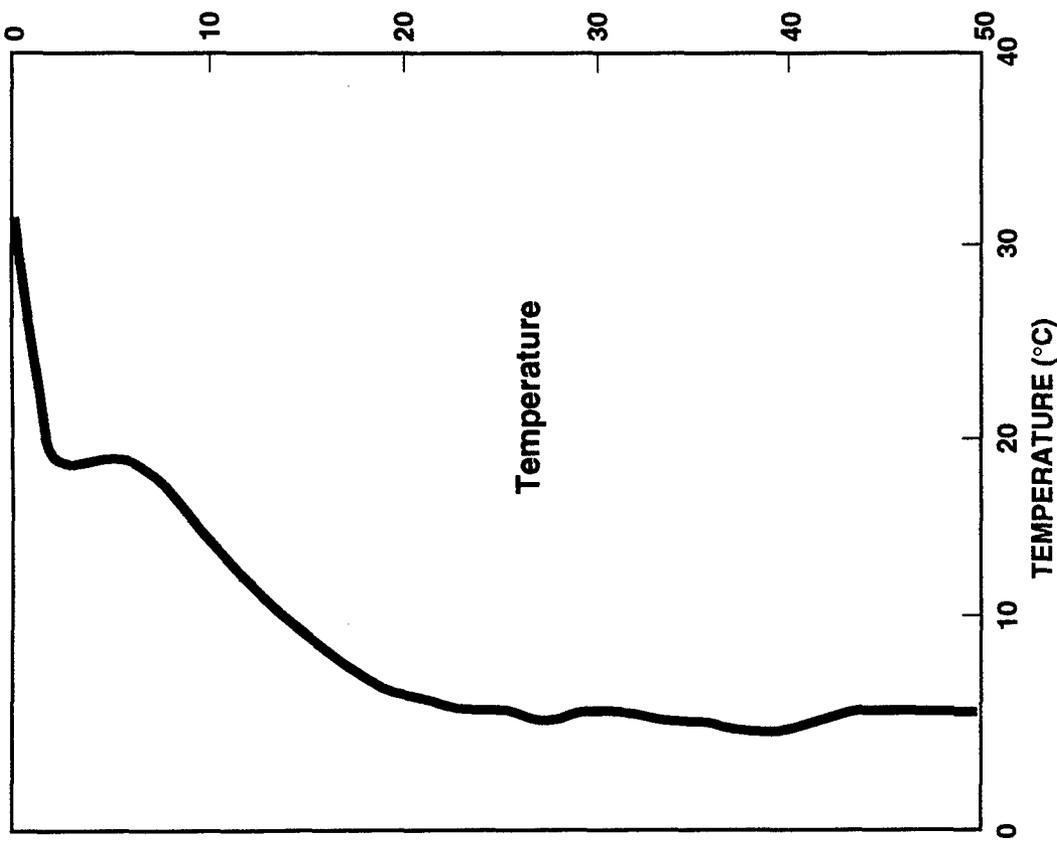
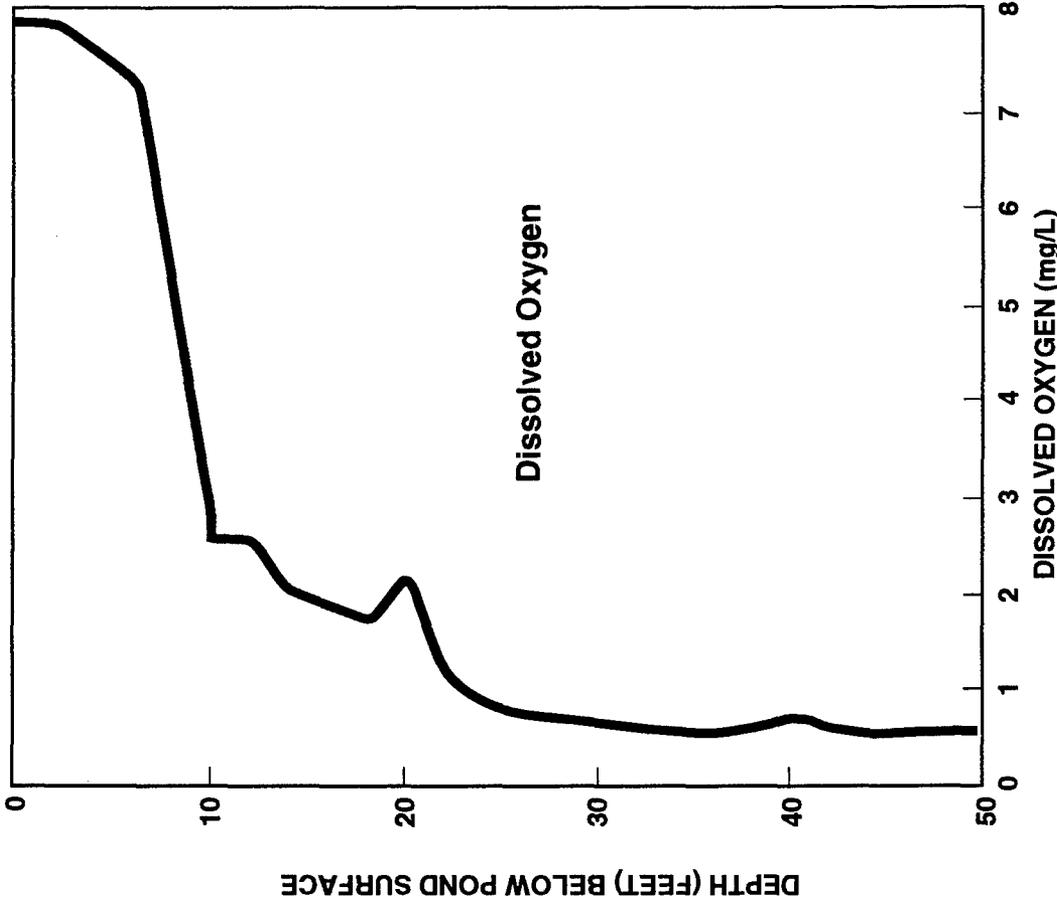


FIGURE 3-2
TEMPERATURE AND DISSOLVED OXYGEN IN
QUARRY POND, AUGUST 1993
DECISION DOCUMENT
SA 14 LANDFILL NO. 10
FORT DEVENS, MA
 ABB Environmental Services, Inc.



ACCESS ROAD

ACCESS ROAD

LT
LT
LT
LT
LT

Ca	3150
Fe	94.8
Hg	1.07
K	1570
Mg	576
Mn	40.4
Na	1550

14D-92-04X

250

EDGE OF ABANDONED SLATE QUARRY

LEGEND

▲ EXISTING SURFACE WATER SAMPLING LOCATION

AI 3610 CONCENTRATION (µg/g)

— ANALYTE

LT LESS THAN DETECTION LIMIT

LT
LT
LT
45.4
LT

TOTAL VOCs in µg/L

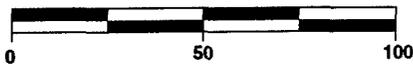
TOTAL SVOCs in µg/L

TOTAL EXPLOSIVES in µg/L

TPHC in µg/L

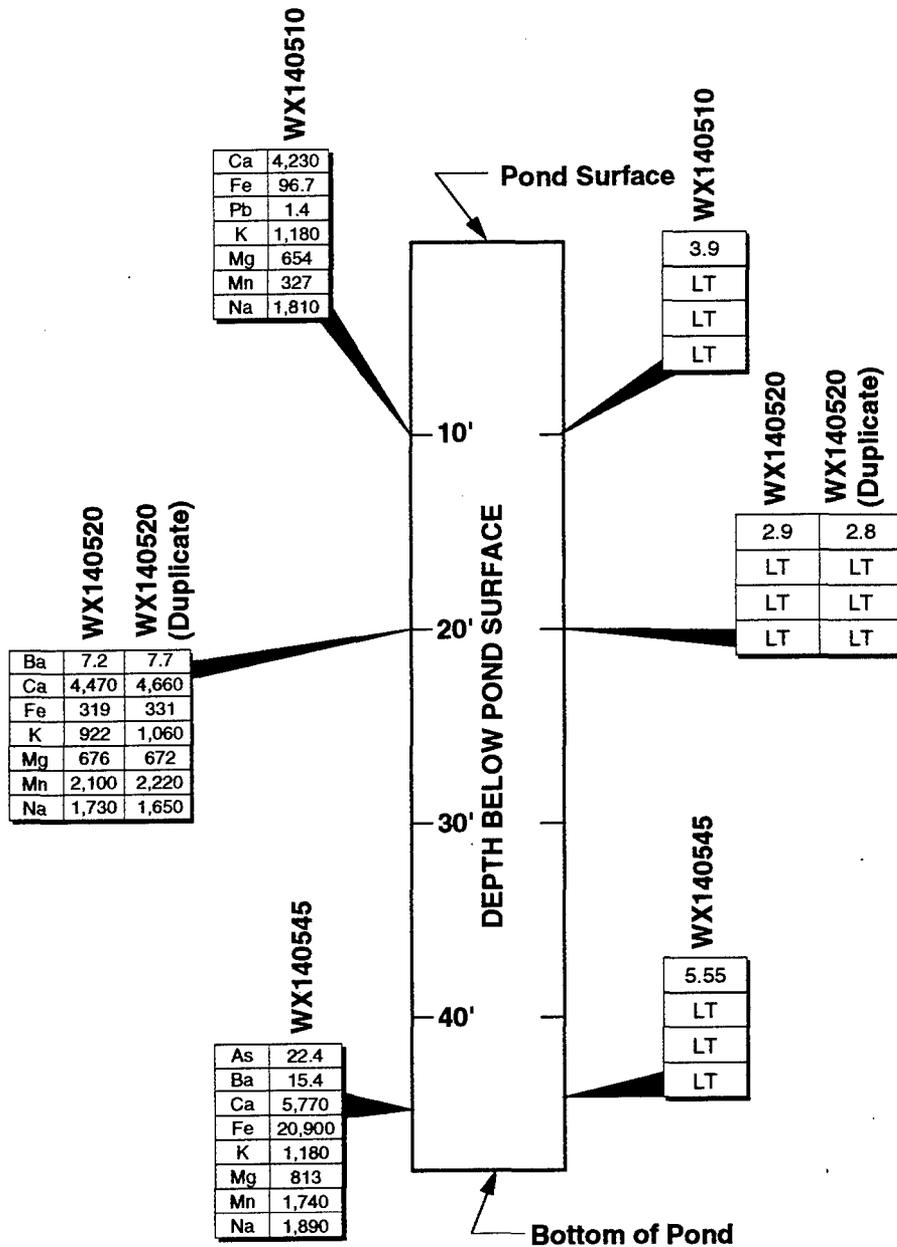
TOTAL PESTICIDES / PCB in µg/L

SCALE IN FEET



**FIGURE 4-1
ANALYTES IN SURFACE WATER-SI SAMPLE
DECISION DOCUMENT
SA 14 LANDFILL NO. 10
FORT DEVENS, MA**

ABB Environmental Services, Inc.



Ca 4,120 — CONCENTRATION (µg/L)
 — ANALYTE
 LT LESS THAN DETECTION LIMIT

LT	TOTAL VOCs in µg/L
LT	TOTAL SVOCs in µg/L
LT	TOTAL EXPLOSIVES in µg/L
LT	TOTAL PESTICIDES / PCB in µg/L

FIGURE 4-2
ANALYTES IN SURFACE WATER BY DEPTH-SSI SAMPLES
DECISION DOCUMENT
SA 14 LANDFILL NO. 10
FORT DEVENS, MA



ACCESS ROAD

ACCESS ROAD

Al	14300
As	75
Ba	62.9
Be	2.34
Ca	1020
Cd	30.3
Co	81.5
Cr	20
Cu	204
Fe	30000
Hg	0.55
K	450
Mg	2310
Mn	437
Na	395
Ni	48.1
Pb	200
V	18.5
Zn	481

0.194
LT
22.3
231
0.408

(dup)
1.0
2.0
26.9
248
0.352

0.255
6.0
68.9
323
0.767

(dup)	
Al	16400
As	100
Ba	75.7
Be	2.7
Ca	969
Cd	8.3
Co	60.8
Cr	28.1
Cu	211
Fe	33000
Hg	.5
K	750
Mg	2880
Mn	465
Na	506
Ni	52.7
Pb	250
Se	1.1
V	19.6
Zn	475

14D-92-02X
14D-92-03X

Al	15000
As	44
Ba	51.2
Be	1.8
Ca	1140
Cd	3.83
Co	49.2
Cr	22.1
Cu	136
Fe	33300
Hg	.239
K	543
Mg	3430
Mn	522
Na	414
Ni	43.8
Pb	220
Sb	8.1
V	15.2
Zn	324

250

EDGE OF ABANDONED SLATE QUARRY

LEGEND

△ EXISTING SEDIMENT SAMPLE SAMPLING LOCATION

Al 3610 CONCENTRATION (µg/g)

— ANALYTE

LT LESS THAN DETECTION LIMIT

(dup) DUPLICATE SAMPLE

LT
6.6
68.9
323
0.03

TOTAL VOCs in µg/g

TOTAL SVOCs in µg/g

TOTAL EXPLOSIVES in µg/g

TPHC in µg/g

TOTAL PESTICIDES / PCB in µg/g

SCALE IN FEET

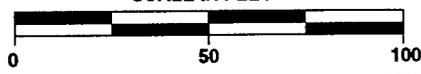


FIGURE 4-3
ANALYTES IN SEDIMENT-SI SAMPLES
DECISION DOCUMENT
SA 14 LANDFILL NO. 10
FORT DEVENS, MA

TABLE 3-1
TEMPERATURE AND DISSOLVED OXYGEN IN QUARRY POND
SA 14 - LANDFILL NO. 10

DECISION DOCUMENT
FORT DEVENS, MA

DEPTH BELOW POND SURFACE (Feet)	WATER TEMPERATURE (Deg. C)	DISSOLVED OXYGEN IN WATER (mg/L)	THERMAL STRATIFICATION
0	31	7.9	EPILIMNION
2	19	7.9	
4	18.9	7.6	
6	19	7.3	
8	17.5	5	THERMOCLINE
10	15	2.55	
12	13	2.59	
14	11	2	
16	9.5	1.85	
18	8	1.7	
20	7	2.2	
22	6.5	1.1	
24	6	0.85	HYPOLIMNION
26	6	0.75	
28	5.5	0.7	
30	6	0.65	
32	6	0.6	
34	5.5	0.55	
36	5.5	0.55	
38	5	0.6	
40	5	0.7	
42	5.5	0.6	
44	6	0.55	
46	6	0.55	
48	6	0.6	

TABLE 4-1
ANALYTES IN SURFACE WATER
SA 14 - LANDFILL NO. 10

DECISION DOCUMENT
FORT DEVENS, MA

ANALYTE	SSI			SI
	14D-93-05X 10 FT	14D-93-05X 20 FT	14D-93-05X 45 FT	
ORGANICS ($\mu\text{g/L}$)				
1,2-DICHLOROETHANE	0.79	< 0.5	< 0.5	< 0.5
1,2-DICHLOROETHENES	< 0.5	< 0.5	< 0.5	< 0.5
CHLOROFORM	< 0.5	< 0.5	< 0.5	< 0.5
METHYLENE CHLORIDE	3.1	2.9	2.8	< 2.3
INORGANICS ($\mu\text{g/L}$)				
ARSENIC	< 2.54	< 2.54	< 2.54	< 2.54
BARIUM	< 5	7.21	7.71	< 5
CALCIUM	4230	4470	4660	3150
IRON	96.7	319	331	20900
LEAD	1.41	< 1.26	< 1.26	< 1.26
MAGNESIUM	654	676	672	576
MANGANESE	327	2100	2220	40.4
MERCURY	< 0.243	< 0.243	< 0.243	1.07
POTASSIUM	1180	922	1060	1570
SODIUM	1810	1730	1650	1550
OTHER ($\mu\text{g/L}$)				
ALKALINITY	18000	19000	25000	13000
NITRITE, NITRATE-NON SPECIFIC	< 10	< 10	< 10	10.1
NITROGEN BY KJELDAHL METHOD	< 183	381	343	305
TOTAL HARDNESS	14000	16000	17600	9600
TOTAL SUSPENDED SOLIDS	< 4	4	< 4	< 4000
PHOSPHATE	< 13.3	28.8	26.9	< 13.3

NOTES:

< = LESS THAN DETECTION LIMIT

TABLE 4-2
ANALYTES IN SEDIMENT
SA 14 - LANDFILL NO. 10

DECISION DOCUMENT
FORT DEVENS, MA

ANALYTE	14D-92-02X	14D-92-02X DUP	14D-92-03X
INORGANICS ($\mu\text{g/g}$)			
ALUMINUM	14300.0	16400.0	15000.0
ANTIMONY	< 1.1	< 1.1	8.1
ARSENIC	75.0	100.0	44.0
BARIUM	62.9	75.7	51.2
BERYLLIUM	2.34	2.68	1.75
CADMIUM	30.3	8.29	3.83
CALCIUM	1020.0	969.0	1140.0
CHROMIUM	20.0	28.1	22.1
COBALT	81.5	60.8	49.2
COPPER	204.0	211.0	136.0
IRON	30000.0	33000.0	33300.0
LEAD	200.0	250.0	220.0
MAGNESIUM	2310.0	2880.0	3430.0
MANGANESE	437.0	465.0	522.0
MERCURY	0.55	0.507	0.239
NICKEL	48.1	52.7	43.8
POTASSIUM	450.0	750.0	543.0
SELENIUM	< 0.2	1.12	< 0.2
SODIUM	395.0	506.0	414.0
VANADIUM	18.5	19.6	15.2
ZINC	481.0	475.0	324.0
ORGANICS ($\mu\text{g/g}$)			
ACETONE	0.16	1.0	0.25
BENZENE	0.011	< 0.008	< 0.002
CHLOROFORM	< 0.004	< 0.004	0.005
XYLENES	0.023	< 0.008	< 0.008
DI-N-BUTYL PHTHALATE	< 0.06	2.0	1.0
N-NITROSODIPHENYLAMINE	< 1.0	< 1.0	5.0
ALPHA-CHLORDANE	0.028 S	0.039 S	< 0.005
GAMMA-CHLORDANE	0.033 S	0.031 S	< 0.005
HEPTACHLOR	0.061	0.064	0.044
4,4'-DDD	0.21	0.13	0.12
4,4'-DDE	0.076	0.063	0.053
4,4'-DDT	< 0.007	0.025	0.55
EXPLOSIVES ($\mu\text{g/g}$)			
2,4-DINITROTOLUENE	< 0.42	0.894	3.39
NITROGLYCERINE	22.3	26.0	65.5
OTHER ($\mu\text{g/g}$)			
TOTAL ORGANIC CARBON	56700.0	59400.0	64000.0
TPHC	231.0	248.0	323.0

NOTES:

TABLE LISTS DETECTED ANALYTES ONLY -
SEE PROJECT ANALYTE LIST FOR SUMMARY
< = LESS THAN DETECTION LIMIT SHOWN
S = RESULTS BASED ON INTERNAL STANDARD
DUP = DUPLICATE SAMPLE

TABLE 5-1
HUMAN HEALTH PRE EVALUATION OF SURFACE WATER
SA 14 - LANDFILL NO. 10

DECISION DOCUMENT
FORT DEVENS, MA

ANALYTE	FREQUENCY OF DETECTION	DETECTED CONCENTRATION [a]		DRINKING WATER STANDARD/GUIDELINE [b] (µg/L)	MAXIMUM EXCEEDS DRINKING WATER STANDARD/GUIDELINE ?
		AVERAGE (µg/L)	MAXIMUM (µg/L)		
ORGANICS					
1,2-DICHLOROETHANE	2/4	0.705	0.79	5	NO
CHLOROFORM	1/4	1.6	1.6	5	NO
METHYLENE CHLORIDE	3/4	2.933	3.1	5	NO
1,2-DICHLOROETHENES (CIS AND TRANS ISOMERS)	1/4	0.53	0.53	70	NO
INORGANICS					
ARSENIC	1/4	22.4	22.4	50	NO
BARIUM	2/4	11.305	15.4	2000	NO
CALCIUM	4/4	4405	5770	NA	-
IRON	4/4	5352.625	20900	300	YES
LEAD	1/4	1.41	1.41	15	NO
MAGNESIUM	4/4	679.75	813	NA	-
MANGANESE	4/4	1051.85	2100	50	YES
MERCURY	1/4	1.07	1.07	2	NO
POTASSIUM	4/4	1213	1570	NA	-
SODIUM	4/4	1745	1890	28000	NO
ANIONS/CATIONS					
NITRITE/NITRATE - NONSPECIFIC	1/4	10.1	10.1	1000	NO

NOTES:

[a] SURFACE WATER FROM SAMPLING LOCATIONS 14D-92-04X AND 14D-93-05X (AT 3 DEPTHS)
[b] INCLUDES THE LOWEST OF EITHER THE EPA OR MA DRINKING WATER STANDARDS, OR IF NO FEDERAL OR STATE STANDARD OR GUIDELINE IS AVAILABLE, THE REGION III TAP WATER CONCENTRATION

NA = NOT AVAILABLE

µg/L = MICROGRAMS PER LITER

- = NOT APPLICABLE

MCP = MASSACHUSETTS CONTINGENCY PLAN
SHADED COMPOUNDS EXCEED STANDARD OR GUIDELINE

TABLE 5-2
HUMAN HEALTH PRE EVALUATION OF SEDIMENT
SA 14 - LANDFILL NO. 10

DECISION DOCUMENT
FORT DEVENS, MA

ANALYTE	Detected Concentration [a]		FREQUENCY OF DETECTION	REGION III RESIDENTIAL SOIL CONCENTRATION ($\mu\text{g/g}$)	MAXIMUM EXCEEDS REGION III CONCENTRATION?
	AVERAGE ($\mu\text{g/g}$)	MAXIMUM ($\mu\text{g/g}$)			
ORGANICS					
2,4-Dinitrotoluene	2.1	3.39	2/3	160	NO
4,4'-DDD	0.2	0.21	3/3	7.1	NO
4,4'-DDE	0.1	0.076	3/3	5	NO
4,4'-DDT	0.3	0.55	2/3	5	NO
acetone	0.5	1	3/3	7800	NO
alpha-chlordane [b]	0.03	0.039	2/3	1.3	NO
benzene	0.011	0.011	1/3	59	NO
chloroform	0.005	0.005	1/3	280	NO
di-n-butyl phthalate	1.5	2	2/3	7800	NO
gamma-chlordane [b]	0.03	0.033	2/3	1.3	NO
heptachlor	0.06	0.064	3/3	0.38	NO
nitroglycerine	37.9	65.5	3/3	103	NO
n-nitrosodiphenylamine	5	5	1/3	350	NO
xylenes	0.023	0.023	1/3	160000	NO
INORGANICS					
aluminum	15233.3	16400	3/3	230000	NO
antimony	8.1	8.1	1/3	31	NO
arsenic	73	100	3/3	0.97	YES
barium	63.3	75.7	3/3	5500	NO
beryllium	2.3	2.68	1/3	0.4	YES
cadmium	14.1	30.3	3/3	39	NO
calcium	1043	1140	3/3	NA	NA
chromium	23.4	28.1	3/3	390	NO
cobalt	63.8	81.5	3/3	NA	NA
copper	183.7	211	3/3	2900	NO
iron	32100	33300	3/3	NA	NA

TABLE 5-2
HUMAN HEALTH PRE EVALUATION OF SEDIMENT
SA 14 - LANDFILL NO. 10

DECISION DOCUMENT
FORT DEVENS, MA

ANALYTE	Detected Concentration [a]		FREQUENCY OF DETECTION	REGION III RESIDENTIAL SOIL CONCENTRATION ($\mu\text{g/g}$)	MAXIMUM EXCEEDS REGION III CONCENTRATION?
	AVERAGE ($\mu\text{g/g}$)	MAXIMUM ($\mu\text{g/g}$)			
lead	223.3	250	3/3	500	NO
magnesium	2873.3	3430	3/3	NA	NA
manganese	474.7	522	3/3	7800	NO
mercury	0.4	0.55	3/3	23	NO
nickel	48.2	52.7	3/3	1600	NO
potassium	581.0	750	3/3	NA	NA
selenium	1.12	1.12	1/3	390	NO
sodium	438.3	506	3/3	NA	NA
vanadium	17.8	19.6	3/3	550	NO
zinc	426.7	481	3/3	23000	NO
OTHER					
TPHC	267.3	323	3/3	NA	NA

NOTES:

[a] SEDIMENT SAMPLES FROM SAMPLING STATIONS 14D-92-02X, AND 14D-92-03X (INCLUDING ONE DUPLICATE)

[b] THE REGION III RESIDENTIAL SOIL VALUE FOR CHLORDANE WAS USED AS A SURROGATE FOR ALPHA - AND GAMMA - CHLORDANE

NA = NOT AVAILABLE

$\mu\text{g/g}$ = MICROGRAMS PER GRAM

**TABLE 6-1
ECOLOGICAL PRE EVALUATION OF SEDIMENT
SA 14 - LANDFILL NO. 10**

**DECISION DOCUMENT
FORT DEVENS, MA**

ANALYTE	CONCENTRATION [a]		FREQUENCY OF DETECTION	ECOLOGICAL BENCHMARK ($\mu\text{g/g}$)	MAXIMUM EXCEEDS BENCHMARK?
	AVERAGE ($\mu\text{g/g}$)	MAXIMUM ($\mu\text{g/g}$)			
ORGANICS					
2,4-dinitrotoluene	2.1	3.39	2/3	NA	NA
4,4'-DDD	0.153	0.21	3/3	0.0497[b]	YES
4,4'-DDE	0.064	0.076	3/3	0.0497[b]	YES
4,4'-DDT	0.288	0.55	2/3	0.0497[b]	YES
acetone	0.5	1	3/3	NA	NA
alpha-chlordane	0.03	0.039	2/3	0.00036[b]	YES
benzene	0.011	0.011	1/3	NA	NA
chloroform	0.005	0.005	1/3	NA	NA
di-n-butyl phthalate	1.5	2	2/3	NA	NA
gamma-chlordane	0.03	0.033	2/3	0.00036[b]	YES
heptachlor	0.06	0.064	3/3	0.0066[b]	YES
nitroglycerine	37.9	65.5	3/3	NA	NA
n-nitrosodiphenylamine	5	5	1/3	NA	NA
xylenes	0.023	0.023	1/3	NA	NA
INORGANICS					
aluminum	15233.3	16400	3/3	NA	NA
antimony	8.1	8.1	1/3	2	YES
arsenic	73	100	3/3	5	YES
barium	63.3	75.7	3/3	NA	NA
beryllium	2.3	2.68	3/3	NA	NA
cadmium	14.1	30.3	3/3	0.8	YES
chromium	23.4	28.1	3/3	26	YES
cobalt	63.8	81.5	3/3	NA	NA
copper	183.7	211	3/3	19	YES
iron	32100	33300	3/3	24000	YES
lead	223.3	250	3/3	27	YES
manganese	474.7	522	3/3	428	YES
mercury	0.4	0.55	3/3	0.11	YES
nickel	48.2	52.7	3/3	22	YES
selenium	1.12	1.12	1/3	NA	NA
vanadium	17.8	19.6	3/3	NA	NA
zinc	426.7	481	3/3	85	YES
OTHER					
total organic carbon	60033.3	64000	3/3	---	---

NOTES:

[a] SEDIMENT SAMPLES FROM SAMPLING STATIONS 14D-92-02X, 14D-92-02X (DUP), AND 14D-92-03X

[b] BENCHMARK IS CARBON-NORMALIZED USING SITE-SPECIFIC TOTAL ORGANIC CARBON DATA

NA = NOT AVAILABLE

$\mu\text{g/g}$ = MICROGRAMS PER GRAM

--- = ANALYTE NOT A CPC FOR THIS MEDIUM

TABLE 6-2
 ECOLOGICAL PRE-EVALUATION OF SURFACE WATER
 SA 14 - LANDFILL NO. 10

DECISION DOCUMENT
 FORT DEVENS, MA

ANALYTE	CONCENTRATION [a]		FREQUENCY OF DETECTION	ECOLOGICAL BENCHMARK ($\mu\text{g/L}$)	MAXIMUM EXCEEDS BENCHMARK?
	AVERAGE ($\mu\text{g/L}$)	MAXIMUM ($\mu\text{g/L}$)			
ORGANICS					
1,2-DICHLOROETHANE	0.705	0.79	2/4	20000	NO
CHLOROFORM	1.6	1.6	1/4	1240	NO
METHYLENE CHLORIDE	2.93	3.1	3/4	NA	NA
1,2-DICHLOROETHENES (CIS AND TRANS)	0.53	0.53	1/4	1160	NO
INORGANICS					
ARSENIC	22.4	22.4	1/4	190	NO
BARIUM	11.3	15.4	2/4	NA	NA
IRON	5353	20900	4/4	1000	YES
LEAD	1.41	1.41	1/4	0.54[b]	YES
MANGANESE	1052	2100	4/4	NA	NA
MERCURY	1.07	1.07	1/4	0.012	YES
OTHER					
TOTAL SUSPENDED SOLIDS	18.5	33	2/4	---	---
TOTAL HARDNESS	14400	18000	4/4	---	---

NOTES:

- [a] SURFACE WATER SAMPLE FROM SAMPLING STATION 14D-92-04X AND 14D-93-05X (10, 20, AND 45 FOOT DEPTHS)
- [b] HARDNESS - DEPENDENT CRITERION; 25 mg/L CaCO₃ USED BECAUSE SITE-SPECIFIC HARDNESS VALUE (14.4 mg/L) IS BELOW THE HARDNESS RANGE (25 TO 200 mg/L) FOR WHICH THE HARDNESS FUNCTION IS VALID (FEDERAL REGISTER, 1992). SEE SECTION 3.6.2 (ABB-ES, 1993) FOR METHODOLOGY USED TO CALCULATE SITE-SPECIFIC HARDNESS - DEPENDENT BENCHMARK VALUES.
- $\mu\text{g/L}$ = MICROGRAMS PER LITER
- = ANALYTE NOT A CPC FOR THIS MEDIUM
- NA = NOT AVAILABLE