



Public Health Assessment for

**ELMENDORF AIR FORCE BASE
ANCHORAGE, ALASKA
EPA FACILITY ID: AK8570028649
DECEMBER 21, 2006**

**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:

Site and Radiological Assessment Branch
Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry

Foreword

The Agency for Toxic Substances and Disease Registry, ATSDR, was established by Congress in 1980 under the Comprehensive Environmental Response, Compensation, and Liability Act, also known as the *Superfund* law. This law set up a fund to identify and clean up our country's hazardous waste sites. The Environmental Protection Agency, EPA, and the individual states regulate the investigation and clean up of the sites.

Since 1986, ATSDR has been required by law to conduct a public health assessment at each of the sites 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 have cooperative agreements. The public health assessment program allows the scientists flexibility in the format or structure of their response to the public health issues at hazardous waste sites. For example, a public health assessment could be one document or it could be a compilation of several health consultations - the structure may vary from site to site. Nevertheless, the public health assessment process is not considered complete until the public health issues at the site are addressed.

Exposure: As the first step in the evaluation, ATSDR scientists review environmental data to see how much contamination is at a site, where it is, and how people might come into contact with it. Generally, ATSDR does not collect its own environmental sampling data but 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 are needed.

Health Effects: If the review of the environmental data shows that people have or could come into contact with hazardous substances, ATSDR scientists evaluate whether or not these contacts may result in harmful effects. ATSDR recognizes that children, because of their play activities and their growing bodies, may be more vulnerable to these effects. As a policy, unless data are available to suggest otherwise, ATSDR considers children to be more sensitive and vulnerable to hazardous substances. Thus, the health impact to the children is considered first when evaluating the health threat to a community. The health impacts to other high risk groups within the community (such as the elderly, chronically ill, and people engaging in high risk practices) also receive special attention during the evaluation.

ATSDR uses existing scientific information, which can include the results of medical, toxicologic and epidemiologic studies and the data collected in disease registries, to determine the health effects that may result from exposures. The science of environmental health is still developing, and sometimes scientific information on the health effects of certain substances is not available. When this is so, the report will suggest what further public health actions are needed.

Conclusions: The report presents conclusions about the public health threat, if any, posed by a site. When health threats have been determined for high risk groups (such as children, elderly, chronically ill, and people engaging in high risk practices), they will be summarized in the conclusion section of the report. Ways to stop or reduce exposure will then be recommended in the public health action plan.

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 warning 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.

Community: ATSDR also needs to learn what people in the area know about the site 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 a site, 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 their comments. 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 comments, suggestions or questions we encourage you to send them to us.

Letters should be addressed as follows:

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List of Abbreviations

ADEC	Alaska Department of Environmental Conservation
ADFG	Alaska Department of Fish and Game
AOC	area of concern
ATSDR	Agency for Toxic Substances and Disease Registry
AWWU	Municipality of Anchorage, Anchorage Waste Water Utility
bgs	below ground surface
BLM	Bureau of Land Management
BTEX	benzene/toluene/ethylbenzene/xylenes
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CMA	U.S. Army's Chemical Materials Agency
CV	comparison value
DoD	Department of Defense
EC	Environmental Contamination
Elmendorf	Elmendorf Air Force Base (U.S. Air Force)
EMEG	environmental media evaluation guide (ATSDR)
EPA	U.S. Environmental Protection Agency
ERP	Environmental Restoration Project (DoD)
FRWTP	Army Fort Richardson Water Treatment Plant
IRP	Installation Restoration Program (DoD) (see ERP)
LTHA	Lifetime Health Advisory (ATSDR)
MCL	EPA's maximum contaminant level
mg/m ³	milligrams per cubic meter
MSHA	Mine Safety and Health Administration
NIOSH	National Institute of Occupational Safety and Health
NFA	No Further Action
NPL	National Priorities List
OSHA	Occupational Safety and Health Administration
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PHA	public health assessment
POL	petroleum, oil, and lubricants
ppb	parts per billion
RCRA	Resource Conservation and Recovery Act
SERA	State-Elmendorf Environmental Restoration Agreement (ADEC)
SVOC	semivolatile organic compound
TCE	trichloroethylene
UST	underground storage tank
UXO	unexploded ordnance
VOC	volatile organic compound
µg/dL	micrograms per deciliter

Summary

Elmendorf Air Force Base (Elmendorf) is an active U.S. Air Force base ([latitude](#): 61.254169, [longitude](#): -149.7917) on the northern boundary of the municipality of Anchorage, Alaska. The installation has operated since 1940, originally under the control of the U.S. Army. In 1951, transfer of land from the Army to the Air Force created Elmendorf Air Force Base out of a portion of Fort Richardson. Elmendorf contains 13,455 acres of land, including 1,592 acres of wetlands. The site is bordered on the west and north by the Knik Arm of Cook Inlet and on the east by the area currently encompassing Fort Richardson. Urban areas of Anchorage are just south of Elmendorf. Elmendorf operates a large fleet of military aircraft and facilities to refuel and maintain these aircraft. Developed areas include runways, taxiways, maintenance buildings, support operations, housing, recreational facilities such as a ski slope and a golf course.

The Agency for Toxic Substances and Disease Registry (ATSDR) prepared this public health assessment (PHA) to evaluate environmental health issues related to contamination at Elmendorf. The objectives of this PHA are (1) to determine whether residents have been exposed to harmful levels of contamination originating from Elmendorf and (2) to make recommendations to ensure that harmful exposures do not occur in the future.

Conclusions in this PHA are based largely on environmental sampling data and other records generated by multiple parties, including the U.S. Environmental Protection Agency (EPA), the United States Geological Survey, Alaskan Department of Environmental Conservation (ADEC), the Alaska Department of Health and Social Services (ADHSS), the Air Force and Fort Richardson.

ATSDR's concerns are limited to a few issues. Overall, the actions by the Air Force with oversight by regulatory agencies have resulted in a very safe place to live. While some areas of the base do have elevated concentrations of some environmental contaminants, ATSDR did not identify any potential exposures that would be expected to result in adverse health effects. In general, people do not have significant access to the environmentally contaminated sites.

This PHA focuses on four situations of health concern: 1) Instability of the ground at Landfill 04 poses a safety hazard to people who may access the top bluff of the landfill, 2) Perchlorate compounds released from various areas where munitions have been used, disposed, or stored may have seeped into the groundwater, infiltrating the low numbers of on-base wells used for drinking water, 3) Due to the close proximity of community gardens to the flight line areas, people may have an increased potential for being exposed to contaminants deposited onto produce, and 4) Once buried heavy metal contaminants may reach ground surface during naturally occurring frost heave events, and therefore, may present a potential exposure for people recreating at or near Landfills 02 and 03.

Evaluation of Landfill 04: ATSDR determined that Landfill 04 poses a potential safety hazard. Official visitors and authorized personnel who access the upper landfill, beyond the gated entrance, could be injured during a landslide or landfill collapse (soil surface may give way if walked on) because of the landfill's inherent instability. Long-term safety hazards are due to the eroding and sliding of the landfill material into the Knik Arm of Cook Inlet. Authorized personnel follow current "Standard Operating Procedures" (SOPs) including providing safety awareness briefings to authorized visitors. However, due to the acknowledged instability of the upper landfill bluff area, ATSDR believes that additional measures, further limiting personnel access to the upper landfill bluff, are warranted and recommends that access by personnel be granted only if absolutely necessary. The Air Force has fenced, gated, locked, and posted the front entrance of the landfill and

at controlled access points leading from the Port of Anchorage onto the beach. Surveillance in 2005 and 2006 has not identified ongoing trespassing. Additional wording should also be added to signs identifying that the landfill is unstable and is subject to collapse without warning.

ATSDR recommends that the Air Force, EPA Region 10, and ADEC ensure that information is provided on the sampling, removals, contents and historical use of Landfill-04 to appropriate groups that may be involved in trawling, dredging or port expansion in or around Landfill 04. This would include providing information to the Port of Anchorage, Army Corps of Engineers, National Oceanic and Atmospheric Administration, and Coast Guard.

Evaluation of On-base Drinking Water: Elmendorf follows state and federal water-testing programs. Perchlorate compounds released from various areas where munitions have been used, disposed, or stored may have seeped into the groundwater, infiltrating the low numbers of on-base wells used for drinking water. Because of the hazardous nature of perchlorate and the potential for its presence, ATSDR recommends that the Air Force add perchlorate to the list of chemicals currently sampled in all drinking water wells especially when well water is being added to system by Elmendorf, Fort Richardson and Anchorage Waste Water Utility. EPA has proposed regulations for sampling perchlorate in drinking water systems by 2010.

ATSDR recommends that ADEC encourage monitoring for munitions compounds in groundwater wells located in areas where munitions or perchlorate compounds were used. The data should be evaluated to identify if chemical contamination levels are increasing or decreasing over time.

Additionally, because of an inquiry received about drinking water in Building 9480, ATSDR recommends a review of the issue by Elmendorf Air Force Base and ADEC to see if additional sampling is needed. ATSDR recommends that the results of the tap water the evaluation be provided to those using Building 9480 and to ATSDR.

Evaluation of Flight Line Soil, Air and Garden Produce: ATSDR believes that people tending gardens adjacent to the flight line area and eating produce from those gardens may have an increased exposure to contaminants in the air generated by flight line operations and deposited on vegetable surfaces. As a precautionary measure, ATSDR recommends that people who consume produce from Elmendorf's community garden area wash produce and peel root vegetables prior to eating.

Evaluation of Landfill 02 and Landfill 03: ATSDR concludes that there is a possibility that freeze/thaw frost heaving at Landfills 02 and 03 increases the potential for exposure of people in nearby on-base housing areas recreating on the landfills to contact once buried material that rises to the surface after these natural events. Only small-round ammunition has been found in Landfill 03. It does not appear that historical seasonal freeze-thaw cycles have caused buried munitions to migrate to the surface. However, prudent policy for the Air Force should include these landfill areas in their ongoing briefing of staff and families informing them of current base rules and procedures related to possible explosive items. Due to the possibility that landfill material and contamination may move up to the surface from frost heaves, the Air Force with regulatory oversight should conduct surface soil, soil gas sampling, and evaluate erosion during each of the future 5 year reviews. Visual inspection for larger items may be useful, but chemical analysis of chemicals including antimony, lead, and thallium is recommended. Landfill gas measurements would be useful to evaluate if gas levels are present that could result in current or future landfill gas related fires and explosions. Sampling of soil and landfill gas especially during times with the greatest potential for buildup or movement of gas when the soil is frozen or snow covered would verify or eliminate ATSDR's concerns.

Background

Site Description and Operational History

Elmendorf Air Force Base (Elmendorf) is an active U.S. Air Force base on the northern border of Anchorage, Alaska, shown in Figure 1. The base is bounded on the west and north by the Knik Arm of Cook Inlet and on the east by Fort Richardson, an active U.S. Army installation. Neighborhoods of Anchorage are located immediately south of Elmendorf. Elmendorf contains 13,455 acres of land, including approximately 1,592 acres of wetlands. Ship Creek passes through Elmendorf near the southern base boundary before crossing into Anchorage and emptying into the ocean at the Knik Arm of Cook Inlet. Glenn Highway (Alaska Highway 1) borders Elmendorf on the southeast. Developed site areas include runways, taxiways, hangers, maintenance buildings, base support operations, housing, and recreational facilities. Elmendorf also owns 5 acres of land at the Kenai Airport, where the Elmendorf Civil Air Patrol operates a hangar. The Air Force also leases property from the city of Seward, 130 miles south of Anchorage, for the Seward Recreational Camp, established in 1960 (Elmendorf 2001).

In 1939, the U.S. Government set aside 45,000 acres of public land in south-central Alaska on the Knik Arm of Cook Inlet to create Fort Richardson, under the U.S. Army, and began building the Fort Richardson airfield in January 1940. The Army named the airfield Elmendorf Field, and renamed it Elmendorf Army Air Base in 1942. Elmendorf Air Force Base was transferred to the then newly created U.S. Air Force in 1951. Some of the original land is now privately owned, some is owned and operated by state and local agencies, and some is leased to private users (USAF 1983).

Elmendorf was used as an active air logistics center during World War II. Chemical warfare services activities before, during, and after World War II include storage and filling of chemical munitions. The military facilities at the base were instrumental in the defense of the United States and Alaska, especially in support of military operations in the Aleutian Islands. Elmendorf's role shifted to air defense after World War II, and in the early 1960s, it began providing support to the Military Airlift Command and other Air Force commands. In the 1970s, the base gained a fighter squadron, which is still active (Elmendorf 2000; USAF 1983).

Through its years of operation, Elmendorf handled various hazardous materials, primarily from industrial operations such as shops involved in aircraft and vehicle maintenance and repair activities, fire training, de-icing of runways, and fuel management. Some activities resulted in site contamination. Major sources of contamination include fuel leaks/spills from underground storage tanks (USTs) and fuel lines, several landfills and sludge disposal areas, a fire training area where fuel was routinely dumped and burned, polychlorinated biphenyl (PCB) transformer leaks, and chemicals that leaked or were poured into floor drains in shops or in storage areas. Additional contamination may have been released during the 1964 Good Friday Earthquake, which dropped the ground in some areas of Anchorage by up to 11 feet and destroyed the former metals plating building at Elmendorf (Elmendorf 2000, ATSDR 2004a).

Types of facilities that have been used for management and disposal of waste at Elmendorf include waste storage sites, landfills and other disposal sites, a low-level radioactive waste disposal site, sanitary sewer systems, oil/water separators, and storm drainage systems. In the 1940s, 1950s, and early 1960s, personnel drained oil, fuels, and solvents directly to storm and sanitary sewers, and disposed of waste solvents in centralized storage tanks. From the 1960s to the 1980s, waste was stored in centralized tanks, and there are several documented releases from these sources. Since 1981,

all waste chemicals have been stored on site at a U.S. Environmental Protection Agency (EPA) permitted hazardous waste storage area (Elmendorf 2000).

The main contaminants found at the source areas include petroleum hydrocarbons and other fuel-related substances, such as benzene, toluene, ethylbenzene, and xylenes (BTEX); solvents, such as trichloroethylene and tetrachloroethylene; polycyclic aromatic hydrocarbons (PAHs); pesticides; polychlorinated hydrocarbons (PCBs); asphalt; and metals, such as lead and manganese (Elmendorf 2000). Specific types of hazardous substances include turbine oil, hydraulic fluid, JP-4 (Jet Propulsion Fuel, Type 4) and mogas (motor gasoline), PD-680 (blend of hydrocarbons used as degreasing agent), paint residue, stripper, methylene chloride, mercury, mercury-contaminated solvents, engine oil, metal plating solutions, caustic cleaning solvents, penetrant, emulsifier, developer, condemned batteries, pesticides, insecticides, waste solvents and paints (USAF 1983). Commonly used de-icers at Elmendorf include ethylene glycol, propylene glycol, alcohol, urea, potassium acetate, and sodium acetate, among others (ATSDR 2004b).

Major site investigation and clean up milestones include: (1) proposed to the National Priority List (07/14/1989), (2) listed as final on the NPL (08/30/1990), 1st cleanup action initiated (08/11/1993) and final remedy selected (07/22/2004). Records of Decisions (RODs) have been established for the following Operative Units (OUs): OU 1 (09/29/94), OU 2 (03/31/95), OU 03 (12/05/96), OU 4 (09/26/95), OU 5 (12/28/94), OU 6 (12/04/96), OU 8 (09/01/92 and 07/22/04). The first five-year or periodic review was completed in September 1998 and the second five-year review was completed in November 2003.

Regional Contaminant Sources

Outside Elmendorf's boundary there are a number of other potential sources of environmental contamination including the railroad and port operations, oil and gas operations, and mining operations. There are two other NPL sites located near Elmendorf: Fort Richardson (U.S. Army) is on the eastern border of Elmendorf, and the Standard Steel and Metal Salvage Yard (U.S. Department of Transportation) is on the southwestern border of Elmendorf. ATSDR public health assessments for Fort Richardson are available on the web at <http://www.atsdr.cdc.gov/HAC/PHA/>.

Remedial and Regulatory History

The Air Force began environmental investigations at Elmendorf in 1983 under the Department of Defense (DoD) Installation Restoration Program (IRP), now known as the Environmental Restoration Program (ERP). EPA placed Elmendorf on the National Priorities List (NPL) in August 1990 due to concerns over contamination in groundwater, soil, and sludge. The Air Force is the primary party conducting investigations and taking cleanup actions at Elmendorf, with support and regulatory oversight by EPA and the Alaska Department of Environmental Conservation (ADEC), as outlined in agreements between the Air Force, EPA, and ADEC. These agreements define the ways that contaminated areas at Elmendorf are managed. The agreements include the 1991 Federal Facilities Agreement with EPA and ADEC for source areas regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); the 1991 Resource Conservation and Recovery Act (RCRA) Federal Facility Compliance Agreement with EPA; and the 1992 State-Elmendorf Environmental Restoration Agreement (SERA) with ADEC to address priority surface water source areas and other areas contaminated by petroleum, oil, and lubricants (POLs). In 2002, Elmendorf and ADEC dissolved the SERA two-party agreement and signed an agreement for new petroleum releases. This new agreement allows the Air Force to take action prior to notifying ADEC.

Under this agreement, these sites are known as Environmental Compliance (EC) sites. The Air Force expects to achieve regulatory levels of contaminants in 2026 and to finish all other remediation by 2034 (Elmendorf 2000, Elmendorf 2001).

Several base-wide investigations have been conducted at Elmendorf between 1983 and 2004. The Air Force conducted records searches and personnel interviews in 1983, 1986, 1989, and 1997, to determine the areas that would likely contain contamination. In 1995, the Air Force reviewed sets of aerial photographs of Elmendorf taken between 1950 and 1993, to identify additional areas of concern that may have been previously overlooked. Beginning in 1986, the Air Force conducted environmental sampling and investigations at Elmendorf, including several remedial investigations and limited field investigations. ADEC conducted a RCRA Facility Assessment in 1988. EPA also inspected and reviewed information in 2004.

The Air Force initially identified 85 potentially contaminated areas at Elmendorf that have been studied and addressed under several regulatory programs, including 40 CERCLA sites, five RCRA sites, and 40 SERA sites; 15 additional areas of concern (AOCs); 85 EC sites; and 3 sites that may contain munition materials. Remedial actions were needed at most POL-contaminated source areas and at many other sites. The Air Force has cleaned up many contaminated areas at Elmendorf, and is still cleaning up other areas. The locations of all sites are shown on Figures 2 through 6 (Elmendorf 2001, Elmendorf 2002a, and Elmendorf 2004c).

The public may review site-related documents, including reports and correspondence relating to site investigation and cleanup activities, at either of two repositories: (1) Alaska Resources Library & Information Services (ARLIS), University of Alaska, Anchorage, Consortium Library, 3211 Providence Drive, Anchorage, AK 99508 (phone 907-272-7547), and (2) Elmendorf Air Force Base Library, 3rd Wing, Service Squadron, 10480 22nd Street, Elmendorf, AK 99506 (phone 907-272-7547).

Demographics

Demographic data provide information on the size and characteristics of a given population. ATSDR examined demographic data to determine the number of people living in the site vicinity and to determine the presence of sensitive populations, such as children (age 6 years and younger), women of childbearing age (age 15 to 44 years), and the elderly (age 65 years and older). These data assist ATSDR in the site-specific exposure and health effect evaluations. The demographics of the facility and surrounding area are described below.

Elmendorf

As of 1995, Elmendorf employed approximately 6,800 active duty personnel with 10,320 dependents, and approximately 1,700 civilian personnel with an unknown number of dependents. Approximately 6,000 people live at Elmendorf, 37% of them are children (Elmendorf 2000). Residents of Elmendorf live in several housing areas in the southwest, southeast, and south-central parts of the base, as shown in Figure 7. Personnel and their families use the Elmendorf hospital for their medical needs.

Community within 1 Mile of Elmendorf

According to 2000 U.S. Census data, 36,291 people live within 1 mile of Elmendorf, as shown on Figure 8. Anchorage encompasses approximately 1,955 square miles and has a population of over 258,000 people (Elmendorf 2000).

Two residential areas of Anchorage, Alaska, are near the southern boundary of Elmendorf, shown in Figure 7. The Mountain View neighborhood sits along the southeast site boundary, just beyond the Boniface Parkway Gate of Elmendorf. It is a mix of residential and commercial uses, and includes an elementary school on Elmendorf property. The Government Hill neighborhood is southwest of the base. Some residents live in apartment buildings immediately adjacent to the Elmendorf boundary. Access to Elmendorf is limited to the Government Hill Gate (southwest side of Elmendorf), the Boniface Parkway Gate (south side of Elmendorf), and the Post Road Gate (southeast side of Elmendorf). Fort Richardson borders Elmendorf to the east, but the residential areas of Fort Richardson are over a mile away from this boundary (Elmendorf 2000).

Land and Natural Resource Use

ATSDR examined the ways that people at and near Elmendorf use the land and natural resources in that area. This helped ATSDR better understand how the people may interact with the environment and what activities could put people at risk for exposure to contamination from Elmendorf. ATSDR used this information to evaluate site-related contamination and exposures.

Developed areas of Elmendorf are located in the southern area of the site. The southern central area is mostly industrial areas, including runways, maintenance buildings, and site support operations. Housing and recreational facilities are also scattered throughout the southern area but are generally outside the main industrial areas, to the southeast and southwest. The northern part of Elmendorf is mostly undeveloped land, wetlands, and lakes, with some small cabins for use by retirees and military personnel. Elmendorf provides a variety of services for the on-site residents, including 1,600 on-site housing units, five schools, three child day-care facilities, a hospital, and three dental clinics (EPA 1995). Access to Elmendorf is limited to residents, workers, and authorized visitors. Site visitors generally enter through the Boniface Parkway Gate or the Government Hill Gate, but not through the Post Road Gate.

On-site residents use Elmendorf for organized and personal recreational activities, and other outdoor activities. There is a golf course just north of Ship Creek, which is also used for cross-country skiing in the winter. There is a picnic area just east of the golf course, on the banks of Ship Creek. Site residents walk, jog, and pick berries in areas along Ship Creek. Boat rentals are available on Hillberg Lake. People fish in Six Mile Lake, Hillberg Lake, and several of the other lakes in the northern areas of Elmendorf. People are expected to stay on paved roads to reach these destinations (Elmendorf 1998).

There are railroad yards and an industrial area just beyond part of the southern Elmendorf boundary. There are also two residential communities (part of Anchorage) located just outside site boundaries to the south/southeast and to the southwest, as discussed above. A public school is also located along the southern fence line.

In 1994, Elmendorf personnel noted a small homeless population living in tents by Ship Creek and by the industrial area southwest of the bluff area, outside Air Force property. Site reports indicated that none of these people lived in this area for a long period of time, and the number of individuals decreases in the winter months due to the cold climate (Elmendorf 1994a). Currently, there is no evidence of these tents.

The Elmendorf fish hatchery, run by the Alaska Department of Fish & Game (ADFG), is southeast of Ship Creek near the southern base boundary, on Air Force land leased to the state of Alaska. People visit Elmendorf throughout the year to see the ADFG fish hatchery, in the southeast corner of the

base. Davis Park, in a corner of the base near the Boniface Parkway Gate, is leased to Anchorage for snow disposal purposes. Historical photos show that Davis Park was formerly used as a trailer park. Local residents and tourists are invited to Elmendorf for the annual Arctic Thunder air show and carnival, which attracted 75,000 people each day over two days in May 2003 (Elmendorf 1994a, 1994b, 2000, and 2003a).

Regulated moose hunting occurs at Elmendorf, but no other hunting is permitted. There are approximately 600 moose in the local herd. Some moose live on Elmendorf year-round, mainly in the undeveloped northern areas of the base, while other members of the herd move to off-site lowlands in the winter (Elmendorf 1996a).

Elmendorf residents are allowed to grow vegetables in a designated garden plot area located west of the east-west runway. Elsewhere, site residents are only allowed to plant flowers because of digging restrictions. There is limited collection of berries and mushrooms at Elmendorf, mostly in the northern areas of the base. The majority of the mushrooms that grow at Elmendorf are poisonous, and the Air Force recommends that people not collect mushrooms on-site (ATSDR 2004c).

Ship Creek is a popular fishing location on Elmendorf and also downstream in Anchorage. Most people fish downstream from the base, where Ship Creek empties into the Knik Arm of Cook Inlet. All summer long, people fish for salmon below Chugach Dam, in Six Mile Lake and Ship Creek when the fish return from the ocean. In the late summer and early fall, people fish for trout and Dolly Varden above Chugach Dam. Elmendorf residents also fish in the lakes in the northern parts of Elmendorf and at the mouth of Six Mile Creek where it empties to the Knik Arm. Salmon in the lakes in the northern areas of Elmendorf are stocked by ADFG. Some fish live in the ponds along Ship Creek, but those areas are not stocked and are not popular fishing spots (Elmendorf 1994a, Elmendorf 1996b).

The municipality of Anchorage obtains its drinking water from distant surface water bodies and local wells. Some off-base residents used shallow wells for drinking water in the past. Current records do not state if these wells are still in use. Two of the nearby residential areas are connected to the municipal water supply system, but it is not known if all homes receive public water. It is likely that there are off-base privately owned drinking water wells. Due to local sources or naturally occurring sources, some wells contain elevated levels of arsenic, cyanide, thallium, radon, lead, and nitrates.

State of Alaska - Drinking Water Program maintains information about water systems in Alaska. Individual homeowners are responsible for the safety of their own drinking water from their well. Safe Drinking Water Act rules do not apply to private wells (although some state rules do). Therefore, EPA recommends that well owners have their water tested annually. Interested well owners can contact Alaska's drinking water program to get a list of certified commercial laboratories that test drinking water. Information on Alaska's drinking water program and local drinking water suppliers can be found at the EPA web site <http://www.epa.gov/safewater/dwinfo/ak.htm#offices>.

Elmendorf has implemented institutional controls to prevent anyone from using the on-base shallow groundwater in areas with known contamination for drinking water until those contaminant levels identified in records of decisions are reduced. Examples include the main base area south of the Elmendorf Moraine. Other institutional controls include restrictions on digging and restrictions on land use beneath runway flight paths.

The physical characteristics of Elmendorf and its surroundings can affect the fate and transport of environmental contaminants. The movement of surface water and groundwater, for example, can

affect the migration of contaminants by determining whether run-off from heavy storms will wash contaminants to nearby bodies of water, down to a groundwater aquifer, or to off-site land areas, and whether groundwater will migrate to nearby rivers or streams or affect a local water supply. ATSDR reviewed available information about the topography and geology of Elmendorf to identify if contaminants released to the soil would be likely to move to areas where people could come in contact with them.

In 1996-1997, a base-wide institutional control program was implemented to protect against future exposure to contaminated media and prevent activities that could affect the performance of the remedial actions now in place. The specific controls range from fences around contaminated sites, to specific land use restrictions, to the prohibition of the use of groundwater from the shallow aquifer. The institutional controls are described in detail in the Elmendorf Air Force Base General Plan and the Environmental Restoration Program's Management Action Plan. Maps in the plans outline the base-wide and site-specific institutional controls. The Elmendorf Environmental Protection Committee (EPC) that has been converted into the Environmental Safety and Occupational Health Committee (ESOHC) is responsible for overseeing compliance with these institutional controls. The implementation and effectiveness of these institutional controls are reviewed annually by the Elmendorf's Environmental Flight and any proposed changes affecting these controls are forwarded to EPA and ADEC for review.

Evaluation of Environmental Contamination, Human Exposure Situations, and Public Health Implications

Introduction

The Agency for Toxic Substances and Disease Registry (ATSDR) first visited Elmendorf in 1991. ATSDR visited Elmendorf again in May 2004, to observe the contaminated sites, collect information about the community's health concerns, evaluate how people on and near the base might be exposed to environmental contamination, and review additional base documents available at Elmendorf. ATSDR also met with base staff and discussed available information and site conditions. In addition to meetings, ATSDR had phone calls with various agency staff ATSDR 2003, 2004a – 2004ac).

ATSDR evaluated the potential for people to come in contact with contaminants present in groundwater, surface soil, surface water, sediment, air, fish, game, and produce, as well as physical hazards at Elmendorf. We examined the nature and extent of contamination, the likelihood of past, current, or potential future exposures and if those exposures are likely to be harmful.

ATSDR identified several concerns expressed by various community members that relate to the general contaminant migration from on-base sources to recreational areas and natural foods obtained by hunting, fishing, or gathering. Although each plant or animal species has not been chemically sampled, from our evaluation of base contamination and a review of general scientific information about uptake of various chemicals, there is no indication that wild plants or animals would contain contaminants from investigated waste sites at levels high enough to present a public health hazard.

From our review of regional groundwater information, there is an indication that several chemicals; thallium, arsenic, and nitrates have the potential to be present in off-base private wells. The source of these chemicals may be naturally occurring, septic use, or from unidentified sources. Since the base tests its water, people on base would not be affected. However, off-base residents on private wells (that are not provided by water suppliers) should take EPA's recommendations to have their wells tested.

ATSDR believes that for other common everyday activities, individuals and families on and off base are unlikely to be exposed to chemical contamination that would result in adverse health impacts from Elmendorf waste sites. From ATSDR's review of the information, we identified four exposure scenarios that warrant more in depth discussion within this report.

- Conditions at Landfill 04 pose a physical safety hazard to people who access the top of the landfill.
- On-base drinking water currently meets all Safe Drinking Water Act regulations. However, perchlorate is currently not included in the SDWA regulations. Because of the military use of munitions, the potential exists for perchlorate to be present in Elmendorf drinking water. Therefore, ATSDR recommends the Air Force add perchlorate to the chemical sampling list for drinking water especially that obtained from groundwater wells.
- People tending gardens adjacent to the flight line area and eating produce from those gardens may have an increased exposure to contaminants in the air and contaminants deposited on vegetable surfaces. ATSDR recommends washing produce prior to eating.

- The freeze/thaw frost heaving at Landfills 02 and 03 increases the potential for exposure of people recreating on the landfills to contact once buried material that rises to the surface after these natural events. Due to the possibility that landfill material and contamination may move up to the surface from frost heaves, the Air Force with regulatory oversight should conduct surface soil, soil gas sampling, and evaluate erosion during each of the future 5 year reviews. Visual inspection for larger items may be useful, but chemical analysis of chemicals including antimony, lead, and thallium is recommended.

Evaluation of Landfill 04

ATSDR is concerned that Landfill 04 poses a potential safety hazard. Official visitors and authorized personnel, who access the upper landfill, beyond the gated entrance, could be injured during a landslide or landfill collapse (soil surface may give way if walked on) because of the landfill's inherent instability. Long-term safety hazards are due to the eroding and sliding of the landfill material into the Knik Arm of Cook Inlet. The Air Force has fenced, gated, locked, and posted the front entrance of the landfill (see Evaluation of Landfill 04) and signs are posted at controlled access points leading from the Port of Anchorage onto the beach. Surveillance in 2005 and 2006 has not identified ongoing trespassing. Authorized personnel follow current "Standard Operating Procedures" (SOPs) including providing safety awareness briefing to authorized visitors. However, ATSDR believes that access should be further restricted based on absolute need to access the area. Visitors, such as those that in the past were escorted by authorized personnel, can view the landfill from the water and air or view photos of the upper bluff area without walking the upper area or below the landfill including the beach area.

Background

Site Description and History

Landfill 04, Site D-4 Disposal Site, Knik Bluff Landfill (CERCLA site, OU 6)

Knik Bluff Landfill (Landfill 04) is on western edge of Elmendorf bordered by Knik Inlet, east of Knik Arm Bluff and Cairn Point, north of the mouth of Ship Creek and north of the Port of Anchorage (See figure). The landfill extends 3,000 feet along the shore of Knik Arm and 400 to 800 feet inland. The major portion of the landfill sits on top of a steep bluff rising 200 feet from sea level. The upper portion of the landfill is covered with a soil and vegetative cap that includes trees and grasses. It has a locked, posted and gated entry to prevent unauthorized access. However, base staff and personnel escort visitors and contractors through the entry onto the eroding and unstable landfill.

Access to the beach area is prohibited by gated fence and signs. The Air Force has posted signs warning of the potential physical hazards, and moved a walking path from along the beach to a path farther east. At one time, trespassers were gaining access from the off-base residential area adjacent to the beach area. The Air Force has taken additional measures to control this access point. Boat access is also restricted. *Authorized personnel follow current "Standard Operating Procedures" (SOPs) including providing safety awareness briefing to authorized visitors.*

The Air Force used this site from 1945 to 1957 to dispose of old cars, construction rubble, empty 55-gallon drums, and small quantities of general refuse although the exact contents of the landfill are unknown. The Air Force burned much of the waste in place. The landfill became inactive in the late 1950s.

Chemical Agent Identification Sets (CAIS) are potentially present in Elmendorf landfills used before 1970 (HartCrowser 2000). CAIS have not been found on Elmendorf during the tours of current AF EOD personnel, (ATSDR 2004g) but have been found (Poleline Road Disposal Area) on Fort Richardson (CMA 2006). A 1993 environmental cleanup project in the Poleline Road Disposal Area of Fort Richardson recovered the CAIS items. In July 2003, the Non-Stockpile Chemical Materiel Project (NSCMP) (CMA 2006) successfully completed treatment operations at Fort Richardson. The

Rapid Response System, a mobile system specially designed to safely treat recovered CAIS items, treated seven CAIS items and their chemical agent in its neutralization chamber (CMA 2006).

Natural processes such as tidal action (second largest in the world), movement of sea ice, infiltration of rain and snowmelt, and movement of groundwater (with tidal influence) is eroding and undermining the landfill, exposing its contents. As stated in the 1997 Record of Decision for OU 6, the selected remedy for Landfill 04 is to allow it to naturally erode into Knik Arm of Cook Inlet.

Surface water and sediment sampling data collected in the vicinity of LF-04 in the Port of Anchorage, though limited, generally support the conclusion that the Elmendorf releases alone do not dramatically increase concentrations of toxic chemicals in the Knik Arm of Cook Inlet.

Erosion of the landfill is expected to continue until 2034 and is believed by the Air Force and regulatory agencies to have limited or insignificant impact compared to other urban point and non-point releases of contamination in the Anchorage Area.

Although there have been reports of oil seeps on Knik Arm beach and chemical and fuel odors along the bluff, sediment and water sampling results have not detected chemical contaminants in the beach or tidal area. However, erosion and corrosion of landfill material may cause the cap to collapse or move at any time, potentially when site visitors or personnel are present on the edge, top, or below the landfill. The movement of landfill material creates a potential safety hazard to Air Force personnel and visitors who may be touring the upper bluff landfill area.

The water level at high tide can reach the base of the bluff causing debris from the landfill to move downhill to the beach, (Elmendorf 1999). The Knik Arm of Cook Inlet at the edge of the landfill is flushed by 9-meter high tides (over 29 foot) with 4-knot currents (about 4.5 mile per hour) which may cause chemicals to become quickly flushed from the area.

Sampling

The Air Force sampled surface soil at Landfill 04 in 1987-1988 and in 1994 (Elmendorf 1996b). Surface soil sampling detected semivolatile organic compounds (SVOCs): benzo(a)pyrene (0.184 ppm), benzo(g,h,i)perylene (0.24 ppm), bis(2-ethylhexyl)phthalate (1.98 ppm), and phenanthrene (0.3 ppm); pesticides/PCBs: 4, 4'-DDD (8.41 ppm), 4, 4'-DDT (47.3 ppm), and dieldrin (0.143 ppm); inorganics: antimony (24.7 ppm), arsenic (56.5 ppm), calcium (13,400 ppm), iron (151,000 ppm), lead (1160 ppm), magnesium (10,900 ppm), manganese (4640 ppm), potassium (2,830 ppm), sodium (2,280 ppm), and thallium (8.75 ppm).

There have been reports of oil seeps on Knik Arm Beach and chemical and fuel odors along the bluff (Elmendorf 2001, Elmendorf 2003b). Groundwater and seep sampling is ongoing at this site. Contaminants detected in the shallow groundwater at levels above drinking water standards were VOCs, primarily benzene, toluene, ethylbenzene, and xylenes (BTEX) from fuels, polycyclic aromatic hydrocarbons (PAHs), pesticides, and heavy metals including aluminum, arsenic, chromium and lead. Shallow groundwater use is not permitted here or at areas south of the Elmendorf Moraine (Elmendorf 2003g).

USGS sampling to support dredging activities for the Port of Anchorage have not reported or identified elevated levels of contamination or debris in dredged sediments.

ATSDR evaluated the sampling information, tidal actions, weather conditions, and other pertinent information relevant to the site and determined that significant chemical contamination has not been identified. Landfill 04 is well flushed by over 29 foot-high tides with about 4.5 mile per hour

currents. Low or moderate levels of chemical contaminants released from landfill material would be quickly mixed and diluted by the strong Cook Inlet tides and currents, and would therefore, be diluted to levels likely to be too low to result in adverse health effects in people who occasionally gain access to the area. Although potential chemical hazards do not appear to be significant, physical hazards at the landfill are of concern to ATSDR.

Beginning in 1997, the Air Force conducted beach visual inspections twice a year, after storms, changes in season, and reports of suspicious items (Elmendorf 2003g). In 1997, the Air Force removed 98 tons of metallic debris from landfill beach area, and 29 tons of solid waste including car parts, electrical parts and other metallic debris (ADEC 1999a, ADEC 1999b). In 1999, the Air Force also found munitions and explosives of concern (MEC) including unexploded ordnance (UXO) during a beach sweep. An explosive ordnance disposal team removed and cleared the MEC material including small arms ammunition, ordnance up to 40mm, and empty casings, some with live primers. By 2000, the Air Force had removed 214 tons of landfill debris. However, an unknown quantity of debris remains. Additionally, the amount of debris that has washed into the inlet is unknown.

The Air Force plans to continue conducting beach inspections (sweeps) until no further debris falls on the beach, tentatively predicted until 2034. (ADEC 1999a, ADEC 1999b, Elmendorf 2000, Elmendorf 2001).

The Air Force constructed fences around Landfill 04 and posted signs that state that the site is restricted because of physical hazards including landslides, landfill waste, broken glass, jagged metal, and possible explosives. The Port of Anchorage restricts access by foot to their property to the south of the landfill beach. As mentioned earlier in this document, Air Force personnel continue to provide safety awareness briefing to authorized visitors entering the posted landfill.

Exposure Situations and Public Health Implications

Collapse of the landfill poses a potential safety hazard to people who visit the top of the landfill even though visitors must be escorted, participate in an awareness safety brief and be authorized to enter the posted area. Visitation is relatively infrequent. Constant erosion and other forces acting on the landfill, causes the landfill cap to become unstable as it slides down into the inlet. People accessing the top of the landfill will be unaware of the actual instability of the landfill at the time of any visit and may become injured during collapse or movement of landfill material because of foot or vehicle travel. Because it is uncertain when areas of the landfill may become unstable enough to collapse, causing injury or harm to visitors, the Air Force should take measures to reduce the chance of this situation occurring. ATSDR believes that additional access restrictions are warranted.

ATSDR Recommendation

While ATSDR acknowledges the proactive steps that the Air Force and other agencies are taking to evaluate, plan and fund potential responses to future physical hazards or chemicals that may be released or unearthed from the landfill, additional steps are needed beyond informing those entering the area that the area may collapse as they walk on or below the landfill. To reduce, stop, or prevent the potential for injury or harm, ATSDR recommends the following:

1. Despite current escorts, safety awareness briefing and SOPs regarding the instability of the landfill surface and bluff area, as a prudent public health measure, ATSDR recommends that the entire Landfill 04 area have further access restrictions. Because different landfill wastes have different decomposition rates, erosion, washout, and compaction potential, the differential settlement, collapse and subsidence, it cannot accurately be anticipated to be safe. Viewing Landfill 04 by boat, aircraft, videotape, surveillance camera or air photos would remain as possible options to see the current condition of the landfill. Additional wording should also be added to signs identifying that the landfill is unstable and is subject to collapse without warning.
2. ATSDR recommends that the Air Force, EPA Region 10, and ADEC ensure that information is provided on the sampling, removals, contents and historical use of Landfill 04 to appropriate groups that may be involved in trawling, dredging and or port expansion in or around Landfill 04. This would include providing information to the Port of Anchorage, Army Corps of Engineers, National Oceanic and Atmospheric Administration, and U.S. Coast Guard.

Evaluation of On-base Drinking Water

ATSDR is concerned that perchlorate could be present in on-base drinking water supplied to Elmendorf residents, workers, and visitors. This would include different seasons of the year and when groundwater is used directly or blended with Ship Creek water. Regional use of perchlorate compounds and historical military use of munitions (training, ranges, and disposal) could have caused contamination of drinking water wells used at Elmendorf. Water supplied to Elmendorf comes from surface water and groundwater wells. Perchlorate is easily disbursed in water and yet can be present at significant concentrations for decades. ATSDR recommends the Air Force add perchlorate and munitions (where applicable) to the list of chemicals currently sampled in all drinking water systems and wells including Class C wells and systems. Sampling on a seasonal basis is recommended

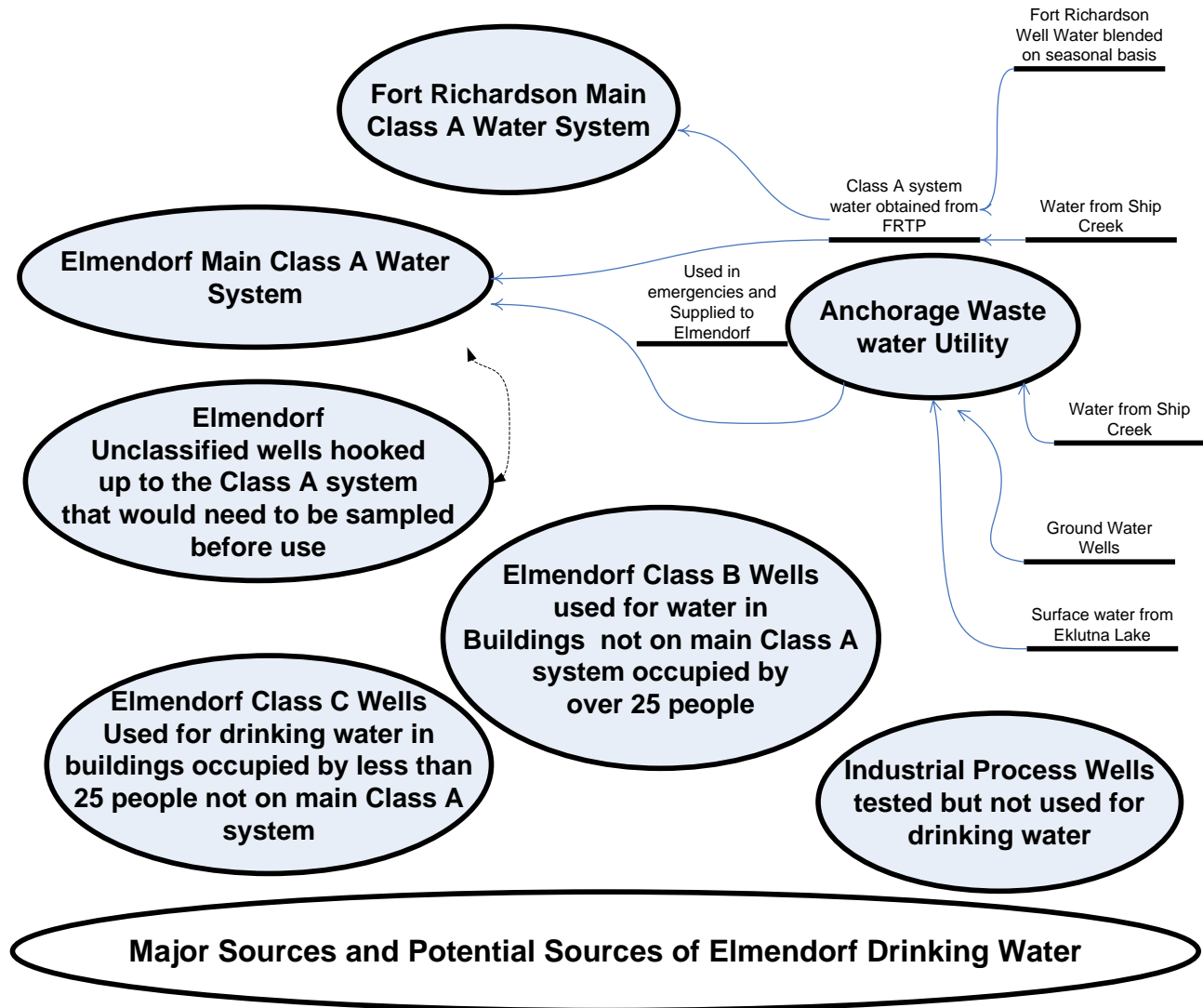
Background

Site Description and History

Elmendorf currently obtains drinking water from several surface water and groundwater sources. The majority of water comes from the surface water of Ship Creek provided by the U.S. Army Fort Richardson Water Treatment Plant (FRWTP) located above the fourth (upper) dam of Ship Creek. The dam is about 12 miles from the mouth of Ship Creek and the Port of Anchorage. The treatment plant also processes and blends water from four Fort Richardson groundwater wells, primarily in the winter when Ship Creek water flow is reduced.

As diagramed below, water is piped through metered mains connected to, owned, and operated by the Fort Richardson Army Base Water Treatment Plant (FRWTP) distribution system to the Elmendorf main Class A distribution system. Water is treated at Fort Richardson and then distributed to 13,000 people at Elmendorf. Water from Fort Richardson drinking water wells is blended by FRWTP with Ship Creek water on an as needed basis usually in the winter when there is lower flow in Ship Creek and supplied to both Elmendorf and Fort Richardson main water distribution systems. Elmendorf like Fort Richardson conducts water sampling in accordance with SDWA, DOD and ADEC requirements.

The Anchorage Water and Waste Water Utility (AWWU) supply system is hooked up as a back up system to supply a second source of water. AWWU water is drawn primarily from Eklutna Lake in the Chugach Mountains, located southwest of Anchorage. Water is also obtained from Ship Creek and 21 groundwater wells (active and standby) in the municipalities of Anchorage, Eagle River, and Girdwood. AWWU has two water treatment plants; the closest is near Fort Richardson on Ship Creek. Elmendorf is also served by two metered back up water lines from AWWU. In the past, six buildings were hooked directly to AWWU water and sewer lines. Currently, the six buildings are provided water by the main Elmendorf Class A water system. AWWU water is always available, but not routinely used by the Elmendorf system, but is used only in emergency situations i.e., natural disasters or major system or supplier disruptions. Unclassified wells are hooked up to the A system, but will not be used unless tested in accordance with SDWA requirements. One well located on the southwest portion of the base provides cooling water to the power plant and has a chlorination system in place in the event it is required for drinking water backup supply in an emergency. Three unclassified wells near the new hospital provide cooling water to the hospital power plant and have a



MIOX disinfection system should they need to be used as a drinking water supply backup in an emergency situation. The drinking water wells would be sampled before use in accordance with Air Force, U.S EPA and ADEC requirements or regulations.

Class B wells provide water directly to specific buildings located away from the major distribution system with occupancies of more than 25 people. ADEC has assigned each well an independent water system identification number. The water from these wells is tested at the wellhead and at the point of use or water tap. The water is chlorinated before use. The following facilities are attached to Class B wells: Munitions Storage (ID# 218478), Golf Course (ID# 218477), Hillberg Ski area (ID# 218475), Six Mile Chalet (ID# 218747) and the Naval Security Group (ID# 218476).

Class C wells provide water directly to specific buildings with occupancies of fewer than 25 people. The water from these wells is tested at the wellhead and at the point of use or water tap. The water is chlorinated before use.

Industrial process wells are not used as a drinking water source. Elmendorf has a program in place to ensure that cross connections do not occur. The Air Force also tests all on-base groundwater used for industrial processes. Because the quality is closely monitored, people using on-base groundwater are not expected to be exposed to any SDWA contaminants.

Sampling

Treated drinking water at Elmendorf meets current state and federal drinking water standards. Fort Richardson samples water supplied to Elmendorf's main drinking water system multiple times a week for bacteria, and every three years for lead, copper, trihalomethanes, and haloacetic acid. Further testing is conducted as required by the Safe Drinking Water Act. Sampling is done at tap locations where the water is used. Elmendorf calls FRWTP in the event that sampling indicates adjustments in pH or chlorine levels are needed. Historically Elmendorf previously adjusted the chlorine and pH on an as needed basis. Groundwater wells are also tested for a wide range of contaminants when they are first installed. After that, sampling of on-site wells consists of quarterly bacteriological testing and yearly nitrate/nitrate testing. No regulatory MCLs, action levels or other regulatory limits have been exceeded in the last three years. Disinfection for on-site drinking water wells is provided with calcium hypochlorite systems. Chlorine residual and pH are monitored daily. Bacteriological and nitrate monitoring is conducted as required by state law. All wells meet SDWA standards.

Currently, perchlorate is not included in the list of chemicals for which AWWU samples. At the time of the ATSDR site visit, perchlorate sampling was not a requirement of DOD, U. S. EPA, ADEC, or Safe Drinking Water Act programs. Elmendorf and Fort Richardson have conducted initial perchlorate sampling for the main water system and for class B systems or wells in accordance with new DoD requirements. Class C systems and wells are not sampled.

Elmendorf is in contact with ADEC concerning perchlorate sampling. At this time, water systems supplying drinking water to Elmendorf and Fort Richardson are not required by ADEC to do perchlorate sampling. EPA is developing relevant regulatory levels. Per Federal Register dated August 22, 2005, "Unregulated Contaminant Monitoring Regulation for Public Water Systems Revision; Proposed Rule," assessment monitoring should start in 2007 through 2010. EPA lab approval process starts in 2006. ADEC will be contacting systems with monitoring requirements. Limited sampling of tap water by FRWTP from several tap water faucets in 2004 on Fort Richardson did not detect perchlorate at levels above 4 ppb (ug/L). Limited sampling by Elmendorf of the tap water provided on Elmendorf by FRWTP in July of 2006 showed levels near, but below the DoD action level of 4ppb. The July 2006 sampling of Class B wells for perchlorate indicated levels below, but near the action level for drinking water.

ATSDR evaluated data for several on-base shallow and deeper drinking water wells. Movement of potential contaminants into groundwater in all aquifers is possible. All wells on Elmendorf have not been tested for perchlorate. However, other contaminants (i.e., thallium, arsenic, and lead) were detected at the wellheads used or potentially used in the drinking water system at levels above ATSDR's screening values (Elmendorf AFB 1993a, 1993b).

Currently Elmendorf soil, sediment, surface water, ground water and air sampling data is not available in electronic format to look for contamination trends over time or locations. The database is still undergoing QA/QC and the electronic data has not been provided to ATSDR or added to EPA's contaminant concentration levels found in the Comprehensive Environmental Response,

Compensation and Liability Information System (CERCLIS) as of September 2006. Once the data is available it may be possible to identify trends in chemical contamination that would indicate if levels are increasing or decreasing over time, identify data gaps, and determine if locations with potentially higher concentrations are likely. Elmendorf uses deep groundwater wells from the second or confined aquifer for drinking water in certain areas of facilities in the northern portions of the base. These Class B and C wells are not tied into the distribution system. Six buildings in the southern portion of the base that were supplied directly by AWWU are currently supplied by the main water system. Currently, Elmendorf is not using shallow groundwater from the areas with identified groundwater contamination.

In the past, Elmendorf used on-base shallow groundwater in the southern part of Elmendorf for drinking water, irrigation, power plant cooling, and firefighting. All such wells are now closed. Land use controls, imposed between 1995 and 2002, strictly prohibit use of shallow groundwater wells in the southern part of Elmendorf for drinking, irrigation, fire control, dust control, or any other use (ADEC 2003a; Elmendorf 2000, Elmendorf 2003d, Elmendorf 2003c).

On-Site Groundwater, Upper Unconfined Aquifer Not Used for Drinking Water

The Air Force began sampling groundwater at Elmendorf in 1986, and has initiated several remedial actions. The Air Force samples monitoring wells for volatiles, metals, and fuel-related contaminants. Sampling revealed a wide range of contaminants in monitoring wells, many at levels above ATSDR's health-based screening values. Contaminant levels in the shallow groundwater south of the divide (but north of Ship Creek) were far higher than elsewhere. However, the Air Force conducted a study with regulatory oversight that found any contamination reaching the site boundary down gradient from contaminated areas is expected to be far below health-based screening values. Therefore, contamination is not expected to impact off-base groundwater that may be used as drinking water for residents in the areas adjacent to Elmendorf.

The Air Force initiated a groundwater monitoring program in 1994, to track groundwater plumes and to ensure that contaminants do not reach Ship Creek or the Knik Arm. The Air Force has over 300 groundwater monitoring wells at Elmendorf. In 2002, the Air Force sampled 86 wells and 9 groundwater seeps (Elmendorf 2003b).

This groundwater monitoring program identified several localized pockets or "plumes" of groundwater contamination that must be cleaned up under regulatory requirements. The identified plumes are all in the shallow groundwater. Most of the plumes are north of Ship Creek, and south of the surface water and possible groundwater divide. The Air Force monitors contaminant migration toward Ship Creek, along an early warning line set of locations that would detect contaminants two years before they could reach Ship Creek. As of 2002, the Air Force has not found any contamination of concern at, or approaching, these wells. The Air Force will continue this monitoring, and expects all plumes to "naturally attenuate" or be fully cleaned up by 2025 (Elmendorf 2001, Elmendorf 2003b).

Exposure Pathways and Public Health Implications

Drinking water at Elmendorf meets current state and federal drinking water standards. However ATSDR is concerned that people drinking from drinking water wells on Elmendorf could be exposed to perchlorate. Perchlorate levels may fluctuate on a seasonal basis in all water systems (surface water and groundwater). Perchlorate has not historically been required to be analyzed in drinking water and may not be required for public wells serving a small number of people.

Perchlorate is an environmental contaminant that is seldom known to occur naturally. Perchlorate compounds contain the perchlorate anion (perchlorate). Perchlorate compounds include both inorganic and organic perchlorate salts (perchlorates) and perchloric acids. Perchlorate compounds may also be found as impurities in other manufactured and natural compounds or may form over time in compounds that include oxygen and chlorine such as aged chlorine bleach.

Perchlorate salts dissociate completely in water and aqueous tissues. Dissolution of perchlorate salts yields the perchlorate anion, which is highly stable and mobile in surface and groundwater systems and may result in the uptake by plants, animals, and humans. Perchlorate salts are strong yet stable oxidizing agents that vary by compound. These salts are highly soluble in water, and because perchlorate adheres poorly to mineral surfaces and organic material, it can be very mobile in surface and subsurface aqueous systems. Because perchlorate is relatively inert in typical groundwater and surface water conditions, perchlorate contamination may persist for extended periods of time.

According to information from California Department of Toxic Substances Control available on the web at http://www.dtsc.ca.gov/LawsRegsPolicies/Regs/upload/HWMP_WS_dPerch-Sec2.pdf

"...In dilute concentrations typically found in groundwater, perchlorate behaves conservatively, with the center of mass of the plume moving at the same average velocity as the water. Dispersion will result in the contaminant front actually moving faster than the average groundwater velocity. Perchlorate is kinetically very stable under environmental conditions and will not react or degrade in solution under ambient conditions. Biodegradation of perchlorate in groundwater will not occur unless significant levels of organic carbon are present, oxygen and nitrate are depleted, and perchlorate-degrading anaerobic bacteria are present. If perchlorate is released as a high concentration brine solution, the movement of the brine in a groundwater system may be controlled by density effects. Flowers and Hunt (2000) explain that, depending on site release history, perchlorate can be distributed in the subsurface as a source area of undiluted perchlorate-contaminated brine, along with a plume of more dilute perchlorate contaminated groundwater...."

In humans, perchlorate interferes with iodide uptake into the thyroid gland. Because iodide is an essential component of thyroid hormones, perchlorate disrupts how the thyroid functions. However, at low levels, this is a temporary condition that does not result in adverse health effects. In adults, the thyroid helps to regulate the metabolism. In children, the thyroid also plays a major role in proper development. Impairment of thyroid function in pregnant mothers may impact the fetus and result in such effects as changes in behavior, delayed development and decreased learning capability.

During the site visit to Elmendorf, ATSDR recommended sampling of perchlorate in drinking water systems including all drinking water wells. At that time EPA, ADEC, and DoD or Air Force did not require sampling for perchlorate in drinking water. Currently, EPA is in the process of expanding the requirement for sampling for perchlorate. ADEC typically enforces federal and state requirements. DoD has issued guidance that is being followed by the Air Force at Elmendorf and the Army on Fort Richardson for water being provided by FRWTP in the Class A water systems on both bases.

Sampling results of the FRWTP water on Fort Richardson was detected at the 4 ppb action level requiring further evaluation on Fort Richardson. This level is well below levels shown to cause temporary reduction of iodine levels in the thyroid. The condition is temporary because the body quickly compensates and iodine levels in the thyroid return to normal healthy levels. On Elmendorf, the levels of perchlorate in the water being bought and supplied by the Class A system and Class B wells were near but below the DoD action level. Therefore, they did not require further sampling. Both the ground water and surface water used for drinking water on Elmendorf has detected

perchlorate below levels expected to result in the most sensitive health effect; short term reduction of iodine in the thyroid. However the B drinking water wells have not been sampled and seasonal sampling of water from groundwater and surface water from Ship Creek may detect lower or higher levels than sampling results that are available from Fort Richardson and Elmendorf. ATSDR continues to believe that sampling of all drinking water is a prudent public health action on base by the Air Force and by well owners or home owners that are not using tested water supplies even if there are currently no state or federal requirements for sampling. ADEC and EPA also encourage everyone to have their water tested (please see recommendations below for further information)

ATSDR continues to believe that it a prudent public health action to sample for munitions in drinking water wells close to areas where munitions or explosives have been used stored, tested or disposed. For this reason, ATSDR is recommending sampling for munitions compounds in the Munitions Storage (ID# 218478) and if appropriate at the Naval Security Group (ID# 218476).

During the public comment period for this public health assessment, ATSDR received a comment that the quality of water in Building 9480 was poor and that some of the water taps had been closed. Elmendorf has no records of the taps being closed nor records of complaints on the water quality. Because in part of the age (1950s) of the building, the building will be renovated in the next few years. It is possible that lead or sediment may be released from the pipes. The water supplied to the building meets safe drinking water requirements, but current state (ADEC) or federal laws do not require testing of water for lead or testing for secondary water quality standards in non-residential buildings. Elmendorf Air Force base is requesting that those with concerns about Building 9480 drinking water contact them.

ATSDR Recommendations

1. Because of an inquiry received about the drinking water in Building 9480, ATSDR recommends a review of the issue by Elmendorf Air Force Base and ADEC to determine if additional sampling is needed. ATSDR recommends that the results of the tap water evaluation be provided to those using Building 9480 and to ATSDR.
2. Elmendorf follows state and federal water-testing programs. Perchlorate compounds released from various areas where munitions have been used, disposed, or stored may have seeped into the groundwater, infiltrating the low numbers of on-base wells used for drinking water. Because of the nature of perchlorate and the potential for its presence, ATSDR recommends the Air Force add perchlorate to the list of chemicals currently sampled in all drinking water systems and wells including Class C wells and systems. Sampling on a seasonal basis is recommended for all wells and for the Class A system especially when well water is being added to system by Elmendorf and Fort Richardson. EPA has proposed regulations for sampling perchlorate in drinking water systems by 2010.
3. ATSDR recommends that the Air Force add munitions compounds to the list of chemicals currently sampled in drinking water wells including unclassified (potential Class A) wells , Class B wells and Class C wells when the drinking water wells are near known munitions areas. This would include the Class B well that is near the current munitions storage area.
4. ATSDR recommends that ADEC encourage seasonal monitoring for munitions compounds including perchlorate in drinking water wells or blended water supplies in areas where munitions or perchlorate compounds were used. Elmendorf should review the electronic

database, once available, to identify if trends in chemical contamination levels are increasing or decreasing over time, identify data gaps, and determine locations with potentially high chemical contaminants.

Evaluation of Flight line Soil, Air, and Garden Produce

ATSDR is concerned that adults and children who maintain gardens in designated areas adjacent to the flight line may have an increased exposure to contaminants in air and from eating contaminants deposited onto garden-grown produce. Limited information and sampling data of vegetation near airports, air bases and roads can be found in the scientific literature. Each location is different with respect to their own climate and geography as well as air or landing strip operations that result in different levels of air emissions. However, emissions are generally believed to be higher near the runways and decrease as you move away from the hangers, runways, and run-up areas. The Air Force currently believes that locations for community gardens are far enough away from ground support and air operations as to not significantly contribute to chemical deposition on crops in the community gardens. However, no data is available to confirm this. ATSDR believes that people tending gardens adjacent to the flight line area and eating produce from those gardens may have an increased exposure to contaminants in the air and contaminants deposited on vegetable surfaces. As a precautionary measure, ATSDR recommends that people who consume produce from Elmendorf's community garden area wash produce and peel root vegetables prior to eating.

Background

Site Description and History

Plots of land adjacent to the flight line near the west ramp of the east/west runway are available through Morale Welfare and Recreation for private vegetable gardening for base personnel and their dependents. The community garden plot area is approximately 2500 square feet and is adjacent to the flight line and snow disposal area.

No air, soil, or produce samples have been taken at Elmendorf to determine the amount of chemicals to which people would be exposed. Several studies have documented airport emission at civilian airports and military bases. However, in accordance with EPA regulations and guidelines these reports focus on "criteria" air pollutants such as carbon monoxide, nitrogen oxides, sulfur oxides, particulates and some hydrocarbons (URS 2003). They have not specifically addressed Hazardous Air Pollutants (HAPs) a designation identified by the Federal Aviation Administration (FAA). FAA has done studies to determine the hazardous air pollutants emitted from aircraft. Data from EPA and the US Air Force used by the FAA identified 188 pollutants present in aircraft exhaust and their ground support equipment (URS 2003). The following ten compounds comprise the majority of emissions: formaldehyde, acetaldehyde, benzene, toluene, acrolein 1, 3-butadiene, xylenes, lead, naphthalene and propionaldehyde. Current FAA guidelines pertaining to air quality do not specifically regulate these compounds (URS 2003).

Public Health Implications

Because adults and children may spend hours several times a week working in these gardens, they may have an increased exposure to contaminants in air and from deposition of contaminants onto garden-grown produce. VOCs, metals, PAHs, and fuel additives may be released from the fuels in the form of fugitive air emissions and subsequent deposition onto soils during refuel, aircraft emissions, and ground vehicle operation. The scientific literature suggests that these contaminants would be present at concentrations greater than other recreational areas on base and may result in increased exposure to adults and children who garden the area. The FAA reports that contaminants significantly decrease as distance from the flight line increases (URS 2003).

ATSDR is concerned that adults and children could be exposed to levels of fuel related contaminants at levels that would increase their health risk. Washing all vegetables and peeling root vegetables significantly reduces the amount of contaminants consumed from contaminants deposited on the surface of produce. Because no samples have been collected from these gardens area, they pose an uncertain health risk. Washing vegetables and peeling root vegetables should help remove deposited contaminants.

ATSDR Recommendation

1. People who participate in flight line gardens should be advised to wash all parts of the plants prior to consumption and peel root vegetables.

Evaluation of Landfill 02 and Landfill 03

ATSDR is concerned that adults and children living in housing areas near Landfill 02 and Landfill 03 could be exposed to heavy metal contaminants (including lead) and unexploded munitions items that come to the surface because of freeze-thaw movement of heavy buried material. Additionally, ATSDR does not have enough information to evaluate the possible migration of landfill gases in the landfill or movement toward homes. ATSDR recommends that future erosion (including freeze thaw and break up of soil lead particles) and frost heave of chemicals to the surface soils be evaluated. ATSDR also recommends sampling and determination of the potential for landfill gases to be present in the summer and winter months when the soil is frozen or snow covered. Evaluations should specifically consider the potential for landfill fires and explosions.

Background

Site Description and History

Landfill 02, Disposal Pit, (CERCLA site, OU 6)

Landfill 02 is a former 8-acre landfill near the Boniface Parkway Gate in the southeastern corner of Elmendorf, west of Vandenberg Avenue. From 1940 to 1942, the Air Force used this landfill to dump hard fill, construction rubble, scrap metal, and general refuse. Hazardous and industrial wastes were not reportedly disposed of at the site (Elmendorf 2001). However, the Air Force's Management Action Plan has identified gasoline-range organics, diesel-range organics, VOCs, and metals as contaminants of concern. The landfill is on a bluff that rises 30 to 40 feet across this site, separating the main Ship Creek floodplain from an upper stream terrace (Elmendorf 2003b). The landfill is covered with soil and vegetation. No daily cover was applied while the landfill was active (Elmendorf 1998).

Landfill 03, Sanitary Landfill, Site D-3 (CERCLA site, OU 6)

Landfill 03 is a former 15-acre landfill surrounded by relatively flat land that slopes to the west. Local drainage is toward Ship Creek. The site is west of Chugach Housing, and it was used from 1943 to 1957. The Air Force disposed of general refuse, rubble from construction, spent WWII small arms ammunition, and small quantities of shop waste, at this landfill. The Air Force also conducted limited open burning here during the 1950s. The Air Force closed this landfill in 1957 because of odor complaints (Elmendorf 2001). Surface debris on or partially buried in the ground has been removed and limited soil cover has been added. The Air Force determined in 1997 that no further action was needed (Elmendorf 2001).

Landfills are frequently large sources of methane and other gases which form when certain wastes decompose. Though relatively benign from a toxicity perspective, methane gas can present serious explosion hazards under certain landfill conditions. Of particular concern, is methane gas migrating beneath the soil surface and collecting in pockets in the landfill, in engineering fill along utility lines, under roads, in cracks and crevasses and may move toward or enter enclosed spaces of nearby structures. Even though it is considered to be a low risk event, in all of these situations methane levels can gradually accumulate to potentially explosive levels that may be initiated by sparks from brush fires or recreational and maintenance activities. Frozen ground or snow cover may result in greater build up of methane or movement of methane to greater distances under some circumstances.

Warmer temperatures may also increase methane production and allow buildup of methane in nearby pockets

Over time natural processes resulting from frost heaving may cause buried contaminants like lead (pb) to break into finer particles and move up to the surface where they have the potential to be contacted by residents of the housing units (adults and children).

Sampling

The Air Force sampled groundwater and soil in 1993 and in 1994 (Elmendorf 1996b). Groundwater monitoring is ongoing at this site. Contaminants detected at levels above ATSDR's screening values are listed below.

Landfill 02 Sampling

Surface Soil: SVOCs: phenanthrene (0.214 ppm). Inorganics: antimony (122 ppm), arsenic (28.6 ppm), cadmium (20.4 ppm), calcium (40,700 ppm), iron (196,000 ppm), lead (6,080 ppm), magnesium (10,600 ppm), potassium (1,790 ppm), sodium (1,460 ppm), and thallium (12 ppm).

Shallow Groundwater: VOCs: benzene (1.7 ppb), chloromethane (4.36 ppb), 1,2-dichloroethane (3.52 ppb), methylene chloride (7.84 ppb), 1,1,2,2-tetrachloroethane (45.1 ppb), and trichloroethylene (6.1 ppb). SVOCs: bis (2-ethylhexyl) phthalate (11.8 ppb). Inorganics: arsenic (32.7J ppb), barium (1,260 ppb), calcium (27,000 ppb), chromium (333 ppb), lead (84.6J ppb), magnesium (9,700 ppb), potassium (1,160 ppb), and sodium (4260 ppb).

Soil Gas: Not reported.

Landfill 03 Sampling

Surface Soil: Inorganics: arsenic (8.11 ppm), calcium (7,580 ppm), iron (29,300 ppm), magnesium (8,300 ppm), potassium (1,000 ppm), and sodium (276 ppm).

Surface Water: Inorganics include aluminum (20,000 ppb), arsenic (1 ppb), calcium (18,000 ppb), magnesium (2,700 ppb), potassium (400 ppb), and sodium (2,100 ppb).

Shallow Groundwater: VOCs: chloromethane (3.34 ppb) and 1,2-dichloroethane (3.21 ppb). Inorganics: aluminum (89,700 ppb), antimony (98.3 ppb), arsenic (63.7 ppb), cadmium (6.04 ppb), calcium (200,000 ppb), chromium (165 ppb), iron (133,000 ppb), lead (55.8 ppb), magnesium (76,400 ppb), manganese (4,180 ppb), nickel (230 ppb), potassium (7,770 ppb), sodium (25,200 ppb), and vanadium (254 ppb).

Soil Gas: Not reported. Records of sampling to meet health and safety plan requirements for sampling of soil and landfill gas groundwater wells and intrusive activities could not be found.

Public Health Implications

Because of the close proximity of the housing areas to Landfills 02 and 03, if frost heaving pushes heavy contaminants to the surface of the landfills, children and adults could contact that material. Additionally, if gases were being produced by the landfills they would likely find easy conduits toward roads and homes thus creating a potential explosive hazard to occupants. When the ground is frozen, movement of water by surface run off or infiltration into the ground may be decreased while the distance that soil gases move may be greater and may result in higher levels of gases in warmer areas under buildings. In other areas of the base, the Air Force has checked several buildings with the potential for movement of gases and vaults associated with water and other utility lines for explosive gases. The utility lines are a potential preferential pathway for the movement of gases. However, no elevated levels of explosive gases have been found (ATSDR 2004). ATSDR remains concerned about recreational and other activities on the landfills by residents of the homes near Landfills 02 and 03.

Landfill gas measurements would be useful to determine if gas levels are present at levels that could result in landfill gas related fires and explosions. Sampling data for soil contamination and landfill gas especially during times with the greatest potential for buildup of gas are needed. This would include sampling to identify the landfill gas, soil gas levels, and potential movement of gas when the soil is frozen or snow covered. Soil sampling would verify or eliminate ATSDR's concerns that frost heave and other processes may bring buried material to the surface of the landfill near homes.

Landfill Gas Investigation: A Case Study

A British Geologic Survey (BGS) website discusses a case where landfill methane and carbon dioxide concentrations increase considerably with depth and distance from the landfill, such that measurements made near the surface might not reflect the highest sub-surface methane concentrations. The depth range with the highest methane levels varied with distance from the landfill. In this specific case, methane concentrations at some locations were approximately 10% and were observed within a few meters of the surface, and much higher methane concentrations (up to 70% methane) were observed about 5 meters below the surface. This highlights a potential need for supplementing shallow soil gas surveying with deeper investigations when assessing potentially contaminated land. (For more information on this particular case study and visualization of lateral and vertical concentrations, see: http://www.bgs.ac.uk/programmes/envhaz/paw/PAW_WWWPages/Project%20Profiles/Landfill/gas/landfillgas.html) last accessed August 2006.

In 1996, the Air Force removed surface debris and added soil covers in three areas to minimize exposure to surface soil. The Air Force recommended monitored natural groundwater attenuation at this site, and expects all contaminant levels at this site to be below regulatory levels by 2027 (Elmendorf 1998, Elmendorf 2001). Frost heaving could cause the material to surface. Children and adults living in the housing area nearby could come in contact with landfill material that surfaces and might be harmed. The soil cover prevents current exposure, but over time the freeze-thaw process could cause once buried material to surface. Shallow groundwater use is not permitted here or at any site south of Elmendorf Moraine. The Air Force allows use of land directly on top of landfills for recreational purposes (e.g. cross-country skiing or snowmobiling).

Recommendations

1. Only small-round ammunition has been found in landfill 03. However, ATSDR recommends the Air Force continue to brief personnel, staff and families and continue to provide fact sheets and other information to inform them of current base rules and procedures for explosive items. The Air Force should continue education not to dig from the area. Use should remain limited to recreational purposes only.
2. Due to the possibility that landfill gas may be present (especially during times of summer heat and winter snow cover). ATSDR recommends that the Air Force with regulatory oversight conduct soil gas sampling during both summer months and times when the ground is frozen and has snow cover.
3. Due to the possibility that landfill material and contamination may move up to the surface from frost heaves, the Air Force should conduct surface soil sampling, and evaluate the level of contamination resulting from erosion, freeze thaw, frost jacking, and horizontal water flow or mass movement in layers above covered waste in each of the future 5 year reviews.

Child Health Considerations

In communities faced with air, water, or food contamination, the many physical differences between children and adults demand special emphasis. Children could be at greater risk than are adults from certain kinds of exposure to hazardous substances. Children play outdoors and sometimes engage in hand-to-mouth behaviors that increase their exposure potential. Children are shorter than are adults; this means they breathe dust, soil, and vapors close to the ground. A child's lower body weight and higher intake rate results in a greater dose of hazardous substance per unit of body weight. If toxic exposure levels are high enough during critical growth stages, the developing body systems of children can sustain permanent damage. Finally, children are dependent on adults for access to housing, for access to medical care, and for risk identification. Thus, adults need as much information as possible to make informed decisions regarding their children's health.

ATSDR evaluated the unique ways in which children could be exposed to contaminants at Elmendorf. In each exposure situation, children are identified as a potentially exposed group. ATSDR's recommendations are specific for each exposure situation and are protective of children and also adults who might be exposed.

Community Concerns

Concern 1:

People have expressed health concerns about lead in homes and drinking water on Elmendorf.

Response 1:

Exposure to lead in housing and the environment at Elmendorf currently does not pose a health hazard. The Air Force has programs in place to monitor lead-based paint in housing and lead in drinking water. Residents are informed of potential lead-based paint in housing and steps to reduce exposure. The Elmendorf hospital evaluates all children for possible lead exposure and tests the blood of children who could have come in contact with lead. ATSDR evaluated sampling results from the last three years and found that no blood lead levels were at or above the level the Centers for Disease Control and Prevention recommends for follow-up action. This suggests that children are not currently being exposed to hazardous levels of lead from lead-based paint, tap water, hazardous waste sites, or recreational areas. Blood lead sampling or other data have been available since 2001.

Concern 2:

Because of historical releases and regional contaminant sources, are base lakes safe for recreational use?

Response 2:

Contact with surface water and sediment on Elmendorf poses no health hazard. People using on-base lakes for recreational purposes are unlikely to be exposed to potential contaminants from known areas of contamination in sediments at levels of health concern. Monitoring of active drinking water wells north of the main outwash plain near lakes and wetlands indicates that contamination if present has not reached the drinking water aquifer near lake and wetlands well locations.

Concern 3:

We live in an off-base area south of Ship Creek in Anchorage. Is it safe for my family to drink from our home's private well? Many private wells and some municipal wells in Anchorage have shown chemicals such as arsenic and nitrates above Alaska State Drinking Water Standards. How is Elmendorf making sure that base chemicals are not moving to off base drinking water wells, fish hatchery wells, Ship Creek or springs in Anchorage?

Response 3:

Contaminants from Elmendorf have not been found to have moved off base. However, drinking water from untested and treated private, shallow and bedrock wells along and south of Ship Creek could contain contaminants from various identified and non-identified sources in Anchorage. Therefore, people drinking water from off-base private wells could potentially be exposed to contaminants at levels that may be of health concern. ATSDR recommends individual well owners have their drinking water wells sampled every few years to be sure their water is safe to drink.

Elmendorf has established sentinel wells in the shallow aquifer zone to serve as an early warning system if contaminants move from the base toward Ship Creek and the off-base residential areas beyond. An artificial wetland is being used to treat and remove petroleum products and as an added benefit would also treat low solvents on leased land near the railroad, south of Elmendorf. Elmendorf

has water use restrictions in place for the shallow aquifer zone. One tested well in the deeper aquifer zone is used for operations, but not for drinking water. The even deeper weathered and fractured bedrock aquifer zones were not historically and are not currently used on Elmendorf or to the west of Elmendorf as a water supply.

Concern 4:

Should I be concerned about my past exposure to asbestos in buildings commonly used by families on base? The base has a great asbestos program once someone finds the asbestos, but my family and I have lived and been in many on-base buildings with asbestos that we found out later had to have asbestos removed.

Response 4:

Current exposure to asbestos at Elmendorf does not pose a health hazard as long as the asbestos is not “friable” or flaking. The Air Force has an aggressive asbestos program to contain and remove all asbestos found in buildings at Elmendorf. People living and working in homes, schools, offices, stores, and hospitals at Elmendorf that may contain asbestos are not expected to be exposed to asbestos at levels likely to cause health effects. Furthermore, asbestos in buildings does not usually present a health concern for office workers and residents because it is in insulation surrounding pipes and other areas, but not in areas where people are. Most people in the United States are exposed to asbestos daily through breathing in a few fibers but do not, and are not expected to, develop asbestos-related diseases. People are unlikely to develop asbestos-related diseases unless they are regularly exposed for several years to very high levels of asbestos fibers in trades that directly handle asbestos, such as asbestos processing, mining, and the shipbuilding and refurbishing industries. Regardless, ATSDR and other public health agencies believe that asbestos exposure should be reduced to the extent possible.

Concern 5:

Since it’s a National Priority List Site, is it safe for my family to eat plants and animals from Elmendorf Air Force Base?

Response 5:

Residents, visitors and others (i.e., wild game is donated to food banks) who consume Elmendorf salmon, trout, geese, moose, berries, mushrooms, wild plants and possibly birch tree sap (as syrup) from designated areas are not expected to ingest contaminants from waste sites at levels that could cause adverse health effects.

Concern 6:

ATSDR received a comment that the water in Building 9480 (ALCOM HQ) smells, looks and tastes bad and is bagged off. In addition, the commenter was concerned that the tap water sample was taken after the line was flushed for a longer time than would occur during normal use.

Response 6:

Because of the inquiry received about drinking water in Building 9480, ATSDR recommends a review of the issue by Elmendorf Air Force Base and ADEC to determine if additional sampling is needed. ATSDR recommends that the results of the tap water evaluation be provided to those using Building 9480 and to ATSDR.

Elmendorf provided the following information relative to drinking water in Building 9480. The building is on the main Class A water system that provides water purchased from Fort Richardson. The building and the water pipes were built in the 1950s and the building and pipes are going to be renovated in 2-2.5 years. The water in the building has been sampled within the last two years and met SDWA requirements. No complaints on the water have been received by the Bioenvironmental Office or the dedicated building facility manager in the last year. Iron (secondary standard for taste and aesthetics) sediment has been identified in the water at times after lines have been purged and lines have not been used for some time. This is typical of water systems throughout the US. In these cases, we have customers purge their taps. The Bioenvironmental Engineering Office is unaware of any drinking water fountains or tap water spigots being currently closed or covered. Staff or personnel with concerns or information identifying the need for re-evaluation of the drinking water in Building 9480 or other buildings are encouraged and requested to call the Bioenvironmental Office at 552-3985.

Conclusions

- 1. Landfill 04 poses a safety hazard to people who visit the top of the landfill because of potential collapse of the landfill.** People accessing the top of the landfill need to be made more aware of the instability of the landfill and that they may become injured during collapse or movement of landfill material because of foot or vehicle travel. Because different landfill wastes have different decomposition rates, erosion, washout, and compaction potential, the safety of the landfill cannot accurately be assured. Currently, additional restrictions on access to the landfill are needed even with the safety briefings, SOPs, and escorted authorized access that is currently in place.
- 2. Although drinking water at Elmendorf meets or exceeds all Safe Drinking Water Act requirements, the presence of munitions and perchlorate has not been evaluated and poses an indeterminate public health hazard.** Because of past use of perchlorate in munitions on base, perchlorate and other munitions may be present in groundwater. This is unrelated to perchlorate levels detected in drinking water supplied by FRWTP from Ship Creek surface water sources near or below the DoD action level.
- 3. Adults and children who garden or consume garden produce from the flight line area gardens may have an increased exposure to contaminants in air and from deposition of contaminants onto garden-grown produce.** VOCs, metals, PAHs, and fuel additives may be released from the fuels used by aircraft, other vehicles, and their operations in the form of fugitive air emissions and subsequent deposition onto soils during refuel, aircraft emissions, and ground vehicle operation.
- 4. Landfills 02 and 03 pose an indeterminate public health hazard to nearby residents.** Due to the close proximity of the housing areas to Landfills 02 and 03, freeze and thaw process may over time push heavy material and contaminants to the surface of the landfills. Children and adults recreating on the landfill could contact the material. Additionally, landfill gases produced by the landfills could build up and create a potential explosive hazard.

Recommendations

Landfill 04

1. Because of the acknowledged instability of the upper landfill bluff area, ATSDR believes that additional measures, further limiting personnel access to the upper landfill bluff, are warranted and recommends that access by personnel be granted only if absolutely necessary. Viewing LF-04 by boat, aircraft, videotape, surveillance camera or air photos would remain possible options to seeing the landfill. Additional wording should also be added to signs identifying that the landfill is unstable and is subject to collapse without warning.
2. ATSDR recommends that the Air Force, EPA Region 10, and ADEC ensure that information is provided on the of sampling, removals, contents and historical use of Landfill-04 to appropriate groups that may be involved in trawling, dredging and or port expansion in or around Land Fill -04. This would include providing information to the Port of Anchorage, Army Corps of Engineers, National Oceanic and Atmospheric Administration, and Coast Guard.

Drinking Water

3. Elmendorf follows state and federal water-testing programs. Perchlorate compounds released from various areas where munitions have been used, disposed, or stored may have seeped into the groundwater, infiltrating the low numbers of on base wells used for drinking water. Because of the hazardous nature of perchlorate and the potential for its presence, ATSDR recommends that the Air Force add perchlorate to the list of chemicals currently sampled in drinking water wells especially when well water is being added to system by Elmendorf, Fort Richardson and Anchorage Waste Water Utility. EPA has proposed regulations for sampling perchlorate in drinking water systems by 2010. This includes the recommendation for seasonal sampling for perchlorate in drinking water systems and drinking water wells when maximum concentrations of perchlorate may be present.
4. ATSDR recommends that the Air Force add munitions compounds to the list of chemicals currently sampled in drinking water wells especially when the drinking water wells are near known munitions areas. This includes the Class B well near the current munitions storage area.
5. ATSDR recommends that ADEC encourage seasonal monitoring of munitions including perchlorate from drinking water wells or blended water supplies. This includes water from areas where munitions or perchlorate compounds were used.

Flight Line Gardens

6. People who participate in flight line gardens should be advised to wash all parts of the plants and peel root vegetables prior to consumption.

Landfill 02 and Landfill 03

7. Only small-round ammunition has been found in landfill 03. However, ATSDR recommends the Air Force continue to brief personnel, staff and families and continue to provide fact sheets and other information to inform them of current base rules and procedures for explosive items. The Air Force should continue education not to dig from the area. Use should remain limited to recreational purposes only.
8. Due to the possibility that landfill gas may be present (especially during times of summer heat and winter snow cover). ATSDR recommends that the Air Force with regulatory oversight conduct soil gas sampling during both summer months and times when the ground is frozen and has snow cover.
9. Due to the possibility that landfill material and contamination may move up to the surface from frost heaves, the Air Force should conduct surface soil sampling, and evaluate the level of contamination resulting from erosion, freeze thaw, frost jacking, and horizontal water flow or mass movement in layers above covered waste in each of the future 5 year reviews.

Public Health Action Plan

The Public Health Action Plan for Elmendorf contains a description of actions taken and to be taken subsequent to the completion of this PHA by the Air Force, ATSDR, EPA, ADEC and other agencies. The purpose of this plan is to ensure that this PHA not only identifies potential and ongoing public health hazards, but also provides a plan of action designed to mitigate and prevent adverse human health effects resulting from exposure to hazardous substances in the environment. Completed, ongoing, and planned public health actions are listed below.

Completed Actions

1. The Air Force studied the regional and local characteristics of the groundwater aquifers beneath Elmendorf and has gained a general understanding of the flow of on-site groundwater in several distinct aquifers (Elmendorf 2003b).
2. The Air Force has installed 300 monitoring wells throughout Elmendorf and tests these wells regularly to determine the extent and movement of chemical and petroleum contamination, including wells that would detect contamination moving toward Ship Creek and provide sufficient time to consider and select additional cleanup or remedial activities if needed (Elmendorf 2003b).
3. The Air Force has removed and recycled petroleum product from several spill locations, and has cleaned up groundwater contamination through active and natural remediation processes (Elmendorf 2003g).
4. In recent years, the Air Force has implemented land use controls to prevent use of groundwater as drinking water in areas of known contamination (Elmendorf 2003g).
5. The Air Force has studied the chemical and physical make-up of the soil and the regional and local geology to help evaluate the distribution and possible movement of contaminants in soil.
6. The Air Force identified areas of soil contamination based on observations, a review of past and present site activities, field investigations and confirmation sampling, and a review of historical aerial photographs of Elmendorf (Elmendorf 2001).
7. Based on the properties of contaminants in soil, the Air Force has used a combination of removal, remediation, and natural attenuation processes to further reduce the levels of contaminants present in surface and subsurface soil (Elmendorf 2001).
8. The Air Force considered the potential movement of dissolved contaminants and soil gases above areas of groundwater contamination to identify contaminant locations and possible sources of on-going indoor air and groundwater contamination.
9. EPA, ADEC, and ATSDR have evaluated other Superfund sites located near Elmendorf, including Fort Richardson and Standard Steel and Metals Salvage Yard.
10. Elmendorf maintains records of weather conditions and air movement because of on-going operations. Site-wide wind roses are available to help evaluate the movement of air and the potential movement of contamination; all of this information is considered in the development and approval of state permits for stationary sources of air contaminants.

11. Elmendorf AFB has completed some of the perchlorate sampling recommended by ATSDR during its site visit in 2004 and the 2006 public comment draft of the Public Health Assessment as indicated in the next seven items listed below.
12. Elmendorf AFB is currently monitoring for perchlorate compounds in accordance with Air Force and DoD policy. Initial sampling of the Class A system water supplied entirely by FRWTP in July 2006 resulted in concentrations below, but near the action level for some samples. Perchlorate sampling of B wells also showed levels below but near the action level for the seasonal summer month sampled. Analytical results are available at Bioenvironmental Engineering but do not include water from wells currently not being used but hooked up to the Class A system or C drinking water wells.
13. Fort Richardson sampled the Class A Water System tap water on Fort Richardson. Water sampled was provided by the U.S Army Fort Richardson Water Treatment Plant from Ship Creek in 2004 and 2005. Perchlorate levels were at the DOD Action Level of 4 ppb. Sampling during winter months for Ship Creek water was conducted, but may not be representative for periods of low water flow in Ship Creek
14. The Air Force Sampled its Class A system water on Elmendorf that was also Ship Creek water purchased from the U.S Army Fort Richardson Water Treatment Plant (FRWTP). Perchlorate levels ranged from .2 ppb to 3.4 ppb in the summer of 2006. Class A groundwater wells on Fort Richardson were not blended with Ship Creek water at the time of sampling for either Fort Richardson or Elmendorf tapwater samples that was being provided by FRWTP.
15. Elmendorf Air Force Base sampled Class B wells for perchlorate in June 2006 and found levels to be near but below the action level. Sampling of Class B wells during winter months and lowest water table (or least infiltration) conditions were not evaluated. No sampling has been done for perchlorate in wells currently (unclassified wells) hooked up to the Elmendorf Class A System. These currently unclassified wells will not be used or authorized for use without SDWA sampling.
16. Elmendorf determined that Class C wells did not need to be sampled for perchlorate because of current DOD and SDWA requirements.
17. The Air Force and ADEC have negotiated permits for stationary sources of air contamination including boilers and heaters at several locations at Elmendorf. Elmendorf is in compliance with its permit requirements (ADEC 2003b, ADEC 2003c, and ADEC 2004b).
18. The Air Force has achieved further reductions below allowed emissions levels by using technologies such as water-based painting of road lines (which decreases ozone emissions), upgrading of fueling and fuel storage and transport procedures, and other measures.
19. In 1993, the Air Force removed 4,500 drums containing asphalt, and used the asphalt to build airport runway shoulders and taxiways (ADEC 2002a, ADEC 2002b).
20. In 1994, the Air Force finished installing bioventing systems to treat petroleum, oil, and lubricant (POL) contaminated soil at nine sites (Elmendorf 2001).
21. In 1994, the Air Force removed 29 underground storage tanks (USTs) from one tank farm, emptied four 1-million-gallon tanks from another tank farm, and started to recover the spilled jet fuel from the tanks. The Air Force closed the 1-million-gallon tanks in 1996 and continued

- to operate the recovery system until 1999. Monitoring from 1999 to 2002 indicated no significant remaining free product (ADEC 2002a, ADEC 2002b).
22. In 1997, the Air Force removed 98 tons of metallic debris from the Knik Bluff Landfill (Landfill 04) beach area, and 29 additional tons of debris in 1999, and transferred the debris to the municipal landfill. In 1999, the Air Force also found possible UXO during a beach sweep, including small arms ammunition, ordnance up to 40mm, and empty casings, some with live primers. An Explosive Ordnance Disposal team removed and cleared the UXO. The Air Force installed fencing and “No Trespassing” signs at the Knik Bluff Landfill to prevent people from accessing the beach area from Elmendorf or the Port of Anchorage (ADEC 1999a, ADEC 1999b; Elmendorf 2001).
 23. In 1997, The Air Force, EPA, and ADEC signed the final CERCLA Record of Decision, and planned and implemented the remedial action by the summer of 1998. Also in 1998, the Air Force successfully removed PCB-contaminated soils from a former transformer storage area (SS21).
 24. In 1998, the Air Force, EPA and ADEC conducted a Five-Year Review to evaluate the effects of remedial actions taken up to that time, and concluded that these remedies remained protective of human health and the environment. They did not recommend any major changes to the remedial actions based on this review.
 25. By 1999, cleanup activities were complete, or remediation systems operational, at 97% of the 84 contaminated sites identified by that time (Elmendorf 2000).
 26. In 2003, the Air Force conducted the second Five-Year Review. The review found that most remedies were operating as expected, but that some cleanup operations would take a few more years than originally anticipated (Elmendorf 2003g).
 27. Munitions that have been found have been removed by Explosive Ordnance Disposal (EOD) teams. Elmendorf has a long history of munitions use. For example, an area where potential unexploded ordnance has been identified is a beach area on the Knik Arm; the Air Force removed unexploded ordnance from this area in 1999, posted signs and constructed fences to secure and to prevent trespassing on the site. The Air Force is continuing to work to ensure that the public does not access the site.
 28. The documentation on the locations and types of possible unexploded ordnance that have been found and removed since World War II is limited. Some of the munitions and munition-use areas that were present during World War II and at the beginning of the Korean conflict are not identified and munitions are unaccounted for in the available records. Sites that have been identified with on base records have been evaluated.

Ongoing Actions

1. The Air Force continues to sample site groundwater several times each year, as well as groundwater testing to monitor the workings of the Wetland Remediation System.
2. The Air Force is coordinating with appropriate DoD commands and the Centers for Disease Control and Prevention (National Center for Environmental Health, Emergency and Environmental Services) to determine whether archival searches or other additional information is needed to locate areas with potential munitions and if public health actions or recommendations are needed.

3. The Air Force continues to use land use controls to prevent use of groundwater in the area of known contamination for drinking water or other purposes.
4. The Air Force has an ongoing abandoned drum reporting and removal program that includes removal of drums and associated contaminated soil as well as evaluation of potential groundwater impacts.
5. The Air Force continues to use multiple lines of evidence to evaluate the impacts of soil contamination on indoor air and groundwater.
6. The Air Force is using bioventing to clean up groundwater and soil at several sites, and continues to operate and monitor other treatment systems and natural attenuation processes for groundwater and soil at several sites (ADEC 2002a, ADEC 2002b, EPA 2002).
7. All historical releases of petroleum will be regulated by regulations regarding contaminated sites or underground storage tanks. This has been the case since 2002, when the Air Force and ADEC signed a presumptive remedy agreement for new petroleum releases that allows the Air Force to take action prior to notifying ADEC.
8. EPA continues to evaluate Ship Creek for metals, PCBs, and other contaminants.
9. The Air Force works to ensure that birds do not establish on-site populations that may interfere with flight of air operations.
10. The Air Force has on-going lead and asbestos management plans to ensure that nobody comes in contact with lead or damaged asbestos-containing materials at levels that would be hazardous.
11. The Air Force began conducting sweeps at the Knik Bluff Landfill in 1997, and will continue to remove debris from the Knik Bluff Landfill site until 2034 (ADEC 1999a, ADEC 1999b).
12. The Air Force continues to meet with community members twice a year in a Community Environmental Board forum to discuss environmental issues/concerns.

Planned Actions

1. The Air Force plans to clean up or implement remedial systems at all contaminated sites by the end of 2014 at the latest (Elmendorf 2001).
2. The Air Force plans to continue monitoring groundwater to ensure the protection of drinking water supplies and of surface water bodies such as Ship Creek, Hillberg Lake, Six Mile Lake and the Knik Arm of Cook Inlet.
3. The Air Force plans to conduct the third five-year review in 2008.
4. The Air Force is planning to conduct surveillance for trespassers at Landfill 4 and continues to consult and work with the Port of Anchorage on this issue.
5. The Air Force is researching a more permanent solution to the issue of landfill debris at the Knik Bluff Landfill (site Landfill 04), in place of annual beach sweeps (ADEC 1999a).
6. EPA and ADEC are planning to study the ARRC Anchorage Terminal Reserve, located along the southwest border of Elmendorf. Additional information is available at EPA's website, www.epa.gov.

7. Per Federal Register dated August 22, 2005, “Unregulated Contaminant Monitoring Regulation for Public Water Systems Revision; Proposed Rule,” assessment monitoring should start in 2007 through 2010. EPA lab approval process starts in 2006. ADEC will be contacting systems with monitoring requirements.

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Tables

Table 1. Potential Exposure Pathways, Elmendorf , Alaska.

Exposure Situation	Potential Source of Contamination	Exposed Population	Time of Exposure	Comments
<p>Physical Safety Hazards Landfill 04 (LF04)</p>	<p>Landfill 04 (LF04)</p>	<p>Authorized personnel and visitors</p> <p>Adults and Children trespassers</p> <p>Boaters</p>	<p>Past</p> <p>Current</p> <p>Future</p>	<p>ATSDR is concerned that even though significant chemical contamination has not been detected at areas where people may be, Landfill 04 poses a potential safety hazard. Official visitors and authorized personnel who access the upper landfill, beyond the gated entrance, could be injured during a landslide or landfill collapse because of the landfill's inherent instability, long-term eroding and sliding into the Knik Arm of Cook Inlet. People walking on the beach or discard collecting who ignore Air Force control measures and trespass may contact sharp objects or explosive debris that could cause harm or injury. In addition, landfill debris may be a safety hazard to boaters who assess the area by water.</p> <ol style="list-style-type: none"> 1. Because of the acknowledged instability of the upper landfill bluff area, ATSDR believes that additional measures, further limiting personnel access to the upper landfill bluff, are warranted and recommends that access by personnel be granted only if absolutely necessary. Viewing LF-04 by boat, aircraft, videotape, surveillance camera or air photos would remain possible options to seeing the landfill. Additional wording should also be added to signs identifying that the landfill is unstable and is subject to collapse without warning. 2. ATSDR recommends that the Air Force, EPA Region 10, and ADEC ensure that information is provided on the sampling, removals, contents and historical use of Landfill-04 to appropriate groups that may be involved in trawling, dredging and or port expansion in or around Land Fill -04. This would include providing information to the Port of Anchorage, Army Corps of Engineers, National Oceanic and Atmospheric Administration, and Coast Guard.

Exposure Situation	Potential Source of Contamination	Exposed Population	Time of Exposure	Comments
<p>On base Drinking water</p>	<p>Industrial areas and landfills at Elmendorf and Fort Richardson Army Base</p> <p>Storage and use of munitions and perchlorate compounds</p> <p>Local and regional levels of perchlorate in groundwater and surface water</p> <p>Off-base water supplied to Elmendorf AFB Water distribution system</p>	<p>On-base residents and visitors (adults and children)</p>	<p>Past</p> <p>Current</p> <p>Future</p>	<p>Although drinking water at Elmendorf meets or exceeds all Safe Drinking Water Act requirements, the presence of munitions and perchlorate has not been evaluated and poses an indeterminate public health hazard. Because of past use of perchlorate in munitions on base, perchlorate and other munitions may be present in groundwater. This is unrelated to perchlorate levels detected in drinking water supplied by FRWTP from Ship Creek surface water sources near or below the DoD action level.</p> <ol style="list-style-type: none"> 1. Elmendorf follows state and federal water-testing programs. Perchlorate compounds released from various areas where munitions have been used, disposed, or stored may have seeped into the groundwater, infiltrating the low numbers of on base wells used for drinking water. Because of the hazardous nature of perchlorate and the potential for its presence, ATSDR recommends that the Air Force add perchlorate to the list of chemicals currently sampled in drinking water wells especially when well water is being added to system by Elmendorf, Fort Richardson and Anchorage Waste Water Utility. EPA has proposed regulations for sampling perchlorate in drinking water systems by 2010. This includes the recommendation for seasonal sampling for perchlorate in drinking water systems and drinking water wells when maximum concentrations of perchlorate may be present. 2. ATSDR recommends that the Air Force add munitions compounds to the list of chemicals currently sampled in drinking water wells especially when the drinking water wells are near known munitions areas. This includes the Class B well near the current munitions storage area. 3. ATSDR recommends that ADEC encourage seasonal monitoring of munitions including perchlorate from drinking water wells or blended water supplies. This includes water from areas where munitions or perchlorate compounds were used.

Exposure Situation	Potential Source of Contamination	Exposed Population	Time of Exposure	Comments
<p>Flight line soil, air, and garden produce</p>	<p>Fugitive emissions during refuel, aircraft emissions, and ground vehicle operation</p>	<p>On-base personnel and their dependents (adults and children)</p>	<p>past current future</p>	<p>ATSDR is concerned that adults and children who maintain gardens in designated areas adjacent to the flight line may have an increased exposure to contaminants in air and from eating contaminants deposited onto garden-grown produce. Fugitive emissions during refuel, aircraft emissions, and ground vehicle operation may release chemicals such as metals, PAHs, VOCs, and fuel additives to the air and adjacent soils. The scientific literature suggests that as you move closer to runway operations, these contaminants would be present at concentrations greater than other recreational areas. This may result in increased exposure to adults and children who garden in the area.</p> <ol style="list-style-type: none"> 1. Because contaminant concentration levels in plants, soil, and air near the flight line is unknown, ATSDR recommends that the Air Force Advise people who eat flightline garden produce to wash all parts of the plants and peel root vegetables prior to consumption of the food.

Exposure Situation	Potential Source of Contamination	Exposed Population	Time of Exposure	Comments
<p>Contact with material brought to the surface of Landfills 02 and 03 by freeze thaw heaving</p>	<p>Landfill 02 and Landfill 03</p>	<p>On-base Adults and children recreating at or living near landfills</p>	<p>Future</p>	<p>ATSDR is concerned that adults and children living in housing areas near Landfill 02 and Landfill 03 could be exposed to heavy metal contaminants and explosive items that come to the surface as a result of freeze-thaw movement of heavy buried material. Additionally, ATSDR does not have enough information to evaluate the possible migration of landfill gases to enter the homes. ATSDR recommends that additional consideration be given to future erosion (including freeze thaw and break up of soil lead particles), frost heave of chemicals including lead to the surface soils, and the potential for landfill gases to be present.</p> <ol style="list-style-type: none"> 1. Only small-round ammunition has been found in landfill 03. However, ATSDR recommends the Air Force continue to brief personnel, staff and families and continue to provide fact sheets and other information to inform them of current base rules and procedures for explosive items. The Air Force should continue education not to dig from the area. Use should remain limited to recreational purposes only. 2. Due to the possibility that landfill gas may be present (especially during times of summer heat and winter snow cover). ATSDR recommends that the Air Force with regulatory oversight conduct soil gas sampling during both summer months and times when the ground is frozen and has snow cover. 3. Due to the possibility that landfill material and contamination may move up to the surface from frost heaves, the Air Force should conduct surface soil sampling, and evaluate the level of contamination resulting from erosion, freeze thaw, frost jacking, and horizontal water flow or mass movement in layers above covered waste in each of the future 5 year reviews.

Table 2. Evaluation of Selected Sites, Elmendorf, Alaska.

Site	Site Description and History	Investigation and Sampling Results	Corrective Action and Current Status	Site Access and Public Health Evaluation
<p><i>LF02, Disposal Pit</i> (CERCLA site, OU 6)</p>	<p>Inactive unit. LF02 is a former 8-acre landfill near the Boniface Parkway Gate in the southeastern corner of Elmendorf, west of Vandenberg Avenue. From 1940 to 1942, the Air Force used this landfill to dump hard fill, construction rubble, scrap metal, and general refuse. Hazardous and industrial wastes were not disposed of at the site (Elmendorf 2001). The landfill is on a bluff that rises 30 to 40 feet across this site, separating the main Ship Creek floodplain from an upper stream terrace (Elmendorf 2003b). The landfill is covered with soil and vegetation, with landfilled material in place, but no daily cover was applied while the landfill was active (Elmendorf 1998).</p>	<p>The Air Force sampled groundwater and soil at LF02 in 1993 and in 1994 (USAF 1983; Elmendorf 1996b). Groundwater monitoring is ongoing at this site. Contaminants detected at levels above ATSDR’s CVs are listed below.</p> <p>Shallow Groundwater: VOCs: benzene (1.7 ppb), chloromethane (4.36 ppb), 1,2-dichloroethane (3.52 ppb), methylene chloride (7.84 ppb), 1,1,2,2-tetrachloroethane (45.1 ppb), and trichloroethylene (6.1 ppb). SVOCs: bis(2-ethylhexyl)phthalate (11.8 ppb). Inorganics: arsenic (32.7J ppb), barium (1,260 ppb), calcium (27,000 ppb), chromium (333 ppb), lead (84.6J ppb), magnesium (9,700 ppb), potassium (1,160 ppb), and sodium (4260 ppb).</p> <p>Surface Soil: SVOCs: phenanthrene (0.214 ppm). Inorganics: antimony (122 ppm), arsenic (28.6 ppm), cadmium (20.4 ppm), calcium (40,700 ppm), iron (196,000 ppm), lead (6,080 ppm), magnesium (10,600 ppm), potassium (1,790 ppm), sodium (1,460 ppm), and thallium (12 ppm).</p>	<p>The Air Force removed surface debris in 1996, and added soil covers in three areas (also in 1996) to minimize exposure to surface soil. The Air Force recommended monitored natural groundwater attenuation at this site, and expects all contaminant levels at this site to be below regulatory levels by 2027 (Elmendorf 1998, Elmendorf 2001).</p>	<p>This site poses an indeterminate potential future health hazard. The site is near a housing area and is used as a recreational area. Frost heaving from freeze thaw processes could cause buried material to surface where people may contact it. Additionally, landfill gases could migrate causing hazard to nearby residents.</p>
<p><i>LF03, Sanitary Landfill, Site D-3</i> (CERCLA site, OU 6)</p>	<p>Inactive unit. This site is a 15-acre landfill, surrounded by relatively flat land that slopes to the west. Local drainage is toward Ship Creek. The site is west of Hospital Housing, and it was used from 1943 to 1957. The Air Force disposed of general refuse, rubble from construction, spent WWII small arms ammunition, and small quantities of shop waste, at this</p>	<p>The Air Force sampled groundwater and soil at LF03 in 1988 and 1994, and surface water in 1983 (Elmendorf 1996b). Contaminants detected at levels above ATSDR’s CVs are listed below.</p> <p>Shallow Groundwater: VOCs: chloromethane (3.34 ppb) and 1,2-dichloroethane (3.21 ppb). Inorganics: aluminum (89,700 ppb), antimony (98.3</p>	<p>The Air Force conducted no cleanup operations and determined in 1997 that no further action was needed (Elmendorf 2001).</p>	<p>This site poses an indeterminate potential future health hazard. The site is near a housing area and is used as a recreational area. Frost heaving from freeze thaw processes could cause buried material to surface where people may contact it. Additionally, landfill gases could migrate causing hazard to nearby</p>

Site	Site Description and History	Investigation and Sampling Results	Corrective Action and Current Status	Site Access and Public Health Evaluation
	<p>landfill. The Air Force also conducted limited open burning here during the 1950s. The Air Force closed this landfill in 1957 because of odor complaints (Elmendorf 2001).</p>	<p>ppb), arsenic (63.7 ppb), cadmium (6.04 ppb), calcium (200,000 ppb), chromium (165 ppb), iron (133,000 ppb), lead (55.8 ppb), magnesium (76,400 ppb), manganese (4,180 ppb), nickel (230 ppb), potassium (7,770 ppb), sodium (25,200 ppb), and vanadium (254 ppb).</p> <p>Surface Soil: Inorganics: arsenic (8.11 ppm), calcium (7,580 ppm), iron (29,300 ppm), magnesium (8,300 ppm), potassium (1,000 ppm), and sodium (276 ppm).</p> <p>Surface Water: Inorganics include aluminum (20,000 ppb), arsenic (1 ppb), calcium (18,000 ppb), magnesium (2,700 ppb), potassium (400 ppb), and sodium (2,100 ppb).</p>		<p>residents.</p>
<p>LF04, Site D-4 Disposal Site, Knik Bluff Landfill (CERCLA site, OU 6)</p>	<p>Inactive unit. LF04 is located east of Knik Arm Bluff on the west edge of Elmendorf. The landfill runs for 3,000 feet along the southern portion of Knik Arm and 400 to 800 feet inland. Next to this site, a steep bluff rises 200 feet from sea level. The Air Force used this site to dispose of old cars, construction rubble, and small quantities of general refuse, from 1945 to 1957. The Air Force has also reported empty 55-gallon drums here. The Air Force burned much of the waste in place. Tidal action is eroding the bluff and slowly undermining and exposing the landfill. Debris from the landfill drifts downhill to the beach, and tidal action exposes the landfill via erosion: the water level at high tide can reach the base of the bluff (Elmendorf 1999b). There have been</p>	<p>The Air Force sampled groundwater and soil at LF04 in 1987-1988 and in 1994 (Elmendorf 1996b). Groundwater monitoring is ongoing at this site. Contaminants detected at levels above ATSDR's CVs are listed below.</p> <p>Shallow Groundwater: VOCs: benzene (7,100 ppb), n-butylbenzene (2.3R ppb), chlorobenzene (840 ppb), chloromethane (5.23 ppb), 1,2-dichloroethane (38.7B ppb), ethylbenzene (3,800 ppb), 2-methyl-2-phenylpropane (0.92F ppb), methylene chloride (290B ppb), 2-phenylbutane (7.6 ppb), n-propylbenzene (3 ppb), 1,1,2,2-tetrachloroethane (0.53 ppb), toluene (20,000 ppb), 1,3,5-trimethylbenzene (66 ppb), vinyl chloride (0.8 ppb), o-xylene (5,600 ppb), and total xylenes (7,080 ppb). SVOCs: acenaphthylene (2.4 ppb), bis(2-</p>	<p>Beginning in 1997, the Air Force has conducted beach sweeps twice a year, and after storms, changes in season, or reports of suspicious items (Elmendorf 2003g). In 1999, an Air Force team removed UXO, including small arms ammunition, ordnance up to 40mm, and empty shell casings, some with live primers, and 29 tons of solid waste including car parts, electrical parts and other metallic debris. As of 2000, the Air Force had removed 214 tons of landfill debris. The Air Force plans to keep conducting beach sweeps until no further debris falls on the beach, tentatively planned for 2031. The Air Force also posted signs warning of the potential physical hazards, and moved a walking path</p>	<p>ATSDR is concerned that even though significant chemical contamination has not been detected at areas where people may be, Landfill 04 poses a potential safety hazard. Official visitors and authorized personnel who access the upper landfill, beyond the gated entrance, could be injured during a landslide or landfill collapse because of the landfill's inherent instability, long-term eroding and sliding into the Knik Arm of Cook Inlet. People walking on the beach or discard collecting who ignore Air Force control measures and trespass may contact sharp objects or explosive debris that could cause harm or injury. In addition, landfill debris may be a safety</p>

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	<p>reports of oil seeps on Knik Arm beach and chemical and fuel odors along the bluff (Elmendorf 2001, Elmendorf 2003b). In 1999, the Air Force found UXO at this site, including small arms ammunition, ordnance up to 40mm, and empty casings, some with live primers (ADEC 1999a, ADEC 1999b).</p>	<p>ethylhexyl)phthalate (4130 ppb), cymene (12 ppb), 2-methylnaphthalene (630 ppb), naphthalene (384 ppb), and phenanthrene (0.454 ppb). Pesticides/PCBs: aldrin (0.0519 ppb), alpha-BHC (0.0197 ppb), beta-BHC (0.0688 ppb), dieldrin (0.0324 ppb), heptachlor (0.0177 ppb), and heptachlor epoxide (0.0603P ppb). Inorganics: aluminum (100,000 ppb), antimony (85.6 ppb), arsenic (74.8 ppb), cadmium (9.76 ppb), calcium (196,000 ppb), chromium (149 ppb), copper (345 ppb), iron (146,000 ppb), lead (648 ppb), magnesium (121,000 ppb), manganese (20,800 ppb), nickel (243 ppb), potassium (16,200 ppb), selenium (91.1 ppb), sodium (480,000 ppb), and vanadium (287 ppb).</p> <p>Surface Soil: SVOCs: benzo(a)pyrene (0.184 ppm), benzo(g,h,i)perylene (0.24 ppm), bis(2-ethylhexyl)phthalate (1.98 ppm), and phenanthrene (0.3 ppm). Pesticides/PCBs: 4,4'-DDD (8.41 ppm), 4,4'-DDT (47.3 ppm), and dieldrin (0.143 ppm). Inorganics: antimony (24.7 ppm), arsenic (56.5 ppm), calcium (13,400 ppm), iron (151,000 ppm), lead (1160 ppm), magnesium (10,900 ppm), manganese (4640 ppm), potassium (2,830 ppm), sodium (2,280 ppm), and thallium (8.75 ppm).</p>	<p>that had gone near the beach to a path farther east. The Air Force hopes to cease the beach sweeps in 2034 (ADEC 1999a, ADEC 1999b, Elmendorf 2000, Elmendorf 2001).</p>	<p>hazard to boaters who assess the area by water.</p>
<p>LF07, D-7 Sanitary Landfill (CERCLA site, OU 1)</p>	<p>Inactive unit, operated until the early 1990s. LF07 is a 35-acre sanitary landfill, south of LF05, that operated from 1965 to 1982. The area was used for the disposal of general refuse, scrap metal, construction rubble, asphalt drums, empty pesticide containers and small quantities of</p>	<p>The Air Force sampled groundwater at LF07 in 1986, 1988, and 1990-1991, sampled soil in 1986 and 1992, and sampled surface water and sediment in 1992. The Alaska Department of Transportation sampled soil in 1990 (Elmendorf 1994b). Groundwater monitoring is ongoing at this site.</p>	<p>The Air Force conducted long-term groundwater monitoring at this site until it met groundwater cleanup standards and was closed in 2004. The groundwater contaminant levels fell below regulatory levels 29 years earlier than was expected. Restrictions</p>	<p>This site poses no past, current, adverse health hazards based on nature and extent of contamination and administrative controls. The site is near a housing or recreational area but the levels of contaminants in soil at this site are not high enough to</p>

Site	Site Description and History	Investigation and Sampling Results	Corrective Action and Current Status	Site Access and Public Health Evaluation
	<p>miscellaneous shop wastes. One report states that 27,000 lbs/year of batteries were thrown away at this site for an unknown number of years (DOE 1991). Later, the southeastern portion of LF07 was used for the disposal of asbestos waste, until 1992 (Elmendorf 2001). It is now covered and partially revegetated; miscellaneous debris is present at the surface in some areas (Elmendorf 1994b). There are no known releases of asbestos from this landfill area.</p>	<p>Contaminants detected at levels above ATSDR's CVs are listed below. No contaminants were detected above ATSDR's CVs in sediment.</p> <p>Shallow Groundwater: VOCs: benzene (2.2 ppb), chloroethane (16 ppb), 1,2-dibromoethane (0.38 ppb), trichloroethylene (8.2 ppb), and vinyl chloride (10 ppb). SVOCs: bis(2-ethylhexyl)phthalate (59 ppb). Pesticides/PCBs: Aroclor 1260 (14 ppb), and PCBs (total) (14 ppb). Inorganics: aluminum (23,000 ppb), arsenic (140 ppb), cadmium (3 ppb), calcium (75,000 ppb), chromium (110 ppb), copper (870 ppb), iron (92,000 ppb), lead (130 ppb), magnesium (21,000 ppb), manganese (33,300 ppb), nickel (310 ppb), potassium (2,300 ppb), sodium (11,000 ppb), and vanadium (140 ppb).</p> <p>Surface Soil: Inorganics: arsenic (8 ppm), cadmium (20.6 ppm), calcium (6,520 ppm), iron (33,600 ppm), magnesium (8,270 ppm), potassium (898 ppm), and sodium (541 ppm).</p> <p>Surface Water: Inorganics: sodium (1,200 ppb).</p>	<p>expired at this site when the site closure document was signed (Elmendorf 2001, Elmendorf 2003g, personal communication 2006).</p>	<p>present a health hazard. There are restrictions on use of shallow groundwater at this site. The Air Force has restricted this area to recreational use (e.g. cross-country skiing or snowmobiling) and unmanned facilities such as parking lots, storage buildings or taxiways. Construction of manned facilities (office buildings or residential structures) is not allowed. Shallow groundwater use is not permitted here or at any site south of Elmendorf Moraine. These restrictions are set to remain in place until 2033 (Elmendorf 2003g).</p>
<p>LF08, <i>Construction Rubble Disposal (SERA site, Phase I)</i></p>	<p>Inactive unit. LF08 is a landfill south of Ship Creek and west of Vandenberg Avenue. It was used for construction rubble and it showed no visible signs of contamination during a 1983 investigation. This site was a bog-like area with uneven terrain, filled in sometime after the 1960s as a clear zone at the south end of the north-</p>	<p>The Air Force conducted no sampling at LF08.</p>	<p>The Air Force conducted no cleanup operations and determined in 1993 that no further action was needed (Elmendorf 2001).</p>	<p>This site poses no past, current, or potential future health hazards based on nature and extent of contamination and administrative controls. The site is near a housing or recreational area but no soil or groundwater contamination was identified, so there is no hazard. Shallow</p>

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Site	Site Description and History	Investigation and Sampling Results	Corrective Action and Current Status	Site Access and Public Health Evaluation
	south runway. Fill material consisted of stumps, brush, concrete and pavement (Elmendorf 2001).			groundwater use is not permitted here or at any site south of Elmendorf Moraine.
<i>LF09, Construction Rubble Disposal (SERA site, Phase I)</i>	Inactive unit. LF09 is a construction rubble disposal site in the northeastern portion of Elmendorf north of Hillberg Lake. This landfill operated from 1964 to 1976. This site was originally a gravel-borrow site in the early 1960s and was later used for the construction and demolition debris, such as concrete, pavement, scrap metal, and building debris (Elmendorf 2001).	The Air Force conducted no sampling at LF09.	The Air Force conducted no cleanup operations and determined in 1993 that no further action was needed (Elmendorf 2001).	This site poses no past, current, or potential future health hazards based on nature and extent of contamination and administrative controls. The site is near a housing or recreational area but no soil or groundwater contamination was identified, so there is no hazard. Shallow groundwater use is not permitted here or at any site south of Elmendorf Moraine.
<i>SS10, D10 Abandoned Asphalt Drums (CERCLA site, OU 4)</i>	Inactive unit. SS10 is located along the Alaska Railroad tracks immediately northeast of the east-west runway. The Air Force used this site as an asphalt plant during the 1940s and 1950s. When production ended, the Air Force filled an estimated 4,500 drums with asphalt and related materials and left these drums on-site, along with an additional 50 drums that contained non-asphalt materials. After several decades of exposure, many of the drums corroded and leaked asphalt onto the ground. The Air Force noted discolored soil by the drums, and noted pools of asphalt, up to 10 inches deep (Elmendorf 2001).	The Air Force analyzed eighteen of the drums at SS10, and most contained fuels. Sixteen drums contained pesticides used for mosquito control; some drums had flash points of less than 60°F (Elmendorf 2001). The Air Force sampled groundwater at SS10 in 1992 and sampled soil in 1988 and in 1992, and (Elmendorf 1994c). Contaminants detected at levels above ATSDR's CVs are listed below. No contaminants were found in groundwater above ATSDR's CVs. Surface Soil: SVOCs: acenaphthylene (0.04 ppm), and phenanthrene (4 ppm).	In 1993 and 1994, the Air Force removed liquid asphalt and asphalt-containing soils left over from former asphalt batch operations. The Air Force recovered and reused over 100,000 gallons of asphalt at Elmendorf (Elmendorf 2000). In 1995, the Air Force installed a bioventing system. In 2003, the level of contamination in soils were below the OU4 ROD cleanup levels (Elmendorf 2004 m)	This site poses no current, or potential future health hazards based on the levels of contamination and restrictions on site use. The establishment of residential areas is not allowed. Shallow groundwater use is not permitted here or at any site south of Elmendorf Moraine. This site is designated for aircraft operations and maintenance, including active and inactive runways, taxiways and parking aprons for aircraft. The restriction is set to remain in place until 2006 (Elmendorf 2003g).
<i>WP14, POL Sludge Disposal Site (CERCLA site, OU 6)</i>	Inactive unit. WP14 is located near the Knik Arm. It was used to dispose of sludge generated from petroleum, oil, and lubricants (POL) tank cleanouts. The Air Force buried oil filters and other liquid petroleum waste here, and also used this area for the weathering or drying out fuel filters and pads. The	The Air Force sampled groundwater at WP14 in 1994 and sampled soil at WP14 in 1988 and 1994 (Elmendorf 1996b). Groundwater monitoring is ongoing at this site. Contaminants detected at levels above ATSDR's CVs are listed below. Shallow Groundwater: VOCs: benzene	The Air Force is conducting long-term groundwater monitoring at WP14 to track natural attenuation of the plume associated with this site and plume migration, aimed to protect the Knik Arm, which is a down gradient of WP14 (Elmendorf 2003b). The Air Force	This site poses no past, current, or potential future health hazards. There are no known releases to the Knik Arm. The site is near a housing or recreational area but the levels of contaminants in soil at this site are not high enough to present a health hazard. Shallow

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	<p>site is located at an elevation of 200 feet, and it slopes to the west: surface water and groundwater from this site may reach the Knik Arm. WP14 is separated from LF04 South by the Knik Bluff Trail. A fuel pipeline (associated with site PL81) runs through the site with an old valve pit located in the center of WP14. The surface of the site has been altered by construction activities and is currently covered by low alder growth (Elmendorf 2001, Elmendorf 2003b).</p>	<p>(2,200 ppb), n-butylbenzene (26 ppb), chlorobenzene (120 ppb), ethylbenzene (2,100 ppb), 2-methyl-2-phenylpropane (3.4 ppb), 2-phenylbutane (32 ppb), n-propylbenzene (130 ppb), 1,1,2,2-tetrachloroethane (0.21F ppb), toluene (10,000 ppb), 1,2,4-trimethylbenzene (630 ppb), 1,3,5-trimethylbenzene (190 ppb), and o-xylene (3,600 ppb). SVOCs: cymene (20 ppb), and naphthalene (340 ppb).</p> <p>Surface Soil: Inorganics: arsenic (15.5 ppm), calcium (11,100 ppm), iron (38,800 ppm), magnesium (10,500 ppm), potassium (1,680 ppm), and sodium (336 ppm).</p>	<p>is also using groundwater natural attenuation to clean up this site. The Air Force expects that groundwater contaminant levels will be below regulatory cleanup levels by 2012 (Elmendorf 2001).</p>	<p>groundwater use is not permitted here or at any site south of Elmendorf Moraine. The Air Force has not yet set a date for the site-specific restrictions to expire (Elmendorf 2003g).</p>
<p><i>SD15, Site D-16 POL Sludge Disposal #2 (CERCLA site, OU 6)</i></p>	<p>Inactive unit. SD15 is a former sludge disposal site in the northeastern portion of the base, just west of Talley Avenue, on the Elmendorf Moraine. It consists of three 4- to 6-inch thick concrete pads, each 30 by 50 feet. The concrete pads were used from the early 1970s until 1983 to weather fuel filters and to dispose of tank sludge. The soil contamination is likely associated with disposal of POLs and tank sludge here. Fuel odors are evident, and minor fuel stains and soil stains are visible (Elmendorf 2001). There are no records of unplanned or episodic discharges at this site. Out of 17 old building pads here, only 3 were used for POL sludge disposal (Elmendorf 1996b).</p>	<p>The Air Force sample groundwater at SD15 in 1994 and sampled soil in 1988, 1993 and 1994 (Elmendorf 1996b). Groundwater monitoring is ongoing at this site. Contaminants detected at levels above ATSDR's CVs are listed below.</p> <p>Shallow Groundwater: VOCs: benzene (1,900 ppb), carbon tetrachloride (10 ppb), chlorobenzene (100 ppb), chloromethane (7.3 ppb), 1,2-dichloroethane (5.92 ppb), ethylbenzene (1100 ppb), 1,1,2,2-tetrachloroethane (8.6 ppb), toluene (5,000 ppb), 1,1,2-trichloroethane (6.97 ppb), trichloroethylene (280 ppb), vinyl chloride (0.31 ppb), o-xylene (2,400 ppb), and total xylenes (3,940 ppb). Inorganics: arsenic (65 ppb), cadmium (4.14B ppb), calcium (153000 ppb), chromium (54.1 ppb), magnesium (33,300 ppb), manganese (15,500 ppb), potassium (2,420 ppb), and sodium (6,330 ppb).</p>	<p>In 1996, the Air Force built a treatment system for soil and groundwater, and removed debris and concrete during construction. The Air Force recycled contaminated soils, and returned this soil as backfill material. As of 2001, the Air Force had removed over 9,813 pounds of VOCs, and treated over 246,750 gallons of contaminated water to a level suitable for drinking and re-injected into the ground. Air Force response actions are still active and are expected to continue until 2004. The Air Force expects to complete the site cleanup by 2005 and hopes to close this site in 2008 (Elmendorf 2001).</p>	<p>This site poses no past, current, or potential future health hazards. Site reports stated that campers and hikers visit this area, which is near Six-mile Lake. The site is near a housing or recreational area but the levels of contaminants in soil at this site are not high enough to present a health hazard to people who visit this site during infrequent visits of short duration. The Air Force restrictions at this site prohibit installation of wells in the shallow aquifer for any residential, industrial or agricultural use until cleanup levels have been achieved. The Air Force has not yet set a date for this restriction to expire (Elmendorf 1993b, Elmendorf 2003g).</p>

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		<p>Deep Groundwater: VOCs: carbon tetrachloride (0.58 ppb), and 1,2-dichloroethane (2.07B ppb). Inorganics: calcium (54.2 ppb), magnesium (7.28 ppb), and sodium (2.55 ppb).</p> <p>Surface Soil: VOCs: chloromethane (0.0285B ppm), 1,1,2,2-tetrachloroethane (98.3 ppm), and trichloroethylene (1.75 ppm). SVOCs: benzo(g,h,i)perylene (0.0352J ppm), bis(2-ethylhexyl)phthalate (2.23 ppm), and phenanthrene (0.00993J ppm). Inorganics: arsenic (13.7 ppm), barium (8,420 ppm), calcium (31,200 ppm), iron (28,900 ppm), magnesium (8,390 ppm), potassium (926 ppm), sodium (1,410 ppm), and thallium (5.97 ppm).</p>		
<p><i>SD16, D-17 Shop Waste Disposal Site (CERCLA site, OU 3)</i></p>	<p>Active unit. SD16 is located east of Building 8197 and south of the west ramp. In the 1950s and 1960s, the Air Force disposed of a variety of shop-generated wastes here, including solvents, paint thinners, and other liquid wastes, into open trenches or applied directly on the soil. The exact locations of the former ditch and disposal areas are unknown. Currently, the eastern area of the site is used as a parking area for heavy equipment. Additionally, there is a snow accumulation area located in the northern portion of SD16 where snow from the east-west runway and associated taxiway is routinely stockpiled during the winter. Surface drainage from this site is directed toward the south and to Cherry Hill</p>	<p>The Air Force sampled groundwater at SD16 in 1986, 1988, 1990 and 1993, soil in 1990, and sediment in 1993 (Elmendorf 1995a). Groundwater monitoring is ongoing at this site. Contaminants detected at levels above ATSDR's CVs are listed below.</p> <p>Shallow Groundwater: VOCs: benzene (3.3 ppb), 1,2-dichloroethane (1.1 ppb), 1,2-dichloroethane (1.1 ppb), methylene chloride (19 ppb), and trichloroethylene (95J ppb). Pesticides/PCBs: aldrin (0.015 ppb), beta-BHC (0.53G ppb), 4,4'-DDT (0.11 ppb), heptachlor (0.01 ppb), and heptachlor epoxide (0.31G ppb). Inorganics: aluminum (21000 ppb), arsenic (15 ppb), calcium (110,000 ppb), calcium (110,000 ppb), chromium (50 ppb), iron (38,000 ppb), lead (120 ppb),</p>	<p>The Air Force conducted no cleanup at this site and determined in 1997 that no further action was needed (Elmendorf 2001).</p>	<p>This site poses no past, current, or potential future health hazards. The site is near a housing or recreational area but the levels of contaminants in soil at this site are not high enough to present a health hazard. Shallow groundwater use is not permitted here or at any site south of Elmendorf Moraine. There are no site-specific Air Force restrictions here (Elmendorf 2003g). The historically-measured levels of contaminants at this site are not anticipated to pose a public health hazard to people who visit this site. Garden plots are located across the road from the snow disposal area, and are on the other side of a run-off channel.</p>

Site	Site Description and History	Investigation and Sampling Results	Corrective Action and Current Status	Site Access and Public Health Evaluation
	Ditch (site SD52), which receives runoff from SD16 (Elmendorf 2001).	magnesium (36,000 ppb), manganese (11,000 ppb), molybdenum (40 ppb), potassium (8,000 ppb), potassium (8,000 ppb), sodium (88,000 ppb), and vanadium (70 ppb). Surface Soil: SVOCs: acenaphthylene (0.1 ppm), benzo(a)anthracene (1.1 ppm), benzo(a)pyrene (0.92 ppm), benzo(b)fluoranthene (1.1 ppm), bis(2-ethylhexyl)phthalate (1 ppm), and phenanthrene (7 ppm). Inorganics: calcium (5,405 ppm), iron (29,063 ppm), magnesium (11,354 ppm), potassium (729 ppm), and sodium (162 ppm).		Groundwater flow is vertical and run-off from this area is not expected to reach the gardens.
<i>RW17, RD-1, Low-Level Radiation Disposal Site (Munitions site)</i>	Inactive unit. RW17 is located approximately 1 1/2 miles north of the north end of the north-south runway. The Air Force reported that this low-level radioactive waste disposal site may have contained small quantities of cyanide and radium buried in the ground (DOE 1990; Elmendorf 2001).	The Air Force conducted no soil, groundwater or surface water sampling at RW17. Radioactive testing after cleanup in 1991 showed no radiation levels above background levels (DOE 1991).	In 1991, the Air Force removed radioactive materials from RW17 in 1991 and disposed of these off-site (Elmendorf 2001).	Current conditions are not expected to pose a public health hazard to people who visit this site. Sampling was not conducted prior to removal of materials, so past exposure could not be fully evaluated, however people are unlikely to be exposed to buried, low-level radioactive waste. The site is near a recreational area but no surface contamination was identified so there is no hazard (Elmendorf 2003g). The Air Force has a radon program to identify radon from natural earth materials. However, radon sampling would also identify radon from other sources. Elmendorf has a radon program to evaluate indoor air from naturally-occurring radon gas unrelated to RW17.
<i>SS18, Pesticide Storage</i>	Inactive unit. Building 5327 (SS18) is located south of Arctic Warrior Drive	The Air Force conducted no sampling at SS18 because no releases are known to	The Air Force conducted no cleanup and determined in 1994	This site poses no past, current, or potential future health hazards.

Site	Site Description and History	Investigation and Sampling Results	Corrective Action and Current Status	Site Access and Public Health Evaluation
<p><i>Building 22-021 (CERCLA site, OU 4)</i></p>	<p>and east of Kenney Drive. The Air Force has stored pesticides and herbicides here since the 1960s. This building houses Elmendorf 's pest management operations. There are no known releases of pesticides at this site. A site inspection in 1991 found a drain that was plugged with concrete. This building is now used for storage and maintenance of pesticide equipment and vehicles (Elmendorf 2001).</p>	<p>have occurred (Elmendorf 2001).</p>	<p>that no further action was needed at this site (Elmendorf 2000, Elmendorf 2001).</p>	<p>The establishment of residential areas is not allowed, because this area is designated for aircraft operations and maintenance, including active and inactive runways, taxiways and parking aprons for aircraft. Shallow groundwater use is not permitted here or at any site south of Elmendorf Moraine (Elmendorf 2003g).</p>
<p><i>FT23 (FTA), FT-1 Fire Training Area (CERCLA site, OU 4)</i></p>	<p>Inactive unit. This site is west of the north-south runway, and it consists of a drum storage area and a bermed burn area. The drum storage area contained as many as one hundred 55-gallon drums of contaminated waste oils, paint thinners, waste fuels, and waste solvents from aircraft maintenance and other shop operations on base. From the 1940s to 1960s, the Air Force used ignitable wastes as fuel for the fire training exercises. During each exercise the Air Force spread 250 to 3,000 gallons of contaminated waste materials on the ground surface and ignited the materials, then used protein foams or chlorobromoethane to extinguish the fires. The bermed area remained saturated with unconsumed fuel following each training exercise (Elmendorf 2001). Runoff from the bermed area to surrounding soil was a common occurrence during fire training exercises (Elmendorf 1994c).</p>	<p>The Air Force sampled groundwater at FT23 in 1992 and sampled soil in 1988 and 1992 (Elmendorf 1994c). Groundwater monitoring is ongoing at this site. Contaminants detected at levels above ATSDR's CVs are listed below.</p> <p>Shallow Groundwater: VOCs: benzene (340 ppb), n-butylbenzene (3.2F ppb), 1,2-dichloroethane (2.4 ppb), cis-1,2-dichloroethene (400 ppb), ethylbenzene (1,600 ppb), 2-methyl-2-phenylpropane (0.17F ppb), 2-phenylbutane (5F ppb), n-propylbenzene (32 ppb), tetrachloroethylene (33 ppb), toluene (1,000 ppb), 1,1,1-trichloroethane (1,400 ppb), 1,1,2-trichloroethane (110 ppb), trichloroethylene (53 ppb), 1,2,4-trimethylbenzene (210 ppb), 1,3,5-trimethylbenzene (63 ppb), and total xylenes (6,300 ppb). SVOCs: cymene (4.2F ppb). Inorganics: iron (22,800 ppb).</p> <p>Surface Soil: VOCs: bromodichloromethane (58 ppm), methylene chloride (1,500 ppm), 1,1,2,2-tetrachloroethane (67 ppm), toluene (19,000 ppm), and total xylenes (11,000</p>	<p>The Air Force installed a bioventing system in November 1995 to clean up soil, and groundwater natural attenuation is underway. The Air Force expects groundwater contaminant levels to be below regulatory cleanup levels by 2009 (Elmendorf 2001).</p>	<p>Under current use, this site poses no past, current, or potential future health hazards. The Air Force noted that site residents visit this site, but the contaminant levels detected are not expected to pose a hazard to people who visit this site. Shallow groundwater use is not permitted here or at any site south of Elmendorf Moraine. The establishment of residential areas is not allowed, because this area is designated for aircraft operations and maintenance, including active and inactive runways, taxiways and parking aprons for aircraft (Elmendorf 2001, Elmendorf 2003g).</p>

Site	Site Description and History	Investigation and Sampling Results	Corrective Action and Current Status	Site Access and Public Health Evaluation
<p><i>SS35, Paxson Park, Oil-Soaked Soil (SERA site, Phase I)</i></p>	<p>Inactive unit. SS35, Paxson Park, is located on Arctic Warrior Drive in the southwestern quadrant of Elmendorf. The park is bordered to the south by a fire station, Mt. Illiamna School, and Orion Elementary School; to the west by Aurora School and Building 5091; and to the north by the park pavilion. This site was a housing complex that was demolished and then converted to a park. Workers installing subsurface pipe at SS35 in 1988 reported POL odors and oil-soaked subsurface soil. The Air Force was unable to determine the site(s) of the odor and the stained soil (Elmendorf 2001).</p>	<p>ppm). SVOCs: acenaphthylene (0.02 ppm), and bis(2-ethylhexyl)phthalate (1 ppm).</p> <p>The Air Force’s preliminary investigation in the late 1980s at SS35 found slightly elevated levels of VOCs in soil vapor in the parking area, but subsequent testing in 1993 found no contamination. The Air Force did not sample any groundwater or soil at this site (Elmendorf 1994d).</p>	<p>The Air Force conducted no cleanup operations and determined in 1994 that no further action was needed (Elmendorf 2001; Jacobs 2004).</p>	<p>Under current use, this site poses no current or potential future health hazards. This site is near a housing or recreational area, however no surface contamination was detected. There is no evidence that past exposures have occurred but exposures prior to 1980 are not well-defined.</p>
<p><i>ST37, Site SP-1, Diesel Fuel Line Leak, Engineered Wetland System (CERCLA site, OU 5)</i></p>	<p>Active unit. This site is located primarily on Elmendorf at the bluff, near the southern border of Elmendorf, and drops 25 to 40 feet to the railroad yard and Ship Creek floodplain where the wetland remediation system is operating. Elmendorf 2003f). The wetland remediation system is not on Air Force property, but on Alaska Railroad Corporation land that the Air Force has an 30 year easement. Between 1956 and 1958, a diesel fuel line broke just south of Building 2204, 600 feet north of Ship Creek. The Air Force reported that fuel seeped out of the ground near the railroad tracks 200 feet to the south. The Air Force recovered thousands of gallons of fuel, but an unknown amount may have remained below ground. Fly ash, a by-product of coal used by power plants</p>	<p>The Air Force sampled groundwater and soil at ST37 in 1988 (Elmendorf 1994a). Groundwater monitoring is ongoing at this site. Contaminants detected at levels above ATSDR’s CVs are listed below. No contaminants were found above ATSDR’s CVs in soil located near the surface.</p> <p>Shallow Groundwater: VOCs: benzene (13 ppb), carbon tetrachloride (0.34F ppb), 2-phenylbutane (0.59F ppb), 1,1,2,2-tetrachloroethane (6.2 ppb), and trichloroethylene (42 ppb). SVOCs: phenanthrene (0.09F ppb).</p>	<p>In 1996 the Air Force leased a portion of adjacent land from the Alaska Railroad for 30 years to conduct cleanup activities. The Air Force drained the snowmelt pond and built the engineered wetland, the overland flow cell, and passive extraction systems. The Air Force excavated approximately 500 cubic yards of soil contaminated with fuel products from two of the seep locations as part of this operation. The engineered wetland system started to operate in April 1997 and is expected to run for 30 years. The Air Force completed wetland construction during the summer of 1996. The Air Force is monitoring natural groundwater attenuation here. The Air Force expects groundwater</p>	<p>This site poses no current or potential future health hazards. Shallow groundwater use is not permitted here or at any site south of Elmendorf Moraine. Air Force reports identified this as a possible recreation area in the past, where children sledged on the bluff hill. No surface contamination was detected (Elmendorf 1994a, Elmendorf 2003g). The site was not restricted in the past, but a fence now prohibits access to this site. Data were not available to define when contaminants were released from this site in the past, or at what levels. EPA and ADEC are further evaluating the Alaska Railroad property under a separate program.</p>

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	<p>before the late 1960s, is found in a continuous horizontal layer 8 feet thick and 500 feet long, from monitoring well SP-102 to the edge of the bluff (Elmendorf 2001). Also, the Air Force formerly used an area near the top of the bluff for disposal of snow collected in on-site areas (Elmendorf 1994a). This area is currently used for the Wetland Recovery System, a series of pumps and ponds that are used to contain contamination in shallow groundwater to prevent discharges of contaminants to Ship Creek.</p>		<p>contamination levels to drop below regulatory cleanup requirements by 2027 (Elmendorf 2001).</p>	
<p><i>ST38/SS42, SP-2/SP-6, JP-4 Line Leak and Diesel Fuel Spill (CERCLA sites, OU 5)</i></p>	<p>Inactive units. The Air Force studied sites ST38 and SS42 together due to their common location, the similarity of contaminants, and the potential for both sites to affect Ship Creek. Seeps occurred at ST38, just north of the Alaska Railroad, periodically throughout the 1950s and 1960s. In 1964 and 1965, an unknown quantity of JP-4 jet fuel seeped out of the bank near the drainage ditch crossing Pease Avenue, southeast of the site. Roughly 8,000 gallons of diesel fuel spilled at SS42 in 1976 in a transfer from aboveground to underground tanks. Most of the fuel was recovered from the frozen soil and very little seeped underground (Elmendorf 2001).</p>	<p>The Air Force sampled groundwater and soil at ST38 and SS42 in 1984 and 1988 (Elmendorf 1994a). No contaminants were found above ATSDR's CVs in groundwater, or in soil located near the surface.</p> <p>There is a small pond between the base of the bluff and the railroad tracks that was covered with a multicolor sheen in 1988. Ship Creek is 150 yards south of the pond and the tracks. In 1987, site workers identified "significant quantities" of oils and grease at SS42 floating on stagnant waters near Ship Creek opposite the diesel fuel storage site, in a marshy area that extended roughly 450 feet east of the building at the fuel storage area (Elmendorf 2001).</p>	<p>No fuel was recovered after the spills in the 1960s. Most of the fuel from the 1976 spill was recovered at the time of the spill: very little fuel is believed to have seeped below the surface. The Air Force determined in 1994 (ST38) and 1995 (SS42) that no further action was needed at these sites (Elmendorf 2001).</p>	<p>No surface contamination was identified, leaving no opportunity for exposure. Shallow groundwater use is not permitted here or at any site south of Elmendorf Moraine. Site reports describe a potential for these two sites to affect surface water in Ship Creek, however this does not appear to have occurred. There are no site-specific restrictions in effect here. (Elmendorf 2003g). Data to document significant releases are not available to define when contaminants were released from this site in the past, or at what levels. EPA and ADEC are further evaluating the Alaska Railroad property under a separate program.</p>
<p><i>ST39, JP-4 Fuel Line Leak (SERA site, Phase I)</i></p>	<p>Inactive unit. ST39, located at the intersection of Arctic Warrior Drive and Pease Avenue in the northern part of the base, was the site of a surface spill of less than 200 gallons of JP-4</p>	<p>The Air Force conducted no sampling at ST39.</p>	<p>The Air Force excavated and removed the contaminated layer of peat. An ADEC report from 1988 stated that no further investigation was needed at this site because of</p>	<p>This site poses no past, current, or potential future health hazards under current land use. The site is near a housing or recreational area but the top six inches of</p>

Site	Site Description and History	Investigation and Sampling Results	Corrective Action and Current Status	Site Access and Public Health Evaluation
	jet fuel in 1962. No surface water contamination occurred at the time of the spill (Elmendorf 2001).		the small amount of fuel spilled, and because microbial activity would be expected to degrade any remaining material that was not cleaned up at the time of the spill (Elmendorf 1994d). The Air Force indicated in 1996 that no further actions were needed at ST39 (Elmendorf 2001; Jacobs 2004).	contaminated peat was removed. Shallow groundwater use is not permitted here or at any site south of Elmendorf Moraine (Elmendorf 2003g).
<i>SD40/ST46, Sites SP-4/SP-11, Railroad Maintenance Area and JP-4 Line Leak at Bldg 23-714 (CERCLA sites, OU 5)</i>	Inactive units. The Air Force investigated sites ST46 and SD40 together due to their common location. In the late 1960s, the Air Force noted brownish oil seeping from the river bank at SD40, by the railroad maintenance facility, into a marsh area that flows into Ship Creek. The report did not indicate whether the oil reached Ship Creek or not. The site of oil was believed to be maintenance activities at the railroad facility. The area is 600 feet north of Ship Creek, near the cooling pond on the south part of Elmendorf. In 1978, an underground pipe at ST46 cracked and leaked an unknown amount of JP-4 jet fuel. The Air Force repaired the pipe, but fuel continued to seep from the bank of a nearby stream that flows into wetlands and to a beaver pond that drains to Ship Creek (Elmendorf 2001).	The Air Force sampled groundwater and soil at SD40 and ST46 in 1984, 1986-1987 and 1988 (Elmendorf 1994a). Air Force reports did not include any surface water data for these sites. Contaminants detected at levels above ATSDR's CVs are listed below. Shallow Groundwater: VOCs: benzene (27 ppb), and dibromochloromethane (1.6 ppb). Surface Soil: Inorganics: calcium (5,000 ppm), iron (26,000 ppm), magnesium (10,000 ppm), potassium (1,100 ppm), and sodium (200 ppm).	The Air Force conducted no cleanup operations and determined in 1994 that no further action was needed (Elmendorf 2001).	This site poses no current or potential future health hazards. The site is near a housing or recreational area but the type and levels of contaminants in soil are not high enough to present a health hazard. Shallow groundwater use is not permitted here or at any site south of Elmendorf Moraine. There are no site-specific land use controls in effect at this site (Elmendorf 2003g). Data were not available to define when contaminants were released from this site in the past, or at what levels. EPA and ADEC are further evaluating the Alaska Railroad property under a separate program.
<i>ST41, Four Million Gallon Hill (CERCLA site, OU 2)</i>	Inactive unit. ST41 is 1,000 feet northwest of the east-west runway and 2,500 feet inland (east) of the Knik Arm of Cook Inlet, on the west end of the Elmendorf Moraine. In the 1940s, the Air Force installed 4 one-million-gallon USTs here. The western edge of the site was previously a one-acre	In the late 1980s, ADEC noted fuel seeping from the hillside to the oil/water separator and an adjacent ditch, and to existing flight line storm drainage ditches, and the Air Force noted strong fuel odors in a ditch by the roadway (DOE 1991; Elmendorf 2001). No odors were reported during follow-up investigations.	In 1976, the Air Force recovered 16,000 gallons of spilled fuel at ST41, and installed an oil/water separator. In 1989, the Air Force installed a dam to contain any fuel products that seeped from the ground in the ditch. In 1990, Air Force pumped all four USTs dry	Fuel vapors and breakdown products, including methane, are potential explosive hazards that would be evaluated by the Air Force during activities such as digging or monitoring well construction. Shallow groundwater use is not permitted

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	<p>sludge disposal area. The Air Force spilled 60,000 gallons of aviation fuel here in the mid-1960s and did not recover any fuel. In 1974, the Air Force spilled 33,000 gallons of jet fuel (JP-4) while filling a UST beyond capacity, and only recovered 16,000 gallons. The remainder seeped into the ground northwest of the tanks, but cleanup efforts prevented fuel from reaching surface water. Some Air Force reports state several hundred thousand gallons of JP-4 fuel were spilled at ST41 between 1975 and 1984, and one ADEC report calls ST41 the “worst contaminated site in Alaska,” however a later review suggested that the two “catastrophic spills” never occurred. In 1983, the Air Force found several seeps in a drainage ditch and in the flat areas to the south (Elmendorf 1998, Elmendorf 2000, Elmendorf 2001, Elmendorf 2003b).</p>	<p>The Air Force sampled groundwater at ST41 in 1986, 1988, and 1990-1992, soil in 1986, 1988, and 1990-1992, and surface water and sediment in 1990-1992 (Elmendorf 1994e). Groundwater monitoring is ongoing at this site. Contaminants detected at levels above ATSDR’s CVs are listed below.</p> <p>Shallow Groundwater: VOCs: benzene (30,000 ppb), 1,2-dibromoethane (0.28 ppb), ethylbenzene (6,100 ppb), 2-methyl-2-phenylpropane (1.8F ppb), methylene chloride (57 ppb), 2-phenylbutane (10 ppb), n-propylbenzene (84 ppb), 1,1,2,2-tetrachloroethane (0.8 ppb), toluene (24,000 ppb), trichloroethylene (12 ppb), 1,2,4-trimethylbenzene (150 ppb), and total xylenes (21,000 ppb). SVOCs: bis(2-ethylhexyl)phthalate (150000 ppb), cymene (11 ppb), 2-methylnaphthalene (850 ppb), 4-methylphenol (220 ppb), and naphthalene (280 ppb). Inorganics: antimony (20 ppb), arsenic (180 ppb), barium (1,900 ppb), cadmium (6.3 ppb), calcium (360,000 ppb), chromium (460 ppb), copper (300 ppb), lead (250 ppb), manganese (34,100 ppb), nickel (620 ppb), thallium (180 ppb), and vanadium (820 ppb).</p> <p>Surface Soil: SVOCs: bis(2-ethylhexyl)phthalate (0.087 ppm). Inorganics: arsenic (16.1 ppm) and thallium (29.4 ppm).</p> <p>Surface Water: VOCs: benzene (1,500</p>	<p>after finding that they were all leaking. From 1992 to 1999 the Air Force removed and treated free product and fuel constituents floating on groundwater. In 1996, the Air Force removed soil, tanks and pipeline segments. The groundwater plume associated with ST41 continues to improve via natural attenuation. Since February 1997, no recoverable quantities of fuel product have been observed. The Air Force indicated that surface water and groundwater data show that contamination is not migrating and natural attenuation is occurring. The Air Force expects to achieve site cleanup by 2021 (Elmendorf 2000, Elmendorf 2001, Elmendorf 2003b).</p>	<p>so no exposure to contaminated groundwater occurs. Site residents may visit this site in the summer to hike or search for berries or mushrooms, or to view wildlife, and in winter to cross-country ski or snowmobile near the power line corridor. However, Individuals are unlikely and not expected to contact subsurface contamination, and the levels of contaminants in soil, surface water and sediment at this site are not high enough to present a health hazard. ST41 is partially within the clear zone for a base runway, and development is restricted because of the possibility of aircraft accidents here (Elmendorf 1994e). Construction of manned facilities (office buildings or residential structures) is not allowed. These land use controls are set to expire in 2016 (Elmendorf 2003g).</p>

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		<p>ppb), 1,2-dichloroethane (33 ppb), 1,1,2,2-tetrachloroethane (1 ppb), toluene (4,200 ppb), and total xylenes (2,900 ppb). SVOCs: bis(2-ethylhexyl)phthalate (7 ppb), 2-methylnaphthalene (920 ppb), naphthalene (170 ppb), and phenanthrene (1 ppb). Inorganics: arsenic (63 ppb), lead (41 ppb), manganese (9,700 ppb), and thallium (440 ppb).</p> <p>Sediment: SVOCs: benzo(a)pyrene (0.21 ppm), bis(2-ethylhexyl)phthalate (0.13 ppm), and phenanthrene (0.42 ppm). Inorganics: arsenic (16.1 ppm), manganese (15,500 ppm), and thallium (200 ppm).</p>		
<p><i>SD52, Cherry Hill Ditch (CERCLA site, OU 3)</i></p>	<p>Inactive unit. Cherry Hill Ditch is an artificial drainage channel on the west side of the base, next to the Cherry Hill housing area. Much of the stormwater at Elmendorf drains to this ditch (Elmendorf 2000). The ditch channels surface water to the bluff above Knik Arm where it then flows west toward Cook Inlet. Prior to the 1990s, a surface slick was occasionally seen in a retention pond upstream, and an oily sheen and an emulsion that created foam (up to two feet thick in places) appeared on water in the ditch. The sites for these materials are unknown. The ditch carried water from runway drains and possibly other shop drains. ADEC issued a notice of violation in 1987 and requested that the Air Force sample stream sediments for halogenated hydrocarbons (Elmendorf 2001).</p>	<p>The Air Force sampled groundwater and soil at SD52 in 1993 and sampled surface water in 1988 and 1990 and sediment in 1990 and 1993 (Elmendorf 1995a). The foam on the pond was not sampled. Contaminants detected at levels above ATSDR's CVs are listed below. No contaminants were found in groundwater in available data above ATSDR's CVs.</p> <p>Surface Soil: SVOCs: acenaphthylene (0.1 ppm), and phenanthrene (4 ppm).</p> <p>Surface Water: Inorganics: arsenic (17 ppb), calcium (94,000 ppb), iron (12,000 ppb), magnesium (28,000 ppb), manganese (13,000 ppb), and sodium (11,000 ppb).</p> <p>Sediment: SVOCs: benzo(a)anthracene (15 ppm), benzo(a)pyrene (16.3 ppm), and phenanthrene (30 ppm). Inorganics: arsenic (70 ppm), calcium (23,709 ppm), iron (49,061 ppm), lead (852 ppm),</p>	<p>In 1994, the Air Force excavated approximately 2 cubic yards of contaminated soil and capped the bottom of Cherry Hill Ditch, and built a stormwater diversion (Elmendorf 2000). EPA, ADEC, and Elmendorf agreed to delist this site, and to study historical contamination from a solvent disposal trench (SD16) under OU3, and to study the impact to Cherry Hill Ditch from ongoing airfield operations under the Environmental Quality Program. The Air Force completed the site cleanup in 1993 and closed this site in 1997 (Elmendorf 2001).</p>	<p>This site poses no past, current, or potential future health hazards. Shallow groundwater use is not permitted here or at any site south of Elmendorf Moraine. This site is on or near a residential or recreational area, however the levels of contaminants in soil, surface water and sediment at this site are not high enough to present a health hazard. The ditch is now enclosed, so no further exposures are expected to occur. The stormwater diversion is expected to eliminate any chance that the remaining contamination could be transported off-site via the ditch (Elmendorf 2001, Elmendorf 2003g). Water flow at the point of compliance may have erosional impacts on areas downhill that are being evaluated by EPA and ADEC.</p>

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<p><i>SS53, Seep #4 Golf Course (CERCLA site, OU 5)</i></p>	<p>Inactive unit. SS53 is located along Pease Avenue north of Ship Creek and just north of the golf course clubhouse (Building 23-100). For an unspecified number of years, workers noted a fuel seep of unknown origin during spring breakup. The fuel seep appeared to flow into a drainage ditch along Pease Avenue. In 1986, the Air Force found fuel floating on puddles in the marshy area. In a 1987 inspection, the Air Force found fuel in small holes dug in the ground, and saw fuel-stained soil in the ditch. The 1988 and 1989 investigations found no fuel in the area. An Army POL line crosses the area, and an Air Force JP-4 pipeline is located immediately north of SS53. The JP-4 pipeline has had minor leaks in the past. The site is within 500 feet of Ship Creek; a well is 500 feet downgradient but is in the shallow aquifer (Elmendorf 2001).</p>	<p>magnesium (9,624 ppm), manganese (13,146 ppm), and sodium (265 ppm).</p> <p>The Air Force sampled groundwater and soil in the marshy area of SS53 in 1988 (Elmendorf 1994a). No contaminants were found above ATSDR's CVs in groundwater, or in soil located near the surface, in available data.</p> <p>Separate sampling of drinking water near this location, which comes from a nearby deep groundwater well, found no fuel-related contamination.</p>	<p>The Air Force conducted no cleanup operations and determined in 1994 that no further action was needed (Elmendorf 2001).</p>	<p>This site poses no current, or potential future health hazards. The site is near a recreational area but surface contamination at levels of concern were not found. Past surface water and sediment contaminant levels in the marsh area are unknown but only those who have occasional mission or occupational tasks will even rarely have accessed that area. Shallow groundwater use is not permitted here or at any site south of Elmendorf Moraine, and no contaminants were found in the downgradient deep groundwater well above ATSDR's CVs. Site reports state that no impacts on the downgradient well or Ship Creek are anticipated (Elmendorf 1994c, Elmendorf 2003g). EPA and ADEC continue to study Ship Creek.</p>
<p><i>SS57, Oil-Soaked Soil (SERA site, Phase I)</i></p>	<p>Inactive unit. SS57 is on the southeast corner of Kenney Avenue and 15th Street, south of the POL parking lot, southwest of Building 7348, east of Hangar 5 (site SD31) and north of Building 6326. The Army Corps of Engineers identified this as a contaminated site in 1989 when they drilled soil borings to characterize soil conditions for proposed construction of a new building, and noted petroleum odors in the groundwater</p>	<p>The Air Force sampled groundwater and soil at SS57 in 1993 (Elmendorf 1994d). Contaminants detected at levels above ATSDR's CVs are listed below. No contaminants were found above ATSDR's CVs in soil located near the surface.</p> <p>Shallow Groundwater: VOCs: benzene (8.6 ppb).</p>	<p>The Air Force conducted no cleanup operations and determined in 1996 that no further action was needed (Elmendorf 2001).</p>	<p>Based on past and current levels and land use, this site poses no past, current, or potential future health hazards. This site is on or near a residential or recreational area. Shallow groundwater use is not permitted here or at any site south of Elmendorf Moraine (Elmendorf 2003g). Limited sampling did not find any contaminants in the surface soil at levels that could pose a hazard to</p>

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	and soil. Construction plans were halted, pending the results of further studies (Elmendorf 2001).			site visitors.
<p><i>LF59, Asphalt Seep (CERCLA site, OU 1)</i></p>	<p>Inactive unit. Site D-8, located near LF59, was used from 1965 to 1983 (or later) for the disposal of construction rubble. In June 1991, the Air Force found an asphalt material seeping out of the ground at LF59, where it had pooled and partially solidified on top of a hiking trail. The Air Force responded by closing the trail. This area may have been used in the past as a landfill for asphalt batch plant operations. The material found here may be consistent with the disposal of construction rubble at Site D-8. The Air Force reviewed aerial photography and found that previous uses of the area include a materials site, landfills, and possibly an asphalt batch plant (Elmendorf 2001). There are no residential or industrial populations at this site (Elmendorf 1994b).</p>	<p>The Air Force sampled groundwater, soil, surface water and sediment at LF59 in 1992 (Elmendorf 1994b). Groundwater monitoring is ongoing at this site. Contaminants detected at levels above ATSDR’s CVs are listed below.</p> <p>Shallow Groundwater: VOCs: benzene (3.7 ppb), chloroethane (9.5 ppb), 1,2-dibromoethane (0.034 ppb), 1,1,2,2-tetrachloroethane (18 ppb), 1,1,2-trichloroethane (0.63F ppb), trichloroethylene (9.9 ppb), and vinyl chloride (10 ppb). SVOCs: bis(2-ethylhexyl)phthalate (24 ppb). Inorganics: arsenic (67 ppb), chromium (81 ppb), lead (27 ppb), manganese (7,100 ppb), nickel (120 ppb), and vanadium (100 ppb).</p> <p>Surface Soil: SVOCs: bis(2-ethylhexyl)phthalate (13 ppm). Inorganics: arsenic (7.1 ppm), calcium (10,400 ppm), iron (25,600 ppm), magnesium (8,630 ppm), potassium (1,030 ppm), and sodium (1,030 ppm).</p> <p>Surface Water: Inorganics: arsenic (7.7 ppb), calcium (24,600 ppb), magnesium (4,100 ppb), and sodium (4,000 ppb).</p> <p>Sediment: Inorganics: arsenic (7.5 ppm), calcium (10,800 ppm), iron (34,400 ppm), magnesium (9,830 ppm), potassium (1,490 ppm), and sodium (708 ppm).</p> <p>The Air Force resampled surface soil</p>	<p>The Air Force removed and recycled the asphalt material from LF59. The Air Force’s response to the site is complete, but the site is not yet closed. A wooden foot bridge was built along a section of an existing pathway where tar-like material was observed. The trail has since been closed to the public. The Air Force expects to close this site in 2027 (Elmendorf 2001).</p>	<p>This site poses no current or potential future health hazards. Recreational is common at this site but the levels of contaminants in soil at this site are not high enough to present a health hazard. The Air Force has restricted this area to recreational use (e.g. cross-country skiing or snowmobiling) and unmanned facilities such as parking lots, storage buildings or taxiways. This site is used for jogging, berry and mushroom picking, horseback riding, picnicking along Ship Creek, and fishing in Ship Creek. People may access Ship Creek adjacent to this site. There is no indication that this area was used as a major food source by anyone. Other areas of Elmendorf are used more extensively for these foods. Construction of manned facilities (office buildings or residential structures) is not allowed. Shallow groundwater use is not permitted here or at any site south of Elmendorf Moraine. These restrictions were set to expire in 2033 (Elmendorf 2003g).</p>

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<p><i>SS63, Classic Owl Dry Well / Leach Field (CERCLA site, OU 6)</i></p>	<p>Inactive unit. SS63 is located in the western portion of the base to the east of 46th Street. Building 52-140, now used as an administrative building, was constructed in 1943 and is the former location of the vehicle maintenance shop. The original building was demolished, giving way to a new U.S. Naval facility called Classic Owl. In September 1991, during pre-construction activities, the US Army Corps of Engineers found a dry well to the east of this building. A floor drain at the bottom of an old oil-changing pit apparently was connected to the dry well thought to flow to Hillberg Lake, but no releases were identified (Elmendorf 2001).</p>	<p>after the cleanup effort at LF59, and found no contaminants above ATSDR's CVs (Elmendorf 1997).</p> <p>The Air Force sampled groundwater at SS63 in 1990-1991 and 1993, and soil in 1990-1991 and 1992 (Elmendorf 1996b). Contaminants detected at levels above ATSDR's CVs are listed below.</p> <p>Shallow Groundwater: VOCs: benzene (9.5 ppb), 1,2-dichloroethane (0.844 ppb), and methylene chloride (170G/I ppb). SVOCs: 2-methylnaphthalene (162 ppb), phenanthrene (4.8 ppb), and phenanthrene (4.8 ppb). Inorganics: lead (31B ppb).</p> <p>Surface Soil: Inorganics: arsenic (4.3 ppm), calcium (5,350 ppm), iron (25,600 ppm), lead (1,300 ppm), magnesium (8,300 ppm), potassium (872B ppm), and sodium (337B ppm).</p>	<p>This facility houses a new operations building that does not appear to be related to any contamination that may have existed. The Air Force is investigating soil and groundwater under SERA. The Air Force closed this site in 1994 (Elmendorf 1993b, Elmendorf 2001).</p>	<p>This site poses no current or potential future health hazards. The site is near a housing or recreational area but the levels of contaminants in soil at this site are not high enough to present a health hazard. Shallow groundwater use is not permitted here or at any site south of Elmendorf Moraine (Elmendorf 1993b). Insufficient data were available to evaluate past exposure at this site.</p>
<p><i>ST65, Leaking UST, Out of Service (SERA site, Phase I)</i></p>	<p>Inactive unit. ST65 is a leaking UST located next to Provider Drive, near Fire Station 3 (Building 3784), in the vicinity of a fuel dispenser and a former 500-gallon diesel UST. The UST at this site was identified as possibly leaking because of a positive result from a soil-vapor survey conducted in December 1990 (Elmendorf 2001).</p>	<p>The Air Force sampled groundwater and soil at ST65 in 1993 (Elmendorf 1994d). No contaminants were found above ATSDR's CVs in groundwater or in soil located near the surface, in available data.</p>	<p>The Air Force conducted no cleanup operations and determined in 1996 that no further action was needed (Elmendorf 2001).</p>	<p>This site poses no past, current, or potential future health hazards. The site is near a housing or recreational area but no surface soil contamination was identified, so there is no exposure. Shallow groundwater use is not permitted here or at any site south of Elmendorf Moraine (Elmendorf 2003g).</p>
<p><i>ST66, Leaking UST to Out of Service (SERA site, Phase II)</i></p>	<p>Inactive unit. ST66 is the site of a suspected diesel leak, southeast of ST36, on a hilltop west of Spring Lake, on the east side of the emergency generator building (Building 27365) near a radar control building,. One 5,000-gallon diesel UST and one 4,000-gallon diesel UST are located on ST66. Both USTs</p>	<p>The Air Force sampled groundwater and soil at ST66 in 1995 (Elmendorf 1995b). No contaminants were found above ATSDR's CVs in groundwater or in soil located near the surface, in available data. The Air Force noted minor surface staining on the parking lot at this site (Jacobs 2004). The Air Force noted a sheen or odor in the groundwater wells at</p>	<p>The Air Force installed bioventing systems here at of August 1996, and continues to monitor groundwater here. The Air Force expects groundwater contaminant levels to reach regulatory cleanup levels in 2011 (Elmendorf 2001; Jacobs 2004).</p>	<p>This site poses no past, current, or potential future health hazards. The site is near a housing or recreational area but no surface soil contamination was identified, so there is no exposure. Shallow groundwater use is not permitted here or at any site south of Elmendorf Moraine (Elmendorf</p>

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Site	Site Description and History	Investigation and Sampling Results	Corrective Action and Current Status	Site Access and Public Health Evaluation
	supply diesel fuel to Building 27365. A 500-gallon above-ground diesel tank was also located in this area. In 1990 the Air Force found that Tank 1 was potentially leaking at more than 0.05 gallons per hour (Elmendorf 2001).	this site (Elmendorf 1995b).		2003g).
<i>ST69, 76-520 Diesel Leak from Diesel Piping (SERA site, Phase I)</i>	Inactive unit. ST69 is a diesel leak on the south side of Fairchild Avenue at Building 76-520, in the southwestern area of Elmendorf. A 500-gallon diesel fuel spill reportedly occurred here in 1989-90, and a ruptured standpipe from a UST north of Building 76-520 spilled 50 gallons of MOGAS here in April 1991 (Elmendorf 2001; Jacobs 2004).	The Air Force sampled groundwater and soil at ST69 in 1993 (Elmendorf 1994d). The Air Force did not note any signs of surficial contamination, but had noted a hydrocarbon sheen on the groundwater during UST removal (Elmendorf 1994d; Elmendorf 2001). Groundwater monitoring is ongoing at this site. Contaminants detected at levels above ATSDR's CVs are listed below. No contaminants were found above ATSDR's CVs in soil located near the surface. Shallow Groundwater: VOCs: benzene (240 ppb), benzene (240 ppb), 1,2-dichloroethane (0.49F ppb), and n-propylbenzene (0.46F ppb). Inorganics: lead (82 ppb).	The Air Force removed the UST at the time of the spill in 1991. The Air Force expects groundwater contaminant levels to achieve regulatory cleanup levels in 2006 (Elmendorf 2001; Jacobs 2004).	This site poses no past, current, or potential future health hazards. The site is near a housing or recreational area but no surface soil contamination was identified, so there is no exposure. Shallow groundwater use is not permitted here or at any site south of Elmendorf Moraine.
<i>ST70, Diesel Fuel Leak, Hillberg Ski Lodge (SERA site, Phase II)</i>	Inactive unit. ST70 is located at Building 23400, a ski lodge near Hillberg Lake. Petroleum-contaminated soil was discovered during the excavation of a heating oil UST at this location in May 1990. Contamination was reportedly the result of spillage and overfills during tank filling operations (Elmendorf 2001).	The Air Force conducted no sampling at ST70.	The Air Force conducted no cleanup operations and determined in 1992 that no further action was needed (Elmendorf 2001).	This site poses no past, current, or potential future health hazards. Only a very small amount of fuel was spilled here. The site is near a housing or recreational area but no surface soil contamination was identified, so there is no exposure. Shallow groundwater use is not permitted here or at any site south of Elmendorf Moraine.
<i>SD73, Surface Disposal Site, NOAA Research Station</i>	Inactive unit. SD73 is a surface disposal area around Building A-6 at the former National Oceanographic and Atmospheric Administration	NOAA sampled groundwater and soil at SD73 in 1993. The Air Force sampled groundwater and soil at SD73 in 1994 (Elmendorf 1996b). Contaminants	The Air Force conducted no cleanup operations and determined in 1997 that no further action was needed (Elmendorf 2001).	This site poses no past, current, or potential future health hazards. The site is near a housing or recreational area but the levels of

Site	Site Description and History	Investigation and Sampling Results	Corrective Action and Current Status	Site Access and Public Health Evaluation
<i>(CERCLA site, OU 6)</i>	(NOAA) Research Station. This building is a former film processing and research laboratory. The Air Force identified a surface disposal area and building drains next to the building. Operations ceased in the summer of 1992 (Elmendorf 2001).	<p>detected at levels above ATSDR's CVs are listed below.</p> <p>Shallow Groundwater: VOCs: 1,2-dichloroethane (2.2 ppb). SVOCs: bis(2-ethylhexyl)phthalate (4.45B ppb). Inorganics: arsenic (7.2 ppb), cadmium (2.56 ppb), calcium (105,000 ppb), lead (21 ppb), magnesium (50,800 ppb), manganese (2,100 ppb), molybdenum (1,290 ppb), potassium (722 ppb), sodium (174,000 ppb), and thallium (13.8J ppb).</p> <p>Surface Soil: SVOCs: acenaphthylene (0.0222 ppm), benzo(a)pyrene (0.327 ppm), benzo(b)fluoranthene (0.945F ppm), benzo(g,h,i)perylene (0.0821 ppm), bis(2-ethylhexyl)phthalate (53.7B ppm), and phenanthrene (0.431 ppm). Inorganics: antimony (280 ppm), arsenic (26 ppm), calcium (8,320 ppm), iron (35,100 ppm), magnesium (9,680 ppm), potassium (1,620 ppm), and sodium (259 ppm).</p>		contaminants in soil at this site are not high enough to present a health hazard. Shallow groundwater use is not permitted here or at any site south of Elmendorf Moraine.
<i>ST74, Heating Fuel Leak behind Old Fire Station #3 (SERA site, Phase II)</i>	Inactive unit. ST74 is an area of contamination from a former fuel tank leak that was used for heating fuel, and was associated with Fire Station 3 (Building A-3) at the NOAA Research Station. Site reports do not state whether the tank was a UST or an AST. The building was used by the Bureau of Land Management (BLM) in the 1930s, possibly for fire training exercises. In the late 1970s and early 1980s, the Air Force used Building A-3 as a fire station (Elmendorf 2001).	The Air Force sampled groundwater and soil at ST74 in 1993 and 1995 (Elmendorf 1995b). No contaminants were found above ATSDR's CVs in groundwater, or in soil located near the surface, in available data.	The Air Force constructed a soil bioventing system here in 1996, and is monitoring bioventing and natural attenuation for subsurface soil contamination. The subsurface soil reached regulatory levels in 2000 (Elmendorf 2001; Jacobs 2004).	This site poses no past, current, or potential future health hazards. The site is near a housing or recreational area but no surface soil contamination was identified, so there is no exposure. Shallow groundwater use is not permitted here or at any site south of Elmendorf Moraine.
<i>ST76, Leaking UST, Building 9154</i>	Inactive unit. ST76 is the location of a 6,500-gallon leaking diesel fuel tank (Tank 155) adjacent to Building 5374	The Air Force sampled groundwater at ST76 in 1995 (Elmendorf 1995b). Groundwater monitoring is ongoing at	In 1993, the Air Force excavated and removed the tank at ST76. The Air Force determined in 1998 that	This site poses no past, current, or potential future health hazards. The site is near a housing or

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Site	Site Description and History	Investigation and Sampling Results	Corrective Action and Current Status	Site Access and Public Health Evaluation
<i>(SERA site, Phase II)</i>	(Elmendorf 2001).	this site. No contaminants were found above ATSDR's CVs in groundwater, or in soil located near the surface, in available data.	no further action was needed at this site (Elmendorf 2001; Jacobs 2004).	recreational area but no surface soil contamination was identified, so there is no exposure. Shallow groundwater use is not permitted here or at any site south of Elmendorf Moraine.
<i>ST77, Leaking USTs at Building 32-127 (SERA site, Phase II)</i>	Inactive unit. ST77 is the former site of two 2,500-gallon MOGAS USTs adjacent to Building 8326. The tanks contained gasoline and JP-8. The Air Force used these tanks for 15 years and then excavated and removed the tanks (Elmendorf 2001).	The Air Force sampled groundwater at ST77 in 1995 (Elmendorf 1995b). No contaminants were found above ATSDR's CVs in groundwater, or in soil located near the surface, in available data, however soil staining was observed.	The Air Force had excavated and removed the two USTs as of May 1997, and determined in 1997 that no further actions were needed at this site (Elmendorf 2001; Jacobs 2004).	This site poses no past, current, or potential future health hazards. The site is near a housing or recreational area but no surface soil contamination was identified, so there is no exposure. Shallow groundwater use is not permitted here or at any site south of Elmendorf Moraine.
<i>OT82 (CERCLA site)</i>	Inactive unit. This site, just south of LF03 and not far from housing areas, consisted of a long, low bluff covered with approximately 1,000 55-gallon drums and other debris, including a large pile (12 cubic yards) of asbestos insulation, littered with rusty metal and a pile of asbestos. The Air Force placed the site off-limits by posting "keep out" signs, at an unknown date. Site reports indicate that this asbestos-containing material was in a cell in the landfill; it is unclear whether this was exposed to the surface or not. Children from nearby on-site housing were seen playing in this area: the Air Force held a town meeting to inform residents about the hazards, advised them to stay out of the area, and described the cleanup plans. Within 6 months of discovery, an expedited cleanup removed drums, metal, and asbestos (Elmendorf 1999b, Elmendorf 2000).	The Air Force sampled soil at OT82 in 1999 following cleanup activities. Data were not listed in any reports provided to ATSDR (Elmendorf 1999b).	In 1988, the Air Force carried out an expedited cleanup action because of the proximity of this site to a nearby housing area. The Air Force removed 190 cubic yards of recyclable materials 15 cubic yards of recyclable concrete rubble, 60 cubic yards of general refuse, 16 cubic yards of asbestos-containing material, and four drums, and then restored the site by placing 340 yards of topsoil, grading the surface and planting grass seed (Elmendorf 2000).	This site poses no current or potential future health hazards. The site is near a housing area. The Air Force had seen children playing in this area, just after the discovery of asbestos, but reports did not state whether the children were able to contact contaminated material. The site was cleaned up soon after discovery and is now covered by topsoil and grass, so no harmful exposures can occur. This site is now a recreational area (Elmendorf 2000). Past exposure to these materials prior to cleanup, is not well-defined.
<i>SS83, Search Light Area #4</i>	Inactive unit. SS83 is a 20-acre World War II anti-aircraft artillery site,	The Air Force sampled groundwater and soil at SS83 in 1997, 1998 and 2000	The Air Force removed POL- and lead-contaminated soil from the	This site poses no past, current, or potential future health hazards.

Site	Site Description and History	Investigation and Sampling Results	Corrective Action and Current Status	Site Access and Public Health Evaluation
<i>(CERCLA site)</i>	abandoned in the late 1950s. It is located near Six-Mile Lake and near the shoreline of Cook Inlet, in the northwestern portion of the base, an uninhabited area that consists of trees and brush. The site is now on the edge of an antenna field, a restricted area, but the southern end of the site is unrestricted. Old aerial photos show individual areas, including a motor pool, offices, generator buildings, bermed areas, radar sites, generators, support buildings and transportation shops (Elmendorf 2001).	(Elmendorf 2000). Contaminants detected at levels above ATSDR's CVs are listed below. Shallow Groundwater: VOCs: benzene (2 ppb). Inorganics: arsenic (351 ppb), barium (2230 ppb), cadmium (5.44 ppb), chromium (1010 ppb), lead (116 ppb), and mercury (13.9 ppb). Surface Soil: SVOCs: acenaphthylene (0.00632 ppm), benzo(g,h,i)perylene (0.00262 ppm), and phenanthrene (0.0224 ppm). Pesticides/PCBs: PCBs (total) (45 ppm).	AAA site. Further soil removal was planned for 2002 and 2003 (Elmendorf 2001). The Air Force expects to finish cleanup at SS83 in 2005, and to close the site in 2008 (Elmendorf 2000, Elmendorf 2001).	The site is used for unorganized recreation but the levels of contaminants in soil at this site are not high enough to present a health hazard, and the Air Force has restricted site access by installing a gated road entrance so much of the site is not accessible. Shallow groundwater use is not permitted here or at any site south of Elmendorf Moraine (Elmendorf 2000, Elmendorf 2003g). As a prudent public health practice, the potential to find UXO should always be a consideration at anti-aircraft artillery sites, however the areas of this site that could contain UXO are restricted.
<i>SA100 (CERCLA site)</i>	Inactive unit. In 2001, the Air Force found buried debris, suspected to contain asbestos or lead-based paint, during excavation for utility lines for housing that was later built here, near the Boniface Gate. The source of the contamination is unknown. The Air Force initiated cleanup activities within two weeks of site identification (Elmendorf 2003g).	The Air Force sampled soil at SA100 in the late 1990s (Elmendorf 2003g). Contaminants detected at levels above ATSDR's CVs are listed below. Surface Soil: Inorganics: arsenic (13.1M ppm), chromium (236 ppm), and lead (2,010M ppm). The Air Force also sampled surface soil again following cleanup at SA100; only arsenic (7.48 ppm) was detected above ATSDR's CVs (Elmendorf 2002b).	In 2001, the Air Force removed 4,600 cubic yards of soil and 568 tons of miscellaneous debris from SA100. The Air Force transported lead-contaminated soil to a disposal facility; POL-contaminated soil was treated off-site then returned as landfill material (Elmendorf 2002c).	Surface soils at this site pose no past, current, or potential future health hazards. The site is near a housing or recreational area but the levels of contaminants in soil at this site are not high enough to present a health hazard, and it is unlikely that individuals have had a reason to have contact or to have been exposed to buried materials. This area was cleaned up before housing was built in the area, so is unlikely that families and individuals contacted the contaminants prior to cleanup. Shallow groundwater use is not permitted here or at any site south of Elmendorf Moraine (Elmendorf 2003g).
<i>ST401, 3 SGPT/CE</i>	Inactive unit. ST401 is the location of a former diesel and motor vehicle gas	The Air Force sampled groundwater and soil at ST401. The Air Force reported no	In 1994, the Air Force removed USTs and associated piping here.	This site poses no past, current, or potential future health hazards.

Site	Site Description and History	Investigation and Sampling Results	Corrective Action and Current Status	Site Access and Public Health Evaluation
<i>Diesel Pump Station (SERA site, Phase II)</i>	pump station. ST401 is the on the northwest side of Building 4347 (Building 22-013) and north of 2nd Street.	contaminants above ATSDR's CVs in groundwater or in soil near the surface (Elmendorf 2004j).	The Air Force continues to monitor two seep locations near this site to ensure that fuel does not affect off-site locations, and the Air Force is also monitoring natural attenuation of soil and groundwater at ST401 (Jacobs 2004).	The Air Force identified no surface contamination, so there is no exposure. ST401 is near the southern Elmendorf boundary, upgradient from an area where off-site wells were used in the past. However, the Air Force found that site-related contaminants were not expected to reach off-site areas at levels of concern. Shallow groundwater use is not permitted here or at any site south of Elmendorf Moraine (Elmendorf 2003g).
<i>ST409, Former Hospital Outbuilding (EC site)</i>	Inactive unit. This site is located near Building 4913 (former Building 24-805), south of the former Elmendorf Hospital, in the southeast corner of the base. This is the former site of an unregulated 20,000-gallon steel underground storage tank (UST) that contained heating oil for the hospital's backup heating system (Elmendorf 2004j).	The Air Force sampled groundwater and soil at ST409 between 1994-1997. The Air Force reported no contaminants above ATSDR's CVs in groundwater or in soil near the surface (Elmendorf 2004j).	The Air Force removed soil from this site in 2002. The Air Force removed the UST and associated piping in 1994 (Elmendorf 2004j). The Air Force is monitoring natural attenuation of soil and groundwater at ST409 (Jacobs 2004).	This site poses no past, current, or potential future health hazards. The Air Force identified no surface contamination, leaving no potential for surface exposure. ST409 is near the southern Elmendorf boundary, upgradient from an area where off-site wells were used in the past. However, the Air Force found that site-related contaminants were not expected to reach off-site areas at levels of concern.
<i>ST431, Former NOAA Facility (EC site)</i>	Inactive unit. This site is located just northeast of the corner of Vandenberg Ave and Provider Ave, near sites SD73 and ST523. There were three surface soil stockpiles here, one 200-gallon diesel fuel aboveground storage tank (AST), one 1,500-gallon underground storage tank (UST), and one 1,000-gallon UST. The 1,500-gallon UST contained gasoline. The 1,000-gallon UST held diesel fuel (Elmendorf 2004j).	The Air Force sampled groundwater and soil at ST431. The Air Force reported no contaminants above ATSDR's CVs in groundwater or in soil near the surface (Elmendorf 2004j).	The Air Force removed the USTs in 1996, and removed the AST in 1997 (Elmendorf 2004j). The Air Force determined in 1998 that no further action was needed at ST431 (Elmendorf 2004j).	This site poses no past, current, or potential future health hazards. The Air Force identified no surface contamination, leaving no potential for surface exposure. ST431 is near the southern Elmendorf boundary, upgradient from an area where off-site wells were used in the past. However, the Air Force found that site-related contaminants were not expected to reach off-site areas at levels of concern. Based on the

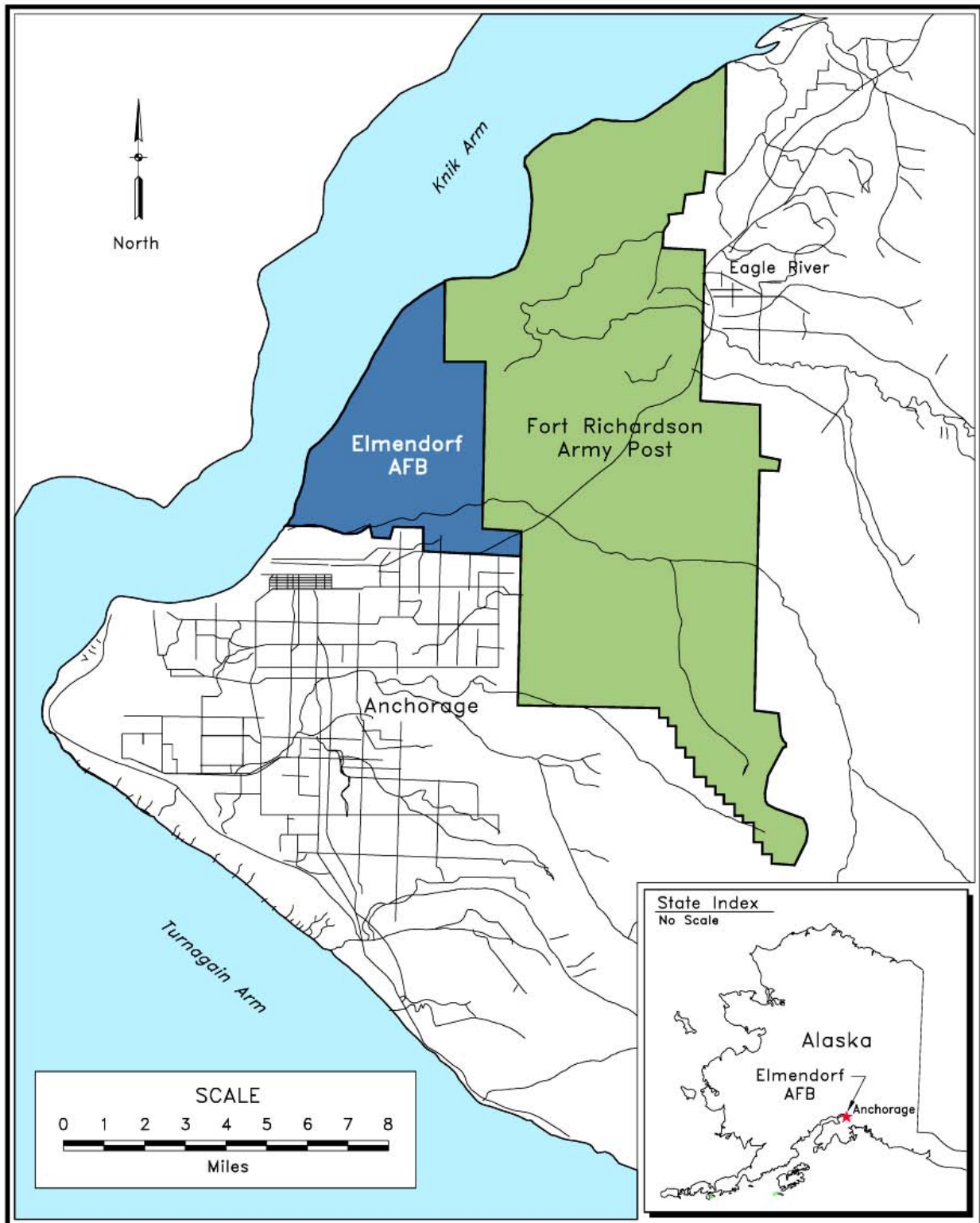
Site	Site Description and History	Investigation and Sampling Results	Corrective Action and Current Status	Site Access and Public Health Evaluation
				contaminant levels of methane, hydrogen sulfide, and carbon monoxide, in air in confined spaces along water supply lines at Elmendorf in 17 years of monitoring, ATSDR has not identified anything to suggest that natural attenuation products of fuels, including methane, have significant impact on indoor air. However, as a prudent public health action, routine evaluation of indoor air near chemical and fuel spills should be considered, including potential explosive hazards of fuel vapors including methane gas.
<p>ST523, NOAA Warehouse (EC site)</p>	<p>Inactive unit. This site is located just northeast of the corner of Vandenberg Ave and Provider Ave, near sites SD73 and ST431, south of former Building 24-301, a warehouse for National Oceanic and Atmospheric Administration that was demolished in 1995. This site contained a 1,000-gallon UST used to store gasoline and diesel fuel (Elmendorf 2004j).</p>	<p>The Air Force sampled groundwater and soil at ST523. The Air Force reported no contaminants above ATSDR's CVs in groundwater or in soil near the surface. During UST removal, the Air Force noted that the tank appeared to be in good condition, but noted stained soil and hydrocarbon odors (Elmendorf 2004j).</p>	<p>The Air Force recommended monitored natural attenuation at this site. The Air Force removed the UST in May 1996, and also excavated and stockpiled 5 cubic yards of soil during the removal. The Air Force backfilled the excavation with contaminated soil and capped it with 5 cubic yards of clean fill. The Air Force is monitoring natural attenuation of subsurface soil contamination at ST523 (Elmendorf 2004j).</p>	<p>This site poses no past, current, or potential future health hazards. The Air Force identified no surface contamination, leaving no potential for surface exposure. ST523 is near the southern Elmendorf boundary, upgradient from an area where off-site wells were used in the past. However, the Air Force found that site-related contaminants were not expected to reach off-site areas at levels of concern. Based on the contaminant levels of methane, hydrogen sulfide, and carbon monoxide, in air in confined spaces along water supply lines at Elmendorf in 17 years of monitoring, ATSDR has not identified anything to suggest that natural attenuation products of fuels, including methane, have significant impact on indoor air.</p>

Site	Site Description and History	Investigation and Sampling Results	Corrective Action and Current Status	Site Access and Public Health Evaluation
				However, as a prudent public health action, routine evaluation of indoor air near chemical and fuel spills should be considered, including potential explosive hazards of fuel vapors including methane gas.
ST528, Fire Station #3 (EC site)	Inactive unit. This site is located east of the corner of Vandenberg Ave and Provider Ave, south of Building 3786 (Fire Station #3, former Building 24-856), and southeast of sites SD73, ST431 and ST523. The Air Force used a 1,000 gallon steel UST here to store diesel/JP-8 fuel for an emergency generator (Elmendorf 2004j).	The Air Force sampled soil at ST528. The Air Force reported no contaminants above ATSDR's CVs in soil near the surface. The Air Force noted hydrocarbon odors and stained subsurface soil (Elmendorf 2004j).	The Air Force removed the UST in 1996, and determined in the late 1990s that this site requires no further action (Elmendorf 2004j).	This site poses no past, current, or potential future health hazards. The Air Force identified no surface contamination, leaving no potential for surface exposure. ST528 is near the southern Elmendorf boundary, upgradient from an area where off-site wells were used in the past. However, the Air Force found that site-related contaminants were not expected to reach off-site areas at levels of concern.
ST702, MAC Chalet (EC site)	Inactive unit. This site is next to Sixmile Lake at the MAC Chalet. Site history is unknown.	Site sampling results are unknown.	The Air Force is monitoring natural attenuation at ST702 (Jacobs 2004).	This site is located near Sixmile Lake. Fuel spills here may pose a risk to that water body. No further information is known about this site. There is an active well at this cabin, but its location relative to ST702 is unknown.
ST703, Green Lake Cabin (EC site)	Inactive unit. This site is located at the Green Lake Cabin, 40 feet from Green Lake. One unregulated 1,000-gallon steel UST here held heating oil for the Green Lake Cabin; the cabin was removed in 2001. The Air Force identified a spill from the heating oil tank at the cabin. (Elmendorf 2004j).	The Air Force did not sample groundwater at ST703. The Air Force sampled soil in the mid-1990s but did not collect any soil from the surface. No surface contamination was identified at ST703 (Elmendorf 2004j).	The Air Force removed the UST and associated piping in 1997, and then conducted a soil cleanup, removing 249 tons of soil. The Air Force found that a clay layer and a utilidor appear to block any contaminant migration to Green Lake. The Air Force will continue to monitor natural attenuation of groundwater to ensure that no contaminants reach Green Lake (Elmendorf 2004j).	This site poses no past, current, or potential future health hazards. The Air Force identified no surface contamination, so there is no exposure. This site is located near Green Lake, but the Air Force found that contaminants are not migrating to the lake (Elmendorf 2004j).

Key:	AAA	anti-aircraft artillery
	AST	above-ground storage tank
	B	not detected significantly above the level reported in laboratory or field blanks
	BHC	benzene hexachloride (also called HCH)
	DDD	dichlorodiphenyldichloroethane
	DDT	dichlorodiphenyltrichloroethane
	EE/CA	engineering evaluation/cost analysis
	GW-NA	groundwater natural attenuation
	J	contaminant present, but value may not be accurate or precise
	JP-4	Jet Fuel Propellant Number Four
	JP-8	Jet Fuel Propellant Number Eight
	MOGAS	motor gasoline
	NOAA	National Oceanic and Atmospheric Administration
	OU	operable unit
	ppm	parts per million
	R	compound may or may not be present
	RBC-C	risk-based level (EPA), cancer
	RBC-N	risk-based level (EPA), non-cancer effects
	RMEG-child	reference media evaluation guide (ATSDR), child

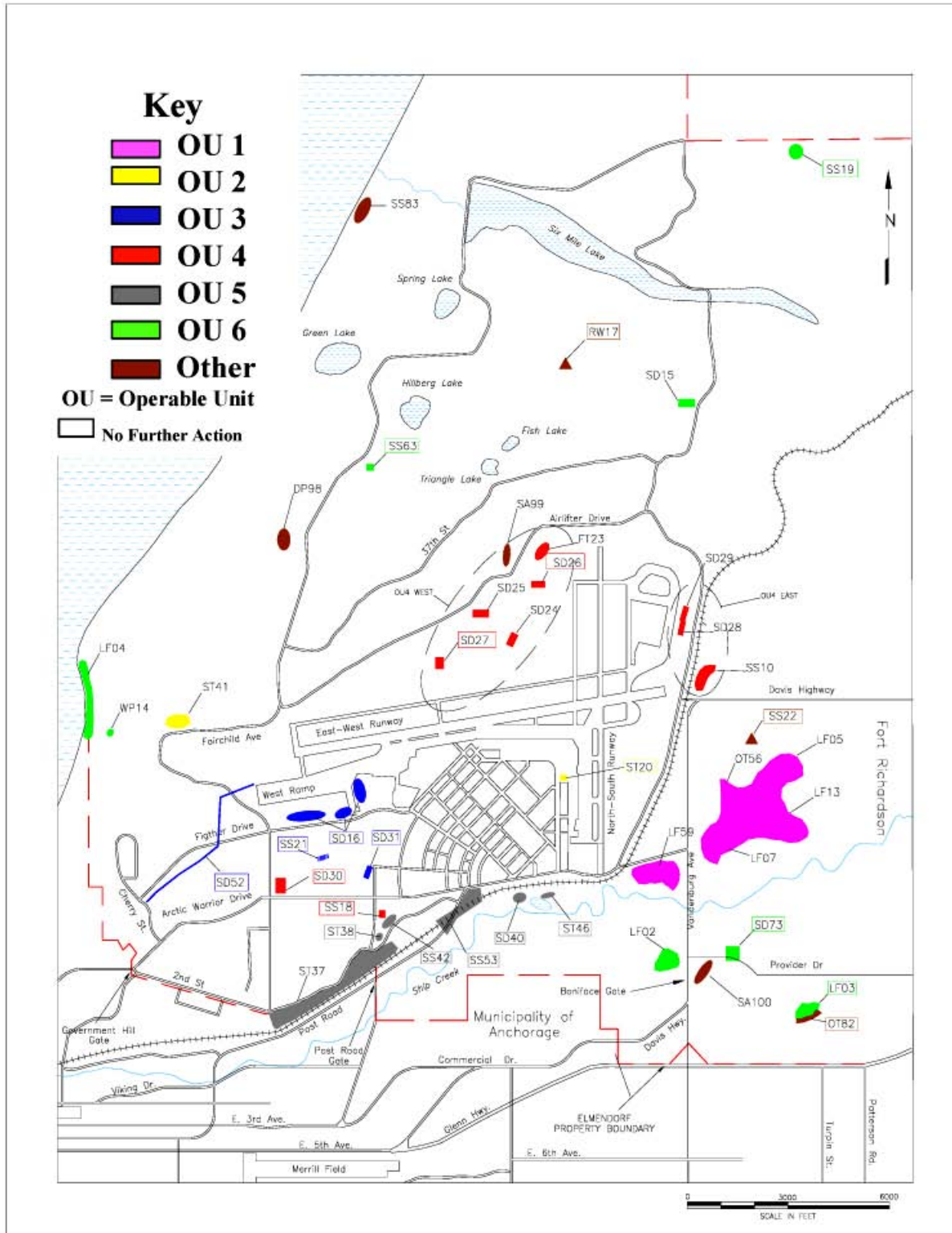
Figures

Figure 1. Location Map, Elmendorf AFB, Anchorage, AK.



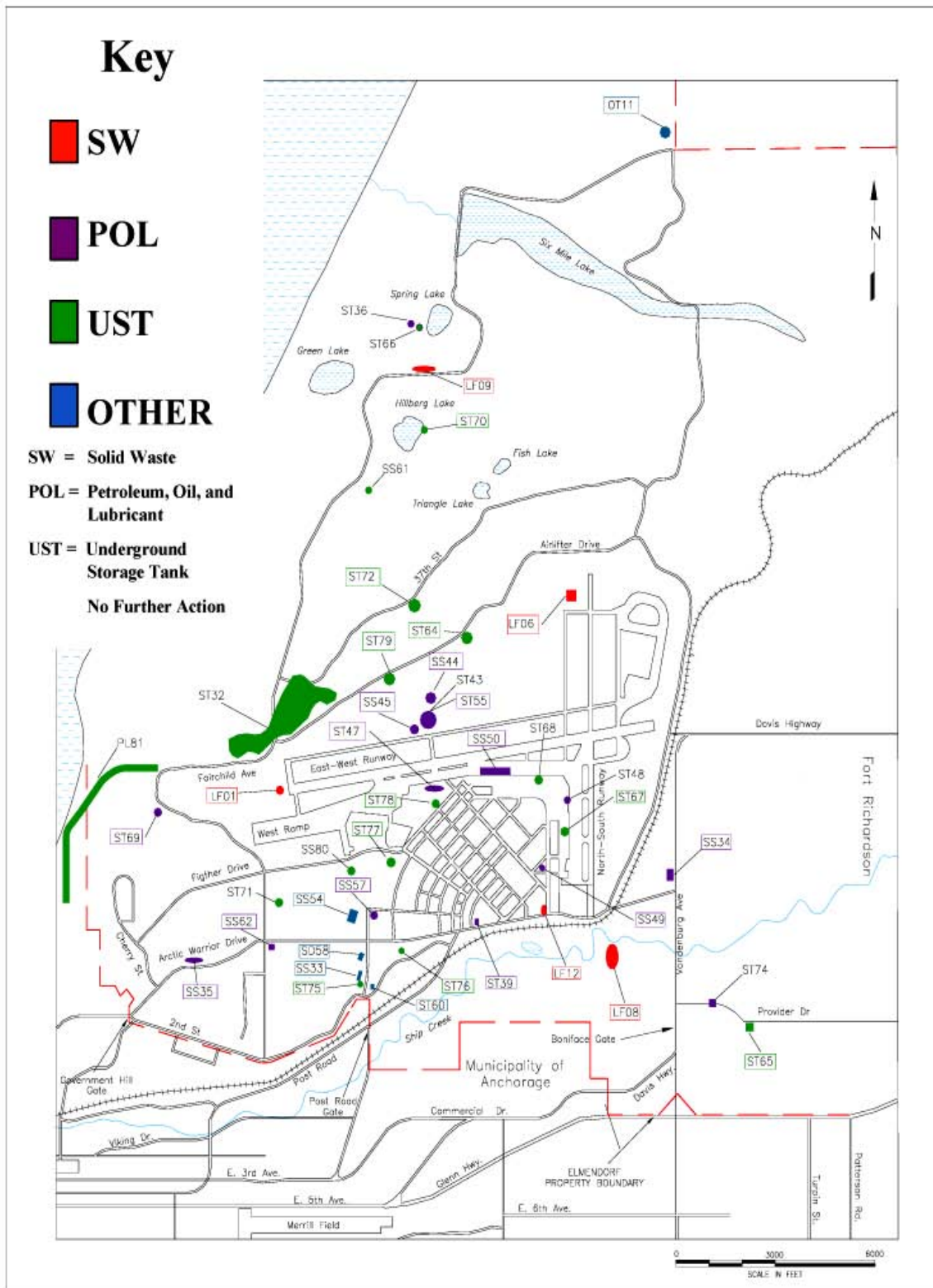
Source: Elmendorf AFB 2003b

Figure 2. CERCLA Sites, Elmendorf AFB, Anchorage, AK.



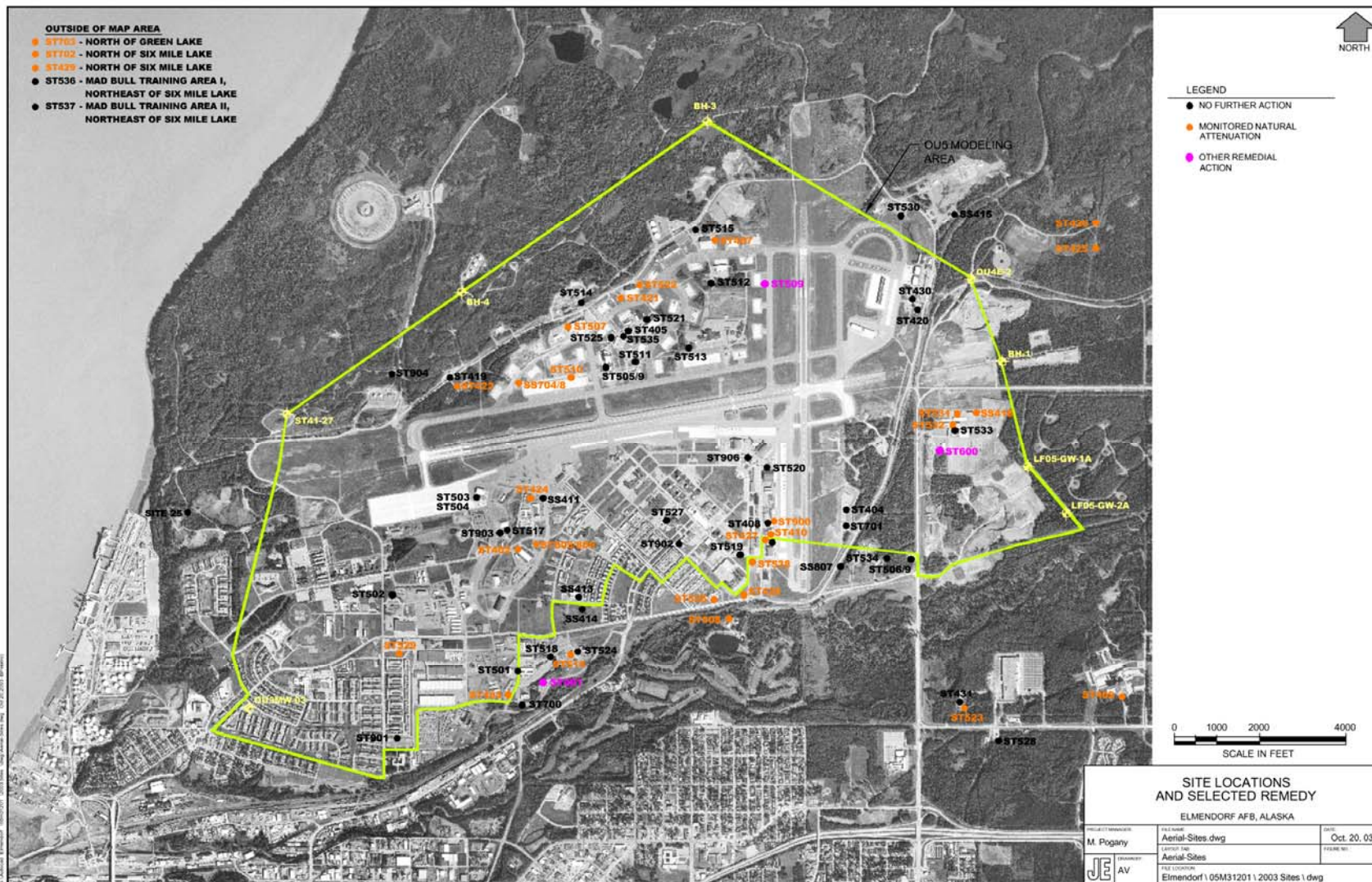
Source: Elmendorf AFB 2001

Figure 3. SERA Sites, Elmendorf AFB, Anchorage, AK.



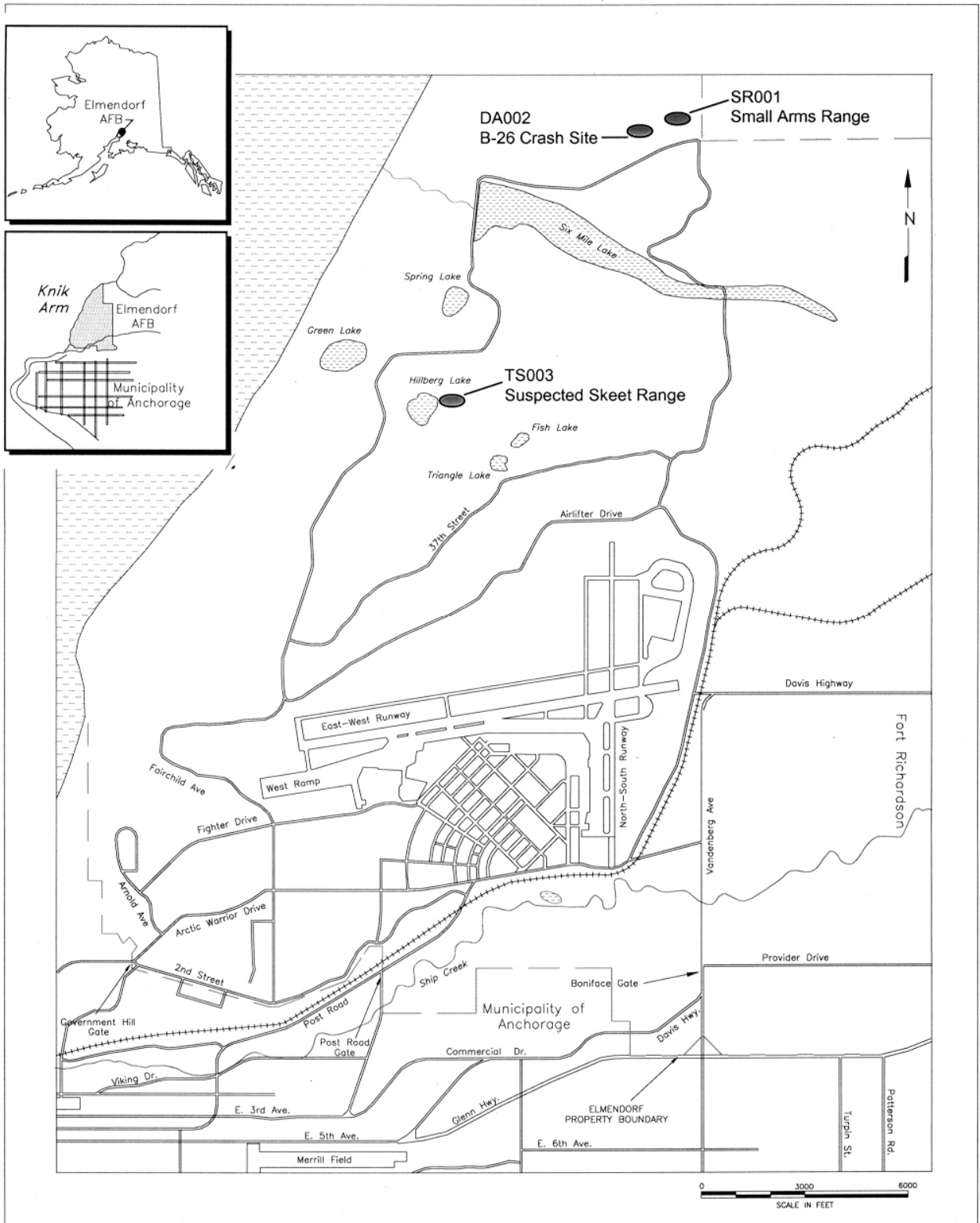
Source: Elmendorf AFB 2001

Figure 4. EC Sites, Elmendorf AFB, Anchorage, AK.



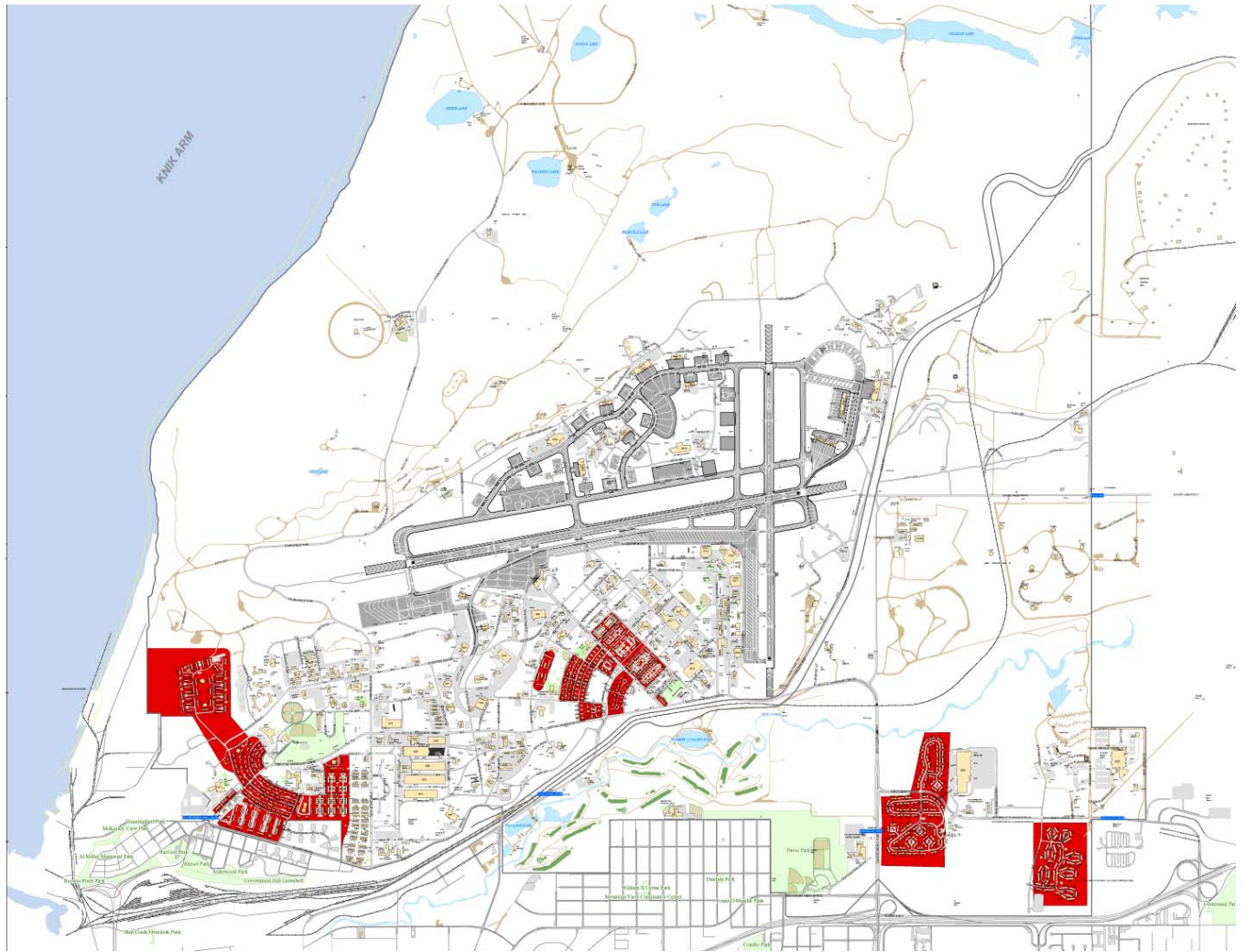
Source: Elmendorf AFB 2004c

Figure 6. Possible Munitions Sites, Elmendorf AFB, Anchorage, AK.



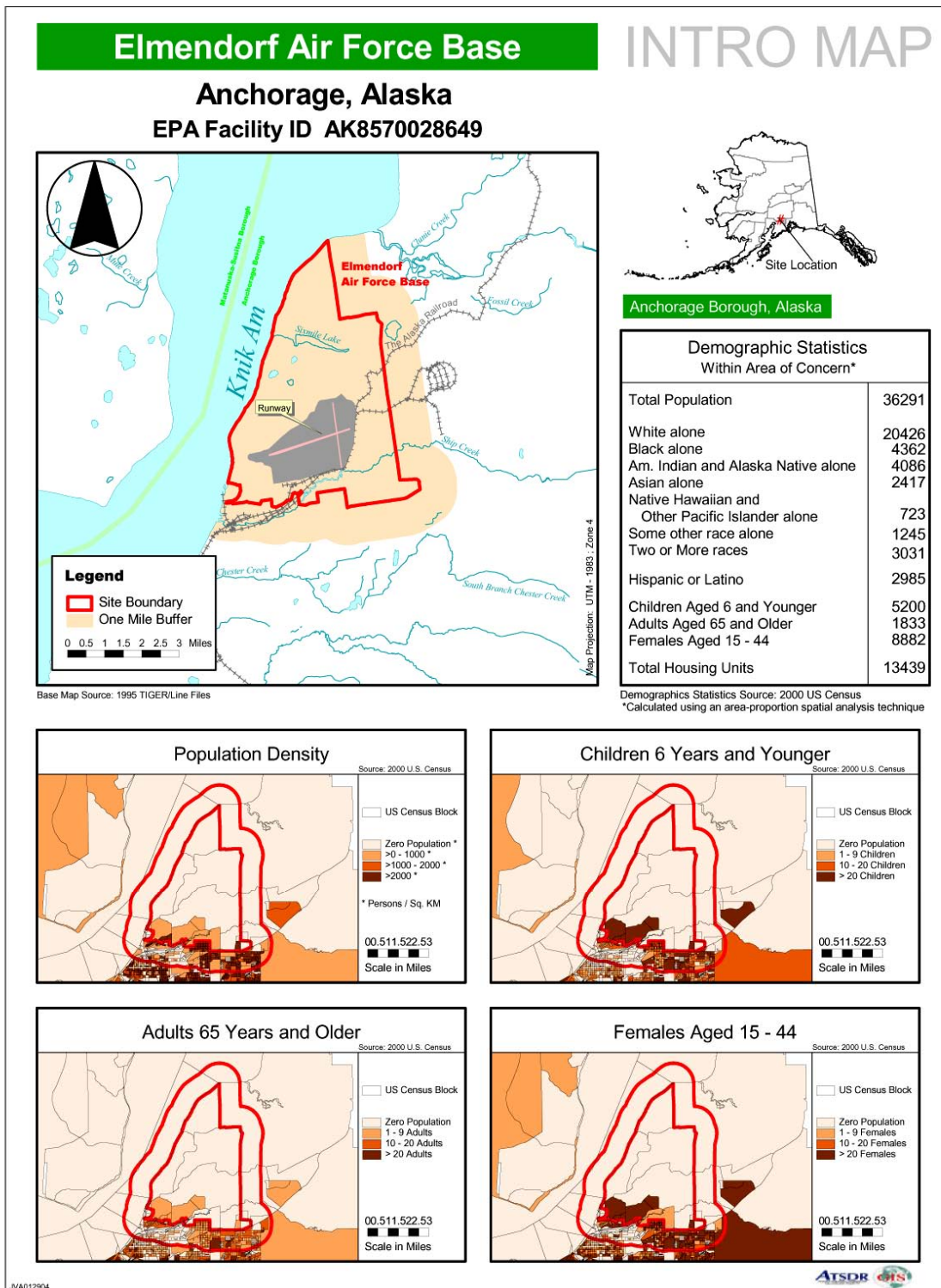
Source: Elmendorf AFB 2004k

Figure 7. Current Land Use, Elmendorf AFB, Anchorage, AK.



Source: Elmendorf AFB 2003h

Figure 8. ATSDR Overview Map, Elmendorf AFB, Anchorage, AK.



Source: ATSDR 2004

Figure 9. ATSDR's Exposure Evaluation Process.

REMEMBER: For a public health threat to exist, the following three conditions must all be met:

- Contaminants must exist in the environment
- People must come into contact with areas that have potential contamination
- The amount of contamination must be sufficient to affect people's health

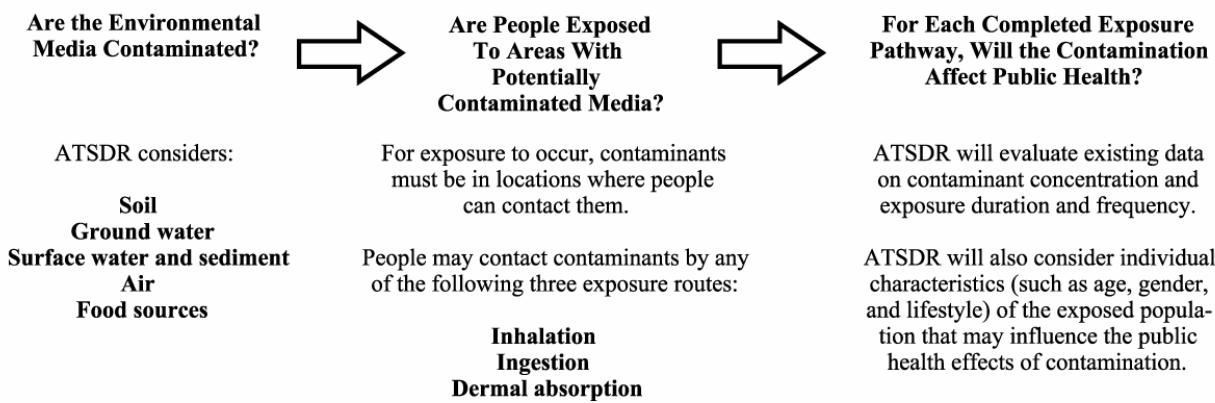
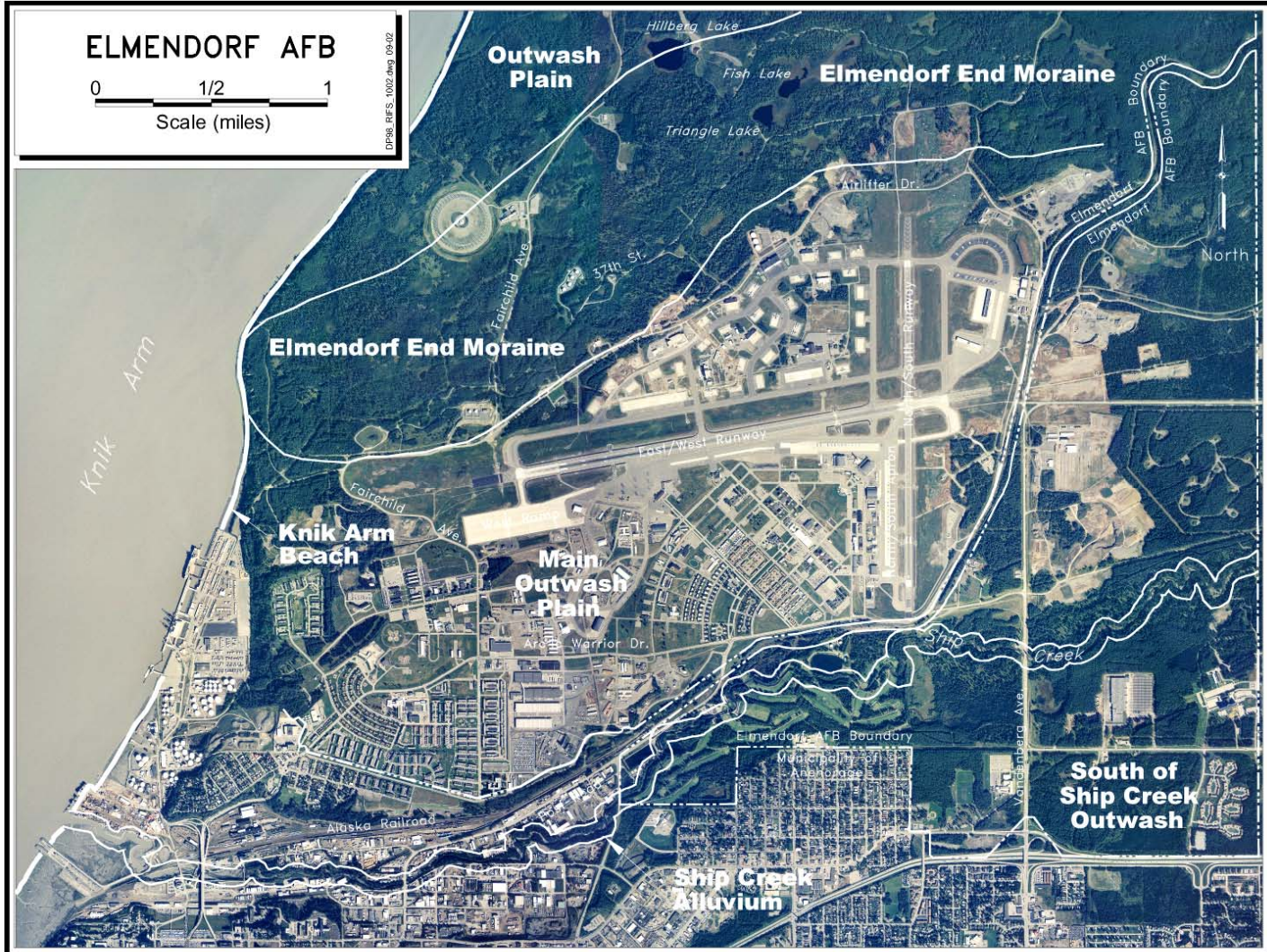


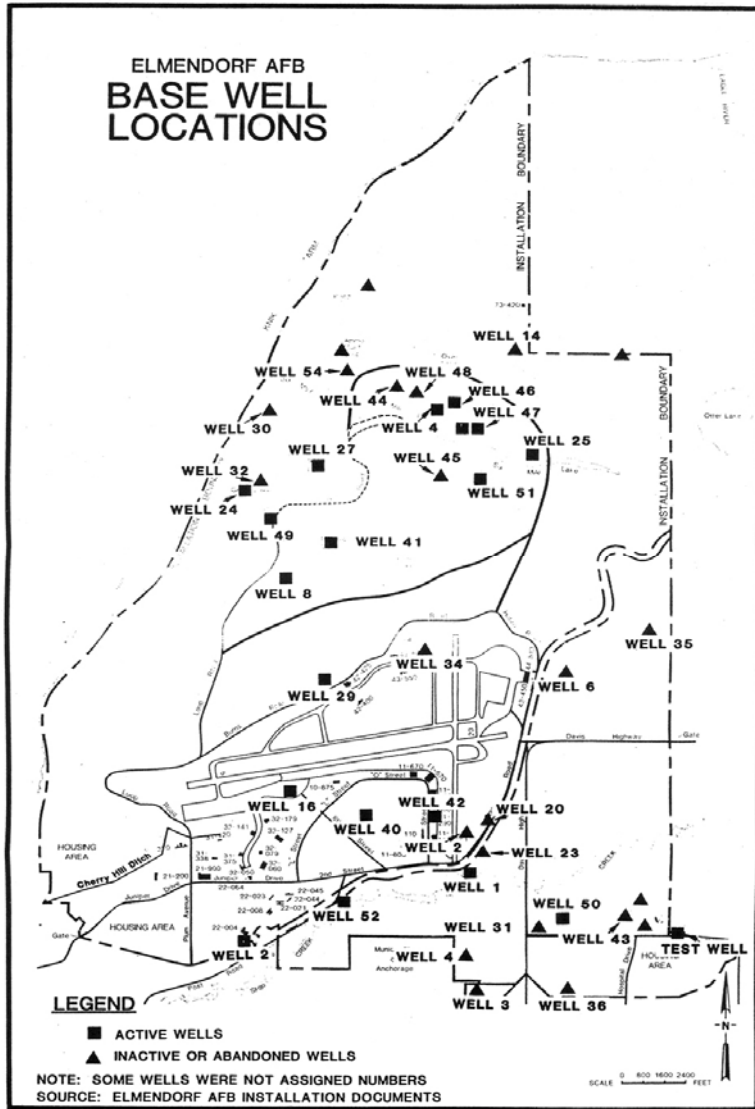
Figure 10. Groundwater Aquifer Zones, Elmendorf AFB, Anchorage, AK.



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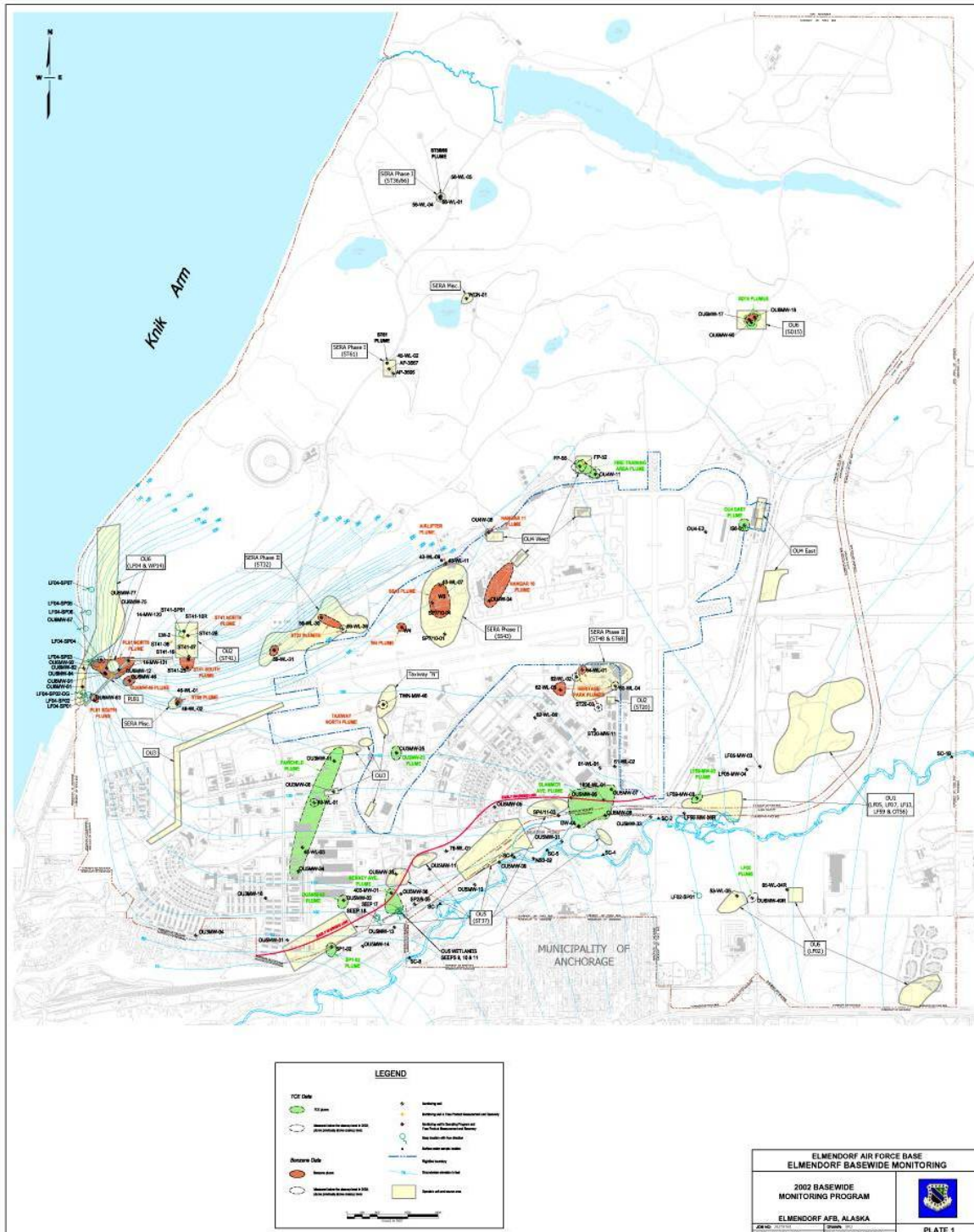
Source: Elmendorf AFB 2003b

Figure 11. Active and Inactive Base Wells, Elmendorf AFB, Anchorage, AK.



Source: USAF 1993

Figure 12. Benzene and TCE Plumes, Elmendorf AFB, Anchorage, AK.



Source: Elmendorf AFB 2003b