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**U.S. Army
Environmental
Center**

**NO FURTHER ACTION DECISION
DOCUMENT FOR STUDY AREA P7,
PATROL ROAD WASTE AREA,
AT FORT DEVENS
SUDBURY TRAINING ANNEX**

FINAL DOCUMENT

CONTRACT DAAA15-90-D-0019

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

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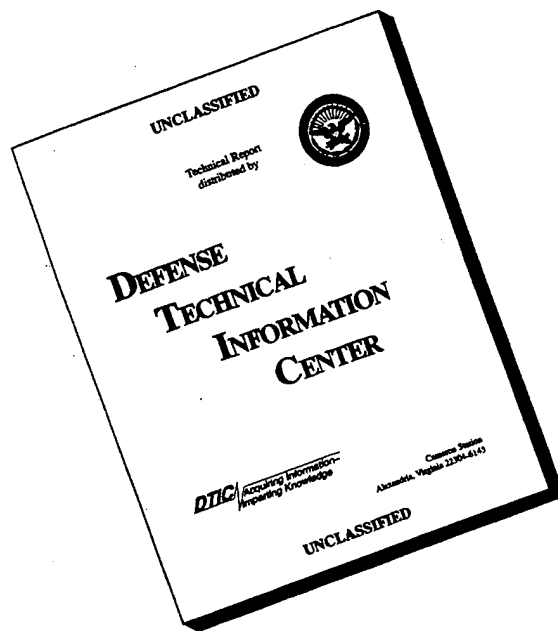
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13. ABSTRACT (Maximum 200 words)
This report is a Final No Further Action Decision Document for Study Area P7, Patrol Road Waste Area at the Fort Devens Sudbury Training Annex located in Sudbury, Massachusetts. This NFADD explains why no further investigation or remediation is required at Area P7. The NFADD provides a review of soil and groundwater investigation results and a comparison of the results to applicable human health and ecological standards.

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GLOSSARY OF ACRONYMS AND ABBREVIATIONS

AMSL	- Above Mean Sea Level
Annex	- Fort Devens Sudbury Training Annex
BGS	- Below Ground Surface
CERCLA	- Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFHA	- Capehart Family Housing Area
CX	- Categorical exclusion
DOD	- U.S. Department of Defense
EM	- Electromagnetics
FEMA	- Federal Emergency Management Agency
FID	- Flame Ionization Detector
IRP	- Installation Restoration Program
MEP	- Master Environmental Plan
NEPA	- National Environmental Policy Act of 1969
NFADD	- No Further Action Decision Document
OHM	- OHM Remediation Services Corp., A Wholly-Owned Subsidiary of OHM Corporation
PA/SI	- Preliminary Assessment/Site Investigation
PCBs	- Polychlorinated Biphenyls
PID	- Photoionization Detector
POL	- Petroleum, Oil, or Lubricants
QM R&E	- Quarter Master Research and Engineering

**GLOSSARY OF ACRONYMS AND ABBREVIATIONS
(CONTINUED)**

RBC	- USEPA Region III Risk-based Concentration
ROTC	- Reserve Officer Training Corps
SARA	- Superfund Amendments and Reauthorization Act of 1986
SI	- Site Investigation
SI/RI	- Site Investigation/Remedial Investigation
SM	- Scanning Magnetometry
SMCLs	- Safe Drinking Water Act National Secondary Drinking Water Standards
TAL	- Target Analyte List
TCL	- Target Compound List
USAF	- U.S. Air Force
USAEC	- U.S. Army Environmental Center
USATHAMA	- U.S. Army Toxic and Hazardous Materials Agency
USEPA	- U.S. Environmental Protection Agency
USGS	- U.S. Geological Survey
µg/g	- Micrograms per gram
µg/l	- Micrograms per liter

EXECUTIVE SUMMARY

Extensive study at Area P7, Patrol Road Waste Area, at the Fort Devens Sudbury Training Annex has resulted in the decision that no further studies or remediation are required at this study area. Area P7 was identified by a Fort Devens memo (May 8, 1990) and through interviews with Natick Laboratories employees as a suspected disposal area.

The Fort Devens Sudbury Training Annex was placed on the National Priorities List under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986 on February 21, 1990. In accordance with these acts and the U.S. Army Installation Restoration Program, a Master Environmental Plan, and a Site Investigation, have been conducted which address Area P7.

Field investigation of P7 was initiated between 1991 & 1992 in conjunction with the Site Investigation/Remedial Investigation of sixty-eight study areas on the Annex. Investigation of Area P7 consisted of an area reconnaissance, a soil gas survey, a geophysical survey, test pit excavation with subsurface soil sampling, monitoring well installation and ground water sampling, and a hydrogeologic assessment. Soil gas survey and test pitting did not detect any evidence of a disposal area. Ground water sampling results also confirm that no chemicals were dumped onto the ground.

All samples collected were analyzed for Target Compound List volatile and semi-volatile organic compounds, pesticides/PCBs, Target Analyte List metals, chlorinated herbicides, and explosives. Cadmium was the only metal identified in the soil that exceeded background concentrations. These concentrations were attributed to analytical problems and are not site related. The only analyte detected at elevated levels in ground water was manganese, which is naturally occurring in the area. Toluene at 2.7 µg/l and an unknown volatile organic compound were detected in one of the three monitoring wells during the final round of sampling (October 1992). This detection was far below the Maximum Contaminant Level (MCL) of 1,000 µg/l for toluene. The three wells were resampled during the Phase II investigation as a confirmatory measure. Toluene and other volatile organic compounds were not detected in the Phase II samples. It was determined that the single low-level detection of toluene was anomalous. The final results support the conclusion that the Phase I ground water samples were exposed to cross contamination.

Based on the preliminary risk evaluation at Area P7, it is concluded that no further investigation or remediation is required at this area.

SECTION 1.0 INTRODUCTION

This decision document has been prepared to support a no further action decision at Study Area P7, Patrol Road Waste Area, at the Fort Devens Sudbury Training Annex in Middlesex County, Massachusetts. The report was prepared as part of the U.S. Department of Defense (DOD) Installation Restoration Program (IRP) to assess the nature and extent of contamination associated with site operations at the Sudbury Training Annex.

On February 21, 1990, the Sudbury Training Annex was placed on the National Priorities List under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA). The U.S. Army Environmental Center (USAEC), formerly the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA), initiated a Master Environmental Plan (MEP) in 1991. Study Area P7 was identified in the MEP as a potential area of concern. In July 1991, DOD, through USAEC, initiated a Site Investigation/Remedial Investigation (SI/RI) for the sixty-eight areas identified by the MEP. The SI/RI was conducted by OHM Remediation Services Corp. (OHM). Study Area P7 was included in the SI/RI.

The activities involved in the OHM investigation qualified for a categorical exclusion (CX) in accordance with National Environmental Policy Act (NEPA), as amended, and did not require prior preparation of an environmental assessment or an environmental impact statement. The investigation qualified for CX following criteria set forth in Appendix A of Army Regulation 200-2.

The Sudbury Training Annex, acquired by the government in the early 1940s during World War II, is located approximately two miles north of the town of Sudbury, Massachusetts. It has historically served as a munitions holding ground, an ordnance test station, a research and development facility, and as a troop training ground. Currently, the facility contains family housing for armed services personnel, a geophysical radar station, and guest houses.

SECTION 2.0 BACKGROUND AND PHYSICAL SETTING

The Sudbury Training Annex is located 20 miles west of Boston, 12 miles northwest of Natick, Massachusetts and 2 miles northwest of the town of Sudbury in Middlesex County, Massachusetts. The installation is located in the Maynard, Massachusetts 7½-minute United States Geological Survey (USGS) quadrangle map. Figure 2-1 presents the site map.

Military operations began at the Annex in 1942, when formal petition was filed by the United States to acquire the land by eminent domain (District Court of United States for District of Massachusetts, Misc. Civil No. 6507, March 25). Transfer of the property (3,100 acres) occurred on November 10, 1942, and initial use of the property, then known as the Maynard Ammunition Depot, was to store ammunition for subsequent shipment to the Port of Boston. The location was selected due to its strategic location (out of range of naval guns) and close proximity to four active railroad lines. Provision of safe storage of ammunition was attained by the construction of 50 earth-covered concrete bunkers located in the center of the Annex. Railroad spurs were developed to provide access between bunkers and the main railroad lines. The railroad spurs were removed in 1966 and no munitions have been stored within the Annex bunkers since 1975.

After World War II, the Maynard Ammunition Depot became known as the Maynard Ordnance Test Station, and in 1957 was acquired by the Quartermaster Research and Engineering (QM R&E) Center to relieve restrictions this command was experiencing at Natick, Massachusetts due to the continuous influx of new projects. The QM R&E used the Annex for testing various materials associated with its mission of research and development in the physical, behavioral, and biological sciences and engineering of clothing and protective equipment. Physical research and development included airdrop techniques, field shelters and equipment, field organization equipment, food, and food service systems. Scientific research and development uses included determination of the stability of various fungicides in materials exposed to outdoor environments, foamed plastics field tests, flame testing of clothing and equipment, toxic fumigant effects on insects, the study of climatic data in support of various test programs, and airdrop testing.

In 1982, custody of the entire Annex was transferred to Fort Devens, which is located 17 miles northwest of Sudbury in the town of Ayer, Massachusetts. The major mission of Fort Devens is to train active duty and reserve personnel, and to support the U.S. Army Security Agency Training Center and School, U.S. Army Reserves, National Guard, ROTC, and Air Defense sites in New England. The Annex presently supports this mission.

2.1 DESCRIPTION AND LAND USE

The 4.3-square-mile Annex is comprised of sections of the towns of Sudbury, Maynard, Hudson, and Stow. The installation is divided into two irregularly shaped parcels by Hudson Road. Approximately 500 acres in the northern parcel of the Annex are leased to the USAF for radar instrumentation. This facility, located near the Assabet River, is supervised by personnel from Bedford Research Laboratories. The Region One Office of FEMA leases approximately 262 acres on the northern parcel, near the East Gate. A relatively flat area on the northern parcel, consisting of approximately 30 acres, is presently used as a drop zone by the Airdrop Engineering Laboratory for testing equipment in actual parachute drops. A number of individual housing units are scattered across the northern parcel of the Annex. In the southern

parcel of the Annex, the Capehart Family Housing Area (CFHA), a military family housing area, occupies approximately 18 acres and includes a small recreational area for children.

The installation is also used by a number of local groups, including Army Reserve units, the National Guard, the Massachusetts State Police, and permitted recreational users. Because of its easy accessibility, the site is also used by unauthorized persons.

2.2 CLIMATE

Site-specific meteorological data are recorded at the USAF radar installation and at the Natick Weather Station on the southern parcel of the installation. A review of meteorological data indicates moderately cold, moist winters and warm, moist summers. July is recorded as the warmest month with a mean temperature of 22.2 degrees Celsius (72 degrees Fahrenheit). Temperatures at or above 27 degrees Celsius (81 degrees Fahrenheit) generally occur between the months of June, July, and August, with the possibility of temperatures dropping below freezing during the months of December through March. Late summer to early fall months bring the possibility of hurricane-influenced weather patterns.

Annual precipitation is moderately abundant with an annual mean of 121 centimeters (44 inches) per year. Winter precipitation is usually in the form of snow with occasional ice storms. Precipitation is, for the most part, distributed evenly throughout the year. The driest months are July and October with mean precipitation of 8½ centimeters (3.3 inches), and the wettest months are March and November with mean precipitation of 12 centimeters (4.7 inches).

Summer precipitation is usually confined to short duration, high intensity thunderstorms (frontal and convective). Winds are light to moderate throughout the year.

2.3 REGIONAL GEOLOGY AND HYDROGEOLOGY

2.3.1 Topography

The installation lies near the western boundary of the Seaboard Lowland Section of the New England-Maritime Physiographic Province. Elevations range from 321 feet above mean sea level (AMSL) along the northern boundary of the installation to 170 feet AMSL in Marlboro Brook on the southern parcel of the installation. The topography at the Annex is dominated by broad flat plains with elevations between 190 and 200 feet AMSL. Hills are scattered throughout the Annex, with most lying in an arc along the northern boundary and concentrated in the central section of the northern parcel. Topographic trends are generally north to south. A previous investigation classified the topographic features as follows: 81 percent lowlands, 16 percent hills, and 3 percent water bodies (USATHAMA, 1980).

2.3.2 Bedrock Geology

The Annex is underlain by igneous and metamorphic rocks of Pre-Cambrian(?) and Paleozoic Age. Six formations underlie the site as part of a tightly-folded, northeast-plunging asymmetrical anticline with a northeast-southwest strike. The Marlboro Formation, a fine-grained amphibolite schist (Pre-Cambrian?) is exposed on the Annex in a band extending from Vose Hill to White Pond. Two formations cross the southeast corner of the Annex: the Salem(?) gabbrodiorite and a quartz diorite facies of the Dedham granodiorite. Both formations are presumably of Devonian age. The Nashoba Formation (Carboniferous),

a light gray biotite gneiss, runs along the northern boundary of the site and underlies the extreme northwest corner of the Annex. Central and northern portions of the Annex are underlain by the Gospel Hill gneiss (Carboniferous). The Gospel Hill is a medium- to coarse-textured granite gneiss and is probably a granitized product of the Nashoba and Marlboro formations. Small bodies of the Assabet quartz diorite (Late Paleozoic?) crop out in northern portions of the site.

Bedrock across the site is closely folded with steep dips. Joints are common in the bedrock outcrops and are mostly vertical or nearly vertical. Joints at the surface were found to have a general northwestward trend. The occurrence and vertical orientation of the joints was confirmed at depth in the pilot hole near the northern boundary of the installation. All bedrock formations are dense and hard. No surface or subsurface indications of major faults were noted in the bedrock.

With the exception of widely-scattered outcrops, bedrock is covered by glacial deposits ranging in thickness from a veneer up to 120 feet. Field examination of the few outcrop locations and the results of the subsurface investigation indicated the bedrock surface to be highly irregular. Previous studies have indicated the existence of a buried bedrock valley beneath the southern parcel of the Annex and other abandoned stream channels in the area (Barnes, 1956).

2.3.3 Surface Geology

The surficial geology at the Annex is dominated by two glacial deposits: glacial till and outwash. Deposits of Recent age include alluvium and organic silt and peat.

Glacial till was deposited by the glacial ice sheet and rests directly on bedrock. When exposed at the surface, till forms both ground moraine and drumlins. As ground moraine, the till creates an irregular blanket on the bedrock surface. Tuttle Hill has been classified as ground moraine (Hansen, 1956). Till also forms drumlins, which are scattered across the Annex (Vose Hill, Hill 321, and Hill 235), and whose long axes have a crude northwesterly alignment.

Glacial till at the Annex is a compact, poorly sorted mixture of soil with grain sizes ranging from clay to boulders. Due to its compactness and poor sorting, till has a low permeability which retards the movement of ground water. At some locations at the Annex, however, the till was found to contain heavily oxidized fissures which greatly increased the flow of ground water.

Over most of the Annex, the glacial till is overlain by glacial outwash. The glacial outwash forms broad plains of well-stratified sand and gravel locally trenched by streams and pitted by shallow depressions containing lakes or swamps. Disregarding the soil zone and thin deposits of Recent age, the outwash is the uppermost deposit across nearly the entire installation.

The glacial outwash plains are of two major types: proglacial deposits and ice-contact deposits. Proglacial deposits were laid down by melt-water streams issuing from the ice margin. These deposits are fine to coarse textured and well stratified. Beneath this upper deposit is a lower zone composed chiefly of beds of gray, very fine sand and silt representing lake-bottom deposits. This lithologic sequence was encountered in the deep boring along White Pond Road, near Patrol Road. Ice-contact deposits on the Annex were laid down against the ice or in holes within the ice, forming roughly circular hills called kames. The stratification of the deposits ranges from poor to good, and the grains range in size from clay

to cobble. Examples of ice-contact deposits can be found near the northern and eastern boundaries of the Annex, where groups of kames have been closely spaced and form kame fields.

Recent deposits are relatively thin and restricted in distribution. They consist of alluvium composed of reworked outwash sand and gravel deposited along stream channels, of gray organic silt and peat deposited on lake bottoms and in swamps, and of loess-like deposits of uniform brown fine sand. The peat and organic silt locally retard the movement of water into or out of the outwash.

2.3.4 Soils

Generalized stratigraphic units prevalent across the site are soil, outwash, till, and bedrock. Weathering of the glacial deposits and the bedrock could have produced the existing soil, while in certain areas, erosion may have removed this soil. Surface soils developed on the kame landforms, the outwash plain, and the alluvium are sandy loam with lenses of gravel. Soils in the lowland swamps and bogs are composed of muck and peat. Soils developed on ground moraines and drumlins are stony loam.

2.3.5 Drainage

Glaciation has profoundly affected surface drainage at the site. Accumulation of glacial debris within the preglacial stream valleys has not only caused streams to alter their course, but in some places disrupted drainage entirely. Drainage on the Annex as a whole is poorly integrated as indicated by the numerous swamps, ponds, and small water holes. Previous geologic investigations have determined that the Assabet River once flowed across the Annex in a southeast trend from Boons Pond, beneath the southern shore of White Pond, and then curving to the northeast towards Hudson Road (Hansen, 1953). The cut of this earlier channel has been located at depths between 80 and 120 feet below ground level through seismic and test drilling surveys (Barnes, 1956; Perlmutter, 1962).

The northern parcel of the Annex lies within the drainage basin of the Assabet River, which flows along the northwestern perimeter of the installation. Taylor Brook, flowing north to the river, is the largest stream draining the area. Honey Brook, Taylor Brooks' major tributary, flows northeastward in a man-made channel along a bunker access path. The southern parcel of the Annex is within the drainage basin of the Sudbury River. The largest stream in the area, Marlboro Brook, flows southeastward from the former railroad classification yard towards the installation boundary.

2.3.6 Hydrogeology

The overburden water-bearing zone is a glacial deposit, consisting of glacial outwash, glacial till, and glacial moraine deposits. The glacial outwash is the most permeable zone and consists of stratified silt, sands and gravel. Ground water flow conditions within the outwash are controlled by changes in the surficial geology, the areal extent of the outwash, and by the less-permeable boundary conditions created by glacial till and bedrock. The glacial till is a dense, poorly sorted mixture of clay, silt, sand, gravel, and boulders. The till has a low hydraulic conductivity and does not provide an appreciable source of water (less than 10 gpm).

Bedrock is hydraulically connected with the overburden. Due to the composition of the bedrock and the slight fracturing observed in the rock cores, the bedrock water-bearing zone may have a very low primary and secondary porosity. This hypothesis is supported by previous studies (Perlmutter, 1962), and by the

low hydraulic conductivity values (2×10^{-5} ft/min) found during the OHM investigation. Although the bedrock does transmit water, the configuration and depth of the bedrock surface have greater influence of the ground water flow regime than does its water-yielding characteristics.

Depth to ground water is relatively shallow, ranging from flowing artesian conditions to 15 feet below ground surface (BGS). On topographic highs, the water table has been measured at depths to 30 feet BGS. The ground water elevation, hydraulic gradient, and flow direction roughly mimic ground surface topography and drainage.

The hydraulic conductivity of the overburden unit varies greatly across the Annex. The portions of the site with the highest permeability were near the southwestern boundary of the installation, and at the western side of the site, near Patrol Road and White Pond Road. The region with the lowest permeability was the eastern portion of the site, and the study areas around Puffer Pond. The highest hydraulic conductivity reported in the literature was from a location in a buried river valley beneath the southern parcel of the installation.

A pumping test was conducted on the abandoned Maynard water supply well installed within the buried valley (Perlmutter, 1962). The pumping test determined the overburden formation to have a hydraulic conductivity of 800 gpd/ft² (8×10^{-2} ft/min), with a storage coefficient of 0.20. Slug tests conducted during the OHM investigation in this vicinity produced results similar to those of the pumping test (2×10^{-2} ft/min).

In locations where the outwash is thick and permeable, the unit can yield approximately 100 gallons per minute. Results of a pump test performed in the 1970s on Maynard Town Well No. 3 reported well yields of 700 gpm.

2.4 STUDY AREA DESCRIPTION AND HISTORY

Area P7, Patrol Road Waste Area, was identified by a Fort Devens memo (May 8, 1990). Based on interviews with employees of Natick Laboratories, this area has been identified as a possible miscellaneous waste chemical disposal area.

Aerial photographs indicate that the area was active in the 1940s and 1950s, and roads were observed leading into the area. The area is mostly overgrown with two cleared sandy areas at either end. A surface water drainage divide is located near the area. Surface water southwest of Patrol Road drains toward Boons Pond and White Pond; surface water northwest of Patrol Road drains toward Taylor Brook.

2.5 RELATED INVESTIGATIONS

In 1978, the DOD established the IRP. Under the IRP, the DOD sought to identify, investigate, and clean up contamination from hazardous substances at federal facilities. Environmental investigations were started at the Annex in 1980 under the IRP in order to address the environmental impact of past land usage.

To date, the following organizations have conducted investigations at the Annex funded under the IRP:

- USAEC in 1980
- United States Army Environmental Hygiene Agency in 1983

- Dames & Moore of Bethesda, Maryland in 1986 and 1991
- OHM, Final Master Environmental Plan in 1992
- OHM, Site Investigation/Remedial Investigations in 1993.

A number of other investigations have been performed at the Annex. NUS Corporation (1985/1987), as a contractor to USEPA, conducted a preliminary assessment/site investigation (PA/SI) at the site in fulfillment of the requirements of CERCLA. SEA Consultants, Inc. (1991) conducted an environmental assessment/ environmental impact study for the Massachusetts Air National Guard at the western boundary of the Annex. GZA Geoenvironmental (1991) conducted a site investigation near the eastern boundary of the Annex, as a contractor to the U.S. Army Corps of Engineers, under the Defense Environmental Restoration Program.

The Site Investigation/Remedial Investigation Report (OHM, 1993) presents a summary of the investigations conducted by each of the above organizations. The following sections present a summary of the investigations conducted in Study Area P7.

2.5.1 Facility Investigation

A facility investigation was performed by Dames & Moore in 1984. The investigation was conducted to identify the potential for contaminant migration off site and included the collection of one surface water sample near Area P7. Results of the Dames & Moore sampling are summarized in Section 4.0.

2.5.2 Master Environmental Plan

The MEP was initiated in 1991 as a part of the IRP action at the Annex. The MEP was completed by OHM in 1992, under contract to USAEC, and listed 68 study areas. The Patrol Road Waste Area was designated as Study Area P7.

The study conducted under the MEP consisted primarily of a review of existing studies and identification of potential environmentally significant areas. Area P7 was designated as a possible source for release of contaminants into the environment and the MEP recommended that a site investigation be performed.

2.5.3 Site Investigation

A site investigation (SI) was performed at Area P7 by OHM under contract to USAEC. The SI of the area was initiated in 1991 and was completed in 1992. The purpose of the investigation was to identify contamination that may have resulted from use of the area as a waste chemical disposal area, and to determine the nature and extent of related contamination. The technical approach and the results of the SI at this study area are presented in Section 4.0 of this report.

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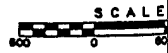
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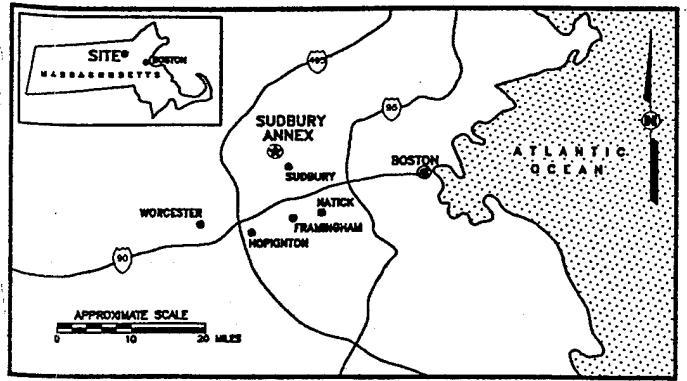
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1. TOPOGRAPHIC MAPPING INITIALLY DEVELOPED BY BIONETICS CORPORATION FROM APRIL 1992 AERIAL PHOTOGRAPHY WITH REVISIONS AND FINALIZATION CONDUCTED BY OHM CORPORATION.
2. GROUND CONTROL FOR AERIAL MAPPING ESTABLISHED BY T. F. MORAN.

PLAT SCALE: 1" = 800'



2



KEY MAP

LEGEND:

- BUILDING/STRUCTURE
- ROAD (SURFACED)
- - - ROAD (UNIMPROVED OR TRAIL)
- + + + + RAILROAD
- FENCE
- - - - - INSTALLATION BOUNDARY
- CONTOUR (5' INTERVAL)
- ▲ SWAMP

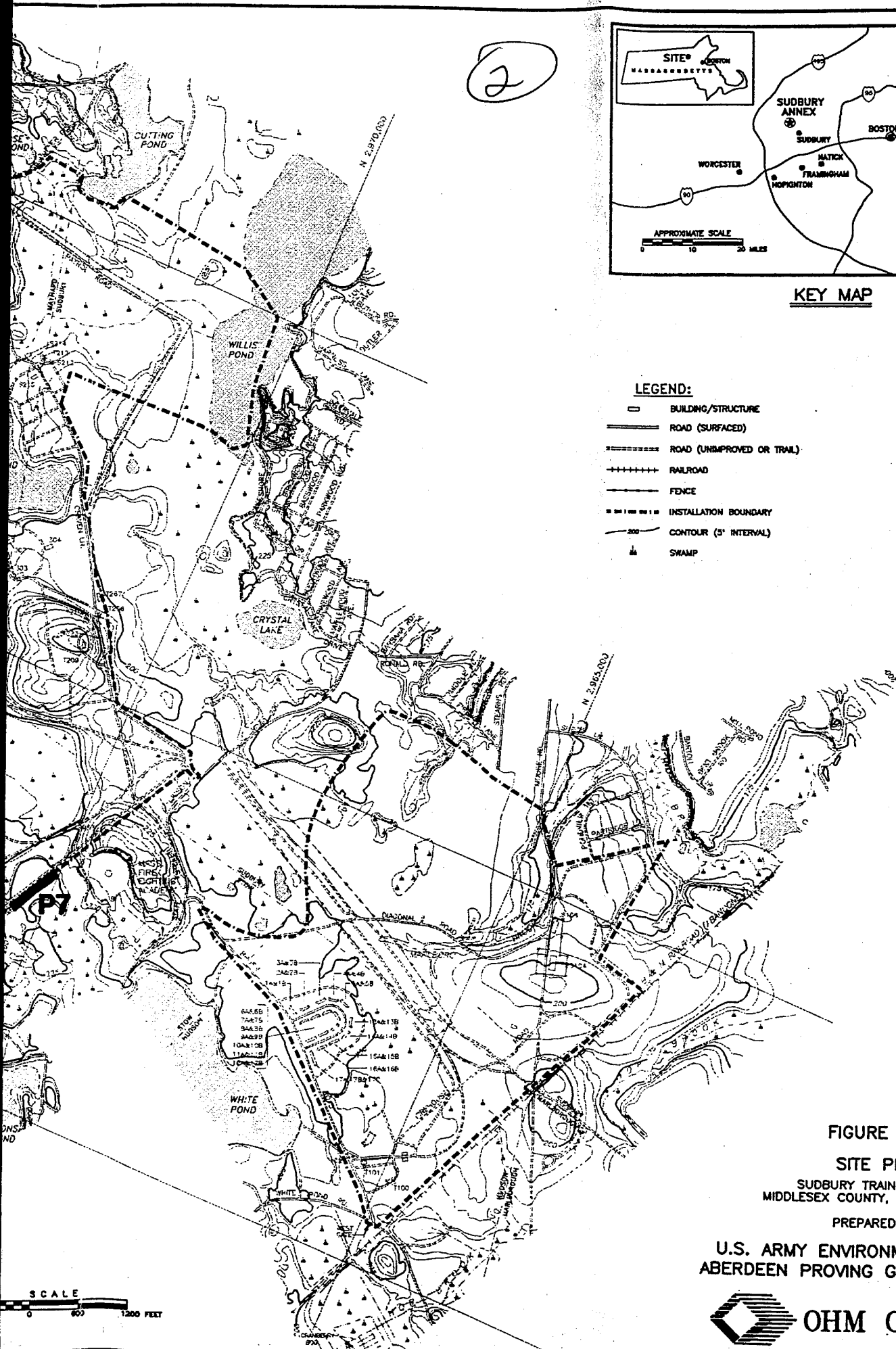



FIGURE 2-1

SITE PLAN

SUDBURY TRAINING ANNEX
MIDDLESEX COUNTY, MASSACHUSETTS

PREPARED FOR

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

 OHM Corporation

SECTION 3.0 AREA-SPECIFIC CHARACTERISTICS

Area P7 is located one-half mile northwest of the Guard Shack on Patrol Road, on the southern side of the installation fence. The area is no longer considered part of the Annex. Figure 3-1 presents a map of the area. The surficial geology of Area P7 has been classified as kame and kame field (Hansen, 1956).

Aerial photographs indicate that the area was active in the 1940s and 1950s. Roads were observed leading into the area. The area is mostly overgrown with two cleared sandy areas at either end of the site. A surface water drainage divide is located near the area and follows the general alignment of Patrol Road. Ground water flow, as determined by the site investigation, is to the south. Aquifer testing in Area P7 yielded a hydraulic conductivity of 40 ft/day, a flow velocity of 0.4 ft/day and a transmissivity of 1000 ft/day. The average aquifer thickness is assumed to be 25 feet.

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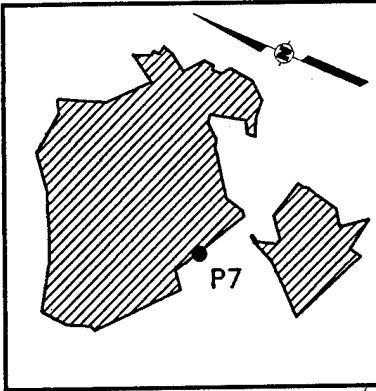
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PLOT SCALE: 1" = 150'



KEY MAP

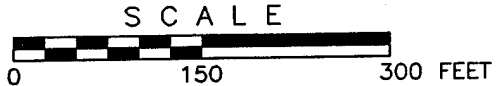
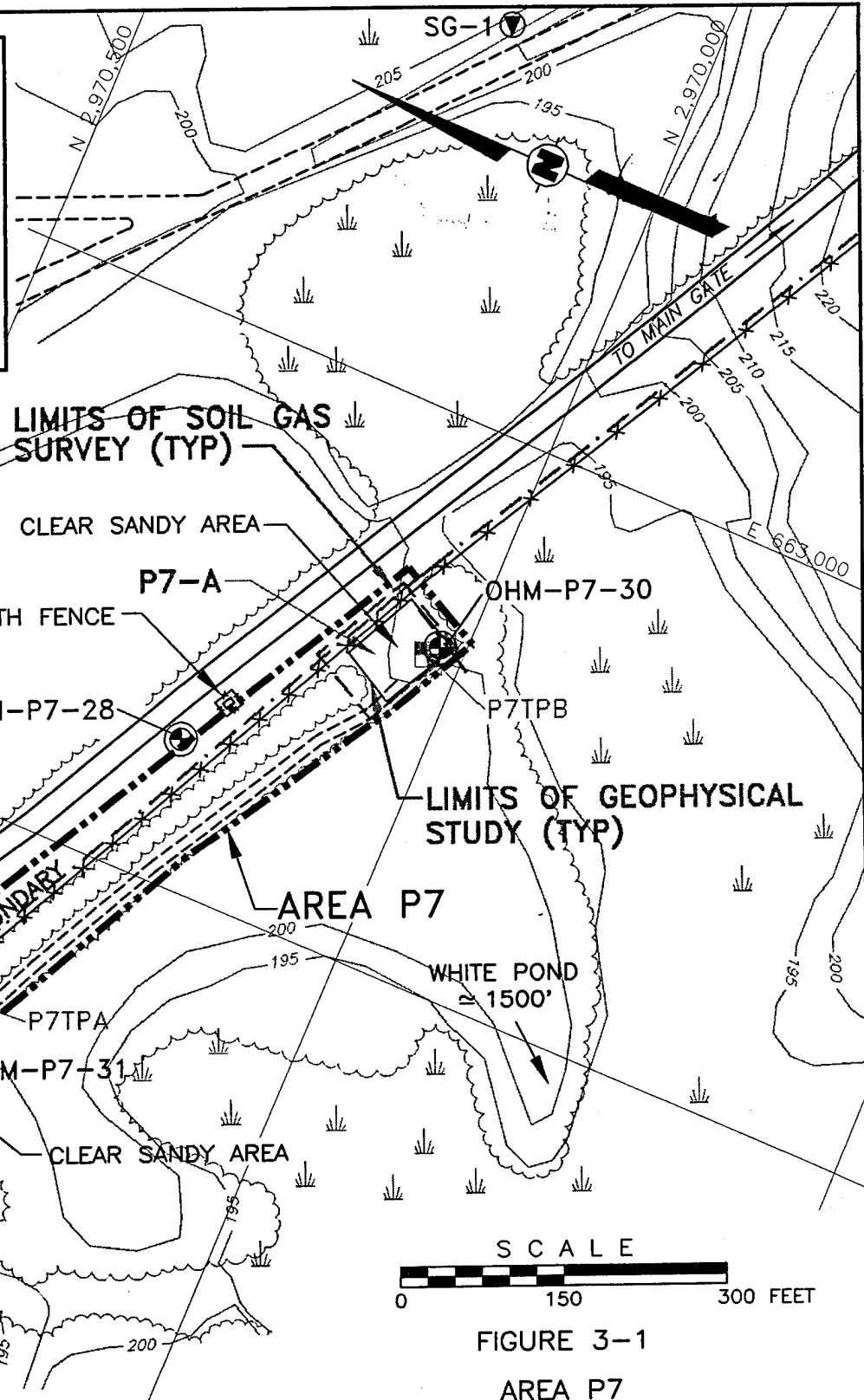
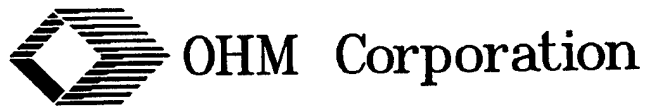


FIGURE 3-1

AREA P7
SITE MAP AND SAMPLE LOCATIONS:
SUDBURY TRAINING ANNEX
MIDDLESEX COUNTY, MASSACHUSETTS

PREPARED FOR

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



- LEGEND:**
- PAVED ROAD
 - UNPAVED ROAD
 - FENCE
 - SWAMP
 - TREELINE
 - STAFF GAGE
 - MONITORING WELL
 - TESTPIT LOCATION
 - STREAM

SECTION 4.0 CONTAMINATION ASSESSMENT

In 1984, Dames & Moore collected one surface water sample (SW9) near Area P7 as part of the Area A5 investigation and analyzed the sample for VOCs only. Methylene chloride was the only exceedance of drinking water standards and was attributed to laboratory interference. Unknown VOCs were also detected at elevated concentrations and were believed to be introduced by either traffic along Patrol Road, or by laboratory handling procedures.

A site investigation of Area P7 was performed by OHM between 1991 and 1992. The investigation consisted of a soil gas survey, a geophysical study, test pit excavations with subsurface soil sampling, monitoring well installation with soil and ground water sampling, and a hydrogeological assessment. A map of the area presenting all sample locations, the soil gas survey, and the geophysical survey is presented on Figure 3-1.

The soil gas survey was conducted by Target Environmental Services in August 1991. Soil gas was sampled and analyzed from 34 locations along a 25-foot grid. Results of the survey are presented on Figure 4-1. Chlorinated hydrocarbons or BTEX constituents were not detected. Total FID volatiles were detected at nine locations. These samples, located adjacent to trees, are believed to represent naturally-occurring terpenes. Total FID volatiles were not detected in the unvegetated sandy areas.

Electromagnetic and scanning magnetometry studies were conducted by Neponset Geophysical Corporation in July 1991 to detect buried waste. Geophysical study area P7-A and P7-B are depicted on Figure 3-1. Three-hundred and fifty nine EM data points and three-hundred and sixty magnetics data points were collected on a 5-foot grid. No geophysical anomalies were detected.

4.1 SOILS

Two test pits were excavated during November 1991. Test pit P7TPA and P7TPB were excavated to a depth of six feet below ground surface (BGS). Ground water was encountered at 5 1/2 feet during the P7TPB excavation. No buried material was uncovered, no contamination was observed and there were no PID or radiological survey readings above background. Three grab soil samples were collected at 2, 4 and 6 feet BGS from each test pit. The samples were analyzed for volatile organic compounds, with one composite sample from each test pit analyzed for all remaining parameters. No contaminants were identified in these soil samples. Sample locations for all soil samples are shown in Figure 3-1.

All samples, except the test pit grab samples for VOCs only, were analyzed for TCL volatile and semivolatile organic compounds, TCL pesticides/PCBs, TAL metals, chlorinated herbicides, and explosives. The positive detections are shown in Table 4-1. Metals identified in the soil were all within the range of background concentrations, with the exception of cadmium. The reported results for cadmium in both test pit samples were approximately ten times background (1 µg/g or less). The high values are believed to be caused by analytical problems and are not site related. Nearly all samples from the remaining analytical lots had cadmium concentrations at background levels (1 µg/g or less). The first six lots, including the P7 test pit samples, were rerun outside the holding times. Metals other than cadmium were found at concentrations similar to the initial runs, indicating that holding time exceedance had little effect. Similar concentrations decreased by factors of five to ten, indicating that analytical problems were

present in the initial runs. The problem was an inaccurate interelement correction related to interference effects of iron on cadmium. The rerun results could not be substituted for the initial results because USAEC policy does not permit substitution of data obtained outside of holding times. Consequently, the initial results are reported.

4.2 GROUND WATER

Three shallow monitoring wells were installed during March 1992. Well OHM-P7-28 is located between Area P7 and Patrol Road. Well OHM-P7-30 is located in the southeast corner of the area. Both of these wells were installed to a depth of 17 feet. Well OHM-P7-31, located in the northwestern portion of the area, was installed to a depth of 15 feet. Each well boring encountered sand with trace gravel. Subsurface soil sample P7SB28A, P7SB30A and P7SB31A was collected from 4 to 8 ft., 4 to 6 ft. and 4 to 6 ft. BGS, respectively, and analyzed. PID or radiological readings did not exceed background levels during the installation of the wells or during sampling.

Ground water samples were collected from the three wells in June and October 1992 to characterize the quality of the ground water in the area. All wells were purged and sampled using standard sampling procedures. Ground water samples P7GW28A and P7GW28B were obtained from monitoring well OHM-P7-28 in June and October, respectively. Ground water samples P7GW30A and P7GW30B were obtained from monitoring well OHM-P7-30 in June and October, respectively. Ground water samples P7GW31A and P7GW31B were obtained from monitoring well OHM-P7-31 in June and October, respectively.

All samples were analyzed for TCL volatile and semi-volatile organic compounds, TCL pesticides/PCBs, TAL Metals, chlorinated herbicides, and explosives. A summary of positive detections is presented in Table 4-2. In addition, TOC analysis was performed on a sample from the screened interval for each monitoring well boring. The only analyte detected at elevated levels in ground water was manganese, which is naturally occurring in the area. Toluene at 2.7 µg/l and an unknown VOC was found in the October ground water sample from well OHM-P7-31. The unknown VOC was believed to be hexane, a common laboratory solvent, but could not be positively identified.

The three wells in Area P7 were resampled during the Phase II investigation to confirm the presence of toluene. A summary of positive detections is presented in Table 4-3. VOCs were not detected in any of the Phase II samples. It was determined that the single low-level detection of toluene during the Phase I sampling was anomalous, and due to possible laboratory contamination.

Table 4-1
Area P7
Summary of Positive Detections
Soil (µg/g)

Site ID	OHM-P7-28	OHM-P7-30	OHM-P7-30	OHM-P7-31	P7TPA	P7TPB
Field Sample Number	P7SB28A	DUPSB02A	P7SB30A	P7SB31A	P7TPA1	P7TPB1
Sample Date	23-Mar-92	20-Mar-92	20-Mar-92	20-Mar-92	10-Dec-91	10-Dec-91
Depth (ft)	4.0	4.0	4.0	4.0	2.0	2.0
<u>BNAs</u>						
Di-N-butyl phthalate	0.47	0.59	0.69	0.32	0.42	0.36
UNK 511	ND	7	7	6	ND	ND
UNK 634	1	ND	ND	ND	ND	ND
UNK 640	1	ND	ND	ND	ND	ND
UNK 654	3	2	2	1	ND	2
UNK 655	2	ND	ND	ND	ND	ND
UNK 663	ND	2	2	1	ND	ND
UNK 664	1	ND	ND	ND	ND	ND
UNK 667	2	ND	ND	ND	ND	ND
<u>Volatile Organics</u>						
Acetone	ND	0.023	0.023	ND	ND	ND
UNK021	ND	0.024	0.036	ND	ND	ND
UNK152	ND	0.012	0.012	0.01	ND	ND
<u>Organic Carbon</u>						
Total Organic Carbon	343	369	369	373	NA	NA
<u>Metals</u>						
Aluminum	3700	4900	3600	4300	3300	3000
Arsenic	6.1	6.2	7.9	11	6.29	3.77
Barium	ND	12.6	ND	ND	ND	ND
Cadmium	ND	ND	ND	ND	7.62	5.79
Calcium	ND	ND	ND	441	406	ND
Chromium	6.27	12	6.17	7.73	7.45	6.1
Cobalt	ND	3.73	ND	3.89	ND	ND
Copper	2.95	6.92	4.99	5.63	5.63	6.57

Table 4-1 (Cont.)
Area P7

Summary of Positive Detections
Soil (µg/g)

Site ID	Field Sample Number	Sample Date	Depth (ft)	OHM-P7-30 DUPS02A 20-Mar-92 4.0	OHM-P7-30 P7SB30A 20-Mar-92 4.0	OHM-P7-31 P7SB31A 20-Mar-92 4.0	P7TPA P7TPA1 10-Dec-91 2.0	P7TPB P7TPB1 10-Dec-91 2.0
			5500	8600	6000	7100	6200	4800
			3	5.3	3.21	4.2	2.68	2.51
			1240	2090	1250	1700	1210	902
			94	260	180	190	120	93.1
			6.75	10.5	7.25	8.24	6.69	6.04
			522	894	538	736	593	478
			5.39	9.27	5.4	6.84	6.49	5.04
			12	18.5	13.4	15	12.9	12.3

Metals

Iron
Lead
Magnesium
Manganese
Nickel
Potassium
Vanadium
Zinc

Table 4-2
Area P7
Summary of Positive Detections
Ground Water ($\mu\text{g/l}$)

Site ID	OHM-P7-28	OHM-P7-28	OHM-P7-30	OHM-P7-30	OHM-P7-30	OHM-P7-31	OHM-P7-31
Field Sample Number	P7GW28A	P7GW28B	P7GW30A	P7GW30B	P7GW31A	P7GW31B	
Sample Date	18-Jun-92	26-Oct-92	18-Jun-92	26-Oct-92	18-Jun-92	26-Oct-92	
Depth (ft)	0.0	0.0	0.0	0.0	0.0	0.0	
BNAs	B	10	B	10	B	10	ND
UNK545							ND
Volatile Organics							
Toluene	ND	ND	ND	ND	ND	ND	2.6
UNK010	ND	ND	ND	ND	ND	ND	ND
UNK149	ND	ND	ND	B	8	ND	ND
UNK150	ND	ND	ND	ND	ND	ND	3
Metals							
Aluminum	286	340	383	460	390	321	
Lead	3.04	1.56	ND	1.56	ND	2.75	
Manganese	103	205	98	103	78	70.5	
Potassium	2120	ND	ND	ND	ND	ND	ND
Sodium	6900	5030	4020	6910	4580	3900	
Zinc	41.5	16.8	20.8	14.3	13.3	22.3	

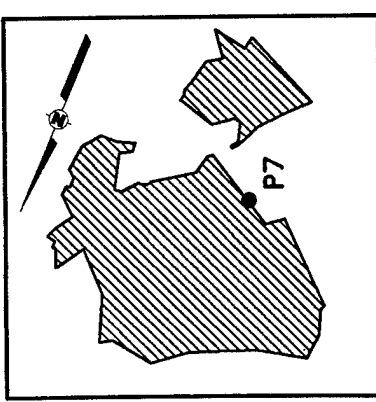
Table 4-3
Area P7
Summary of Positive Detections
Phase II Ground Water (ug/L)

Site ID	OHM-P7-28	OHM-P7-28	OHM-P7-28	OHM-P7-30	OHM-P7-30	OHM-P7-30	OHM-P7-30	OHM-P7-31	OHM-P7-31	OHM-P7-31	OHM-P7-31	OHM-P7-31
Field Sample Number	P7GW28A	P7GW28B	P7GW28C	P7GW30A	P7GW30B	P7GW30C	P7GW31A	P7GW31B	P7GW31C	P7GW31A	P7GW31B	P7GW31C
Sample Date	18-Jun-92	26-Oct-92	02-Dec-93	18-Jun-92	26-Oct-92	02-Dec-93	18-Jun-92	26-Oct-92	09-Dec-93	18-Jun-92	26-Oct-92	09-Dec-93
Filtered/Unfiltered Metals	Filtered	Filtered	Not Applicable	Filtered	Filtered	Not Applicable	Filtered	Filtered	Not Applicable	Filtered	Filtered	Not Applicable
VOCs												
Toluene	--	--	--	--	--	--	--	--	--	--	2.6	--
Pesticides/PCBs												
ppDDT	0.0547	--	*	--	--	*	--	--	*	--	--	*
Metals												
Aluminum	266	340	*	383	460	*	390	321	*	390	321	*
Lead	3.04	1.56	*	--	1.56	*	--	2.75	*	--	2.75	*
Manganese	103	205	*	98	103	*	78	70.5	*	78	70.5	*
Potassium	2120	--	*	--	--	*	--	--	*	--	--	*
Sodium	6900	5030	*	4020	6900	*	4580	3900	*	4580	3900	*
Zinc	41.5	16.6	*	20.8	14.3	*	13.3	22.3	*	13.3	22.3	*

-- = Tested for but not detected
* = Not Analyzed for this compound

OHM CORPORATION PITTSBURGH, PA
 DRAWN BY B.O'Connor 6-7-93
 CHECKED BY
 APPROVED BY
 DRAWING NUMBER 14316-A77

PLOT SCALE: 1" = 1'



KEY MAP

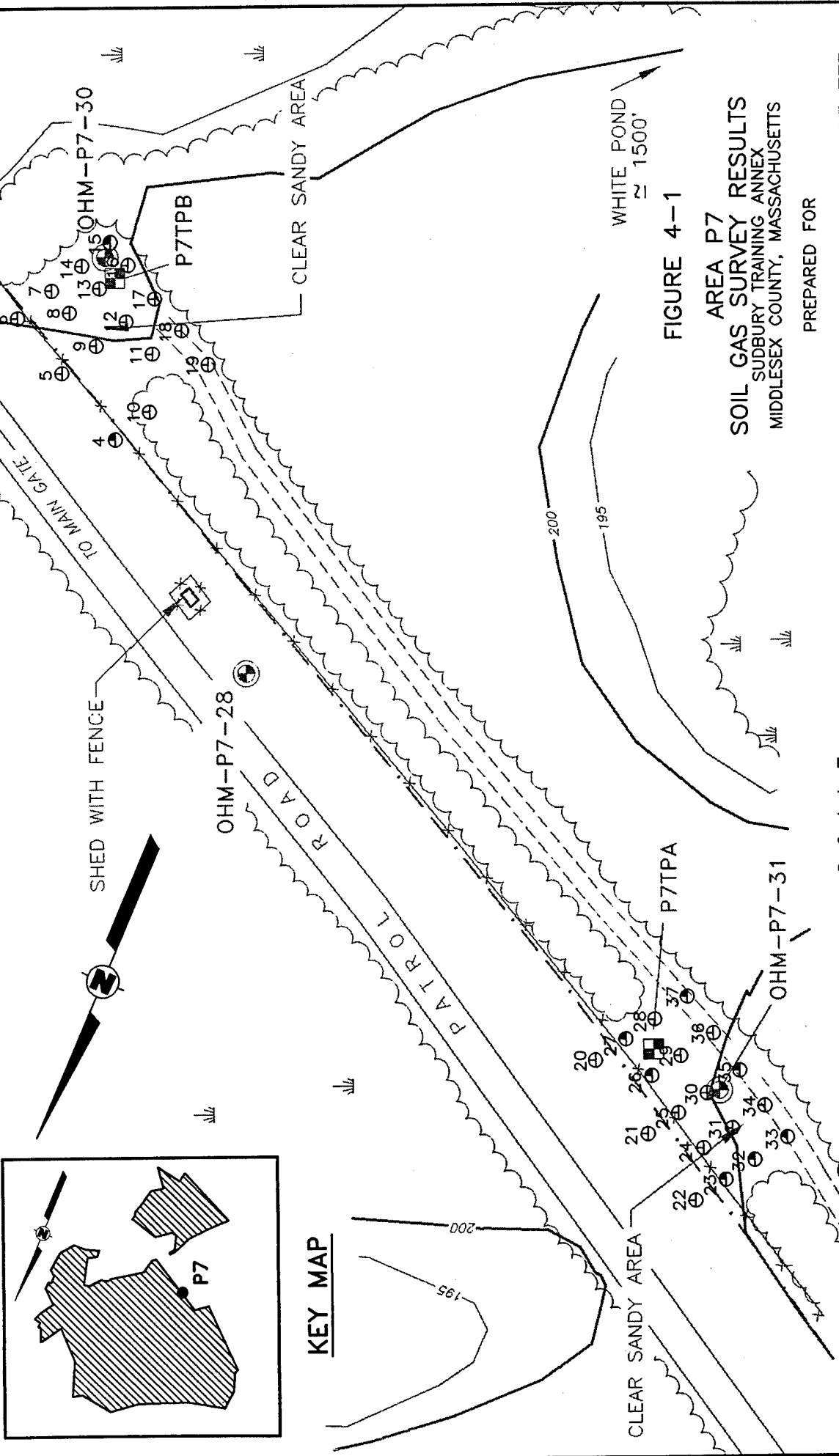
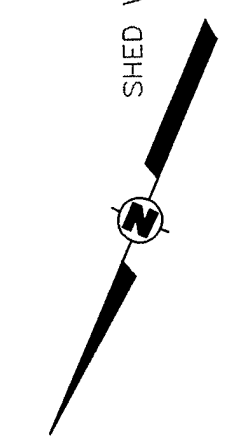
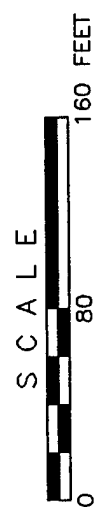


FIGURE 4-1

AREA P7
 SOIL GAS SURVEY RESULTS
 SUDBURY TRAINING ANNEX
 MIDDLESEX COUNTY, MASSACHUSETTS

PREPARED FOR

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



NOTE:

1. FOR GENERAL NOTES AND LEGEND, SEE FIGURE 3-1.

LEGEND:
 BTEX
 TOTAL FID VOLATILES
 GC/ECD ANALYTE
 (SAMPLE NUMBER) 6

NOTE: SHADED AREA ON SAMPLE LOCATION MARKER DENOTES A DETECTION.



OHM Corporation

**SECTION 5.0
PRELIMINARY RISK EVALUATION**

Human Health

For the human health preliminary risk evaluation, the ground water samples were compared the Maximum Contaminant Levels (MCLs) and Secondary Maximum Contaminant Levels (SMCLs). With a detection of 2.6 µg/l, toluene does not pose a risk since it is well below its MCL of 1000 µg/l. Both aluminum and manganese exceeded their SMCL of 50 µg/l in all samples. Aluminum detections ranged from 286 to 460 µg/l, and manganese from 70.5 to 205 µg/l. Although aluminum and manganese exceeded their SMCLs, they do not pose a risk since SMCLs are not health-based standards and are based only on aesthetics and taste.

Ecological

No ecological risk evaluation could be made because all soil samples were taken two feet or greater below ground surface and no potential exposure pathway for any ecological receptor exists.

SECTION 6.0 CONCLUSION

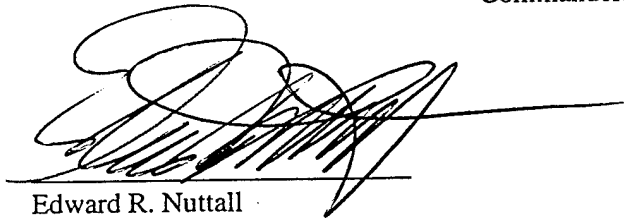
Based on the preliminary risk evaluation of Study Area P7 (Patrol Road Waste Area), it is concluded that no further investigation or remediation is required at this study area. Investigation and sampling confirms that the area was not used for disposal. A volatile organic compound, toluene, was detected below its ground water standard.

The decision of no further action is protective of human health and the environment due to the fact that no evidence of possible contamination was identified in the area.

SECTION 7.0
DECISION

On the basis of study at Area P7, Patrol Road Waste Area, there is no reason or evidence to conclude that activities at this location have caused significant environmental contamination or pose a threat to human health or the environment. The decision has been made to remove Area P7 from further consideration in the Installation Restoration Program and the Comprehensive Environmental Response, Compensation, and Liability Act, as amended.

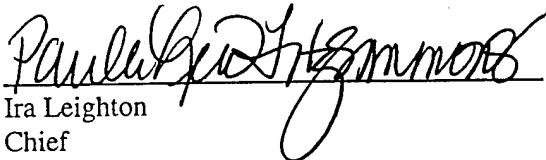
Commander, Fort Devens



Edward R. Nuttall
Colonel, U.S. Army
Commanding

31 Aug 95
Date

U.S. Environmental Protection Agency
Region I, Federal Facilities Office



Ira Leighton
Chief
Superfund II Branch

11/14/95
Date

Concur

Non-concur (please provide reasons)

APPENDIX A

SECTION 8.0 REFERENCES

- Barnes, D.F., 1956, "Seismic Surveys of Maynard Ordnance Test Station, Maynard, Massachusetts," USGS, Open-File Report.
- Dames & Moore, November 26, 1986, "Remedial Investigation Report", Contract No. DAAK11-84-D-0002, submitted to USATHAMA, Aberdeen Proving Ground, Maryland.
- Fort Devens, May 8, 1990, "Additional Installation Restoration Program (IRP) Sites for Investigation at Sudbury Training Annex, Sudbury, Massachusetts," Memorandum for: Commander, USATHAMA.
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- Hansen, W. R., 1956, "Geology and Mineral Resources of the Hudson and Maynard Quadrangles, Massachusetts," USGS, Geological Survey Bulletin 1038.
- Interview, 1991, "Notes On Interview Between, and Site Visit With Dr. Murray Hamlet of ARIEM and USTHAMA/OHM."
- OHM Corporation, January 1992, "Final Master Environmental Plan for the Fort Devens Sudbury Training Annex, Middlesex County, Massachusetts."
- OHM Corporation, July 1993, "Draft Final Site Investigation/Remedial Investigation Report for the Fort Devens Sudbury Training Annex, Middlesex County, Massachusetts."
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OHM Corporation

VISUAL CLASSIFICATION OF SOILS

Project Number 9768
 Project Name USAEC-Sudbury Annex
 Boring Number OHM-P7-28

Elevation 202 Feet MSL Location N2,970.209 E662,631 Page 1 of 1
 Engineer/Geologist D. Demers Date March 23, 1992
 Drilling Co. Soil Exploration Date Started Mar. 23, 1992
 Driller M. Camacho Date Completed Mar. 23, 1992
 Drilling Method 6-1/4" ID Hollow-stem Auger Date Backfilled N/A

DEPTH (FEET)	SAMPLE NUMBER	BLOWS ON SAMPLER PER 6 INCHES	RECOVERY (INCHES)	DESCRIPTION	U.S.C.S. SYMBOL	GRAPHIC LOG	REMARKS
	S-1	10 6 6	20	Humus, (brown, silty, medium to fine sand, and frozen) $\approx 0.8'$	pt		
	S-2	11 14 12 12	20	Medium dense, brown, silty, FINE TO COARSE SAND, trace gravel, dry $\approx 2.0'$	sm		
5	S-3	12 8 9 11	16	SAA Medium dense, tan, FINE TO COARSE SAND, moist	sw		Sheen noted on spoon during rinsing
	S-4	9 10 6 5	20	SAA	sw		Sheen noted on spoon during rinsing
10	S-5	3 3 2 3	10	Loose, grayish tan, FINE TO COARSE SAND, wet	sw		$\nabla \sim 8'$ Sheen noted on spoon during rinsing
15	S-6	3 3 3 5	24	loose, grayish tan, FINE TO COARSE SAND, wet $\approx 18.0'$	sw		Silt encountered on lead auger upon removal from boring
20				Bottom of Boring			

Note:

Elevation is approximate

- MSL = Mean sea level
- ∇ = Water level at time of drilling
- ∇ = Water level measurement
- SAA = Same as above
- BGS = Below ground surface

Checked by Dan Prinale Date 2-14-94



OHM Corporation

VISUAL CLASSIFICATION OF SOILS

Project Number 9768

Project Name USAEC-Sudbury Annex

Boring Number OHM-P7-30

Elevation 199 Feet MSL Location N2,970.023 E662.797 Page 1 of 1

Engineer/Geologist D. Demers

Date March 20, 1992

Drilling Co. Soil Exploration

Date Started Mar. 20, 1992

Driller M. Camacho

Date Completed Mar. 20, 1992

Drilling Method 6-1/4" ID Hollow-stem Auger

Date Backfilled N/A

DEPTH (FEET)	SAMPLE NUMBER	BLOWS ON SAMPLER PER 6 INCHES	RECOVERY (INCHES)	DESCRIPTION	U.S.C.S. SYMBOL	GRAPHIC LOG	REMARKS
	S-1	10 12 8 8	18	Medium dense, brown, MEDIUM SAND, some gravel, moist	sp		
	S-2	10 10	12	Medium dense, tan, FINE SAND, lense from 3.5 to 4.5', moist	sp		
5	S-3	4 5 8 8	20	Medium dense, brown, FINE TO COARSE SAND, some gravel, wet	sw		~4.5'
	S-4	3 3 3 3	24	Loose, brown, FINE TO COARSE SAND, wet	sw		
10	S-5	0 0 0 0	15	Very loose, brown, FINE TO COARSE SAND, trace silt, gravel, wet	sw		
15	S-6	3 3 3 2	13	Loose, brown, FINE TO COARSE SAND, trace gravel, wet	sw		~15.0'
				Bottom of Boring			

Note:
Elevation is approximate

MSL = Mean sea level
 ∇ = Water level at time of drilling
 ∇ = Water level measurement
 SAA = Same as above
 BGS = Below ground surface

Checked by Dan Prinale Date 2-14-94

BLP730



OHM Corporation

VISUAL CLASSIFICATION OF SOILS

Project Number 9768
 Project Name USAEC-Sudbury Annex
 Boring Number OHM-P7-31

Elevation 200 Feet MSL Location N2,970,320 E662,286 Page 1 of 1
 Engineer/Geologist D. Demers Date March 20, 1992
 Drilling Co. Soil Exploration Date Started Mar. 20, 1992
 Driller M. Camacho Date Completed Mar. 20, 1992
 Drilling Method 6-1/4" ID Hollow-stem Auger Date Backfilled N/A

DEPTH (FEET)	SAMPLE NUMBER	BLOWS ON SAMPLER PER 6 INCHES	RECOVERY (INCHES)	DESCRIPTION	U.S.C.S. SYMBOL	GRAPHIC LOG	REMARKS
	S-1	3 4 4	10	Loose, tan, MEDIUM SAND, trace silt, trace oxidized lenses, trace gravel, wet	sp		
	S-2	6 6 7 8	17	Medium dense, brown, MEDIUM TO COARSE SAND trace gravel, moist $\approx 4.7'$	sp		
5	S-3	8 9 13 10	20		Medium dense, gray, FINE TO COARSE SAND, trace fine to medium gravel, moist		sw
	S-4	6 6 8 10	17	Medium dense, gray, FINE TO COARSE SAND, trace silt and gravel, wet	sw		
10	S-5	6 6 8 9	11	Medium dense, dark gray, FINE TO COARSE SAND, trace silt, and gravel, wet	sw		
15							$\approx 15.0'$
				Bottom of Boring			

Note:
 Elevation is approximate

MSL = Mean sea level
 ∇ = Water level at time of drilling
 ∇ = Water level measurement
 SAA = Same as above
 BGS = Below ground surface

Checked by Dan Pringle Date 2-14-94