



Public Health Assessment for

**NAVAL AIR STATION BRUNSWICK
BRUNSWICK, CUMBERLAND COUNTY, MAINE
EPA FACILITY ID: ME8170022018
MAY 16, 2005**

**U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE**

Agency for Toxic Substances and Disease Registry

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment was prepared by ATSDR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6)), and in accordance with our implementing regulations (42 C.F.R. Part 90). In preparing this document, ATSDR has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate.

In addition, this document has previously been provided to EPA and the affected states in an initial release, as required by CERCLA section 104 (i)(6)(H) for their information and review. The revised document was released for a 30-day public comment period. Subsequent to the public comment period, ATSDR addressed all public comments and revised or appended the document as appropriate. The public health assessment has now been reissued. This concludes the public health assessment process for this site, unless additional information is obtained by ATSDR which, in the agency's opinion, indicates a need to revise or append the conclusions previously issued.

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PUBLIC HEALTH ASSESSMENT

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Prepared by:

Federal Facilities Assessment Branch
Agency for Toxic Substances and Disease Registry
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Foreword

The Agency for Toxic Substances and Disease Registry, ATSDR, is an agency of the U.S. Department of Health and Human Services. It was established by Congress in 1980 under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), also known as the Superfund law. This law set up a fund to identify and clean up our country's hazardous waste areas. The U.S. Environmental Protection Agency (EPA) and the individual states regulate the investigation and clean up of the areas.

Since 1986, ATSDR has been required by law to conduct a public health assessment at each of the areas on the EPA National Priorities List. The aim of these evaluations is to find out if people are being exposed to hazardous substances and, if so, whether that exposure is harmful and should be stopped or reduced. If appropriate, ATSDR also conducts public health assessments when petitioned by concerned individuals. Public health assessments are carried out by environmental and health scientists from ATSDR and from the states with which ATSDR has cooperative agreements.

Exposure: As the first step in the evaluation, ATSDR scientists review environmental data to see how much contamination is at an area, where it is, and how people might come into contact with it. Generally, ATSDR does not collect its own environmental sampling data. Instead, it reviews information provided by EPA, other government agencies, businesses, and the public. When there is not enough environmental information available, the report will indicate what further sampling data is needed.

Health effects: If the review of the environmental data shows that people have or could come into contact with hazardous substances, ATSDR scientists then evaluate whether or not there will be any harmful effects from these exposures. The report focuses on public health, or the health impact on the community as a whole, rather than on individual risks. Again, ATSDR generally makes use of existing scientific information, which can include the results of medical, toxicologic, and epidemiologic studies and the data collected in disease registries. The science of environmental health is still developing, and occasionally scientific information on the health effects of certain substances is not available. When this is so, the report will suggest what further research studies are needed.

Conclusions: The report presents conclusions about the level of health threat, if any, posed by an area. In its public health action plan, the report recommends ways to stop or reduce exposure. ATSDR is primarily an advisory agency, so usually these reports identify what actions are appropriate to be undertaken by EPA, other responsible parties, or the research or education divisions of ATSDR. However, if there is an urgent health threat, ATSDR can issue a public health advisory to warn people of the danger. ATSDR can also authorize health education or pilot studies of health effects, full-scale epidemiology studies, disease registries, surveillance studies, or research on specific hazardous substances.

Interactive process: The health assessment is an interactive process. ATSDR solicits and evaluates information from numerous city, state, and federal agencies, the companies responsible for cleaning up the area, and the community. ATSDR then shares its conclusions with them. Agencies are asked to respond to an early version of the report to make sure that the data they provide is accurate and current. When informed of ATSDR's conclusions and recommendations, the agencies sometimes will begin to act on them before the final release of the report.

Community: ATSDR also needs to learn what people in the area know about the area and what concerns they may have about its impact on their health. Consequently, throughout the evaluation process, ATSDR actively gathers information and comments from the people who live or work near an area, including residents of the area, civic leaders, health professionals, and community groups. To ensure that the report responds to the community's health concerns, an early version is also distributed to the public for comment. All the comments received from the public are responded to in the final version of the report.

Comments: If, after reading this report, you have questions or comments, we encourage you to send them to us.

Letters should be addressed as follows:

Attention: Chief, Program Evaluation, Records, and Information Services Branch,
Agency for Toxic Substances and Disease Registry, 1600 Clifton Road, NE (MS E-32),
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ATSDR	Agency for Toxic Substances and Disease Registry
BEQ	Bachelor Enlisted Quarters
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylene
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CREG	ATSDR’s cancer risk evaluation guide
CVs	comparison value
DCA	dichloroethane (1,1-;1.2-)
DCE	dichloroethene
EMEG	ATSDR’s environmental media evaluation guide
EPA	U.S. Environmental Protection Agency
HVAC	heating, ventilation, and air conditioning
IRP	installation restoration program
LTMP	long-term monitoring program
MCL	EPA’s maximum contaminant level
MEDEP	Maine Department of Environmental Protection
MEDHHS	Maine Department of Health and Human Services
MW	monitoring well
NAS	naval air station
NEX	Navy exchange
NFA	no further action
NPL	EPA’s National Priorities List
PAHs	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PCE	tetrachloroethylene (perc)
PHA	public health assessment
PHAP	Public Health Action Plan
ppb	parts per billion
ppm	parts per million
RAB	restoration advisory board
RBC	EPA Region III’s risk-based concentration
RfD	EPA’s reference dose
RI	remedial investigation
RMEG	ATSDR’s reference dose media evaluation guide
ROD	record of decision
SVE	soil vapor extraction
SVOCs	semi-volatile organic compounds
1,1,1-TCA	1,1,1-trichloroethane
TCE	trichloroethylene
USTs	underground storage tanks
UV	ultraviolet
VOCs	volatile organic compounds

I. Summary

The Agency for Toxic Substances and Disease Registry (ATSDR) prepared this public health assessment (PHA) to evaluate potential health hazards from past, current, and future exposures to contaminants originating from Naval Air Station Brunswick (NAS Brunswick).

NAS Brunswick, in Brunswick, Maine, is an active air station that has provided military support services since 1943, when it served as an outpost for the operation and maintenance of the U.S. Navy's anti-submarine warfare operations. As a result of former site operations and waste disposal practices at the air station, various chemicals have spilled or have been released to the ground. Some of those chemicals have reached the underlying groundwater and on-site tributaries. In 1987, the U.S. Environmental Protection Agency (EPA) listed NAS Brunswick on its National Priorities List of sites to be investigated. The primary contaminants of concern are volatile organic compounds (VOCs), such as those in cleaning solvents, and petroleum hydrocarbons associated with fuels.

In 1989, ATSDR initiated the public health assessment process at NAS Brunswick to evaluate possible exposures to site contaminants. Through this process, ATSDR identifies populations who may have been exposed in the past, are currently exposed, or could be exposed in the future to hazardous substances and determines the public health implications of those exposures. From its initial evaluation, ATSDR prepared a preliminary PHA in 1989. That PHA determined that further environmental characterization and sampling of the site were needed to further assess environmental health hazards at the air station. After more information became available, ATSDR visited NAS Brunswick in 2003 to collect information for the public health assessment, and to identify public health issues and community health concerns related to environmental contamination at the air station.

Using information gathered during the site visit and findings of site investigations conducted at NAS Brunswick, ATSDR examined the nature and extent of contamination associated with the site. ATSDR considered past, current, and future potential exposure situations in its evaluation. ATSDR evaluated possible hazards associated with these exposures and concluded that they are not of health concern:

- ***Contaminated groundwater and drinking water use.*** ATSDR determined that there is no exposure to harmful levels of contaminants in groundwater via municipal wells, private wells, the base golf course well, or the Dyer's Gate well. VOCs are the primary contaminants of concern in groundwater beneath NAS Brunswick. There is no public exposure to these groundwater contaminants. Groundwater underlying NAS Brunswick has not been used as the main source of drinking water for base employees and residents, and is not expected to be used as a drinking water source in the future. NAS Brunswick and most of the surrounding community receive drinking water from municipal water sources that meet federal and state drinking water standards. Local private wells, the base golf course well, and the Dyer's Gate well are the only wells utilizing groundwater on or near NAS Brunswick. These wells are outside of the area

of groundwater contamination, and compounds have not been detected at levels of health concern. The Navy will continue to monitor groundwater movement from the site to identify and mitigate, if necessary, any potential future threats to drinking water supplies.

- ***Possible exposure to contaminants in on-site or nearby surface water.*** ATSDR determined that there are no harmful exposures to site-related contamination associated with on-site or nearby surface water bodies. Low levels of contaminants have been detected in on-site streams. Because people do not use the on-site streams as a source of drinking water or for recreational activities, any exposure is minimal and likely limited to infrequent, short-term skin contact. Incidental exposures to the low detected levels of contaminants are not expected to pose a public health hazard. Contaminant concentrations are expected to further decrease with continued remediation and natural degradation.
- ***Possible exposure to contaminants for consumers of venison.*** ATSDR determined that consumption of locally caught deer poses no public health hazard related to NAS Brunswick activities. Seasonal deer hunting is permitted at NAS Brunswick. Chemicals, such as those concentrated in soil in certain areas of NAS Brunswick, do not typically accumulate to harmful levels in deer tissue. ATSDR concludes that venison from NAS Brunswick is safe to eat.
- ***Possible vapors in buildings above or near groundwater contamination.*** ATSDR determined that occupants of on-site buildings located near groundwater contamination would not have encountered harmful levels of indoor air contaminants. The Fleet and Family Support Center and the footprints of two bachelor enlisted quarters (BEQ) sit above or near VOC groundwater contamination from former site releases. VOCs can travel upward from the groundwater through overlying soils, into building foundations, and possibly contaminate air inside the buildings. Using available indoor air monitoring data or reliable estimates of indoor air concentrations, ATSDR determined that no harmful levels of vapors have or did seep into the on-base buildings. Even though there is no current long-term health hazard associated with the air inside the Fleet and Family Support Center, ATSDR encourages the Navy to continue to track the groundwater contamination associated with the upgradient gasoline release and potential impact on the family center.

II. Background

II.A. Site Description and Operational History

The Naval Air Station (NAS) Brunswick is an active naval air station. It is located on 3,094 acres of land along the coast of Maine in Brunswick, about 27 miles northeast of Portland. The southern edge of the base extends to the estuary of Harpswell Cove, which is one of several elongated coves and inlets of the Casco Bay. Figure 1 illustrates the site and its surrounding area (NEESA 1983).

NAS Brunswick became active in 1943. During World War II, F4U-1 Corsairs were stationed at NAS Brunswick. P-2 Neptune aircraft flew at NAS Brunswick from 1952-1968. P-3 Orion aircraft arrived at NAS Brunswick in 1965 and have remained stationed at NAS Brunswick to date. For a period after the war, the air station was demobilized and rented out for non-military activities. From 1946 to 1949, the University of Maine and Bowdoin College used the air station for student housing and classroom space. The Brunswick Flying Service then took over the air station and used the hangars for a skating rink, a civilian flying school, and automobile servicing, among other activities. In 1951, the station was officially reinstated as a Naval Air Station (NAS Brunswick 2004a; PCS 2004).



This photo taken of the Naval Air Station Brunswick shows the runways (foreground) and the operational area (center). Harpswell Cove is in the background.

Source: NAS Brunswick 2004a

During the 1950s, the air station underwent a major expansion, with the construction of 222 structures and buildings. Included in this development was the construction of a fuel pier at Harpswell Neck in 1952, and bachelor housing and most of the on-station family housing, starting in 1954 (NEESA 1983). By the mid-1950s, outlying areas of the air station were developed, including the ordnance magazine area south of the runways and the communications and navigational components west of the runways.

Today, NAS Brunswick is the last active-duty Department of Defense airfield remaining in New England. It is home to five active-duty and two reserve squadrons. Among these is Patrol and Reconnaissance Wing 5, which uses Lockheed P-3 Orion long-range maritime patrol aircraft. About 20% of NAS Brunswick's activities, facilities, and services directly support the shipbuilding program at the nearby Bath Iron Works Corporation. The air station also supports the Navy's only cold weather Survival, Evasion, Resistance, and Escape School, which occupies 12,000 acres near Rangeley in northwestern Maine (NAS Brunswick 2004a). Recently, the air station gained aircraft and personnel from the recently closed South Weymouth Naval Air Station in Massachusetts (PCS 2004).

II.B. Remedial History

Routine activities and former waste disposal practices at NAS Brunswick have resulted in accidental spills or releases of chemicals to the environment. Examples of the former routine activities include on-site disposal of waste oil, food waste, pesticides, and solvents at Sites 1 and 3; incineration and disposal of solid waste at Site 2; disposal of asbestos pipes at Site 5; and disposal of construction debris at Site 6. Figure 2 shows the locations of these sites and others investigated by the Navy at NAS Brunswick. Contaminants released to surrounding soil as a result of these activities include heavy metals and petroleum hydrocarbons. Under certain circumstances, a portion of the contaminants released to the ground seeped through the soil, eventually reaching the underlying groundwater or being carried toward local tributaries.

In 1987, because of the contamination detected at NAS Brunswick, EPA added the site to the National Priorities List (NPL) of sites to be investigated. The NPL is part of EPA's Comprehensive Environmental Response, Compensation, and Liability Act, or CERCLA, which is commonly known as "Superfund." NAS Brunswick is responsible for conducting environmental investigations and completing remedial actions on NAS Brunswick property where hazardous materials might have been disposed of, spilled, or stored. EPA Region I and the Maine Department of Environmental Protection (MEDEP) provide review and guidance throughout the CERCLA process (EC Jordan 1991a; 1991b). In October 1990, the Navy entered into a Federal Facilities Agreement with EPA and MEDEP to outline the cleanup of environmental contamination at NAS Brunswick (EPA 1998).

Environmental investigations began at NAS Brunswick under the Department of Defense's Installation Restoration Program (IRP) in 1983 and 1984. At that time, the Navy initiated a Preliminary Assessment (then known as an Initial Assessment Study) and records review to identify background information on hazardous material use, historical operations, and waste disposal practices at the air station (EC Jordan 1991a; 1991b). The initial assessment identified 10 sites with hazardous releases. The Navy further evaluated seven of the sites considered to be most harmful to human health on the basis of a priority hazard ranking. It then conducted either a site inspection field investigation or a pollution abatement confirmation study for each. The Navy continued environmental investigations at NAS Brunswick in July and September 1988 with the start of a remedial investigation (RI) to determine the nature and extent of contamination at NAS Brunswick. Through the RI, the Navy conducted geophysical testing and sampled groundwater, soil, surface water, sediment, and leachate (EC Jordan 1991b). The investigations identified several contaminants at on-site locations, including solvents and metals in groundwater and/or soil. Data collected through this process were then used to evaluate potential risks to human health in a February 1989 risk assessment. In total, the IRP has identified 20 sites at NAS Brunswick. Table 1 describes the operational history, environmental contamination, and remedial measures at each of these sites.

During its investigations, the Navy identified a groundwater plume of volatile organic compounds (VOCs), called the "Eastern Plume," extending north to south along the eastern boundary of the base. The primary contaminants in the plume are the VOCs

1,1,1-trichloroethane (1,1,1-TCA), trichloroethylene (TCE), tetrachloroethylene (PCE or perc), and 1,2-dichloroethane (1,2-DCA). These contaminants, which primarily affect the deeper portion of the overburden groundwater beneath the site (between 40 feet and 80 feet below ground surface), have been traced to Sites 4 (an acid/caustic disposal pit), 11 (a former fire training area), and 13 (the Defense Reutilization and Marketing Office). See Table 3 for more information on the contaminants found in the groundwater of the Eastern Plume.

To address the contamination at NAS Brunswick, the Navy undertook measures to control the spread of contamination at certain IRP sites, including:

- Installed an extraction and treatment system in 1995 as an interim action to contain the Eastern Plume and prevent further migration toward Harpswell Cove.
- Constructed a slurry wall around the landfill waste at Sites 1 and 3 in 1996, and then installed a low-permeability Resource Conservation and Recovery Act (RCRA) compliant cap over the waste to extend beyond the top of the slurry wall and to divert clean water from the landfills.
- Removed soils at Sites 4, 11 and 13 that were considered the source of the Eastern Plume; removed asbestos-contaminated soil and pipes and other debris from Sites 5 and 6.
- Formally added institutional controls in 2000 to restrict the use of groundwater in the area of the Eastern Plume and at other sites on base.

II.C. ATSDR Activities

Through the public health assessment (PHA) process, ATSDR assesses conditions at a site from a public health perspective to determine whether people can be exposed to site-related contaminants through contact with the site's groundwater/drinking water, surface water, soil, biota, or air. ATSDR prepared a preliminary PHA in 1989 that determined that additional environmental characterization and sampling of the site were needed to further assess environmental health hazards at the air station (ATSDR 1989). After more information became available, ATSDR visited NAS Brunswick in 2003 to collect information necessary to conduct a public health assessment, to identify public health issues related to environmental contamination at the air station, and to identify community health concerns. During the visit, ATSDR met with NAS Brunswick personnel responsible for environmental clean-up, industrial hygiene, the lead program, and public works.

From those discussions, the site visit, and data reviews, ATSDR concluded at the time that there was little potential for immediate threats to human health. ATSDR did, however, identify several possible exposure pathways that required further evaluation, including ingestion of groundwater-supplied drinking water, contact with local surface water bodies, vapors in buildings above or near groundwater plumes, and indirect

exposure from consumption of venison that grazed at the air station. *ATSDR prepared this PHA to further evaluate these pathways.*

II.D. Demographics

ATSDR examines demographic information, or population information, to identify the presence of sensitive populations, such as young children (age 6 years and under), the elderly (age 65 years and older), and women of childbearing age (ages 15 to 44). Demographics also provide details on population mobility and residential history in a particular area. This information helps ATSDR evaluate how long residents might have been exposed to environmental contaminants.

As Maine's second largest employer, NAS Brunswick employs about 4,800 military and civilian personnel, including about 700 officers, 3,400 enlisted personnel, and 650 civilians. To accommodate its residents, the air station offers 140 officer-family housing units, 610 enlisted-family units, and 20 mobile home lots. On-site facilities for authorized personnel include a medium-size commissary, a large exchange, and two convenience stores. For medical care, a branch clinic is available for all active-duty personnel and dependants. School-age children attend public or private schools off base. A childcare facility accommodating 122 preschool children is available, although there is a waiting list (Brunswick 2004; PCS 2004). More than 1,600 Naval Reservists travel from throughout New England to drill at Naval Air Reserve Brunswick, SeaBee Battalion, and many other reserve commands. In addition to its own workforce, NAS Brunswick has 29 tenant commands, including a Reserve P-3 squadron and a Reserve Fleet Logistics Support Squadron flying C-130 "Hercules" transports (NAS Brunswick 2004a).

The town of Brunswick surrounds the perimeter of the base and is the largest of a tri-town area made up of Brunswick, Topsham, and Bath. The tri-town area has a population of 37,000 (PCS 2004). Figure 3 shows 2000 demographics information for the population near NAS Brunswick. As the figure indicates, about 10,322 people live within a 1-mile buffer of the site, including 909 children aged 6 years and younger and 1,317 adults aged 65 years and older.

II.E. Land Use

ATSDR examines land use to determine what activities might put people at risk for exposure to contaminants related to NAS Brunswick. Land at the air station is used primarily for operations to support the base's mission. Access to the base is restricted to military personnel, base residents, and civilian employees. A member of the general public may enter by passing security guard stations located at the main entrance and another site entrance, registering his or her vehicle, and obtaining a pass. Certain sites under CERCLA investigations are fenced to deter access.

Land at the air station is a mix of forested land (48 %), grassland (28 %), paved areas for flight ramps and runways (12 %), and the operations area (5 %) (EC Jordan 1990). The remaining 7 % of the air station consists of shrubland, marshes, and open water. The operations located east of the two parallel runways consist of office buildings, a fuel farm, recreational facilities, base housing, hangars, repair shops, and other facilities (A.

Williams, IRP manager, NAS Brunswick, personal correspondence, June 18, 2004). Groundwater underlying the site is described as a potential source of drinking water, but the majority of NAS Brunswick currently is serviced by a public water supply system (EPA 2004).

Land use controls have been in place and enforced at NAS Brunswick since 2000. The land use controls at the base include physical and administrative mechanisms to limit access to, and restrict the use of, property to prevent or reduce risks to human health. Physical controls include the controlled-entry gates mentioned above (which are manned 24 hours a day, 7 days a week), as well as fencing around the industrial area of the base and posted warning signs (e.g., No Fishing or Swimming at Picnic Pond). Administrative controls at NAS Brunswick include measures to prohibit use of groundwater on or near remaining contaminated sites on base. The RODs for NAS Brunswick contain language about specifying measures that will be taken in the event of transfer, leasing, or closure of the base property affected by site-related contamination. The language indicates that the Navy will notify EPA and MEDEP in accordance with the Federal Facility Agreement prior to the change. In cooperation with EPA and MEDEP, the Navy will include use restrictions, such as institutional controls, in all documents regarding the transfer or lease so as to prevent the use of and contact with site groundwater and soil.

The land use in the area surrounding the air station is predominantly suburban and rural residential, with some light industrial uses (EC Jordan 1990). The southern edge of the base borders coves and estuaries of Harpswell Cove (EPA 2004). The air station is located within the town of Brunswick. An elementary school, a hospital, and a college are located 1 mile west of the site boundary. During the 1950s and 1960s, the local population increased 50 % when the base was reactivated (EC Jordan 1990). Most of the residential growth at this time was located in the central part of Brunswick, about 2 miles north of the air station. Residents of the Brunswick community include military families and the Bowdoin College community. During recent years, residential and commercial land uses have expanded to the outlying areas of the town, in the vicinity of Cook's Corner just northeast of the base. Fewer residents live along the coves and coastal areas south of the air station, where zoning ordinances limit residential use (EC Jordan 1990). Undeveloped tracts of land border the site to the north. The Town of Brunswick has designated this land an aquifer protection zone and has restricted development (P. Kempf, water program manager, NAS Brunswick, personal correspondence, July 8, 2004). The towns of Brunswick and Topsham are considering a plan to develop a portion of this land for recreation and conservation.

NAS Brunswick lies within four major drainage basins: the Androscoggin River, Mere Brook, Middle Bay Cove, and Buttermilk Cove (NEESA 1983). None of the waterways that flow through the air station are suitable for a drinking water supply or recreation (e.g., swimming) (NEESA 1983). The Androscoggin River is one of the major rivers that empties into the Atlantic Ocean along the Maine coast. It flows east along the northern boundary of the town of Brunswick and about 3,000 feet north of the air station boundary. About 13 % of the air station sits within the Androscoggin watershed.

Most of the air station (about 74 %) sits within the Mere Brook watershed. Mere Brook enters the air station at the northwestern boundary and flows for about ½ mile in its natural streambed. The brook then travels under the operations area in an artificial conduit for about 0.6 miles (1 km) before joining a number of small intermittent streams to form the relatively narrow and deeply cut Merriconeag Stream. Eventually, this tide-influenced stream empties into Harpswell Cove, where it is bordered by extensive tidal flats. The Middle Cove watershed and the Buttermilk watershed account for only 4 % and 9 % of the air station area, respectively (NEESA 1983).

II.F. Quality Assurance and Quality Control

ATSDR reviewed and evaluated information provided in the referenced documents. Documents prepared for the CERCLA program must meet standards for quality assurance and control measures for chain of custody, laboratory procedures, and data reporting. The environmental data presented in this PHA come from Navy site and remedial investigations. ATSDR has determined that the data's quality is adequate for making public health decisions.

III. Evaluation of Environmental Contamination and Potential Exposure Pathways

III.A. Introduction

Identifying Exposure

ATSDR's PHA evaluations are exposure (or contact) driven. People who work or live in the area of an environmental release can only be exposed to a contaminant if they come in contact with it. Exposure might occur by breathing, eating, or drinking a substance containing the contaminant or by skin contact with a substance containing the contaminant. Therefore, *a release does not always result in exposure.*

ATSDR evaluates site conditions to determine if people could have been (a past scenario), are (a current scenario), or could be (a future scenario) exposed to site-related contaminants. When evaluating exposure pathways, ATSDR identifies whether exposure to contaminated media (soil, water, air, waste, or biota) has occurred, is occurring, or will occur through ingestion, dermal (skin) contact, or inhalation. ATSDR also identifies an exposure pathway as *completed* or *potential*, or *eliminates the pathway from further evaluation*. Completed exposure pathways exist if all elements of a human exposure are present. (See "Exposure Pathway" in Appendix A for a description of the elements of a completed exposure pathway.) A potential pathway is one in which one or more of the pathway elements cannot be definitely proven or disproved. A pathway is eliminated if at least one element is absent.

Interested persons can learn more about the ATSDR evaluation process by reading ATSDR's *Public Health Assessment Guidance Manual* (available at <http://www.atsdr.cdc.gov/HAC/HAGM/>) or by contacting ATSDR at 1-888-42ATSDR.

Exposure and Health Effects

Given sufficient exposure levels, chemical contaminants disposed of or otherwise released into the environment can cause adverse health effects. The type and severity of health effects caused by contact with a contaminant depend on the exposure concentration (how much), the frequency and/or duration of exposure (how long), the route or pathway of exposure (breathing, eating, drinking, or skin contact), and the multiplicity of exposure (the combination of contaminants). Once exposure occurs, characteristics of the exposed person—such as age, sex, nutritional status, genetics, lifestyle, and health status—influence how the person absorbs, distributes, metabolizes, and excretes the contaminant. Together, these factors and characteristics determine the health effects that might occur as a result of exposure to a contaminant in the environment.

ATSDR selects contaminants for further evaluation by comparing them against health-based screening values. Screening values are developed from the available scientific literature on exposure and health effects. They are derived for each of the different media, and each reflects an estimated contaminant concentration that is *not expected* to cause adverse health effects for a given chemical, assuming a standard daily contact rate (e.g.,

amount of water or soil consumed or amount of air breathed) and body weight. To be conservative and protective of public health, screening values are generally based on contaminant concentrations *many times lower than levels at which no effects were observed* in experimental animals or human epidemiologic studies. ATSDR does not use screening values to predict the occurrence of adverse health effects, but rather to serve as a protective screen and a first step in the evaluation of public health implications.

Screening values include ATSDR's comparison values (CVs): environmental media evaluation guides (EMEGs), reference dose media evaluation guides (RMEGs), and cancer risk evaluation guides (CREGs). CREGs, EMEGs, and RMEGs are non-enforceable, health-based CVs developed by ATSDR for screening environmental contamination for further evaluation. In addition, ATSDR uses EPA's maximum contaminant levels (MCLs). MCLs are enforceable drinking water regulations developed to protect public health. (See Appendix B for a further description of the CVs.)

If contaminant concentrations are above screening values, ATSDR analyzes exposure variables (for example, duration and frequency), the toxicology of the contaminant, and epidemiology studies for possible health effects. Figure 4 provides an overview of ATSDR's exposure evaluation process.

Possible Exposure Situations at NAS Brunswick

ATSDR reviewed data collected since 1985 for NAS Brunswick's 20 IRP sites to determine if the sites are associated with past, current, or future public health hazards.¹ (Table 1 describes each site and briefly summarizes the evaluation.) When evaluating these areas, ATSDR assessed the level of contamination present or degree of physical hazard, the extent to which individuals come into contact with the contamination or hazard, and whether this contact would result in a public health hazard. The review indicated that most sites at the air station are not associated with any known public health hazards because (1) no site-related contaminants are present, (2) contaminant concentrations detected are too low to pose a health hazard, or (3) past and current exposure to the general public has been reduced or eliminated through site remediation and safeguards, such as institutional controls.

In this review, however, ATSDR did identify the following four potential exposure situations at NAS Brunswick for further evaluation in this PHA:

- Contaminated groundwater and drinking water use,
- Possible exposure to contaminants in on-site and nearby surface water,

¹ The Navy collected environmental data between 1985 and 2003. Essentially no environmental data exist to describe site conditions before 1985. The lack of data before this time makes it challenging to fully assess past environmental effects of NAS Brunswick operations before 1985, when the landfills and operations associated with the IRP sites were active. In the absence of these data, ATSDR relies on the existing site data and knowledge of environmental toxicology and chemical fate and transport to predict the likelihood of past health hazards.

- Possible exposure to contaminants for consumers of venison,
- Possible vapors in buildings above or near groundwater contamination.

Exposure situations at NAS Brunswick are evaluated in detail in the following discussion and summarized in Table 2. To acquaint the reader with terminology and methods used in this PHA, Appendix A provides a glossary of environmental and health terms presented in the discussion and Appendix B describes the CVs ATSDR used in screening contaminants for further evaluation. Appendix C contains comments and ATSDR's responses to the comments received during the public comment review period (September 30 to January 27, 2005) of this public health assessment.

III.B. Contaminated Groundwater and Drinking Water Use

Summary

Groundwater beneath certain areas of the NAS Brunswick site has become contaminated with chemicals from former operations or disposal practices. Of the chemicals, volatile organic compounds, such as those from cleaning solvents, have been detected most frequently and in the highest concentrations. No exposures are occurring for base residents, employees, or community members who receive drinking water from the Brunswick and Topsham municipal water supply wells, the drinking water at the base golf course, or nearby private wells. These wells are located away from the sources releasing contaminants, and are unaffected by groundwater contamination. The Navy continues to monitor groundwater quality to ensure that implemented remedial measures control the source and limit migration of contaminated groundwater. Accordingly, ATSDR determined that there are no past, current, or future health hazards associated with the groundwater exposure pathway.

Discussion

This discussion addresses groundwater contamination around the NAS Brunswick site and how people might come in contact with this contamination. First, we address features of the underlying groundwater or hydrogeology that might influence exposure and groundwater uses at or near NAS Brunswick. Then, we present an overview of groundwater monitoring programs and discuss the results of these groundwater monitoring efforts. Finally, we evaluate possible exposure to contaminated groundwater from the NAS Brunswick site and the possibility of a resulting health hazard. ATSDR reviewed groundwater monitoring data associated with all the IRP sites. ATSDR's aim is, however, to determine whether and to what extent exposure occurs. ATSDR focused much of its attention on the Eastern Plume because it appears to be the only contaminant plume with the potential to threaten drinking water supplies, as it is moving toward site boundaries.

Groundwater Hydrogeology and Use at NAS Brunswick

Groundwater beneath NAS Brunswick is found in both the overburden and in the underlying bedrock *aquifers* (NEESA 1983; EA 2000a). The overburden is made up of three units (a sand layer, a transition layer, and a low permeable clay layer) that are capable of yielding more water than the bedrock aquifer. Groundwater in the overburden is encountered under unconfined conditions at about 10 to 80 feet below ground surface (bgs) and generally flows toward the Gulf of Maine. In most places on base, clay overlies bedrock and acts as a confining layer that greatly limits downward movement of groundwater (and contamination) into the bedrock. Shallow overburden groundwater might still enter the bedrock where the bedrock is close to the ground surface or where there is no clay layer (MEDEP 2004). Even so, the bedrock beneath the air station produces only limited amounts of groundwater. Groundwater movement within the bedrock unit is controlled by the presence of fractures and joints and is highly variable (NEESA 1983; EA 2000a).

An **aquifer** is a subsurface geologic unit capable of storing and transmitting quantities of useable water.

Groundwater serves as the primary source of drinking water for NAS Brunswick and the surrounding community, as follows:

- **NAS Brunswick drinking water wells.** Two water wells are located at NAS Brunswick. One supplies drinking water to the golf course on the western side of the air station. The other is a bedrock well that supplies drinking water to the guardhouse facilities at the new Dyer’s Gate. These wells are outside of the area of groundwater contamination at NAS Brunswick. Additionally, compounds have not been detected in these wells at levels of health concern. Most residents and employees of NAS Brunswick obtain their drinking water from an off-base municipal water supply (see below).

- **Municipal water supply.** NAS Brunswick, residences, and businesses to the north, northeast, and northwest of the air station obtain drinking water from the Brunswick/Topsham Water District municipal water supply (NEESA 1983). Groundwater used for the municipal water supply is drawn from the shallow or overburden aquifer (A. Frazier, engineer, Brunswick and Topsham water district, personal correspondence, September 21, 2004). Like all public drinking water suppliers, the Brunswick/Topsham Water District must ensure that the quality of its drinking water meets EPA standards (see the text box). Water that meets the standards is generally considered safe to drink. The closest public well field is the 138 well Jordan Avenue field operated by the Brunswick/Topsham Water District, less than ½ mile from the northern boundary of the air station (EPA 1987; P. Kempf, water program manager, NAS Brunswick, personal correspondence, July 8, 2004).

Under the Safe Drinking Water Act, EPA set standards called maximum contaminant levels (MCLs) that limit the amount of certain contaminants in water provided by public water systems. MCLs are developed to protect individuals who could be exposed over a lifetime (70 years).

- **Private wells.** Some people living in the Brunswick community south of the air station rely on private wells for their drinking water. The most recent complete private well survey, conducted in 1990, identified 23 off-base private wells within a 1-mile radius of the site (EC Jordan 1991b). Since the survey, a new residence was built a couple of hundred feet from the plume's eastern extent, on Purington Road. This residence has a deep private well in the bedrock reportedly used for drinking water (MEDEP 2003, MEDEP 2004). This well has been tested, and no VOCs were detected. Sampling of these wells is described in greater detail in the next section. The Maine Geological Survey also maintains drilling information on private wells. Their database identified 12 private bedrock wells located south and east of the base boundary—including 5 private wells located on Coombs Road—but further from the plume than the well on Purington Road. According to the Maine Geological Survey, the database is not comprehensive and lacks information on other existing wells in the area (Maine Geological Survey 2005).

Nature and Extent of Groundwater Contamination at NAS Brunswick

On-Site: Eastern Plume

Site investigations identified a VOC groundwater contamination plume that extends approximately 4,000 feet along the eastern boundary of NAS Brunswick (MEDEP 2004). Contaminants detected within the groundwater include TCE, PCE, 1,1-dichloroethene (1,1-DCE), 1,1-dichloroethane (1,1-DCA), 1,2-DCA, and 1,1,1-trichloroethane (1,1,1-TCA) (EA 1997a). Former solvent disposal practices at Site 4 (an acid/caustic pit), Site 11 (a former fire training area), and Site 13 (the Defense Reutilization and Marketing Office) are the suspected sources of this contamination. Sites 4, 11, and 13 are located within several hundred feet of each other off Old Gurnet Road between the intersection of Orion Street and Sandy Road.

Because the magnitude and distribution of contamination differs at, and downgradient of, these source areas, each is discussed separately below.

- **Site 4.** The acid/caustic pit site, used for disposal of liquid waste from 1969 to 1974, was the likely source of contamination at Site 4. During RI field investigations, groundwater contamination at Site 4 was detected in only one well (MW-405), where TCE was measured in two of the four sampling rounds at 623 parts per billion (ppb). Downgradient wells did not contain VOC contamination. Soils surrounding the pit do not appear to be an ongoing source of groundwater contamination, and therefore Site 4 is no longer deemed a contributor of groundwater contamination to the Eastern Plume.
- **Site 11.** The ½ acre at Site 11 was contaminated with liquid waste (such as fuels, oils, and degreasing solvents) used in fire training exercises held at the site from 1960 to 1990. VOC concentrations in the shallow groundwater increased from 500 to 2,900 ppb from the fall of 1989 to the fall of 1990. These increased concentrations were associated with a 2-foot increase in water level, suggesting that the contaminated soil just above the water table acted as a source of groundwater contamination. Lower

concentrations of total VOCs (18 ppb) were detected in the bedrock at this source area. The Navy completed two soil removal actions at Site 11 after it conducted the RI field activities (EPA 1998). Table 1 describes these actions. Both the MEDEP and the Navy no longer consider this site to pose a concern. More recent investigations showing only trace levels of groundwater contaminants at Site 11 indicate that residual soils at the site no longer contribute to the contamination in the Eastern Plume. As of 2002, a large infiltration gallery (leach field) constructed over a portion of Site 11 has accepted clean treatment plant effluent without any detectable changes to the downgradient groundwater quality (MEDEP 2004).

- **Site 13.** VOC-contaminated groundwater was identified downgradient of three former underground storage tanks (USTs) that were used to store waste fuels, oils, and degreasing solvents. All three USTs were removed in the late 1980s, but no soil was excavated at the time of removal. VOC concentrations have decreased over time following the removal of the tanks. For example, the VOC 1,2-DCE (total) exceeded 700 ppb before the removal of the eastern UST, but fell to 63 ppb after the tank's removal (EPA 1998). As a result of the lower VOC concentrations, Site 13 is no longer a source of contamination to the plume (EPA 1998).

Contaminants have radiated to the northeast, east, and southeast of these source areas. Because of the influence of the Mere Brook and Merriconeag Stream, the contaminants tend to travel southeasterly as a plume along the eastern boundary of the site toward Harpswell Cove. Recent data suggest that the leading edge of the plume may be reaching the wetlands or adjacent surface waterways (MEDEP 2004). This plume is referred to as the “Eastern Plume.”

Initial investigations (before any treatment) showed that concentrations of total VOCs in the plume varied from a high of 12,000 ppb in the center of the plume to very low concentrations along its edges (EPA 1998). VOCs did not contaminate the bedrock because of the presence of the clay confining layer overlying the bedrock throughout most of the plume's extent. Within the overburden, the highest VOC concentrations migrated into the semi-confined lower sand unit near the bottom of the transition layer (EA 2000a, MEDEP 2004). Since the source of contamination has been eliminated, much lower concentrations now exist in the upper sand unit (which is about 20 to 30 feet thick) (EA 2000a). Recent monitoring has identified VOCs in groundwater or groundwater springs near Mere Brook (just north New Gurnet Road), Merriconeag Stream, and Picnic Pond. These VOCs may be discharging from the groundwater to surface water, however, at such low concentrations, the VOCs are expected to dissipate quickly and become scarcely detectable in these waterways (A. Williams, IRP manager, NAS Brunswick, personal correspondence, June 18, 2004).

The Navy predicted in 1995 that, if left untreated, the plume would reach the tidal area of the cove by 1997 (EA 1997a). To prevent the plume's further advance toward and potential discharge into Harpswell Cove, the Navy established a pump and treat system in 1995 (EPA 1998). The system was also intended to reduce the amount of contamination in the groundwater plume. Originally, the system captured groundwater using five

extraction wells screened through the shallow and deep zones of the overburden (more shallow) aquifer—where most of the contamination had settled—and relied on ultraviolet (UV)/oxidation technology to treat VOCs in the contaminated groundwater (EA 1997a). The Navy added a sixth well in 1998 to extract groundwater from an area of high contaminant concentrations (monitoring well [MW]311) and replaced the UV/oxidation process with an air stripper and carbon polisher in 2000 (EPA 2003). Typically, four of the six wells described were operational in 2004 (BACSE 2005).

Through a long-term program, the Navy monitors the groundwater quality in the plume to check the effectiveness of the groundwater treatment system. Samples are collected from up to 49 groundwater monitoring wells in either the shallow overburden or the deeper overburden. The wells are situated in the center of the plume and along its perimeter. (Samples were also collected downgradient, which is discussed later in this section.) Groundwater samples are analyzed for VOCs. The most notable reduction in VOC concentrations since the start of the treatment system occurred in the vicinity of the extraction wells. VOC concentrations in other areas have decreased to a lesser extent; largely because of natural attenuation (MEDEP 2004). In the past few years, the extraction system has become much less effective. By late 2003, the total rate of remedial groundwater extraction at the Eastern Plume had declined to about a third of the mid-to-late 1990s rate of approximately 3 million gallons per month (MEDEP 2004).

Results of the Navy's long-term groundwater monitoring of the Eastern Plume show that VOCs are still present at some on-site locations, but generally at lower concentrations than were present before treatment. Of these VOCs, 1,1,1-TCA, TCE, and PCE were most frequently detected at concentrations above their ATSDR CV (EA 1997a; NAS Brunswick 2004a). The highest VOC concentration in the **shallow overburden** (upper stratified sand/silt and transition layer) was attributed to the 770 ppb of TCE detected in 1998 (EPA 2002).² Most of the individual VOC detections are, however, less than 3 ppb. Overall, total VOC concentrations were generally noted to be decreasing over time in the shallow overburden wells. As an example, total VOC concentrations in the center of the plume have declined from 300 ppb to 15 ppb at MW332 and from 50 ppb to 1 ppb at MW224 (MEDEP 2004).

Long-term monitoring also indicated that two areas in the **deep overburden** (lower semi-confined coarse sand) of the Eastern Plume still had VOC concentrations above ATSDR's CV for drinking water. One area is located along the north portion of the plume, near extraction well [EW]-5, and the other is located in the southern portion of the plume near extraction wells EW-1, EW-2, and EW-3. This later area of elevated VOC concentrations (total VOCs of 100 ppb and greater) seems to be located within the clay depression underlying the plume (EA 1997a). The concentration of 1,1,1 TCA detected at 11,000 ppb in MW311 during the June 1996 sampling was among the highest concentrations of any VOC detected (EA 1997a). According to MEDEP, more recent

² Total VOCs were detected at a maximum concentration of 12,000 ppb in a sample from MW101 collected during a December 1996 sampling event. More than 2,000 ppb were attributed to TCE. ATSDR does not have any other data for this well.

monitoring trends have highlighted the need for additional deep groundwater sampling of the plume in 2004 (MEDEP 2004).

The Navy conducted perimeter monitoring in wells placed along the southern and eastern boundaries of the air station property (MW230A, MW231A, MW313, MW318, MW309A, MW309B, MW303, and MW305). These wells are considered sentinel wells: they help to determine the location of the plume to ensure that it is not migrating off base. The wells along the southern perimeter (MW230A, MW231A, MW231B, MW313, and MW318) had low concentrations (generally less than 3 ppb), which were below ATSDR's CV for drinking water. On the basis of these findings, the southern limit of the plume is believed to be near New Gurnet Road on base property. Figure 5 depicts the current extent of the Eastern Plume. Groundwater from the Eastern Plume is not used for drinking water or other domestic purposes (EPA 1998).

Sentinel and Off-Site: Eastern Plume

The Navy collected groundwater samples between 1995 and 2002 from bedrock wells (MW308, MW309A, MW309B) at sentinel locations. Sentinel locations are outside the area of known contamination and are used to warn of the plume's migration. With the exception of sporadic occurrences of TCE, PCE, and 1,1-DCA at low levels (about 1 ppb), no other individual VOCs were reported (NAS Brunswick 2003a). The Navy also conducted a one-time groundwater sampling of wells (MW312, MW316A, MW316B, MW317A, and MW317B) located north of New Gurnet Road to assess possible off-site migration in that direction. Collected samples were analyzed for VOCs. Analytical results show that VOCs were either not detected or detected at levels below ATSDR's CVs for drinking water (EA 1997a).

MEDEP has also tested the water from a deep private well in the bedrock at the new residence on Purington Road, beyond the current Eastern Plume boundary. Site investigations have not yet established whether this well, which is located on the flank of a large west-facing ridge across Merriconeag Stream, is hydraulically downgradient—and in the path—of the Eastern Plume (MEDEP 2004). Samples were collected in October 2003 and analyzed for VOCs as a precautionary measure because the home is near the VOC plume. No VOCs have been detected in the well water (MEDEP 2003). Neither MEDEP or the Maine Geological Survey have monitoring data for wells located on Coombs Road.

On-Site: Golf Course Well

A water well located at the NAS Brunswick Golf Course supplies the golf course with drinking water. The golf course, located along the southwestern portion of the air station, is cross-gradient to and away from the groundwater contamination associated with the Eastern Plume. The well is located along the west bank of an unnamed stream in the golf course, and adjacent to Site 16, the Swampy Road debris site, where surface debris was visible (EA 2001). The well and a farmhouse that it originally served were acquired by the base in the late 1940s or early 1950s (A. Williams, IRP manager, NAS Brunswick, personal correspondence, June 18, 2004). Site investigations conducted in the early 1990s involved a magnetometer survey, drilling test pits, and collection of soil, surface water,

and sediment samples. Most of the domestic refuse and building demolition debris found during the survey was removed in 1990–2000, or otherwise assessed and left in place (EA 2001). Contaminant levels measured in the surface soil, surface water, and sediment samples were reportedly below levels of health concerns, prompting a “no further action” recommendation for this site. The Site 16 investigations revealed no significant environmental threats to the integrity of groundwater that supplies the golf course drinking water well. Additionally, the Navy has tested the golf course well for VOCs, PCBs, herbicides, pesticides, metals, and coliform. ATSDR reviewed sampling data from 2000–2004. Few compounds were found above detection limits. Of the few compounds that were detected in the golf course well, none were above available CVs (NAS Brunswick 2004d).

On-Site: Dyer’s Gate Well

In 2003, the base drilled a new drinking water well near Dyer’s Gate and the Site 2 landfill. The well is located about 80 to 100 feet from the institutional control boundary of the Site 2 and roughly 240 to 300 feet from the center of the landfill. The well water passed a standard residential analysis for drinking water. The well was also tested for VOCs, PCBs, pesticides, and total and dissolved metals. Toluene was the only organic compound found at detectable levels, which were below ATSDR’s CV. Additionally, the toluene is considered to be a laboratory artifact because it was below method detection limits (P. Kempf, water program manager, NAS Brunswick, personal correspondence, July 8, 2004). This well is now in use and does not appear to pose a public health hazard.

Evaluation of Public Health Implications of Groundwater Contaminants

Groundwater in the overburden material beneath certain portions of NAS Brunswick is contaminated predominantly with VOCs. People have not come in contact with contaminated groundwater, nor are they likely to in the future, for several reasons.

First, groundwater in the area of the Eastern Plume has not been used as a source of domestic water, nor are there plans to use this groundwater for domestic water in the future. Second, NAS Brunswick and most residents of Brunswick obtain their water from the Brunswick/Topsham Water District. As required by EPA, the district routinely tests its water to comply with *Safe Drinking Water Act* standards. Drinking water that meets these standards is considered safe to drink.

Furthermore, contamination in the shallow aquifer has not and is not expected to migrate to the municipal or private wells in the area. Through long-term monitoring, the Navy, with EPA and MEDEP oversight, has shown that the plume is contained on site.

III.C. Possible Exposure to Contaminants in On-Site or Nearby Surface Water Bodies

Summary

Former activities at NAS Brunswick have resulted in contaminant releases to on-site sections of Mere Brook, Merriconeag Stream, and other tributaries. Only low levels of contaminants have been measured in surface water and sediment samples collected from the waterways that run through NAS Brunswick. No Fishing and No Swimming signs are posted at surface water bodies on-site, and people do not use the surface water on base for recreation or drinking water. Therefore, any exposure to contaminants in the waterways is minimal, and limited to infrequent, short-term dermal contact. This type of exposure is not expected to be of health concern.

Discussion

This section discusses surface water hydrology, surface water and sediment contamination in and around the NAS Brunswick site, and possible sources of contamination. It also considers how people might come in contact with these contaminants and the health implications of these exposures.

Surface Water Hydrology at NAS Brunswick

Mere Brook and Merriconeag Stream are the major natural surface water bodies that flow through NAS Brunswick. A number of other smaller tributaries empty into Mere Brook or flow north from the site into the Androscoggin River. The Androscoggin River flows east along the northern boundary of the town of Brunswick, about 1,800 feet north of the air station boundary. It is one of the major rivers that empties into the Atlantic Ocean along the Maine coast. None of the waterways that flow through the air station are used for a drinking water supply or recreation (e.g., swimming) (NEESA 1983; EC Jordan 1990).

Mere Brook enters the air station at the northwestern boundary and flows for about ½ mile in its natural streambed. (Refer to Figure 1 for the location of Mere Brook and other on-site waterways.) The brook then travels under the operations area in an artificial conduit for about 1.6 miles (EC Jordan 1990). Merriconeag Stream enters the base along the eastern boundary and flows south from Picnic Pond. As it meanders from the Picnic Pond, Merriconeag Stream eventually joins with Mere Brook just south of the Gatchell Cemetery. Mere Brook continues to flow south past the air station's southern boundary, eventually running into the tidal estuary of Harpswell Cove.

Nature and Extent of Surface Water and Sediment Contamination at NAS Brunswick

Mere Brook, Merriconeag Stream, and several of the smaller streams flow past installation restoration program (IRP) sites at NAS Brunswick. To illustrate, Mere Brook bisects the waste disposal areas of Sites 1 and 3, situated north of the brook, and the former landfill area at Site 2, south of the brook. Mere Brook joins Merriconeag Stream

downstream (USFWS 1997). Leachate seeps downgradient of Sites 1, 2, and 3 continue to release metals associated with former landfill activities (MEDEP 2004). Other unnamed streams are located just north of Site 8 and south of Site 9. As they flow across the site, these waterways receive surface runoff or shallow groundwater discharges from the contaminated areas. Note that Mere Brook and the Androscoggin River also receive contributions from other sources upstream of NAS Brunswick. Within a 1-mile radius of the site, land is used for commercial and industrial processes, which may release other contaminants via runoff to Mere Brook or the Androscoggin River.

The Navy conducts surface water monitoring in NAS Brunswick to study the effects of possible contaminant source areas on surface water quality. Samples were collected during the 1988–1989 RI activities and again during 1995–2002 environmental investigations. More than a hundred surface water and sediment samples were collected from along Mere Brook, Merriconeag Stream, and the unnamed tributaries near Site 8 and Site 9 (refer to Figure 1). Samples are analyzed for VOCs, semi-volatile organic compounds (SVOCs), pesticides/polychlorinated biphenyls (PCBs), and metals. Table 4 provides environmental concentrations at the surface water near on-site source areas. The Navy continues to monitor surface water as part of the long-term monitoring program for the Eastern Plume. A total of five surface water sampling locations are included in the long-term monitoring plan for the Eastern Plume: one location at the eastern limit of the plume along Merriconeag Stream and the other four sample locations along Mere Brook (two within the plume and two locations beyond the limit of the plume). All the long-term monitoring surface samples are analyzed for VOCs (EA 2002a).

VOCs, SVOCs, metals, and pesticides were detected in surface water and sediment at locations throughout the air station. ATSDR screened the surface water and sediment sampling data collected for NAS Brunswick by comparing the detected concentrations to health-based screening values.³ Few chemicals were present at levels that exceeded ATSDR's CVs. Detections that did exceed CVs differed by less than an order of magnitude and mostly occurred in pre-1997 sampling rounds. Later sampling rounds show that the detected contaminant concentrations were generally lower—typically below the contaminants' CVs. Overall, the sampling results show little variation by type or extent of contamination between locations on site.

VOCs and metals were the most common contaminants in surface water samples. Polycyclic aromatic hydrocarbons (PAHs) and manganese slightly exceeded their CVs, while other VOCs and metals were reported at concentrations well below their respective CVs. Most of the tested analytes in sediment were also below ATSDR's CVs. Benzo(a)pyrene concentrations at Site 9 exceeded the ATSDR CV of 0.1 parts per million (ppm) in several rounds of early sampling. PAHs were measured in the early

³ ATSDR does not have CVs for surface water or sediment. For comparison, ATSDR uses CVs for drinking water and soil when assessing surface water and sediment exposures, respectively. Using the drinking water and soil CVs is more protective because these CVs consider greater exposure to contaminants than people are likely to incur through incidental ingestion of surface water or contact with stream sediment.

sampling rounds at concentrations up to almost 400 ppm. Those concentrations, although still high at some sample locations, have generally decreased over time. Levels of benzo(a)pyrene and PAHs are considered to be by-products of aircraft engine combustion that are washed from aircraft flight line pavements and into surface water by storms (P. Kempf, water program manager, NAS Brunswick, personal correspondence, July 8, 2004).

Evaluation of Public Health Implications of Surface Water and Sediment Contamination

Low levels of contamination have been detected in Mere Brook and Merriconeag Stream, which run through NAS Brunswick. ATSDR examined whether anyone who lives near or frequents the NAS Brunswick facility has been or could be exposed to the contaminants in surface water or sediment of area water bodies. According to the Navy, waterways on the base are not used for any recreational purposes (e.g., fishing and swimming). Picnic Pond is located in a recreational area of the base; however, use of the pond for any recreational activity is prohibited because of historical contamination by PAHs. The Navy posts signs around the pond to warn visitors against swimming, fishing, and ice skating. Waterways are not used for drinking water, either. Therefore, little contact with surface water occurs.

People who could come in contact with Merriconeag Stream surface water include NAS Brunswick workers and residents who might occasionally visit the stream. Exposure to any contaminants in surface water would be limited to dermal contact (e.g., wading) and would likely be infrequent for most exposed people. Furthermore, surface water and sediment data collected since 1988 indicate that only low levels of contaminants were measured in the surface water and sediment samples on site. These levels are sufficiently low that they would not be expected to cause health effects following short-term contact. Therefore, ATSDR concludes limited use of the waterways, which might result in exposure to relatively low levels of contamination, is not likely to be a public health hazard. Ongoing groundwater and soil remediation activities described in site documentation should reduce or eliminate possible future sources of surface water and sediment contamination entering Mere Brook and Merriconeag Stream.

III.D. Possible Exposure to Contaminants for Consumers of Venison

Summary

NAS Brunswick supports a local white-tailed deer population. Contaminants have been detected in on-site soil where deer might graze. Bioaccumulation studies conducted at other military bases demonstrate that deer are unlikely to accumulate contaminants similar to those found at NAS Brunswick to levels that could be harmful to consumers of venison. Therefore, consumption of venison taken from the air station poses no harm to public health.

Discussion

NAS Brunswick supports a large white-tail deer population. People are allowed to bow hunt on the base itself, between noon and 4 p.m., from September through December each year. All bow hunters have restricted access—they are required to remain in hunting stands during their hunts. (No hunting stands exist in the enclosed weapons area where an albino deer population resides.) The base also conducts hunts to control the base's deer population. Deer meat from the controlled hunts is donated to local charities. About 40 deer were taken in 2003 (K. Moore, NAS Brunswick Natural Resources, personal correspondence, 2003).

No studies have been conducted to monitor accumulation of contaminants, if any, by the air station's grazing deer population. It is possible that the deer may have been exposed to contaminants in soil present at the site. These contaminants, according to site investigations, include asbestos at Site 5, PAHs and pesticides at Sites 7 and 8, and metals at Site 8. There is a concern that someone consuming venison that has accumulated site-related contaminants may be indirectly exposed to those contaminants. Most of the contaminated soil has been removed from those sites so that current and future exposure would be limited.

In the absence of these site-specific data, ATSDR reviewed the findings of studies that investigated whether grazing deer at other military sites had accumulated chemical contaminants similar to those found at NAS Brunswick (USACHPPM 1994; USAEHA 1994). The studies showed that the deer demonstrated limited ability to bioaccumulate the contaminants at these sites (USACHPPM 1994). The authors of these studies concluded that the health hazard from consuming muscle (and liver) from the deer was minimal (USAEHA 1994). As a result, ATSDR believes harmful levels of site-related contaminants are not likely to accumulate in deer that graze at the air station. Therefore, ATSDR believes that people who consume venison taken from NAS Brunswick are not likely to experience any harmful health effects. Potential future exposures to site contaminants via this indirect exposure pathway are being reduced, as the Navy has removed and continues to remove contaminated soils from the site. *ATSDR concludes that consumption of deer poses no apparent health hazard to hunters and those who eat venison taken from NAS Brunswick.*

III.E. Possible Vapors in Buildings Above or Near Groundwater Contamination

Summary

Contaminated groundwater from leaks and spills at the base has migrated near certain on-base buildings. The most common contaminants in the groundwater are VOCs. Under some conditions, these VOCs can travel from the groundwater through the soils, seeping into air inside buildings. Occupants of on-site buildings were most likely not exposed to indoor air vapors at high enough levels or for long enough periods to develop long-term health effects. Vapors possibly associated with the low level of groundwater contamination have not entered the buildings and adversely affected indoor air quality. Buildings above or near the groundwater contamination, therefore, are not expected to accumulate indoor air contaminants to levels that could pose harm to the occupants.

Discussion

Spills or releases of chemicals have occurred near the Fleet and Family Support Center and the BEQ on Neptune Drive. ATSDR assessed groundwater contamination in and around these buildings, considered whether vapors seeped into the buildings above the contamination, and assessed whether occupants of these buildings might have been exposed to harmful levels of air contaminants.

Fleet and Family Support Center and VOC Groundwater Contamination

Building 27, the Fleet and Family Support Center, was built at the base to provide transition assistance and other support services to families living at the air station. Activities conducted at the center are largely administrative. The center sits downgradient of the Navy Exchange (NEX) service station (Building 538), where—before the family center was built—gasoline started leaking into the subsurface soil (NAS Brunswick 2003b, EA 2004a). Figure 6 shows the location of the NEX service station and Building 27. Most of the gasoline releases at the site appear to be associated with the corroded piping in use from 1975 to 1992. The piping, or product lines, connected three underground storage tanks (USTs) to the pumping island at the service station. Initial indications of a release occurred in 1981, when gasoline odors in the area of the product were first reported. At that time, a leaking product line fitting was found and repaired following a surface soil removal action. Another incident of gasoline releases from a leaking piping was reported in 1992 during the removal of the former USTs.

Environmental investigations at the gas station, beginning in 1992 when the USTs were inactive, confirmed the presence of petroleum hydrocarbons and benzene, toluene, ethylbenzene, and xylene (BTEX) in the soils near the USTs (EA 2000b; EA 2004a). The most heavily affected area was located just southwest of the UST area. After removing the USTs, piping, and 40 tons of petroleum-contaminated soils in 1992, the Navy maintained a soil vapor extraction (SVE) system from 1993 to 2003 to treat residual contaminants in soil and groundwater at the gas station. In total, the system actively removed more than 1,800 gallons of gasoline from the subsurface soil in the area of contamination. Following use of the SVE remedial system, the vadose zone soil (from 0

to 6–8 feet below ground surface [bgs]) appears to be essentially free of petroleum contamination. The Navy installed three new 10,000-gallon fiberglass USTs in 1993 to continue petroleum storage and distribution operations at the service station. Information was not available, however, regarding potential gasoline releases associated with the existing fiberglass UST and product lines (EA 2004a).

Some residual soil contamination associated with weathered gasoline is still present from the groundwater interface (approximately 6–8 feet bgs) to the marine clay formation (approximately 16–20 feet bgs) in the fueling island and UST-related source areas. Soil in these areas exhibits petroleum hydrocarbon concentrations ranging from 500 ppm to greater than 8,000 ppm. Residual saturated soil contamination likely serves as an ongoing source of petroleum hydrocarbons in groundwater.

As noted, the Fleet and Family Support Center is downgradient of the NEX service station. Around 1983, employees at the center reported petroleum odors within the building (EA 2004a). Employees continued to periodically file complaints about the odors over time. The Navy installed a passive SVE vent (wind turbine) to the footing drain at the northern foundation wall of the center in 1989 as a means to divert and exhaust organic vapors into the atmosphere. An inspection of the exhaust stack and associated discharge point at the center indicated that the building could have been impacted by potential gasoline releases from the upgradient service station (EA 2004a).

In 1994, some center employees reported episodes of headaches, nausea, and burning eyes. In response, the Navy tested air quality and inspected the ventilation system. Indoor air samples were collected at the time to identify possible airborne contaminants that could produce the symptoms, and determine whether these contaminants could be linked to the upgradient fuel releases. Samples were analyzed for constituents of gasoline. Results of the air sampling showed no evidence of airborne contaminants inside the center—including benzene, a key component of gasoline. Results of the ventilation system investigation determined that the system was not working effectively. Employees' symptoms disappeared once the system was repaired (NAS Brunswick 2003b).

Starting in March 1995, the Navy began a quarterly monitoring program to test groundwater downgradient of the gas station. The highest levels of fuel-related constituents were measured in monitoring wells immediately south and downgradient of existing USTs or south of the pump island (EA 2000b). By 1999, the Navy started direct-push soil and groundwater sampling near Buildings 538 and 27 to better describe the source, extent, and concentration of contaminants near and downgradient of the former and existing USTs and to further assess the existing SVE system at Building 538.⁴ Groundwater collection included samples taken at depths from 5 to 10 feet bgs west and southwest of the Fleet and Family Support Center. It appears that gasoline constituents, such as benzene, had sorbed to soil, therefore VOCs were not detected in groundwater samples.

⁴ Direct-push sampling was used because it permitted frequent sampling with limited disruption to the site and ongoing service station activities.

The air in Building 27's work spaces was sampled again in July 2003 (with a deactivated heating, ventilation, and air conditioning [HVAC] system) and January 2004 (with an activated HVAC system) as part of the overall remedial action for the NEX site. The July samples were collected every 3 hours over an 18-hour period and the January samples were collected at various times over a 3-day period. Samples were analyzed for constituents of petroleum hydrocarbons, including benzene, toluene, ethylbenzene, total xylenes, n-hexanes, naphthalene, n-nonane, sec-butylbenzene, iso-propylbenzene, n-propylbenzene, 2-butanone, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene. Table 5 lists the results of this air sampling at Building 27. As noted in the table, toluene (1.2–1.8 ppb), 2-butanone (4.0 ppb), and naphthalene (1.5–3.5 ppb) were detected in the indoor air; however, only naphthalene was measured at concentrations above its ATSDR CV (0.7 ppb) (EA 2004b). No other petroleum compounds were detected in the air samples. One sample collected from the outside footing drain contained VOCs, including benzene at a concentration (8.2 ppb) above its ATSDR CV. As noted, no elevated concentrations of benzene were reported inside the building. Soil vapor concentrations beneath the building (0.54–1.78 ppm) were low and consistent with background (EA 2004b).

It is still unclear what triggered the Fleet and Family Support Center employees' symptoms. The effects reported (eye irritation, headaches, and nausea) are among the symptoms that some people experience shortly after breathing in air containing certain compounds in petroleum hydrocarbons. Even so, no contaminants were detected in the air inside the support center following the reports of symptoms in 1994. The VOCs detected more recently were at concentrations far lower than those known to cause immediate health effects. For example, the maximum detected concentration of toluene inside the building is more than 555 times lower than the ATSDR CV for acute (short-term) exposure. Exposure to concentrations of toluene at this level is not expected to result in health effects.

Whether an exposure to VOCs might cause long-term health effects varies greatly from one pollutant to another, and depends on many factors including level of exposure and length of time exposed. As Table 5 indicates, naphthalene was detected at concentrations above its ATSDR CV for chronic exposure. Concentrations of other VOCs in the indoor air were more than 44 times lower than ATSDR CVs. Potential background sources of naphthalene common to the indoor environment include industrial uses, moth repellents, and burning wood and tobacco (ATSDR 2003). These sources are especially likely given the low maximum reported concentration and the absence of other petroleum constituents in indoor air (NAS Brunswick 2003b, EA 2004b).

Currently, the base is assessing the potential effectiveness of *in situ* denitrification-based biodegradation to mitigate residual petroleum hydrocarbons remaining below the groundwater interface (EA 2004a). The preliminary results show that groundwater concentrations of petroleum hydrocarbons have recently increased by several orders of magnitude due to releases of contaminants from soils. As a result, petroleum hydrocarbons may migrate to downgradient locations and likewise increase in concentration in downgradient wells during future sampling rounds.

Symptoms reported by the Fleet and Family Support Center employees in 1994 disappeared once the ventilation system was repaired, and there appears to be no current threat to indoor air. Accordingly, ATSDR finds no long-term health hazard associated with the air inside the center, but encourages the Navy to continue to track the groundwater contamination associated with the upgradient gasoline release and potential impact on the family center.

Bachelor Enlisted Quarters

Three bachelor enlisted quarters (BEQ) facilities, Buildings 218, 219, and 220, are located along Neptune Drive, in what is now a portion of Site 9.⁵ The barracks, which were constructed in 1953 to house single military personnel, are still in use but will be demolished in 2005. While these buildings lack basements, they have below-grade insulated crawl spaces and mechanical rooms (NAS Brunswick 2004b). Figure 7 shows the location of the barracks. Before being used for residential facilities, a portion of the land occupied by the barracks was reportedly used as a 125 x 75-foot ash landfill (underneath Building 219) in the 1940s and 50s and was the location of an incinerator (underneath the north corner of Barracks 220).

Site documents indicate that the incinerator operated at times between 1943 and 1953 to burn solid waste. Ash from the incinerator was disposed of in the landfill, as were other wastes, including solvents which were burned on the ground, paint sludges, and possibly waste from the Metal Shop (ABB 1994a, 1994b).

Groundwater in the area of the barracks varies in depth from 10 to 14 feet bgs and generally flows to the south and southeast (ABB 1994b). Groundwater sampling in 1988, 1990, and 1993, and before site remediation, at five wells in the area of the barracks 219 and 220 identified VOCs at concentrations above ATSDR's CVs for drinking water. Vinyl chloride (up to an estimated 10 ppb) was detected at concentrations above the ATSDR CV of 0.03 ppb in a groundwater monitoring well (MW915) located south and downgradient of the ash landfill area (ABB 1994b). The VOCs 1,1-DCA and 1,2-DCE were detected in the same well, but only at concentrations up to an estimated 1 ppb—below ATSDR's CVs. These compounds were not detected in the ash or soil samples from the disposal area. PAHs in the ash and soil at the disposal area were not, however, found in the groundwater (ABB 1994b).

Groundwater contamination in the vicinity of the barracks involved the shallow aquifer at depths less than 15 feet. The contaminants in the groundwater are VOCs that can volatilize into vapor. At such shallow depths, these vapors can, in turn, move from the groundwater through soil, and eventually seep into foundations and affect the indoor air. Indoor air sampling data were not available for the barracks situated in the area of the VOC groundwater contamination. To help determine whether vapor intrusion contributed

⁵ Buildings 216 and 217 were also a part of the bachelor enlisted quarters (BEQs) located within the current Site 9 boundaries. Building 216 no longer exists and Building 217, now vacant, is scheduled for demolition in the fall of 2004. Other buildings (212–215) once part of the BEQ area were located upgradient to and away from the current Site 9 contamination.

to unhealthy levels of indoor air at the barracks, ATSDR applied an *attenuation factor* to the groundwater concentrations detected in the area of the barracks (see text box) to estimate air contaminant concentrations inside the BEQs. Factors such as foundation type, soil type, and depth to water will likely influence VOC migration. ATSDR believes that the median attenuation factor of 10^{-4} is protective for most situations.

ATSDR has no way of determining what the groundwater concentrations were over the entire time the barracks have been occupied. As a protective measure, ATSDR used the maximum contaminant concentrations detected in the groundwater collected in 1985, 1990, and 1993 (before the implementation of Site 9 clean-up measures) to estimate indoor air concentrations. Table 6 presents ATSDR's estimated indoor air concentrations for the barracks based on the maximum concentrations of VOCs detected in the groundwater near the BEQs. The maximum groundwater concentrations used by ATSDR to estimate indoor air concentrations are 10 ppb for vinyl chloride, 1 ppb for 1,1-DCA, and 1 ppb for 1,2-DCE. The indoor air concentrations that would result from applying the median attenuation factor of 10^{-4} to the maximum groundwater concentration are on the order of 0.001 to 0.0001 ppb and would be below ATSDR's CV for these compounds. ATSDR's estimates suggest that concentrations of vapors that possibly entered the barracks would have been much lower than the CVs and the concentrations at which we would expect to see adverse health effects. By comparing these estimated concentrations to ATSDR's CVs, which are based on a lifetime of exposure, we add a greater level of conservatism, because residents of the barracks would have been exposed at most for only a few years, the typical length of a military assignment.

Attenuation factors concentration to the groundwater concentration at some depth below the building foundation. Scientists have measured groundwater-to-indoor air attenuation factors ranging from 10^{-2} to 10^{-7} , with a median value around 10^{-4} . The median attenuation factor corresponds to a 10,000-fold decrease of indoor air concentrations relative to groundwater concentrations. Factors such as foundation type, soil type, and depth to water influence VOC migration.

IV. Community Health Concerns

Through the PHA process, ATSDR has gathered information about health concerns voiced by members of the community. In gathering this information, ATSDR interviewed base public affairs personnel who address community questions and concerns about NAS Brunswick, met with other base personnel (including the industrial hygienist, natural resources, public works, and housing) who also meet with the public, and reviewed the results of the base's survey of community concerns. The primary concern identified through these sources focused on the impact of Site 8 on the Jordan Wellfield. One individual also asked about the potential for site contamination to affect Mere Brook and Harpswell Cove. ATSDR has considered these issues in Section III of this PHA.

The Navy established a community relations plan in September 1988. This outlined the Navy's approach to address public concerns and keep citizens informed about and involved in remedial activities (EC Jordan 1988). As part of its community relations activities, NAS Brunswick formed a restoration advisory board (RAB). The RAB, made up largely of local community members, meets to periodically review base documents and comment on actions and proposed actions by NAS Brunswick.

V. Child Health Initiative

ATSDR recognizes that the unique vulnerabilities of infants and children demand special emphasis in communities faced with contamination of their water, soil, air, or food. Children are at greater risk than adults from certain exposures to hazardous substances emitted from waste sites and emergency events involving hazardous chemicals. In general, children are more likely to be exposed because they play outdoors, have more hand-to-mouth behavior, and often bring food into contaminated areas. They are shorter than adults, which means they breathe dust, soil, and heavy vapors that are close to the ground. Children are also smaller, so they receive higher doses of chemical exposures proportional to their body weight. The developing body systems of children can sustain permanent damage if toxic exposures occur during critical growth stages. Most importantly, children depend completely on adults for risk identification and management decisions, housing decisions, and access to medical care.

ATSDR has attempted to identify populations of children in the vicinity of NAS Brunswick and any public health hazards associated with the site that have threatened or could threaten these children. There are approximately 909 children aged 6 years and younger within a 1 mile radius of NAS Brunswick.

After carefully evaluating potential exposure pathways associated with NAS Brunswick, ATSDR determined that no harmful childhood exposures have occurred in the past, nor are they expected to occur now or in the future. Although contaminants have been detected at NAS Brunswick, ATSDR determined that children cannot access the site or locations of contamination at the site. Children could visit Mere Brook or Merriconeag Stream that flow through the site. Contaminants that have entered the surface water and sediment of the tributaries are below levels that could cause harmful health effects for these children. (Exposure pathways are discussed in the “Evaluation of Environmental Contamination and Potential Exposure Pathways” section of this public health assessment.)

VI. Conclusions

Conclusions regarding potential past, current, and future exposure situations on NAS Brunswick, and in the communities near NAS Brunswick, are based on a balanced evaluation of site investigation data and observations made during site visits. Conclusions about exposures are described below. (The public health hazard conclusion categories are described in Appendix A.)

- **Contaminated groundwater and drinking water use.** Contaminants from former site activities have leached into the groundwater beneath NAS Brunswick. No one has come in contact with contaminated groundwater, nor is anyone expected to in the future. The majority of NAS Brunswick and the surrounding community obtain their drinking water from the Brunswick and Topsham Water District. Testing required by EPA and Maine Department of Health and Human Services (MEDHHS) Bureau of Health indicates that the municipal drinking water meets safe drinking water standards. A few wells at or near the base that supply the golf course, gatehouse, and private residents with drinking water are not affected by site contamination. The groundwater will be monitored in the future, and deed restrictions will prevent any future use of contaminated water for drinking purposes. ATSDR concludes that *no apparent past, current, or future public health hazard is associated with groundwater contamination from NAS Brunswick and local private well use.*
- **Possible exposure to contaminants in on-site or nearby surface water bodies.** NAS Brunswick contaminants have reached local tributaries that run through the air station. These tributaries are not used for drinking water or for recreation. Incidental exposures (via skin contact) during occasional visits to the tributaries are the only types of exposures that are likely to occur. It is reasonable to expect that people will not contact contaminants in the tributaries' surface water and sediment often enough or at high enough levels for a health concern to exist. Moreover, the low contaminant concentrations are expected to further decrease through remediation and natural attenuation before the water reaches the downstream waterways. Thus, *past, current, and future exposures associated with on-site or nearby waterways pose no apparent public health hazard.*
- **Possible exposure to contaminants for consumers of venison.** NAS Brunswick supports a large population of deer that graze at some IRP sites where soil contamination has been detected. Deer hunting is permitted at the air station. Deer at the air station that have been consumed or might be consumed by humans do not appear to pose a public health hazard because the chemicals detected in the soil do not typically accumulate to harmful levels in deer tissue. Therefore, *past, current, and future consumption of venison poses no apparent public health hazard.*
- **Possible vapors in on-site buildings above or near groundwater contamination.** The Fleet and Family Support Center and the bachelor enlisted quarters (BEQ) at NAS Brunswick sit near or above groundwater contaminants released by former site activities. ATSDR believes that people who worked or lived in the buildings did not

encounter harmful levels of indoor air vapors from the underlying groundwater plumes. ATSDR concludes that there is *no apparent past public health hazard associated with vapor intrusion*. Likewise, *vapor intrusion poses no apparent current or future public health hazards* at the family center. Even though there is no current long-term health hazard associated with the air inside the center, ATSDR encourages the Navy to continue to track the groundwater contamination associated with the upgradient gasoline release and potential impact on the family center. The remaining BEQ buildings are scheduled to be demolished in 2005 and thus pose no future public health hazard.

VII. Public Health Action Plan

The public health action plan (PHAP) for NAS Brunswick describes actions taken and to be taken by the Navy, ATSDR, EPA, MEDEP, and MEDHHS Bureau of Health at and near the site after this PHA is completed. It provides a plan of action designed to mitigate and prevent adverse human health effects resulting from exposure to hazardous substances in the environment. The public health actions that are completed, ongoing/planned, or recommended are as follows:

Completed Actions

1. The Navy began an investigation of the environmental conditions at NAS Brunswick in 1983 and 1984 to identify possible contaminant sources. The initial assessment—and subsequent Navy investigations—did confirm the presence of contamination at the air station.
2. EPA placed NAS Brunswick on the NPL in 1987.
3. The remedial investigation/feasibility study process began in 1987 for seven sites. Through the various investigations, the Navy eventually identified and investigated 13 sites with hazardous releases.
4. In October 1990, the Navy entered into a Federal Facilities Agreement with EPA and MEDEP regarding the cleanup of the environmental contamination at NAS Brunswick.
5. The Navy identified a VOC groundwater plume, called the Eastern Plume, extending north to south along the eastern boundary of the base. The VOCs in the plume, which primarily affect the deeper portion of the overburden groundwater beneath the site, have been traced to Sites 4 (an acid/caustic disposal pit), 11 (a former fire training area), and 13 (the Defense Reutilization and Marketing Office).
6. The Navy installed an extraction and treatment system in 1995 as an interim action to contain the Eastern Plume as a measure to prevent it from migrating further toward Harpswell Cove.
7. The Navy has instituted long-term monitoring plans that call for semi-annual sampling of various media (including surface water) at most IRP sites. To date, they have completed between 18 and 23 sampling events for groundwater, surface water, and stream sediment at Sites 1 and 3 (and the Eastern Plume), Site 7 (Building 95), and Site 9. They have also concluded eight monitoring events at Site 2.
8. The Navy has undertaken measures to reduce the sources of contamination at NAS Brunswick. These measures include the construction of a low-permeability RCRA cap over the landfills at Sites 1 and 3 in 1996, and a slurry wall around the waste to divert clean water from the landfills; the 1999 removal of soils from Sites 4 and 13 that were considered the source of the Eastern Plume; removal of asbestos-

contaminated soil and pipes and other debris from Sites 5 and 6; a limited soil removal at Site 7; and two soil removal actions at Site 11.

9. ATSDR visited NAS Brunswick in December 2003 to tour the site, meet with site representatives, and gather environmental and exposure information to complete the public health evaluation.

Ongoing and Planned Actions

1. The Navy plans to test a denitrification-based biodegradation process to accelerate cleanup at the NEX service station site to reduce gasoline range organic petroleum concentrations in soils beneath the water table to 500 mg/kg within the area of highest contamination.
2. The Navy has agreed to conduct routine groundwater monitoring along the Eastern Plume and at other sites (e.g., Site 1 and 3) where contamination in groundwater exceeds regulatory guidelines.
3. The Navy continues to operate the groundwater extraction system to control the migration of, and reduce the VOC concentrations in, contaminated groundwater on the site. The system has been most effective in reducing VOC groundwater concentrations in the vicinity of the extraction wells. In total, the system has removed 425 kilograms (or about 1,140 pounds) of VOCs since pumping began (MEDEP 2004).
4. The Navy plans to remove contaminated soil from Site 7, demolish the barracks and remove the landfill at Site 9, and conduct additional investigation at Site 2.
5. The Navy formally added institutional controls in 2000 as safeguard to restrict the use of groundwater from beneath specific areas on the air station. They are currently considering instituting base-wide controls for groundwater use restrictions.

Recommended Actions

1. If new information from site investigations identifies contaminants in site media above ATSDR's health-based CVs, and if requested, ATSDR will assess contaminant data and exposure situations to determine if any public health hazards exist. If requested, ATSDR also will re-evaluate the potential for public health hazards if changes in proposed land use, remedial activities, or risk management actions (e.g., institutional controls) might lead to future exposures.

VIII. Preparer of the Report

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Tables

Table 1. Evaluation of Public Potential Health Hazards at NAS Brunswick

Site	Site Description/Waste Disposal History	Investigation Results/Environmental Monitoring Results	Corrective Activities and/or Current Status	Evaluation of Public Health Hazard
<p>Site 1 Orion Street Landfill-North</p>	<p>Site 1 covers about 60 acres in the restricted munitions area in the center of the of the air station. About 8½ acres of this site were used for disposal of garbage, refuse, waste oil, solvents, paint wastes, and aircraft and vehicle parts. The site was open from about 1955 to 1975.</p>	<p>Groundwater: Samples collected during the 1988-1989 remedial investigation (RI) field activities were analyzed for volatile organic compounds (VOCs), pesticides/ polychlorinated biphenyls (PCBs), and metals. One area of contamination near the Site 1 and 3 landfills contained vinyl chloride (up to 180 parts per billion [ppb]) and benzene (up to 7 ppb) at levels above ATSDR’s comparison values (CVs). Another collection of VOCs was observed east of the Site 1 and 3 landfills and contained tetrachloroethylene (PCE) (up to 24 ppb), trichloroethylene (TCE) (up to 240 ppb), and 1,1,1-trichlorethane (TCA) (up to 530 ppb), but lacked benzene, toluene, ethylbenzene, and xylene (BTEX). Arsenic (up to 107 ppb) and manganese (up to 3,500 ppb) exceeded their ATSDR CVs. Pesticides and PCBs were not reported.</p>	<p>The Navy issued a record of decision (ROD) in 1992 to address containment of the buried wastes at Sites 1 and 3, and recovery of contaminated groundwater to prevent further migration. The selected remedy consisted of construction of a 12-acre double barrier landfill cap, a 2,220-foot slurry wall, and a groundwater extraction and treatment system. After 2½ years of groundwater extraction, the Navy shut down the extraction wells within the landfill in 1997. The groundwater table had dropped below the landfill waste except at one location. The selected remedy also included monitoring of groundwater, surface water, sediment, leachate, and leachate seep sediment, as well as land use and groundwater use restrictions.</p>	<p>After reviewing the site data and potential exposure scenarios, ATSDR anticipates no public health hazards at this site. There is no public access, groundwater beneath the site is not used for drinking purposes, and measures have been taken to reduce contaminant concentrations.</p>

Table 1. Evaluation of Public Potential Health Hazards at NAS Brunswick

Site	Site Description/Waste Disposal History	Investigation Results/Environmental Monitoring Results	Corrective Activities and/or Current Status	Evaluation of Public Health Hazard
<p>Site 1 (continued)</p>		<p>Surface water and sediment: Samples were analyzed for VOCs, semi-volatile organic compounds (SVOCs), pesticides/PCBs, and metals. TCE was detected up to 31 ppb in surface water samples collected next to a spring near Mere Brook beaver marsh. SVOCs, metals, pesticides, and PCBs were either not detected or detected at concentrations below CVs in surface water samples. Total polycyclic aromatic hydrocarbons (PAHs) up to 18,060 ppb were detected in sediment. VOCs, pesticides/PCBs, and metals were either not detected or detected at concentrations below ATSDR’s CVs.</p> <p>Leachate seeps: Seven seep locations were sampled during the 1988-1989 RI activities for VOCs, SVOCs, pesticides/PCBs, and metals. The seeps contained VOCs, metals, and in one case, pesticides. Some of the concentrations exceeded ATSDR’s CVs. The detected compounds were consistent with those found in the landfill area groundwater.</p>	<p>Monitoring continues on a biannual basis. In 1994, the Navy—with EPA and MEDEP concurrence—used the excavated material from Sites 5, 6, 8 and 8 as subgrade material in the cap at Site 1. Wastes from Site 11 were also placed under the landfill cap at this site.</p>	

Table 1. Evaluation of Public Potential Health Hazards at NAS Brunswick

Site	Site Description/Waste Disposal History	Investigation Results/Environmental Monitoring Results	Corrective Activities and/or Current Status	Evaluation of Public Health Hazard
<p>Site 2</p> <p>Orion Street Landfill-South</p>	<p>Site 2 was reportedly used as the primary base landfill from 1945 to 1955. Although the base was closed from 1946 to 1951, the September 1998 ROD for Site 2 indicates that non-military tenants may have used the property during that time. The site is located south of Mere Brook, opposite Sites 1 and 3. The actual waste disposal area of the site covers about 2 acres and was used for the disposal of paints, solvents, oils, toluene, methyl ethyl ketone, and medical supplies. Solid waste was also reportedly incinerated at the site.</p>	<p>Groundwater: Groundwater was analyzed for VOCs, SVOCs, PCBs/pesticides, and metals during the 1988–1989 RI activities. No VOCs, SVOCs, or PCBs/pesticides were detected at concentrations above CVs. Arsenic (up to 15 ppb) was detected at levels above its CV.</p> <p>Surface soil: Three surface soil samples collected near a seep were analyzed for VOCs, SVOCs, pesticides, and metals. No VOCs or SVOCs were detected. Metals were detected but at concentrations below CVs. DDT (up to 23 ppb) exceeded ATSDR CVs.</p> <p>Surface water: Surface water samples collected from a tributary of Mere Brook were analyzed for VOCs, SVOCs, PCBs/pesticides, and metals during 1988–1989 RI activities and again between 1995 and 2002. VOCs, PCBs, and pesticides were either not detected or detected at concentrations below CVs. Cadmium (up to 15.4 ppb) and manganese (up to 3,100 ppb) exceeded ATSDR CVs for drinking water. Total PAHs ranged from 1,630 ppb to 1,670 ppb. (ATSDR has no CV for total PAHs.)</p> <p>Sediment: RI field work found no VOCs, SVOCs, or PCBs/pesticides. Metal concentrations exceeded levels typical of background sediments.</p>	<p>Visible metal debris was removed in 1999 and the landfill slope was stabilized and regraded. Because of the minimal risks at the site, the remedy selected in the 1998 ROD was long-term monitoring and institutional controls. Institutional controls were implemented in 1999. Long-term monitoring started in 2000 and was revised in 2001. Long-term monitoring program (LTMP) results show that groundwater, surface water, and sediment contaminant concentrations are below ATSDR’s CVs.</p>	<p>After reviewing site data and potential exposure scenarios, ATSDR anticipates no public health hazards at this site. The site is surrounded by a chain-link fence to limit public access, groundwater beneath the site is not used for drinking purposes, and measures have been taken to reduce contaminant concentrations.</p>

Table 1. Evaluation of Public Potential Health Hazards at NAS Brunswick

Site	Site Description/Waste Disposal History	Investigation Results/Environmental Monitoring Results	Corrective Activities and/or Current Status	Evaluation of Public Health Hazard
		<p>Leachate Seeps: Metals (e.g., mercury and iron) were found at levels above background concentrations. Low levels of pesticides (less than 1.0 parts per million (ppm) and polycyclic aromatic hydrocarbon (PAH) compounds (maximum of 1.7 ppm) were also detected. These contaminants are consistent with the historical land use and disposal of incinerated wastes at this site. Buried ash would contribute to metal contamination in leachate downgradient of the landfill. The low levels of pesticides detected are assumed to be residual concentrations resulting from historical, basewide use of these compounds in the 1960s and 1970s.</p>		
<p>Site 3 Hazardous Waste Burial Area</p>	<p>Site 3, just southwest of Site 1, was operated from about 1960 to 1973 for disposal of waste. Waste disposed of in the area included solvents and paints. The site currently consists of a small knoll covered with grass and a pine grove.</p>	<p><i>See Site 1.</i></p>	<p><i>See Site 1.</i></p>	<p><i>See Site 1.</i></p>

Table 1. Evaluation of Public Potential Health Hazards at NAS Brunswick

Site	Site Description/Waste Disposal History	Investigation Results/Environmental Monitoring Results	Corrective Activities and/or Current Status	Evaluation of Public Health Hazard
<p>Site 4 Acid/Caustic Pit</p>	<p>Site 4 reportedly consisted of a small open pit (4 square feet by 3 feet deep) that was used for liquid waste disposal during part of the 1960s and early 1970s. Waste disposed of in the pit included transformer oils, battery acids, caustics, paint thinners, TCE, and other solvents. This site is currently covered by the eastern end of Building 584 (at the Active Defense Reutilization and Marketing Office).</p>	<p>Groundwater: Groundwater samples collected during the 1989–1990 RI activities were analyzed for VOCs, SVOCs, PCBs/pesticides, and metals. TCE was detected at concentrations up to 23 ppb, above its CV. Metals were also detected, but at concentrations below ATSDR’s CVs. SVOCs, PCBs, and pesticides were not detected.</p>	<p>A no further action (NFA) ROD for soils was signed in February 1998. The lack of contamination in subsurface soils, in conjunction with the low groundwater concentrations, suggests that the source area is no longer contaminated. Some site documentation questions whether the presence of Building 584 prevented the collection of the soil samples directly beneath the pit. If the building is ever removed, then additional investigations and remedial actions may be necessary.</p>	<p>Having reviewed site data and potential exposure scenarios, ATSDR anticipates no public health hazards at this site. The public has limited access, groundwater beneath the site is not used for drinking purposes, and measures have been taken to reduce contaminant concentrations.</p>
<p>Site 5 Orion Street Asbestos Disposal</p>	<p>Site 5 consists of two trenches reportedly used for a short period in 1979 to bury asbestos-lined pipes from a demolished building. The ¼-acre site was covered with 1 foot of soil and marked with two warning signs in 1980.</p>	<p>Soil: Four surface soil samples taken in the vicinity of the pipes did not contain asbestos.</p>	<p>An ROD addressing Sites 5 and 6 was completed in August 1993. The selected remedy included removal of soil, construction debris, and asbestos-containing materials; backfilling with clean soil; encapsulation of asbestos-containing pipes in two layers of polyethylene; and transportation of all materials to Sites 1 and 3 for use as part of the landfill cap. Cleanup activities were completed in mid-1995. No land use restrictions, monitoring, or 5-year reviews are necessary at this area, as all materials were removed.</p>	<p>Having reviewed site data and potential exposure scenarios, ATSDR anticipates no public health hazards at this site. The public has limited access and measures have been taken to remove debris and asbestos-contaminated material from the site.</p>

Table 1. Evaluation of Public Potential Health Hazards at NAS Brunswick

Site	Site Description/Waste Disposal History	Investigation Results/Environmental Monitoring Results	Corrective Activities and/or Current Status	Evaluation of Public Health Hazard
<p>Site 6</p> <p>Sandy Road Rubble and Asbestos Disposal Site</p>	<p>Site 6 is a semicircular zone about 300 feet long in the northern portion of the site. The Navy reportedly used this site until the late 1970s for general dumping of asbestos-lined pipes, construction rubble, and aircraft parts. Vehicle access to Sandy Road is restricted to site personnel by a locked gate.</p>	<p>Groundwater: Groundwater samples were analyzed for VOCs, SVOCs, and metals. Contaminants either were not detected or were detected at concentrations below ATSDR CVs.</p> <p>Soil: Asbestos contamination was confined to subsurface layers because surface soil samples taken in the vicinity of the pipes did not contain asbestos.</p>	<p><i>See Site 5.</i></p>	<p>Having reviewed site data and potential exposure scenarios, ATSDR anticipates no potential public health hazards at this site. The public has limited access, the groundwater is not used beneath the site, and measures have been taken to remove debris and asbestos-contaminated material from the site.</p>

Table 1. Evaluation of Public Potential Health Hazards at NAS Brunswick

Site	Site Description/Waste Disposal History	Investigation Results/Environmental Monitoring Results	Corrective Activities and/or Current Status	Evaluation of Public Health Hazard
<p>Site 7</p> <p>Old Acid/Caustic Pit</p>	<p>Site 7 consists of the old acid/caustic pit operated from 1952 to 1969 for disposal of liquid, including transformer oil, battery acids, caustics, and solvents. The site was also reportedly used as an outdoor storage and equipment area. The site is located in the northern portion of the base, west of the main entrance road, and abuts the northeast fuel farm.</p>	<p>Groundwater: Samples collected during the 1988–1989 RI were analyzed for VOCs, SVOCs, and metals. Cadmium levels (up to 23 ppb) exceeded the EPA maximum contaminant level (MCL) of 5 ppb.</p> <p>Surface soil: Soil samples were analyzed for VOCs, SVOCs, PCBs/pesticides, and metals. Total PAHs reached levels up to 21.5 part per million (ppm). All other analytes were below ATSDR’s CVs.</p> <p>Surface water: Surface water collected between 1988 and 2002 were analyzed for VOCs, SVOCs, and metals. Cadmium was detected at a maximum concentration of 43.4 ppb, above the ATSDR CV for drinking water. Other analytes were either not detected or detected at concentrations below CVs.</p>	<p>In 2001, the Navy performed a limited removal of the source of cadmium in groundwater at levels slightly above EPA’s MCL. Groundwater sampling after the removal indicated that it had not been successful: cadmium was still detected in groundwater above the MCL. A ROD implementing groundwater monitoring and institutional controls was signed in September 2002. Five-year reviews will also be required. It is expected that the cadmium MCL will be reached in 10 years time via natural flushing. The Navy plans to remove contaminated soil from Site 7.</p> <p>The EPA produced a “Preliminary Close-Out Report” in September 2002 to document that the milestone of construction completion had been reached with the signing of the Site 7 ROD. This milestone means that a ROD has been signed for each site and that all sites have remedies in place.</p>	<p>Having reviewed site data and potential exposure scenarios, ATSDR anticipates no potential public health hazards at this site. The public has limited access, groundwater beneath the site is not used for drinking purposes, and measures have been taken to reduce contaminant concentrations.</p>

Table 1. Evaluation of Public Potential Health Hazards at NAS Brunswick

Site	Site Description/Waste Disposal History	Investigation Results/Environmental Monitoring Results	Corrective Activities and/or Current Status	Evaluation of Public Health Hazard
<p>Site 8</p> <p>Perimeter Road Disposal Site</p>	<p>Site 8 is an approximately 0.6-acre area located at the northern boundary of NAS Brunswick. Perimeter Road is adjacent to the southern edge of Site 8. North of Perimeter Road, the site is a flat, open area with steep, wooded embankments down to two small tributaries bordering the site on the northeast and northwest. Surface runoff from the northern 2,000 feet of NAS Brunswick drains into these tributaries, which flow north and discharge to the Androscoggin River. The Jordan Avenue Wellfield, used as a municipal drinking water supply for the town of Brunswick, is located north-northwest and upgradient of Site 8. The groundwater flow from Site 8 is not expected to impact the Jordan Wellfield. Seeps have been observed at the base of the slope of the embankment down to the northeastern tributary.</p>	<p>Groundwater: Samples collected during the 1988–1989 RI were analyzed for VOCs, SVOCs, pesticides, and metals. VOCs and most metals were detected, but at concentrations below ATSDR’s CVs for drinking water. Manganese (up to 4,240 ppb) was detected at levels above its CV.</p> <p>Surface soil: Soil samples were analyzed for VOCs, SVOCs, PCBs/pesticides, and metals. Total PAHs reached levels up to 21.5 ppm. All other analytes were below ATSDR’s CVs.</p> <p>Surface water/sediment: Samples collected from drainages on the south side of Perimeter Road during the 1988–1989 RI investigations were analyzed for VOCs, SVOCs, pesticides/PCBs, and metals. In surface water, lead (up to 1,500 ppb) and manganese (up to 910 ppb) exceeded ATSDR CVs for drinking water. Other analytes were either not detected (SVOCs, pesticides, and PCBs) or detected at levels below ATSDR’s CVs. In sediment, total PAHs reached a maximum of 80.2 ppm in one sample.</p>	<p>The Navy, with community involvement, has completed the site remediation, as outlined in the 1993 ROD for Site 8. The selected remedy involved excavation and removal of PAH-contaminated soil, backfilling with clean soil, construction debris, and rubble, and transportation of the material to Sites 1 and 3 (where it was used as part of the landfill cap). Cleanup activities, including site restoration, were completed in the fall of 1995. No land use restrictions, monitoring, or 5-year reviews are necessary at this area, since all materials were removed.</p>	<p>Having reviewed site data and potential exposure scenarios, ATSDR anticipates no potential public health hazards at this site. The public has limited access, groundwater beneath the site is not used for drinking purposes, and measures have been taken to reduce contaminant concentrations.</p>

Table 1. Evaluation of Public Potential Health Hazards at NAS Brunswick

Site	Site Description/Waste Disposal History	Investigation Results/Environmental Monitoring Results	Corrective Activities and/or Current Status	Evaluation of Public Health Hazard
<p>Site 9 Neptune Drive Disposal Site</p>	<p>Site 9 was identified as having three areas of potential contamination: (1) the former location of an incinerator in the northeast corner of Building 220 (BEQ) and an inactive ash landfill/dump area in the current location of Buildings 218 and 219, (2) a reported disposal area behind Building 201, and (3) the streams adjacent to Site 9. The incinerator reportedly burned solid waste. Incinerator ash was dumped in the disposal area. Likewise, solid waste consisting of solvents, paint sludge, and possibly waste from the metal shop was dumped at the disposal area. Solvents and liquids were also burned on the ground. A septic system east of Building 201 is thought to be the source of VOCs in groundwater.</p>	<p>Groundwater: Samples collected during the 1988–1989 RI were analyzed for VOCs, SVOCs, pesticides, and metals. No SVOCs or pesticides were detected. VOCs and metals were detected, but at concentrations below ATSDR’s CVs for drinking water.</p> <p>Surface soil: Soil samples were analyzed for VOCs, SVOCs, PCBs/pesticides, and metals. Total PAHs reached levels up to 24 ppm. DDT and DDE (up to 100 ppm) were detected at concentrations above ATSDR’s CVs. All other analytes were below ATSDR’s CVs.</p> <p>Surface water/sediment: Samples collected during the 1988–1989 RI and 1995–2002 LTMP investigations were analyzed for VOCs, SVOCs, pesticides/PCBs, and/or metals. In surface water, manganese (up to 1,300 ppb) exceeded its ATSDR CV for drinking water. Other analytes were either not detected (SVOCs, pesticides, and PCBs) or detected at levels below ATSDR’s CVs. In sediment, total PAHs reached a maximum of 383 ppm in one sample. VOC concentrations are relatively low.</p>	<p>An interim ROD was issued for Site 9 groundwater in September 1994. As the selected remedy for Site 9, the Navy began long-term monitoring of groundwater, surface water, and sediments in early 1995. Additional source investigations in the fall of 1995 did not identify a particular source of the VOC groundwater contamination. A final ROD was signed in 1999 and initiated in 2000 for natural attenuation, long-term monitoring, institutional controls, and 5-year reviews as the final remedy. An additional groundwater investigation was performed in 2003. The Navy agreed to continue to investigate possible groundwater contamination to the south during 2004. Demolition of the remaining barracks and removal of the landfill material is planned for 2005.</p>	<p>Having reviewed site data and potential exposure scenarios, ATSDR anticipates no potential public health hazards at this site. The public has limited access, groundwater beneath the site is not used for drinking purposes, and measures have been taken to reduce contaminant concentrations.</p>

Table 1. Evaluation of Public Potential Health Hazards at NAS Brunswick

Site	Site Description/Waste Disposal History	Investigation Results/Environmental Monitoring Results	Corrective Activities and/or Current Status	Evaluation of Public Health Hazard
<p>Site 11</p> <p>Fire Training Area</p>	<p>Site 11 is the Fire Training Area located on ½ acre in the central portion of the site. Liquid waste, such as fuels, oils, and degreasing solvents, were used in fire training exercises held at the site from 1960 to 1990.</p>	<p>Groundwater: Samples collected during the 1988–1989 RI were analyzed for VOCs, SVOCs, pesticides, and metals. PCE (up to 9 ppb), 1,1,1-TCA (up to 450 ppb), TCE (up to 10 ppb), and manganese (up to 733 ppb) were detected at concentrations above ATDSR’s CVs for drinking water. Other analytes were either not detected or detected at concentrations below CVs. More recent investigations showing only trace levels of groundwater contaminants at Site 11 indicate that residual soils at the site no longer contribute to the contamination in the Eastern Plume.</p>	<p>Soils from Site 11 were removed in two separate removal actions. An NFA ROD for soils was signed in February 1998. The Navy continues to monitor groundwater at this site through its LTMP. According to the Preliminary Close-Out Report for the site, a supplemental investigation detected no remaining contamination at Site 11. As of 2002, a large infiltration gallery (leach field) constructed over a portion of Site 11 has accepted clean treatment plant effluent without any detectable changes to the downgradient groundwater quality.</p>	<p>Having reviewed site data and potential exposure scenarios, ATSDR anticipates no potential public health hazards at this site. The public has limited access, groundwater beneath the site is not used for drinking purposes, and measures have been taken to reduce contaminant concentrations.</p>

Table 1. Evaluation of Public Potential Health Hazards at NAS Brunswick

Site	Site Description/Waste Disposal History	Investigation Results/Environmental Monitoring Results	Corrective Activities and/or Current Status	Evaluation of Public Health Hazard
<p>Site 12</p> <p>Explosive Ordnance Demolition</p>	<p>Site 12 consists of a bermed area of about 60 feet by 100 feet, with 5- to 6-foot berms. Located within the area are two small demolition craters and a dumpster. The dumpster was reportedly used for igniting small amounts of explosives and propellants. The pit was used from 1981–July 2004 and had a 25-pound explosive limit.</p>	<p>Groundwater: Not tested at this site.</p> <p>Soil: Soil samples were analyzed for explosive compounds and select metals. Low levels of mercury and nitrate/nitrite were measured in the surface soil samples, below background concentrations and ATSDR CVs. No explosive compounds were detected.</p>	<p>A risk assessment considering both worker and potential future residential exposure scenarios demonstrated that the concentrations in the surface soil were not of health concern. The Navy has proposed the closure of Site 12. EPA and MEDEP will assess closure documentation with the Navy in 2004. According to the Preliminary Close-Out Report, Site 12 was included in the Federal Facilities Agreement, but was deferred to the base compliance program due to continued occasional explosive ordnance disposal.</p>	<p>Having reviewed site data and potential exposure scenarios, ATSDR anticipates no potential public health hazards at this site. The public has limited access because Site 12 is a remote and highly secured area where access is controlled. Furthermore, groundwater beneath the site is not used for drinking water.</p>
<p>Site 13</p> <p>Defense Reutilization and Marketing Office</p>	<p>Site 13, the Defense Reutilization and Marketing Office, is a fenced enclosure of about 280 by 300 feet that borders Orion Street. Three USTs were first used at the site in the early 1970s. The USTs were used to store waste oils, fuels, and solvents. The three tanks were removed in the late 1980s.</p>	<p>Groundwater: Samples collected during the 1988–1989 RI were analyzed for VOCs, SVOCs, pesticides, and metals. The VOCs benzene (up to 16 ppb), 1,2-DCE (up to 770 ppb), and TCE (up to 15 ppb) were detected at concentrations above their ATSDR CVs. SVOCs, pesticides, and metals were either not detected or detected at concentrations below CVs.</p>	<p>The Navy removed the USTs from Site 13 in the late 1980s. An NFA ROD for soils was signed in 1998. The Navy continues to monitor groundwater at this site through its LTMP.</p>	<p>Having reviewed site data and potential exposure scenarios, ATSDR anticipates no potential public health hazards at this site. The public has limited access, groundwater beneath the site is not used for drinking purposes, and measures have been taken to reduce contaminant concentrations.</p>

Table 1. Evaluation of Public Potential Health Hazards at NAS Brunswick

Site	Site Description/Waste Disposal History	Investigation Results/Environmental Monitoring Results	Corrective Activities and/or Current Status	Evaluation of Public Health Hazard
<p>Site 14 Old Dump No. 3</p>	<p>Site 14 was shown as a former disposal area on a 1946 base map. The drawing showed an area labeled as Dump No. 3 at a location that is now surrounded by runway I-19 and taxiways A and D.</p>	<p>As part of the supplemental RI activities, a magnetometer survey was conducted in the area shown in the 1946 map. No anomalies were detected. Accordingly, no further investigations were conducted.</p>	<p>Site 14 was not included in the Federal Facilities Agreement, but was investigated with other sites under the NPL program. An NFA consensus statement was signed in July 2001 because Dump No. 3 either never existed or was removed during the construction of runway I-19 and taxiways A and D.</p>	<p>Having reviewed site data and potential exposure scenarios, ATSDR anticipates no potential public health hazards at this site. No area of contamination was identified, the public has had limited access to the site, and the underlying groundwater is not used as a source of drinking water.</p>
<p>Site 15 Merriconeag Extension Debris Site</p>	<p>Site 15 consists of concrete rubble and a soil dam that creates a ¾-acre pond on a small unnamed stream. The Navy first identified the site in 1990, which is located southeast of the NAS Brunswick golf course near Harpswell Cove. Although there has been no documented use of the area for dumping, miscellaneous debris was observed on the face of the dam and the ground surface.</p>	<p>Soil: PAH, pesticide, and metal concentrations were below background concentrations. Surface water: Contaminant concentrations were below background concentrations. Sediment: Contaminant concentrations were below background concentrations in the unnamed stream and pond.</p>	<p>Site 15 was not included in the Federal Facilities Agreement, but was investigated with other sites under the NPL program. The Navy conducted a magnetometer survey as part of the 1992 site inspection. All asbestos cement pipe sections and scrap metal debris items found were removed from the site and disposed of in 1999. A handheld magnetometer survey in 1999 confirmed the removal of all metal from the area. An NFA consensus statement was signed in July 2001.</p>	<p>Having reviewed site data and potential exposure scenarios, ATSDR anticipates no potential public health hazards at this site. The public has had limited access to the site and the underlying groundwater is not used as a source of drinking water.</p>

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Site	Site Description/Waste Disposal History	Investigation Results/Environmental Monitoring Results	Corrective Activities and/or Current Status	Evaluation of Public Health Hazard
<p>Site 16 Swampy Road Debris Site</p>	<p>Site 16 is located along the west bank of an unnamed stream in the NAS Brunswick golf course. The debris site was first noted by the Navy in 1990. Although no records on dumping exist, surface debris was visible along a 1,700-foot section of this stream.</p>	<p>Soil: PAH, pesticide, and metal concentrations were below background concentrations.</p> <p>Surface water: Contaminant concentrations were below background concentrations.</p> <p>Sediment: Contaminant concentrations were below background concentrations in the unnamed stream.</p>	<p>Site 16 was not included in the Federal Facilities Agreement, but was investigated with other sites under the NPL program. The Navy conducted a magnetometer survey as part of the 1992 site inspection. All debris items found were removed from the site and disposed of in 1999. Handheld magnetometer surveys in 1999 and 2000 confirmed the removal of all debris from the area. An NFA consensus statement was signed in 2001.</p>	<p>Having reviewed site data and potential exposure scenarios, ATSDR anticipates no potential public health hazards at this site. No areas of contamination were identified, and all debris items found were removed from the site and disposed of in 1999. Drinking water drawn from the nearby golf course well has been tested and has been shown to be free of site contamination.</p>

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Site	Site Description/Waste Disposal History	Investigation Results/Environmental Monitoring Results	Corrective Activities and/or Current Status	Evaluation of Public Health Hazard
<p>Site 17</p> <p>Building 95</p>	<p>Site 17, or Building 95, was used as the pesticide/herbicide storage area until 1985. The Navy has since demolished the building.</p>	<p>Groundwater: Groundwater samples collected since 1995 during the LTMP were analyzed for VOCs, SVOCs, pesticides, and metals. Manganese exceeded its ATSDR CV; all other parameters were generally below ATSDR’s CVs for drinking water.</p> <p>Surface soil: Pre-soil removal samples collected in 1994–1995 were found to contain high concentrations of DDT. Low levels of pesticides and herbicides were detected after the 1998 soil removal action.</p>	<p>At the completion of the baseline risk assessment, the Navy excavated the upper 1–7 feet of soil in the area of contamination, added a permeable liner to the excavated area, and backfilled the area with clean fill. (The interim soil removal report was issued in August 1998.) The Navy initiated a LTMP in 1995 for groundwater to assess whether residual levels found in confirmatory sampling might affect the groundwater. They revised their LTMP for this site in May 2000. According to the Preliminary Close-Out Report, Site 17 was not within the Federal Facilities Agreement or NPL listing. The site is being closed by MEDEP as the lead, with EPA oversight.</p>	<p>Having reviewed site data and potential exposure scenarios, ATSDR anticipates no potential public health hazards at this site. The public has limited access to the site, the Navy removed soil in the contaminated areas, and the underlying groundwater is not used as a source of drinking water.</p>

Table 1. Evaluation of Public Potential Health Hazards at NAS Brunswick

Site	Site Description/Waste Disposal History	Investigation Results/Environmental Monitoring Results	Corrective Activities and/or Current Status	Evaluation of Public Health Hazard
<p>Site 18</p> <p>West Runway Study Area</p>	<p>Site 18 is a seep located about 650 feet west of runway I-19 between Mere Brook and Ordnance Road No. 3. It was first observed in 1990. The seep is near the former location of an ordnance bunker that was dismantled some time in the mid-1970s. There are no records of historical dumping at this site and no evidence of a dump site in historical aerial photos.</p>	<p>Soil: PAH, pesticide, and metal concentrations were below background concentrations.</p> <p>Surface water: Contaminant concentrations were below background concentrations.</p> <p>Sediment: Contaminant concentrations were below background concentrations in Mere Brook.</p>	<p>Site 18 was not included in the Federal Facilities Agreement, but was investigated with other sites under the NPL program. The Navy conducted a geophysical survey as part of the August 1999 site inspection. It revealed a small number of anomalous areas that might contain buried debris. Further investigations found no sources of environmental contamination. An NFA consensus statement was signed in July 2001.</p>	<p>Having reviewed site data and potential exposure scenarios, ATSDR anticipates no potential public health hazards at this site. Investigations found no areas of contamination, the public has had limited access to the site, and the underlying groundwater is not used as a source of drinking water.</p>
<p>Old Navy Fuel Farm</p>	<p>The old Navy fuel farm is located in the northeast portion of the NAS Brunswick site. Until 1993, the site was used as a petroleum bulk storage facility. It included two farms with a total of nine USTs. All USTs and associated piping were removed in 1993. Currently, the area is covered with grass. It contains a storm water sewer and components of a biosparging system installed after the facility was decommissioned.</p>	<p>Groundwater: Petroleum constituents have been detected in groundwater monitoring at this site from 1990–2001. For example, benzene (up to 1,300 ppb) and toluene (up to 12,000 ppb) were detected during a 1996 sampling.</p>	<p>The Navy activated a biosparging system in 1996 to treat the contaminated groundwater after the attempts to build a soil vapor extraction (SVE) system were unsuccessful. Following operation of the biosparging system, 14,678 tons of contaminated soil were excavated from the old Navy fuel farm and disposed of off site at an asphalt-batch facility. The current remedy in place is natural attenuation with long-term monitoring and land-use controls.</p>	<p>Having reviewed site data and potential exposure scenarios, ATSDR anticipates no potential public health hazards at this site. The public has had limited access to the site and the underlying groundwater is not used as a source of drinking water.</p>

Table 1. Evaluation of Public Potential Health Hazards at NAS Brunswick

Site	Site Description/Waste Disposal History	Investigation Results/Environmental Monitoring Results	Corrective Activities and/or Current Status	Evaluation of Public Health Hazard
<p>Navy Exchange (NEX) Service Station</p>	<p>The Navy Exchange service station (Building 538) is the site of a release of petroleum-based constituents. The Navy removed the UST and leaking piping in 1992.</p>	<p>Groundwater: In 1999, The Navy collected 37 direct push samples from the area of the NEX. Twenty of 37 ground-water samples contained reportable concentrations of total BTEX, ranging from 7.0 ppb to 20,000 ppb. The highest concentrations of total BTEX were reported in groundwater samples collected immediately downgradient of the existing USTs at Building 538.</p> <p>Soil: Three of 13 soil samples collected in 1999 contained detectable concentrations of total BTEX, ranging from 0.007 ppb to 28.3 ppm. The highest concentration of total BTEX was reported in a soil sample collected immediately downgradient of the existing UST, about 8 to 16 feet bgs and directly below the groundwater table.</p>	<p>The Navy began a SVE/aquifer air sparging (AAS) system operation in 1993. The 1999 direct push sampling indicated, however, that elevated concentrations of petroleum hydrocarbons in groundwater persisted. The Navy planned to initiate a denitrification-based biodegradation pilot test in late 2004.</p>	<p>Having reviewed site data and potential exposure scenarios, ATSDR anticipates no potential public health hazards at this site. The public has had limited access to contaminated subsurface soils and the underlying groundwater is not used as a source of drinking water.</p>

Table 1. Evaluation of Public Potential Health Hazards at NAS Brunswick

Site	Site Description/Waste Disposal History	Investigation Results/Environmental Monitoring Results	Corrective Activities and/or Current Status	Evaluation of Public Health Hazard
<p>Eastern Plume</p>	<p><i>See descriptions for Sites 4, 11 and 13, the suspected source areas of the Eastern Plume.</i></p>	<p>Groundwater: Monitoring of the Eastern Plume during the 1988–1989 RI field activities and long-term monitoring starting in 1995 indicated that the groundwater was contaminated with VOCs. The plume extends south from Sites 4, 11, and 13 to about New Gurnet Road. Trichloroethylene (TCE) (up to 770 ppb) and PCE (up to 80 ppb) were detected in the shallow portion (30–40 feet bgs) of the overburden in the center of the plume. Lower concentrations, typically less than ATSDR’s CVs, were measured along the boundaries of the plume. Lower concentrations have been reported during more recent sampling rounds.</p>	<p>An interim remedy was selected for the Eastern Plume in July 1992. The goal of the remedy was hydraulic containment of contaminated groundwater to prevent further migration and potential discharge into the Harpswell Cove estuary. Groundwater extraction and treatment and a LTMP began in 1995. An additional extraction well was added in 1998 to extract a hot spot of contaminated groundwater near MW311. The final ROD was signed in February 1998 and the LTMP was revised in 1998 to reduce monitoring to twice a year and improve the monitoring well network. In 1999, the Navy improved the treatment system with an air stripper and carbon polisher to improve contaminant removal efficiency from 50% to >90%. A 2000 explanation of significant difference (ESD) document also specified switching the plant effluent discharge to an infiltration gallery; construction of the gallery was completed in early 2002. Institutional controls to prevent use and exposure to the groundwater while it is being cleaned up were formally added as a remedy component by the ESD.</p>	<p>Having reviewed site data and potential exposure scenarios, ATSDR anticipates no potential public health hazards for groundwater. No drinking wells have been or are expected to be impacted by harmful levels of contaminants from the plume.</p>

Sources: ABB 1993; DERP 2004; EA 1997b, 2000c, 2000d, 2001, 2002, 2003; EC Jordan 1990; 1991a, 1991b; EPA 2002.

Key:			
BTEX	benzene, toluene, ethylbenzene, and xylenes	PCB	polychlorinated biphenyl
CV	ATSDR's comparison value	PCE	tetrachloroethylene
1,2-DCA	1,2-dichloroethane	ppb	parts per billion
1,2-DCE	1,2-dichloroethene	ppm	parts per million
EPA	U.S. Environmental Protection Agency	RI	remedial investigation
ESD	explanation of significance difference	ROD	Record of Decision
LTMP	long-term monitoring program	SVOC	semi-volatile organic compound
MCL	EPA's maximum contaminant level	1,1,1-TCA	1,1,1-trichloroethane
MEDEP	Maine Department of Environmental Protection	TCE	trichloroethylene
NEX	Navy Exchange	UST	underground storage tank
NFA	no further action	VOC	volatile organic compound
PAH	polycyclic aromatic hydrocarbon		

Table 2. Evaluation of Exposure Pathways at NAS Brunswick

Pathway	Elements of an Exposure Pathway						Comment
	Source	Media	Point of Exposure	Route of Exposure	Time Frame	Exposed Population	
Potential Exposure Pathways							
On-Site and Off-Site Groundwater Private Wells Exposure of nearby visitors to the golf course, workers at Dyer’s Gate, and residents to possible contaminants in off-site private wells.	Former NAS Brunswick activities	Groundwater	Area private well taps	Incidental ingestion, skin contact, and inhalation of vapors from water	Past, Current, Future	People who utilize the golf course, personnel working at Dyer’s Gate, and private well owners located near NAS Brunswick	<i>Past, Current, and Future: No exposure to groundwater contaminants has occurred, is occurring, or is expected to occur. The drinking water well at the golf course is available to the public while utilizing the golf course. The new Dyer’s Gate well provides drinking water to personnel working at Dyer’s Gate. The rest of the air station and the surrounding community obtain their drinking water from the Brunswick/Topsham Water District. The municipal water is tested to comply with Safe Drinking Water Act standards. The base golf course well, the Dyer’s Gate well, and several private wells in the area have not been affected by site-related contamination. Routine testing of the nearest downgradient well to the Eastern Plume has not shown evidence of site contamination.</i>

Table 2. Evaluation of Exposure Pathways at NAS Brunswick

Pathway	Elements of an Exposure Pathway						Comment
	Source	Media	Point of Exposure	Route of Exposure	Time Frame	Exposed Population	
Surface Water/Sediment Exposure of visitors to contaminants in on-site tributaries, Mere Brook, and Merriconeag Stream.	Former and current NAS Brunswick activities	Surface water and sediment	On-site tributaries Mere Brook Merriconeag Stream	Dermal contact	Past, Current, Future	Visitors to the waterways	<i>Past, Current, and Future: No harmful exposure to surface water/sediment contaminants has occurred, is occurring, or is expected to occur. Low levels of contaminants were detected in surface water and sediment of the on-site tributaries, Mere Brook, and the Merriconeag Stream. These waterways are not used for drinking water or recreational activities. Consequently, exposures to surface water and sediment affected or potentially affected by NAS Brunswick are expected to be infrequent and incidental. The low levels of contaminants and limited exposures would not be expected to cause harm to visitors to the waterways.</i>

Table 2. Evaluation of Exposure Pathways at NAS Brunswick

Pathway	Elements of an Exposure Pathway						Comment
	Source	Media	Point of Exposure	Route of Exposure	Time Frame	Exposed Population	
Indoor Air Exposure to vapors possibly inside buildings near or above groundwater plume.	VOCs in the groundwater plumes that possibly volatilized and seeped into buildings at NAS Brunswick	Indoor air	Fleet and Family Support Center Bachelor Enlisted Quarters	Inhalation	Past, Current, Future	Former residents of the bachelor enlisted quarters and employees at the Fleet and Family Support Center	<i>Past, Current, and Future: No exposure to harmful levels of indoor air contaminants occurred in the past. Some on-site buildings were or are situated near groundwater contamination at NAS Brunswick. For the Fleet and Family Support Center, no air contamination has been detected that could be linked to groundwater sources. For the bachelor enlisted quarters, estimates suggest that the groundwater contaminant concentrations beneath the bachelor enlisted quarters would have been too low to produce harmful indoor air concentrations in the past.</i>

Table 2. Evaluation of Exposure Pathways at NAS Brunswick

Pathway	Elements of an Exposure Pathway						Comment
	Source	Media	Point of Exposure	Route of Exposure	Time Frame	Exposed Population	
<p>Consumption of Venison Exposure to contaminants that possibly accumulated in deer that graze at the air station.</p>	Former NAS Brunswick activities	Deer meat		Consumption of venison	Past, Current, Future	Hunters and other consumers of venison	<p><i>Past, Current, and Future: No exposure to contaminants has occurred or is expected to occur for people who consume venison caught at NAS Brunswick. Some contamination has been found in soil and surface water in areas of NAS Brunswick where deer might graze. However, studies conducted at other military bases show that deer that graze in contaminated areas do not accumulate harmful levels of toxins similar to those found in NAS Brunswick soil. The contaminants found in NAS Brunswick soil, VOCs and PAHs, are not expected to bioaccumulate in deer. Therefore, people are not likely to experience harmful health effects from eating venison from NAS Brunswick in a varied diet.</i></p>

Table 3. Contaminant Concentrations in the Groundwater of the Eastern Plume

Chemical	Range of Concentrations in Groundwater (ppb) for Contaminants That Exceeded Screening Values		Comparison Values for Drinking Water (ppb)
	Shallow (Near Source)	Deep (Downgradient)	
1,1-Dichlorethene	ND-6	ND-1,810	7 MCL
1,1-Dichloroethane	ND-130	ND-170	800 RBC
Cis-1,2-Dichloroethene	63-680*	ND-98*	70 MCL
Trans-1,2-Dichloroethene	*	*	100 MCL
1,1,1-Trichloroethane	13-1,200	11-11,000	200 MCL
Trichloroethylene	5-770	6-2,800	5 MCL
Tetrachloroethylene	ND-42	ND-68	5 MCL

Source: EPA 2002

* 1,2-Dichloroethene was reported by the laboratory as total 1,2-DCE.

Key: MCL=EPA’s maximum contaminant level; ND=non-detect; ppb=parts per billion; RBC=EPA’s risk-based concentration.

Table 4. Contaminant Concentrations in Surface Water Bodies

Contaminant Concentration in Surface Water Bodies				
Surface Water	Potential On-Site Source and Mechanism of Release		Historical Operations	Contaminant Concentrations Above Screening Values ⁶
Mere Brook	Sites 1 and 3	Mere Brook flows eastward across the southern edge of Sites 1 and 3. A minor tributary of Mere Brook beaver marsh borders Site 3 to the west.	Site 1 was used from 1955 to 1975 and Site 3 from 1960 to 1973 for disposal of industrial and domestic refuse.	Surface water: Volatile organic compounds (VOCs), polychlorinated biphenyls (PCBs), and pesticides were either not detected or detected at concentrations below ATSDR's comparison values (CVs) for drinking water. Cadmium (up to 15.4 parts per billion [ppb]) and manganese (up to 3,100 ppb) exceeded ATSDR's CVs for drinking water. Total polycyclic aromatic hydrocarbons (PAHs) ranged from 1,630 ppb to 1,670 ppb. (ATSDR does not have a CV for total PAHs.) Sediment: Arsenic and manganese were detected at concentrations above ATSDR CVs for soil.
	Site 2	A tributary of Mere Brook beaver marsh flows from Site 2. A shallow inorganic plume discharges to Mere Brook beaver marsh.	Site 2 was reportedly used as the main base disposal area for a few years between 1945 and 1955. It was also the site of an incinerator that generated a significant amount of ash.	Surface water: VOCs, PCBs, and pesticides were either not detected or detected at concentrations below CVs. Cadmium (up to 15.4 ppb) and manganese (up to 3,100 ppb) exceeded ATSDR's CVs for drinking water. Sediment: Only low levels of VOCs, SVOCs, metals, and pesticides were detected in sediment for soil.

⁶ ATSDR does not have CVs for surface water or sediment. For comparison, ATSDR uses CVs for drinking water and soil when assessing surface water and sediment exposures, respectively. Using the drinking water and soil CVs is more protective since these CVs consider greater exposure to contaminants than people are likely to incur via incidental ingestion of surface water or contact with stream sediment.

Table 4. Contaminant Concentrations in Surface Water Bodies

Contaminant Concentration in Surface Water Bodies				
Surface Water	Potential On-Site Source and Mechanism of Release		Historical Operations	Contaminant Concentrations Above Screening Values ⁶
	Site 9	A southern unnamed stream and a northern unnamed stream border Site 9. Leachate seeps have been observed along the northern stream. These streams may flow to Picnic Pond, 3,000 feet downstream of Site 9.	Site 9 is the location of a former incinerator used before 1946 and a disposal area used through the 1950s for solvents, paint sludges, waste from the metal shop, and possibly ash from the incinerator.	Surface water: Manganese was detected at concentrations up to 1,300 parts per billion (ppb), which is above its ATSDR CV for drinking water. Sediment: Total PAHs reached a maximum of 383 parts per million (ppm) in one sample.
Androscoggin River	Site 8	This site is located between two tributaries of a brook flowing north toward the Androscoggin River, about 1,800 feet north of the site. The Navy, with community involvement, has completed the site remediation, as outlined in the 1993 ROD for Site 8. The selected remedy involved excavation and removal of PAH-contaminated soil; backfilling with clean soil, construction debris, and rubble; and transportation of the contaminated material to Sites 1 and 3 (where it was used as part of the landfill cap). Cleanup activities, including site restoration, were completed in the fall of 1995. No land use restrictions, monitoring, or 5-year reviews are necessary at this area, since all materials were removed.	Site 8 was used between 1964 and 1974 for disposal of construction and demolition debris.	Surface water: Lead (up to 1,500 ppb) and manganese (up to 910 ppb) concentrations exceeded their CVs for drinking water. Sediment: Samples contained total PAHs up to 80.2 ppm.

Key: CVs= ATSDR comparison values; PAHs=polycyclic aromatic hydrocarbons; PCBs=polychlorinated biphenyls; ppb=parts per billion; ppm=parts per million; VOCs=volatile organic compound

Table 5. Contaminant Concentrations in Indoor Air at Building 27, the Fleet and Family Support Center

Chemical	Range of Concentrations in Indoor Air (ppb)*		Comparison Values for Air (ppb)	
	July 2003	January 2004	Acute	Long Term
Toluene	1.2–1.8	ND	1,000 Acute EMEG	80 Chronic EMEG
2-Butanone	ND–4.0	ND	No value	1,701 EPA RfC
Naphthalene	ND	1.5–3.5	No value	0.7 Chronic EMEG

Source: (NAS Brunswick 2003b, EA 2004b)

* The air samples were collected after the soil vapor extraction (SVE) system was installed at the Fleet and Family Support Center in 1989. The Navy collected these samples in July 2003 (with a deactivated heating system) and January 2004 (with an activated heating system) as part of the remedial action for the NEX site.

Key: EMEG=ATSDR’s environmental media evaluation guide; ND=non-detect; ppb=parts per billion; RfC=EPA’s risk-based concentration; RfC=EPA’s reference concentration.

Table 6. Estimated Contaminant Concentrations in Indoor Air at the Bachelor Enlisted Quarters (BEQs)

Contaminant	Maximum Groundwater Concentration Near the BEQs (ppb)	Groundwater to Indoor Air Attenuation Factor	Estimated Indoor Air Concentration in the BEQs (ppb)	Comparison Value for Air (ppb)
Vinyl chloride	10	10 ⁻⁴	0.001	30 Intermediate EMEG
1,1-Dichloroethane	1	10 ⁻⁴	0.0001	126 EPA RBC
1,2-Dichloroethene	1	10 ⁻⁴	0.0001	200 Intermediate EMEG (trans-1,2-dichloroethene)

Source: (NAS Brunswick 2003b, EA 2004b)

* The air samples were collected after the soil vapor extraction (SVE) system was installed at the Fleet and Family Support Center in 1993. The Navy collected these samples in July 2003 (with a deactivated heating system) and January 2004 (with an activated heating system) as part of the remedial action for the NEX site.

Key: BEQs=Bachelor Enlisted Quarters; EMEG=ATSDR's environmental media evaluation guide; ppb=parts per billion; RBC=EPA's risk-based concentration..