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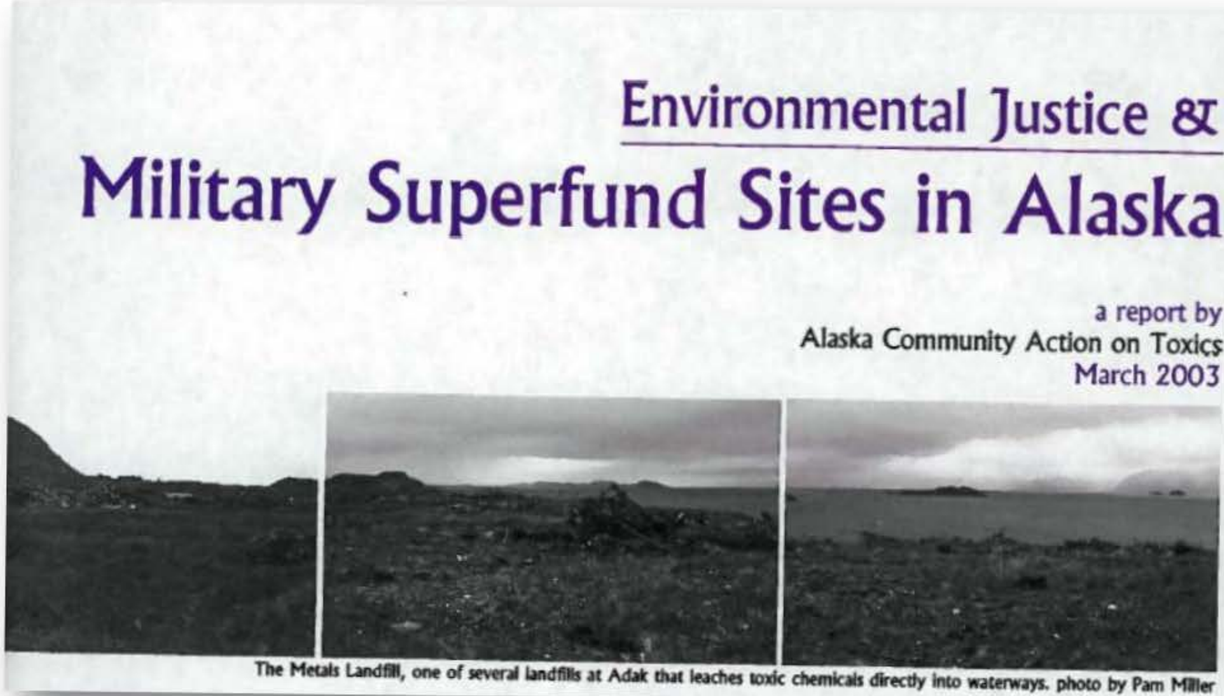

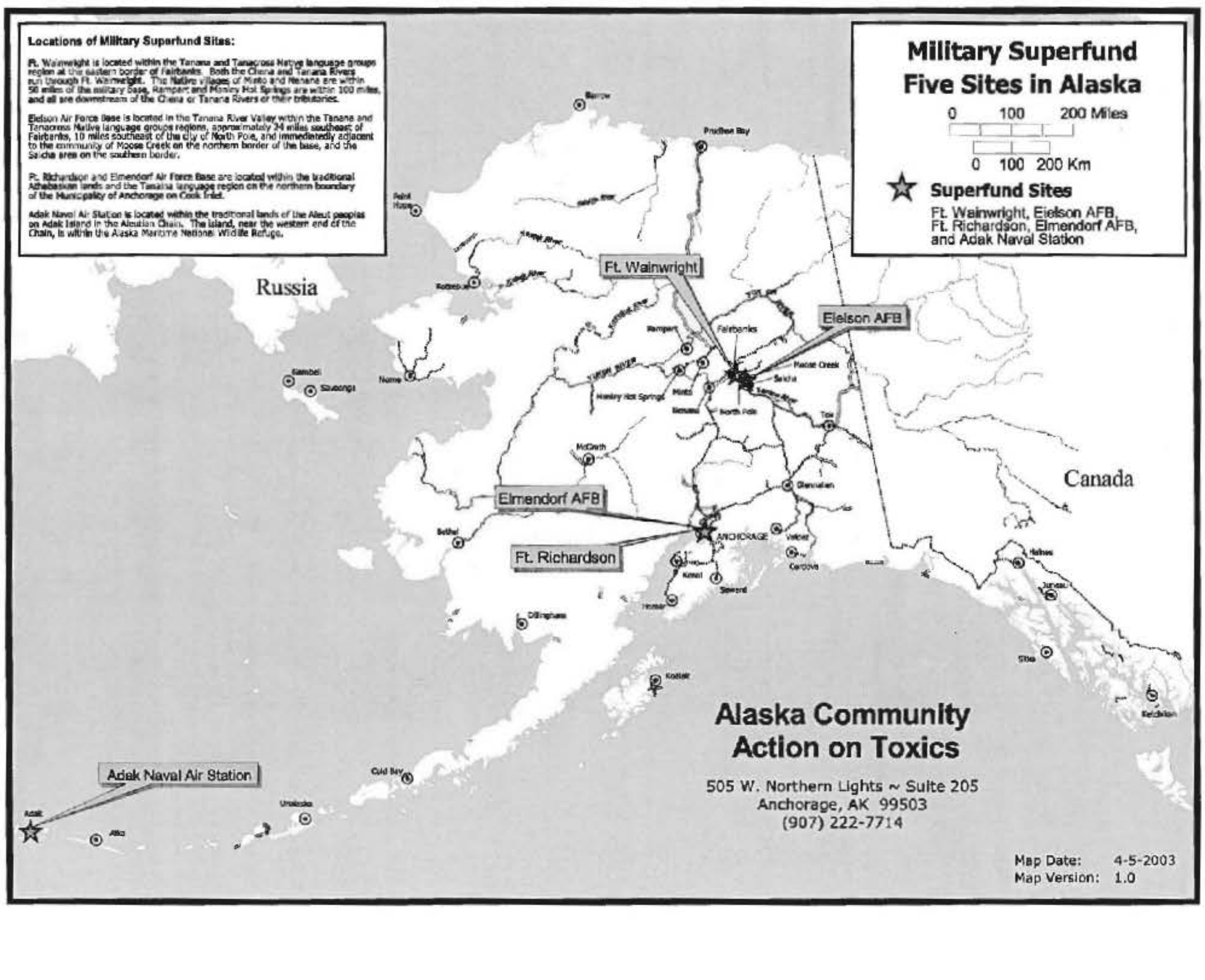

Overview of Key Issues

Environmental Justice at Alaska Military Superfund Sites
an accompaniment to individual site reports

This document serves as a supplement to individual **Superfund*** site reports, published by Alaska Community Action on Toxics. In it, we discuss issues that are relevant to all the sites, an overview of the most predominant contaminants, and environmental justice. This report aims to educate the general public about issues found in common at Department of Defense (DoD) Superfund sites in Alaska. The complete administrative record for each Superfund site contains many volumes, which can be examined at public repositories in the state, listed at the end of this report.

While sites on the **National Priority List (NPL)** for Superfund represent the most contaminated sites in the country, it's also important to point out that few contaminated sites actually make it on the NPL. In Alaska, military activities have contaminated nearly seven hundred different locations, yet only five of these sites have been designated for Superfund clean up. It is our hope that this report will serve not only as an overview for existing Superfund sites, but will serve as a community alert for how to hold public agencies more accountable at future sites.

A Superfund Primer
The **Comprehensive Environmental Response, Compensation and Liability Act**, or **CERCLA**, was passed in 1980. An extremely powerful law, it gives the **Environmental Protection Agency (EPA)** authority and funding to clean up the nation's most dangerous abandoned hazardous waste sites. It also gives EPA authority for site regulation and for holding polluters financially liable.

How Superfund Works
Once a hazardous site is reported, EPA determines if it constitutes an emergency, requiring immediate cleanup. Whether the site requires immediate action or not, the next step is site threat evaluation. In this step, EPA performs a **preliminary assessment** of potential hazards. During this **site inspection**, evidence is gathered, including past known activities, samples of soil, water and air, and the presence of hazardous waste, such as leaking drums or a landfill. EPA then uses a scoring method called the **Hazard Ranking System** to assess the potential threat to human health and the environment. Only sites that receive a high enough score are proposed to be added to the National Priorities List (NPL) and be cleaned up from a hazardous waste trust fund, the "Superfund." The process of evaluation and Superfund determination can take many months.

The **Agency for Toxic Substances and Disease Registry (ATSDR)** is in charge of human health issues at Superfund sites. The Agency is a division of the Centers for Disease Control, not EPA. Other governmental agencies are also involved in Superfund sites, depending on the type of site. In Alaska, all military Superfund sites were active installations at the time of their designation. In addition, there are nearly 700 contaminated sites from former military activities; these are called Formerly Used Defense Sites (FUDS). At this time, there are no FUDS that are Superfund sites, though there may be in the future. The **Army Corps of Engineers**, a division of the U.S. Army, is most often the agency responsible for formerly used defense sites. Active military installations that are placed on the NPL take the lead for those sites. In these instances, the Army, Air Force, or Navy (in Alaska) partners with EPA. The Alaska State Department of Environmental Conservation (DEC) is also involved. A document called a **Two-Party** or **Third-Party Agreement** and/or **Federal Facilities Agreement** details responsibilities and cleanup agreements at each individual site. Because CERCLA does not address all toxic substances, such as the petroleum, oils, and lubricants found at all military Superfund sites in Alaska, these additional agreements are necessary to delineate responsibility for that portion of the cleanup.

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* Words in **bold** signify terms used in the world of Superfund.

Once listed, the site goes through a five-phase process with the ultimate goal of permanent cleanup, which can take many years. The first phase is **remedial investigation**, in which the extent of contamination is investigated. Second, EPA studies the range of possible cleanup remedies in the **feasibility study**. Third, the cleanup remedy is chosen through a **Record of Decision** (**ROD**). Fourth, the cleanup remedy is planned in the **remedial design**. Lastly, cleanup is performed through **remedial action**.

In the remedial investigation phase, areas that have been identified as contaminated (**source areas**) are further broken down into **operable units**. These "OUs" are defined by the EPA as units "in which similar types of contamination sources have been grouped together, based on similarities in types of contaminants present, source locations, or types of remedial actions anticipated."

The law requires the public be given opportunity to comment on the proposed cleanup. A comment period of at least 30 days is given after the **remedial investigation/feasibility study** (RI/FS) during which public hearings are held and either written or verbal comments are accepted. By law, all concerns brought forward by the public must be addressed in the ROD.

At each Superfund site, a **Community Relations Plan** is developed. The CRP documents the community relations history and the issues of community concern. In theory, these are supposed to include affected communities, Tribes, and any individual comments of concern noted throughout the process. They are intended to identify concerns and plan techniques that will address those concerns when planning any technical work at the affected site.

A **Restoration Advisory Board** is generally established at each site; all Superfund sites in Alaska have established them. RABs include a representative from each involved public agency, as well as members of the public, including local communities and Tribes that may be affected by the contamination. Department of Defense (DoD) policy sets forth the requirements under which the military must set up a RAB. Only one of the following criteria must be met: when closure of the installation involves transfer of property to the community (such as at Adak); when 50 citizens petition for a RAB; when federal, state, or local government requests the formation; or when the military installation determines a RAB is needed.[1]

Under Presidential Executive Order[2] the EPA has a trust responsibility to Tribes, which includes an obligation for formal consultation and government-to-government relations. In response to the Executive Order, DoD developed the "Department of Defense American Indian and Alaska Native Policy" directives[3] that specifically support tribal self-governance and mandate government-to-government relations between DoD and Tribes. What this means is that local Tribes should be included in all aspects of CERCLA activities; for example, consultation with regard to site investigation and remedial action plans, risk assessment review, assignment of a Tribal Liaison, and so forth. Instead, as is further discussed in the Environmental Justice section, the administrative record shows that Tribes were more often thought of only at the stage of inviting them to participate on the RAB. Tribes have the right to insist they be included in CERCLA reviews.

In theory, CERCLA is a powerful law that protects human health and the environment from polluters. Unfortunately it doesn't work as well as intended. The EPA, which governs CERCLA regulations, is often under tremendous pressure to maintain an NPL list that is small, giving the appearance that there are not as many heavily polluted sites in the country. For example, Northeast Cape on St. Lawrence Island met criteria to be designated for Superfund, yet was not listed. And, even if a site is listed, it doesn't necessarily mean it will be cleaned up to the point where a potential threat to human health or the environment is prevented, as is the case at the Open Burning/Open Detonation site at Fort Richardson, which, deplorably, was determined through a risk assessment process not to present a threat.

In Alaska the DoD has approximately 700 formerly used defense sites (FUDS), all of which are polluted with a variety of toxic contaminants. Most have never been assessed under CERCLA; the Army Corps of Engineers is responsible for contaminated military sites, yet the EPA has become more involved as the Corps has made little significant effort at clean up of these sites. The EPA will complete an inventory of Alaska FUDS by the end of 2003, and then systematically assess each one under CERCLA. This is good news for Alaska, since military activities have polluted a significant amount of Alaska's land, water and air. It also means communities and Tribes have an important opportunity to become involved and push for better clean up standards.

According to the report *Defend Our Health: A Peoples Report to Congress,*[4] the Department of Defense produces a disproportionate share of the federal government's pollution and environmental liability. The DoD controls 34% of federal facilities and only 3% of federal lands. However, DoD sites comprised 81% of federal sites on the Superfund National Priorities List (or 129 of 160 sites) as of August 1995.[5] In Alaska, these heavily contaminated sites are often in close proximity to densely populated areas and/or lands used traditionally to hunt and gather food. These sites are degrading our environment and harming our health.

Clearly, there must be a better way. And there is. Ultimately, the only way to stop the poisoning of our water, air and food is to stop the sources of pollution at all levels: production, proliferation, use and disposal. The military simply must stop poisoning the people it is sworn to protect. The Precautionary Principle[6] outlines exactly how to do just that. In essence, it states: "When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically, and that affected communities must be involved at each level of decision-making."[7]

Alaska's northern location, the reliance of its residents on traditional, subsistence foods, and the fragility of its arctic and sub arctic landscape make protection of our air and waters from toxic pollution particularly critical. Until the burden of proof shifts to polluters so they must demonstrate that their discharges are safe, Alaska will be unduly vulnerable to pollution created within and outside of its boundaries. DoD sites pose a threat because of the military's use of persistent and toxic chemicals. The DoD must clean up their toxic waste and cause no further harm.

Military Superfund in Alaska

Alaska currently has six sites on the National Priorities List. Five are military installations, four of which are still active bases; they are Adak Naval Air Station (the one inactive installation), Elmendorf Air Force Base, Ft. Richardson Army Base (both near Anchorage), Eielson Air Force Base, and Ft. Wainwright Army Base (both outside Fairbanks). The sixth site, Arctic Surplus in Fairbanks, was a salvage yard used extensively by the military. Two other Superfund sites have been deleted from the list: Alaska Battery in Fairbanks was deleted in 1996; Standard Steel & Metals Salvage in Anchorage was deleted in 2002. (There is disagreement as to whether they have been "cleaned" and whether they should have been removed from the NPL list.)

Contaminants of Concern

A wide number of contaminants are found at Alaska's five military Superfund sites. Below are listed the major groups of chemicals found most often at the sites. The categories in which different chemicals are included are confusing and often overlapping. For the purposes of this report, categories are those used throughout Alaska military Superfund sites. (Definitions of all chemicals found at Alaska Superfund sites are listed at the **Agency for Toxic Substances and Disease Registry** (ATSDR) website under **ToxFAQs** at http:// www.atsdr.cdc.gov/.

Contaminants most common to military Superfund sites in Alaska include: **POLs** (petroleum, oils, and lubricants); **VOCs** (volatile organic chemicals), including benzene and trichloroethylene (TCE); **SVOCs** (semi-volatile organic chemicals), including phenol and naphthalene; **POPs** (persistent organic pollutants), including pesticides such as dieldrin and DDT, dioxins, and PCBs (polychlorinated biphenyls); **heavy metals**, such as cadmium, lead and arsenic; and **munitions-associated chemicals**, including white phosphorus, propellants, DNT, and RXD.

Each class of chemicals includes numerous individually identifiable chemicals, which are often closely related. Because of this, understanding one chemicals relationship to another can be quite complicated. We provide a very general overview only. More specific information can be found on-line at the website given above.

POLs (Petroleum, Oils, and Lubricants) – includes a variety of petroleum products such as gasoline, motor oils, anti-freeze, and diesel fuels. These contaminants are not addressed under CERCLA, which governs the Superfund process. Instead, they are dealt with separately under Two-Party or Third Party Agreements between the State of Alaska and the U.S. Army. Although POLs contain volatile organic chemicals (VOCs), which are governed under CERCLA, at sites where petroleum product is the main contaminant, they are dealt with under these agreements. When only VOCs are found, the site remains under the jurisdiction of Superfund.

According to ToxFAQs, petroleum products are toxic. Inhaling or swallowing large amounts of gasoline can cause death. Inhaling high concentrations of gasoline is irritating to the lungs when breathed in and irritating to the lining of the stomach when swallowed. Gasoline is also a skin irritant. Breathing in high levels of gasoline for short periods or swallowing large amounts of gasoline may also cause harmful effects on the nervous system. Serious nervous system effects include coma and the inability to breathe, while less serious effects include dizziness and headaches.

Short-term health effects of fuel oils include nausea, eye irritation, increased blood pressure, headache, light-headedness, loss of appetite, poor coordination, and difficulty concentrating. Long-term effects of fuel oil vapors include kidney damage, and decreased blood-clotting ability. Exposure to jet fuels from breathing in the vapor caused poor coordination and convulsions in animals, and depressed activity level. Other effects seen in animals were skin and eye irritation, changes in liver cells, and decreased numbers of white blood cells. Long-term effects in humans have not been well defined, and it is undetermined whether jet fuels have reproductive effects; they are not considered to cause cancer in humans.

A cluster of childhood leukemia near a naval airbase in Nevada has raised concerns about a new kerosene-rich fuel, JP-8 or Jet A, introduced in the 1990s. The fuel's low volatility means it stays on skin and clothes longer. Little is yet known about the human health effects, but animal tests have shown it can cause lung, kidney and liver damage, and is highly toxic to the immune system. When pregnant mice were exposed, up to 70 percent of offspring died. At this time, the U.S. military plans to universally use JP-8 or Jet A until 2025.[8]

Volatile Organic Chemicals – VOCs have boiling point *below* that of water and can easily vaporize or volatilize. They are among the main constituents of petroleum products and gasoline, as well as commonly used solvents, degreasers, paint thinners, lacquer thinner, and dry cleaning fluids (the bulk of Ft. Wainwright's contamination). They include substances containing carbon and different proportions of other elements such as hydrogen, oxygen, fluorine, chlorine, bromine, sulfur, or nitrogen; these substances easily become vapors or gases.These specific chemicals are differentiated from the presence of gasoline and diesel fuels, and other contaminants described as POLs because they are distinctly identifiable in the environmental receptors of concern, that is, soil and water - particularly groundwater. They readily volatilize (evaporate and become a gas) and dissolve in water (highly soluble). As a result, these chemicals also tend to travel through groundwater and soil into waters used for drinking, which can result in long-term, chronic, low-dose exposure, and in some cases, serious health effects.

According to federal agencies, the presence of VOCs "in water is of national concern because of their relatively high aqueous solubility [ability to dissolve in water], mobility, and persistence [long-lasting presence], because many are known or suspected carcinogens [cancer-causing], because of their widespread use, and because they have been found in drinking-water supplies."[9]

Many of the chemicals listed at Alaska's military Superfund sites are VOCs. Two examples include:

- Benzene: Benzene is lipophilic, meaning it can dissolve or combine with fatty tissues and is not easily dissolved by water. Because of this, it was widely used as a solvent, and in paints, thinners, degreasers and industrial cleaners. It ranks as in the top 20 chemicals for production volume in the U.S and has been found in over half of the nation's Superfund sites.[10] It is present at all military Superfund sites in Alaska.

  In humans, benzene tends to concentrate in the bone marrow and in tissue that has a high fat (lipid) content. It primarily affects the central nervous system, the formation of blood and blood cells, and may affect the immune system. Breathing very high levels of benzene can result in death, while high levels can cause drowsiness, dizziness, rapid heart rate, headaches, tremors, confusion, and unconsciousness. Ingestion (consuming contaminated foods or water) can cause vomiting, irritation of the stomach, dizziness, sleepiness, convulsions, rapid heart rate, and death. According to ATSDR, zero benzene concentration in drinking water is the ideal goal that would allow an adequate margin of safety for the prevention of adverse effects.[11]

The Department of Health and Human Services has determined that benzene is a known human carcinogen.[12] The major exposure pathway of concern for benzene is contamination of groundwater, which can result in contamination of drinking water. However, benzene in the air can attach to rain or snow and be carried back down to the ground.[13] At the military Superfund sites in Alaska, underground storage tanks are a major source of benzene contamination.

- Trichloroethylene (TCE): TCE dissolves easily in water and can remain for decades in the environment, which is particularly problematic if it migrates to groundwater used as a drinking water source. TCE is also found as an air vapor because it evaporates quickly from surface waters such as rivers. In soil, TCE can stick to individual soil particles where it also remains for decades. If these particles end up in water and become sediment, TCE remains in the water as part of the sediment load. TCE is not known to accumulate in plants and animals in a significant way.[14]

  TCE is not classified as a human carcinogen by the International Agency for Research on Cancer (IARC), but is considered a probable human carcinogen by the EPA. Chronic low-dose exposure (for example, drinking small amounts for long periods) may cause liver and kidney damage, nervous system effects, impaired immune system function, and impaired fetal development in pregnant women, although according to ATSDR the extent of some of these effects is not yet clear.[15]

Semi Volatile Organic Chemicals - SVOCs are somewhat similar to VOCs. They can also be differentiated from the presence of gasoline and diesel fuels, and other contaminants described as POLs. They are distinguished from VOCs in that they have a boiling point *above* that of water (VOC's boiling point is *below* that of water). They can volatilize (evaporate and become a gas) when exposed to temperatures above room temperature.[16] As a result, these chemicals also tend to travel through groundwater and soil into waters used for drinking, which can result in long-term, chronic, low-dose exposure, and in some cases, serious health effects. Two examples include:

- Nitrobenzene: Nitrobenzene is produced in large quantities for use in industry. It is used mainly as an intermediate to produce another chemical, such as aniline, an octane booster in gasoline. Nitrobenzene is also used in the production of lubricating oils, such as those used in motors, machinery, and munitions.

  The major exposure pathway of concern for nitrobenzene is contamination of groundwater, which can result in contamination of drinking water.

  According to ToxFAQs, small amounts of nitrobenzene can cause mild irritation if it contacts the skin or eyes directly. Repeated exposures to a high concentration can result in methemoglobinemia, a condition in which the blood's ability to carry oxygen is reduced. This causes the skin to turn a bluish color and causes nausea, vomiting, and shortness of breath. Effects such as headache, irritability, dizziness, weakness, and drowsiness may also occur. There is also some evidence that breathing high concentrations of nitrobenzene may damage the liver. The International Agency for Research on Cancer (IARC) has determined that nitrobenzene is possibly carcinogenic to humans.[17]

- Polycyclic aromatic hydrocarbons – PAHs include over 100 chemicals found in tar, oil, creosote, person care products, dyes, plastics, and pesticides. They are produced through the incomplete combustion of fossil fuels and other materials.[18]

  The major exposure pathways of concern for PAHs are contamination of groundwater and air. PAHs can occur in air attached to dust particles. Some PAH particles can readily evaporate into the air from soil or surface waters. Most PAHs do not dissolve easily in water. They stick to solid particles and settle to the bottoms of lakes or rivers. In soils, PAHs are most likely to stick tightly to particles; certain PAHs move through soil to contaminate underground water. PAH contents of plants and animals may be much higher than PAH contents of soil or water in which they live.[19]

  Health effects from PAHs are not well known. Mice that were fed high levels of one PAH during pregnancy had difficulty reproducing and so did their offspring. These offspring also had higher rates of birth defects and lower body weights. It is not known whether these effects occur in people. The Department of Health and Human Services (DHHS) has determined that some PAHs may reasonably be expected to be carcinogens. Some people who have breathed or touched mixtures of PAHs and other chemicals for long periods of time have developed cancer.[20]

Persistent Organic Pollutants (POPs) – these are organic chemical compounds that are highly toxic, persist in the environment, bio-accumulate in fatty tissues of living organisms, travel long distances, and naturally migrate toward colder climates. POPs at Alaska military Superfund sites include pesticides (such as dieldrin and DDT and its metabolites such as DDE from historical storage and use), dioxins, and PCBs. POPs have a wide range of extremely adverse human health effects, including effects on the nervous system and reproduction and development. POPs have also been linked to cancer, genetic impacts, and behavioral disorders.[21]

Recent research demonstrates that some of these chemicals, such as dioxin, have no safe threshold for which adverse health effects do not occur.[22] Some are developmental toxins, which means they affect the fetus during its prenatal development. Some are endocrine disruptors, meaning the chemicals interfere with the body's ability to respond and regulate itself hormonally, which can result in hormonal disruptions, such as thyroid activity. POPs are long lasting in the environment and bioaccumulate, meaning they intensify in concentration as they move up the food chain. This is why humans, bears, and birds of prey, which are at the top of the food chain, often have high levels of POPs in their fatty tissue. Because the marine food chain is longer, humans who eat marine mammals are at highest risk for exposure to POPs from ingestion. (For more information about POPs, see www.pen.org)

White Phosphorus – The U.S. military has used white phosphorus in pyrotechnics and incendiary munitions. It is found in both water and sediments, and reacts rapidly with oxygen in the air. It also reacts with oxygen in water, and does not persist longer than a few days once it is exposed to oxygen. In water with low oxygen, it may degrade to a highly toxic compound called phosphine, which eventually evaporates to the air where it changes to less harmful chemicals. White phosphorus is somewhat persistent in fish that live in contaminated lakes or streams. It is also somewhat persistent in soils where it may affix itself before it degrades, usually within a few days. In deep soil or sediments with little oxygen, however, white phosphorus can persist unchanged for many years. It is this context in which white phosphorus is most threatening to the wildlife and waterfowl with whom it comes into contact. Acute, short-term (immediate) exposure through food sources is known to be deadly to waterfowl based on studies conducted at Fort Richardson. Its effects on other wildlife with long-term exposures are not as well understood.[23]

Little is known, either, about long-term health effects in humans exposed to white phosphorus. Breathing white phosphorus for short periods is known to cause coughing and irritation of the throat and lungs. Breathing white phosphorus for long periods may cause a condition known as phossy-jaw, which involves poor, wound healing of the mouth and breakdown of the jawbone. Contact with the skin while burning may cause burns and liver, heart, and kidney damage. White phosphorus causes reproductive effects. Inhalation of vapors may irritate the nose, throat, lungs, skin, eyes, and mucous membranes. Ingestion may cause liver, heart, or kidney damage, as well as vomiting and death. Based on current information, white phosphorus is not believed to cause cancer in humans.[24]

Environmental Fate and Transport: Pathways of Exposure

The implications of such widespread contamination at these Superfund sites can be better understood with awareness of how humans and animals become exposed to these chemicals of concern (**routes and pathways of exposure**) and how these chemicals travel through and operate in the environment (**fate and transport**). Critical to both these factors are the geological and geographical contexts into which the contaminants have been released. The terms in bold are those used in risk assessment.

Routes and pathways of exposure and exposure media For humans, there are three basic routes of exposure:

- *Dermal absorption*: absorption of the chemical through the skin. The primary occurrence is through exposure to contaminated soil and/or water.
- *Inhalation*: breathing in contaminants that are in the air. This is a very important pathway in the case of chemicals that volatilize easily (transformation into gases or vapors, like steam), such as PCBs, or which attach onto very small particles of dust easily breathed in during normal respiration. Chemicals present in household water are easily absorbed both dermally and through inhalation from volatilization during bathing, cooking, and washing.
- *Ingestion*: eating food or drinking beverages that are contaminated, or swallowing particles of dirt or dust to which contaminants have attached themselves. Food can be contaminated in two significant

ways. The contaminant can be in the food itself, such as fish or mammals which have themselves eaten prey contaminated with a chemical, dairy products made with contaminated milk, produce that has been treated with pesticides, herbicides or fungicides that are taken up systemically into the plant, or food that has been grown in contaminated soil. The contaminant can also be on the food, such as residues that remain from spraying with pesticides or herbicides or contaminated dust that has settled onto the plant.

Exposure pathways refer to routes by which chemicals travel from the sources of the contamination into the environment where humans and animals become exposed. The three most common pathways are through environmental media such as air, water (surface water or groundwater), and soil.

In reviewing Alaska Superfund administrative records, most agency documents address soil and water contamination exclusively, even though air migration is also a relevant pathway. This is a gross oversight if historical practices at the site resulted in significant emissions into the air, which can travel miles as a result of air deposition (tiny particles of toxins that travel though the air to be deposited at an entirely new location).

This is also true with the volatilization of chemicals when exposed to the air. Although once considered insoluble in water and not susceptible to volatilization, recent research has demonstrated that PCBs and other persistent organic pollutants do in fact volatilize. When this happens, they are transported on air streams north to colder climates where they are redeposited into water bodies and snow, where they migrate up the food chain. Once in the arctic environment, they move up the food chain, from small aquatic organisms, to fish, and then to seals, bears, or whales, where they concentrate in the blubber of these animals. Because PCBs lodge in fatty tissue, they become more concentrated with each successive movement up the food chain. When humans eat these animals, the PCBs are transferred again, ending up in human fat and blood, and concentrating in the breast milk of human mothers who then transfer these chemicals in a more concentrated form to their nursing infants. Yet, the impacts of air contamination, both on humans and in the environment, are not factored into damage evaluations or risk assessments related to these Superfund sites. They should be.

The EPA's decision not to address air pollution and deposition as a pathway of contamination is a problem for accurately assessing impacts to humans and the environment. This is particularly relevant for potential contamination that extends beyond the boundaries of a Superfund site to nearby or downstream areas. At several sites reviewed for this document, no investigation was made to determine whether traditional hunting and fishing areas within site vicinity were contaminated by air deposition, potentially affecting river water, sediments, flora and fauna. This omission seriously jeopardizes the adequacy of the risk assessment and subsequent chosen remedy for remediation. Moreover, it casts serious doubt on the adequacy of the environmental justice analysis for several of the sites.

Risks and Remediation:

Risk Assessment

The risk assessment process is one of the most important aspects of the Superfund cleanup effort. EPA's stated policy is that remedies for each site are driven by what will maximize protection of human health and the environment. Yet, there are many problems associated with the risk assessment and with the methods used by EPA.

Risk assessment is based on the premise that a certain number of human and non-human deaths and a certain amount of environmental degradation are acceptable. In this model, activities that are known to cause harm are accepted, as long as the harm is not too great. How is the degree of harm calculated? Through a complicated process called "quantitative risk assessment," which is described below. Basically, it is the process of estimating how much damage may occur if a certain activity or if a certain amount of exposure to a chemical takes place. Risk assessment isolates certain activities, individual chemicals, and the age, weight and diet of people in order to estimate this damage. Yet, life does not take place in such isolation. Life is a complex web that depends on the health of all its members in order to be healthy as a whole. As scientist Mary O'Brien points out, "it is not acceptable for people to tell you that the harms to which they will subject you and the world are safe or insignificant. You deserve to know good alternatives to those harms, and deserve to help decide which alternative will be chosen."[25] This is what we advocate, alternatives to risk – that is, alternatives to activities or chemicals that are known to cause harm.

Other problems are also inherent in risk assessment. Guidance documents used to determine risk are based on outdated information, from the 1980s and earlier. In the past decade, tremendous advances in research have revealed much more about known and suspected health effects from different chemicals. For example, little was known or understood about persistent organic pollutants, such as dioxin and PCBs in the 1980s. Current understanding is that risks from these chemicals are far more dangerous and far more subtle than previously thought. A Dutch study has shown exposure to PCBs can adversely affect not only physical health, but also intelligence, cognitive development, and other behaviors, such as over-aggressiveness.[26] None of these data are integrated into current risk assessments. Additional faults are discussed in more depth below.

EPA outlines several objectives for risk evaluations carried out during the remedial investigation phase:

- to help determine whether additional response action is necessary at the site
- to provide a basis for determining residual chemical levels that are adequately protective of public health
- to provide a basis for comparing potential health impacts of various remedial alternatives, and
- to help support selection of the no action remedial alternative (where appropriate)

In order to meet these objectives, two types of risk assessments are done: Human Health and Ecological.

Human Health Risk Assessment

This consists of a cancer risk assessment and a non-cancer hazard determination. Emphasis of this assessment is on the probability of developing cancer, although an equation for determining other risks is also included. According to the EPA, the cancer assessment is to provide an estimate of the excess lifetime cancer risk, which is the incremental probability of an individual developing cancer over a lifetime as a result of exposure to cancer-causing chemicals at a source area. In this scenario, the EPA considers an average lifetime to be 70 years and excess lifetime cancer risks between 1 in 1 million (1×10^{-6}) and 1 in 10,000 (1×10^{-4}) to be within the generally acceptable range. This means agency decisions as to the degree of clean up at each site is based on the risk of more than 1 in 10,000 people getting cancer over their lifetimes from exposure to the contamination.

The second part of the human health risk assessment is called a **hazard risk index**. This is done for chemicals believed to be non-carcinogenic. Acceptable levels of exposure are determined for a single chemical in a single medium (that is, one chemical at a time, looked at in one medium at a time), which does not adversely affect humans over their expected lifetime, with a built-in margin of safety, according to the EPA. The margin of safety is supposed to assure that members of vulnerable populations, children, the elderly, pregnant and nursing women, and the ill or infirm, are adequately protected. The margin of safety is also supposed to compensate for uncertainties in knowing exactly what dose may cause what is called an adverse effect. The non-cancer hazard assessment is very problematic for a number of reasons. The key problem is both the data and methods available for doing the assessment are extremely narrow and in many cases outdated and inadequate for accurately predicting true risks. In addition, it is unclear what approach is taken when a chemical is carcinogenic and has non-cancer effects.

In both types of human health assessments, the risks from each chemical are calculated one by one, for each substance found in the remedial investigation at the site. Two main problems arise from this approach.
Additivity: the risk of each chemical added to the risks of all the other chemicals of concern. The EPA clearly states additivity is considered in the non-cancer hazard assessment, however the same language does not appear in the cancer risk assessment, leaving the public with an unclear understanding of the Agency's approach.
Synergism: the risk that might occur from interactions between different chemicals, including carcinogens and non-carcinogens. Synergism is not evaluated at all because no method currently exists for doing so. However, frequent documented interactions have been found to be of significance in epidemiological studies. Smoking, for example, is known to interact with benzene inhalation exposure to increase the risk of lung cancer. Unfortunately for the communities exposed, these types of issues are considered outside the purview of the Superfund risk assessment context.

Ecological Risk Assessment

This assessment focuses on impacts from the contaminated site to animals and the environment. This is of particular importance in Alaska, where military activities often encompass thousands of acres, rendering the potential for impacts on wildlife, including fish and birds, and large animals used for subsistence, significant.

An **ecological hazard index** is calculated, similar to the calculation for risk to human health. In this one though, specific animals, called indicator species, are selected to determine the potential exposure and effects in these species from chemicals in the source areas. The lack of synergistic effects and compound exposures is also a problem in this type of assessment.

Because the mathematical methodologies used in these assessments are quite complicated, this document will focus on the more important aspects of Superfund risk assessments. Discussions will focus on the methods and criteria used to carry out the risk assessments at the Alaska military sites, the conclusions, and the implications of the decisions that were made as a result.

Methods

The methodology used by EPA to do risk analysis at Superfund sites is called **quantitative risk assessment** (QRA). QRA follows five fundamental steps to derive the risk assessment estimates:

- Identification of the chemicals of concern
- Exposure assessment, what are the pathways and routes of exposure
- Toxicity assessment of the chemicals of concern
- Risk characterization, a synthesis of the first three steps
- Analysis of uncertainties which identifies all the factors that mitigate the accuracy of the risk assessment

1. ***Identification*** of the **chemicals of concern** is done at the beginning of the Superfund process at any site, during both the preliminary site evaluation and again in the remedial investigation. Identification is based on knowledge of what activities occurred at the site and what chemicals were used, (or, in the cases of landfills, who used the site and what wastes went into it). Finally, the most important method of identifying contaminants at a site is testing samples of various media from various locations at the site and comparing contaminant levels found in these samples to levels which are considered background levels. Agencies may use background levels to excuse themselves from the necessity of clean up, though, as was the case at Fort Richardson Open Burning/ Open Detonation pit. The unlined pit was used for years to openly burn a variety of fuels, munitions and other items for which the Army no longer had a use. Although high levels of heavy metals were detected at the pit, no further action was deemed necessary for clean up because background levels of the nearby Eagle River Flats were no higher. Its highly likely the background levels at Eagle River Flats were high due to leaching from the pit, located at a site both uphill and in highly porous gravel. This misuse of risk assessment leaves one to question the Army's commitment and integrity with regard to clean up at the other sites on the base. (See the report *Fort Richardson Army Base Fact Sheet*)

2. Next step is the ***exposure assessment***, which determines by what pathways nearby human populations and the environment (including wildlife) may come in contact with the contaminants. For example, suppose drums leaking a toxic substance are found buried at a site yet the area in which they are found has no contact with either groundwater or surface water, and they're buried under several feet of soil far removed from regular human use. Suppose further that in this urban setting there is little wildlife. Because of all these conditions, even though the chemicals may be extremely toxic, the exposure risk may be assessed as very low. The rationale would be its very unlikely there would be significant human or animal contact with these chemicals through the air, water, or from the soil. This low-risk assessment would be an important factor in determining the cleanup remedy which, in this case, might well be fencing and monitoring access to the area, a remedy called institutional controls. Geography, hydrology, and physical setting of the site are very important in this step.

This step also includes the **quantification of exposure**, meaning how much of the contaminant is available for exposure and absorption through one of the routes of exposure previously described (skin, lungs, gut). Determining this involves figuring out at what concentration the contaminant is present, identifying the maximum exposure level, based on the routes and pathways of exposure, and determining the toxicity of the contaminant - which may be also related to how persistent they are.

The EPA uses several different methods to determine these values for the risk assessment. Two important ones are NOAEL, or the **no observable adverse effect level** and **maximum contaminant level** or MCL. NOAEL is the level below which no effects are seen (based on animal testing in a laboratory and in some cases, human epidemiological studies). If contaminants are found below these levels, they are not considered to present a significant risk. MCL refers to the highest level of any given contaminant that either U.S. EPA or the state agency considers acceptable in the water, soil, or air. It is not referred to a safe level, but rather as the highest level that can be allowed for which the risk of harm is acceptable under the regulatory structure.

Part of the problem with these methods is dependence on the assumption that all chemicals strictly follow what is called the traditional dose-response effect. This is a fundamental precept of toxicology, based on the belief that the higher the dose, the greater the effect. In reality however, very little is known about how numerous chemicals – both carcinogens and noncarcinogens (cancer-causing and non-cancer-causing) – actually act in the human body, other than at extremely high doses. The assumption that lower doses over a long period of time (chronic exposure) pose less of a risk than higher doses over a short period of time (acute exposure), yet this assumption is currently being challenged by research related to endocrine-disrupting chemicals. These studies suggest that very short-term, quick exposures to very low levels of certain persistent organic chemicals may be enough to disrupt the development of key systems in children and fetuses. In addition, studies now indicate that the timing of exposure is very critical. Children, pregnant and nursing mothers, chronically ill people, and the elderly are much more vulnerable to exposure than other segments of the population.

3. The ***toxicity assessment*** plugs in the measure of how toxic the chemicals are to the affected community. This takes into account concentration of the contaminant, how toxic the particular contaminant is, and any uncertainties that may exist. For example, it is well known that steel mill workers who labor in the coke ovens where coal is turned into fuel are exposed to high levels of benzene. This puts them at a higher risk than the general population for certain cancers. However, if these workers also smoke, those cancer risks are increased ten times. This is called synergism. This opens the door to many questions: Is there an even greater risk from being exposed to benzene and other volatile organic chemicals (VOCs) at the same time? Is there an increased risk from being exposed to heavy metals such as lead or nickel while also being exposed to VOCs? What happens if a person is exposed to multiple chemicals and is taking medications? Very little is known about these synergistic effects, yet it is the risk assessor's job to make assumptions to cover these gaps, or uncertainties, so that a quantitative risk number (the level of acceptable risk) can be arrived at.

4. After all the information has been gathered and analyzed, calculations are done to determine the ***risk characterization***. The purpose is to look at all the different factors which influence the risk: the risk of the chemicals themselves, the amounts of the chemicals at the site, the pathways and routes of exposures, the way the chemicals behave in the environment, the characteristics of the populations and environments at risk, and the assumed future uses of the area being evaluated. The risk characterization is a key step, because the decisions made at this step drive all cleanup decisions that follow.

Implications of the risk assessor's assumptions are significant. If there are highly toxic chemicals at a site, yet the risk assessor determines there are no significant pathways by which human or animal populations will be exposed, the level of cleanup will be very different than if it had been determined the toxins were more readily available. These decisions are greatly influenced by the assessors level of knowledge and understanding of the history and geography of the site and its surrounding environs; site activities and chemical usage, wildlife migration routes, and areas used for traditional hunting all form a complex web that, if not well understood, will result in the perpetuation of environmental injustices. Local knowledge from Tribes must be included on equal par with government agencies. In Alaska there are many risk assessment aspects to consider that are different from other regions in the country. For example, a large percentage of Alaska Native peoples rely on marine mammals, wildlife, fish, and birds for subsistence food sources. These animals travel vast distances and may be taken from areas not directly adjacent to a Superfund site. In addition, many of the pollutants from Alaska's military Superfund sites include those that are environmentally persistent and bioaccumulate in the far north, the very region where there is more reliance on subsistence activities.

5. The final step in risk assessment is the acknowledgement of uncertainties in the process: the ***analysis of uncertainties***. At all five Superfund sites, these uncertainties are listed. Using the Fort Wainwright Operable Unit-1 Ecological Risk Assessment as an example, the EPA lists no less than ten significant uncertainties which may have overestimated or underestimated the risk. These include:

- No pesticide data were available for down gradient Chena River sediment sampling locations;
- No organic [i.e., plants, biota, etc.] data were collected for surface water samples;
- Speculative assumptions were made to generate tentative toxicity reference values for inhalation by burrowers. It is unknown whether these assumptions underestimated or overestimated exposures; and
- Although no significant risks were indicated with the measured surface water concentrations in the Chena

River, the collection of only one surface water sample [emphasis added] allows for only limited analysis of potential impacts due to potential transport of chemicals of potential ecological concern from the source area.

Considering that potential transport of chemicals from the source area is a key environmental justice concern, and a crucially important aspect of determining whether there are downstream impacts from a Superfund site, the implications of the uncertainties involved in the risk assessment process cannot be underestimated. The most important criticism of the quantitative risk assessment method is its inadequacy for assessing risk for all affected populations. This is particularly true in terms of risks to children and other more vulnerable populations. Most risk assessments are based on risks to an average adult male who weighs 70 kilos. According to a 1999 article in the National Institute of Environmental Health Services monthly publication, *Environmental Health Perspectives*, however:

> Three to 4 million children and adolescents in the United States live within 1 mile of a federally designated Superfund hazardous waste disposal site and are at risk of exposure to chemical toxicants released from these sites into air, groundwater, surface water, and surrounding communities. Because of their patterns of exposure and their biological vulnerability, children are uniquely susceptible to health injury resulting from exposures to chemical toxicants in the environment.[27]

The current method of addressing the risk to children is to increase the level of acceptable risk by one magnitude in the risk characterization process, but as Landrigan points out:

> Children form a unique subgroup within the population who require special consideration in risk assessment. Children are not little adults. Their tissues and organs grow rapidly, developing and differentiating. These development processes create windows of great vulnerability to environmental toxicants. Furthermore, the exposure patterns of children to environmental chemicals are very different from those of adults.[28]

The combination of uncertainties inherent in quantitative risk assessment are compounded at the Alaska's military Superfund sites by the fact that there may be a significant population who rely for subsistence on fish and wildlife which may have been contaminated by the sites. Not only are these populations likely to eat a greater range of animals than recreational hunters, but also consume far higher levels. Finally, unlike the population of sport and recreational hunters and fishers, subsistence users include significant numbers of children and adolescents. Current risk assessment methods do not adequately address any of these factors, yet are fundamental in order to render environmental justice and to ensure protection of human health, as is mandated under CERCLA.

Important to note are some of the unique qualities of Alaska's population. First, a high percentage of all Alaskans supplement their diet with food they have hunted, fished or gathered. Second, many rural and non-rural Alaska Natives still rely on traditional foods for a large part of their diet. These communities are often using the same land and water for hunting, fishing and gathering that the military has used for strategic defense sites. Assessments used by the EPA, which use foods consumed elsewhere in the United States for their evaluation, give an inaccurate picture of the risks faced by Alaskans in general and Alaska Native peoples in particular.

Many risk assessment assumptions, therefore, are made based on average circumstances which may or may not reflect the reality at the site itself. Often, decision-makers lack the scientific data to assure confidence of no harm. Especially if Tribes have not been included as an equal partner in the process, assessors run the danger of lack of critical information, such as the location and use of traditional grounds. Risk assessments also do not account for the cumulative threat of long-range transport of contamination in addition to local sources. People in the north are more likely to be more exposed to contaminants such as POPs, which accumulate in northern environments, wildlife and people. Studies of populations such as the Inuit, who rely on marine animals as part of their subsistence diet, demonstrate that their blood PCB levels are high, and Inuit women have some of the highest levels of PCBs in their breast milk of any population in the world.

Many scientists, environmental health and justice activists, and public health officials believe that the methodology that should be used instead of quantitative risk assessment is the precautionary principle, which includes providing a range of alternatives to risk. The precautionary principle dictates an emphasis on prevention of harm, rather than on limitation of effects, which is the underlying construct of quantitative risk assessment.

This discussion of some of the ideas and principles of risk assessment methodologies used by EPA has been included in an effort to give affected communities a basis on which to judge whether proposed and on-going cleanup activities at sites are acceptable to them. When evaluating various cleanup remedies, the questions to keep in mind are how protective is it? How permanent is it? And is the amount of money being spent on it going to be worth the degree of confidence that risk has been reduced when it is finished?

Cleaning up the site removal and remediation

Superfund cleanup mandates do not return the contaminated site to zero. In the United States, the environmental regulatory framework does not eliminate chemical contamination, but only attempts to control and manage it. In many instances contaminants may be found at a site and cleanup does not actually occur. The CERCLA approach looks at each chemical separately and independently of the others, and incorporates no mechanism for their aggregate effects. Each risk assessment is conducted as if it were being done on a blank slate where no other exposures occur. In the real world multiple exposures often occur. All risk assessments using this method are fraught with uncertainties that underestimate actual exposures, and the risks associated with them.

Superfund legislation also limits the parameters of the cleanup to include only chemicals which meet EPA's definition of "hazardous." A partial list of chemicals exempted from Superfund are: fly ash and bottom ash from burning fossil fuel, cement kiln dust, radioactive waste, waste oil and waste burned as fuel, and recycled waste. In order to understand the remediation decisions made under Superfund, it is important to remember that if a substance is not officially considered hazardous it does not factor into the risk assessment.

Criteria and types of remedial action

The National Contingency Plan mandates that nine criteria be used to evaluate all remediation alternatives considered for any hazardous waste site. The first two are considered threshold criteria, which means they must be met by all cleanup alternatives:

- Overall protection of human health and the environment
- Compliance with applicable or relevant and appropriate requirements (known as ARARs); that is, compliance with all relevant state and federal regulations. The source(s) of releases in all media must be adequately controlled so as to reduce or eliminate, to the extent practicable, further releases of hazardous wastes (including hazardous constituents) that could threaten human health or the environment.

The next five criteria are called balancing criteria, which means they are used to compare different alternatives:

- Long-term effectiveness; that is, maintenance of reliable protection of human health and the environment effectively and permanently once cleanup goals are met
- Reduction of toxicity, mobility, or volume of wastes and contaminants through treatment
- Short-term effectiveness, that is, how long does it take and how protective is it while cleanup activities are being carried out
- Implementability, that is, that the alternative is technically and administratively feasible with the availability of the materials and services needed to effect the solution
- Cost

The last two criteria are called modifying criteria, which means that they are considered on the basis of the public comment:

- Acceptable to the state
- Acceptable to the affected community or communities.

Alternatives for Cleanup

For each source area at a Superfund site, several cleanup alternatives are proposed, ranging from no action to the use of a variety of engineering and remediation (cleanup) technologies, often in combinations. The determination of what is called the **preferred alternative** is based on how well the alternatives meet the above criteria.

The EPA describes the **no action alternative** as a baseline that reflects current conditions without any cleanup effort. This alternative is used for comparison to each of the other alternatives and does not include any type of monitoring or institutional controls. Other proposed alternatives may include **institutional controls, natural**

attenuation, and a variety of other active technologies that address the specific type of contamination; these are often referred to as "engineering measures." The different types of cleanup remedies are described below.

Institutional controls are non-engineering measures intended to prevent exposure to hazardous waste or hazardous constituents by limiting the use of land (including soil, groundwater, surface water or sediments) to specified activities. Institutional controls often mean fencing or posting "no trespassing" signs. According to law however, institutional controls are not a substitute for active or permanent corrective measures that are available and practical. Further, institutional controls are not intended to be the sole remedial action, even though they have been used as such at many military Superfund sites in Alaska.

Natural attenuation is a combination of the no action alternative with soils, air or water monitoring for the presence and concentration of the chemical for a specified length of time. It relies on the natural breakdown of contaminants *in situ* (that is, in their natural or original place) without additional treatment. The way natural attenuation (or reduction) occurs over time is dilution (less concentrated), biological and chemical processes, and volatilization (evaporation). It may be an extremely slow process, which can take 100 years to reach health-based cleanup levels. This includes air, water or soil sampling to determine whether or not the contaminant plume is expanding, and contaminant levels increasing over time.

A backup contingency treatment plan, such as **soil vapor extraction**, is frequently part of the natural attenuation alternative, should it prove ineffective based on monitoring. The length of the monitoring commitment is therefore critical to assure that contaminant levels are decreasing, and that they are not migrating. Natural attenuation is most acceptable in situations where the contaminants of concern have a relatively short half-life, meaning that they tend to break down in the environment in a relatively short time, and more importantly, where they are not readily available for transport through a pathway of exposure that would bring them into contact with the environment, including human and animal populations.

Active and complete cleanup measures are always preferable to leaving contamination in place. Instead, with natural attenuation, the EPA leaves the contaminants in place and relies on time and dilution for cleanup. Two additional drawbacks are it allows cleanup to proceed at a slow pace over a very long time, and relies on institutional controls under conditions for which those controls may be inadequate, such as institutional controls in a floodplain, as is the case as Ft. Wainwright. (See the report *Fort Wainwright Army Base Fact Sheet*, Operable Unit 3) What happens after 20 years if contaminants are still present in the groundwater and soil? Who will be responsible for monitoring and remediation at that point? What will happen if the military is no longer in charge of this site in ten, twenty, or one hundred years? Better alternatives, though more costly, need to found to eliminate this contamination permanently, rather than to expend resources on monitoring it for the next century.

Engineering measures and remediation technologies are site-specific alternatives are used in situations where permanent remediation is necessary to protect human health and the environment, and the chemicals must be removed from the source area or treated on-site with the goal of permanent elimination. Technologies include the following:

Excavation This is the removal of soils, buried materials, barrels, tanks, or all of the above. Where an *initial* removal action usually removes only the top layers of the soil and the visible or shallowly buried barrels, *excavation* typically removes soils as far down as possible. At Fort Wainwright, for example, one alternative for Operable Unit 1 is to excavate soil and barrels down to as much as 15 feet below the surface. Options for disposing of the soil include on-site or off-site treatment or disposal in a regulated landfill.

Alternative remediation methods include using hydrogen peroxide to break down contaminants to harmless elements. An added benefit is soils need not be disrupted to the degree they are when excavated.

Soil vapor extraction and air sparging Often referred to as **SVE**, this process physically separates contaminants from soil, the only medium (the surrounding environment; air, water or soil) in which it works. The chemicals are separated, or extracted, from the soil in the form of a gas. The vapor (gas) is then treated using a variety of methods including carbon adsorption (where the gases adhere to the carbon), incineration, or condensation. This is a very frequently used technology because it is cost-effective and relatively simple to implement. It has an additional benefit of stimulating natural bioremediation when oxygen is introduced. A companion process, called air sparging, is used when the contaminants are in a water-saturated medium, such as tundra. A potential drawback of this process is if inadequate incineration or filtering were used, it would then just transfer the contaminants from the original medium to the atmosphere. In general, however, this technology seems adequate for treatment of VOCs, although it does not seem to capable of completely eliminating all contaminants, which are then left to be addressed through natural attenuation and dilution.

Bioventing This process introduces oxygen to the subsurface soil environment. The presence of oxygen stimulates natural microbes (small organisms) in the soil that carry out biological degradation of petroleum contaminants in the soil. Sometimes bioventing is also effective in breaking down thin layers of floating petroleum products. Bioventing is used to prevent further leaching of contaminants from soil into groundwater.

No further action At several of the Alaska military Superfund sites, several source areas were eliminated from the evaluation process and designated as no further action sites. In general, this designation was based on one of three situations. In the first, a source area had already undergone a previous remediation process, either before the Superfund process began, or as part of an initial removal action in the early stages of the Superfund evaluation. If no further contamination was discovered at the site, it was decided that the earlier actions had been sufficient remediation. The second situation is one that occurred at several source areas at all the Alaska Superfund sites covered by this report. Source areas initially identified on the basis of anecdotal evidence, old documents or photographs were included in the list of source areas in order to undergo a CERCLA preliminary evaluation to determine whether any contamination actually existed, and if so, to what extent. In many instances the result was that no evidence of current or past contamination could be found, either because of earlier cleanup actions years earlier, or because the initial information was apparently incorrect. The third situation is one in which levels of contamination at the source site were found to be no higher than background levels of adjacent areas, as took place, for example, at the Open Burning/Open Detonation pit on Fort Richardson.

It is important that communities carefully review remediation options and not necessarily accept the choices provided by DoD or the EPA. Many effective cleanup technologies are being developed that may offer more complete, less harmful ways to address contamination problems. A website that provides information on alternative technologies is www.cpeo.org.

Environmental Justice and Military Superfund Sites in Alaska

Historically, reports show that low-income and minority communities in the United States bear a disproportionate burden of pollution in our society. Hazardous and other waste facilities, mining and other forms of resource extraction, nuclear plants and testing, and military activities are much more likely to occur in these communities. In Alaska, this is particularly true of military actions; the majority of their 700 or so installations and contaminated sites are in or adjacent areas where traditional subsistence activities take place.

For years minority communities have worked to bring the concept of environmental justice into public dialogue. Over the last 10 years, the federal government finally recognized the impacts of environmental injustice and put forward policies seeking to remedy the problem.

In 1994, President Clinton issued an Executive Order emphasizing that all communities and persons across this nation should live in a safe and healthful environment. He declared that remedying this environmental justice problem was a national priority and directed federal agencies to make environmental justice an integral part of their missions. As mandated by the "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," all U.S. agencies whose activities have environmental impacts were required to develop environmental justice implementation strategies specific to their activities. This included the Department of Defense (DoD), whose installations and activities, as noted throughout this report, have had a significant impact on Alaska's environment and its peoples. In 1998, President Clinton issued an additional Memorandum[29] that specifically ordered consultation with Indian/Native Tribal governments in the development of regulatory practices on Federal matters that significantly or uniquely affect their communities.

It has to be recognized that much of the work done at the various sites was completed before these Executive Orders. Still, much of the cleanup operations at Alaska's military Superfund sites have occurred after these Executive Orders and to the DoD's environmental justice policies in 1995. How, then, has DoD's approach to Tribes changed once these policies were instituted? A short review of Alaska reveals two key factors fundamental to the disposition of land rights and ownership in Alaska. First is the deeply held and long-institutionalized belief in a system of private property and the supremacy of the individual landowner in determining land use. Historically unrecognized is that the current land-ownership belief system is entirely culturally based, and is vastly divergent from that held by Native peoples in Alaska. The historical record of appropriation of Indian/Native lands in Alaska by the U.S. military is an integral aspect of the history of the U.S. military's presence in Alaska, which has a significant impact on the implementation of environmental justice initiatives.

Ownership and land use exclusively to the benefit of a single entity, such as a corporation or the military, was not introduced into Alaska and did not begin to achieve dominance until Russian occupation of Alaska in the late 1700s. Prior to that, lands were held in common, as a shared resource, very much the same as other indigenous peoples in North America before the arrival of Europeans to the continent. Even we may not agree with much of the Alaska Native Settlement Claims Act of 1971, nonetheless this pattern of lands held in common is retained in its modern form with the boundaries of Alaska Native corporations.

Although some efforts were made by Alaska Natives to win back their lands in the early 1900s, with the passage of the Native Allotment Act of 1906, the U.S. did not acknowledge Native sovereignty over their lands in any form until 1971 with the passage of ANSCA. By this time, however, the U.S. government had unilaterally taken over millions of acres of land for military installations established throughout the state.Second is the practice of EPA and its CERCLA program to define as narrowly as possibly the population(s) that has been affected by the contaminated site(s). This practice severely limits the extent of investigation and assessment undertaken, which then affects the scope of remediation activities. Because EPA considers the population who may be affected as those who are immediately neighboring the Superfund site, downstream communities are frequently excluded from consideration.

Consistent with this historical practice, of Alaska's five military Superfund sites, only one (Adak) looked beyond its boundaries. The other four military (Eielson, Elmendorf, Ft. Richardson, and Ft. Wainwright) narrowly defined the primary population of concern as the military and civilian populations living or working in the main base area in closest proximity to where the operable units are located. In the event that the contaminated sites are considered remote from those population centers, the affected populations have been considered workers at the site or potential future residential or occupational inhabitants. In only one instance were off-base impacts considered, in a situation in which churches close to installation boundaries used well water from the Chena River. In not a single instance, however, was the potential for downstream impacts from on-base contamination acknowledged or discussed, nor was there any acknowledgement or discussion of Alaska Native interests or potential impacts on Alaska Natives, their lands, or their hunting and fishing grounds downstream of the contamination sources but outside of base boundaries.

If the military had previously investigated whether there were Native allotments or other Alaska Native lands upon which there may have been impacts from the contamination, no documentation of such was available. It is important to acknowledge this narrow interpretation of the Superfund mandate is not limited to military applications. Still, it is crucial to recognize that by imposing the narrowest interpretation of population and environmental impacts on the Superfund process, an inherent and irreconcilable barrier to meaningful implementation of environmental justice has been created.

Environmental justice goes unacknowledged in all the Superfund records available for this analysis. For all intents and purposes, the issue of Alaska Natives as a population that may be uniquely affected is entirely absent, which is a direct violation of the Executive Order and DoD's own policy mandates, which are listed below.*Department of Defense Strategy on Environmental Justice*:

- Affected communities will be partners in the process to address these concerns; together we will build a foundation that reflects an awareness and understanding of environmental justice issues. . .
- DOD will improve existing outreach and communication systems to include environmental justice stakeholders. . .
- DOD installations will . . . increase the use of . . . non-traditional news organizations that may be primary sources of information for minority and low-income populations . . .
- Identify the patterns of consumption for, and communicate the health risks to, populations who principally rely on fish and/or wildlife for subsistence at DOD U.S. installations . . .
- Encourage stakeholder participation in the implementation of the Executive order. Improve existing outreach and communication systems to include Environmental Justice stakeholders.[30]

From *Department of Defense American Indian and Alaska Native Policy*:

> These principles are based on tribal input, federal policy, treaties and federal statues. The DOD policy supports tribal self-governance and government-to-government relations between the federal government and tribes.[31]

Two articles of the *American Indian and Alaska Native Policy* are particularly relevant to this discussion. The first is Article III, which recognizes a "unique and distinctive political relationship" between the U.S. and tribes that requires the DoD to "provide affected tribes an opportunity to participate in the decision-making process" in any situations in which tribal lands are affected. This consultation is to occur on a government-to-government basis, occur with timely notice, in good faith, with the objective of developing and maintaining effective communications, coordination and cooperation with tribes. In Article IV, entitled "Natural and Cultural Resources Protection", the first point states that the DoD will undertake actions and manage DoD lands "consistent with the conservation of protected tribal resources and in recognition of Indian treaty rights to fish, hunt, and gather resources at *on and off-reservation locations*."[32] [emphasis added]

Unfortunately, based on a review of its own public documents, there is little indication the military recognizes that any of its operations which resulted in CERCLA remediation had or have a potentially on-going environmental impact on Alaska Native lands or subsistence fishing, hunting or gathering resource areas. Nor is there indication that it has been necessary to include tribal governments in negotiations related to the disposition of these sites since at least 1994.

Further complicating the assurance of environmental justice can be lack of revealing relevant information. For example, beluga whales, which have been hunted by local tribes for centuries, were in serious decline in the 1990s. The National Marine Fisheries Service (NMFS) has monitored beluga counts and conducted studies in order to determine the cause of decline. Throughout, the Army never revealed sightings by their biologists in Eagle River Flats. This information came to light only through discovery after Alaska Community Action on Toxics brought suit against the Army for their failure to adequately address white phosphorus contamination at the CERCLA site. This is significant in a number of ways; first, contamination at Eagle River Flats may have contributed to beluga decline, yet without this information NMFS would not know to test the whales for toxics present at the site. Second, without fulfilling their obligation to include Alaska Native peoples on a level on par with other involved agencies, remedial action decisions at Eagle River Flats may be inadequate. Third, had local Tribes been involved since the beginning, they would likely have had the historical knowledge about beluga feeding patterns, which could have made a significant contribution to risk assessment and remedial action decisions.

This illustrates what may be considered the most egregious and offensive violation of the environmental justice policies by the military at these Alaskan sites – the consistent failure to include tribal governments as equals in multilateral agreements regarding cleanup decisions. Although the policies are very explicit that in all multi-party governmental negotiations, tribal governments must be included on an equal basis, there was not a single instance in which this occurred. The multi-party agreements at the sites are agreements between the state of Alaska and the federal government, or the state and the military and the federal government.

Defining the scope of cleanup within specific military base boundaries further compounds the invisibility of tribal interests. This is one of the issues brought forward in "Inventory of Environmental Impacts to Indian Lands Resulting from Former Military Activities in Interior Alaska", a 1997 report by the Tanana Chiefs Conference. The report clearly documents the lack of communication and inclusion by the military in remedial action decisions. The mandate that tribal governments be included in the decision-making process from the beginning has yet to be part of the equation In Alaska; the entire CERCLA (Superfund) process is assumed to be completely independent of Alaska Native interests or empowerment.

At the time of this writing, EPA Region 10 is conducting an inventory of Formerly Used Defense Sites (FUDS) in Alaska, which they expect to be complete by the end of 2003. Each site will then have a CERCLA review conducted. Many of these sites are heavily contaminated and affecting nearby communities, such as the Northeast Cape site on St. Lawrence Island, or the FUDS in Galena. It would be extremely interesting to see what the response would be to tribal government efforts to become equal partners in future cleanup processes, and to gain standing in the current reevaluation processes occurring every five years. Undoubtedly, there will be ample opportunity.

This review reveals there have been serious deficiencies throughout the CERCLA process in implementing environmental justice policy at four of Alaska's five military Superfund sites. Even in the Final Community Relations Report for the Environmental Restoration Program at Elmendorf Air Force Base, released in 2000, there is no section or discussion devoted to environmental justice. While it may be true, as one representative from Eielson Air Force told the authors by phone, no Native lands were, in fact, affected by military contamination at any of the sites reviewed by ACAT. However, the repeated failure of the military to explicitly discuss environmental justice concerns within the context of its larger analysis of contamination and remediation at any of these sites, violates both the spirit and word of the environmental justice executive order, subsequent policy directives, and the DoD's own policies. More importantly, it is an indication that this failure is not the result of the actions of a particular individual at the community relations or technical implementation level; to the contrary, it represents an institutional failure to address the issue in any meaningful way, and originates at the highest levels of command. Finally, it is important to reiterate that an executive order is, unfortunately, not a regulatory document and is therefore not illegal to ignore. Thus, until policies are enacted into law, there is little reason to believe the institutions will change. What can cause this shift, though, is continued pressure from affected communities and tribes, grassroots organizing efforts, and independent scientific review by advocacy groups.

If community members or tribes have an issue or complaint about environmental justice being served, and neither DoD nor EPA is responding, Region 10 has an Ombudsman office that may be able to assist. Either call EPA toll free at 800.424.4372 and leave a message for the ombudsperson, or call directly at 208.378.5761.

Glossary of Terms:

ATSDR: Agency for Toxic Substances and Disease Registry; a division of the Centers for Disease Control and the agency in charge of human health issues at Superfund sites; www.atsdr.cdc.gov

CERCLA: Comprehensive Environmental Response, Compensation and Liability Act of 1980; official name for Superfund; www.epa.gov/superfund/whatissf/cercla.htm

CERCLIS: Comprehensive Environmental Response, Compensation and Liability Information System; lists abandoned hazardous waste sites the EPA considers for clean up; www.epa.gov/enviro/html/cerclis

EPA: Environmental Protection Agency; www.epa.gov

HRS: Hazard Ranking System; a scoring system that determines whether or not a CERLIS site makes it to the NPL; the current scoring is 28.5 out of a possible 100

NPL: National Priority List; the most contaminated sites in the country, these are the only ones that qualify for remedial action

Removal Action: more common type of Superfund action; immediate, short-term responses, often to an emergency spill or potential contamination to groundwater

Remedial Action: type of clean up reserved for the most heavily contaminated sites in which long term actions take place, can also refer to the phase in which actual clean up takes place

Remedial Action Terms:

PA/SI: Preliminary Assessment and Site Inspection; the first two phases in which EPA determines whether or not the site will be listed on the National Priorities List

RI/FS: Remedial Investigation and Feasibility Study; if EPA decides to clean up the site, this is the phase in which the agency determines how

ROD: Record of Decision; document that officially announces how the site will be cleaned up; public is given a specified time in which to make comments; follows the feasibility study

RD/RA: Remedial Design and Remedial Action; the actual clean up – design, construction and clean up

RCRA: Resource Conservation and Recovery Act of 1976; agency that tracks hazardous waste from its creation to its disposal

TAG: Technical Assistance Grant; monies a community may request in order to hire an expert to assist interpreting the technical aspects of clean up

Footnotes:

[1] *RAB Resource Book, Forming a RAB*, www.dtic.mil/envirodod/Policies/RAB/forming_rab.htm

[2] Executive Order 12898, Federal Actions To Address Environmental Justice In Minority Populations And Low-Income Populations, president William J. Clinton, 1994, www.fs.fed.us/land/envjust.html

[3] "Department of Defense American Indian and Alaska Native Policy," October 20, 1998, William S. Cohen, Secretary of Defense, www.bauuinstitute.com/Articles/DOD1998.html

[4] *Defend Our Health: The U.S. Military's Assault on Communities, A People's Report to Congress,* a joint report by the Military Toxics Project and Environmental Health Coalition, May 2001

[5] Ibid

[6] The Precautionary Principle has appeared in various forms since the Wingspread Statement on the Precautionary Principle; full text at www.sehn.org. As agreed upon in the Declaration on Environment and Development (United Nations Environmental Summit, Rio de Janero, 1992), the precautionary principle states that where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.

[7] Ibid

[8] http://www.eces.org/earth_crash/showarticle.php?id=291#sources

[9] Lapham, W and Tadayon, S, "Plan for Assessment of the Occurrence, Status, and Distribution of Volatile Organic Compounds in Aquifers of the United States," 1996, United States Geological Survey, National Water-Quality Assessment Program, http://wwwsd.cr.usgs.gov/nawqa/pubs/ofr/ofr96.199/body.html

[10] Benzene Fact Sheet, ToxFAQs: www.atsdr.cdc.gov/toxfaq.html

[11] ToxFAQs: www.atsdr.cdc.gov/toxfaq.html

[12] Benzene Fact Sheet

[13] Ibid

[14] ToxFAQs: www.atsdr.cdc.gov/toxfaq.html

[15] Ibid

[16] www.epa.gov/reg3hwmd/bfs/regional/analytical/semi-volitile.htm

[17] Nitrobenzene Fact Sheet, ToxFAQs: www.atsdr.cdc.gov/toxfaq.html

[18] Polycyclic Aromatic Hydrocarbon Fact Sheet, ToxFAQs: www.atsdr.cdc.gov/toxfaq.html

[19] Ibid

[20] Ibid

[21] Weisglas-Kuperus, N, S Patandin, GAM Berbers, TCJ Sas, PGH Mulder, PJJ Sauer and H Hooijkaas. 2000. *Immunologic Effects of Background Exposure to Polychlorinated Biphenyls and Dioxins in Dutch Preschool Children*

[22] "The Inventory of Sources of Dioxin in the United States," U.S. EPA, 1998, Office of Research and Development, EPA/600/P-98/002Aa, External Review Draft, April

[23] ToxFAQs: www.atsdr.cdc.gov/toxfaq.html

[24] Ibid

[25] O'Brien, M, MIT Press, Cambridge, Massachusetts, 2002, *Making Better Environmental Decisions: An Alternative to Risk Assessment*

[26] Weisglas-Kuperus, et al

[27] Landrigan PJ; Suk WA; Amler RW. Chemical wastes, children's health, and the Superfund Basic Research Program. Environ Health Perspect 1999 Jun;107(6):423-7.

[28] Landrigan PJ. Risk assessment for children and other sensitive populations. Ann N Y Acad Sci 1999;895:1-9

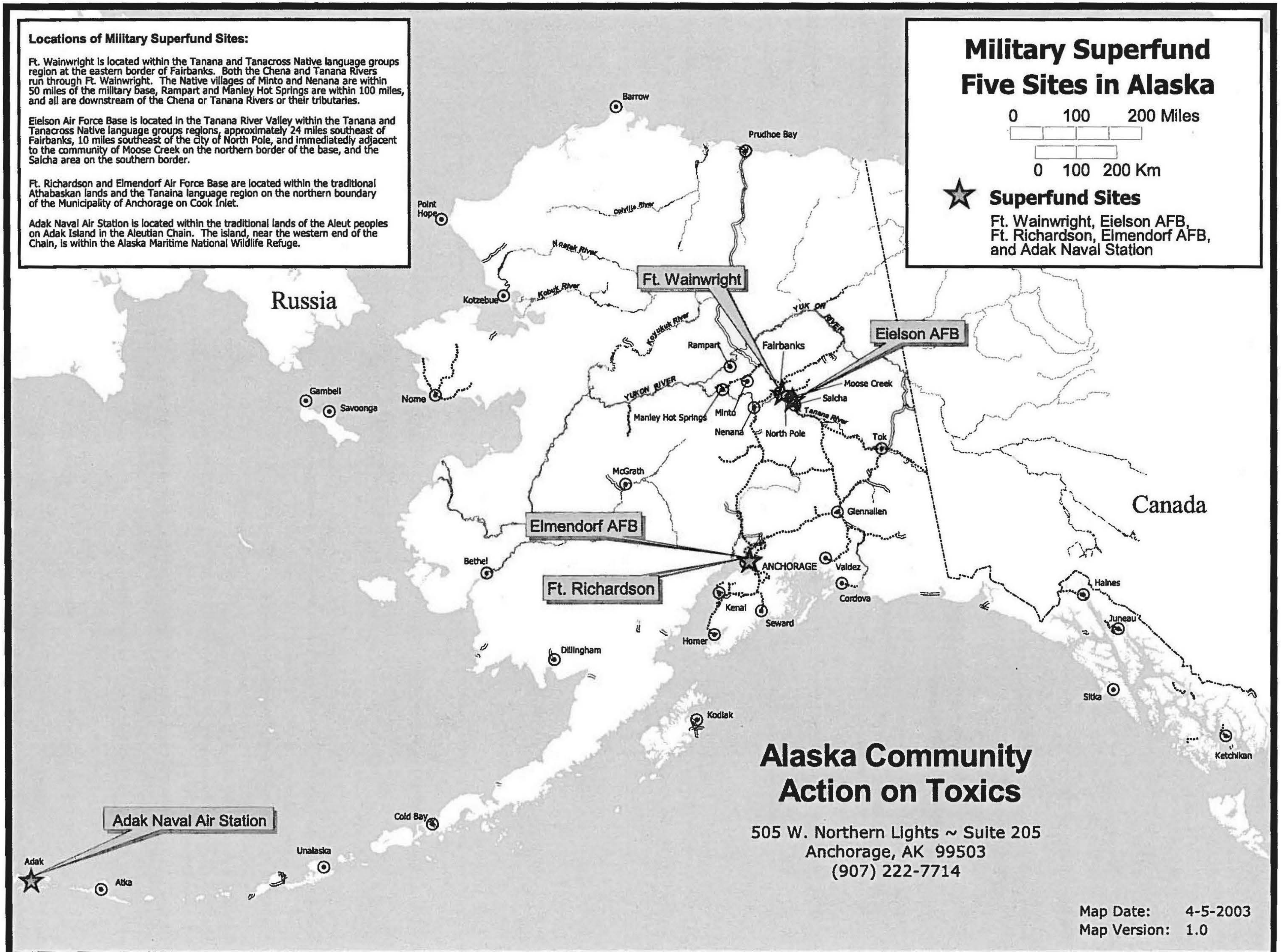
[29] Government-to-Government Relations With Native American Tribal Governments, April 29, 1994, President William J. Clinton

[30] Department of Defense "Strategy on Environmental Justice," March 24, 1995, web.dandp.com/enviroweb/asn/ejletter.htm

[31] "Department of Defense American Indian and Alaska Native Policy"

[32] Ibid

Prepared by Karen Button for Alaska Community Action on Toxics, 505 West Northern Lights Blvd, #205, Anchorage, AK 99503, (907) 222-7714, www.akaction.net. Based on a previous report by Dr. Lin Kaatz Chary, Lydia Darby, Dr. Lorraine Eckstein, Sharon Rudolph, Susan C. Klein, Pamela K. Miller, Elizabeth Movius, Felicien Poncelet, Dr. Ron Scrudato, and Sir Darby Muldoon. Funded by the Environmental Protection Agency, through an environmental justice grant. March 2003.


Locations of Military Superfund Sites:
Ft. Wainwright is located within the Tanana and Tanacross Native language groups region at the eastern border of Fairbanks. Both the Chena and Tanana Rivers run through Ft. Wainwright. The Native villages of Minto and Nenana are within 50 miles of the military base, Rampart and Manley Hot Springs are within 100 miles, and all are downstream of the Chena or Tanana Rivers or their tributaries.
Eielson Air Force Base is located in the Tanana River Valley within the Tanana and Tanacross Native language groups regions, approximately 24 miles southeast of Fairbanks, 10 miles southeast of the city of North Pole, and immediatedly adjacent to the community of Moose Creek on the northern border of the base, and the Salcha area on the southern border.
Ft. Richardson and Elmendorf Air Force Base are located within the traditional Athabaskan lands and the Tanaina language region on the northern boundary of the Municipality of Anchorage on Cook Inlet.
Adak Naval Air Station is located within the traditional lands of the Aleut peoples on Adak Island in the Aleutian Chain. The island, near the western end of the Chain, is within the Alaska Maritime National Wildlife Refuge.
Military Superfund
Five Sites in Alaska
0 100 200 Miles
0 100 200 Km
Superfund Sites
Ft. Wainwright, Eielson AFB, Ft. Richardson, Elmendorf AFB, and Adak Naval Station
Russia
Canada
Barrow
Prudhoe Bay
Point Hope
Colville River
Noatak River
Kobuk River
Kotzebue
Koyukuk River
YUKON RIVER
Ft. Wainwright
Eielson AFB
Rampart
Fairbanks
Moose Creek
Salcha
Tanana River
Gambell
Savoonga
Nome
Manley Hot Springs
Minto
Nenana
North Pole
Tok
McGrath
Glennallen
Elmendorf AFB
Bethel
ANCHORAGE
Valdez
Cordova
Ft. Richardson
Kenai
Seward
Homer
Haines
Juneau
Dillingham
Sitka
Kodiak
Ketchikan
Alaska Community
Action on Toxics
505 W. Northern Lights ~ Suite 205
Anchorage, AK 99503
(907) 222-7714
Adak Naval Air Station
Cold Bay
Unalaska
Adak
Atka
Map Date: 4-5-2003
Map Version: 1.0

Adak Naval Air Station

Environmental Justice at Alaska Military Superfund Sites
Fact Sheet

Location:

Adak Naval Air Station is located within the traditional lands of Aleut peoples on Adak Island in the Aleutian Chain. The island, near the western end of the Chain, is within the Alaska Maritime National Wildlife Refuge.

Primary Contaminants:

- **Petroleum, Oils and Lubricants** (POLs): benzene, toluene, ethylbenzene, xylene (these four are also referred to BTEX, as a group), diesel fuels, gasoline
- **Volatile Organic Chemicals**: (VOCs): trichloroethane, (TCE), tetrachloroethene, benzene, vinyl chloride, carbon tetrachloride, ethylbenzene
- **Semi-Volatile Organic Chemicals:** (SVOCs): fluoranthene, pyrene
- **Persistent Organic Pollutants** (POPs): pesticides (including dieldrin, DDT and DDD), PCBs
- **Heavy Metals**: lead
- **Others:** chlorinated solvents (trans-1,2,-dichloroethylene, and chloromethane)
- **Munitions:** unexploded ordnance (UXO), chemical warfare agents (mustard gas, lewisite)

Note: The categories used here are those used by the Environmental Protection Agency for Superfund sites. Other methods of categorizing do exist. Chemicals listed as "Others" were those not found on the EPA's list. See www.epa.gov/reg3hwmd/bfs/regional/analytical. Chemicals listed as "Munitions" are discussed in more detail under the section Contamination Background.

History:

The Aleutian Islands, including Adak are traditional lands of the Unangan ("the original people") or Aleut (a name introduced by Russians at early contact). Russians first visited the Aleutian Islands in the early 1740s and were trading with the Aleuts by the 1750s. As recently as 1827, Adak was a busy trading settlement with a population of 193 Aleuts. By 1830, Russian settlers had occupied Adak and relocated the Aleuts to Russian settlements in Kodiak, the Pribilof Islands, and Sitka.[1] Adak Island was designated part of the Aleutian Islands National Wildlife Refuge by Executive Order in 1913. Withdrawn lands were later included in the Alaska Maritime National Wildlife Refuge by the Alaska National Interest Lands Conservation Act on December 2, 1980.

The island was used seasonally for hunting and fishing, but uninhabited in the early 1940s when Adak became a key operations and supply location for United States military forces after the Japanese occupation of Kiska and Attu Islands during World War II. The World War II (WWII) military forces at Adak (both on island and in support ships) numbered approximately 100,000 troops.[2] During this time the military housed chemical warfare agents and nuclear submarines amongst their arsenal at Adak.[3] In 1959 77,000 acres on the northern half of the Island was transferred to the Navy. By the early 1990s, the military facility at Adak Island included approximately 6,000 military personnel, civilian federal employees, and civilian support contractors.[4]

The base was officially closed in September 2000. At this time Navy operations consist solely for long-term maintenance of Superfund cleanups and final clearance of ordnance items. The U.S. intends to transfer the former Base from the U.S. Navy to U.S. Fish and Wildlife Service (FWS) who will then exchange the property with The Aleut Corporation for other lands in the Aleutian Islands. The island is being actively marketed to commercial fishing fleets and other businesses by the Adak Reuse Corporation, a subsidiary of The Aleut Corporation.[5]

Navy investigation of environmental issues related to military activities began in 1986 with oversight from the **Environmental Protection Agency*** (EPA) and the State of Alaska Department of Environmental Conservation (ADEC). In October 1992, the Adak naval site was proposed for addition to the **National Priorities List** under **CERCLA** and added to the list in May 1994.

Given that Adak was a site of great strategic importance during World War II, the number and variety of activities that took place at the installation left behind a legacy of extreme contamination. Issues at the site are complex; the military will neither confirm nor deny the earlier presence of nuclear weapons, a variety of chemical weapons were "lost" and the military cannot guarantee they are not still present somewhere on the island, the sheer volume of contamination and the remoteness of the site has resulted in the military's reluctance to remove contamination, opting, instead, for institutional controls at the majority of sites. A **Technical Assistance and Public Participation** (TAPP) grant was received for the **Restoration and Advisory Board (RAB)** for the Adak Naval site. Scientist Dr. Ron Scrudato of the State University of New York, Oswego provided independent technical interpretation and comment to the highly complex investigative data from the contaminated sites. The RAB chose not to renew the TAPP grant in 2002.[6]

With the imminent land transfer from the Navy to U.S. Fish & Wildlife Service, and then to The Aleut Corporation, Alaska Community Action on Toxics is concerned about liability issues taken on by the Corporation. Landfills that still contain toxic materials were "capped" (a thick cover of soils and vegetation) and fenced rather than having the contaminants removed, are being transferred to The Aleut Corporation. Understandably, the Corporation seeks to provide an economic base for the growing community of Adak, yet concerns remain about future human and ecological health from exposure to remaining chemicals.

Geography & Geology:

Three steep, highly weathered volcanic peaks dominate Adak Island's topography. Streams have eroded deep valleys between the peaks and provide runoff to the coast. Tidal lagoons and deltas are interspersed along the coastline. Vegetation is mostly tussocks, grasses, lichen and mosses. Coastal cliffs in some areas rise to 2,500 feet; the tallest point on the island is Mt. Moffett at 3,875 feet. The island's maritime weather consists of periodic fog, high winds and frequent, often violent, storms. A wide variety of marine mammals and birds inhabit the near-shore areas.

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* Words in **bold** signify terms used in the world of Superfund. For a comprehensive discussion of Sueprfund law and how it works, please see the accompanying document, *An Overview of Key Issues at Alaska Military Superfund Sites.*

The terrain surrounding the former naval facility at Adak Island includes steep ridges, deep ravines, rolling hills, and some flatlands. The island is a federally designated wilderness area, and is part of the Alaska Maritime National Wildlife Refuge. Access to remote areas is allowed, but restrictions are in place (institutional controls) due to potential presence of unexploded ordnance.

Approximately 100 people currently reside on the island and the community is growing; residents use the area for hunting, fishing, and recreational purposes.

Contamination Background:

Over a 40-year period, hazardous substances were disposed of in areas on the island, including landfills, storage areas, drum disposal areas, spill sites, and pits for waste oil and fire-fighting training. Petroleum, chlorinated solvents, batteries, and transformer oils containing polychlorinated biphenyls (PCBs) are some of the hazardous materials present at the site. Primary releases include: PCBs (over 2,000 gallons), unexploded ordnance (70,000 items located, not including ranges and offshore disposal), petroleum (1,000,000 gallons), solvents, and pesticides. Twenty, one-ton containers (40,000 pounds) of chemical weapons agents that included lewisite and mustard gas were transferred to Adak Island by the military and "lost." The Army states that documentation on their ultimate disposition has not been found.[7] During World War II and the cold war, nuclear submarines and nuclear bombs were housed at the Adak station. However, remedial investigation for site contaminants did not include radioactive contamination, effectively making the problem go away by not looking at it. At this time, there have been no studies conducted to determine levels of potential radiation contamination.

Health concerns related to mustard gas vary depending on the type of exposure. Effects include severe damage to the eyes, cancer (skin, lung, throat), and respiratory conditions.[8] No information was available for this report on environmental effects.

Lewisite is a blister agent, highly and immediately irritating to the eyes, skin, and airways (nose and throat). Contact with liquid or vapor can cause skin blistering, damage to the eyes, damage to the airway, and pulmonary edema (an excess of fluid in the heart).[9] It is a systemic (affects the whole body) poison that can have long-term health consequences. Chronic (on-going, low level) exposure can lead to arsenic poisoning, which results in skin disorders and nerve effects.[10]

Unexploded ordnance that deteriorates releases toxic heavy metals, such as cadmium, lead, chromium, nickel, copper, and barium, into the environment. These metals easily transport into and through groundwater, and are long-lasting in the environment.[11] Serious health effects can arise from exposure to each of these heavy metals. Current studies indicate there is no known safe level of exposure to lead.[12]

Sources of Contamination:

All sites on Adak Island were divided into two **operable units** in 1998 for evaluating contamination and creating cleanup plans. OU B was further subdivided into OU B-1 and OU B-2 to facilitate expedited transfer of real estate within OU B-1. The Navy holds responsibility for cleanup and closure, while the EPA and the Alaska Department of Environmental Conservation have federal and state regulatory oversight.

Operable Unit A

OU-A covers all hazardous substance and petroleum related issues, as well as solid waste management. Many of the sites had underground storage tanks (USTs) that housed petroleum products. In October 1999, the Navy signed the final **record of decision** (ROD) for OU-A. EPA undertook formal government-to-government consultation with the Aleut Tribes in September 1999 on the OU-A ROD. These were completed in February 2000 and EPA signed the OU-A ROD on March 31, 2000. The **Five Year Review** for OU-A was completed in January 2002, and all **cleanup remedies** were found by the contractor to be protective of human health and the environment.

Overall, the Navy has relied entirely too much on **institutional controls** and **soil capping**, having chosen these remedies for a majority of the sites. Although the plan for cleanup identifies surface water as the likely future source of drinking water, this should not preclude the Navy implementing cleanup actions that effectively clean groundwater. For these petroleum sites, a greater level of remedial action, rather than a preponderance of "**monitored natural attenuation**" and **no action**, should take place.

The OU-A ROD represents remedial decisions at approximately 200 sites. The complexity of contamination and sheer number of these sites belies by the rather simplistic approach taken for remedial action.

Of the 66 sites contaminated by petroleum, the **remedial action** chosen for 40 of them is monitoring. Twelve sites had "limited" soils removed and fourteen sites had **free-product** recovery systems installed.

With regard to the soil removal sites, concerns arise from a reading of the Five Year Review. At three sites, Navy Exchange Building (UST 30027-A), Officer Hill and Amulet Housing (UST 31049-A), and Officer Hill and Amulet Housing (UST 31052-A) "limited soil removals were started, but terminated before cleanup levels were achieved *due to site obstructions* at three petroleum sites".[13] [emphasis added]

At another three sites, Finger Bay Quonset Hut (UST FBQH-1), Mount Moffett Power Plant 5 (USTs 10574 through 10577), and Yakutat Hangar (USTs T-2039-B and T-2039-C), limited soil removals were started, but terminated *due to larger than anticipated quantities of affected soil* at three petroleum sites."[14] [emphasis added] These include excavating PCB and petroleum-contaminated sediments in two surface water bodies, pumping and treating groundwater contaminated with petroleum, monitoring natural attenuation for petroleum-contaminated soils, and capping a solid waste landfill.

- Finger Bay Quonset Hut (UST FBQH-1): Soil removal was started but terminated due to larger than anticipated quantities of petroleum-affected soil. The Navy installed one additional well in 2001 and annual groundwater monitoring has been recommended for five consecutive years beginning in 2002. Additional soil removal was eliminated as an option because the removal of protective tundra (along with the petroleum-affected soil) from the steep hillside at the site would increase the potential for source erosion such that additional excavation activities would pose a greater risk to the environment than leaving the affected material in place.
- Mount Moffett Power Plant 5 (USTs 10574 through 10577): An agreement between the Navy and ADEC regarding further action at this site has not yet been completed. Groundwater monitoring is currently planned to continue at this site.
- Navy Exchange Building (UST 30027-A): A removal was started but terminated due to site obstructions. Subseque nt work included installation of one well; completion of one soil boring; quarterly sampling of the well for one year; and receipt of concurrence of no-further-action from ADEC comments dated August 30, 2001.
- Officer Hill and Amulet Housing (UST 31049-A): A removal was started but terminated due to site obstructions. A no further action designation was received from ADEC in comments dated August 30, 2001.

- Officer Hill and Amulet Housing (UST 31052-A): A removal was started but terminated due to site obstructions. One additional well was installed and annual groundwater monitoring is recommended for five consecutive years starting in 2002.
- Yakutat Hangar (USTs T-2039-B and T-2039-C): Soil removals at these two sites were started but terminated due to larger than anticipated quantities of petroleum affected soil. Subsequent work at both sites included quarterly groundwater monitoring in 1999-2000, and the Navy and ADEC have agreed that no further action is required per ADEC comments dated August 30, 2001.

Not surprisingly, according to the Adak Five-year Review, released in January 2002, all remedies at OU-A remain protective of human health and the environment. What *was* surprising, as noted above, was the number of sites that were deemed remediated with no further action necessary.

Institutional controls are used at many contaminated source areas to restrict land use and access, and signage to advise against subsistence fishing in two marine water bodies, Kuluk Bay and Sweeper Cove. A long-term monitoring program will determine when the fishing advisories can be removed, or whether further remedial actions are necessary in the two marine water bodies. Rock sole and blue mussels were chosen as the indicator species for human health. According to the Five-Year Review, the most recent samples from Sweeper Cove for rock sole continues to exceed acceptable levels of PCBs, while blue mussels hover close to or barely below acceptable levels. In Kuluk Bay PCB levels in rock sole dropped below acceptable levels in 2000, and have been below acceptable levels in blue mussels for the past 4 sampling seasons. Monitoring will continue through 2003.

Indeed, the Aleutian/Pribilof Islands Association (the non-profit arm of The Aleut Corporation) has voiced concern that "some sites on Adak have not been adequately addressed." They stated categorically that the "Tribes still maintains that the Navy has decided to implement an unacceptably high number of institutional controls rather than committing to more aggressive and effective cleanup methods. The outcome of the use of institutional controls is a long-term need for residents to protect themselves from dangers in their community. The Tribes are fundamentally opposed to any controls which would restrict traditional use of their lands."[15]

The letter from the Association reiterates that the EPA has remained silent on their previously stated concerns about reliance upon the natural attenuation process. "We are not convinced that natural attenuation is an appropriate restoration strategy at Adak or any cleanup sites."[16]

One of the problems associated with depending on institutional controls, rather than content removal, at the landfill sites was demonstrated in 2000. A severe winter storm cut away at the bluff where the metals landfill abuts Kuluk Bay. Several hundred feet of the landfill was exposed, where landfill contents and debris littered the area. After as much of the debris was recovered as possible, a new riprap barrier was placed along 95 percent of the edge of the landfill.[17] Hopefully, this will remedy another event, but in truth, the only guarantee would be removal of the contents.

Water quality is a major concern from military activities. According to the EPA: "Much of the downtown area drains into Sweeper creek and Sweeper Cove. Ecological chemicals of potential concern in sediment include semi volatiles and are distributed throughout the 450 acres of the cove. PCBs and semi volatile organics are the ecological chemicals of potential concern in fish and shellfish in Sweeper Cove and Creek include arsenic and PCBs."[18] Yet, after evaluating potential risks to environmental and human health, the proposed plan requires institutional controls prohibiting subsistence and commercial fishing in Sweeper Cove and Creek. The contamination has created unsafe conditions for harvest of fish and shellfish after conversion of the base to civilian use.

In a document prepared under a Techanical Assistance grant, Dr. Ron Scrudato addresses the complexity of the problem as follows:

- **The extent of groundwater contamination at Adak and proximity of a large number of the sites to surface water, including tidal waters, offers significant potential to impact down gradient surface water quality and associated aquatic and terrestrial biota.** The developing monitoring program should be expanded and designed to determine whether contaminated groundwater is migrating into Adak area surface waters. The extensive groundwater contamination is likely impacting area surface waters including near shore marine waters;

- **Landfill and SWMU cover designs should be an integral part of the ROD.** These designs should specify, in detail, the measures that are to be employed to reduce the amount of water infiltration and the anticipated leachate (a solution containing contaminants picked up through the leaching of soil) to be produced based on the cover design and materials to be used as cover. Additionally, the designs should also specify how surface water would be controlled as well as the procedures that will be used to maintain the integrity of the cover material.

- **Leachate quantity and quality projections should be developed for each of the SWMUs and landfills that will require monitoring including those sites mentioned above.** The amount of total precipitation at Adak indicates considerable quantities of leachate will potentially be produced at select SWMUs and landfills. For example, if the average rainfall at Adak is 60 inches per year, and 10 percent of the total precipitation infiltrates the cover of a two-acre landfill, more than 300,000 gallons of leachate per year will be produced. Depending on the character of the waste that the 300,000 gallons comes in contact with as it migrates into the waste material and down gradient, the composition of the contaminated liquid will vary from uncontaminated to highly contaminated. Contaminated leachate should not be allowed to migrate off of the landfill site and will therefore require some form of leachate collection and management. As long as there is water infiltration into the waste material, leachate will be produced. In order to keep the contaminated liquid from impacting down gradient water resources, it must be recovered and effectively managed. A comprehensive plan detailing the procedures and processes that will be used to characterize, monitor, collect and treat generated leachate should be included as part of the remedial plan being developed for the Adak containment sites including the SWMUs, landfills and any other waste containment facility.

- Additionally, a plan needs to be developed detailing how leachate will be distinguished from contaminated groundwater. Contaminated groundwater down gradient of a covered waste containment facility indicates the engineered site is producing leachate as precipitation has infiltrated the cover and is mixing with the contained contaminants. Since the designed landfill cover is inadequate to prevent liquid from infiltrating and mixing with the waste, leachate is being produced. In contrast to a uncontained waste site that is contributing contaminants to the environment, the engineered site is contributing leachate as a consequence of design failure. Leachate at engineered containment facilities should be collected and managed and the presence of contaminants down gradient of SWMUs and/or landfills is evidence that the containment facility has failed. The site is producing leachate as water has infiltrated the designed cover. The produced leachate should be collected and effectively managed and this needs to be fully integrated into a comprehensive remedial plan for Adak.

Dr. Scrudato discusses difficulties in the decision making process due to the lack of available information and general understanding on the part of those people involved in his draft responses of March 6, 2000:

> **Limited understanding by RAB members of the extent of contamination, site characterization and basis and/or rationale for site remedies.** Although the RAB has been working on the remediation of Adak for more than three years, specifically focused on the OU-A, there is little understanding by RAB members on the extent or degree of contamination. This can be attributed to the large number of petroleum and CERCLA sites incorporated in OU-A as well as a lack of effective communication employed by the Navy and agencies in informing interested citizens. Monthly meetings are not sufficient to keep interested citizens informed on the characterization and proposed remedies for the large number of sites located at Adak. In addition, a user-friendly GIS system available at a convenient public location such as the University of Alaska library would provide ready access to the enormous amount of data, information and effective depictions of individual sites and interrelationships to the surrounding environments as well as adjacent sites. Ineffective communication has led to a general mistrust of the proposed remedial measures being advocated for the Adak CERCLA and petroleum sites. I believe a great deal of anxiety shared by concerned citizens would dissipate if a more user friendly and effective public participation process were in place. The large number and diversity of the OU-A sites and manner in which they have been described and depicted, makes is very difficult for a lay audience to gain a comprehensive understanding of the processes and objectives being promoted by the Navy, the agencies, and contractors.

Dr. Scrudato recommends that additional coordination work be done prior to the signing of the Record of Decision by concurring regulatory agencies:

> **The monitoring program and Institutional Control plan should be fully developed and approved prior to the signing of the ROD, particularly for the No Further Action and Institutional Control sites and for those sites that will be managed and monitored for natural attenuation.** Because a significant number of the Adak sites will be managed as NFA and IC, effective monitoring is essential to ensure the sites are performing as projected. An effective monitoring plan is a critical element in determining whether the site remedies are effective in controlling the migration and exposure of contaminants to residents and natural systems. I reviewed a draft copy of the monitoring program and it appeared to be generically acceptable. However, site-specific monitoring programs are required to ensure individual sites are performing as projected. I also believe select NFA and IC sites should also be monitored to determine performance and gauge whether the sites are no longer impacting the local environment. At a minimum, a rationale should be more fully presented for the IC and NFA sites that will not be monitored. The IC plan should be developed and fully implemented as soon as is practicable since contractors and an increasing number of visitors will be travelling to Adak during the time the range of sites are being remediated. The draft of the IC plan I reviewed requires a great deal of work and expansion to provide the safeguards needed to protect against exposure to contaminants.

It should be noted that none of Dr. Scrudato's comments resulted in changes by the Navy or the EPA.

Operable Unit B
Because vast areas of Adak were used for military training including artillery ranges, an ordnance, explosives, and unexploded ordnance operable unit was created. This has been designated as Operable Unit B (OU-B). To facilitate transfer of lands 47,000 acres from USFWS to The Aleut Corporation the unit was further divided. OU B-1 contains mostly those lands identified for transfer. The remaining lands are contained within OU B-2. The Navy, EPA, ADEC, the Aleut Corporation, and the Aleut/Pribilof Island Association undertook investigation and remedy evaluation jointly for OU B-1. The Navy, EPA and ADEC signed the final record of decision for OU B-1 in December 2001.

Most disturbing are the institutional controls (fencing and signs) at sites where UXO may present a significant danger, especially to children who may disregard the controls.

Operable Unit B-1
Of the 131 sites in OU B-1, 104 were designated as needing no further action. The remaining 27 have not yet had remedies selected.

Operable Unit B-2
Site investigation and feasibility studies conducted for the 62 OU B-2 sites are in draft as of this writing; the record of decision is not expected until late 2003/early 2004.

Conclusions:

The Aleutian/Pribilof Islands Association has been involved with the remedial planning for Adak restoration. The leaders of the Association have been concerned with the lack of acknowledgement of Native traditional use of the lands. In a February 24, 2000 letter from the President of the Association to the EPA Region 10 administrator, the Association points out that the EPA was misinformed about Native use of the lands: "Please note that our archaeological staff has identified historical evidence that Adak was being actively used by Aleuts at the time the military arrived on Adak to survey the site for use during the war, and that the Naval base was constructed on an existing Aleut trapping camp."[19] This has not changed. EPA should revise their website to reflect the historical knowledge of local peoples.

The Association is also concerned about the long-term impacts to the Tribes. "Our concern is that existing reports may focus on impacts to natural resources without considering the long-term impacts to the Tribes. Consideration of traditional Native resources and *how* the resource use will be impacted should be fully integrated into the assessment."[20]

The Association challenged the methods used for risk assessment, indicating that they would like to see more details. "We need further clarification by EPA of risk assessment methodologies selected. Based upon the results of this clarification, we may request re-evaluation of the development of these methodologies." The Association indicated that risk assessment should focus on "the actual diet of local people."[21]

The Association made an argument for "more emphasis placed on public perception issues as related to the environmental restoration process." They pointed out that even if all contamination is remediated, "the perception of the use of resources" must also be addressed if the restoration process is to be successful. "People need to feel reassured and safe in their surroundings."[22]

In the opinion of the authors, the Navy has done the absolute minimum to address the contamination at Adak. Virtually nothing has been removed from the island. Instead, landfills have been capped, chemical agents lost, institutional controls such as fencing and "no trespassing" signs posted where unexploded ordnance remains, and monitoring and warning signs put in place where waters are contaminated. The Navy's position is they will neither confirm, nor deny that nuclear submarines and bombs were housed at Adak, although military personnel do, in fact, confirm such. The Navy has avoided proper assessment and monitoring for radioactive contaminants.

According to information released by the Department of Defense in 2002, a series of biological and chemical weapons tests were conducted in mission SHAD (Shipboard Hazard and Defense). However, many of these tests were conducted on lands. In Alaska, tests were conducted at Gerstle River and Fort Greely, and may have been conducted elsewhere. Additional records will be released spring 2003.[23] The Navy ought to come forward with all records regarding Adak. The Cold War is over. The island is now home to some 100 people, with a growing community. They are about to inherit whatever legacy the Navy leaves behind when a transfer of lands from the Navy to the community of Adak takes place. The community of Adak deserves to know just what that legacy consists of.

Unexploded ordnance (UXO), mustard gas and lewisite, in particular, are a serious concern. Not only are they toxic, the quantity in which they are present constitutes a much higher risk to human health. The "loss" of some 40,000 pounds of mustard gas and lewisite ought not to be taken lightly. In addition, UXO presents a very immediate danger should they explode.

The authors commend the Navy for their consultations with the Association, fulfilling their environmental justice obligation much better than at any other military Superfund site in Alaska. However, they failed to actually implement suggestions or adequately address concerns brought forward by the Association. As the Association stated, the Navy has relied entirely too much on institutional controls at a site that is horrible contaminated. Radiation contamination has never been investigated and ought to, especially now that a community of civilians occupies the island.

The authors also commend the Navy on the provision of Superfund documents through the website www.adakupdate.com/. The Army and Air Force ought to follow the example set forth by the Navy.

A glossary of terms and laws, commonly found contaminants, and a comprehensive discussion of environmental justice issues can be found in the accompanying document, *Overview of Key Issues at Alaska Military Superfund Sites.*

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Information is available online at:
www.adakupdate.com and

http://www.state.ak.us/dec/dspar/csites/dod/rabs.htm

Sites where Adak Superfund documents are located:
University of Alaska Anchorage (Administrative Records)
Library Reserve Room
3211 Providence drive
Anchorage, AK 99501
907-786-1871

Information repository, Adak community
Second Floor, Adak City Hall Building

Footnotes:

[1] http://adakupdate.com/bkg.html

[2] Record of Decision, Operable Unit B

[3] anecdotal evidence: conversations with former military personnel who chose to remain anonymous

[4] Ibid

[5] http://yosemite.epa.gov/r10/nplpad.nsf

[6] RAB meetings notes, June 2002: "There was a decision by the community members to not renew the TAPP grant. The rationale was that there appeared to be sufficient oversight provided by EPA, ADEC, and USGS. Cathy Villa thanked Dr. Scrudato for his efforts to date."

[7] get this from Pam

[8] Department of Veterans Affairs, VA Fact Sheet, "Mustard Gas Exposure and Long-Term Health Effects," April 1999, www.va.gov/pressrel/99mustd.htm

[9] Agency for Toxic Substances and Disease Registry, "Blister Agents, Lewisite and Mustard-Lewisite Mixture," www.atsdr.cdc.gov/

[10] Harte, J, Holdren, C, Schneider, R, Shirley, C, *Toxics A to Z: A Guide to Everyday Pollution Hazards*, University of California Press, Berkeley, 1991

[11] "Communities in the Line of Fire: The Environmental, Cultural, and Human Health Impacts of Military Munitions and Firing Ranges," Military Toxics Project, June 2002

[12] Greater Boston Physicians for Social Responsibility, *In Harm's Way: Toxic Threats to Child Development*, January 2001

[13] Adak-Final Five Year Review, January 2002

[14] Ibid

[15] Ongoing consultation between the EPA and Aleutian/Pribilof Islands Association (AP/IA), Adak Island Operable Unit "A", Superfund Record of Decision, Feb 24, 2000, letter to Chuck Clark from Dimitri Philemonof, AP/IA

[16] Ibid

[17] Adak-Final Five Year Review, January 2002

[18] Record of Decision, Operable Unit A

[19] Ongoing consultation between the EPA and Aleutian/Pribilof Islands Association (AP/IA), Adak Island Operable Unit "A", Superfund Record of Decision, Feb 24, 2000, letter to Chuck Clark from Dimitri Philemonof, AP/IA

[20] Ibid

[21] Ibid

[22] Ibid

[23] American Forces Information Service News Articles, "DoD Releases Info on Cold War Chemical, Biological Weapons Tests," October 9, 2002, www.defenselink.mil/news/Oct2002/n10092002_200210092.html

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Eielson Air Force Base

<u>Environmental Justice & Alaska Military Superfund Sites</u>
Fact Sheet

Location:

Eielson Air Force Base is located in the Tanana River Valley within the Tanana and Tanacross Native language groups region, approximately 24 miles southeast of Fairbanks, 10 miles southeast of the city of North Pole, and immediately adjacent to the community of Moose Creek on the northern border of the base, and the Salcha area on the southern border.

Primary Contaminants:

- **Petroleum, Oils and Lubricants** (POLs): benzene, toluene, ethylbenzene, xylene (these four are also referred to BTEX, as a group), diesel fuels, gasoline
- **Volatile Organic Chemicals**: (VOCs): benzene, trichloroethane (TCE), vinyl chloride, chlorinated solvents (acetophenone and chlorobenzene)
- **Semi-Volatile Organic Chemicals:** (SVOCs): chlorinated solvents (1-methylphenol, 4-methylphenol and 2-methylnaphthalene)
- **Persistent Organic Pollutants** (POPs): pesticides (including chlordane and dieldrin), PCBs
- **Heavy Metals**: lead
- **Others:** chlorinated solvents (trans-1,2,-dichloroethylene, tetrachloroethene, and chloromethane)

Note: The categories used here are those used by the Environmental Protection Agency for Superfund sites. Other methods of categorizing do exist. See www.epa.gov/reg3hwmd/bfs/regional/analytical. Chemicals listed as "Others" were those not found on the EPA's list.

History:

Eielson Air Force Base is located in the Tanana River Valley within the Tanana and Tanacross Native language groups. The Alaska Native villages of Minto, Rampart and Manley Hot Springs are within 100 miles of Eielson, and all are downstream of the Chena or Tanana Rivers or their tributaries. Nenana and Healy Lake are within 50 miles of the base.

The base encompasses 19,700 acres, most of which is forest, wetlands, lakes, and ponds beyond the approximately 3,650 acres which have been improved or partially improved, and are used for the bulk of base activities. An additional two-acre facility called the Blair Lakes Target Range has also been included in the Eielson Air Force Base **Operable Unit One Superfund*** site. The Blair Lakes site is approximately 25 miles southwest of the main base, but is included in the cleanup activities because of its proximity to the base and the similarity of the contaminants.

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* Words in **bold** signify terms used in the world of Superfund. For a comprehensive discussion of Sueprfund law and how it works, please see the accompanying document, *An Overview of Key Issues at Alaska Military Superfund Sites.*

Several thousand people frequent Eielson, which is one of the major employers in the Fairbanks area. According to the most recent figures, the base employs approximately 3,400 military personnel and an additional 500 civilians. The total residential population of the base is 5,132, and an additional 1,600 people live 10 miles away in North Pole. The total population of people living and working on the base is over 9,000 people. Related to the residential and work populations at the base and nearby, there is a child care center, three elementary schools and one junior-senior high school. "The area is active with ongoing base functions, including work, school, and recreational activities," according to the administrative record which notes that "significant wildlife frequents Eielson AFB, and the base supports a variety of recreational and hunting opportunities."[1]

Originally constructed in 1944, Eielson began as a satellite installation of Fort Wainwright. Until designated as Eielson Air Force Base in 1948, the Army and the Air Force used it jointly. The mission of the base is "to train and equip personnel for close air support of ground troops in an arctic environment."[2] Over the years this has included a variety of industrial, maintenance, operational, and other waste-generating activities, including landfilling for waste disposal and an active aircraft runway.

Geography & Geology:

All of the Eielson AFB Records Of Decision contain descriptive geography locating the base in central Alaska, on the Richardson Highway, in the Fairbanks North Star Borough, approximately 10 miles southeast of the city of North Pole and 24 to 26 miles (depending on the report) southeast of the city of Fairbanks. The site is located in the Tanana River Valley, in the floodplain of the Tanana River.[3] The **National Priorities List** narrative states: "Surface water within 3 miles downslope of hazardous substances at the base is used for fishing."[4]

The approximate population of the area according to the OU-1 ROD is 115,600, which includes the Fairbanks North Star Borough, Fairbanks, and the community of Moose Creek. It is important to point out, however, that this is a narrow and limited description of the geography. Geography has important implications relative to the reach and impact of the contamination from the site, particularly with regard to the issue of environmental justice and the impacts of this site on populations other than those described by the EPA's analysis.

Several small sloughs or creeks pass through the Base and discharge to the Tanana River. Moose Creek is the main receiving stream for small local drainages around the Base. Both French Creek, along the eastern edge of the Base, and Piledriver Slough, along the western side, discharge to Moose Creek just above its confluence with the Tanana River. Garrison Slough, which is a surface drainage, also discharges to Moose Creek. Prior to 1979, effluent from the Base sewage treatment plant was discharged to Garrison Slough.[5]

Groundwater is the only source of potable (drinking) water at Eielson AFB and the surrounding communities. An extensive regional aquifer system occurs within the unconsolidated alluvial/glaciofluvial (aquifer) deposits in the broad valley of the Tanana River. This aquifer is about 45 to 50 miles wide at Eielson AFB and is approximately 200 to 300 feet thick. The aquifer consists primarily of interbedded layers or lenses of unconsolidated sand and gravel. The water table at Eielson AFB lies only approximately 8-10 ft below the surface with seasonal fluctuations bringing it up to 1.5 ft during spring snow melts and rain.[6]

Drinking water at Eielson is supplied by three large-capacity wells, which extend to depths averaging 100 ft., presumably below the reach of current contamination, although as noted later, the groundwater down gradient has not been able to be measured. Only the upper 60 to 90 ft of the aquifer were characterized by the Superfund investigation. Seven additional wells on the base provide water for fire fighting and other emergency uses.

Forty-one private wells are located within a 3-mile radius of the base, downstream and down gradient, mostly in the community of Moose Creek, and in neighboring areas. The city of North Pole has both a small public water supply system and private wells, but both North Pole and Moose Creek rely primarily on wells for their drinking water.

Eielson AFB contains 13 lakes totaling 313 acres, 54 ponds totaling 265 acres, and ten designated wetlands totaling about 252 acres. One of the lakes and six of the ponds are natural; the remaining 12 lakes and 48 ponds are old borrow pits or gravel pits.[7]

According to the **record of decision (ROD)** for Operable Unit 1B, although almost 70% of Eielson and virtually all of the Blair Lakes Target Range are wetlands, all **remediation** activities occurred in areas previously filled, and none, according to the ROD, had "adverse environmental impacts on wetlands". In addition to the wetlands, several surface water bodies, including lakes, ponds, creeks, and sloughs, are near the operable units. These include Hardfill Lake, Garrison Slough (which runs through the developed portion of the base and empties into Moose Creek), French Creek, Pile Driver Slough, and the Tanana River.[8]

Due to the shallowness of the water table, and to the seasonal variations in water level in both surface and groundwater, a high level of exchange between the two is probable in many areas, although the Eielson 1998 Five-Year Review states that "little is known about the interaction between the groundwater system and local ponds, lakes, and wetlands because of the lack of synchronous groundwater and surface-water elevation measurements."[9] Still, the same document points out that different streams on the base are either influent (that is, lose water to the subsurface groundwater system) or effluent (gains water from the subsurface). Interaction between surface and groundwater facilitates the migration of contaminants that have entered the groundwater or surface water areas from spills, drainage, or percolating water through the surface and subsurface soils.

This exchange also creates a higher likelihood of contamination of sediments in surface waters, which in turn increases the availability of some persistent organic chemicals to fish and wildlife. Fish and wildlife that are attracted to wetland areas may be exposed to contaminants available in adjacent wetland areas.

Contamination Background:

The diversity of industrial, maintenance, operational, and other waste-generating activities at Eielson, including landfilling for waste disposal and an active aircraft runway, has produced a wide variety of pollution. The ROD for Operable Unit 1B (the ROD for interim selected remedial actions at the base) notes, "Industrial operations and related wastes were insignificant prior to 1950."[10] From the period between 1950 and 1982, however, an estimated 25,000 to 40,000 gallons *per year* of industrial waste were generated.[11] This waste falls into three categories: waste oils, contaminated fuels and sludges, and spent solvents and cleansers. Many similar industrial activities are the primary activities at the base today, and many of the sites continue to be used as industrial areas.

Contamination at Eielson was first evaluated in 1982 under the auspices of the U.S. Air Force Installation Restoration Program, a four-phase project that carried out several initial or interim cleanup actions at sites throughout the base. Eielson was added to the National Priorities List (NPL) for Superfund cleanup in November of 1989. Though it was not until May 1991 that the U.S. Air Force, the EPA, and the Alaska Department of Environmental Conservation (ADEC) signed a **Federal Facility Agreement**, initiating the cleanup process. Eielson was divided into six operable units (OUs) for investigation under **CERCLA (the Comprehensive Environmental Response, Compensation, and Liability Act)**, which governs Superfund actions. A seventh, sitewide, operable unit was added after PCBs were discovered in Garrison Slough.

The first **five-year review** at Eielson was held in 1998 and is evaluated in this report. The next five-year review is scheduled for early fall 2003.

Sources of Contamination:

A total of 66 **source areas** were initially identified as sources of possible contamination, although as of 1998 34 had been eliminated from further investigation "because they did not appear to present a significant **risk to human health or the environment**".[12] The seven operable units at the base include the remaining source areas.

In addition to the source areas described above, 44 other "Areas of Concern (AOC)" have been identified by the Air Force, according to an Eielson Environmental Restoration Program report.[13] An AOC is a potential or suspected area of contamination based largely on limited historical or circumstantial information. These sites mostly consist of abandoned drums. The Air Force estimates that there are thousands of drums in these areas, with hundreds found in surface waters such as ponds and lakes. According to this report, "No sampling or analysis data exists for the sites and the contents or conditions of the drums are largely unknown."[14] Five of the sites have been closed (no further details are provided), and seven are reported as being "programmed for removal actions." Removal and disposal of the remaining drums is planned, and the site indicates that a future report will provide documentation for the disposition of the remaining 32 sites.[15]

Also mentioned in the report is a source area called the Chena River Annex, which was originally used as a control center for the Atomic Energy Detection System to monitor nuclear detonations. Low levels of fuel and PCBs have been found on this site in previous investigations, and the reports states that the "potential also exists for some contamination resulting from photochemical processing." Clean up at this site was supposed to have been completed in 1998, after which the site was to be demolished. We found no further mention of this site.[16]

Superfund Source Areas:

The major source areas at Operable Units 1 through 4 at Eielson are related to petroleum and fuel contamination. Contamination at OU5 is related to landfilling activities, and OU6 is separate because the geology is fractured bedrock in contrast to the sand and silt of the other sites. Contamination in the sitewide OU7 focuses on polychlorinated biphenyls (PCBs) found in the Garrison Slough. The operable units are briefly described below, then reviewed as a whole within the framework laid out by the 1998 Five-Year Review.

Operable Unit One

OU1 addresses the eight sites that have caused petroleum contamination through leaks and spills of fuels. They are: ST20E-7, E-8, and E-9 Complexes (Refueling Loop), Power Plant (ST48); Alert Hanger (ST49); Blair Lakes Vehicle Maintenance (SS50); Blair Lakes Ditch (SS51); Blair Lakes Diesel Spill (SS52): Blair Leaks Fuel Spill (SS53); Blair Lakes Drum Disposal Site (DP54). Most of the contamination is in subsurface soils and the shallow groundwater.

In order to minimize the spread of contamination from floating product at OU1 source areas, the Air Force recommended an Interim **Remedial Action** to remove the major source of contamination through recovery of petroleum product floating on the water table. A ROD implementing the interim action was signed in 1992 and a ROD specifying a final Remedial Action (RA) for the OU1 source areas was signed in 1994. The final RA included the upgrading and operation of **bioventing** systems at source areas ST20 and ST48 and continued operation of a **product recovery system** at SS50-52 (Blair Lakes). These systems are in full operation and a **monitoring** program is in place. Bioventing involves the injection of relatively small amounts of air into the ground to provide an oxygen rich environment for the bacteria that degrade POL contaminants.

Operable Unit Two

OU2 consisted of seven source areas that were combined because of commonalty in contamination, caused mainly by leaks and spills of fuels. These areas are: the E-2 petroleum oil and lubricant storage area and Hardfill Lake (ST10); the E-2 Railroad JP-4 Spill Area (SS14); Building 3224 subsurface diesel fuel contamination (ST11); ST13 and DP26, located close to each other, have similar types of contaminants, and the individual releases to groundwater have created an overlapping groundwater contaminant plume; an oil boiler fuel saturated area (ST18); and the JP-4 Fuel Spill Area (ST19). Soils, subsurface soils, and groundwater were contaminated with petroleum products. Contaminant plumes on the top of the shallow groundwater table fluctuate seasonally. Remedial actions consisted of passive skimming to remove fuels floating on surface waters, bioventing/**soil vapor extraction**, monitoring, and **institutional controls**.

Operable Unit Three

OU3 includes the following source areas: Disposal Pit (DP)44, Waste Pond (WP)45/SS57, ST56, and SS61. The Disposal Pit is located near the Large Aircraft Maintenance Hangar and included a wastewater disposal leach field from the Battery Shop and the surrounding area between the runway, taxiway, and Flightline Avenue west of the North Street intersection. An additional Source Area (WP45) was designated for the photo laboratory and dry well at the Battery Shop. Source Area SS57 is the area surrounding the fire station, Building 1206. Engineer Hill Spill Site (ST56) is an active munitions storage and maintenance compound about 3 miles north-northeast of the main part of the base. SS61 is in the center of the developed portion of the base, just north of the water treatment plant pond on Garrison Slough, and is on the east and south sides of the Vehicle Maintenance Shop (Building 3213). Only the Battery Shop was deemed to pose an **unacceptable risk** to human health and the environment, and was remedied with soil vapor extraction, groundwater monitoring, and institutional controls. All other sites were designated **no further action**.

Operable Unit Four

OU4 includes the source areas DP25, ST27, WP33, SS35, SS36, SS37, SS39/SS63, ST58, and SS64. DP25, the E-6 Fuel Storage Tank Area, is located north of Quarry Road, adjacent to the E-11 Fuel Storage Tank Area, ST27. ST27, the E-11 Fuel Storage Tank Area, is a fence-enclosed complex of five fuel tanks on the south side of Quarry Road approximately 600 m southeast of Hardfill Lake. WP33, the effluent infiltration pond, is a 7.7 hectare unlined pond into which treated liquid effluent from the wastewater treatment plant is discharged.

SS35, the Asphalt Mixing and Drum Burial Area, is located in the central part of the base adjacent to Central Avenue, just south of the Water Treatment Plant. SS36, a drum storage site, is located in the central portion of the base, east of Industrial Drive and south of the base power plant. SS37, the Drum Storage/Asphalt Mixing Area, is located just east of Building 4333, just east of Flightline Avenue, between Quarry Road and Chena Street. Asphalt Lake (SS39) and the adjacent Asphalt Lake Spill Site (SS63) are located approximately 1.3 miles south of the Eielson AFB main gate. ST58, site of the old Quartermaster service station, is located on the northwest corner at the intersection of Division Street and Wabash Avenue. The service station covered approximately 400 sq. meters. SS64, the Transportation Maintenance Drum Storage Area, is located in the center of the developed portion of the base, just north of the Water Treatment Plant pond on Garrison Slough, on the west side of the Vehicle Maintenance Shop.

Only two sites received remediation. The Asphalt Mixing and Drum Burial Area (SS35) remedy was **capping** (placement of a soil cover over the source area) and monitoring, with removal of the contaminated drums if they were found to be leaching into groundwater. The Quartermaster service station (ST58) remedy included bioventing, monitoring and institutional controls.

In 1998, the ROD was amended for the Asphalt Mixing and Drum Burial Area and even the capping found unnecessary. "The maximum concentration found for pesticides did indicate a potential human health risk if this area were developed for residential use in the future. However, these maximum concentrations were isolated and were not consistent over the area. In addition, the potential for residential development in this area is very low. Therefore, additional soil cover is not necessary for protectiveness; the current soil cover is protective of both human and ecological receptors."[17]

Operable Unit Five

OU5 is primarily the landfill and waste areas. It includes source areas LF02, LF03, LF04, LF06, and Fire Training Area (FT)09. LF02 is an abandoned, approximately 6-acre landfill located about .5 miles northwest of Manchu Road and Gravel Haul Road on the banks of French Creek, a tributary of Moose Creek. LF03 is located east of the south end of the runway and north of the refueling loop. FT09, a former fire-training area, is located within the west-central part of LF03. LF04 is located approximately 3 miles east-northeast of the south end of the runway and covers an area of greater than 100,000 sq. meters. LF04 received general refuse, small quantities of waste oil spent solvents, and possibly small amounts of munitions and spent cartridges. LF06, the old landfill, is located near the central power plant just south of the power plant cooling pond on the eastern side of the main developed portion of Eielson AFB.

The **selected remedy** for the former landfill (LF02) and fire-training area (FT09) was capping, groundwater monitoring, and institutional controls.

OUs 3-5 were dealt with in a singe record of decision. Of the 23 contaminated source sites, thirteen did "not pose an unacceptable risk to human health and the environment"[18] according to EPA and received no further action. Groundwater monitoring at or close to the sites was initiated as part of the sitewide monitoring program. An additional five sites received "limited action", which included institutional controls to "prevent exposure to contaminated groundwater".[19] Only five of the original 23 had any remedial action, and of those, two included capping.

Operable Unit Six

Operable Unit 6 is a single contaminated source area, also referred to as WP38, located in the southeastern area of the base. It includes approximately 200 acres of southwest-facing hillside near the Eielson AFB Ski Lodge. The ski hill is used primarily for recreational and military training purposes. Groundwater contamination was detected in 1986, when routine sampling revealed the presence of benzene in the water supply well in the basement of the ski lodge and then in a second well installed slightly uphill of the lodge. Subsequent sampling in 1988, 1989, and 1993 has confirmed the presence of petroleum-related contaminants in the groundwater near the ski lodge. In 1987, all three water supply wells were removed from service. According to the ROD, the potential contribution of the bedrock aquifer to groundwater in the vicinity, and the amount and direction of flow in the bedrock aquifer are difficult to determine.

The selected remedy included monitoring the groundwater, **natural attenuation**, institutional controls that restrict access to groundwater and signs warning of the contamination, and provision of an alternate water supply of potable water.

Operable Unit Seven

OU-7 addressed PCB contamination found in Garrison Slough. A shallow drainage channel which entered the slough from its west bank was determined to be the likely source of the PCBs, although no specific source was identified. The PCBs were found in the soil of the channel, and in both fish tissue and sediment as far as 1,000 feet downstream of the channel. The original source of the PCBs is believed to be past dumping or spills of transformer oils used at the base, but no records were discovered to confirm this. PCBs were found in fish in several surface water bodies on the base, according to the Environmental Restoration web page,[20] yet only in Garrison Slough were the levels "significantly above background levels." Subsequent investigation also revealed that PCBs were found in fish tissue in Moose Creek due to an unknown source, but these are not mentioned in the 5-year review.[21] There were no other references in the documents available for review for this report regarding the source of the background PCB contamination in fish. One possibility that can be inferred from the general description of the area is that over the years when transformer oils with PCBs were in widespread use at many military and industrial sites, a significant amount of PCB contamination entered the environment through spills and unregulated disposal.

The selected remedy included excavation of contaminated soils and sediments; on-site and off-site disposal or treatment of; and environmental monitoring of soils, sediments, surface water, fish, and groundwater. Institutional controls were put in place to prevent fishing in Garrison Slough until it is confirmed that levels in fish tissue are protective.

Discussion of the Five-Year Review

The major **chemicals of concern** throughout Eielson are POLs (petroleum, oils, and lubricants). They present a significant threat to groundwater in the area. POLs encompass all the major constituents of fuel and gasoline contaminants such as lead, benzene, volatile and semi-volatile organics, and solvents. Four of these, referred to with the acronym BTEX, are responsible for virtually all the contamination, both in the soil and in the groundwater, at Operable Unit1, for example. BTEX stands for benzene, toluene, ethylbenzene, and xylenes, all of which are constituents of fuels and petroleum. Chlorinated solvents are a major source of contamination at Operable Unit 3, and lead is a significant contaminant at Operable Unit 4. All of these contaminants can remain in the groundwater for some time as a source of contamination to users exposed through drinking the water or breathing the vapors. Certain chemicals, such as pesticides and PCBs, are known as persistent organic pollutants (POPs). Persistent organic pollutants do not degrade for many years and accumulate in higher concentrations in animals and humans at the top of the food chain.

Several additional contaminants are present at various sites. Vinyl chloride was found in one soil sample, and several chlorinated solvents were also found in the groundwater. Chlordane and dieldrin, both pesticides, were found in what were characterized as residual amounts in some areas, but were attributed to historical spraying for insect control and were considered unrelated to the source areas under remediation. All of these chemicals were found in small concentrations where they were detected. They were determined to be present at levels too low to adversely affect human health and the environment, and therefore were determined not to require remediation.

The human health risk assessments land-use scenarios for both were based on ongoing industrial use and for future land-use scenarios of residential use, based on the assumptions of a small family farm scenario with adults and children. Assumptions of how much exposure will be received differ with different types of land use determinations. Residential exposures are higher than other uses. The purpose for doing the risk assessment in this way is to produce what is considered the most conservative, that is, protective, predictions possible.

The land use scenario is also very important in determining whether a *completed exposure pathway* exists. This means that even though a contaminant may exist in the environment, if the agencies determine that there is no way for humans to be exposed to that contaminant, then no exposure pathway exists. If, for example, a person lived next door to a garage that was storing extremely hazardous chemicals in well-sealed barrels, which were well-maintained and carefully monitored inside a concrete building, the assumption is that even though there is *potential* exposure, under the current conditions there is no *completed* exposure pathway between the contaminant and the person. Exposure only occurs if there is some means by which a person either breathes (inhalation), eats or swallows (ingestion), or has skin contact (dermal absorption) with the contaminant of concern, also called the COC.

The risk assessment also makes assumptions about how much exposure individuals will receive, how long that exposure lasted, and how concentrated the exposure was. In the case of all the risk assessments at Eielson, the standards regarding exposure duration to soil and sediments were adjusted to reflect the subarctic climate which assumes that individuals would only be exposed for the mean number of days without snow cover, using Fairbanks as the model (146 days). The maximum number of days is also assumed; in this case it was 180 days. For each contaminant, therefore, exposure was calculated based on 180 days/year for nine years at whatever the RME was. This is then translated into a risk prediction.[22]

These elements are important to understanding the basis on which risk is assigned to contaminants at a Superfund site. At Eielson, although several chemicals were detected in either the soil or groundwater, not all are determined to pose equal risk. Many contaminants were determined to be present in concentrations so low that they were below the levels which trigger cleanup activities. At Eielson in many cases, the assumption was made that some chemicals were either at such low levels that they did not present a risk to human health or the environment, or that as they were detected in small amounts in only one or two samples they did not represent a significant enough source of contamination to justify the cost of a clean up.

If contaminant levels are below what CERCLA considers a risk to human health or the environment, action is not warranted from the EPA's perspective. Many of the contaminated areas within operable units have not been remediated because the agencies determine that leaving the contamination is an "acceptable risk." A more comprehensive discussion of risk assessment is presented in the accompanying document *An Overview of Key Issues at Alaska Military Superfund Sites.*

The 5-year review reports that at Operable Unit 2, as of February 1998, approximately 380 gallons of floating petroleum product had been recovered. OU2 was also a source of significant lead contamination that was initially slated to have groundwater extraction and treatment facilities installed in areas where groundwater lead levels were highest at source areas ST13/DP26, sites of diesel fuel spills and fuel tank sludge burials. After field studies to evaluate the feasibility of using pump and treat technologies to clean up the lead, however, the conclusion was that "the lead is apparently immobile and that remediation of the aquifer for lead contamination by pump and treat technology would require decades."[14] As a result, the selected remedy was changed to what is called a "Technical Impracticability Waiver" and institutional controls and monitoring were substituted in ROD amendments made in 1998. Three other source areas, all sites of fuel spills or fuel saturation (ST11, ST18, and ST19), were also designated as needing no further remedial action based on a determination that they did not pose an unacceptable risk to human health or the environment.

At the same time, however, the 5-year review indicates that the groundwater will continue to be monitored as part of the Sitewide Monitoring Program (SWMP), and that institutional controls will be in effect to prevent exposure to contaminated groundwater and soil. It is precisely these types of actions, which seem extremely contradictory and raise concerns as to what the true status of the sites are. Unacceptable risk in this context should apparently not be mistaken for no risk, because the contamination is significant enough to warrant institutional controls to prevent access to the groundwater and the soil. Although not explicitly stated, it also seems apparent that natural attenuation is being relied upon at these sites and in the meantime, they are off-limits. These controls may not be adequate to protect wildlife visiting the area or humans who consume these animals. These areas may not be used as anything other than waste sites for decades to come.

Several source areas in Operable Units 3,4,5 are old landfills with a variety of contaminants. Remediation for these sites includes soil vapor extraction at both DP44 and ST58 to cleanup soil contamination which represents a leaching threat to the groundwater. Ongoing groundwater monitoring at the landfill site will also continue "as appropriate, to verify that the contaminant concentrations remain within acceptable screening levels." Also at the landfill site, a soil cover will be used to address what is described as the "direct contact threat" to areas where disposal occurred prior to 1980. A soil cover is nothing more than a layer of soil and usually vegetation placed over the surface soil or top of a landfill to protect the contents from contact with water runoff, animals, and humans. The 5-year review, however, states:

> The final cover will be constructed to: (1) provide long-term minimization of migration of liquids, (2) function with minimum maintenance, (3) promote drainage and minimize erosion, (4) accommodate settling and subsidence, and (5) have a permeability less than or equal to the natural subsoil present.[23]

Monitoring of soil covers is essential, as the integrity of such covers is variable, particularly under severe weather conditions and animal activity. Finally, the use of institutional controls and groundwater monitoring are considered key aspects of the "remediation." Yet, none of these activities represent actual permanent remediation of the sites involved, other than the soil cleansing.

The lead contamination from Operable Unit 2, and at ST58, an old service station site, will be monitored in the groundwater to assure that it is not migrating. At ST58, the 5-year review reports, "regulatory requirements for lead contamination in groundwater would be waived within the established containment area."[24] The review continues, stating that ongoing "monitoring at SS35 of surface water, sediment, and aquatic organisms in Garrison Slough confirm that concentrations remain at levels that are protective of human health and the environment." As noted earlier, however, fish in both Garrison Slough and Moose Creek continue to show PCBs from unknown sources.[25] Decisions leave room for doubt regarding how protective the chosen remedies will be.

Conclusions:

Overall, the 1998 Five-Year Review found all remedies to be protective of human health and the environment. With the next Five-Year Review, due out in early fall 2003, the public has the opportunity to comment on the effectiveness of remedial actions.

Conversations with the EPA reveal the Agency considers Eielson mostly remediated.[26] It is the opinion of the authors that the absolute minimum has been done at Eielson. In entirely too many instances, no action was deemed necessary for contaminated source areas. Of those where action was taken, far too many included the minimum: capping, groundwater monitoring, natural attenution, and institutional controls. If the majority of contamination was present in soils alone, these approaches may be adequate. However, the predominant contaminated media at Eielson is groundwater. As stated earlier, groundwater is the only source of potable water at Eielson and the surrounding communities. The water table at Eielson lies only approximately 8-10 ft below the surface with seasonal fluctuations bringing it up to 1.5 ft during spring snow melts and rain. The authors are concerned that cumulative effects to the groundwater have not been taken into account. Given the extent of groundwater contamination at Eielson and at the adjacent Fort Wainwright Army Base, both of which sit atop the Tanana alluvium, remedies at the air Force base ought to be much more protective.

A glossary of terms and laws, commonly found contaminants, and a comprehensive discussion of environmental justice issues can be found in the accompanying document, *Overview of Key Issues at Alaska Military Superfund Sites.*

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Limited documentation is available online at:
http://www.eielson.af.mil/news/envr/main.htm and

http://www.state.ak.us/dec/dspar/csites/dod/rabs.htm

Site where Eielson Superfund documents are located:
Elmer E. Rasmusen Library, Archives Section (Administrative Records)
Alaska & Polar Regions Department
University of Alaska Fairbanks
Fairbanks, Alaska 99775
(907) 474-6594

Footnotes:
1 *Eielson Air Force Base, Record of Decision, OU-1*, U.S. EPA, September 1992.
2 *Eielson Air Force Base, Record of Decision, OU-1B* [Interim Remedial Actions], U.S. EPA, September 1992.
3 Eielson Air Force Base, NPL Site Narrative, www.epa.gov/oerrpage/superfund/sites/npl/nar1237.htm
4 Eielson Air Force Base, NPL Site Narrative, www.epa.gov/oerrpage/superfund/sites/npl/nar1237.htm
5 *Eielson Air Force Base 5-Year Review*, September 1998
6 *Eielson Air Force Base, Record of Decision, OU-1B* [Interim Remedial Actions], U.S. EPA, September 1992.
7 *Eielson Air Force Base 5-Year Review*, September 1998
8 *Eielson Air Force Base, Record of Decision, OU-1B*
9 *Eielson Air Force Base 5-Year Review*, September 1998
10 *Eielson Air Force Base, Record of Decision, OU-1B* [Interim Remedial Actions], U.S. EPA, September 1992.
11 Ibid
12 *Eielson Air Force Base Final Community Relations Plan*, U.S. Air Force, April 2000.
13 http://www.eielson.af.mil/news/envr/main.htm
14 Ibid
15 Ibid

[16] Ibid

[17] *Eielson Air Force Base, Amendment to the Record of Decision, OU- 3, 4, 5,* U.S. EPA, September 1998

[18] *Eielson Air Force Base, Record of Decision, OU- 3, 4, 5,* U.S. EPA, September 1995.

[19] Ibid

[20] *Eielson Air Force Base Restoration Program* web page, http://www.eielson.af.mil/new/envr/

[21] *Eielson Air Force Base 5-Year Review*, September 1998.

[22] *Eielson Air Force Base, Record of Decision, OU-1,* U.S. EPA, September 1992

[23] *Eielson Air Force Base 5-Year Review*, September 1998.

[24] Ibid

[25] Ibid

[26] personal communication, November 2002, Mary Jane Nearman, Project Manager, EPA

Prepared by Karen Button for Alaska Community Action on Toxics, 505 West Northern Lights Blvd, #205, Anchorage, AK 99503, (907) 222-7714, www.akaction.net. Based on a previous report by Dr. Lin Kaatz Chary, Lydia Darby, Dr. Lorraine Eckstein, Sharon Rudolph, Susan C. Klein, Pamela K. Miller, Elizabeth Movius, Felicien Poncelet, Dr. Ron Scrudato, and Sir Darby Muldoon. Funded by the Environmental Protection Agency, through an environmental justice grant. March 2003.

Elmendorf Air Force Base

Environmental Justice & Alaska Military Superfund Sites
Fact Sheet

Location:

Elmendorf Air Force Base is located within traditional Athabaskan lands and the Tanaina language region on the northern boundary of the Municipality of Anchorage on Cook Inlet.

Primary Contaminants:

- **Petroleum, Oils and Lubricants** (POLs): benzene, toluene, ethylbenzene, xylene (these four are also referred to BTEX, as a group), diesel fuels, gasoline
- **Volatile Organic Chemicals**: (VOCs): trichloroethane, (TCE), tetrachloroethene, benzene, vinyl chloride, carbon tetrachloride, ethylbenzene
- **Semi-Volatile Organic Chemicals:** (SVOCs): fluoranthene, pyrene
- **Persistent Organic Pollutants** (POPs): pesticides (including dieldrin, DDT and DDD), PCBs
- **Heavy Metals**: lead
- **Others:** chlorinated solvents (trans-1,2,-dichloroethylene, and chloromethane)

Note: The categories used here are those used by the Environmental Protection Agency for Superfund sites. Other methods of categorizing do exist. See www.epa.gov/reg3hwmd/bfs/regional/analytical. Chemicals listed as "Others" were those not found on the EPA's list.

History:

Elmendorf is located within the traditional lands of the Athabaskan peoples and within the Tanaina Alaska Native language region. It is upstream of a traditional fishing site for the Eklutna people and borders Cook Inlet, which has been traditionally hunted by local villages.

In a 1939 executive order, President Franklin Roosevelt designated public lands in Southcentral Alaska for military use. By 1940 168,000 acres were occupied by military personnel and Fort Richardson was established under the jurisdiction of the U.S. Army. In 1950, the Fort was divided between the Army and Air Force. The airfield at the fort was named Elmendorf Field, and in 1948, the airfield (encompassing about 13,000 acres) was renamed Elmendorf Air Force Base. In 1951, after the creation of the Department of the Air Force, jurisdiction of the base was officially transferred to the Air Force. Elmendorf now occupies 32,500 acres.

Although Elmendorf is within an urban area, it borders areas that continue to be important to Alaska Native peoples. Elmendorf's location is relevant regarding concerns about contamination of fishing and hunting areas that may be used to provide some portion of the yearly diet of affected Alaska Native communities. Several Alaska Native villages on both sides of the Cook Inlet, including Knik, Eklutna, Chickaloon, Alexander Creek, Tyonek, Pt. Possession, Kenai, Salamatof, and Ninilchik could potentially be affected by contamination migrating from the

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* Words in **bold** signify terms used in the world of Superfund. For a comprehensive discussion of Sueprfund law and how it works, please see the accompanying document, *An Overview of Key Issues at Alaska Military Superfund Sites.*

site by air or water. In addition, the base abuts Anchorage residential neighborhoods, which could also be affected by migrating toxins.

Activities that caused contamination are described within each specific site further on in this document.

Geography & Geology:

Elmendorf Air Force Base is bounded by the Knik Arm of Cook Inlet to the west and portions of the north. Ship Creek forms a portion of the southern border and runs through the base before emptying into the waters of Knik.

Approximately 1,592 acres within Elmendorf's boundaries are wetlands, important habitat for birds and other wildlife. Several other sensitive environments exist within, adjacent to, or down gradient from the areas of contamination at the base, such as moose habitat, beaver ponds, and several active fisheries (including salmon) in Ship Creek.[2]

There are two main groundwater aquifers on the Elmendorf moraine, including a deep confined aquifer, and a shallow unconfined aquifer, which appears to be separated from the deep aquifer by the Bootlegger Cove formation. This formation is made up of shallow marine deposits, silt and clay, which may be up to 250 feet thick at its maximum depth. It underlies the glacial moraine and outwash deposits that constitute the major geological feature of the contaminated areas of the base, and are below the surface cover.

The deep aquifer runs under the entire area of the base, generally flowing in a westerly direction from the Chugach Mountains toward the Knik Arm. The Municipality of Anchorage uses the deep aquifer extensively for industrial, commercial, domestic, and public supply uses. According to monitoring data from Elmendorf, this aquifer has not been affected by contamination from the base. The base itself relies on the public water supply for drinking water, using the deep aquifer only for backup purposes. According to the source documents for this report, the shallow aquifer is the immediate concern, because of historical contamination and its potential availability to humans, wildlife, and other organisms.

Most of the developed areas of Elmendorf are built on a glacial outwash plain alluvium, which is a relatively flat area of land made up of unconsolidated deposits of sand and silt left over after glacial melt. An alluvium is relatively porous, so contaminants that spill or are poured on the ground will migrate below the surface into the groundwater beneath.

Ship Creek is important to highlight because it runs through the Air Force base at its southern boundary. Although the *1998 Elmendorf Five-Year Review* reports that "There is no evidence of surface water contamination from sources on Elmendorf AFB,"[1] the deep aquifer and the upper basin of Ship Creek are interrelated. Ship Creek provides as much as one quarter of the total recharge to the deep aquifer system, which would have tremendous implications if the Creek were to be affected by contamination from nearby military installations.

Contamination Background:

Investigation of environmental contamination at Elmendorf was formally initiated in 1983. Since then 84 potential sources of contamination were identified, including five landfills classified as solid waste source areas. In August 1990, Elmendorf was placed on the **National Priorities List** (NPL) and became a **Superfund** site. In response, the Air Force, EPA, and Alaska Department of Environmental Conservation signed a **Federal Facility Agreement** for Elmendorf in November 1991.

The Air Force maintains primary responsibility for conducting **remedial** activities, with the State and EPA working jointly in planning and decision-making. The multilateral State-Elmendorf Environmental Restoration Agreement (SERA), between Elmendorf and the Alaska Department of Environmental Conservation was signed in October 1992. SERA addresses the cleanup and restoration of sites contaminated with petroleum, oils, and lubricants, not addressed under **Comprehensive Environmental Response Compensation and Liability Act**

(CERCLA). In the end, 37 source areas were addressed under **CERCLA** (the Superfund law) and 39 areas were addressed under the SERA; the remaining five sites were transferred to the base's Environmental Compliance Section as **RCRA (Resource Conservation and Recovery Act)**[1] sites.

In July 1998, the first five-year review of the remediation activities at Elmendorf was carried out. Remedial actions and long-term monitoring are ongoing at the site, with a second five-year review scheduled for late summer 2003.

Particularly notable in all these agreements is the lack of acknowledgement and inclusion of tribal governments none include tribal governments as equal partners in the process. This omission is discussed in more detail in the environmental justice section of this document.

Sources of Contamination:

The 37 CERCLA **source areas** were initially divided into seven **operable units** (OUs). Source areas in OU7 were subsequently redistributed among the other six OUs, so OU7 was removed from Superfund remediation and closed under the base's Environmental Remediation program.

After cleanup had begun, the Air Force initiated investigation of additional sites at Elmendorf thought to have been overlooked in the original effort to catalog all the contaminated sites. A number of new areas **of concern** (AOC) were revealed, which warranted further investigation. These sites ranged from oil barrel dumps to formerly used training sites. Studies of 22 sites were completed in 1997; three were identified as areas of potential environmental concern, 19 required no further action.

The two sites needing more study were investigated in 1998. SS83, a former World War II anti-aircraft artillery site near Six-Mile Lake, was found to be contaminated with fuel products, fuel-related chemicals and lead. An engineering evaluation/cost analysis (EE/CA) was begun in FY00. During the EE/CA, a landfill was discovered, which, as of the date of this writing, is still being evaluated for cleanup remedies.

DP98, where fuel products and slightly elevated levels of chlorinated solvents were found, was discovered during an underground tank removal. During further investigation in 2000, higher than anticipated levels of chlorinated solvents were measured. The site is now undergoing a formal Remedial Investigation under CERCLA. Rather than amend the former **Record of Decision** (ROD) for Elmendorf, a new ROD will address DP98 on its own. The ROD will be available for a 30-day public review within the first six months of 2003.

Superfund Source Areas:

All of the information in this section is adapted directly from the *Record of Decision (ROD) Abstracts for Elmendorf Air Force Base* on the EPA Superfund website,[1] and the *Environmental Restoration Five-Year Review for Elmendorf Air Force Base.*[9] Institutional controls, natural attenuation (also called intrinsic attenuation), and long-term monitoring (LTM) are included in the remedies of all operable units at Elmendorf AFB, even if not specifically noted in the text.

Operable Unit 1

Operable Unit 1 (OU1) consists of five general waste disposal areas, including landfills and gravel pits, located next to the Davis Highway. These landfills and general disposal areas received a variety of materials over the years, including old pesticide containers, used chemicals, scrap metal, asphalt drums, used chemicals and construction debris. Contaminants of concern at OU1 were identified as arsenic, 1,2-dibromethane (EDB), polychlorinated biphenyls (PCBs), lead, manganese, vinyl chloride, and volatile organic chemicals (VOCs). Although not listed as a contaminant of concern, it is known that refuse-containing asbestos was dumped at one of the landfill source areas in OU1.

OU1 is located approximately three-quarters of a mile northeast of an Anchorage subdivisioin; it is separated from that populated area by Ship Creek. The area is zoned as undeveloped outdoor recreational use and consists of grassy fields, gravel pits and wooded areas adjacent to Ship Creek. The only medium of concern noted in the available documents is the groundwater, and all remediation activities were geared toward preventing further contamination and the spread of contamination in the groundwater. The selected remedial actions for this site included establishing institutional controls to the site; monitoring groundwater for five years; and evaluating the monitoring results periodically to determine if there is need for further remedial action.

At the time of the 1998 five-year review it was reported that response actions were ongoing. EDB (a highly toxic fungicide also used as a petroleum additive) and vinyl chloride (a carcinogen) were reported as being below detection limits and cleanup goals. Two additional contaminants, manganese and the volatile organic chemical trichloroethylene (TCE), were found to be migrating downstream through the groundwater (downgradient). As there are no reported drinking water wells within or down gradient of OU1, and because the chemicals are diluted as they move down gradient, the *Five-Year Review* determined that there was no evidence of a current or future threat to human health or the environment. Based on current cleanup goals, the groundwater at OU1 is expected to reach cleanup goals through **natural attenuation** by 2004.

Operable Unit 2

This OU contained two areas where underground storage tanks (USTs) had been constructed. Storage tank 20 is located in the central portion of the base and ST41 is located in the western part. ST20 is the former site of a 338,000-gallon UST used to store bunker C fuel oil for the original base power plant. After the power plant was shut down, the tank stored waste oils, used solvents, and other wastes generated by industrial shops. The tank was cleaned and demolished in 1990. ST41 is the former site of four one-million gallon USTs. The primary contaminants of concern at this site were petroleum, oils, and lubricants as well as petroleum-related contaminants.

An interim Record of Decision (Air Force, 1992) for the groundwater contamination at ST41 was signed in September 1992. It mandated treatment efforts to address free product and dissolved phase contaminants (from petroleum spills) in the groundwater. A system was designed to remove product from the groundwater table and to decrease off-site migration of contaminants from groundwater seeps on the north and south sides of storage tank 41. During the operation of the groundwater treatment system at ST41, far less fuel product was recovered than predicted. When the underground storage tanks and associated pipelines were removed in 1996, it was discovered that the tanks and pipeline system had not leaked as assumed in the original conceptual site model. The fuel at the groundwater seeps were found to be coming from a woodstove pipe that drained the valve pits at each tank.

During the evaluation of the ST41 treatment system (Air Force, 1997a), a complete review of historical spills was completed which revealed that the Remedial Investigative/ Feasibility Study and ROD had erroneously reported two catastrophic spills (since the mid 1970's) that could not be confirmed through a complete search of base records. One spill was reported to be several million gallons and the other several hundred thousand gallons. It is now believed, by the agencies, that these two catastrophic spills never occurred. With this information, a new conceptual site model was developed that illustrates there is less fuel to recover than what was originally anticipated and explains why large quantities of fuel have not been recovered.

The final ROD for OU2 (Air Force, 1995b) was signed in May 1995. It focused on removal of contaminant sources and continued groundwater cleanup at storage tank 41. Due to minimal soil contamination at ST20, this site was designated as needing **no further action**. This final ROD incorporates the interim remedial action, and includes additional remedies for source control and groundwater remediation. The selected remedy for ST41 groundwater included monitoring the groundwater beneath and adjacent to the site to evaluate contaminant migration and waiting for the reduction of contaminant concentrations by **natural attenuation** within 21 years. The first five-year review in 1998 assessed the protectiveness of the remedial action and determined that all site activities were adequately protective of human health and the environment, and that a major reduction of risk had been achieved. Surface water monitoring and groundwater data confirmed that dissolved contamination is not migrating and that natural attenuation is occurring, meaning that the expectation continues to be that cleanup goals – all contaminants below maximum contaminant levels – will be achieved by 2016.

Institutional controls that restrict access to groundwater will be implemented at the site as long as hazardous substances remain at levels that preclude unrestricted use. The specific institutional controls include: development of a site map that shows the areas currently and potentially impacted by groundwater contaminants to be included in the Base Comprehensive Plan; zoning the affected area for undeveloped outdoor/recreational use only; continued enforcement of base policy that prohibits installation of groundwater wells (other than for monitoring purposes) into the shallow aquifer underlying OU2; and prohibition of unauthorized access to existing water supply and groundwater monitoring wells.

To ensure long-term integrity of the above land use controls, the Air Force will ensure that deed restrictions or equivalent safeguards will be implemented in the event that property containing groundwater contamination is transferred from Air Force ownership.

It should be noted that the ROD assumes groundwater is the only **pathway** for contaminants and that use of the site for recreational purposes is acceptable. It is unclear whether or not children will be allowed to use the site, or whether recreational activities include hunting and fishing.

Operable Unit 3

OU3 is located in the southwest quarter of Elmendorf, on relatively flat terrain at an approximate elevation of 150 feet above sea level. As part of the ongoing mission at Elmendorf Air Force Base, shop facilities, storage buildings, and hangars located within OU3 are used to support base operations. These facilities have been in operation for over 30 years.OU3 consists of three source areas and one **receptor** area called Cherry Hill Ditch. Cherry Hill Ditch is an artificial drainage channel that flows westward from the east-west runaway toward Knik Arm. The source areas include: a former shop waste disposal site (SD16), a former PCB transformer storage area (SS21), and a dry well at an aircraft maintenance hangar (SD31). Site SD52 (Cherry Hill Ditch) is not considered a source of contamination but did receive water runoff from the eastern portion of the base, and was considered a contaminated receptor of PCB contamination. Presently, the eastern portion of the area is occupied by heavy equipment and the northern portion is used to stockpile snow during the winter.

Contaminants of concern at this site included polychlorinated biphenyls (PCBs), waste solvents, shop wastes, and pesticides. Remedial action focused on cleaning up the PCBs and contaminated sediments. The remedies selected were the excavation of PCB-contaminated soil and transfer to the Lower-48 states for disposal, backfilling and grading of the site to its original elevation, and landscaping. In 1994, low levels of PCBs were capped in the bottom of Cherry Hill Ditch and a storm water diversion project was completed. By 1998, some 980 tons of PCB-contaminated soil had been removed from the site. Subsequent soil samples demonstrated that there were below 0.6 ppm of PCBs remaining in the soil (which is probably below background levels), and the site was reopened for unlimited and unrestricted use. The only restriction remaining (as required by other RODs) are institutional controls that prohibit the use of the shallow aquifer in the outwash plain for groundwater in this operable unit.

Operable Unit 4

OU4 consists of ten source areas, including floor drains in eight maintenance facilities (SD24 through SD30 and SS18), a fire training area (FT23), and an asphalt drum storage and processing area (SS10). Eight of the ten source areas in OU4 are located north of the east-west runway. The remaining two source areas (SD30 and SS18) are located south of the east-west runway, near Second Street between operable units 3 and 5. Due to minimal soil contamination at SD26, SD27, SD30, and SS18; these have been designated as no-further-action sites, and decision documents were signed in May 1993.

Operable Unit 4 is divided into two sections: OU4 West and OU4 East. Land use for both includes light industrial, aircraft operations and maintenance, and an airfield. Light industrial use includes maintenance, storage, and supply functions directly related to aircraft. Primary land use within OU4 is for airfields, which includes active and inactive runways, taxiways, and parking aprons for aircraft. Other land uses include designated outdoor recreation and open areas. The right-of-way for the Alaska Railroad is located in OU4 East. The Base Master Comprehensive Plan has designated this area for airfield, and aircraft operations and maintenance in the future, which affects the acceptable levels of risk for human health and the environment in decision documents.

Contaminants of concern at OU4 included benzene, 1,1-dichloroethene, 1,2-dichloroethane, trichloroethene, dieldrin, chloroform, chloromethane, carbon tetrachloride, vinyl chloride, toluene, ethylbenzene, cis-1,2-dichloroethene, tetrachloroethene, 1,1,1-trichlor benzo(a)anthracene, PCB-1260, benzo(k)fluorsnthene, indeno(1,2,3-cd)pyrene, benzene, BTEX, diesel, gasoline, jet fuel, and kerosene. All of these chemicals are petroleum or fuel-gas constituents, also called diesel-range organics and gas-range organics and are related to the land uses of the source area for maintenance, fueling, and other petroleum-related activities.

Selected remedies included **intrinsic remediation**[2] for the groundwater, and *in situ* bioventing for soils that were contaminated at levels greater than five feet in depth (which could potentially contribute to contamination of the groundwater). No detailed information about the bioventing was available in agency documents used for this report, but in the administrative record for Fort Richardson (where bioventing was also used) it is clearly stated that the air emissions for the bioventing were monitored and were required to meet regulatory limits. At the time of the 1998 five-year review, sufficient intrinsic attenuation had occurred. Cleanup goals for the soil had been reached for two source areas. As a result, no further monitoring is being conducted at these sites, but institutional controls have been established and will continue until all of OU4 meets cleanup goals.

Reviews in 1997 and 1998 continued to find contamination in deep soils that exceeded cleanup levels for fuel-related constituents such jet fuel, diesel-range organics and gas-range organics. The groundwater in the shallow aquifer also exceeded cleanup levels of benzene, ethylbenzene, toluene, and other solvents. Monitoring and bioventing will continue until cleanup goals are achieved, and institutional controls will continue to be relied upon to protect human health and the environment from exposures. It should be noted that flight operations continue in the area of the remediation activities, which assures that some level of contamination will inevitably continue as long as those activities continue.

Operable Unit 5

OU5 is located along the southern boundary of the base. It is a geographically diverse area that covers an area over 7,000 feet long and 1,200 feet wide. OU5 is known to capture approximately 90% of the groundwater flowing from Elmendorf. In the western part of OU5, a steep bluff gives way to a broad flat area that ends in Ship Creek. In the eastern area, a more gently sloping bluff leads to a wetland identified as the Beaver Pond area, where there are several shallow connected water bodies and marsh areas. The central part of the operable unit is a transitional area with a bluff and some surface water features, including a snowmelt pond and a fish hatchery. The snowmelt pond is an elongated shallow water body measuring approximately 50 x 300 feet formed by beavers backing up natural drainages. It is called the snowmelt pond because snow is often piled on top of the bluff near the pond.

Land uses in OU5 vary. An Army Corps of Engineers building is located near the western side of the operable unit above the bluff. Some military residential units are located back from the bluff on the eastern and western sides of the operable unit. Ship Creek flows from east to west along the southern edge of the base. The primary land use is light industrial, including the presence of diesel, jet, and multi product fuel and distribution lines. These fuel lines have leaked fuel into the soil and groundwater surrounding the pipelines. Before the leaks could be detected, fuel product and fuel constituents, such as benzene, migrated from the leak to the water table. This migration from source areas is the primary cause of contamination at OU5.

Major contaminants of concern are identified as primarily solvents and volatile organic chemicals related to fuel constituents. PCBs are also identified, with the implication that they migrated from other operable units upgradient from OU5. The risk assessment considered the current and future transport of contaminants to potential receptors, which at this site include soil, sediment, groundwater, and surface water. Solvent constituents, primarily

Trichloroethylene (TCE), were detected in the upper aquifer groundwater in OU5. Upgradient sources from Operable Unit 5 (Operable Units 1, 2, 3, 4 and several SERA sites) are the source of some of the groundwater contamination in Operable Unit 5. Regardless of the source of contamination, groundwater contamination is being treated through Operable Unit 5 remedial actions.

The ROD for OU5 (Air Force, 1995d) was signed in February 1995. Remedies rely heavily on natural attenuation and other passive approaches. Source area ST37, which included both TCE and PCB contamination, is the one exception. In this area, approximately 3,000 cubic yards of soil contaminated with fuel were excavated and treated at an on-base treatment facility, and contaminated seep water in the western and middle portions of OU5 from this area was passively drained using horizontally inserted extraction wells in the bluff. A wetland was constructed to receive the contaminated seep water at the location of the snowmelt pond. A layer of gravel was placed over sediments in the snowmelt pond to isolate low levels of PCB contamination. Monitoring is ongoing and will be fully reviewed in the upcoming five-year review, late summer, 2003.

Although the *1998 Five-Year Review* maintains that the OU5 remedies (which are functioning as designed) remain protective of human health and the environment, serious questions remain about the efficacy of institutional controls in protecting wildlife from the contaminated areas. Land use restrictions, including fencing and signs, may be adequate to prevent human access to the site, but given that response actions at OU5 are expected to continue for over twenty years into the future, it is doubtful that this approach is adequately protective of the environment. Relying on the transfer of contamination from one medium to another through evaporation and volatilization as a means of remediation, and attempting to maintain and monitor large tracts of contaminated soils and groundwater are clean up strategies that should be examined. These practices do not constitute progressive environmental health policy. This is an issue which ought to be brought into the 2003 five-year review discussion. Thousands of residents and non-residents eat salmon from Ship Creek annually. The State DEC and Elmendorf should conduct a joint study of contaminant levels in Ship Creek salmon populations to give the public adequate information about inherent risks associated with food consumption, and to more holistically address cleanup goals for the Creek.

Operable Unit 6

OU6 consists of six source areas: three former landfills, two sludge disposal pits, and a surface disposal area around a rock-testing laboratory. Past landfill and general waste management practices are the principal reason for the contamination present at these sites. In addition, several fuel lines and the associated valves and storage tanks associated with the base fueling facilities are located within OU6 source areas. These fuel systems have leaked fuel into the soil and groundwater surrounding these facilities. Three of the sources are in the northern part of the base, and three are in the southern part of the base.

Major contaminants of concern include benzene, ethylbenzene, toluene, 1,2-dichloroethane, methylene chloride, 1,1,2,2-tetrachloroethane, 1,1,2-trichloroethane, trichloro-ethane, and lead; all of which are fuel-related chemicals. Pesticides were also found to be contaminating soil at one of the source areas, SS19. As a result, an expedited response action was conducted at the site to remove the soil, which was accomplished in 1995. Following this, it was determined that the residual risk was at an acceptable level (primary data regarding levels was not available for this report), which can be assumed to mean that the remaining pesticide levels in the soil were below **maximum contaminant levels** (MCLs), and the source area was designated as requiring no further action.

The Knik Bluff Landfill (LF04) was used for disposal of construction rubble, debris and other solid waste from 1945 to 1957. It parallels the Knik Arm with a steep bluff that drops about 200 feet down to the shoreline. Daily tidal action erodes the base of the bluff causing it to subside into the ocean, leaving approximately 20 acres of solid wastes exposed. Although the primary contaminant found is benzene, unexploded ordinance (UXO) was discovered in 1999. Institutional controls include fencing and "no trespassing area" signs, groundwater testing is ongoing and debris on the beach is removed annually to prevent human exposure to the wastes. The Air Force has agreed to maintain these land/groundwater use controls indefinitely.[11]

Remediation at OU6 included several cleanup activities in addition to monitoring and institutional controls. At two sites, recoverable quantities of free product found on top of the water table were removed during groundwater monitoring events. Annual debris removal on the beach was proposed, which was done in 1997 as reported in the 1998 five-year review. Debris removal at other source areas was accomplished as of 1996, and soil covers were constructed over three areas to minimize potential human exposure to lead contaminated soils in these areas. Groundwater in one source area was treated by a high-vacuum-extraction process to remove contaminants including removable free product. Groundwater in all other source areas was included in the base wide monitoring program and sampled twice yearly. Institutional controls are also listed as remedial actions to prohibit the use of the shallow aquifer and/or designate the areas as "restrictive use area" to prohibit the construction of any sort of manned facility, such as an office building or residence.

As of the *1998 Five-Year Review*, all of these activities were operational and considered to be protective of human health and the environment.

Risk Assessment:

Two risk assessments are done for each operable unit. One assesses the effects of contaminant exposure to human health and the other to wildlife and the environment. An initial risk assessment establishes baseline conditions at the time of the remedial investigation. At this time, if contaminant levels measured at the site are below what the EPA considers to be a risk to human health or the environment, they rule that action is not warranted. This is called "acceptable risk." With regard to the site, it means the EPA has determined that the expense of cleanup is greater than the risks to human health presented by not cleaning up. Due to this concept of acceptable risk, many contaminants will remain present in the environment at some level.

Two main problems arise out of this traditional model of assuming there is some level of exposure that is "safe." One: there is no way of knowing what is safe. For example, very little information is known about how different chemicals at the same site will interact with one another, or react in a person's body that already has another chemical present (this is a process called synergistic affects). Two: the old toxicological approach that "the dose determines the poison" is being proven unsound. Recent research shows a key factor to human health is not dosage as much as it is timing of exposure, such as during pregnancy, puberty, or menopause. Certain persistent pollutants, such as dioxin, PCBs, and pesticides, can interfere with cellular and molecular processes that may manifest only years later as cancer or show up only in offspring.

These issues represent what is called *uncertainty.* Under the current paradigm of risk assessment, the burden of uncertainty falls entirely on those who are exposed to the contaminants.

The *uncertainty* discussed in the EPA risk assessments is related, but is expressed somewhat differently. Records of decision always include a section that states, "Health risk assessment methodology has inherent uncertainty associated with how accurately the calculated risk estimates represent the actual risk,"[3] and it is acknowledged that risk in the laboratory is not the same as risk in the field. Uncertainties may overestimate- or under-estimate the calculated risks. Some of the kinds of uncertainty the EPA recognizes include the possibility of underestimating risk because groundwater detection limits for some contaminants are higher than risk-based screening concentrations, in other words, uncertainty due to the time of year samples were drawn, the possibility that two few surface soil composite samples may have been taken, or that standardized calculations may not accurately reflect Arctic conditions.

A third issue with risk assessment is particular to Alaska and is relevant in terms of environmental justice. In order to accurately assess risk to human health, the assessment must take into consideration the dietary intake of the population being evaluated.

In the risk assessment paradigm, the question asked is: how much damage is safe? Instead, the question should be: how little damage is possible? This can be accomplished by shifting the paradigm to the Precautionary Principle in which the burden of uncertainty bore by the public is replaced by the burden of proof of lack of harm, which is bore by the proponents of an activity (in this case, the Army, the EPA and the State Department of Environmental Conservation).

A more in-depth discussion of risk assessment, including exposure pathways and routes of exposure, is available in the *Overview of Key Issues at Alaska Military Superfund Sites*, which accompanies this report.

Conclusions:

Elmendorf Air Force personnel did not adequately address environmental justice in the process, however, with DP98 undergoing a formal CERCLA Remedial Investigation, the opportunity exists to do otherwise. The EPA and Elmendorf should include local tribes in all investigative and decision-making steps, so as to fulfill government-to-government obligations under federal statute.

With the upcoming Five Year Review, due in late summer of 2003, areas that the public may want to pay particular attention to: SS83 – a landfill discovered in 2001, the extent of contamination is unknown at this time, however, significant levels of lead are already known to be present; OU5 - because 90 percent of the shallow aquifer flowing through Elmendorf flows through this area, and much of the waters end up in Ship Creek, this site is of particular importance. The Air Force ought to participate in more holistic approaches given that fish hatcheries and salmon habitat play an important role in public consumption of the fish; and Knik Bluff Landfill (LF04) - tidal erosion continues to expose contaminated waste on the shoreline. The Air Force is researching other methods of cleanup other than annual removal of the debris.

In general, the Air Force and Navy have chosen natural attenuation for most groundwater contamination at their Superfund sites in Alaska, while the Army has been more willing to install active cleanup systems. The Air Force should follow this example and apply more active systems, especially in areas, such as OU5, where the migration of groundwater contamination could pose serious consequences. The Air Force should also pay particular attention to cleanup of areas contaminated with POPs.

Finally, the authors had this space reserved to commend the Air Force for making some of the their Elmendorf Superfund documentation available on the Internet. Up until early March 2003, one could easily access this information through their website. Now, however, the website has changed, with absolutely no reference to environmental issues, nor the ability to do a search. Unfortunately, the Air Force has taken a step backward instead of forward. The Air Force and the Army should follow the example of Adak and provide the public with a webpage devoted to their contaminated sites. Adak can be viewed at www.adakupdate.com.

A glossary of terms and laws, commonly found contaminants, and a comprehensive discussion of environmental justice issues can be found in the accompanying document, *Overview of Key Issues at Alaska Military Superfund Sites.*

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Limited information is available online at:
http://www.state.ak.us/dec/dspar/csites/dod/rabs.htm

Sites where Elmendorf Superfund documents are located:
Alaska Resources Library (Administrative Records)
3150 C Street
Magnum Electronics Building
Anchorage, AK 99513

University of Alaska at Anchorage Consortium Library (Selected Documents)
Reserve Desk
3211 Providence Road
Anchorage, AK 99508

Footnotes:

[1] U.S. EPA Superfund, Record of Decision (ROD) Abstracts, Elmendorf Air Force Base, http://www.epa.gov/superfund/topics.htm.

[2] "Intrinsic remediation" is the same thing as natural attenuation, which refers to the process of eventual natural elimination of contaminants from media either by virtue of biodegradation, volatilization, or simple transfer to another medium due to weather, animals, etc. The EPA referred to the same process by different terms in RODs signed before 1998. The term now in use is "monitored natural attenuation". Environmentalists ironically refer to this so-called remedy as, "Dilution is the solution to pollution."

[3] Site Summary Update November 1999

Prepared by Karen Button for Alaska Community Action on Toxics, 505 West Northern Lights Blvd, #205, Anchorage, AK 99503, (907) 222-7714, www.akaction.net. Based on a previous report by Dr. Lin Kaatz Chary, Lydia Darby, Dr. Lorraine Eckstein, Sharon Rudolph, Susan C. Klein, Pamela K. Miller, Elizabeth Movius, Felicien Poncelet, Dr. Ron Scrudato, and Sir Darby Muldoon. Funded by the Environmental Protection Agency, through an environmental justice grant. March 2003.

Fort Richardson Army Base

Environmental Justice at Alaska Military Superfund Sites
Fact Sheet

Location:

Fort Richardson is located within traditional Athabaskan lands and the Tanaina language region on the northern boundary of the Municipality of Anchorage on Cook Inlet.

Primary Contaminants:

- **Petroleum, Oils and Lubricants** (POLs): benzene, toluene, ethylbenzene, xylene (these four are also referred to BTEX, as a group), diesel fuels, gasoline
- **Volatile Organic Chemicals**: (VOCs): trichloroethane, (TCE), tetrachloroethene, benzene, vinyl chloride, carbon tetrachloride, ethylbenzene
- **Semi-Volatile Organic Chemicals:** (SVOCs): polycyclic aromatic hydrocarbons (PAHs), such as fluoranthene, pyrene
- **Persistent Organic Pollutants** (POPs): pesticides (including DDT and DDD), PCBs
- **Heavy Metals**: lead
- **Munitions:** white phosphorus & other unexploded ordnance (UXO)
- **Others:** chlorinated solvents (trans-1,2,-dichloroethylene, and chloromethane)

Note: The categories used here are those used by the Environmental Protection Agency for Superfund sites. Other methods of categorizing do exist. See www.epa.gov/reg3hwmd/bfs/regional/analytical. Chemicals listed as "Others" were those not found on the EPA's list. Chemicals listed as munitions are of particular concern and are discussed in more detail under the Eagle River Flats Source Area.

History:

Ft. Richardson is located within the traditional lands of the Athabaskan peoples and within the Tanaina Alaska Native language region.

In a 1939 executive order, President Franklin Roosevelt designated public lands in Southcentral Alaska for military use. By 1940, 168,000 acres were occupied by military personnel and Fort Richardson was established under the jurisdiction of the U.S. Army. Fort Richardson now occupies 56,000 acres of land adjacent the Municipality of Anchorage, Alaska's largest city.

Although Ft. Richardson is within an urban area, it borders areas that continue to be important to Alaska Native peoples. Elmendorf's location is relevant regarding concerns about contamination of fishing and hunting areas that may be used to provide some portion of the yearly diet of affected Alaska Native communities. Several Native Alaskan villages on both sides of the Cook Inlet, including Knik, Eklutna, Chickaloon, Alexander Creek, Tyonek, Pt. Possession, Kenai, Salamatof, and Ninilchik could potentially be affected by contamination migrating from the site by air or water. Given the diverse number and character of the activities at Fort Richardson, significant hazardous waste was generated on the base, including contaminants of concern to communities that rely on wide-ranging wildlife species for subsistence foods. In addition, the base includes lands through which salmon-bearing creeks feed urban residents, and host hatcheries important to local fisheries.

* Words in **bold** signify terms used in the world of Superfund. For a comprehensive discussion of Sueprfund law and how it works, please see the accompanying document, *An Overview of Key Issues at Alaska Military Superfund Sites.*

Fort Richardson was added to the U.S. **Environmental Protection Agency** (EPA) **National Priorities List.** (NPL) in June 1994. On December 5,1994, the Army, Alaska Department of Environmental Conservation, and the EPA signed a **Federal Facility Agreement** that outlines the procedures and schedules required for a thorough investigation of suspected hazardous substances at Fort Richardson. Under the agreements, all **remedial response** (cleanup) activities will be conducted to protect public health and welfare and the environment, in accordance with **CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act)**, the National Contingency Plan (NCP), the Resource Conservation and Recovery Act (RCRA), and applicable state laws. CERCLA is the law that governs investigation, risk assessment, and cleanup activities for designated **Superfund** sites.

None of these agreements include tribal governments nor is there acknowledgement of the status of tribal governments as equal partners in the process. The agencies involved insist their invitations of local tribes to the **RAB (Resource Advisory Board)** meetings are adequate. A tribal liaison has never been assigned to the project. This omission and other issues related to environmental justice are discussed in more detail in the *Overview of Key Issues at Alaska Military Superfund Sites.*

Activities that caused contamination are described within each specific site further on in this document.

Geography & Geology:

Fort Richardson Army Base is bounded to the west by Elmendorf Air Force Base, along the southern and eastern boundaries by the Chugach Mountains and State Park, to the north by Knik Arm of Cook Inlet, and to the south by the Municipality of Anchorage. The Glenn Highway bisects the base.

Topographical features include flat to rolling wooded terrain. Upland areas near the adjacent Chugach Mountain Range rise to approximately 5,000 feet above mean sea level. Vegetation is made up of stands of mixed coniferous and deciduous forest of varying ages. Diversity in plant communities provides habitats for a large wildlife population including moose, bear, Dahl sheep, swans, and waterfowl.

Fort Richardson is believed to overlie a major portion of the recharge area for the confined aquifer that serves Anchorage. Groundwater recharge originates in the Chugach Mountains and probably involves the entire glacial outwash underlying the landfill and major portions of Fort Richardson south of the Elmendorf moraine (Cederstrom et al. 1964).

The primary source of raw water for the central water supply system that serves the city of Anchorage and Fort Richardson is a permanent 2.5 million-gallon underground reservoir located along Ship Creek approximately 7 miles upstream of the Fort Richardson Landfill. Logs from the Fort Richardson fish hatchery, located about two miles south of the landfill, show aquifers ranging in depth from 38 to 144 feet deep. These logs, coupled with the proximity of Ship Creek, suggest that a shallow aquifer is hydraulically connected to the creek.

Sources of Contamination:

Contaminated sites at Ft Richardson include landfills, disposal areas and spill sites, fire fighting training areas, storage tank areas, buildings, and the Eagle River Flats, for a total of nineteen source areas.

A Federal Facility Agreement between the State Department of Environmental Conservation, the Army, and the Environmental Protection Agency divided Fort Richardson into four **operable units** (OUs): OU-A, OU-B, OU-C, and OU-D. These include landfills, disposal areas and spill sites, fire fighting training areas, storage tank areas, buildings, and the Eagle River Flats, for a total of nineteen source (of contamination) areas. During clean-up activities in summer 2002, groundwater contamination in OU-D was sourced to a previously unknown location. With that discovery, OU-E was added.

Superfund Source Areas:

Operable Unit A

Operable Unit-A comprises three source areas. **Contaminants of concern** at this operable unit include heavy metals, petroleum, polychlorinated biphenyls (PCBs) and dioxin. Even though all these contaminants were present, the 1997 **record of decision (ROD)** determined the principal contamination was petroleum and would be the only contaminant addressed. Since CERCLA does not address petroleum, a **Two-Party Agreement** was developed between Alaska Department of Environmental Conservation and Fort Richardson for these sites.

Source Area One: The Roosevelt Road Transmitter Site Leachfield (Transmitter Site) is located north of the main Fort area near Otter Lake and includes an underground communications bunker used from World War II through the Korean War. In 1978, vandalism in this area resulted in a spill of dielectric fluids containing PCBs. The concrete foundation of the former transmitter annex building was then washed with diesel fuel in an effort to clean up the PCBs. In 1988, 150 tons of PCB-contaminated soil surrounding the concrete pad was excavated, and in 1992, at least 600 tons of PCB-contaminated soil was removed. It was determined the site required no further action, land use controls were put in place to prohibit unwarranted use of the site.

Source Area Two: The Ruff Road Fire Training Area (Fire Training Area) is located east of Bryant Airfield near the Glenn Highway. The site consists of an area used for fire-fighting exercises from the 1940s to 1980. These exercises involved applying fuels and other waste combustible liquids to an unlined earthen pit, igniting the fuels, and extinguishing the resulting fires with water. Between 1986 and 1992, three investigations of the site documented the presence of petroleum hydrocarbons; benzene, toluene, ethylbenzene, and total xylenes. Dioxins were found in surface and subsurface soils at the site. The highest levels of contamination were detected in the surface and near-surface soils in the immediate area of the fire training pit. This area later was regarded, and much of the original surface soil was spread and/or buried under three feet of fill or less. No further remediation was deemed necessary, and the risk assessment concluded the site presented no "unacceptable" risks of cancer or non-cancer hazards.

Source Area Three: The Building 986 Petroleum, Oil and Lubricant Laboratory Dry Well (Dry Well) is located at Building 986 near Loop Road and Warehouse Street. The well was used for the disposal of drain and sink water from the adjacent petroleum oil and lubricants laboratory. Numerous chemicals were used at the laboratory during quality testing of fuels used at Fort Richardson. The remedy for the POL lab was removal of a drywell (the source of contamination).

Exposure pathways for the **Human Health Risk Assessment** were evaluated in operable unit-A on the basis of recreational and industrial exposure. Two pathways were assessed: First, ingestion of soil and/or inhalation of vapors or dust; and, second, groundwater.

The **Ecological Risk Assessment** must address impacts and potential risks posed by to natural habitats, including plants and animals, in the absence of remedial action. For this risk assessment, the masked shrew, red fox, robin, and kestrel were the species selected to determine the impacts of contaminants on wildlife. Based on the risk analysis, the Army determined the potential for adverse effects negligible.

The two risk assessments concluded that only the petroleum derivatives found at the Fire Training Area were at levels high enough to pose a threat to human health or the environment. Therefore, no further remediation was necessary under Superfund requirements at any, but this site.

Operable Unit B

Operable Unit B consists of one source area: the Poleline Road Disposal Area (Poleline Road).

Poleline Road is located approximately one mile south of the Eagle River and 0.6 mile north of the Anchorage

Regional Landfill in a low-lying wooded area at Poleline Road and Barrs Boulevard. In 1990, Poleline Road was identified as having been used as a disposal area for chemicals, smoke bombs, and Japanese cluster bombs from 1950 to 1972. During this time, chemical agent identification sets and other military debris were burned and disposed of in trenches. The chemical sets were neutralized with a mixture of bleach or lime and chlorinated solvents before burial.

During soil excavation of the site, groundwater was discovered at 14 feet below the surface. Sampling indicated the presence of chlorinated solvents, including TCE, PCE; and 1,1,2,2- tetrachloroethane, in soil and groundwater within 20 feet of the surface. This soil was removed in 1997. Not all areas were sampled due to the potential presence of unexploded ordnance. However, geophysical surveys of these areas indicated that they contained lesser quantities of buried waste. Sampling of soil and groundwater surrounding the areas of concern did not detect any compounds or breakdown products associated with ordnance, but did detect relatively lower concentrations of chlorinated solvents.

The contaminants of concern at OU-B have contaminated the groundwater. The area with the greatest contamination at the site was referred to as the *"hot spot,"* which is approximately 150 feet by 300 feet. The results of the **Remedial Investigation** indicated the presence of chlorinated solvents in soil up to a maximum concentration of 2,030 mg/kg for 1,1,2,2-tetrachloroethene. These are extremely high levels.

Four separate groundwater zones were identified at Poleline Road, all of which show levels of contamination. Contaminants in all four zones suggest that they are interconnected. TCE concentrations in these zones exceeded the state and federal maximum.

Nevertheless, based on analytical results from surface and subsurface soil, the risk of cancer and non-cancer health effects from exposure to low concentrations of solvents in soil was determined to be negligible.

Federal and state regulations require protection and restoration of water resources. Contamination of OU-B groundwater if used as a drinking water source, presents an unacceptable risk to human health. But, groundwater at OU-B is not used, there are no known residents or wells down gradient of the site, and there are no current plans for commercial or residential development in the site area. Because the contaminated soils are 14 feet below ground surface, the likelihood of direct exposure to humans was considered unlikely and therefore not expected to pose a threat to human health, however they pose a potential for continuing contamination to groundwater.

In the end, it was determined that remedial action was appropriate to address actual or threatened releases of chlorinated solvents to the groundwater.

The remedial alternative chosen consists of **high-vacuum extraction** of the "hot spot" and **institutional controls** with long-term groundwater monitoring to assess the progress of **natural attenuation** and/or plume migration of the contaminants remaining after the extraction is completed. This alternative also includes enforcement of land use restrictions designed to prohibit extraction and use of the groundwater. Periodic **groundwater monitoring** will be conducted to track the progress of contaminant breakdown and provide an early indication of unforeseen environmental or human health risk.

The estimated time frame for cleanup goals to be achieved in the "hot spot" was seven to twelve years, but was greatly reduced due to use of a six-phase soil heating system. As of summer 2002, the Army reported soil contaminant levels in the "hot spot" areas were reduced by about 97 percent, and an approximate 70 percent decrease of contaminant levels in groundwater.[1] Unfortunately, even with the great success, the Army chose not to use the system for other contaminated soils due to cost. This is indicative of many of the chosen remedies where short-term costs override long-term protection.

The estimate for the remainder of the plume to remediate and for monitoring to be performed is 150 years, although the cost estimate includes only thirty years of annual operation costs. The practice of transferring contamination from one medium – the soil and/or groundwater – to another, the air, is not an environmentally positive approach. It simply transfers the risk from one pathway to another. It is important that monitoring and surveillance of the process be done carefully to assure that the air released to the atmosphere does not further contribute to the global transport of toxics.

The question of using institutional controls as a remediation alternative is a concern that EPA itself has voiced concerns about. In comments to the Directorate of Public Works at the U.S. Army Alaska Headquarters in

Anchorage on the OU-B Preliminary Remediation Design Plan, EPA Region 10 states,

> While future land use at the site may remain under DOD control, the future of many DOD installations is unclear in light of potential future BRAC legislation and the uncertain time frame for funding of such programs. The risk assessment section does adequately compare its findings to conservative residential standards; however, given the persistence and mobility of TCE, PCE, and 1,1,2,2-tetrachloroethene, the potential to impact ground and surface water resources for some time in the future should not be minimized.
>
> There is no reason to believe that people will stop inhabiting the Anchorage area. It is therefore appropriate to question the long-time reliance on institutional controls.

However, long-term monitoring is the current remedial action, being conducted on the deep aquifer to ensure that contamination in the groundwater is decreasing through natural attenuation.

Operable Unit C

Operable Unit-C comprises two source areas: the Eagle River Flats an ordnance impact area, and the former Open Burning/Open Detonation (OB/OD) Pad.

Source Area One: Eagle River Flats is a 2,160-acre estuarine salt marsh at the mouth of the Eagle River. Eagle River, which flows through the fort's land before it empties into Knik Arm, is used for recreational rafting and fishing. It supports king, silver, red, pink, and chum salmon; dolly varden; arctic char; rainbow trout; grayling; and whitefish, and maintains spawning runs of Chinook, Coho, and pink salmon. Stickleback inhabits salt marshes along the Knik Arm and is common within the shallow ponds and some impact craters within the Flats. The American peregrine falcon, a federally designated endangered species, and the federally designated threatened Arctic peregrine falcon, migrate through the area. The Flats are surrounded by forested uplands on the west, south, and east sides. Two creeks, the Clunie and Otter, drain into the Flats. Although the Flats are an active impact area, the area remains a productive wetland, serving as an important staging ground for migrating waterfowl during the spring and fall migrations. It also supports local populations of fish, birds, mammals, and macro invertebrates, and a series of ponds distributed throughout the Flats provides excellent habitat for dabbling ducks and other waterfowl.

Eagle River Flats is the only impact area for heavy artillery and mortars on Fort Richardson, and have been used for military training since 1949. This has created thousands of craters in the wetlands and associated mud Flats, and left an estimated 10,000 unexploded mortar and artillery shells buried in the shallow subsurface. Four types of munitions have been fired into the Flats: high explosives, white phosphorus smokes, illumination flares, and hexachloroethane-zinc mixture. In 1980, Army biologists noticed an unusually high number of waterfowl carcasses, including several dead swans, in the marshes of the Eagle River Flats. Subsequently, the Army, U.S. Fish and Wildlife Service, and Alaska Department of Fish and Game discovered abnormally high numbers of dead waterfowl. Ground searches conducted in September 1983 found 368 dead waterfowl, including about 35 fresh carcasses. In August and September 1984, about 175 carcasses were discovered. At that time, the Army estimated the number of waterfowl deaths to be between 1,500 and 2,000 per year. A 1988 series of aerial and ground surveys documented more than 900 waterfowl carcasses and feather piles in one area of the Flats. It was clear that there was a significant problem.

Field and laboratory studies conducted in 1990 provided evidence that white phosphorus was the likely cause of the mortality, although sediment and surface water samples collected from the Flats in August and October of 1989 and in 1991 also revealed elevated levels of heavy metals, copper, cadmium, nickel, zinc, and mercury in wetland surface waters. In 1990, the Army temporarily banned the firing of smokes containing white phosphorus into the Flats, but did not discontinue use of other ordnance. The high death rate, for ducks in particular, continued even after the ban was instituted. Eventually it was discovered that once white phosphorus submerged in the water and sediment, it remains in the environment and continues to be available to ducks and other wildlife. In January 1992, the Army permanently banned the firing of smokes containing white phosphorus into the Flats, and into any areas nationwide that could have an impact on wetlands. In addition, a minimum of 6 inches of ice must cover the Flats before it can be used for firing.

Currently, there are no plans to resume warm-weather firing onto the Flats, however the Army has left open the possibility that future changes to the mission of Fort Richardson could necessitate the use of the training area during the summer months. There is no question that this would result in a significantly negative impact on the wetlands, and on the wildlife for which it provides habitat.

Although hundreds of pages have been dedicated to analyzing the problems and assessing solutions to remediating the contamination of the Eagle River Flats, the Army clearly states that white phosphorus is the only contaminant of interest, and is the only contaminant that will be addressed in the record of decision. Elevated levels of heavy metals, copper, cadmium, nickel, zinc, and mercury had also been described as contaminants in surface waters in the wetlands in the initial listing narrative for Operable Unit-C, yet there is no subsequent mention of these contaminants in later data reports. The human health risk and ecological risk assessments focus exclusively on the impacts of white phosphorus to the exclusion of any risks from other contaminants, including the risks of unexploded ordnances at the site. It must be understood that the risk assessments, remedial alternatives, and all cleanup criteria, thus directed narrowly at only one contaminant, are not reliable assessments of the actual situation at the site.

Secondary receptors include predators and scavengers such as the bald eagle, herring gull, raven, wolf, coyote, and fox. Studies of activities and potential risk related to scavengers and predators indicated a potential for indirect impacts from white phosphorus exposure through consumption of dead and moribund white phosphorus-contaminated waterfowl.

The chronic effects of white phosphorus in wildlife and waterfowl are not easily detected. Unlike significant acute exposure that results in death in humans, wildlife, and waterfowl; repeated chronic exposures are far more difficult to measure. Because white phosphorus has a short half-life (which means it leaves the body within a few days after exposure), it does not bioaccumulate. Behavioral changes or slow die-offs one at a time away from the site would not be noticed. The resulting hypothesis in the risk assessment is that if waterfowl survive their ingestion of white phosphorus, the levels in their bodies are low enough to preclude a significant risk to predators, including humans, who may later eat the exposed fowl. Also absent was any discussion of the potential impacts of exposure on small herbivores and omnivores could be exposed through ingestion of the same vegetation as the waterfowl, as well as through ingestion of scavenged prey. And, no data were presented discussing the dosage that would be required for an immediately fatal acute dose versus short-term chronic doses, the impacts of which may be less appreciable. These questions are important for understanding the implications for animals that may be part of a subsistence diet for humans and whose foraging range may include the Flats.

The remediation alternative chosen for this site is described as "Pumping with Capping and Filling." Wetland ponds where there is white phosphorus "hot spots" will be temporarily drained to allow the pond sediments to dry and allow white phosphorus to evaporate and mix with the atmosphere. Ponds are drained by pumping after flooding cycles and/or rain. After five years of drying periods and verification sampling, capping and filling will be performed in areas where white phosphorus remains.

This pumping technology was tested during the summer of 1997. Baseline and verification samplings showed an 80 percent decline in white phosphorus concentrations in the top 3.5 inches of sediments. Summer 2003 is the final of the five year pumping plan, after which those pond systems where white phosphorus exposure remains a concern would be capped and filled. A composite material would be applied to areas of the pond systems that do not dry and still contain white phosphorus. The cap-and-fill material is a manufactured gravel and bentonite mixture. This material expands in water, sealing spaces in gravel and creating a barrier to permeability. It will be applied only to small, deep portions of the pond bottoms. Therefore, despite its swelling characteristics, it is not expected to change feeding habitat or overall pond depths significantly. This material also supports vegetation growth. It provides a barrier between the dabbling waterfowl and the sediment contaminated with white phosphorus. Following application, restoration of the pond systems would occur naturally through precipitation and tidal flooding. Bird mortality studies will continue annually until 2008 and every 5 years thereafter until 2018.

Although this remediation alternative appears to be the best of the proposals, many aspects of it raise concerns that have not been adequately addressed by the Army in its response. While unexploded ordnance is a major environmental hazard in the flats, neither the human health risks nor the potential risks to wildlife and waterfowl are addressed in either the risk assessment or the remediation proposals. No information is provided about the contents and toxicological makeup of these weapons used at the Flats. Are they susceptible to leaching? How does weather affect them, including freeze/thaw cycles and snow pack and melt activity? What are the ecological impacts (beyond the obvious) on the wetlands and river, if accidental detonation of unexploded ordinance occurred with regard to release of chemicals into the ecosystem? Coupled with the level of damage and alteration of the Eagle River Flats wetlands caused by past and present detonation and burning of munitions within and around the salt marsh and riparian habitat, it is clear that this is an issue that requires further consideration. The Eagle River riparian zone and delta are ecologically significant and sensitive areas that should not be subjected to further abuse, and the failure to address these questions is extremely problematic.

Not only white phosphorus, but unexploded ordnance and spent munitions threaten continuing and long-term damage to the environment, wildlife, human health and safety, regardless of the Army's unwillingness to acknowledge them or address them as risk factors. Hydrological and ecological restoration of the Eagle River wetlands (which also requires intense focus) was not addressed in the ecological or human health risk assessments; neither were the plans to resume explosives testing in the Flats. These activities will undeniably result in further environmental damage as well as represent a hazard to human health and safety. But these activities, too, were not addressed in favor of the narrow focus on white phosphorus. While the Army's assertion has some merit that the methods in the currently pursued remediation alternative are the least disruptive to the hydrology and ecology of the ecosystem, this alternative does not respond adequately to the larger questions posed here.

Instead of responding to these questions, the top military command at U.S. Army Alaska at Fort Richardson has repeatedly refused to address the environmental impacts of the military uses of the Eagle River Flats Impact Area. The Army has attempted to justify its lack of compliance under federal regulations and policy on the basis that its use of the Flats as an artillery range fulfills the Army's national security training mission, and is therefore neither related nor relevant to the remedial action for white phosphorus contamination. This assertion is disingenuous at best, and an affront to the efforts of the community to protect the Eagle River ecology. Virtually all activities at all military installations in Alaska and throughout the lower 48 states fulfill the military's mission and obligation to defend national security. The reality is that the failure to stop munitions and explosives testing in the Eagle River Flats will inevitably result in the failure to prevent additional damage and disruption of the hydrology and ecology of the Eagle River wetlands, and the result will be the need for yet further environmental restoration in years to come. The position taken by the command at Fort Richardson is particularly difficult to understand in light of the recent reiteration in June 2000, of the "Environmental Security Vision Statement" in the report on *Environment, Safety and Occupational Health in the Department of Defense*:

> To have fully incorporated environmental, health and safety values into the culture of the Department of Defense. These core values are recognized by the uniformed and civilian customers throughout the Department of Defense and its external stakeholders not only as key elements of national security policy, but as a necessary underpinning of sound business practices that allow the Department to maximize its financial and human resource potential. They are vital parts of all operational and business decisions whereby the safety and health of our people and protection of weapons systems, facilities, and the environment are integrated into all worldwide national defense activities.[2]

The position of the Fort Richardson command on this issue highlights the contradiction between the two directions to which the U.S. Army has committed itself, apparently with the acquiescence of the EPA, and involving millions of taxpayer dollars. On the one hand, the Army has devoted a tremendous amount of time and resources to cleaning the Eagle River Flats of white phosphorus in order to restore the habitat of dabbling waterfowl. On the other hand, the Army has stated its intention to continue using the Flats as an active heavy artillery range, which will inevitably result in the ongoing contribution of additional disruption and contaminants into the wetlands and estuarine ecology, including unexploded ordnance. The objectives of the Superfund cleanup process, stated repeatedly throughout all site documents, is to protect human health and the environment. It is impossible to understand how the continued and intentional contamination of the Eagle River Flats with both unexploded ordnance and live ammunition is consistent with these objectives.

As a result of the Army's failure to adequately address cleanup at the Flats, Alaska Community Action on Toxics, Military Toxics Project, Cook Inlet Keeper, Chickaloon Village Traditional Council, and two individual members of the Chickaloon Tribe filed a Notice of Intent to Sue on June 15, 2001.

Both defendants (the Army) and plaintiffs (those groups listed above) entered into negotiations that September in an attempt to reach an out-of-court settlement. The plaintiffs wanted the Army to comply with the federal Clean Water Act and to cleanup unexploded ordnance (UXO) as required under CERCLA. The Army's past and present training exercises at Eagle River Flats have resulted in the release of cancer-causing chemicals (such as RDX, 2,4-DNT and heavy metals).

Negotiations proceeded in good faith until April 2002; when the Army unexpectedly terminated discussion. They then requested of the Alaska State Legislature an exemption from state law regulating wastewater discharge. Arguing that compliance with environmental laws interfered with their ability to maintain a state of "military preparedness," the legislature, unfortunately, readily agreed. This tactic has been used by the Department of Defense for years, pitting the health of communities and the environment against national security. (For a more detailed discussion, see the accompanying document *Overview of Key Issues at Alaska Military Superfund Sites.*)

Despite state law, however, the Army must still comply with federal law. Plaintiffs continue to negotiate with the Army to determine whether an out-of-court settlement is possible or if further legal action is necessary.

Only because of these legal proceedings was it learned that Army biologists had sighted belugas on numerous occasions in the 1990s.[3] The whales were sighted as far as two kilometers up river. The Army did not bring this information forward during the CERCLA environmental risk assessment.*

The Army's failure to provide this information calls into question the legitimacy of the CERCLA ecological risk assessment. They Army may also be in serious violation of CERCLA for failing to provide accurate and complete information during the risk assessment process. Further, the Army's deliberate omission of critical information illustrates exactly why the public does not always trust what they're told by the military. In this instance, the Army has fostered additional public mistrust. Had local Tribes been included as equals during the CERCLA process, it is likely this information would have surfaced from their historical and traditional knowledge.

Source Area Two: The Open Burn/Open Detonation (OB/OD) Pad is also referred to as Demolition Area One or Demo 1. It is an 8.5-acre clearing with a 4-acre gravel pad constructed along the east side of Eagle River Flats. The pad contains remains of destroyed surplus and outdated munitions, along with assorted objects such as junked vehicles and rocket motor casings. The OB/OD Pad has restricted public access, which is controlled and monitored by the Range Control at Fort Richardson.

The Pad was used for burning and detonating explosives and other waste materials from at least 1956 until November 1988, at which time OB/OD activities ceased. Records and literature that specifically address the OB/OD Pad is limited, especially information about the types and quantities of wastes burned and disposed. The quantity of material disposed of at the site since its initial use in the 1950s is not known. OB/OD activities conducted in the 1980s were limited to a 2-acre area in the western portion of the pad. Occasionally, explosive materials from non-military sources were detonated on the pad. Many of the materials destroyed at the pad were originally reactive, ignitable, and toxic.

The OB/OD Pad was engineered in glacial till composed of sandy gravel and gravelly sand. The pad slopes toward the southwest, from the surrounding upland forest to the edge of Eagle River Flats. On its southern

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* In fact, the Army declined to bring this information forward even when the National Marine Fisheries Service (NMFS) was researching Cook Inlet belugas and reasons for their declining numbers. Beluga feeding and migration habits were studied, as well as tissue from the animals to determine if contaminants played a role. The Army's failure to provide critical information about the presence of belugas at Eagle River Flats is an egregious act of omission. NMFS's study of the causes of the beluga decline, which cites over-harvest as primary cause, is incomplete without this information. Belugas are known to be very habitual in their feeding behaviors, visiting the same sites year after year. The Army documents state the last beluga sighting was in the early 1990s. The question remains whether the cumulative effects of military bombing, associated contamination, and habitat alteration have so adversely affected the beluga population that they cannot use the Eagle River Flats.

side, OB/OD Pad contacts the wetlands of Eagle River Flats. The contact appears to consist of surface material pushed from the pad a short distance onto the wetlands. This edge now forms a bluff rising approximately 10 feet from the marsh.

Disposal through burning was performed either on the ground surface or in an excavated pit. Materials that were destroyed during OB/OD activities included fuses, high explosive (HE) projectiles, smoke pots, mortar rounds, star clusters, flares, mines, rocket motors, shape charges, detonation cord, dynamite, and some flammable solids. Existing records indicate that no liquids were disposed there. During the 1960s, smaller pieces of ordnance were ignited on the ground surface by using diesel fuel. Occasionally pits were excavated and small-arms ammunitions were disposed of by covering with other material soaked in a small volume of diesel fuel and igniting. The ordnance disposal by detonation spread shrapnel and explosives over adjacent areas on the pad surface.

The 1996 Remedial Investigation revealed a layer of gravel, generally 6 to 13 feet thick, overlies poorly graded sand throughout the depth of the wells. The coarse-grained material suggests that precipitation infiltrates freely through the pad surface to the groundwater table. Groundwater elevations range from 19 to 36 feet below the ground surface. It is believed that the groundwater movement patterns are strongly influenced by both the tides and by Eagle River. A 1991 study conducted at the Eagle River Flats analyzed 128 sediment samples collected along transects extending from the edge of OB/OD Pad into Eagle River Flats. Elevated concentrations (greater than 1 part per million) of 2,4-dinitrotoluene (2,4-DNT) were recorded in over half the samples, indicating that some migration of OB/OD Pad contaminants into the Flats had occurred in the past.

After extensive discussion in the record of decision regarding various agencies' responsibilities for the OB/OD pad, several conclusions were reached regarding how this source area will be handled. For example, neither the human health risk assessment nor the ecological risk assessments were deemed to have demonstrated sufficient risk to warrant remediation of the site.

Adequacy of the Army's analysis and the soundness of their conclusions are called into question given several factors. For example, the Army did not include some chemicals in their risk analyses (such as 2-amino-4,6-DNT and 4-amino-2,6-DNT) because the EPA 1996 Integrated Risk Information System (IRIS) database has no information for them, even though the Agency for Toxic Substances and Disease Registry (ATSDR) Public Health Statement states:

> Heart disease has been seen in workers exposed to 2,4- or 2,6-DNT. 2,4- and 2,6-DNT may also affect the nervous system and the blood of exposed workers.
>
> Exposure to high levels of these compounds in animals regularly show lowered numbers of sperm and reduced fertility. Studies of animals have also shown that a reduction in the numbers of red blood cells, nervous system disorders, and liver and kidney damage can occur. Both 2,4- and 2,6-DNT can cause liver cancer in laboratory rats, and may produce the same effect in humans. The U.S. Environmental Protection Agency has determined that the mixture of 2,4- and 2,6-DNT is a probable human carcinogen.[5]

Despite this, on the basis of the risk investigation results at the OB/OD Pad and evaluation of data collected during previous studies at this site, the Army selected, and the EPA approved, the no further action alternative for the hazardous chemicals at the OB/OD Pad, including the UXO. This means that EPA also approved an open-ended delay in the closure of the site, which is required by RCRA (Resource Conservation and Recovery Act)[4] under the Federal Facilities Agreement. Because a permanent remediation is not being effected, 5-year-reviews of the site will still be required under the Comprehensive Environmental Response, Compensation, and Liability (CERCLA). The Army must evaluate whether acceptable delay of closure by the EPA is still viable, which is the case unless any of the following has occurred.

The findings of the Army's evaluation must be submitted to EPA for review and approval. If either the EPA or the Army believes that delay of closure is no longer viable, the OB/OD Pad will be closed under RCRA closure requirements in effect at that time. Then, the Army will revise and resubmit the interim closure plan for the OB/OD Pad to the EPA for review and approval. The Army can decide to close the site at any earlier time.

The assertion in the *Record of Decision* that sampling during the RI "found that all contaminants identified at OB/OD Pad were at levels low enough that cleanup is not required" is certainly questionable. Bases such as the Massachusetts Military Reserve Camp Edwards, the Army Grafenwohr Training Area in Germany, and Fallon NAS have all demonstrated widespread contamination from munitions. Large quantities of heavy metals such as lead, copper, zinc, cadmium, as well as arsenic were deposited within and around the weapons ranges. At the Grafenwohr Training Area, surface soils contaminated with heavy metals had to be classified as hazardous waste (measured through toxic characterization leaching procedures). The vegetation was contaminated with heavy metals.[5]

At other sites, toxic components of the explosives/propellants contaminate ground and surface waters with such chemicals as RDX, nitrobenzene, nitrotoluene, and trinitrobenzene. It is widely known that detonation and burning may result in the formation of persistent and toxic chemicals such as dioxins and furans. None of the documents in the Administrative Record for OU-C were persuasive that an adequate sampling program has been undertaken which identifies the nature and extent of contamination and exposure pathways, and until this is done, a no action conclusion is unacceptable.

Operable Unit D

OU-D is comprised of the remainder of all other sites on the fort. It originally consisted of 12 sites. Three of the sites are petroleum-related and as such are being addressed under a separate agreement between the U.S. Army and the Alaska Department of Environmental Conservation. The remainder of the sites was addressed in a September 2000 ROD, in which "no further action" was declared necessary. However, during summer 2002 field work, TCE and PCB contamination was discovered. The source of contamination was new, so an additional operable unit – OU-E – was added.

Operable Unit E

OU-E, a former armored vehicle storage area and antenna farm, is the source of PCB contamination. Transformers were drained into a parking lot and the PCBs covered with dirt. Sampling was conducted, but the results have not yet been made public. However, because the source is a new one and the amount of contamination significant enough, a new ROD will be developed for this site. A Remedial Investigation/Feasibility Study was begun for OU-E in the fall 2000. The Remedial Investigation work for OU-E took place during summer of 2002. Data from these investigations was not available at the time of this report. The draft ROD ought to be available to the public summer 2003.

Conclusions:

The Army, although mandated by the Clinton Administration and through their own policy documents, has never included any Alaska Native Tribes as equal partners in investigations, decision-making, risk assessments, or remedial actions. Unfortunately, this has been the standard at Alaska military Superfund sites.

Ft. Richardson has been particularly obstinate in taking full responsibility for the environmental degradation of Alaska's lands at the fort. With the upcoming Five Year Review, due in late summer of 2003, the public has the opportunity to push for changes. We are particularly concerned about the implications of ongoing contamination of Eagle River Flats, the Army's lack of disclosure about the presence of belugas, and the lack of inclusion of local Tribes, especially those whose traditional diets include fish and wildlife from these areas. That Tribes were not included in any CERCLA decision-making is a concern throughout most military Superfund sites (Adak being the one exception). Fro a comprehensive discussion on environmental justice issues, see the accompanying report *An Overview of Key Issues at Alaska Military Superfund Sites.*

As stated earlier, the Eagle River riparian zone and delta are ecologically significant and sensitive areas that should not be subjected to further abuse. Unexploded ordnance presents a major environmental hazard in the Flats, whether or not the Army acknowledges such.

A primary source of raw water for the city of Anchorage and Fort Richardson is a permanent 2.5 million-gallon underground reservoir located along Ship Creek approximately 7 miles upstream of the Fort Richardson Landfill. Further downstream, 90 percent of the shallow aquifer flowing through Elmendorf flows through sites that have been contaminated. At the mouth of Ship Creek, Alaska residents and visitors fish throughout the summer months for salmon they then consume. The Army ought to participate in more holistic approaches to ensure these important waterways are contaminant-free.

A glossary of terms and laws, commonly found contaminants, and a comprehensive discussion of environmental justice issues can be found in the accompanying document, *An Overview Issues at Alaska Military Superfund Sites.*

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Limited information is available online at:
http://www.state.ak.us/dec/dspar/csites/dod/rabs.htm

Sites where Fort Richardson Superfund documents are located:
Fort Richardson Post Library
Building 636, B Street
Fort Richardson, AK 99503
(907) 384-1648

Alaska Resource Library and Information Services (ARLIS)
3150 C Street
Anchorage, AK 99503
(907) 272-7547

University of Alaska Anchorage
Consortium Library (Reserve Desk)
3211 Providence Drive
Anchorage, AK 99508
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Footnotes:

[1]Environmental Restoration News, U.S. Army, Fort Richardson, June 2002.

[2] "Environmental Security Vision Statement", *Environment, Safety and Occupational Health in the Department of Defense,* June 2000.

[3]APVR-DE-PSE, Memorandum for Record: Beluga Whale Sightings in Eagle River Flats, December 1991, Bill Gossweiler, Fort Richardson Wildlife Biologist.

[4] RCRA is the Resource Conservation and Recovery Act of 1976, which is the legislation governing hazardous waste.

[5] Pamela Miller, on behalf of Alaska Community Action on Toxics: Comments submitted to the U.S. Army on the "Proposed Plan" for remediation of OU-3 and the Record of Decision, Fort Richardson, Anchorage, Alaska, 1998.

Prepared by Karen Button for Alaska Community Action on Toxics, 505 West Northern Lights Blvd, #205, Anchorage, AK 99503, (907) 222-7714, www.akaction.net. Based on a previous report by Dr. Lin Kaatz Chary, Lydia Darby, Dr. Lorraine Eckstein, Sharon Rudolph, Susan C. Klein, Pamela K. Miller, Elizabeth Movius, Felicien Poncelet, Dr. Ron Scrudato, and Sir Darby Muldoon. Funded by the Environmental Protection Agency, through an environmental justice grant. March 2003.

Fort Wainwright Army Base

Environmental Justice at Alaska Military Superfund Sites
Fact Sheet

Location:

Fort Wainwright is located within the Tanana and Tanacross Native language groups region at the eastern border of Fairbanks. Both the Chena and Tanana Rivers run through Fort Wainwright. The Native villages of Minto and Nenana are within 50 miles of the military base, Rampart and Manley Hot Springs are within 100 miles, and all are downstream of the Chena or Tanana Rivers or their tributaries.

Primary Contaminants:

- **Petroleum, Oils and Lubricants** (POLs): benzene, toluene, ethylbenzene, xylene (these four are also referred to BTEX, as a group), diesel fuels, gasoline, ethylene dibromide (a highly toxic substance that was banned from agricultural use in 1987, but was also used as a solvent and an anti-knock ingredient in gas) and other solvents
- **Volatile Organic Chemicals**: (VOCs): benzene, trichloroethane (TCE), vinyl chloride, methylene chloride, 1,2-dichloroethane, 1,1,2-trichloroethane, 1,1,2,2-tetra-chloroethane (PCA)
- **Semi-Volatile Organic Chemicals:** (SVOCs): naphthalene, di-n-butylphthalate, polyaromatic hydrocarbons
- **Persistent Organic Pollutants** (POPs): PCBs, dioxin, pesticides* (including DDT, DDD, dieldrin, aldrin, heptachlor, lindane, 1,2-dibromethane or EDB)
- **Heavy Metals**: arsenic, chromium, lead, manganese, mercury
- **Others:** isopropylbenzene, trimethylbenzene, bis(1-ethylhexyl)phthalate, cis-1,2-dichloroethene

Note: The categories used here are those used by the Environmental Protection Agency for Superfund sites. Other methods of categorizing do exist. See www.epa.gov/reg3hwmd/bfs/regional/analytical. Chemicals listed as "Others" were those not found on the EPA's list.

History:

Fort Wainwright is located within the traditional lands of a number of Interior tribes from the Tanana and Tanacross language groups; these lands are also held within the Doyon Regional Corporation. Both the Chena and Tanana Rivers run through Fort Wainwright. The Native villages of Minto and Nenana are within 50 miles of the military base, Rampart and Manley Hot Springs are within 100 miles, and all are downstream of the Chena or Tanana Rivers or their tributaries.

Originally established in 1938 as a cold weather testing station, Ladd Airfield was officially designated in 1939. During World War II, the site served as crew-transfer point in the U.S./Soviet Union Lend-Lease Program. After the war, it continued to be an active Air Force base and a supply and maintenance facility for Nike Hercules missile sites, experimental research stations in the Arctic Ocean, and the remote Distant Early Warning radar sites (the DEW line). In 1961, all operations at the base were transferred to the Army, and it was officially designated as Fort Wainwright.

The Fort now occupies 918,000-acres. Current activities include training infantry, defense and deployment capabilities, and equipment testing under Arctic conditions. In addition, it also supports a number of industrial

* With the exception of lindane and EDB, the other pesticides listed here are so toxic they are targeted for international phase-out in the Stockholm Convention on Persistent Organic Pollutants, commonly referred to as the POPs Treaty. For more information about POPs, go to www.ipen.org.

activities that have played a role in the historical contamination of the site. These include the operation, maintenance, and repair of heavy military transport and defense machinery and weaponry, power generation, and drinking water production, treatment, and distribution. The issue of drinking water production and protection are particularly important for Superfund activities at Fort Wainwright, as the Chena River is used for drinking water for both the post and the city of Fairbanks - under questionable conditions. Proximity of the Chena River to many of the contaminated source areas puts drinking water sources at high risk for contamination from chemicals of concern.

Geography & Geology:

Although Fort Wainwright encompasses over 900,000 acres, the majority of sites under Superfund are all within the cantonment area, which covers approximately 4,500 acres immediately east of Fairbanks. Remaining lands are range and military maneuver areas. The Chena River flows through the cantonment area and into the Tanana River, which flows generally westward until it meets the Yukon River.

The main drinking water source for the fort and the city of Fairbanks is the alluvium of the Tanana basin. Alluvium is a geological term that describes layers of silt, soil, gravel, and other materials that are deposited by running water, and that act as the aquifer, or groundwater, that is used as a source of drinking water. The Tanana basin ranges in depth from a few feet to at least 300 feet thick in the cantonment area. The relationship between the groundwater and the rivers that flow through and around the cantonment areas are important to understand in terms of the implications of its contamination. The surface soil at Fort Wainwright is described as being "generally less than five feet thick."[1] Permafrost in this area is uneven and discontinuous throughout the basin. In two of the critical contaminant source areas for Operable Unit 5, "much of the native vegetation has been removed near the military facilities south of the Chena River, and the land surface has been extensively reshaped. Permafrost has degraded here to the extent that no significant amount remains in the WQFS or EQFS" (two of the contaminated sites).[2]

Because groundwater is not held in place by the permafrost, it is free to flow in warmer weather. Spilled and dumped contaminants are able to percolate through soils into the groundwater, moving freely between the river and groundwater table. Unimpeded by permafrost, groundwater, at several points, flows directly into the Chena River from the fort. Due to this direct flow, a large percentage of soil and groundwater contaminants are likely to end up in the Chena River, the water supply for thousands of people. Approximately 15,000 people alone live and work at Fort Wainwright and obtain drinking water from wells that are in close proximity to contaminated source areas. Once theses contaminants enter the Chena, they will eventually enter the Tanana River, with even more far-reaching implications.

Records of Decision (ROD) fail to note the potential impact to downstream communities, especially with regard to the status of Native Alaska villages and traditional hunting and fishing grounds.

Contamination Background:

Fort Wainwright was formally placed on the National Priorities List for Superfund remediation in August 1990. It was divided into five separate operable units, each with its own remedial investigation, feasibility studies, risk assessments, and records of decision. Operable Unit 5 (OU5) is a comprehensive assessment of the entire area. According to the OU5 ROD, the intent of OU5 was to address "potential cumulative human health or ecological risks that may become evident from the aggregate of source areas and areas not otherwise resolved in previous OUs."

The Army maintains primary responsibility for conducting remedial activities at Ft. Wainwright, but the EPA and the State are supposed to work jointly in planning and decision-making. Missing in this group are any tribal governments, which should have been included from the onset, and certainly post-1994 when President Clinton's Executive Order outlining environmental justice guidelines for federal agencies. See *Overview of Key Issues* for a complete discussion of environmental justice as it pertains to Alaska's military Superfund sites.

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* Words in **bold** signify terms used in the world of Superfund. For a comprehensive discussion of Sueprfund law and how it works, please see the accompanying document, *An Overview of Key Issues at Alaska Military Superfund Sites.*

The first five-year review of remediation activities was completed in September 2001. It was determined by the three involved agencies that all treatment systems and institutional controls are functioning as intended and that the selected remedies for the five project areas remain protective of human health and the environment. However, in September 2002, the Army released a document entitled, *Explanation of Significant Differences*, which outlined gross underestimates of contamination in the OU3 ROD versus levels that were actually found. Because the source of contamination was not different, neither new risk assessments nor a new ROD were determined necessary.

Sources of Contamination:

Operable Unit 1

OU-1 was initially comprised of a total of twenty-two potential contaminated sites, or source areas, to be investigated for remediation. Only four source areas were eventually recommended for further action.

801 Drum Burial Site: The site is an otherwise undeveloped area on the west bank of the Chena River approximately one tenth of a mile from the 801 military housing area. The entire area including soil, subsurface soil, and groundwater was contaminated with petroleum-based compounds such as diesel-range organics and gasoline-range organics; pesticides including DDT, DDD, dieldrin, aldrin, heptachlor, and lindane; various chemicals including volatile organic chemicals; toluene; xylenes; vinyl chloride; methylene chloride; naphthalene; di-n-butylphthalate; cis-1,2-dichloroethane; trichloroethane; arsenic; various metals; and solvents.

Cleanup objectives focus on remediation of the soil and groundwater at the site alone. Downstream contamination is not considered within the purview of any cleanup action related to Superfund, regardless of whether the contamination originated with site activities. One of the reasons cited is the problem of attribution, that is, how much of any contamination downstream is actually related to the original source area, and how much was contributed by additional sources along the way?[3]

Because of these self-imposed constraints, objectives at the site are first, to ensure that groundwater meets federal and state standards, and second, to minimize potential migration of the contaminated groundwater to the Chena River and down gradient drinking water wells. These objectives will not return the water to a pristine state, but will limit the amount of contamination that is allowed to remain. The third objective regarding groundwater is to "[e]stablish and maintain institutional controls to ensure that the groundwater will not be used until federal and state MCLs [maximum contaminant levels] are attained." [4]

While institutional controls may be effective in preventing or limiting access to the site by humans for the duration of military occupation of the area, this is not the only concern. Due to area hydrogeology, the water table is very shallow in some areas adjacent the Chena River. During warmer months there is significant potential for interchanges between the groundwater and surface waters. Secondly, the site is in a flood plain. Because it is a designated "500-year flood plain" the assumption is that flooding represents little danger. Nevertheless, only one significant flood could bring contaminated groundwater to the surface where it could recontaminate surface soils or volatilize contaminants. The institutional controls described in the record of decision would hardly prevent these events.

Cleanup remedies chosen include excavation of soil and drums to remove the source of the contamination, and monitoring to assure that the contamination has been contained. Contaminated soil and drums were reburied in a hazardous waste facility. Removing them from Fort Wainwright remediates contamination at the 801 sites, but until the soil, the drums, and their contents are permanently disposed of through environmentally acceptable destruction technologies, they will continue to pose a potential danger to the environment and public health. On-site destruction by environmentally sound, non-incineration technologies is the more appropriate method of cleanup.

Natural attenuation, institutional controls, and long-term groundwater monitoring with the *possibility* of soil vapor extraction and air sparging are the additional cleanup remedies. The agencies believe that natural attenuation is sufficient to restore groundwater to levels of contamination acceptable to state and federal regulations. Long-term monitoring is to assure natural attenuation is working. If it does not control the contaminant plume after three consecutive testing events over a 20-year period, or if the contaminant plume appears to be migrating away from the site, the treatment contingency would be implemented. This alternative does not treat the contaminated groundwater other than under the circumstances described above*

Buildings 1599 and 2077: Building 1599, located one-tenth of a mile south of the Chena River, was historically used for automobile and heavy equipment maintenance, and dispensing diesel and gasoline. Prior to 1973 it was also used for pesticide mixing and storage. It was intentionally destroyed in 1984. The remedial investigation focused on surface soil contamination; diesel-range organics, gasoline-range organics, dioxins, and pesticides were found in the surface soil both adjacent to and south of the former building. Based on the risk assessment for the dioxin and pesticides, it was determined that no further action was necessary at this site under CERCLA requirements. Petroleum contamination, on the other hand, exceeded the State's acceptable levels, which resulted in a Two Party Agreement. The Army's cleanup response includes institutional controls (land and groundwater use restrictions) and "annotation in the Fort Wainwright Master Plan to ensure proper handling and management of the soil at this source area."[5]

Building 2077, also known as *Hangars 7 and 8*, was built in 1958, and a paint booth added in 1973. The building is currently used for aircraft maintenance and paint shop operations. Site activities included storage of barrels containing spent solvents, used oil and contaminated fuels. Dumping and/or burning waste of paint chips outside the building may also have occurred. Since 1989 the barrels have been removed and the soil beneath them excavated for disposal. Soil contamination ten feet deep was found during the remedial investigation, and included diesel-range organics, gasoline-range organics, benzene, toluene, ethylbenzene, and total xylenes. Benzene and petroleum contamination were also found in groundwater wells at the site. Again, based on the human health risk assessments for the non-petroleum contaminants, the site was determined to require no further action under CERCLA, but was referred to the Two Party Agreement because of the petroleum levels.

No Further Action Sites: Twenty-seven sites were recommended for no further action. After reviewing the rationale for each site, the site of most concern to the authors is discussed below.

Blair Lakes Drum Site – This site is located in the Tanana Flats Training Area, approximately 35 miles to the southeast of the main fort cantonment area. There are two lakes in the area, plus a gas runway and a taxiway for aircraft, with "lowland and upland areas" surrounding it. In 1986, halogenated organics, ketones, benzene derivatives, and alkanes were found in 25 drum samples, and cyanide and metals were detected in sediment samples from surface waters. In 1987, a removal action was done at the site that removed all structures and miscellaneous debris. In 1993 diesel-range organics and DDT were found at various sites, but the majority of the samples were within what the EPA considers "risk-based concentrations," that is, in concentrations not considered high enough to exceed acceptable risk.[6]

An ecological evaluation finds no significant risk to fish, wildlife or the ecosystem. However, the assessment fails to take into account the geographic relationship of the area to Alaska Native villages or allotments. It does not address whether species used by subsistence fishers and hunters were included in the risk analysis, nor whether the range of such species might bring them into proximity to the contaminated areas. This is of particular concern with regard to the pesticide DDT. Without these considerations, it is impossible for the agencies to fulfill their environmental justice mandates.

Operable Unit 2

Eight sites were initially identified. The final decision on six of these areas was that no further action was required. Two sites, described below, required remediation under CERCLA.

The DRMO Yard: This site encompasses approximately 25 acres and includes seven buildings. Both groundwater and surface water from the site drain into the Chena River, approximately one mile away, through a drainage ditch and a "riprapped conveyance that parallels the west boundary of the DRMO Yard and connects the Chena and

* After leaving Fort Wainwright, the Chena River flows through Fairbanks, passing at least one non-military Superfund site along the way, and receiving run-off from various non-point sources as well as permitted discharges. Even if the stream and its sediments were tested as part of the Superfund process (they are not), how would it be possible to know how much came from the Fort Wainwright sources? This is the argument given by the EPA for limiting the scope of the cleanup to the source areas at Fort Wainwright itself. The question remains: who will be responsible for assessing and remediating the impacts of the contamination on downstream users from upstream sources?

Tanana Rivers."[7] Although only 200 feet from the DRMO Yard is another Superfund site (Arctic Surplus), because it is a private facility it is not at all addressed under the Fort Wainwright Superfund. Any issues related to cumulative impacts were essentially ignored.

The remedy chosen consists of soil vapor extraction, groundwater air sparging, natural attenuation and groundwater monitoring/evaluation. The engineering treatments seem appropriate to treat the volatile organic chemicals identified, as long as the soil vapor extraction and air sparging emissions are closely monitored to assure that the contaminants are actually destroyed and not simply transferred from the water and soil to the air. However, this remedy includes a no action component for the benzene-contaminated soil hotspots. The rationale in the ROD is: "[a]fter evaluation of the potential risks and appropriate cleanup standards and comparison with the nine CERCLA criteria, it was determined that action is not required."[8] No further explanation is offered.

The expected length of time for volatile-organic-chemicals-contaminated soil and groundwater to be remediated after the treatment is completed is fifty years, with monitoring continuing for an estimated fifteen years. Again, this approach fails to incorporate an adequate environmental justice analysis in the investigations and remedies. Regrettably, this failure exists for all records of decision at Fort Wainwright.

Building 1168 Leach Well: The Leach Well is located 1,800 feet west of the Chena River. Floor drains in the building are thought to have received spilled oil and lubricants, fuels, solvents, and engine coolants that contaminated subsurface soil and then groundwater. The main contaminants of concern in both the soil and the groundwater are trichloroethylene and benzene, both of which are above state and federal maximum contaminant levels. Petroleum hydrocarbons, ethylbenzene, xylenes and other aromatic and chlorinated volatile organic chemicals as well as inorganic elements were also found in this area.

The remedy chosen for this site includes in-place treatment of soils and groundwater by soil vapor extraction and air sparging, followed by groundwater monitoring and institutional controls. Because this remedy will actually eliminate or destroy the contaminants of concern through treatment, rather than attenuation, this appears to be one of the better decisions.

Operable Unit 3

Operable Unit 3 is located within the Chena River floodplain. It consists of three broadly defined source areas, all of which were involved in petroleum fuels storage or transfer in underground (USTs) and aboveground storage tanks (ASTs), and through pipelines such as the Canadian Oil Line and the Fairbanks-Haines Pipeline. The primary contaminants are petroleum fuels and petroleum constituents that have seeped into the groundwater over large areas. Only one portion of the original Fairbanks-Haines pipeline is still active; it is the Fairbanks-Eielson Pipeline that connects Eielson Air Force Base with the Mapco refinery in North Pole.

Birch Hill Tank Farm Source Area: This large tank farm is located in the northeast corner of Wainwright, on the northwest bank of the Chena River. Included in this area were a total of twenty steel storage tanks, both under and above ground, three buildings, the Canadian Oil Line pipeline and Valve Pit A.

Railcar Off-Loading Facility Source Area (ROLF): This facility was built in 1939. It is connected to the tank farm by a pipeline, and is located south of the tank farm with the Chena River to the north and west of it. The facility is no longer in use; and the fuel in under ground storage tanks was removed in 1990.

Milepost Source Areas: This source area is divided into several sub-areas based on milepost locations along the Fairbanks-Eielson Pipeline where spills have been either reported or detected. At least 40 ruptures occurred. All of the contamination addressed in this source area is related to fuel spills at different points along the pipelines.

Major contaminants in the soil, subsurface soil, and most markedly in the groundwater throughout OU-3 include benzene, toluene, ethylbenzene, 1,2-dichloroethane, total xylenes, isopropylbenzene, trimethylbenzene, lead, and ethylene dibromide, a highly toxic substance banned from agricultural use in 1987, but was used as a solvent and an anti-knock ingredient in gas.[9]

The record of decision (ROD) indicated low levels of petroleum were believed to be contaminating groundwater discharged into the Chena River from the railcar off-loading facility area and Valve Pit A. However, the Army's 2002 document, *Explanation of Significant Differences (ESD)*, shows gross underestimates. As outlined in the ESD, throughout OU3 contamination levels are actually 3-4 times greater than in the ROD, though at the Birch Hill Tank Farm levels are up to *5,000 times greater*. Due to the nature of the "complex fractured bedrock", the ESD states that contamination levels can only be estimated; historical records document the transfer of millions of gallons of petroleum product.

The ESD also demonstrates that contaminants at the base of the hill at the Milepost source areas are not decreasing from the selected remedy (bioremediation) as expected, due to level ground and, mostly, to permafrost in the soils. Additional monitoring will be added in the spring of 2003 for groundwater flows, contaminant levels, and flow levels for different times of the year. A different remedial action may be needed, as which time the Army intends to either amend the ROD or develop a new Explanation of Significant Differences. Despite these differences from the earlier ROD, the Army believes a new ROD is not warranted because source areas remain the same.

However, the authors believe a new ROD is necessary for a number of reasons. First, and foremost, investigation of the Birch Hill site did not begin until after the ROD. According to the ESD, "At the time of the RI [remedial investigation], no wells or deep borings were installed on Birch Hill; thus, free product within the bedrock aquifer was missed. Post ROD activities, which identified the free product, have led to the addition of a sub-area known as the Birch Hill Product Recovery System." This site should undergo a remedial investigation/feasibility study under CERCLA.

Second, given that an investigation of Birch Hill (part of the Birch Hill Tank Farm site) was not conducted prior to the ROD, risk assessments for the ROD contain insufficient data from which decisions for remediation were made and the public had insufficient information from which to make informed comment. Third, according the ESD, fractured bedrock in the subsurface "makes it difficult to estimate the volume of free product." The best the Army can do is refer to historical records, which indicate the Farm handled millions of gallons of fuel. Yet, "high concentrations of DCA and EDB in the Birch Hill bedrock aquifer is believed to be the major source of groundwater contamination in the alluvial aquifer."[10] As discussed before, the Tanana alluvium is the main source of drinking water for the city of Fairbanks and the fort itself.

Several contaminated areas border Fairbanks and/or have residential developments nearby. A military residential area on the base lies within one-fourth mile of one source area, and two Fairbanks churches have drinking water wells approximately one-fourth-mile down gradient from the tank farm source area. Although ecological receptors of concern to Alaska Natives may exist, the record of decision failed to take these concerns into account, because they are outside of the boundaries of the fort. The risk assessment documents fail to report data about ecological receptors in these and other down gradient areas that are outside of the boundaries of the post itself, even when acknowledged recipients of historical contamination exist.

While these populations were taken into consideration, the risk assessment documents fail to include data about ecological receptors down gradient, even though these lands may be of importance to wildlife taken for subsistence uses. With levels of contamination up to 5,000 times greater than stated in the ROD, these risk assessments are certainly inadequate.

In the ROD, the same remedies were chosen for all areas in OU-3: soil vapor extraction and air sparging in permafrost-free areas to meet Safe Drinking Water Act levels, and natural attenuation to meet Alaska Water Quality Standards. The time frame for remediation, based on the assumption that land uses in the affected areas will not change, was set at no more than 30 years to achieve cleanup. Also according to the ROD, long-term monitoring was a component of the remedies, with the qualification if, during implementation, it become apparent that "contaminant levels cease to decline and are remaining constant at levels higher than the remediation goal," a re-evaluation of the process could occur. The ESD document describes enhancement and significant expansion of these treatment systems, including off-gas treatment of soil vapor exhaust, *ex situ* treatment of soils (treatment of soils after they've been removed), and underground piping to enhance biodegradation through the introduction oxygen

In the ESD, two off-Post wells still show levels of contamination; annual testing show fluctuations above and below MCL, rather than a steady decrease. The Army continues to provide water to these two churches. A product recovery system has been added in addition to expanding the area that soil vapor extraction and air sparging is conducted.

Contamination at the Railcar Off-loading facility was also underestimated in the ROD. Remedial methods are similar to those above, except that a thermal/catalytic oxidizer is also being used for off-gas treatment.

Unfortunately, the ESD did not use its opportunity to further investigate impacts downstream from these sites. Clearly, with the extent of contamination greater than originally thought, potential impacts to downstream communities and their fishing and/or hunting grounds is also that much greater. Yet, nowhere in the document is this discussed. Again, the Army has failed to meet environmental justice mandates by this omission.

Operable Unit 4

Operable Unit 4 consists of three clearly defined source areas: the Landfill, the Coal Storage Yard, and the Fire Training Pits.

Landfill Source Area: This is the main landfill serving Fort Wainwright. Originally a 60-acre site, the active portion now consists of approximately 40 acres north of the Chena River at the base of Birch Hill. The remaining 20 acres, including a large trench area, are across a main road to the south. Use of the site as a landfill began in the early 1950s.

Activities included waste burning in addition to dump and covering operations. There is a high probability that burning activities resulted in hazardous air emissions that led to air deposition of contaminants into nearby waterways and sediments – sites where dioxin and furans have been identified. According to the record of decision,[11] trenching and burning activities at the Landfill ended sometime in the 1960's, at which time the wastes remaining at the site were spread, compacted by bulldozer, and covered with coal ash.

Wastes disposed at this site during the '50s included human waste; household refuse; waste petroleum, oils, and lubricants; hazardous waste including solvents; pesticides; asbestos; construction debris; and inert munitions. Investigations revealed drums and debris from other dumpsites on the Fort, remnants of buildings that had been demolished, excavated materials from the Glass Park Tar Site, various pesticide cans, asbestos and vehicular paint waste.

The major contaminants identified in the remedial investigation were benzene, bis(1-ethylhexyl)phthalate, TCE, 1,1,2-trichloroethane, 1,1,2,2-tetra-chloroethane (PCA), and cis-1,2-dichloroethene in the groundwater under the Landfill and in the down gradient southwest thaw channel that intersects the Chena River. Concentrations indicated there was a contaminant source within the Landfill area itself, as opposed to the chemicals leaching from elsewhere. Contaminants exceeded both the federal drinking water maximum contaminant levels and the risk-based screening concentrations of EPA. Exceedance of only one of these criteria usually sufficient for remediation, but in practice the maximum contaminant levels seem to be the measure that drives cleanup decisions.

Lead and chromium also exceeded both these governmental levels, yet the agencies decided because contaminants were below background levels no action was required. Several additional petroleum contaminants, including high concentrations of lead that were also found in one area were believed to be the result of a spill. The area was covered permanently in 1995 with eight feet of materials, and this was considered to eliminate of the exposure pathway for the lead.

The main concern is contamination of groundwater at contaminant levels that are considered to pose a risk to down gradient groundwater users.

The remediation alternative is described as "a phased approach involving capping of the soils in the older, inactive portion of the Landfill, natural attenuation of groundwater; groundwater monitoring/evaluation; and institutional controls. Phase 2, if necessary, would involve evaluation and implementation of an active groundwater treatment system."[12] The choice of this alternative is a classic example of how cost considerations can drive remediation decisions. Although this initially costs almost six times less than the technological treatment of groundwater (alternative 5), the expected length of time to reach some semblance of "clean" groundwater is seven times greater.

The decision to choose capping as a method of remediation is particularly surprising, given that capping is not a permanent treatment, and will eventually need to be remediated itself. Moreover, capping is susceptible to rupture, especially under conditions of regular weather-related contractions and expansions. Animal activity can also challenge the integrity of the cap over time. (A major "advantage" to capping is that the site will probably not need attention again until after the current decision-makers have retired.)

The decision to rely on natural attenuation and institutional controls is not acceptable for a site that has been described as a significant threat to down gradient water quality because of the nature of the thaw channel exposure pathways. The assurance that technologies will be used eventually (should natural attenuation prove to be ineffective after monitoring) is a hollow promise given that the proposed Phase 2 calls only "for *evaluation of implementation* [emphasis added] of an active groundwater treatment system."[13] How long would the public have to wait before there was an actual decision to act? The greater problem is this entire approach is a reactive strategy; it is the antithesis of the prevention and permanent remediation that Superfund was intended to ensure. This alternative offers action only after *further damage* from the site has been determined. Natural attenuation and institutional controls should not be considered protective in any way.

The Coal Storage Yard: This site is located approximately 12,000 feet north of the Tanana River and approximately 4,000 feet south of the Chena River. It is the storage area for the Fort's coal-fired cogeneration power plant, the sole source of heat and electricity for all of Fort Wainwright. The coal is stored directly on the ground, and from the 1960's through 1993 was sprayed regularly with waste petroleum fuel products such as diesel, fuel oil, solvents, and lubricants from tanks, railroad cars, and drums in order to increase the BTU value.

The remediation alternative chosen is a combination of on-site technologies to treat both soil and groundwater, with ongoing monitoring and evaluation to assure the efficacy of the procedures, and institutional controls to prevent access to the site during treatment. The expected length of time until soil and groundwater would reach cleanup goals was estimated at approximately nine years. The advantage of these technologies is that the treatment is also expected to be permanent once the sources of contamination are removed.

Operable Unit 5

OU-5 addresses source areas deferred from previous operable units, source areas not resolved in earlier operable units and three new areas identified in OU-5. Deferred from earlier investigations are the Open Burning/Open Detonation Area (OB/OD), the Former Explosive Ordnance Disposal Range (Blair Lakes Impact Area), and the Motor Pool Buildings.

The ordnance disposal range and the motor pool buildings were eventually designated as "no further action" sites under CERCLA and, for undetermined reasons not discussed further in the ROD. The OB/OD was evaluated separately from the new areas. The three new areas are the West Section, Former Quartermaster's Fueling System (WQFS); East Section, Former Quartermaster's Fueling System (EQFS); and Remedial Area 1A. The first two are among the most contaminated sites at Fort Wainwright.

Remedial Area 1A: The major contaminant is lead, which was detected in the surface soil at levels above EPA guidance for industrial cleanup levels. The risk assessment discusses the inability to address lead exposure because it is not considered a carcinogen and because exposure to lead is measured by blood-lead levels rather than based on an average daily intake. However, there is also no threshold below which exposure to lead is considered safe.

The area is located in the upper northwest corner of the post, and it is unclear how great a magnitude of fugitive dust from the site would reach either the Chena River or residential areas.

Institutional controls, monitored for 30 years, are the chosen remedy for lead contamination at this site even though the ROD admits that Alternative 4, removing the soil, would provide the greatest protection of human health and the environment, and a permanent solution. This is based on the assumption that area land use will continue to be restricted, as it is currently. While clearly more expensive, Alternative 4 would constitute permanent remediation, which would be appropriate regardless of what land use or changed circumstances occur in the future. But it is also clear, from the willingness of all parties to accept a lesser solution, that permanent protection is not necessarily what drives the decisions at these sites. The petroleum-contaminated soil will be cleaned up separately under Two-Party Agreement requirements, including removal of tanks on the site.

Quartermaster Site: The two quartermaster sites include numerous buildings and fueling system components (such as pipes, pipelines, and aboveground and underground fuel and oil storage tanks), resulting in a complex mixture of amounts and types of contamination.

<u>East Section:</u> Many of these buildings were used for vehicle maintenance activities, fuels testing, offices, storage, and communication facilities. Storage included an array of oils and fuels, PCB transformers, pesticides, varieties of other waste products, and chemicals from testing kits, paints, and solvents. Evidence of drainage pipes leading directly into the Chena River was also found.[14]

In a 1994 investigation of the North Airfield area of east section, plumes of free-product, benzene, 1,1,1,-trichloroethane, TCE, cis-1,2-DCE, diesel and gasoline range organics were all discovered in the groundwater. Other contaminants found at the site include low levels of pesticides, including aldrin, as well as total xylenes, toluene, ethylbenzene, and petroleum hydrocarbons.

West Section: The primary activity here was supplying fuel for vehicles and aircraft. Historically, the site included at least one building and numerous aboveground and underground fuel storage tanks, as well as both buried and exposed piping and pipelines. Several major leaks and spills were documented in this source area, many of which leaked into the Chena River at different points. Also documented are out-falls for sewer lines that emptied into the Chena. Several events where fuel oil spills were burned-off are documented, including one instance in which a spill on river ice was set on fire.[15] Contaminants include pesticides and dioxins in the soil, gasoline range organics, benzene, gasoline, free-product, chlorinated solvents, fuel constituents including xylenes, naphthalene, and lead.

According to the Five-Year Review, a new contaminant of concern, EDB, was identified. EDB (1,2-dibromethane) is a highly toxic fungicide also used as a petroleum additive. Unlike earlier selected remedies, the one selected here is a more active system, which included removal of the free liquid product from groundwater, air sparging, soil heating, and oxidation release (which helps prevent transfer of the contaminant from soils and water to the air.[16]

Open Burning/Open Detonation (OB/OD): The pad is within an active small-arms impact range on the post. It is located approximately 1,000 feet north of the Tanana River and 1,500 south of the flood control dike. The area was apparently used by the Army beginning in the mid-1960s through sometime in the 1980s, but operating records are no longer available for the site. It was reportedly used for disposing of unexploded ordinances (UXO) and dud ordnance, unused propellants (e.g., black powder, a toluene-based substance), and other hazardous materials. After extensive investigation using record searches, historical aerial photography and interviews with individuals with institutional knowledge of ordnance activities on the post, it was determined that this site is the only historically active and identifiable ordnance disposal area at the post.

Field investigation and sampling revealed the significant contaminant to be diesel range organics, present at very low levels. An organosulfur compound, p-chlorophenyl methyl sulfoxide, was also found in three (of eight) samples, and is believed to be a degradation product of the herbicide Planevin. Several metals were found in levels less than or equal to background levels; barium, chromium, and lead did exceed background levels but were below acceptable risks in soil.[17]

As a result of the low levels of the contaminants found, and because the "OB/OD area is within an active range, where human access is extremely restrictive"[18], no further actions beyond institutional controls were determined necessary for this site.

The risk assessment for OU5 contains serious flaws. Populations of concern are discussed only in terms of current and future. The current population is limited to "facility workers," while future populations include "facility workers, construction workers, and military and nonmilitary residents."[19] The assessment fails to include populations beyond the post itself; communities downstream of contaminated sites on the Chena or Tanana are left out of the discussion. Several questions arise from this assessment.

According the ROD, "(C)hemicals detected at concentrations below the risk-based screening concentrations were eliminated from the source-area risk assessments."[20] This may, at first, sound reasonable, however it fails to address two important risk factors. One: for chemicals such as dioxin, and many other carcinogens, there is no agreed-upon threshold exposure. In other words, anything above zero is considered a risk. Two: the classic quantitative risk approach used here does not address situations where multiple chemicals may interact with each other or with background contaminants. The total amount of all chemicals at a site may add up to an aggregate of several parts per million of contaminants of known toxicity. There is no adequate risk assessment method to determine what the long-term risk will be if people are exposed to multiple contaminants on a chronic basis.

In addition, the post-wide assessment is notable for its uncertainty, hedging and qualifying comments abound throughout the document. Contaminants and risk indices are first reported and in the next sentence described as being either greatly overestimated and therefore unstable, or possibly underestimated and therefore uncertain. In some instances, if the data necessary to include a particular chemical in the risk assessment equation is not available, that chemical is simply left out. Nowhere is this problem more evident than in the post wide human health risk assessment. The reported risks are significant; for example the excess lifetime cancer risk to a hunter from eating moose is 5 in 10,000. It's unlikely that the EPA's "reasonable-maximum-exposure scenario" (RME) is based on a subsistence diet. The non-cancer hazard index for moose meat ingestion for the RME was 5.2 (anything over 1.0 is considered an "unacceptable" risk).

For each of the high risks calculated, there are several uncertainties presented to demonstrate that these risks are extremely conservative and probably greatly overestimated as a result. These risk assessments may be confusing to the average person trying to grasp if there are truly concerns from these contaminants. On the one hand, the EPA invests large amounts of time and resources into determining a risk value and the source of that risk. On the other hand, once the assessment has been made, the agency emphasizes how uncertain the results may be, casting into question the usefulness of the risk product and doubt as to whether or not a risk is actually present. What does this translate to for persons who may live in the area or downstream, who come into daily contact with these contaminants, or who may rely on certain wildlife species for important contributions to their diet?

The ecological risk assessment is fraught with the same inconsistencies. For example, the risk characterization finds first that the muskrat has a hazard index of 1.9 to 3.1 based on exposure to surface water and sediment in the Chena River. However, the end of the paragraph draws the conclusion that due to the uncertainties this hazard figure is "unlikely to be significant at the population level".[21] Several paragraphs later, the ROD reports a hazard index for the northern goshawk of 1.3 from dioxin/furans and DDT, and in the area south of the Chena River, an index of 225 for the red fox, primarily from dioxin.

North of the Chena River the index for the red fox is 62, 99% related to lead exposure. Again, these figures are immediately questioned by emphasizing the high degree of uncertainty in their determination. In the case of the lead contamination, this qualification of the true risk is offered: "the potential for adverse effects to the red fox population is not considered to be significant because of existing fencing, unsuitable habitat in the areas considered, and uncertainty in risk estimates resulting from necessary conservative assumptions."[22] Reading this risk assessment, one comes away questioning the value of all this effort, as virtually every elevated risk is explained away as being due to an overly conservative approach fraught with uncertainty. Even if the risk is elevated, the source of that risk is not related to the source areas identified as part of the Superfund process but to accepted background levels that will therefore not be remediated.

This is a key point that requires further consideration. For the first time in all of the operable units for Fort Wainwright, contaminants such as dioxin/ furans, mercury, and pesticides such as DDT and dieldrin show up as significant factors in the risk analyses. Persistent organic pollutants such as DDT and its metabolites, PCBs, dieldrin, and dioxins/furans, several volatile and semi-volatile organic chemicals, and a number of heavy metals were also identified in the sediments and waters of at least one segment of the Chena River, and some segments, notably Segment D, were particularly contaminated.

In the *Postwide Risk Assessment* the presence of these chemicals is attributed to the common use of chlorinated pesticides "several decades ago . . . to control mosquitoes through both widespread aerial and local application." It concludes that "regional background concentrations of these chemicals [DDT and its metabolites DDD and DDE, and dioxin] may pose potentially significant risks even without any contribution from specific source areas"[23] The ROD recommends identification of "Fort Wainwright-specific background levels of DDT and its metabolites DDD and DDE to help distinguish source area-related risks from regional background risks."[24] The same recommendation was made with regard to dioxin. Although recommendations are made, there is no clarification of what is actually to be done.

Unfortunately, institutional controls* are a major component of all the remedies chosen in OU-5.

Conclusions:

Not surprisingly, the Five Year Review, released in September 2001, found that all remediation methods at the five operable units on Fort Wainwright were protective of human health and the environment. In it, the additional contamination discovered at Birch Hill in OU3 is considered a minimal issue even though contamination levels in some source areas were as much as 5,000 times greater than the record of decision indicated.

As stated earlier, the Army should conduct a new CERCLA Remedial Investigation for OU3 given the extent and volume of contamination at the Birch Hill site, and the lack of remedy at the Milepost site. The Army acknowledges the difficulty of estimating actual levels given that the bedrock is of a complex fractured type. The potential for contamination to the drinking water supply for the city of Fairbanks and the base itself, and the potential for seepage into the Chena River, ought to trigger a review that includes a new risk assessment.

Aggregate contamination to the aquifer from operational units 1-3 from petroleum-based products and the known health consequences from these chemicals is a primary concern. Eight years after cleanup has begun, the Army continues to provide water to two local churches. Although contamination levels in their wells have declined somewhat, it continues to spike rather than show a continued decrease.

Although institutional controls are used far too often, where remediation is the chosen alternative, the Army has used active systems for cleanup, rather than natural attenuation, as many of the other military Superfund sites have done. They are to be commended for doing so.

Fort Wainwright personnel did not adequately address environmental justice in the CERCLA process, as noted earlier by the authors and by inference to a report from the Tanana Chiefs Conference. Should a new CERCLA review for OU3 be undertaken, it would provide the Army the opportunity to fulfill its environmental justice mandates by including local tribes from the onset, on a government-to-government basis.

Finally, the authors suggest the Army be as open as the Navy with the Adak Superfund site in making documents easily accessible to the general public via the Internet. (See www.adakupdate.com.) Although some RAB notes are available (www.usarak.army.mil/DPW/Environmental), they are sporadically posted, and do not provide the detail as do other investigative and decision documents.

A glossary of terms and laws, commonly found contaminants, and a comprehensive discussion of environmental justice issues can be found in the accompanying document, *Overview of Key Issues at Alaska Military Superfund Sites.*

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Limited information is available online at:
http://www.state.ak.us/dec/dspar/csites/dod/rabs.htm

Sites where Fort Wainwright Superfund documents are located:
Directorate of Public Works (Administrative Records)
Building 3023
Fort Wainwright, Alaska 99703
(907) 353-9886

Noel Wien Library (Selected Documents)
1215 Cowles Street
Fairbanks, Alaska 99701
(907) 459-1020

Footnotes:

[1] *Revised Areawide Community Relations Plan Fort Wainwright, Fairbanks, Alaska, October 1997*, U.S. EPA, Region 10.

[2] Ibid

[3] Community relations plan, op cit.

[4] Fort Wainwright No Further Action Site Summaries, Final, August, 1995

[5] Ibid

[6] Ibid

[7] Community relations plan, op cit

[8] Fort Wainwright ROD OU-2

[9] OU-3 ROD

[10] *Ft. Wainwright OU3 Explanation of Significant Differences*, September 2002

[11] U.S. EPA Record of Decision, Operable Unit 4, Fort Wainwright, Fairbanks, Alaska, 1996

[12] Ibid

[13] Ibid

[14] *Revised Areawide Community Relations Plan Fort Wainwright,* Fairbanks, *Alaska, October 1997*, U.S. EPA, Region 10.

[15] Fort Wainwright Community Relations Plan 1997

[16] Fort Wainwright Five-Year Review, September 2001

[17] OU-5 ROD

[18] Ibid

[19] Ibid

[20] Ibid

[21] Ibid

[22] Ibid

[23] Ibid

[24] Ibid

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